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Solidification/Stabilization Treatability Study Work Plan

Former Vicksburg Chemical Company
Vicksburg, Mississippi

4 January 2007

ARCADIS

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Former Vicksburg Chemical Company
Vicksburg, Mississippi

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1. Introduction and Work Plan Rationale

1.1 Objectives/Rationale

This Work Plan presents a scope of work for performing a solidification and stabilization treatability study at the former Vicksburg Chemical Company (Vicksburg Chemical). The site was formerly a pesticide and herbicide manufacturing facility divided into two areas called the North Plant and South Plant. The primary objective of the activities proposed in this document will be to collect and evaluate soil and sludge samples to determine the necessary amendments to adequately solidify and/or stabilize the materials. Solidification is a process that adds strength to material, while stabilization chemically fixates chemicals of concern (CoC) within a matrix. This treatability study will be performed in anticipation of the usage of solidification and/or stabilization as a component of the final remedy for on-site CoC.

1.2 Summary of Solidification and Stabilization Processes and Applicability

Solidification, also referred to as fixation, denotes contaminant entrapment within a solid matrix of high structural integrity (a monolith). The chemical immobilization of contaminants is defined as stabilization. These terms are usually referred to interchangeably as solidification/stabilization. Solidification/stabilization is applicable to solid, liquid, or sludge wastes and can be performed in containers or *in situ*. The leachability of contaminants from a stabilized waste is reduced through the binding of the hazardous constituents into a solid mass of low permeability. The stabilized mass will resist leaching or extraction of contaminants by water.

Important aspects of this treatment approach include selection of stabilizing agents and other additives, the waste to additive ratio, the mixing, and curing conditions. All of these parameters depend on the chemical and physical characteristics of the waste. Bench scale treatability tests described in subsequent sections will be conducted to select the proper additives and determine an estimated curing time. Leaching tests and compressive strength tests will also be conducted to determine the integrity of the solid end product. In addition to the bench scale treatability studies, large scale field demonstrations are often necessary to confirm laboratory results.

It is anticipated that the sludge material removed from the North Pond (Area 5) will require solidification prior to the on-site consolidation within Solid Waste Management Unit (SWMU) 2 and capping. Increased strength achieved by solidification will dramatically improve the handling characteristics of the sludge material. However,

some areas within the site may only require stabilization (i.e., the areas with elevated or "hotspot" concentrations of CoC in the vicinity of the railroad tracks located in the South Plant).

1.3 Property Background

1.3.1 Property Location

Vicksburg Chemical was formerly owned by Cedar Chemical Corporation (Cedar Chemical). The facility is located south of Interstate 20 on Rifle Range Road and within the southwestern section of the city of Vicksburg in Warren County, Mississippi. The site is composed of approximately 535 acres located in Sections 4, 5, 8, 9, and 10, township 15 north, range 3 east (Latitude: North 32° 18' 01", Longitude: West 90° 53' 57"). The site location is shown on Figure 1.

1.3.2 Property History

The North Plant began operation in 1961 and produced potassium nitrate, liquid chlorine, and liquid nitrogen tetroxide. The raw materials for the North Plant included potassium chloride and nitric acid. The South Plant began operation in 1953 manufacturing chlorinated pesticides, nitrogen-based herbicides, and other agricultural chemicals. The only active operations at the South Plant after 1992 were the nitric acid unit constructed in 1986 and a potassium carbonate unit constructed in 1994. During various periods prior to 1987, the South Plant produced dinitro butyl phenol (dinoseb or DNBP), monosodium methane arsenate (MSMA) diethyl hexyl phosphoric acid (DEHPA), 1-hydroxy-ethylidene-1-1-diphosphonic acid (UNIHIB), toxaphene, methyl parathion, cyanazine (bladex), and atrazine. Toxaphene and methyl parathion are insecticides, while atrazine, dinoseb, and MSMA are herbicides. Raw materials for these operating processes included chlorine, camphene, ortho-secondary butyl phenol (OSBP), sodium arsenate, sodium hydroxide, methyl chloride, sulfuric acid, sodium paranitrophenolate, and phosphorus trichloride.

Originally, the two plants were completely separate, owned and operated by two different companies. The South Plant was originally constructed by Spencer Chemical in 1953. American Metal Climax Corporation (Amax) constructed the North Plant in 1961. After purchasing the South Plant in 1964, Gulf Chemical added a formaldehyde unit in 1966. According to historical environmental documents, Vicksburg Chemical was formed in early 1972 and purchased both the Gulf Oil and Amax facilities (except the formaldehyde plant) in July 1972. In 1978, Vicksburg Chemical was merged into

Vertac, Inc., which merged into Vertac Chemical Corporation (VCC) in September 1979. Cedar Chemical acquired the Vicksburg Chemical plant from VCC in February 1986. Fermenta A.B. of Sweden acquired Cedar Chemical in June 1986. Nine West Corporation (Trans Resources, Inc.) acquired Cedar Chemical in January 1988.

In addition to the above-mentioned operations at the plant, the property was the location of two additional operations: 1) an operation by Reagent Chemical to produce aqueous hydrochloric acid from a by-product of the toxaphene operation; and 2) a Gulf formaldehyde plant. The formaldehyde unit owned and formerly operated by Borden Chemical is located inside the former boundary of the South Plant.

1.4 Project History

1.4.1 Background

Vicksburg Chemical initiated a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) in 1994 and continued through 2001. Soil and groundwater sample locations evaluated in the RFI are shown in Appendix A. The *RCRA Facility Investigation Draft Final Report* (URS 2001a) and *Draft Groundwater Assessment Report* (URS 2001b) were completed in August 2001 and November 2001, respectively. Both reports were submitted to the U.S. Environmental Protection Agency (USEPA) and subsequently approved in December 2001. A draft Corrective Measures Study was developed in the spring of 2002.

On March 8, 2002, VCC and Cedar Chemical filed for bankruptcy in the United States Bankruptcy Court for the Southern District of New York. The bankruptcy was contested by the Mississippi Department of Environmental Quality (MDEQ), the Arkansas Department of Environmental Quality, USEPA Region 4, USEPA Region 6, and the U.S. Department of Justice. The court eventually approved an agreement allowing Vicksburg Chemical to abandon its properties and authorizing MDEQ to direct the transfer of the Vicksburg Chemical property to any entity identified by MDEQ. Since that time, MDEQ has kept the site under its control while structuring an agreement to clean up the plant site in a manner protective of human health and the environment. On December 19, 2005, MDEQ finalized an agreement for Mississippi Silvertip Development, LLC (Silvertip), to remediate the abandoned Vicksburg Chemical site. The developer, Silvertip, intends to create a Mississippi Bluffs Industrial Park to foster the sustainable reuse of the former chemical plant site and adjacent areas. It is anticipated that mixed use (i.e., light industrial, commercial, recreational, and residential) will be possible at the completion of the remedial action.

Harcros Chemicals, Inc., is currently leasing portions of the former North Plant to facilitate a chemical blending, mixing, and distribution facility. Concurrently, ARCADIS U.S., Inc. (ARCADIS), is performing the remediation services with MDEQ oversight and control. Silvertip plans to construct high-end commercial and residential sites and a championship golf course on a majority of the remaining acreage.

1.4.2 Summary of Previous Investigation Activities

Previous investigation activities summarized below were conducted during the RFI process. The SWMUs and sampling locations discussed are shown in Appendix A.

