



U.S. Army

**Final Work Plan
for Interim Remedial Action
and Corrective Action Progress Report
at Wright Army Airfield Fire Training Area
(SWMU 13)
Fort Stewart, Georgia**



IMA

March 2008

**Submitted to:
Directorate of Public Works
Environmental Branch
Fort Stewart, Georgia**

**Submitted by:
U.S. Army Corps of Engineers
Savannah District**

**Prepared by:
SpecPro Environmental Services LLC
1006 Floyd Culler Court
Oak Ridge, Tennessee
Under
Contract No. W912HN-07-D-0012
Delivery Order No. 0003**



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Appendix A

ORC® Manufacturer's Recommendations

Acronyms and Abbreviations

bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
CAP	corrective action plan
CLP	contract laboratory program
CoC	chain-of-custody
COC	contaminant of concern
CRT®	Controlled Release Technology
DPW	Directorate of Public Works
DO	dissolved oxygen
EPD	Environmental Protection Division
ft	foot/feet
GSSL	Georgia Soil Screening Level
IDW	investigative derived waste
IM	interim measure
IRA	interim remedial action
mg/L	milligrams per liter
MS	matrix spike
MSD	matrix spike duplicate
ORC®	Oxygen Release Compound
ORC® Advanced	Advanced Formula ORC®
PAH	polynuclear aromatic hydrocarbon
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RL	remedial level
SAIC	Science Applications International Corporation
SES	SpecPro Environmental Services LLC
SVOC	semi-volatile organic compound
SWMU	solid waste management unit
µg/L	micrograms per liter
UPC	Utility Protection Center
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

1. INTRODUCTION

SpecPro Environmental Services LLC (SES) has been contracted by the U.S. Army Corps of Engineers (USACE), Savannah District, to perform interim remedial actions (IRAs) at a solid waste management unit (SWMU) within Fort Stewart, Georgia. This work plan provides the details of the remedial activities and field procedures that will be followed during the IRAs.

1.1 PURPOSE OF THIS WORK PLAN

The purpose of this work plan is to provide site-specific and background information related to IRAs at former fire training area, SWMU 13. This work plan describes the remedial activities, the numbers and types of samples to be taken, sampling rationale and criteria, field investigation techniques and procedures, analytical requirements and methods, quality control (QC) requirements to be applied, and necessary reporting requirements.

1.2 SCOPE

The objectives of the scope of work for the SWMU 13 site are to:

- excavate a 20 feet (ft) by 20 ft area in the vicinity of a pipeline on the site to a depth of 15 ft or to groundwater (whichever is less),
- apply Oxygen Release Compound® (ORC®) to the excavation floor and four side walls,
- install three groundwater monitoring wells at the site,
- inject ORC® into the soil at the site,
- conduct annual groundwater monitoring at the site,
- characterize and properly dispose the investigative derived waste (IDW), and
- prepare the corrective action plan (CAP) progress report for Calendar Year 2007.

1.3 PROJECT ORGANIZATION

Figure 1-1 depicts the project organization. A listing of project key personnel, which includes contact information, follows the organizational chart.

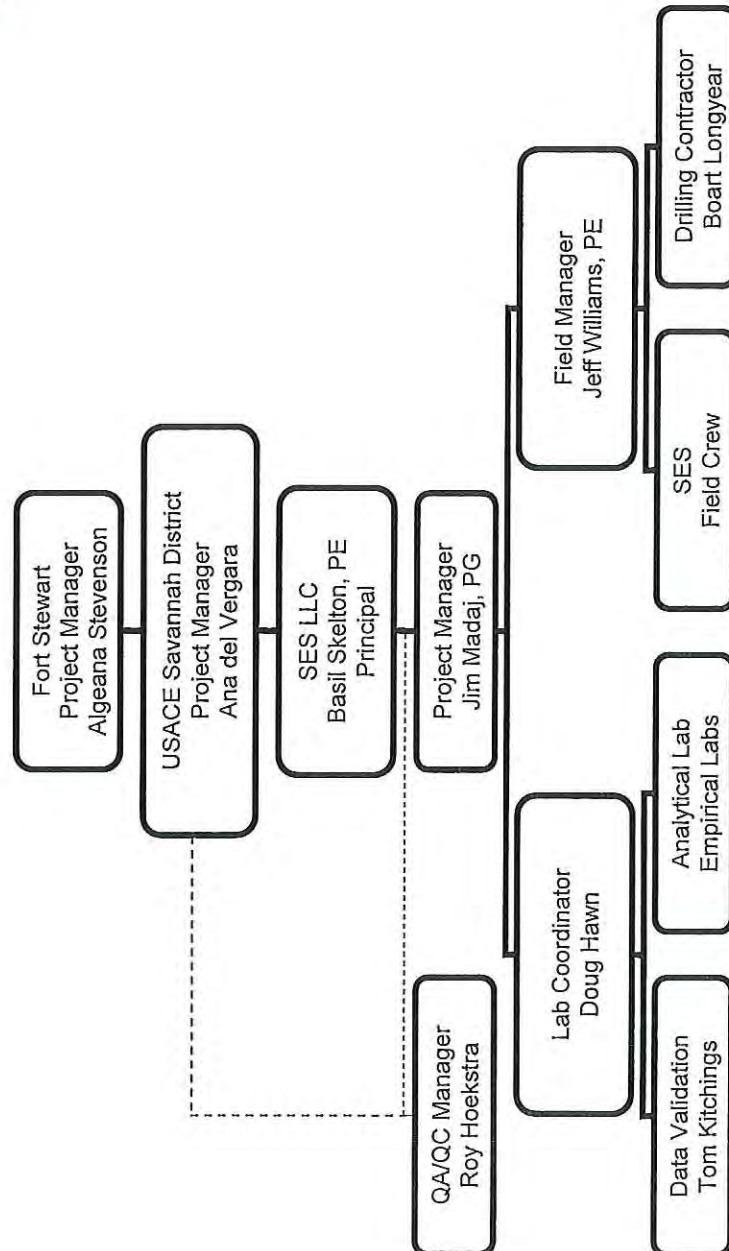


Figure 1-1 Organizational Chart

Contact Information – Key Personnel

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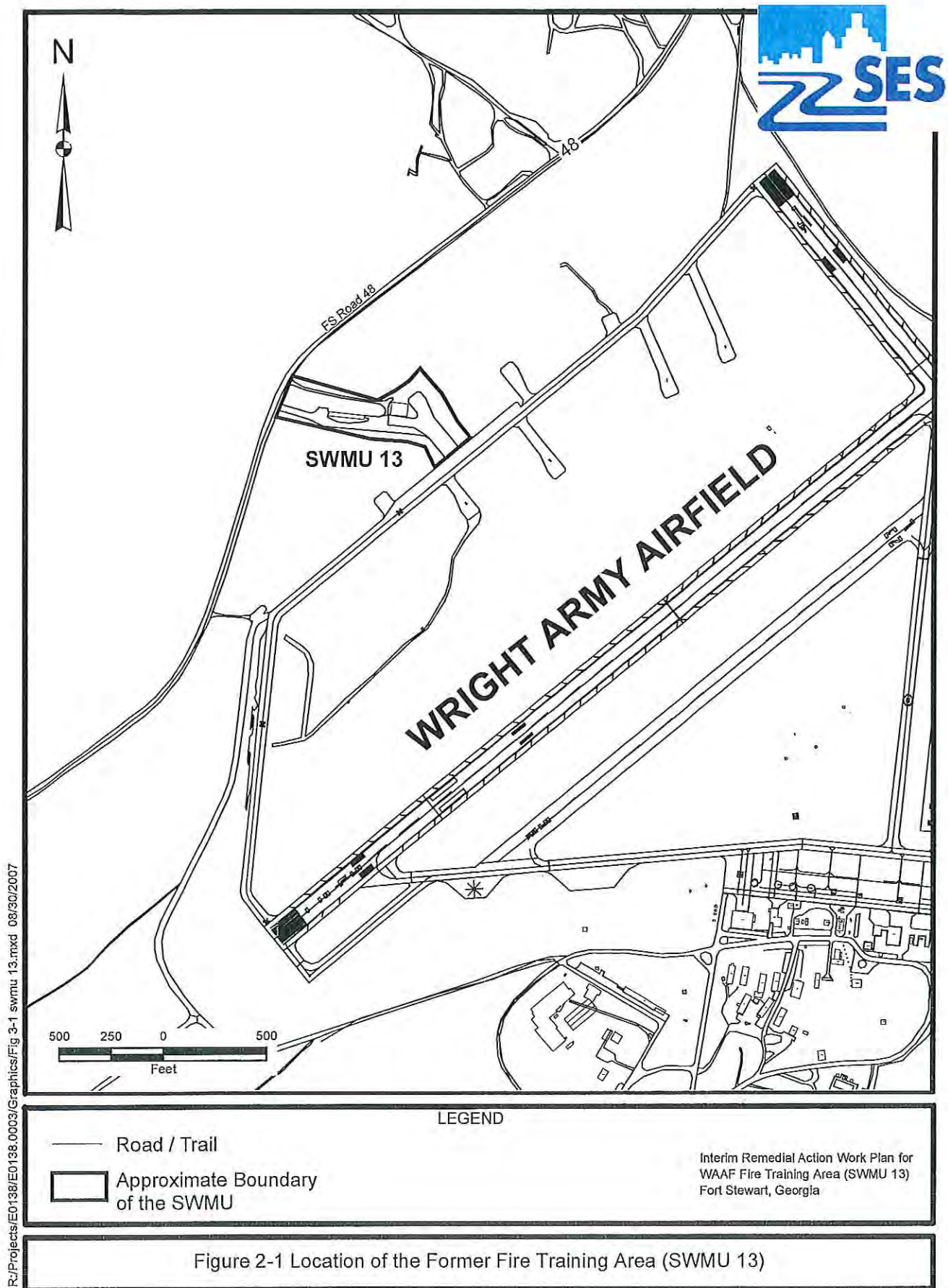
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2. SITE BACKGROUND

Fort Stewart is located in portions of Liberty, Long, Tattnall, Evans, and Bryan counties, Georgia, approximately 40 miles southwest of Savannah, Georgia. The nearest city is Hinesville, approximately 1½ miles to the south.