High arsenic concentrations were detected during the RFI at SWMUs 1 (Container Drum Storage Area), 5 (South Plant Drainage System), 11 (Former Methyl SMA Production Area), 12 (Former MSMA Salt Unloading Area), 15 (Former Methyl Parathion Production Area), 16 (Former Atrazine Production Area), and 17 (Returned Product Storage Area).

RFI sampling for SWMUs 1, 16, and 17 was conducted in 1997. Concrete, shallow (0-1 foot below land surface [ft bls]), and deep (1-2 ft bls) samples were collected from each sample location. The samples were analyzed for arsenic, atrazine, benzene, cyanazine, dinoseb, dioxin, ethylbenzene, toluene, USEPA's target analyte list (TAL), USEPA's target compound list (TCL), toxaphene, toluene, xylene, and total petroleum hydrocarbons. The contaminant concentrations reported in the RFI were compared to February 2002 MDEQ target remediation goals (TRGs). The concentrations that exceed the TRGs are shown in Table 1.

The South Plant Drainage System transferred storm water and process water to the surface impoundment. Samples were collected from the 6-inch interval below the depth of the buried drainage pipes. The pipes were buried from 3 ft bls to 10 ft bls. These samples were analyzed for arsenic, atrazine, cyanazine, dinoseb, and toxaphene. The contaminant concentrations reported in the RFI were compared to February 2002 MDEQ TRGs. The concentrations that exceed the TRGs are shown in Table 1.

SWMUs 11, 12, and 15 were evaluated together during RFI activities. Concrete, asphalt, and soil samples were collected from land surface to a maximum depth of 12 ft bls. Additionally, sump samples were collected in these areas. The samples were analyzed for arsenic, atrazine, cyanazine, dinoseb, dioxin, USEPA's TAL, and

USEPA's TCL. The contaminant concentrations reported in the RFI were compared to February 2002 MDEQ TRGs. The concentrations that exceed the TRGs are shown in Table 1.

SWMU 20 is described in the RFI as the "Railroad Area." It encompasses SWMU 7 (Former Dinoseb Production Area) and SWMU 14 (Former Toxaphene Production Area). SWMU 20 is a former railroad car loading/unloading station located at the eastern boundary of the previous manufacturing activities in the South Plant. Sixteen borings were advanced in this area. Each boring was sampled at two distinct intervals, 2 to 4 ft bls and 6 to 8 ft bls. The samples were analyzed for atrazine, cyanazine, dinoseb, toxaphene, and arsenic. Subsequent to the advancement of the initial 16 borings, composite samples were obtained from surface soil and soil piles located in this area. These soil samples were obtained from the 0 to 0.5 ft bls interval. The composite samples were analyzed for dinoseb and toxaphene. The contaminant concentrations reported in the RFI were compared to February 2002 MDEQ TRGs. The concentrations that exceed the TRGs are shown in Table 1.

The above listed SWMUs are a part of Areas 1 and 4 as defined in Section 2.1. Based on the results of the sampling conducted in SWMU 20, stabilization activities are proposed in this area. The focus of remediation in these areas will be in-place stabilization of high CoC concentrations to prevent leaching to and transport via groundwater.

The North Pond area, designated SWMU 23 in the RFI, is comprised of an unlined pond and the surrounding area located in the North Plant. This pond was used to neutralize acidic wastewater from the potassium nitrate production process. The neutralization was accomplished through the introduction of limestone into the pond water. Toxicity characteristic leaching procedure (TCLP) testing was performed on the pond sludge during November and December 1993. The TCLP analysis determined that the sludge was nonhazardous. A soil and groundwater investigation was conducted in this area to assess the extent of a potential contaminant plume. As a part of this investigation, samples were collected from the locations surrounding SWMU 23. In addition, some of the sample locations advanced as a part of the investigation of SWMU 22 were located in close enough proximity to SWMU 23 to provide useful data in the RFI evaluation. SWMU 23 is a part of Area 5 as defined in Section 2.1. The focus of remediation in this area will be to solidify the pond sludges for transport and consolidation at the on-site landfill (SWMU 2).

1.5 Data Needs and Objectives

Additional site data are needed to evaluate which solidification/stabilization agent or combination of agents is appropriate to either chemically fixate elevated concentrations of hotspot CoC in soils or provide sufficient strength during sludge consolidation to support an engineered cap. Data collected as part of the RFI process have been used to identify the hotspot locations and are considered valid and usable. The objective of this sampling effort is to collect soil and sludge samples for the performance of a laboratory treatability study to ascertain this technology's potential as part of an effective overall remediation strategy for this site.

1.6 Work Plan Approach

The general Work Plan strategy was developed to obtain samples representative of present site conditions. Personnel will be deployed to the Vicksburg Chemical site to collect soil and sludge samples from locations representative of areas known to require remediation. Samples will be containerized and submitted to geotechnical and analytical laboratories. The geotechnical laboratory will perform the solidification/stabilization analyses outlined in this Work Plan. The analytical laboratory will perform the leachability analyses outlined in this Work Plan. A summary of the proposed analyses is presented on Table 2.

2. Methodology

2.1 Sample Locations

The sample locations for this solidification/stabilization study are shown on Figure 2. These sample locations were selected because they contain high concentrations of site CoC or sludge material, based on data presented in the RFI. The RFI indicated five main impacted areas. These areas were defined in the *Quality Assurance Project Plan* (QAPP; ARCADIS 2006a) developed for this site. Four distinct areas were defined in the South Plant and one in the North Plant. The areas which were designated include:

- Area 1 – South Plant –SWMUs 1, 5, 7, 8, 9, 11, 12, 14, 15, 16, and 17;
- Area 2 – South Plant – Portion of Southwest Corner SWMU 20;
- Area 3 – South Plant – SWMU 2;

- Area 4 – South Plant – Part of SWMU 20 Bounded by MW-1, MW-13, and MW-14; and

- Area 5 – North Plant Pond – SWMU 23.

Treatability study activities are proposed in Areas 1, 4, and 5 as presented in the QAPP. Soil samples will be collected from locations within these areas based on the RFI analytical results and/or visual indications of CoC (i.e., yellow stained soils from dinoseb releases).

2.1.1 Stabilization Samples

Table 1 shows CoC concentrations detected during the RFI that exceed February 2002 MDEQ Tier 1 TRGs for restricted soil use. A subset of Table 1 is shown below. Chemical concentrations of particular concern for stabilization purposes in this area were measured in the following soil samples:

SWMU	Sample ID	Sample Depth (ft)	Chemical of Concern	Site Concentration[1]	MDEQ Tier 1 TRG (Restricted)	Units
Soil Samples						
1, 16, 17	I-1-B	0-1	Toxaphene	31,700	5,200	µg/kg
5	5-4	3-10	Arsenic	39,200	11,800	µg/kg
5	5-11	3-10	Arsenic	30,800	11,800	µg/kg
5	5-13	3-10	Arsenic	174,000	11,800	µg/kg
5	5-14	3-10	Arsenic	39,000	11,800	µg/kg
11, 12, 15	E-1-D (S/D)	0-1	Arsenic	345,000	11,800	µg/kg
11, 12, 15	BB-1-D (S/D)	0-1	Arsenic	2,870,000	11,800	µg/kg
11, 12, 15	Q-1-D (S/D)	0-1	Arsenic	2,080,000	11,800	µg/kg
11, 12, 15	EE-1-D (S/D)	0-1	Arsenic	456,000	11,800	µg/kg
11, 12, 15	V-1-D (S/D)	0-1	Arsenic	2,770,000	11,800	µg/kg
11, 12, 15	W-1-D (S/D)	0-1	Arsenic	145,000	11,800	µg/kg
11, 12, 15	C-1-G	0-1	Arsenic	216,000	11,800	µg/kg
11, 12, 15	C-2-G	1-2	Arsenic	501,000	11,800	µg/kg
11, 12, 15	D-2-G	1-2	Arsenic	309,000	11,800	µg/kg
11, 12, 15	I-4-G	4-6	Arsenic	241,000	11,800	µg/kg
11, 12, 15	J-2-G	1-2	Arsenic	205,000	11,800	µg/kg
11, 12, 15	K-6-G	8-10	Arsenic	55,100	11,800	µg/kg
11, 12, 15	O-1-G	0-1	Arsenic	254,000	11,800	µg/kg
11, 12, 15	Z-1-G	0-1	Arsenic	323,000	11,800	µg/kg

SWMU	Sample ID	Sample Depth (ft)	Chemical of Concern	Site Concentration(1)	MDEQ Tier 1 TRG (Restricted)	Units
Composite Surface Samples (2 to 8 grab samples composited from each quartile of each section)						
20	20-C	0-0.5	Dinoseb	355,541	204,000	µg/kg
20	20-F	0-0.5	Dinoseb	1,078,068	204,000	µg/kg
20	20-I	0-0.5	Toxaphene	110,964	5,200	µg/kg

(1) Analytical data obtained from RFI process.
CoC Chemical of concern.
MDEQ Mississippi Department of Environmental Quality.
S/D Sump/drainage sample.
Tier 1 TRG (Restricted) MDEQ Tier 1 Target Remediation Goal for restricted soil use.
µg/kg Micrograms per kilogram.

These locations are of particular concern due to the magnitude of the exceedance of MDEQ Tier 1 TRGs.

2.1.2 Solidification Samples

Presently anticipated remediation in the North Plant Pond area will require the removal and transport of the pond sludges to the on-site landfill area (SWMU 2) for consolidation. Prior to transport, the volume of sludge in the pond must be determined. Additionally, an evaluation of the transportability of the pond sludges using conventional construction equipment is needed. The collection and analysis of the solidification samples will aid in the determination of the most efficient and cost-effective path forward for remediation in this area.

2.2 Sample Collection Procedures

Some of the tasks that will be conducted during sampling activities have been outlined in detail in the QAPP. The pertinent sections are listed below and incorporated by reference. A summary of sample methods, containers, preservatives, and hold times for the analyses discussed below is included as Table 3.

2.2.1 Sampling Equipment and Procedures

Soil and sludge samples will be collected for geotechnical and Synthetic Precipitate Leaching Procedure (SPLP) analyses. Sampling equipment for the surficial samples

will consist of a hand auger, shovel, or trowel. The proper use of a hand auger in the collection of samples representative of site conditions is detailed in Section 11.3 (Soil Sampling – Hand Auger) in the QAPP. Decontamination procedures for the shovel and trowel equipment shall be the same procedures used for the hand auger as described in Section 10.3 of the QAPP. The proposed surficial soil sampling locations are shown on Figure 2.

The method used to collect sludge samples will depend on the amount of water in Area 5 at the time of sampling. In the event that water is present in the pond, sampling personnel will enter the pond in a boat to collect samples. If water is not present in the pond, sludge samples will be collected either from the shore or by using plywood mats to enter at the edge of the pond. Sludge samples will be collected using lengths of a hollow sampling device. All coring equipment shall be new and unused, or decontaminated prior to sample collection. The coring equipment will be inserted to the bottom of the pond and retrieved to the surface. For either case, sampling personnel will wear life preservers while conducting sludge sampling. Additionally, for safety reasons there will be more than one person on site during sludge sampling. Safety precautions to protect workers during sludge sampling will be appended to the *Health and Safety Plan* (ARCADIS 2006b). The proposed sludge sampling locations are shown on Figure 2.

The samples collected for analytical testing will be containerized immediately and placed into an ice chest with wet ice. Samples collected for geotechnical analysis will be placed into 5-gallon plastic buckets and covered with a self-sealing lid. The geotechnical samples will remain at ambient temperature until relinquished to the laboratory.

2.2.2 Sample Handling and Analysis

Sample handling and analysis were discussed in detail in Chapters 10 and 11 of the QAPP. These procedures will be followed during the implementation of this Work Plan. Table 6 (Summary of Methods, Containers, Preservatives, and Holding Times) of the QAPP contains information relative to specific analyses. This table was revised to include only the analytical SPLP analyses discussed in Section 2.4 and additional information required for the Unconfined Compressive Strength of Cohesive Soil (UCS) analyses (ASTM D2166). The revised table is included as Table 2 of this Work Plan.

2.2.3 Quality Assurance/Quality Control Samples (QA/QC)

QA/QC samples consisting of trip blanks, field blanks, and field duplicates will be collected as a part of the SPLP analyses because the sample results will be used for design purposes. In addition, control samples will be collected prior to the addition of solidification/stabilization amendments. The results of the control samples will be used to determine the effectiveness of the solidification/stabilization program. In the event that the soil amendments tested do not impart the desired characteristics to the soil and sludge samples, additional reagents and methodologies will be considered.

2.3 Solidification/Stabilization Amendments

Various reagents can be used to achieve the desired solidification/stabilization of the on-site materials. A literature review indicated that the constituents present in the subsurface at Vicksburg Chemical are amenable to solidification/stabilization processes. Due to the varied contaminant combinations found in the subsurface (i.e., organics, pesticides, herbicides, metals), more than one amendment may be required to achieve solidification/stabilization of the multiple compounds present. The goal of solidification/stabilization study is to determine an acceptable amendment mixture for implementation in the field.

Portland cement, fly ash, and lime are commonly used amendments and will be included in the solidification/stabilization study. These reagents are successful in solidification/stabilization for a wide range of constituents due to their effectiveness, ease of use, ability to scale up from laboratory efforts to field operations, and cost. However, additional amendments and/or combinations may be required. While guided by information obtained during the literature review and through the laboratory's experience, the actual volumetric ratios of soil sample to reagents will be determined during laboratory mixing based on the behavior exhibited by each material during the mixing process.

The solidification study will be conducted as follows:

- Samples collected for the solidification study will be containerized as described in Section 2.2 and submitted to a geotechnical laboratory for analysis;
- Two control samples will be containerized in UCS molds. The molded material will be obtained from the sludge composite samples. The two control sample locations

will be chosen at random and strength tested by ASTM Method D2166. These samples will be labeled "Solidification Control 1" and "Solidification Control 2";

- Reagents will be added to the remaining sludge collected from each sample location. Four UCS molds will be filled from each resultant mixture. Each UCS mold will be labeled with the sample location and the percentage of reagents added by weight followed by "3 days", "7 days", "14 days", or "28 days"; and

- The UCS molds labeled "3 days", "7 days", "14 days", and "28 days" will be analyzed by ASTM Method D2166 (Unconfined Compressive Strength of Cohesive Soil), USEPA SW-846 Method 8260 (volatile organic compounds), USEPA SW-846 Method 8151 (herbicides), and/or USEPA SW-846 Method 6020 (metals) at the time interval indicated on the sample label. The results of the testing will be reported to ARCADIS.