SWMU 13 is located in the northwest area of Wright Army Airfield, approximately 3000 feet northwest of the control tower as shown on Figure 2-1.



R:\Projects\E0138\E0138.0003\Graphics\Fig 3-1 swmu 13.mxd 08/30/2007

3. PREVIOUS INVESTIGATIONS

Several site investigations have been conducted at SWMU 13. These investigations include a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI), three supplemental investigations, an interim measure (IM), an IRA, a CAP, and groundwater monitoring. Information on previous investigations was taken from the *Final Corrective Action Plan, Progress Report for Calendar Year 2006, for the Former Fire Training Area at Wright Army Airfield (Solid Waste Management Unit 13) at Fort Stewart Military Reservation, Fort Stewart, Georgia, SAIC, February 2007*.

3.1 RCRA FACILITY INVESTIGATION

An RFI was conducted at SWMU 13 in September 1999 by Earth Tech, Inc. Soil samples and groundwater samples were obtained and analyzed. The RFI concluded that contamination in surface soil was dominated by polynuclear aromatic hydrocarbon (PAH) contamination and one RCRA metal; subsurface soil was contaminated by benzene, toluene, ethylbenzene, and xylenes (BTEX), PAHs, and RCRA metals; and BTEX contamination in groundwater extended to a depth of approximately 40 ft below the water table and an area approximately 150 ft wide by 300 ft long, extending from the former fire training area facilities to the south.

To support the development of the CAP, supplemental investigations were conducted at SWMU 13. Groundwater samples were collected from eight monitoring wells in December 2000 and analyzed for BTEX and PAHs. Benzene and ethylbenzene continued to exceed their respective maximum contaminant levels in the shallow aquifer near the source. The presence of benzene and the other BTEX compounds was consistent with the results of the previous sampling. The December 2000 sampling indicated that the dissolved benzene groundwater plume covers an area of approximately 10,992 ft², which is smaller than previously observed. Naphthalene continued to be detected in the groundwater and other PAHs, including fluorine and phenanthrene, were also reported during the December 2000 sampling event.

Six groundwater monitoring wells (MW-14 through MW-19) were installed by Science Applications International Corporation (SAIC) in April 2001. During well installation activities, subsurface soil samples were collected from each of the six well locations and were analyzed for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). None of the VOCs or SVOCs

detected in the subsurface soil samples exceeded the U.S Environmental Protection Agency (USEPA) Region 3 residential risk-based criteria.

Groundwater samples were collected from five monitoring wells (MW-13, MW-15, MW-16, MW-18, and MW-19) during June 2002 and were analyzed for BTEX constituents. BTEX constituents were all detected at concentrations exceeding their respective USEPA Region 3 risk-based criteria for tap water.

3.2 INTERIM MEASURE

In 1997, CAPE Environmental performed an IM at SWMU 13 to remove and properly dispose the fire training facilities, which included the aboveground storage tank, the mock aircraft with associated foundations and piping, the concrete fire training pad and cover soils, the concrete oil/water separator sump and appurtenances, sump sediments, and soil that exceeded the preliminary cleanup targets established in the project specifications. After removing the fire training facilities and contaminated surface soil [to approximately 4 ft below ground surface (bgs)] and completing the confirmatory sampling, the excavated area was backfilled with clean soil and seeded.

3.3 INTERIM REMEDIAL ACTION

In December 2001/February 2002, Earth Tech, Inc., conducted an IRA at SWMU 13. The purpose of the IRA was to remove a portion of an 8-in-thick concrete pad, which covered a 20-ft by 8-ft area. The IRA also removed approximately 337 tons of soil and well MW-12. Six confirmatory soil samples were collected and were analyzed for VOCs and SVOCs. None of the detected concentrations exceeded the EPA Region 3 residential or industrial risk-based screening levels.

3.4 CORRECTIVE ACTION PLAN

In accordance with the recommendations of the RFI, a CAP was developed for SWMU 13 to develop remedial levels (RLs) and to evaluate potential remedial alternatives for human health contaminants of concern (COCs) in surface soil [benzo(a)pyrene] and groundwater (benzene, ethylbenzene, 2-methylnaphthalene, and naphthalene), and for contaminant migration constituents of concern in subsurface soil (arsenic, chromium, and benzene). The CAP recommended that no remediation be performed for surface soil for benzo(a)pyrene; subsurface soil for arsenic, chromium, or benzene; or groundwater for 2-

methylnaphthalene. The remedial objective for SWMU 13 is to reduce the present concentrations of the site COCs in groundwater (benzene, ethylbenzene, and naphthalene) to the RLs presented in the CAP.

3.5 ANNUAL GROUNDWATER MONITORING

Groundwater has been monitored at the site on an annual basis for calendar years 2003, 2004, 2005, and 2006, and the results were published in the annual monitoring reports.

3.6 FINAL CORRECTIVE ACTION PLAN

Subsurface soil samples were collected along the abandoned pipeline in April 2006 to determine the extent of potential remaining subsurface soil contamination that may be influencing groundwater contamination. Groundwater samples were also collected during the calendar year 2006 sampling event. The conclusions and recommendations of the final CAP Progress Report are presented below. These conclusions and recommendations are the basis for the current work being performed as discussed in this work plan. Additional information can be found in the *Final Corrective Action Plan, Progress Report for Calendar Year 2006, for the Former Fire Training Area at Wright Army Airfield (Solid Waste Management Unit 13) at Fort Stewart Military Reservation, Fort Stewart, Georgia, SAIC, February 2007.*

3.6.1 Soil Removal and Addition of Oxygen-Releasing Compound

The report concluded that residual subsurface soil contamination remaining around SB-15 seems to be contributing to petroleum contamination in groundwater at MW-18 and reducing available oxygen for natural attenuation to proceed at a reasonable rate; therefore, soil needs to be removed around the area of SB-15 to reduce its contaminant migration to groundwater and the natural attenuation time. There is a level of uncertainty associated with the natural attenuation modeling given that modeling continues to extend the natural attenuation period. Undiscovered residual soil contamination may be located in the area of SB-15.

The report recommended that the soil should be excavated around SB-15, the location indicating residual soil contamination above its Georgia Soil Screening Level (GSSL). The area of contaminated soil is estimated to be approximately 20 ft by 20 ft and is primarily located in the direction (southeast) of the former area of the pipeline. Soil excavated to approximately 8 ft bgs would be set aside, analyzed, and placed back in the excavation based on soil results, which are expected to be below GSSLs. The soil

would continue to be excavated to a maximum of 15 ft bgs generating approximately 60 cubic yards of contaminated soil. Confirmation soil samples should be collected from the bottom and sidewalls of the excavation and analyzed for BTEX and SVOCs. Before the excavation is backfilled, ORC[®] should be placed in the bottom of the excavation. It should be noted that the addition of ORC[®] in the excavation would promote aerobic biological degradation.

3.6.2 Installation of Groundwater Monitoring Wells

The report concluded that the groundwater flow direction varies from southeast to east based on seasonal fluctuations. MW-18 is downgradient (based on October 2006 groundwater flow) of SB-15, a subsurface soil location that indicated concentrations of ethylbenzene and an elevated detection level of benzene above their GSSL, indicating the soil may be contributing petroleum contamination through contaminant migration. A number of monitoring wells (e.g., MW-17) at SWMU 13 have been destroyed.

The report recommended that two new shallow monitoring wells (MW-20 and MW-21) and one new replacement well (MW-18R) need to be installed to replace compromised existing monitoring well (MW-18) and to monitor the extent of contamination based on removal of the soil and changes in groundwater direction due to seasonal fluctuations. The wells should be standard 2-inch diameter monitoring wells with flush surface completions to prevent their destruction during military exercises.

3.6.3 Injection of Oxygen-releasing Compounds

The report concluded that field measurements at MW-18 indicated the lowest dissolved oxygen (DO) concentration (0.48 mg/L), a negative Redox (-5), and an elevated concentration of ferrous iron (5.2 µg/L). MW-18 was the only well in which methane was detected (347 µg/L). These conditions are characteristic of anaerobic biological activity through natural attenuation. Oxygen is being depleted as an electron acceptor by microorganisms, and secondary constituents (i.e., iron) are then being used. The location is slightly anaerobic given the negative Redox, and methane detected in the groundwater indicates that DO is being depleted through biological activity. Petroleum contaminants biologically degrade at a faster rate under aerobic conditions (with oxygen) than anaerobic conditions (without oxygen). Additional oxygen needs to be added to the groundwater to promote aerobic biological degradation and prevent the subsurface conditions from moving towards anaerobic conditions. It is believed that after the removal of the residual contaminated soil in the area of SB-15, the aerobic conditions in the groundwater will rebound sufficiently to support aerobic biological degradation. However, if the annual groundwater monitoring

indicates continued borderline aerobic/anaerobic conditions and continued elevated benzene conditions, then ORC[®] injection will be needed to promote aerobic biological degradation.

The report recommended that the area downgradient of SB-15 and upgradient of MW-18 should be the focus of the ORC[®] injections. It is estimated that two injections of ORC[®] at six month intervals will be necessary to reduce the remaining benzene to below its regulatory level.

3.6.4 Annual Groundwater Sampling

The report concluded that the benzene concentration found in MW-18 is at an unacceptable level. The fate and transport model has extended the time required for the RLs to be achieved through natural attenuation.

The report recommended that annual groundwater monitoring of the nine shallow monitoring wells (seven existing/replaced and two new wells) be performed. These wells [MW-3, MW-4, MW-10, MW-15, MW-16, MW-18R, MW-19, MW-20 (new), and MW-21 (new)] are located within, downgradient of, or near the contaminant plume at SWMU 13 and represent a groundwater network to monitor the characteristics and potential migration of the contaminant plume at SWMU 13. The groundwater should be sampled using low-flow techniques and analyzed for VOCs, SVOCs, and natural attenuation parameters.

4. INTERIM REMEDIAL ACTIVITIES

SES will perform IRAs at the SWMU 13 site. Tasks to be performed include:

- excavating contaminated soil,
- installing three groundwater monitoring wells,
- injecting ORC[®] into the subsurface soil, and
- groundwater monitoring.

4.1 EXCAVATION PERMITS AND UTILITY CLEARANCES

Before field activities begin, all excavation permits and utility clearances for the SWMU 13 site will be obtained. The locations of all intrusive activities will be marked on the ground using white paint, flags, or stakes. Once the site is marked, the request for utility clearance will be made to the Georgia Utility Protection Center (UPC). UPC will accept these requests either by phone or internet. The phone number is

(800) 282-7411. The UPC web address is www.gaupc.com. (After accessing the site, click on the IRTTH login.) The Fort Stewart Directorate of Public Works (DPW) will accept responsibility for accuracy of the locations pertaining to gas and fuel lines, water lines, electrical lines to include secondary electricity, airfield lighting, low voltage, fire systems, sewer lines, roof drain lines, storm drain lines, industrial waste lines, chilled water lines, high temperature water lines, irrigation systems, and DPW non-fiber computer lines. These requests will be forwarded to all utility companies with services present in the excavation site. It is noted in the procedure that:

- Permits will be issued within 48 hours of the next business day following the receipt of the request by UPC.
- Permits will only be valid for 21 days. Renewal requests should be submitted at a minimum of 3 days prior to expiration.
- Requesting contractors are responsible for maintaining marks during the 21-day period.
- If after acquiring a permit, a utility is damaged during the excavation process, the excavating contractor will notify the appropriate utility company. DPW's utilities are listed above. The DPW point of contact for this area of Fort Stewart is Carletha Joyce at (912) 767-6669. The excavating contractor should be prepared to submit proof of a valid permit at that time.

4.2 SOIL EXCAVATION

An area 20 ft by 20 ft to a depth of 15 ft or to groundwater (whichever is less) will be excavated using a trackhoe and/or backhoe at SWMU 13. The proposed excavation area is shown on Figure 4-1. The first 8 ft of soil encountered is expected to be clean and will be set aside and placed on plastic and covered with plastic in a "clean stockpile." It is anticipated that the remaining 7 ft of soil will be contaminated and, therefore, will be placed in a separate pile on plastic and covered with plastic in a "contaminated stockpile." A storm sewer pipeline of unknown diameter or composition is potentially within the proposed excavation area. Proper care will be observed so as to not disrupt the pipeline traversing the excavation. The area nearest the pipeline will be excavated and backfilled in sections so as to allow continued support of the pipe.

Once the excavation has reached its desired depth or has encountered groundwater, ORC[®] will be applied to the bottom and sidewalls of the excavation. It is estimated that 350 pounds of ORC[®] should be adequate. Refer to the Regenesys recommendations found in Appendix A of this work plan. The ORC[®] will be applied to the excavation bottom in accordance with the manufacturer's recommendations.

R:\Projects\E0138\E0138.0003\Graphics\Fort Stewart Fig 4-1 SWMU 13.mxd (08/30/07)

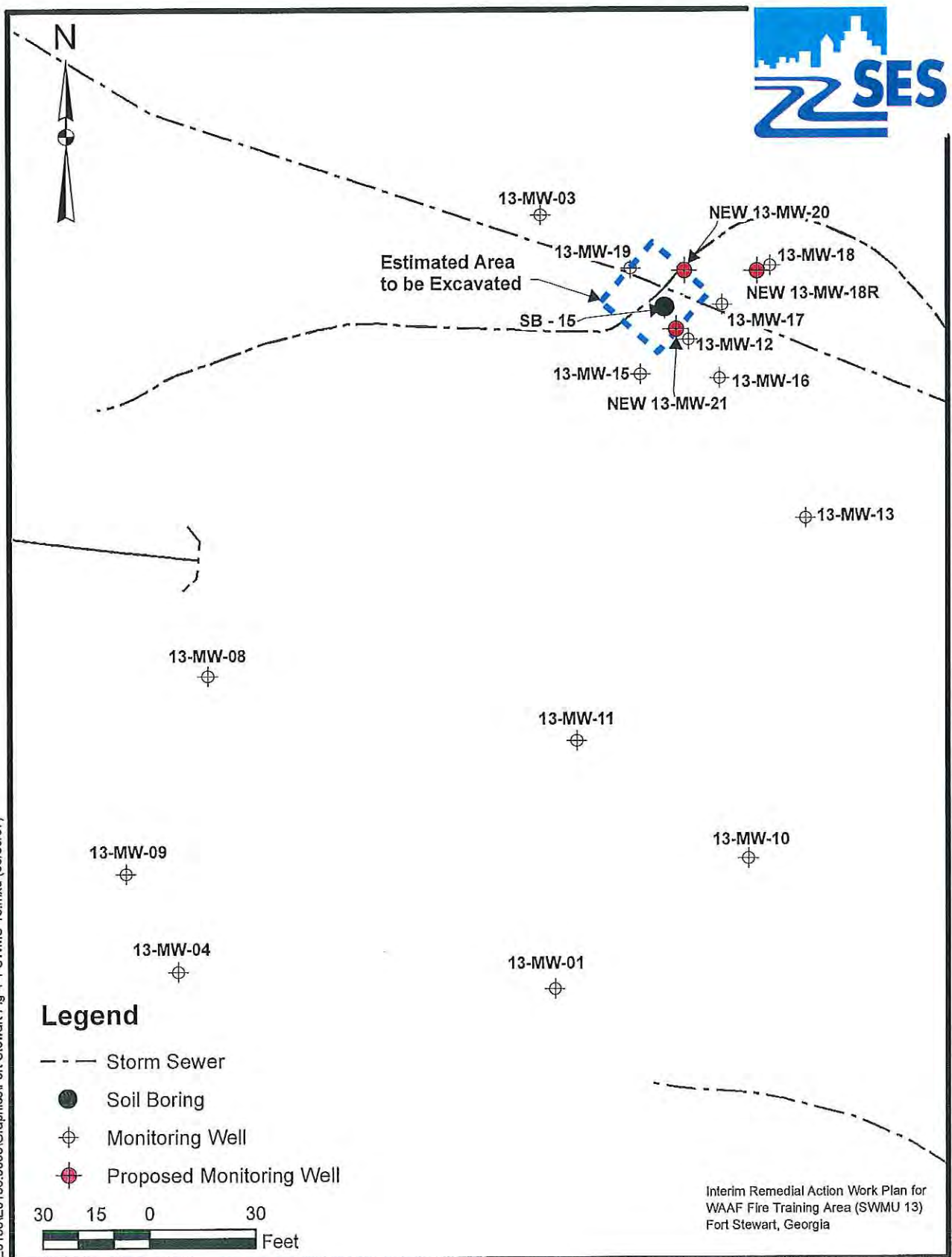


Figure 4-1 Area to Be Excavated at SWMU 13

After the ORC[®] has been applied to the excavation, the soil in the stockpiles will be sampled and characterized. The clean stockpile will be characterized to determine if it meets the criteria to be placed back into the excavation and used as backfill material. Since it is anticipated that 67 cubic yards of potentially clean soil will be excavated, only one composite sample of the clean stockpile will be obtained. A grab sample from the most contaminated area based on visual evidence and field screening using a photoionization detector will be obtained. The characterization sample will be analyzed for VOCs and SVOCs on a "rush" basis to minimize the time the excavation is left open. The soil will also be tested to determine its physical characteristics for use as backfill material. The results of the characterization analyses will be compared to the GSSLs and, if the concentrations are acceptable, the soil will be placed back into the excavation and used as backfill material.

The excavation will be backfilled using material from a borrow source, supplemented with soil from the clean stockpile (if it is acceptable). The soil will be placed into the excavation using the backhoe or trackhoe, or it will be dumped into the excavation until it has reached 4 ft bgs. Compaction will be achieved using the bucket(s) of the equipment tamping the soil. The compaction effort of the first 11 ft will not be measured. Compaction of the top 4 ft will be achieved using a compactor, hand-tamper, or other compaction device. Loose soil will be placed in lifts not to exceed 8 inches and compacted to 6-inch lifts. Compaction will be measured using a nuclear testing device or other acceptable means that measures the moisture and density of the soil. The soil will be compacted to 90% or greater of the maximum dry density with a moisture content of +/- 3 % optimum. It is noted that a geotechnical testing company will provide the quality control to ensure the soil is compacted to the required specifications. Once the excavation has been backfilled to match the surrounding terrain, it will be seeded, fertilized, and mulched to provide a ground cover of grasses.