The stabilization study will be conducted as follows:

- Samples collected for the stabilization study will be containerized as described in Section 2.2 and submitted to a geotechnical laboratory for analysis;

- Two control samples will be molded from the soil samples collected in the field. One of the control sample locations will be randomly selected from Area 1 and the other will be randomly selected from Area 4. The control samples will be labeled "Stabilization Control 1" and "Stabilization Control 4" according to where the sample was collected. The two control samples will be strength tested by ASTM Method D2166;

- Reagents will be added to the remaining soil collected from each sample location. Four UCS molds will be filled from each resultant mixture. Each UCS mold will be labeled with the sample location and the percentage of reagents added by weight followed by "3 days", "7 days", "14 days", or "28 days";

- The UCS molds labeled "3 days", "7 days", "14 days", and "28 days" will be analyzed by ASTM Method D2166 at the time interval indicated on the sample label. The results of the compressive strength testing will be reported to ARCADIS;

- After the samples are tested by ASTM Method D2166, the remains of each mold will be segregated and containerized;

- The segregated remains of each mold will be submitted to an analytical laboratory for SPLP sampling. Each sample will be labeled with the sample location followed by "SPLP (3 days)", "SPLP (7 days)", "SPLP (14 days)", or "SPLP (28 days)" depending on the time interval in which the UCS sample was analyzed; and

- The samples will be containerized and shipped to an analytical laboratory under proper chain-of-custody procedures. The samples will be analyzed by the SPLP method for the CoC listed in Table 2. The results of the SPLP testing will be reported to ARCADIS.

2.4 Laboratory Testing

The sample collected during the implementation of this Work Plan will be containerized and submitted to an analytical laboratory and a geotechnical laboratory for analyses. Table 2 contains a summary of the required analyses. The results of the testing procedures discussed below will be utilized in the development of the final remedy for known CoC concentrations in excess of MDEQ Tier 1 TRGs. All investigative sampling proposed in this Work Plan will be conducted in accordance with MDEQ's Brownfields program.

2.4.1 Unconfined Compressive Strength of Cohesive Soil Analyses

A control sample consisting of site material without amendments and material samples from the treatability study will be submitted to a laboratory for UCS analyses (ASTM D2166) as a part of the treatability study. The samples will be collected in containers that meet laboratory requirements for this analysis. Proper chain-of-custody procedures will be followed during the transport and relinquishment of sample volumes. Each sample will be described in the field upon collection. The observed characteristics will be documented on a Soil/Sediment Sampling Log or Sample/Core Log (Appendix B) completed by sampling personnel.

The remaining sample volumes will be used to conduct a solidification/stabilization study on the material. The solidification/stabilization study will be conducted by mixing various combinations of Portland cement, fly ash, lime, and other reagents with the site samples. The mixtures will be molded into sample cores. The resultant sample cores will be subjected to compressive strength testing to determine strength characteristics of the mixture. In order for the solidified material to support an engineered cap, the solidified material must have an unconfined compressive strength of 8 pounds per

square inch after 3 days. The material remaining after compressive strength testing will be packaged and submitted to an analytical laboratory for leachability analyses.

2.4.2 Leachability Analyses

SPLP analyses will be conducted on the control and test samples provided by SW-846 Method 1312. The SPLP analyses will provide a measure of the potential for CoC bound in the solidified/stabilized material to leach into the soil. SPLP analyses will be conducted on the material samples at four intervals: 3 days, 7 days, 14 days, and 28 days. SPLP results will be compared to quantitative risk-based remediation goals developed in accordance with guidance provided in Chapter 6 of the *Final Brownfield Regulations, Subpart II*, February 28, 2002. Fate and transport modeling will be used to determine acceptable groundwater concentrations in the stabilized areas. The results of SPLP testing will give an indication of the long-term stabilization of CoC in the resultant solidified matrix.

The SPLP samples will be collected in containers that meet laboratory requirements for this analysis. Proper chain-of-custody procedures will be followed during the transport and relinquishment of sample volumes.

2.5 Survey

The locations of the samples collected during this evaluation will be marked. A topographic survey of the sample locations will be conducted. The survey will include the collection of location and elevation data. All surveying activities will be conducted by a surveyor licensed by the State of Mississippi.

2.6 Investigation Derived Wastes

Waste materials generated during this investigation and corrective action will include soil, sludge, used sampling equipment, decontamination water, and used personal protective equipment. Waste materials will be containerized in 55-gallon drums or similar appropriate containers or will be placed back into the North Pond. The drums will be staged in a secure location and will be incorporated into the remediation to be conducted at the site. Waste characterization and on-site disposal will be completed in accordance with MDEQ-approved methodology specific to this site.

2.7 Regulatory Involvement

All site activities will be conducted after receiving approval from MDEQ of this Solidification/Stabilization Treatability Study Work Plan. MDEQ will have oversight on all aspects of remediation activities conducted at this site as per the Agreed Order. Future sampling frequencies, parameter lists, methodology, etc., will be approved by MDEQ prior to field implementation.

3. Reporting

Following the completion of all field activities, the results of the Stabilization/ Solidification Treatability Study activities will be included in the Solidification/ Stabilization Study report that will be prepared for submittal to MDEQ. The report will document all field activities and present an interpretation of surface and subsurface conditions. Appropriate historical and new data tables, figures, and appendices will be included in the report to support the text. The report will conclude by presenting recommendations for a path forward to obtain site closure.

4. Schedule

The sampling program will be initiated within 3 weeks of receiving written authorization to proceed from MDEQ. It is anticipated that the planned field activities can be completed within 2 to 3 weeks. Analytical data should be received within 6 weeks of completing the Solidification/Stabilization Treatability Study. A report will be prepared and submitted to MDEQ within 8 weeks of receipt of the analytical results. If field activities are delayed or if additional field activities are required to completely define the nature and extent of subsurface impacts, MDEQ will be promptly notified.

5. References

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Table 1. Exceedances of MDEQ Tier 1 TRG for Restricted Soil Use, Solifification/Stabilization Treatability Study Work Plan, Former Vicksburg Chemical Company, Vicksburg, Mississippi.