4.3 ORC[®] INJECTION

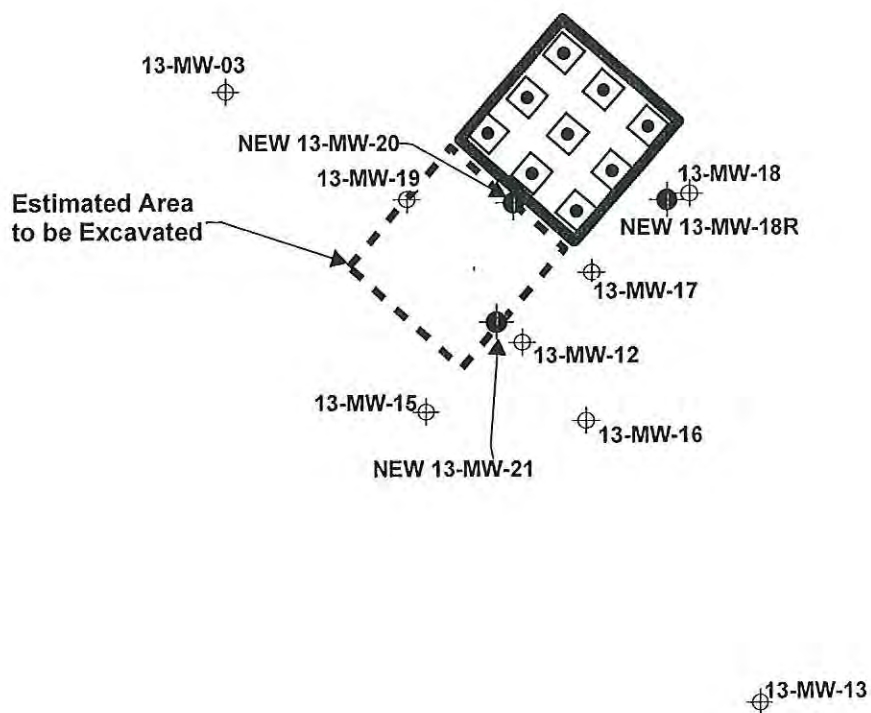
Advanced Formula Oxygen Release Compound[®] (ORC Advanced[®]) is a formula of calcium oxyhydroxide that produces a controlled release of oxygen for up to 12 months. Oxygen has been shown to be the limiting factor for microbes capable of aerobically degrading contaminants such as petroleum hydrocarbons. If there is not adequate oxygen, contaminant degradation will either cease or may proceed by slower anaerobic processes. ORC Advanced[®] is designed in such a way that when it becomes hydrated it will release its full amount of oxygen (17% by weight) over a 12-month period. This product contains patented Controlled Release Technology[®] (CRT[®]) to deliver its oxygen consistently over an extended

period of time. CRT[®] avoids excessive foaming and oxygen loss that is seen commonly with chemicals. As a direct result, aerobic microbes are enabled to significantly accelerate rates of natural attenuation over long periods of time. ORC Advanced[®] saves time and money by increasing degradation rates and improving remediation performance by providing more oxygen on a single injection. It is effective at higher demand sites where oxygen may be limited and scavenged by competing carbon sources. ORC Advanced[®] is typically applied using direct push techniques. This process requires ORC Advanced[®] to be mixed with water to form an injectable slurry, which is then pressure injected (using a pump) into the zone of contamination. Once it has been applied to the area, ORC Advanced[®] particles can reside in the soil and produce a controlled release of oxygen.

The field investigation requires application of ORC Advanced[®] that will be accomplished through direct push technology (i.e., geoprobe). This will be accomplished immediately after the excavation discussed previously.

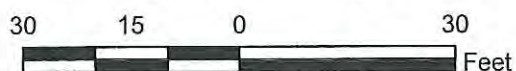
The ORC Advanced[®] application locations are shown on Figure 4-2. This application location and the application rates stated below are based on the recommendations of the manufacturer (Regenesis) as shown in Appendix A. The ORC Advanced[®] compound will be mixed with water at a rate of 14 gallons of water per injection point, or 14 gallons of water per 50 pounds of ORC Advanced[®]. Once the ORC Advanced[®] has been applied, each application point will be filled with bentonite (hole plug), and the ground surface will be restored to match its surrounding terrain. A total of nine injection points will be used. The treatment thickness will be 10 ft (the first 10 ft below the vadose zone) estimated to start at least 14 ft bgs with an application rate of 5 pounds per vertical foot, for a total of 450 pounds. The second injection (if needed), as discussed in Section 3.6.4, will be accomplished in the same manner, approximately six months after the first injection.

All fieldwork will be conducted under the supervision of a registered geologist or engineer, as required by the State of Georgia.



Legend

-  ORC Injection point
-  Monitoring Well
-  Proposed Monitoring Well



Interim Remedial Action Work Plan for
WAAF Fire Training Area (SWMU 13)
Fort Stewart, Georgia

Figure 4-2 Area to Be Injected with ORC at SWMU 13

R:\Projects\E0138\E0138_0003\Graphics\Fort Stewart Fig 4-2 SWMU 13.mxd (09/20/07)

4.4 MONITORING WELL INSTALLATIONS

As an aid to further delineation of the groundwater contamination at the site, SES will install three groundwater monitoring wells at or near the locations shown in Figure 4-1. The well locations will be determined in the field at the time of installation; therefore, actual well locations may vary from those shown on the figure. These three wells will be installed with standard auger drilling techniques to a depth of approximately 20 ft bgs. The wells will be constructed with 2-inch diameter Schedule 40 polyvinyl chloride piping with 10 ft screens to allow for 7 ft of screen below the water table and 3 ft of screen above the water table to allow for seasonal fluctuations. The wells will be finished with flush mount surface completions.

4.5 ANNUAL GROUNDWATER SAMPLING, SWMU 13

At least six months after the ORC[®] injection at the site, the groundwater from nine of the groundwater monitoring wells will be sampled. These wells are 13-MW-03, 13-MW-04, 13-MW-10, 13-MW-15, 13-MW-16, 13-MW-19 and the three new wells 13-MW-18R (near 13-MW-18), 13-MW-20, and 13-MW-21 as shown on Figure 4-1. Each of the groundwater samples will be submitted for VOCs and SVOCs analysis. Table 4-1 lists the number of samples to be obtained and includes the samples and analysis for quality control.

Table 4-1 Groundwater Samples for SWMU 13

	VOCs	SVOCs
Laboratory Analytical Method	USEPA 5030-8260B	USEPA 8270C
Number of Primary Samples	9	9
QC Duplicate Samples	1	1
Field Blank	1	1
Field Rinsates	1	1
MS/MSD	1	1
QA/QC Trip Blanks	1	0
Total Analyses	14	13

Note: Equipment rinsates and field duplicates will be taken at a rate of 10 percent of the total number of samples for each parameter by matrix and event.

MS/MSD = matrix spike / matrix spike duplicate

VOCs = volatile organic compounds

SVOCs = semi-volatile organic compounds

QA = quality assurance

QC = quality control

USEPA = U.S. Environmental Protection Agency

5. INVESTIGATIVE DERIVED WASTE

All IDW will be properly disposed in accordance with state and federal regulations. The soil IDW will be stored in the two stockpiles and any liquid (free-product and/or water) IDW will be stored in drums at the site or in a nearby area designated by USACE or Fort Stewart representatives pending receipt of characterization results required to determine appropriate off-site disposal.

Each IDW container will be labeled in accordance with applicable state and federal requirements. IDW shall be labeled "UNCLASSIFIED WASTE, ANALYSIS PENDING." In addition, the following information shall be included on the waste label:

- the well number,
- SES's point of contact and telephone number,
- the USACE point of contact and telephone number, and
- a description of the contents.

The area(s) in which the IDW is stored will be flagged with surveying tape and stakes. All other wastes (e.g., trash, tyvek suits, gloves, respirator cartridges, etc.) will be disposed off site in accordance with all applicable regulations.

IDW will be characterized for disposal within 60 days of the date of generation and properly disposed (on site and/or off site) within 90 days of generation. All IDW will be disposed at an approved, permitted facility. All emptied drums, pallets, etc. will be removed from the site by SES.

All required manifests for waste disposal will be completed by SES, and a 72-hour notice will be provided to DPW personnel. A DPW representative will sign each manifest. SES will be on site during all waste removal activities.

6. QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES AND REQUIREMENTS

6.1 SAMPLE COLLECTION, PRESERVATION, AND HOLDING TIMES

Procedures for collecting the IDW samples will follow USEPA protocols. Samples will be collected with properly decontaminated equipment and placed in properly cleaned sample containers. The steps required

for sample control and identification, data recording, and chain-of-custody (CoC) documentation are discussed in Section 6.2. All field sampling equipment will be decontaminated before use and after each sampling location.

All samples for chemical analysis will be placed on ice as soon as possible following collection. Samples will be chilled to 4 +/-2 degrees centigrade and maintained at that temperature through transport and subsequent storage at the analytical laboratory. In no case will samples be retained over 48 hours on site.

6.2 SAMPLE IDENTIFICATION AND CHAIN-OF-CUSTODY PROCEDURES

Sample CoC procedures require that possession and handling of the sample from the moment of its collection through analysis be documented by written record. The record must clearly reflect the movement of the sample through the CoC to ensure that the sample has been positively controlled and has not been tampered with in any way. A sample is judged to be in one's custody when one of the following criteria has been met.

- The sample is in one's actual physical possession.
- The sample is in one's clear field of view after being in one's physical possession.
- The sample is in one's physical possession and is then locked up in a secure container so that no one can tamper with it.
- The sample is kept in a secured area that is restricted to authorized personnel only.

6.2.1 Sample Identification

A standardized system will be used to uniquely identify all samples collected during IRA activities. The field sample number is a unique number assigned to each individual sample collected and relates a specific result set to the IDW container or containers from which it was collected. The numbering system provides a tracking procedure to ensure accurate data retrieval of all samples taken.

6.2.2 Sample Labels

All samples will be identified with a label attached directly to the container. Sample label information will be completed using waterproof black ink and will, at a minimum, contain the following information:

- company name and site,
- sample identification number,
- date and time of sample collection,
- parameters to be analyzed,
- preservative (if any), and
- initials of person collecting the sample.

6.2.3 Chain-of-Custody Record

To maintain a record of sample collection, a CoC record will be filled out documenting the collection and shipment of samples and receipt by the laboratory. Each time samples are transferred, the signatures of the person relinquishing and receiving the samples, as well as the date and time of transfer, will be documented.

6.2.4 Transfer of Custody and Shipment

Before samples are shipped, the CoC record will be signed and dated by a member of the field team who has verified that those samples indicated on the CoC record are indeed being shipped. After packaging has been completed, the samples will be locked within the cooler, and custody seals, signed and dated by a member of the field team, will be placed over the lid edge.

All samples will be shipped by courier (e.g., Federal Express or United Parcel Service) to the analytical laboratory. Upon receipt of samples at the laboratory, the receiver will complete the transfer by dating and signing the CoC record. If shipped by commercial courier, the air bill number and shipping data will be transcribed to the CoC in the appropriate signature/date block. A copy of the air bill is to be kept with the field copy of the CoC form to reflect specific shipping information.

6.3 DOCUMENTATION PROCEDURES

All documentation must be legible and completed in indelible ink. Corrections must be marked with a single line, dated, and initialed. Serialized documents are not to be destroyed or discarded, even if illegible or inaccurate. Voided entries must be maintained within project files. Every line in the logbook should contain text or have notations that the line is intentionally not being used. Text should be continuous, with

no breaks between topics. Empty lines should have a diagonal line drawn across them and be signed and dated.

Field documentation will consist of a master site logbook, one or more job- or area-specific field logbooks, field forms, and sample logs/labels. This format of documentation allows for detailed recording of information in various field logbooks and forms that are referenced in the site logbook.

Site and field logbooks provide a daily handwritten record of all field activities at an investigation site. All logbooks will be permanently bound and have a hard cover. Field logbooks must be waterproof.

Logbooks will be ruled, or ruled and gridded, with sequentially numbered pages. The site logbook is a master record of all site activities, and entries are usually made at the end of each workday. Field logbooks are detailed daily records that are kept in real time and are assigned to specific activities, positions, or areas within the site. Separate logbooks will be used for each sampling and field (drilling) team.

6.4 QUALITY CONTROL FOR FIELD MEASUREMENTS

Most data will be developed in the analytical laboratory from the samples collected; however, field measurements for health and safety monitoring and sample collection locations may be performed and recorded in the field. The primary quality assurance (QA) objectives of field activities where measurements will be taken are to verify that QC checks are performed, verify that measurements were obtained to the degree of accuracy consistent with their intended use, and provide documentation of adherence to the measurement procedures.

Measurement data may be generated during field activities (1) to make qualitative organic vapor screening measurements from samples before disposal segregation or health and safety monitoring using a photo ionization detector or flame ionization detector and (2) to determine gross levels of contaminant concentrations

Field measurement instruments will be calibrated according to manufacturers' specifications before and after each field use, or as otherwise required. Where necessary, instruments will be calibrated each day during field use, and calibration information will be documented on calibration log sheets or in logbooks. Information to be recorded includes date, operator, and calibration standards (concentration, manufacturer, lot number, and expiration date). Field measurements are considered valid provided that:

- calibration records for field measurement equipment are properly maintained,
- training records exist that document field personnel are familiar with standard procedures for taking measurements, and
- there is verification that calculations and observations are accurately recorded and transcribed.

Chemical data will be generated using USEPA SW-846 analytical methods. For SW-846 methods, forms that include similar information to that on the referenced contract laboratory program (CLP) forms must be included in the data package. Forms do not need to be presented in the format specified by the CLP but must include similar laboratory information as required by the CLP forms, including specifications for any QC acceptance limits or criteria required by the method performed. The laboratory identified on the project organizational chart (Figure 1-1) holds a current USACE laboratory certification and holds accreditation for environmental laboratories in the State of Georgia.

6.5 PERFORMANCE AND SYSTEM AUDITS

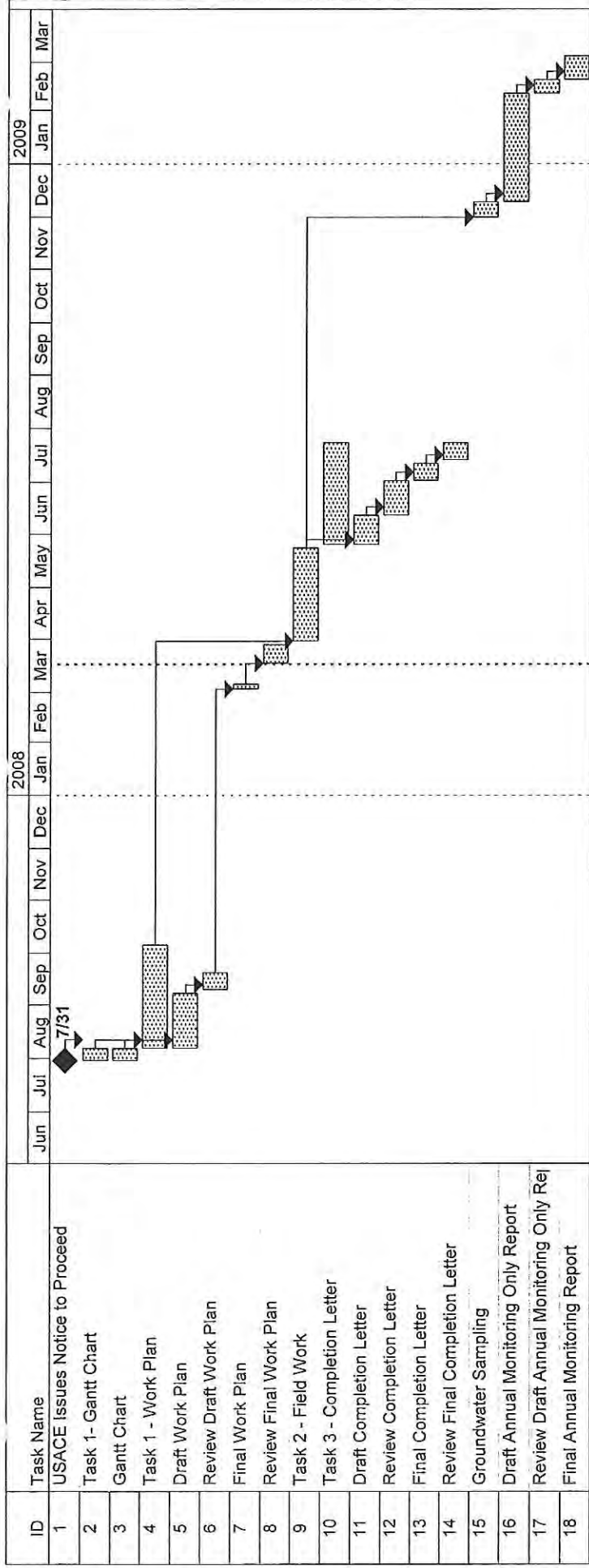
If deemed appropriate by Fort Stewart DPW personnel or the USACE project manager, surveillance of project field and/or laboratory operations may be conducted. The QA adequacy of these operations will be assessed against the requirements outlined in this document.

7. REPORTING

In addition to this work plan, required project reporting for the IRAs at SWMU 13 include a project schedule, monthly progress reports, a letter completion report, and an annual monitoring only report for SWMU 13. Each of these deliverables is more fully described in the following sections.

7.1 SCHEDULE

A detailed schedule for preparation and submittal of this project work plan, conducting fieldwork, preparation and submittal of the draft and final completion letter report, and preparation and submittal of the annual monitoring only report is provided in Figure 7-1.



Task

Split

Progress

Milestone

Summary

Project Summary

External Tasks

External Milestone

Deadline

7.2 MONTHLY PROGRESS REPORTS

SES will prepare and submit a monthly progress report to the USACE project manager. Each monthly report will describe the work completed during the current reporting period, indicate the work planned for the next reporting period, and discuss any problems, issues, or concerns encountered on the project. Progress reports will be submitted on the 10th of each month.

7.3 LETTER COMPLETION REPORT

SES will prepare a letter completion report documenting the soil removal action (excavation), ORC[®] injection, and the monitoring well installations for the site. This letter report will be prepared and signed by a Professional Engineer or a Professional Geologist, duly registered with the State of Georgia. The report will summarize the activities conducted during the IRA, will include a detailed site map, and will also include all manifests for the disposal of the IDW generated by the project. The letter completion report will be submitted first in draft form that will be reviewed by USACE and DPW personnel. After comments are incorporated, a final letter completion report will be prepared and submitted. Upon acceptance of the final letter completion report, copies will be submitted to the USACE Savannah District and Fort Stewart DPW in both electronic and written format.

7.4 ANNUAL MONITORING ONLY REPORT

After completing the groundwater monitoring activities at SWMU 13, SES will compile and submit an Annual Monitoring Only Report for the site. This report will be prepared in accordance with the most current guidance document issued by the Georgia Department of Natural Resources Environmental Protection Division (EPD). It will meet the requirements of the Georgia EPD, Fort Stewart, and the USACE. The report will summarize the current year of sampling and analytical results and will also incorporate any sampling results from prior years. Inclusion of both current and previous sampling results will indicate any changes in contaminant concentrations, plume migration, etc. and indicate if the predictions of the fate and transport model provided in prior reports are accurate. If deemed necessary, SES will incorporate a revised fate and transport model based on current site conditions. Based on current site conditions, SES may propose revised alternative cleanup levels or alternative threshold levels for the site. An updated site ranking form will be completed and submitted with the report.

The report will be submitted first in draft form that will be reviewed by USACE Savannah District and Fort Stewart DPW personnel. After comments are incorporated, a final report will be prepared and submitted to USACE Savannah District and Fort Stewart DPW in both electronic and written format.