SWMU	Sample ID	Sample Depth (ft)	Chemical of Concern	Site Concentration[1]	MDEQ Tier 1 TRG (Restricted)	Units	Concentration Exceeds Tier 1 TRG (Restricted)
Soil Samples							
1, 16, 17	D-1-B	0-1	Arsenic	12,500	11,800	µg/kg	Yes
1, 16, 17	I-1-B	0-1	Toxaphene	31,700	5,200	µg/kg	Yes
1, 16, 17	I-1-B	0-1	Arsenic	27,000	11,800	µg/kg	Yes
1, 16, 17	L-1-A	0-1	Arsenic	14,500	11,800	µg/kg	Yes
1, 16, 17	2-C-C	Concrete	Arsenic	36,000	11,800	µg/kg	Yes
1, 16, 17	11-C-C	Concrete	Atrazine	52,800	25,800	µg/kg	Yes
1, 16, 17	12-2-A	1-2	Arsenic	13,300	11,800	µg/kg	Yes
1, 16, 17	15-2-A	1-2	Arsenic	12,900	11,800	µg/kg	Yes
1, 16, 17	16-C-A	Concrete	Arsenic	13,700	11,800	µg/kg	Yes
1, 16, 17	18-C-A	Concrete	Arsenic	27,000	11,800	µg/kg	Yes
1, 16, 17	19-C-A	Concrete	Arsenic	18,800	11,800	µg/kg	Yes
4	4-4	0.5-1	Arsenic	15,700	11,800	µg/kg	Yes
5	5-4	3-10	Arsenic	39,200	11,800	µg/kg	Yes
5	5-11	3-10	Arsenic	30,800	11,800	µg/kg	Yes
5	5-13	3-10	Arsenic	174,000	11,800	µg/kg	Yes
5	5-14	3-10	Arsenic	39,000	11,800	µg/kg	Yes
9	8S	0.5-1	Arsenic	61,000	11,800	µg/kg	Yes
9	8D	1.5-2	Arsenic	60,000	11,800	µg/kg	Yes
9	A-1 Result		Benzo(a)pyrene	1,160	784	µg/kg	Yes
11, 12, 15	B-1-D (Sump/Drainage)	0-1	Arsenic	39,400	11,800	µg/kg	Yes
11, 12, 15	E-1-D (Sump/Drainage)	0-1	Arsenic	345,000	11,800	µg/kg	Yes
11, 12, 15	BB-1-D (Sump/Drainage)	0-1	Arsenic	2,870,000	11,800	µg/kg	Yes
11, 12, 15	Q-1-D (Sump/Drainage)	0-1	Arsenic	2,080,000	11,800	µg/kg	Yes
11, 12, 15	EE-1-D (Sump/Drainage)	0-1	Arsenic	456,000	11,800	µg/kg	Yes
11, 12, 15	EE-1-D (Sump/Drainage)	0-1	PCDD/PCDF (Dioxin)	0.344	0.0763	µg/kg	Yes
11, 12, 15	V-1-D (Sump/Drainage)	0-1	Arsenic	2,770,000	11,800	µg/kg	Yes
11, 12, 15	W-1-D (Sump/Drainage)	0-1	Arsenic	145,000	11,800	µg/kg	Yes
11, 12, 15	Y-1-D (Sump/Drainage)	0-1	Arsenic	60,200	11,800	µg/kg	Yes
11, 12, 15	M-1-D (Sump/Drainage)	0-1	Arsenic	35,600	11,800	µg/kg	Yes
11, 12, 15	1-C-D	Concrete	Arsenic	18,400	11,800	µg/kg	Yes
11, 12, 15	5-C-D	Concrete	Arsenic	70,600	11,800	µg/kg	Yes
11, 12, 15	6-1-D	0-1	Arsenic	24,900	11,800	µg/kg	Yes
11, 12, 15	6-2-D	1-2	Arsenic	14,100	11,800	µg/kg	Yes

Table 1. Exceedances of MDEQ Tier 1 TRG for Restricted Soil Use, Solifification/Stabilization Treatability Study Work Plan, Former Vicksburg Chemical Company, Vicksburg, Mississippi.

SWMU	Sample ID	Sample Depth (ft)	Chemical of Concern	Site Concentration[1]	MDEQ Tier 1 TRG (Restricted)	Units	Concentration Exceeds Tier 1 TRG (Restricted)
Soil Samples (continued)							
11, 12, 15	C-1-G	0-1	Arsenic	216,000	11,800	µg/kg	Yes
11, 12, 15	C-2-G	1-2	Arsenic	501,000	11,800	µg/kg	Yes
11, 12, 15	C-3-G	2-4	Arsenic	76,000	11,800	µg/kg	Yes
11, 12, 15	C-4-G	4-6	Arsenic	109,000	11,800	µg/kg	Yes
11, 12, 15	C-5-G	6-8	Arsenic	114,000	11,800	µg/kg	Yes
11, 12, 15	D-1-G	0-1	Arsenic	48,800	11,800	µg/kg	Yes
11, 12, 15	D-2-G	1-2	Arsenic	309,000	11,800	µg/kg	Yes
11, 12, 15	D-4-G	4-6	Arsenic	27,600	11,800	µg/kg	Yes
11, 12, 15	D-5-G	6-8	Arsenic	14,700	11,800	µg/kg	Yes
11, 12, 15	H-1-G	0-1	Arsenic	22,300	11,800	µg/kg	Yes
11, 12, 15	I-1-G	0-1	Arsenic	72,800	11,800	µg/kg	Yes
11, 12, 15	I-2-G	1-2	Arsenic	57,500	11,800	µg/kg	Yes
11, 12, 15	I-3-G	2-4	Arsenic	185,000	11,800	µg/kg	Yes
11, 12, 15	I-4-G	4-6	Arsenic	241,000	11,800	µg/kg	Yes
11, 12, 15	I-5-G	6-8	Arsenic	138,000	11,800	µg/kg	Yes
11, 12, 15	J-1-G	0-1	Arsenic	101,000	11,800	µg/kg	Yes
11, 12, 15	J-2-G	1-2	Arsenic	205,000	11,800	µg/kg	Yes
11, 12, 15	K-1-G	0-1	Arsenic	38,800	11,800	µg/kg	Yes
11, 12, 15	K-2-G	1-2	Arsenic	31,500	11,800	µg/kg	Yes
11, 12, 15	K-3-G	2-4	Arsenic	14,600	11,800	µg/kg	Yes
11, 12, 15	K-4-G	4-6	Arsenic	46,000	11,800	µg/kg	Yes
11, 12, 15	K-6-G	8-10	Arsenic	55,100	11,800	µg/kg	Yes
11, 12, 15	L-1-G	0-1	Arsenic	132,000	11,800	µg/kg	Yes
11, 12, 15	L-2-G	1-2	Arsenic	80,600	11,800	µg/kg	Yes
11, 12, 15	O-1-G	0-1	Arsenic	254,000	11,800	µg/kg	Yes
11, 12, 15	O-2-G	1-2	Arsenic	41,400	11,800	µg/kg	Yes
11, 12, 15	T-2-G	1-2	Arsenic	14,400	11,800	µg/kg	Yes
11, 12, 15	X-1-G	0-1	Arsenic	64,400	11,800	µg/kg	Yes
11, 12, 15	X-2-G	1-2	Arsenic	63,300	11,800	µg/kg	Yes
11, 12, 15	Z-1-G	0-1	Arsenic	323,000	11,800	µg/kg	Yes
11, 12, 15	Z-2-G	1-2	Arsenic	51,200	11,800	µg/kg	Yes
11, 12, 15	Z-3-G	2-4	Arsenic	22,300	11,800	µg/kg	Yes
11, 12, 15	DD-1-G	0-1	Arsenic	24,300	11,800	µg/kg	Yes
11, 12, 15	DD-2-G	1-2	Arsenic	59,600	11,800	µg/kg	Yes
11, 12, 15	ZZ-1-G	0-1	Arsenic	11,900	11,800	µg/kg	Yes
11, 12, 15	ZZ-2-G	1-2	Arsenic	18,100	11,800	µg/kg	Yes
11, 12, 15	7-C-G	Concrete	Arsenic	68,200	11,800	µg/kg	Yes
18	18-1	0.5-1	Arsenic	17,500	11,800	µg/kg	Yes
18	18-3	0.5-1	Arsenic	12,800	11,800	µg/kg	Yes
20	20-21C		Chloroform	2,186	478	µg/kg	Yes
23	22-B		Chloroform	830	478	µg/kg	Yes
30	30-1	0.5-1	TPH (conservative)	4,433,000	300,000	µg/kg	Yes
30	30-2	0.5-1	TPH (conservative)	699,000	300,000	µg/kg	Yes
30	30-3	0.5-1	TPH (conservative)	15,431,000	300,000	µg/kg	Yes

Table 1. Exceedances of MDEQ Tier 1 TRG for Restricted Soil Use, Solidification/Stabilization Treatability Study Work Plan, Former Vicksburg Chemical Company, Vicksburg, Mississippi.