8. REFERENCES

SAIC (Science Applications International Corporation), February 2007. *Final Corrective Action Plan, Progress Report for Calendar Year 2006, for the Former Fire Training Area at Wright Army Airfield (Solid Waste Management Unit 13) at Fort Stewart Military Reservation, Fort Stewart, Georgia.*

Appendix A
ORC[®] Manufacturer's Recommendations for SWMU 13



ORC Advanced Design Software for Grid Applications Using Slurry Injection

Aug 2006

Regenesis Technical Support: USA (949) 366-8000

www.regenesis.com

Site Name: FL Stewart-Savannah

Location: SWMU 13

Consultant: SpecPro (Doug Hawn)

Estimated Plume Requiring Treatment

Width of plume (intersecting gw flow direction)
Length of plume (parallel to gw flow direction)
Depth to contaminated zone
Thickness of contaminated saturated zone
Nominal aquifer soil (gravel, sand, silty sand, silt, clay)
Total porosity
Hydraulic conductivity
Hydraulic gradient
Seepage velocity
Treatment Zone Pore Volume

20	ft	500	ft ²
25	ft		
14	ft		
10	ft		
silty sand			
0.4		0.2	
10	ft/day	3.5E-03	cm/sec
0.005	ft/ft		
91.3	ft/yr	0.250	ft/day
2,000	ft ³	14,962	gallons

Dissolved Phase Oxygen Demand:

Individual species that represent oxygen demand:

Benzene
Toluene
Ethylbenzene
Xylenes
MTBE
cis-1,2-DCE
Vinyl Chloride
Naphthalene
User added, add stoich. demand and Koc (see pull-down)
Reduced metals: Fe²⁺ and Mn²⁺

Contaminant Conc. (mg/L)	Contaminant Mass (lb)	Stoichiometry (wt/wt) O ₂ /contaminant	ORC-Adv Dose (lb)
0.01	0.0	3.1	0
0.00	0.0	3.1	0
0.50	0.1	3.2	1
0.00	0.0	3.2	0
0.00	0.0	2.7	0
0.00	0.0	0.7	0
0.00	0.0	1.3	0
0.13	0.0	3.0	0
0.00	0.0	0.0	0
10.00	1.2	0.1	1

TPH-g

<- pull-down menu

Measures of total oxygen demand

Total Petroleum Hydrocarbons (see pull-down for Koc)
Biological Oxygen Demand (BOD)
Chemical Oxygen Demand (COD)

0.00	0.0	3.1	0
0.00	0.0	1.0	0
0.00	0.0	1.0	0

Parameters for Sorbed Phase Oxygen Demand:

Soil bulk density
Fraction of organic carbon (foc)

1.78	g/cm ³	=	110	lb/cf
0.003		range:	0.0001 to 0.01	

(Estimated using sorbed phase = foc*Koc*Cgw)
(Adjust Koc as necessary to provide realistic estimates)

Benzene
Toluene
Ethylbenzene
Xylenes
MTBE
cis-1,2-DCE
Vinyl Chloride
Naphthalene
User added, add stoich. demand and Koc (see pull-down)

Koc (L/kg)	Contaminant Conc. (mg/kg)	Contaminant Mass (lb)	Stoichiometry (wt/wt) O ₂ /contaminant	ORC-Adv Dose (lb)
123	0.00	0.0	3.1	0
267	0.00	0.0	3.1	0
327	0.49	0.3	3.2	5
298	0.00	0.0	3.2	0
12	0.00	0.0	2.7	0
80	0.00	0.0	0.7	0
2.5	0.00	0.0	1.3	0
1000.0	0.39	0.2	3.0	4
0.0	0.00	0.0	0.0	0
373	0.00	0.0	3.1	0

Measures of total oxygen demand

Total Petroleum Hydrocarbons

Summary of Estimated ORC-Adv Requirements

	Dissolved Phase ORC-Adv Demand (lbs)	Sorbed Phase ORC-Adv Demand (lbs)	Additional Demand Factor (1 to 10x)	Total ORC-Adv Demand (lbs)	ORC-Adv Cost
Total BTEX, MTBE, etc.	2	9	5.0	56	\$671
Total Petroleum Hydrocarbons	0	0	2.0	0	\$0
Biological Oxygen Demand (BOD)	0	0	2.0	0	\$0
Chemical Oxygen Demand (COD)	0	0	1.5	0	\$0

Required ORC-Adv quantity (in 25 lb increments)

75 pounds ORC-Adv

Delivery Design for ORC-Adv Slurry

Spacing within rows (ft)
points per row
Spacing between rows (ft)
of rows
Advective travel time bet. rows (days)
Number of points in grid
ORC-Adv application rate
Total ORC-Adv required

Minimum Dose Override

Minimum Dose Override

8.0	feet
3	points/row
10.0	ft
3	rows
40	days
9	points
3.0	lbs/foot
270	lbs of ORC-Adv

Slurry Mixing Volume for Injections

Pounds per location
Buckets per location
Design solids content (20-40% by wt. for injections)
Volume of water required per hole (gal)
Total water for mixing all holes (gal)
Simple ORC-Adv Backfilling: min hole dia. for 67% slurry
Feasibility for slurry injection in sand: ok up to 15 lb/ft
Feasibility for slurry injection in silt: ok up to 10 lb/ft
Feasibility for slurry injection in clay: ok up to 10 lb/ft

50	pounds
2.0	buckets
30%	
14	gallons
128	gallons
3.7	inches
(ok)	
(ok)	
(ok)	

Project Summary

Number of ORC-Adv delivery points (adjust as necessary for site)
ORC-Adv application rate in lbs/ft (adjust as necessary for site)
ORC-Adv bulk material for slurry injection (lbs)
Number of 25 lb ORC-Adv buckets
ORC-Adv bulk material cost (\$/lb)
Cost for bulk ORC-Adv material
Shipping and Tax Estimates in US Dollars
Sales Tax
Total Material Cost
Shipping (call for amount)
Total Regenesis Material Cost

rate: 0.00%

5.0	
18.0	
8.95	
4,028	
-	
4,028	
-	
4,028	

ORC-Adv Slurry Injection Cost Estimate (responsibility of customer to contract work)

Footage for each point = uncontaminated interval + ORC-Adv injection interval (ft)	24
Total length for direct push for project (ft)	216
Estimated daily installation rate (ft per day: 300 for push, 150 for drilling)	300
Estimated points per day (10 to 30 is typical for direct push)	12.5
Required number of days	1
Mod/demob cost for injection subcontractor	\$ -
Daily rate for injection subcontractor (\$1-2K for push, \$2-4K for drill rig)	\$ -
Total injection subcontractor cost for application	\$ -
Total Install Cost (not including consultant, lab, etc.)	\$ 4,028

Other Project Cost Estimates

Design	\$ -
Permitting and reporting	\$ -
Construction management	\$ -
Groundwater monitoring and rpts	\$ -
Other	\$ -
Other	\$ -
Other	\$ -
Other	\$ -
Total Project Cost	\$ 4,028

ORC/ORC ADVANCED TREATMENT GUIDELINES FOR UNKNOWN CONTAMINANT LEVELS

(IT IS RECOMMENDED THAT HYDROCARBON MEASUREMENTS BE TAKEN INSTEAD OF RELYING ON THIS SPREADSHEET)

ORC Advanced Treatment

Excavation Length (ft)	15
Excavation Width (ft)	15
Thickness of Saturated Treatment Zone (ft)	3
Weight of Saturated Soil (lbs / cu. yd.)	2,700.00

(normal sandy soil ≈ 2700 lbs./cu. yd.)

Volume (cubic yards)	25
Total Weight of Treatment Area (lbs)	67,500
Percent ORC-Adv to use (wt/wt for soil)	0.43 %

(REGENESIS recommends using 0.1% minimum)

ORC-Adv Required (lbs)	300
ORC-Adv Unit Cost (\$/lb)	8.95
Total Cost of ORC-Adv	\$ 2,685.00

GENERAL TABLE - ORC Advanced

Percent ORC-Adv per wt of soil	0.1%	0.2%	0.3%	0.4%	0.5%
Pounds ORC-Adv	75	150	225	275	350
Total Cost of ORC-Adv	\$671	\$1,343	\$2,014	\$2,461	\$3,133

Percent ORC-Adv per wt of soil	0.6%	0.7%	0.8%	0.9%	1.0%
Pounds ORC-Adv	425	475	550	625	675
Total Cost of ORC-Adv	\$3,804	\$4,251	\$4,923	\$5,594	\$6,041

**Final
Accident Prevention Plan
for Interim Remedial Action
and Corrective Action Progress Report
at Wright Army Airfield Fire Training Area
(Solid Waste Management Unit 13),
and Interim Remedial Actions
at Underground Storage Tank 210
and Underground Storage Tanks 208 & 209
Fort Stewart, Georgia**

March 2008

**Submitted to:
Directorate of Public Works
Environmental Branch
Fort Stewart, Georgia**

**Submitted by:
U.S. Army Corps of Engineers
Savannah District**

**Prepared By:
SpecPro Environmental Services LLC
1006 Floyd Culler Court
Oak Ridge, Tennessee 37830
under
Contract Number W912HN-07-D-0012
Delivery Order 0003**

SIGNATURE PAGE

Accident Prevention Plan
for Interim Remedial Activities
at Solid Waste Management Unit 13,
Underground Storage Tank 210 and 208 & 209,
Fort Stewart, Georgia

Contract Number W912HN-07-D-0012
Delivery Order No: 0004

Prepared By:	
	Jeff Williams, Project Manager SES, Inc. (865) 481-7837

Plan Approval:	
	Clark Roberts, C.I.H., R.E.A. Environmental Projects Manager Bristol Environmental & Engineering Services (210) 490-5877

Plan Concurrence:	
	Jim Madaj, Program Manager SES, Inc. (865) 481-7837

**ACCIDENT PREVENTION PLAN
for Interim Remedial Action
and Corrective Action Progress Report
at Wright Army Airfield Fire Training Area
(Solid Waste Management Unit 13),
and Interim Remedial Actions
at Underground Storage Tank 210
and Underground Storage Tanks 208 &209
Fort Stewart, Georgia**

PURPOSE AND SCOPE

This accident prevention plan (APP) will serve, in essence, as a safety and health policy and program document for this project. This plan will address the job-specific hazards associated with this project and also any unusual or unique aspects of the project. To avoid duplication, the U.S. Army Corps of Engineers (USACE) EM 385-1-1 minimum basic requirements for an APP that are not specifically addressed in this APP are included in the project site-specific safety and health plan (SSHP) found in Attachment 1.

1. SIGNATURE SHEET

The signature page is included on page 1 of this document.

2. BACKGROUND INFORMATION

- 2 a. Contractor:** SpecPro Environmental Services LLC (SES)
- 2 b. Contract Number:** W912HN-07-D-0012, Delivery Order No. 0003
- 2 c. Project Name:** Interim Remedial Action and Corrective Action Progress Report at Wright Army Airfield Fire Training Area (Solid Waste Management Unit 13), and Interim Remedial Actions at Underground Storage Tank 210 and Underground Storage Tanks 208 &209, Fort Stewart, Georgia.
- 2 d. Project Description:** See Section 1 of the work plan for description of project and scope of work. Figure 2-1 of the work plan contains a layout of the project site.
- 2 e. Accident Experience:** As of 2006, SES has an experience modification rate (EMR) of 0.77.
- 2 f. List of Phases of Work and Activity Hazard Analysis:** Types of hazards are listed in Section 2 of the SSHP.

3. STATEMENT OF SAFETY AND HEALTH POLICY

SES's commitment to excellence in the areas of health and safety performance is consistent with the company's goal of being acknowledged as an industry leader. As such, SES is committed to the following principles:

- **Decision-making:** SES will make health and safety concerns an integral part of corporate decision-making. All strategic and operational decision-making will take into account health and safety implications.
- **Compliance:** SES will comply with all applicable health and safety laws and regulations. Health and safety programs will be established and maintained. Audits will be conducted to assess compliance with laws and regulations as well as these principles.
- **Communication with Employees:** SES will promote among its employees an individual and collective sense of responsibility for the protection of health and safety.
- **Subcontractor Selection:** SES will preferentially select subcontractors with excellent safety programs and who demonstrate a commitment to these principles of worker safety and health.
- **Measurement of Performance:** SES will develop a means to measure both current and future health and safety performance in meeting these principles.
- **Risk Management:** SES will constantly strive to identify, evaluate, and control risks in the work place that present a potential loss due to personal injury, property damage, or harm to the environment.
- **Responsibility:** All SES employees are empowered to use the necessary means to protect their personal safety, as well as that of their coworkers. SES employees are responsible for complying with safety requirements, as well as bringing safety concerns to the attention of management.

SES believes that all work-related accidents are preventable. The safety of our workers holds the same priority as production and client satisfaction.

4. RESPONSIBILITIES AND LINES OF AUTHORITY

- 4 a. **Personnel Responsible for Safety:** See the SSHP Section 3 for safety program administration for this project. Key corporate and project personnel resumes are included in Appendix F of the SSHP.
- 4 b. **Lines of Authority:** See the SSHP Section 3 for lines of authority.

5. SUBCONTRACTORS AND SUPPLIERS

- 5 a. **Identification of Subcontractors:** Figure 1-1 in the work plan contains an organizational chart showing subcontractors required for completion of this project.

- 5 b. Subcontractor Coordination and Control:** Section 3.6 of the SSHP contains a discussion of coordination and control of subcontractors.
- 5 c. Safety Responsibilities of Subcontractors:** See Section 1.1 of the SSHP for a discussion of the safety responsibilities of subcontractors and suppliers.

6. TRAINING

- 6 a. Safety Training:** See SSHP Section 4 for descriptions of the safety orientation, safety meetings, and safety training requirements associated with this project. Employee training certifications are contained in Appendix C of the SSHP.
- 6 b. Mandatory Safety Training:** See Section 4 of the SSHP.
- 6 c. Emergency Response Training:** See Section 4 of the SSHP.
- 6 d. Supervisor and Employee Safety Meetings:** See Section 4.2 of the SSHP for a description of requirements for the site orientation briefing, pre-work briefings, and daily safety meetings.

7. SAFETY AND HEALTH INSPECTIONS

- 7 a. Safety Inspection Personnel:** The site safety and health officer (SSHO) will conduct weekly site and daily equipment and drill rig inspections. These inspections will be documented using the inspection forms included in Appendix A of the SSHP.
- 7 b. External Inspections/Certifications:** The corporate health and safety manager may make announced or unannounced site visits. The corporate health and safety manager also performs a quarterly review of all projects to ensure the proper documentation and follow-up of safety meetings, inspections, and briefings.

8. SAFETY AND HEALTH EXPECTATIONS, INCENTIVE PROGRAMS, AND COMPLIANCE

- 8 a. Safety Goals:** SES's project safety goal is to complete the project and all associated activities with no recordable accidents or illnesses and no first aid incidents. All accident records are maintained by the SES's human resources department.
- 8 b. Safety Incentive Programs:** SES does not currently have a safety incentive program in place.
- 8 c. Policies and Procedures for Noncompliance:** Noncompliance with safety and health requirements will be corrected immediately as designated by on-site supervisory personnel. Documentation will be made in the logbook. The site manager or SSHO will report serious, noncompliant personnel to the immediate supervisor. The supervisor shall counsel the employee. SES complies with all federal, state, and local safety and health regulations. SES also has instituted internal requirements to help us reduce the potential for accidents or illnesses. All employees are expected to follow safe work practices, to take responsibility for

their own safety, and to respect the safety of others. SES's safety management approach attempts to motivate employees to work safely, rather than punishing them for unsafe behaviors, but there may be instances where disciplinary action may be necessary.

Any personnel not abiding by regulatory or internal safety rules or policies will be subject to progressive discipline. The general approach to progressive discipline includes the following steps.

- First Offense - Documented verbal warning
- Second Offense - Written warning
- Third Offense – Three days suspension without pay
- Fourth Offense – Termination

Disciplinary actions will be documented by the supervisor, and a notice will be placed in the individual's personnel record.

Depending on the nature, severity, or frequency of safety violations, and at SES's sole discretion, individual or multiple steps in this progressive discipline approach may be bypassed, with potential actions up to or including termination on the first offense.

8 d. Supervisory Accountability for Safety: See Section 3 of the SSHP.

9. ACCIDENT REPORTING

9 a. Exposure/Man-hours: Mr. Jeff Williams (SES) will provide monthly reporting of man-hours and exposure data per contract requirements.

9 b. Accident Investigations, Reports, and Logs: See Section 11 of the SSHP for accident investigation reporting. Accident investigation reports and logs are included in Appendix A of the SSHP.

9 c. Accident Notification: See SSHP Section 11 and Appendix A.

10. MEDICAL SUPPORT

Section 11 of the SSHP contains procedures for emergency response efforts, including the requirements for medical support. Section 11.2 contains the emergency phone numbers necessary for medical support and Appendix E contains a map to the hospital.

11. PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment requirements for this project are addressed in Section 5 of the SSHP.

12. PLANS REQUIRED BY THE SAFETY MANUAL

12 a. Hazard Communication Program: Hazard communication is discussed in Section 8.10 of the SSHP.

12 b. Emergency Plans: Emergency plans are detailed in Section 11 of the SSHP.

12 c. Layout Plans: See Appendix D of the SSHP.

12 d. Respiratory Protection Plan: Table 4-1 of the SSHP requires respiratory protection training for work conducted inside a controlled area. The use of respiratory equipment is not anticipated for this project; however, if work conditions indicate that respiratory protection is required or that it is necessary to upgrade PPE, the SSHO will stop work and notify the site manager and the health and safety manager.

12 e. Health Hazard Control Programs: See Table 2-2 and Section 8 of the SSHP for identification of health hazards.

12 f. Lead Abatement Plan: Not applicable to this project.

12 g. Asbestos Abatement Plan: Not applicable to this project.

12 h. Abrasive Blasting: Not applicable to this project.

12 i. Confined Space: Not applicable to this project.

12 j. Hazardous Energy Control Plan: See Section 8.8 of the SSHP for lockout/tagout safety precautions. Overhead line distances will be checked prior to raising loads overhead. Dig permits will be obtained prior to any excavation; however, no lockout/tagout activities are anticipated at this time that would require development of a hazardous energy control plan.

12 k. Critical Lift Procedures: Not applicable to this project.

12 l. Contingency Plan for Severe Weather:

Site personnel shall follow standard safety guidelines for severe weather. These include but are not limited to:

- Use a weather radio in remote areas or set portable or vehicle radio to a local station during peak tornado and storm seasons and check every 1-2 hours for weather conditions.
- Shut down operations and lower any elevated parts to heavy equipment when lightning discharge is within 3 - 5 miles. The distance used is dependent on the speed of the approaching storm.
- Inspect stream and riverbanks for flood potential and stability and secure equipment and personnel at a safe distance.
- Notify local authorities that you are on site and request notification if severe weather conditions arise. Authorities may include: Installation point of contact, USACE construction and real estate field offices, and fire and police services.

12 m. Access and Haul Road Plan: Not applicable to this project.

- 12 n. Demolition Plan:** Not applicable to this project.
- 12 o. Emergency Rescue:** Not applicable to this project.
- 12 p. Underground Construction Fire Prevention and Protection Plan:** Not applicable to this project.
- 12 q. Compressed Air Plan:** Not applicable to this project.
- 12 r. Formwork and Shoring Erection and Removal Plans:** Not applicable to this project.
- 12 s. Lift Slab Plans:** Not applicable to this project.
- 12 t. SHP and SSHP:** A SSHP is included as Attachment I of the APP.
- 12 u. Blasting Plan:** Not applicable to this project.
- 12 v. Diving Plan:** Not applicable to this project.
- 12 w. Alcohol and Drug Abuse Prevention Plan:** SES participates in a drug-free workplace program, which is certified by the State of Tennessee. No alcoholic beverages or illegal substances may be used during work hours or stored on the person or in company vehicles. Personnel who appear to be under the influence of these substances at any time during the work period shall not operate any motorized tools, equipment, or vehicles. Personnel who appear to be under the influence of over-the-counter drugs or medications (antihistamines, allergy medication, etc.) that impair their ability to function (fitness for duty such as operating equipment or vehicles) shall be prevented from doing so. The on-site manager (SSHO or alternate) shall contact the SES project manager and human resources manager for guidance in accordance with the SES Alcohol and Drug Abuse Policy.

13. ADDITIONAL INFORMATION

Additional safety and health requirements are included in the SSHP.