SWMU	Sample ID	Sample Depth (ft)	Chemical of Concern	Site Concentration[1]	MDEQ Tier 1 TRG (Restricted)	Units	Concentration Exceeds Tier 1 TRG (Restricted)
Composite Surface Samples (2 to 8 grab samples from each quartile of each section composited)							
20	20-A	0-0.5	Toxaphene	8,240	5,200	µg/kg	Yes
20	20-B	0-0.5	Toxaphene	18,989	5,200	µg/kg	Yes
20	20-C	0-0.5	Dinoseb	355,541	204,000	µg/kg	Yes
20	20-C	0-0.5	Toxaphene	8,401	5,200	µg/kg	Yes
20	20-D	0-0.5	Toxaphene	14,200	5,200	µg/kg	Yes
20	20-F	0-0.5	Dinoseb	1,078,068	204,000	µg/kg	Yes
20	20-F	0-0.5	Toxaphene	10,318	5,200	µg/kg	Yes
20	20-G	0-0.5	Toxaphene	22,981	5,200	µg/kg	Yes
20	20-H	0-0.5	Toxaphene	19,052	5,200	µg/kg	Yes
20	20-I	0-0.5	Toxaphene	110,964	5,200	µg/kg	Yes
20	20-J	0-0.5	Toxaphene	41,652	5,200	µg/kg	Yes
20	20-K	0-0.5	Toxaphene	6,098	5,200	µg/kg	Yes
20	20-N	0-0.5	Toxaphene	9,263	5,200	µg/kg	Yes
20	20-O	0-0.5	Toxaphene	6,727	5,200	µg/kg	Yes
20	20-T	0-0.5	Arsenic	12,100	11,800	µg/kg	Yes
20	20-T	0-0.5	Toxaphene	7,617	5,200	µg/kg	Yes
Composite Soil Pile Samples (8 grab samples composited)							
20	20-BB	0-0.5	Toxaphene	37,036	5,200	µg/kg	Yes
20	20-CC	0-0.5	Toxaphene	6,852	5,200	µg/kg	Yes
20	20-DD	0-0.5	Toxaphene	14,691	5,200	µg/kg	Yes
20	20-EE	0-0.5	Toxaphene	16,815	5,200	µg/kg	Yes
20	20-FF	0-0.5	Toxaphene	76,683	5,200	µg/kg	Yes
20	20-II	0-0.5	Toxaphene	17,413	5,200	µg/kg	Yes
20	20-LL	0-0.5	Toxaphene	14,673	5,200	µg/kg	Yes
20	20-MM	0-0.5	Toxaphene	11,152	5,200	µg/kg	Yes

(1) Analytical data obtained from RFI process.
MDEQ Mississippi Department of Environmental Quality.
SWMU Solid Waste Management Unit.
Tier 1 TRG (Restricted) MDEQ Tier 1 TRG for the restricted use of soil.
TPH Total Petroleum Hydrocarbon.
TRG Target Remediation Goal.
µg/kg Micrograms per Kilogram.

Table 2. *Summary of Required Analyses, Solidificaton/Stabilization Treatability Study Work Plan,* Former Vicksburg Chemical Company, Vicksburg, Mississippi.

Area	Material	Number of Sample Locations [1]	Unconfined Compressive Strength Samples (ASTM D2166)	SPLP Samples (Method 1312)[2][3]
1	Surficial Soil	15	2 Controls + 15 Samples (3 days) 15 Samples (7 days) 15 Samples (14 days) 15 Samples (28 days)	1 Control + 15 Samples 15 Samples 15 Samples 15 Samples
4	Surficial Soil	6	1 Control + 6 Samples (3 days) 6 Samples (7 days) 6 Samples (14 days) 6 Samples (28 days)	1 Control + 6 Samples 6 Samples 6 Samples 6 Samples
5	Sludge	6	1 Control + 6 Samples (3 days) 6 Samples (7 days) 6 Samples (14 days) 6 Samples (28 days)	Not Analyzed Not Analyzed Not Analyzed Not Analyzed

(1) Sample locations shown on Figure 2.
(2) Samples obtained from sample remaining after UCS break, except the control sample. Control sample to be submitted for analyses upon collection.
(3) Analyzed for SPLP-Arsenic, SPLP-Chloroform, SPLP-Dinoseb, and SPLP-Toxaphene.

SPLP Synthetic Precipitation Leaching Procedure

Table 3. Summary of Methods, Containers, Preservatives, and Holding Times, Solidification/Stabilization Treatability Study Work Plan, *Former* Vicksburg Chemical Company, Vicksburg, Mississippi.

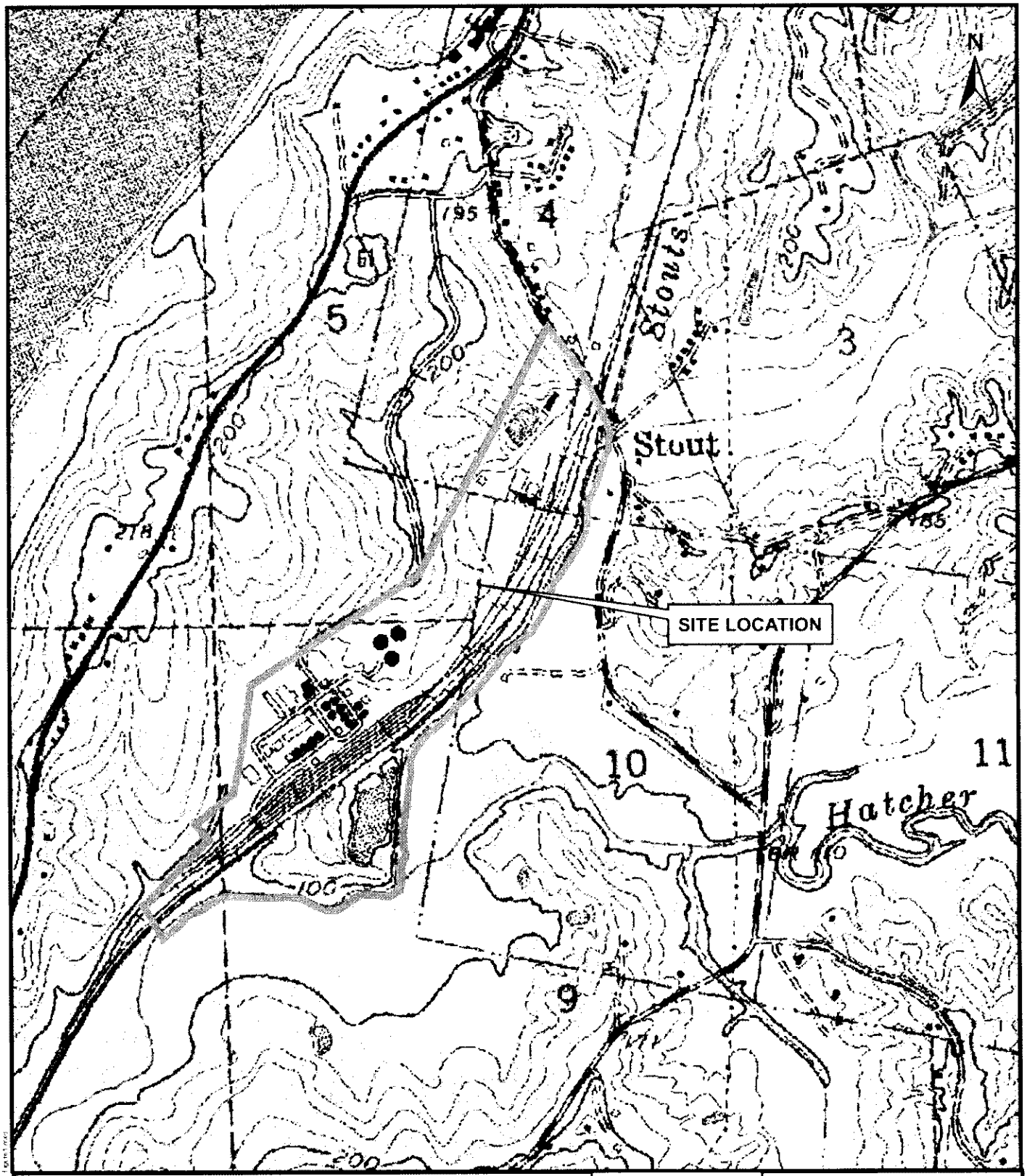
Parameter	Matrix	Preparation Method	Analytical Method [a]	Container [b]	Preservative	Holding Time [c]
Analytical Parameters						
VOCs	Water	5030, 5032	8260/624	3 x 40-mL vial with Teflon lined septum	pH < 2 with HCl, Cool 4°C	14 days
	Water	5030, 5032	8260/624	3 x 40-mL vial with Teflon lined septum	If effervescence is observed, eliminate HCl preservative and Cool 4°C	7 days
	Solid	5035	8260	3 x Encore™ OR 2 x Sodium Bisulfate vial	Cool 4°C	48 hours to preservation for Encore™, then 14 days to analysis
SPLP	Solid	1312 to Generate Leachate	Above Methods for Determination of CoCs in Leachate	1 x 4-oz G packed full for VOCs and 1 x 8-oz wide-mouth G for other parameters	Cool 4°C	14 days from collection to Leach
Geotechnical Parameters						
UCS	Solid	Not Applicable	ASTM D2166	2 x 5-gallon plastic bucket	None	None

(a) The 8000 series methods will be used for assessment and remediation; the 600 series methods will be used only for wastewater or storm water analyses performed in accordance with discharge permits.

(b) Sample volumes may be combined for MNA parameters where preservatives are the same and adequate sample volume is supplied to the laboratory. Volumes listed are based on sample containers and not minimum volumes required for some of the General Chemistry Parameters listed under the MNA heading only. All other volumes are minimum volumes required to be submitted to the laboratory.

(c) Maximum holding time allowed from date of collection.

ASTM American Society for Testing and Materials.
°C Degrees Centigrade.
CoC Chemical of Concern.
G Glass.
GPC Gel Permeation Chromatography.
HCl Hydrochloric Acid.
HDPE High Density Polyethylene.
mL Milliliter.
MNA Monitored Natural Attenuation.
oz Ounce.
SPLP Synthetic Precipitation Leaching Procedure.
UCS Unconfined Compressive Strength of Cohesive Soils.
VOCs Volatile Organic Compounds.
< Less than.



Former Plant Site

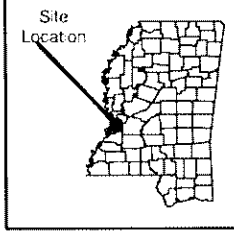
Note: Approximate Property Boundary

ARCADIS
10352 Plaza Americana Drive
Baton Rouge, Louisiana 70816
Tel 225 292 1004 Fax 225 218 9677

SITE LOCATION MAP

VICKSBURG CHEMICAL COMPANY

VICKSBURG, MISSISSIPPI



500 0 500 1,000
Feet

Project Manager: JE	Completed By: AB
Task Manager: CD	Date: 07/31/2006
Project No.: LA002656.0001	Figure No.: 1

REFERENCE:

USGS: Vicksburg West Quadrangle, Mississippi
7.5 Minute Series (Topographic)

User Name : sme

Path\Name : G:\APROJECT\Mississippi Bluffs\LA002656.0001\Figures\2456-01-02c.dwg

LEGEND

- PROPOSED SURFICIAL SOIL SAMPLING LOCATION (AREA 1 AND 4)
- PROPOSED SLUDGE SAMPLING LOCATION (AREA 5)
- ARSENIC AND TOXAPHENE CONTAMINATION FOUND WITHIN INVESTIGATED BOUNDARIES
- SOIL/SLUDGE CONTAINING VOCs
- ARSENIC CONTAMINATION FOUND WITHIN INVESTIGATED BOUNDARIES
- CONCENTRATION OF CONTAMINATION EXCEEDS VALUES IN MDEQ TIER 1 TRG TABLE
- TOXAPHENE CONTAMINATION FOUND WITHIN INVESTIGATED BOUNDARIES
- DINOSEB AND TOXAPHENE CONTAMINATION FOUND WITHIN INVESTIGATED BOUNDARIES

AREA 1 – SWMU 1, 5, 7, 8, 9, 11, 12, 14, 15, 16, AND 17
AREA 2 – SWMU 20 (SW CORNER)
AREA 3 – SWMU 2
AREA 4 – SWMU 20 (AREA BOUNDED BY MW-13, MW-14, AND MW-1)
PROPOSED SOIL SAMPLE LOCATION
AREA 5 – SWMU 23

0 200' 400' 800'

DRAWN BY	CHECKED
D. EKINIA	CAD
PROJECT MANAGER	DEPARTMENT MANAGER
DRE	DRE
DATE	TASK/PHASE NUMBER
11-6-06	0008

ARCADIS
10352 PLAZA AMERICANA DRIVE
BATON ROUGE, LA 70816
TEL: 225-292-1004
FAX: 225-218-9677
WWW.ARCADIS-US.COM

PROPOSED SOLIDIFICATION/STABILIZATION SAMPLING LOCATIONS

FORMER VICKSBURG CHEMICAL COMPANY SITE

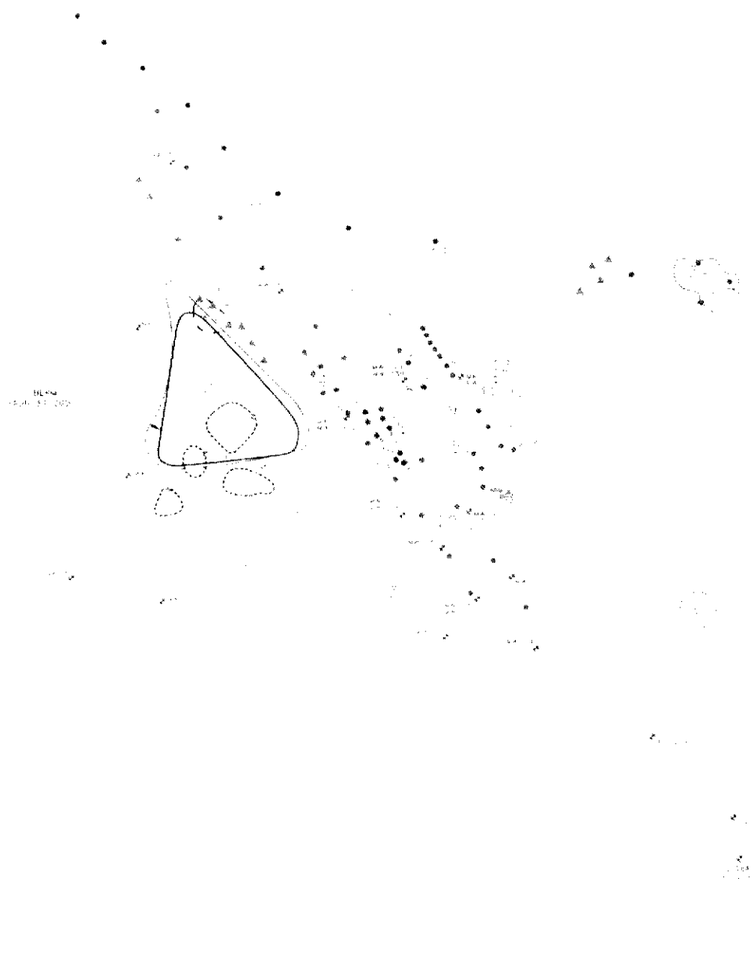
PROJECT NUMBER
LA002656.0001

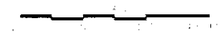
DRAWING NUMBER
2

ARCADIS

Appendix A

RCRA Facility Investigation Soil and Groundwater Sample Locations





VICKSBURG CHEMICAL COMPANY
VICKSBURG, MISSISSIPPI

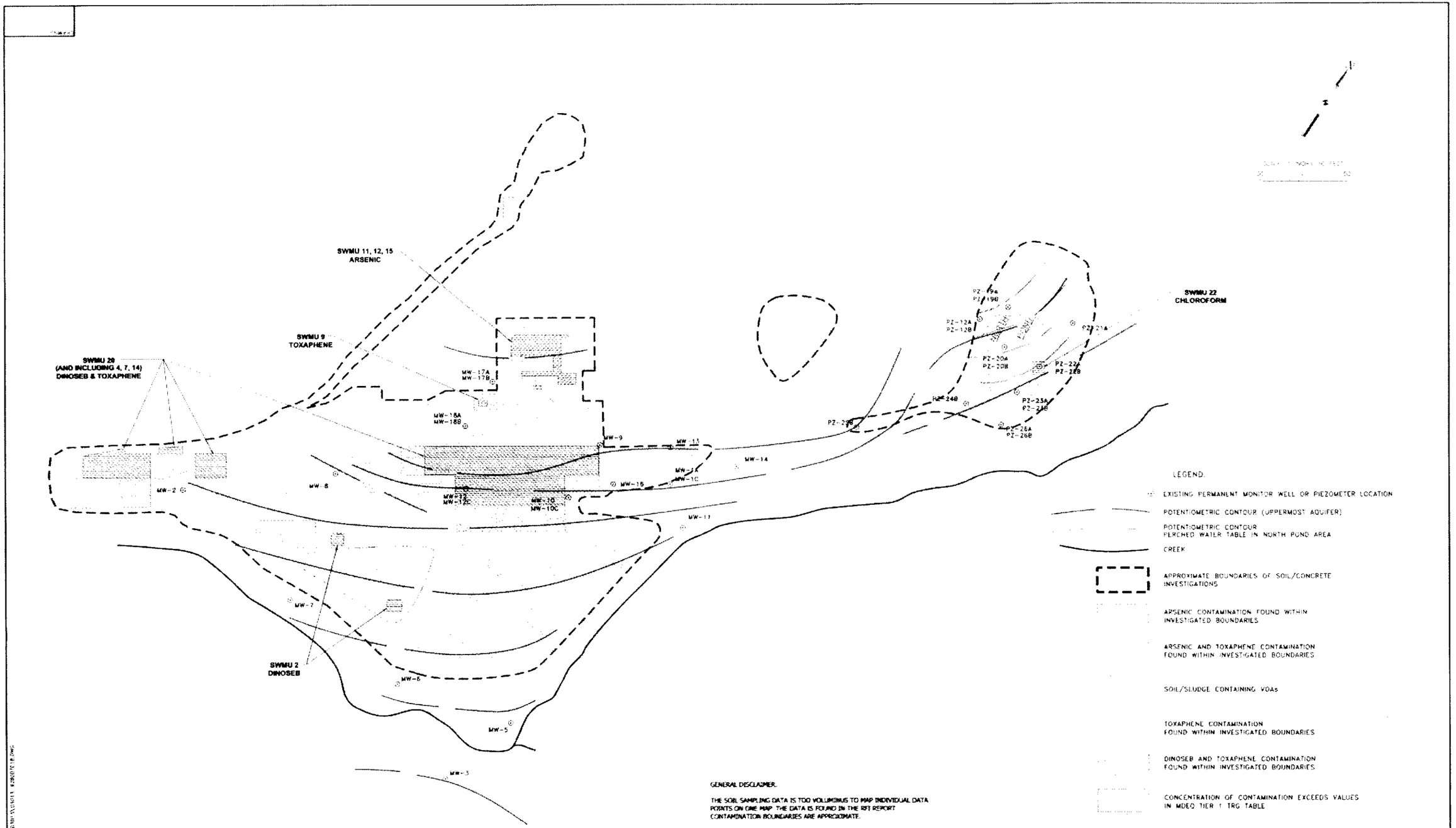
URS
2822 O'Neal Lane
Baton Rouge, Louisiana 70816
225/751-1873

REFERENCE DRAWINGS

RCRA FACILITY INVESTIGATION
(AS EXECUTED)

SWMU LOCATIONS, REI SOIL AND CONCRETE
SAMPLE POINTS, GWA MONITOR WELL LOCATIONS

1



GENERAL DISCLAIMER:

THE SOIL SAMPLING DATA IS TOO VOLUMINOUS TO MAP INDIVIDUAL DATA POINTS ON ONE MAP. THE DATA IS FOUND IN THE RFI REPORT. CONTAMINATION BOUNDARIES ARE APPROXIMATE.

VICKSBURG CHEMICAL CORPORATION
VICKSBURG, MISSISSIPPI

URS
2822 O'Neal Lane
Baton Rouge, Louisiana 70816
225/751-1873

REFERENCE DRAWINGS

GROUNDWATER ASSESSMENT

SITE WIDE SOIL CONTAMINATION WITH AREAS OF CONTAMINATION GREATER THAN MDEQ TIER 1 TRG TABLE VALUES FOR RESTRICTED USE SHOWN

PROJECT: 35092B007C

FIGURE: 4-6

Appendix B

Field Forms

ARCADIS

SOIL / SEDIMENT SAMPLING LOG

PROJECT NAME: _____

PROJECT NUMBER: _____ Date: _____

SITE LOCATION: _____ CODED/

SAMPLE ID NUMBER: _____ REPLICATE NO: _____

TIME SAMPLING BEGAN: _____ ENDED: _____

WEATHER: _____

SITE DESCRIPTION: _____

SAMPLING DATA

COLLECTION METHOD: _____

DEPTH (ft): _____ MOISTURE CONTENT: _____

COLOR: _____ ODOR: _____

DESCRIPTION: _____

ANALYSES REQUIRED	*CONTAINER DESCRIPTION*
	From Lab: X or GM

SAMPLING MONITORING (TIP, OVA, HNU, etc.) _____

REMARKS: _____

SAMPLING PERSONNEL: _____

ARCADIS G & M, Inc.
10352 Plaza Americana Drive
Baton Rouge, LA 70816

SAMPLE / CORE LOG

Boring/Well: _____ Project No.: _____

Site Location: _____ Drilling Started: _____ Drilling Completed: _____

Land-Surface Elev.: _____ Surveyed: _____ Estimated: _____ Datum: _____

Drilling Fluid: _____ Drilling Method Used: _____

Drilling Contractor: _____ Driller: _____ Helper: _____

Prepared By: _____ Hammer Weight: _____ Hammer Drop (inches): _____

Fill | Silty Clay | Silt | Sandy Silt | Silty Sand | Acetate Sleeve | Water First Encountered

Clay | Sandy Clay | Clayey Silt | Sand | Clayey Sand | Split Spoon | Water Level After 10 Minutes

SAMPLE DEPTH (ft)	SAMPLE TYPE	RECOVERY (ft)	SYMBOL	VISUAL DESCRIPTION	USCS (LL/PL/PI)	PP H	PP V	OVA (wo/F)(w/F) (ppm) (ppm)	REMARKS