ATTACHMENT 1

SITE-SPECIFIC SAFETY AND HEALTH PLAN

**Final
Site-Specific Safety and Health Plan

for Interim Remedial Action
and Corrective Action Progress Report
at Wright Army Airfield Fire Training Area
(Solid Waste Management Unit 13),

and Interim Remedial Actions
at Underground Storage Tank 210
and Underground Storage Tanks 208 & 209
Fort Stewart, Georgia**

March 2008

**Prepared for:
U.S. Army Corps of Engineers
Savannah District**

**Prepared by:
SpecPro Environmental Services LLC
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ACRONYMS AND ABBREVIATIONS

$\geq$	greater than or equal to
$\leq$	less than or equal to
ACGIH	American Council of Government Industrial Hygienists
BTEX	benzene, toluene, ethylbenzene, and xylene
CAP	corrective action plan
CFR	<i>Code of Federal Regulations</i>
CHMM	Certified Hazardous Materials Manager
CIH	Certified Industrial Hygienist
CPR	cardiopulmonary resuscitation
CRZ	contamination reduction zone
dBA	A-weighted decibels
DPT	direct push technology
DRO	diesel range organic
eV	electron volt
EZ	exclusion zone
°F	degrees Fahrenheit
FID	flame ionization detector
FP	flash point
FSMR	Fort Stewart Military Reservation
ft	foot/feet
FY	fiscal year
GEPD	Georgia (Department of Natural Resources) Environmental Protection Division
GFCI	ground fault circuit interrupter
HAZWOPER	hazardous waste operations and emergency response
IDLH	immediately dangerous to life or health
IP	ionization potential
IRA	interim remedial action
m ³	cubic meters
mg	milligrams
mm	millimeter
mph	miles per hour
MSDS	material safety data sheet
MTBE	methyl tertbutyl ether
NA	not available
NIOSH	National Institute of Occupational Safety and Health
NRR	noise reduction rating
ORC [®]	Oxygen Release Compound [®]
OSHA	Occupational Safety and Health Administration
PAH	polynuclear aromatic hydrocarbon
PEL	permissible exposure limit
PPE	personal protective equipment
ppm	parts per million
PT	physical training
PVC	polyvinyl chloride
REA	Registered Environmental Assessor
S&H	safety and health
SES	SpecPro Environmental Services LLC
SES S&H Manual	<i>SpecPro Environmental Services LLC Safety and Health Program Manual</i>
SOW	scope of work

SSHO	site safety and health officer
SSHP	site-specific safety and health plan
STEL	short-term exposure limit
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TLV	threshold limit value
TPH	total petroleum hydrocarbon
USACE	U.S. Army Corps of Engineers
UST	underground storage tank
UXO	unexploded ordnance
VOC	volatile organic compound
VP	vapor pressure
WAAF	Wright Army Airfield

1. INTRODUCTION

1.1 GENERAL

SpecPro Environmental Services LLC (SES) conducts activities in accordance with its corporate environmental safety and health (S&H) program that is intended to ensure safe operation and regulatory compliance during all fieldwork. SES is committed to compliant operation under provisions of this program. The corporate policy states, "It is the policy of SES to take every reasonable precaution to protect the health and safety of our employees, the public, and the environment."

The SES S&H program, which is contained in *SpecPro Environmental Services LLC Safety and Health Program Manual* (SES, March 2007), hereinafter referred to as the SES S&H Manual, together with site-specific safety and health plans (SSHPs) presents the requirements for safely performing fieldwork. This SSHP sets forth the basic procedures required to protect SES and subcontractor personnel involved in the field phase of the interim remedial actions (IRAs) to be performed at the Wright Army Airfield (WAAF) Fire Training Area [Solid Waste Management Unit (SWMU) 13], and at former underground storage tank (UST) sites UST 210 and UST 208 & 209 at the Fort Stewart Military Reservation (FSMR) in Georgia.

This plan represents a good-faith effort to identify, evaluate, and prescribe controls for the hazards that will be posed by this work. The site safety and health officer (SSHO) will perform daily safety inspections to verify that the controls in this plan are appropriate and sufficient and will revise these controls as necessary to ensure that the work is performed safely. Revisions to the SSHP will be documented, and those revisions that result in decreasing or eliminating a hazard control will be approved by the SES health and safety manager before they are implemented. SES subcontractors will be informed of the requirements of this plan and will be provided with copies of or unrestricted access to copies of this plan. SES's subcontractors will be required to comply with the requirements of this plan; however, use of this plan does not relieve subcontractors of the regulatory requirement to provide a safe workplace for their employees. For this reason, SES subcontractors will be required to supplement the requirements of this plan, as necessary, to ensure that their employees perform their specific tasks safely.

This document is designed to satisfy the requirements of ER 385-1-92, *Safety and Occupational Health Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW) Activities* [U.S. Army Corps of Engineers (USACE), July 2003]; the requirements of EM-385-1-1, *Safety and Health Requirements Manual* (USACE, November 2003); relevant Occupational Safety and Health Administration (OSHA) regulations; and the SES S&H Manual.

This SSHP is included as a stand-alone portion of the project work plan. In cases in which required information is contained in another portion of the work plan, the information will be referenced rather than repeated in this SSHP.

The objective of the scope of work (SOW) is to perform IRAs at SWMU 13 and at the former UST 210 and former UST 208 & 209 sites to address remaining soil and/or groundwater contamination. The results of the IRAs will be reported in a Corrective Action Plan (CAP) Progress Report for SWMU 13 and in semi-annual monitoring reports for the UST 210 and UST 208 & 209 sites. The field work to be performed at each site is summarized in the following list.

WAAF Fire Training Area (SWMU 13)

- Excavate petroleum contaminated soil from an area in the vicinity of a pipeline at the site and apply Oxygen Release Compound® (ORC®) to the excavation before backfilling,
- Install three groundwater monitoring wells at the site,
- Use direct push technology to inject of ORC® at a separate location at the site, and
- Sample the groundwater from nine groundwater monitoring wells at the site.

UST 210

- Excavate and remove a monitoring well (Well 43-08/11) and dispose of the well materials as petroleum-contaminated non-hazardous construction materials;
 - If free product is encountered, SES will absorb and/or otherwise contain any free product and sheen that may be encountered in the excavation.
 - Cut concrete around the well to be abandoned and remove and dispose the concrete.
 - Excavate petroleum contaminated soil surrounding the well and sample the soil for disposal characterization.
 - Sample the soil remaining in the four walls and the bottom of the excavation. The samples will be analyzed for petroleum constituents.
 - Place and spread ORC® over the excavation bottom and four sidewalls.
- Install one new 4-inch diameter groundwater monitoring well, finished as a flush mount well, in the center of the excavation and restore the site with reinforced concrete to replace the concrete removed; and
- Collect a groundwater sample from three wells at UST 210 on a semi-annual basis for two years (4 events).

USTs 208 & 209

- Remove a monitoring well (Well 42-07) and dispose the well screen and casing as petroleum-contaminated non-hazardous construction materials;
 - If free product is encountered, SES will absorb and/or otherwise contain any free product and sheen that may be encountered in the excavation.
 - Cut concrete around the well to be abandoned and remove and dispose the concrete.
 - Excavate petroleum contaminated soil surrounding the well and sample the soil for disposal characterization.
 - Sample the soil remaining in the four walls and the bottom of the excavation. The samples will be analyzed for petroleum constituents.
 - Place and spread ORC® over the excavation bottom and four sidewalls.
- Install one new 4-inch diameter groundwater monitoring well, finished as a flush mount well, in the center of the excavation and restore the site with reinforced concrete to replace the concrete removed; and
- Collect one groundwater sample from three wells at UST 208 & 209 on a semi-annual basis for two years (4 events).

The greatest hazards posed by the planned tasks are those associated with the heavy equipment (such as backhoes). Entry into any open excavation will not be permitted during this project. Based on previous sampling results, there is a potential for exposure to site contaminants; however, this potential should be minimal and will be readily controllable through adherence to standard operating procedures and personal protective equipment (PPE) requirements.

This project will be performed in Level D modified PPE unless one of several action levels specified in the plan is exceeded or the potential for increased risk becomes apparent during the field activities. Protective procedures, including protective clothing, will be upgraded as necessary by the SSHO based on established action levels or judgment.

Site visitors will not be allowed inside areas controlled by SES without the specific approval of the SSHO and the SES field manager. Site visitors must meet all regulatory and site health and safety requirements (e.g., training, medical surveillance) to be considered for entry into exclusion zones (EZs) or contamination-reduction zones (CRZs). Site visitors are requested to contact the SES project manager or field manager prior to visiting.

2. HAZARD/RISK ANALYSIS

The purpose of the site task hazard analysis is to identify and assess potential hazards that could be encountered by site personnel and to prescribe required controls. Table 2-1 is a checklist of common hazards that could result from this type of project. It indicates whether a particular major type of hazard is or could possibly be present. In general, the site tasks will consist of activities required to install monitoring wells and collect soil and water samples. Overexposure to site contaminants appears to be very unlikely.

Table 2-1 Hazards Inventory

Yes	No	Hazard
X		Biological hazards (wasps, bees, snakes, poison ivy, ticks, fire ants)
	X	Confined-space entry (no confined spaces are present)
	X	Drowning (no work near water)
X		Electrical shock
	X	Excavation entry
X		Exposure to chemicals (PAHs, BTEX, MTBE, and DRO)
	X	Exposure to boiling water
X		Fire (fuels and contaminants)
	X	Unexploded ordnance (no reported use or sightings; the site has been subject to extensive excavation)
X		Heavy equipment (backhoe, DPT)
X		Noise
	X	Radiation or radioactive contamination (none present)
X		Temperature extremes (possible)

BTEX = benzene, toluene, ethylbenzene, and xylene
DPT = direct push technology
DRO = diesel range organics

MTBE = methyl tertbutyl ether
PAH = polynuclear aromatic hydrocarbons

Site tasks present some possible physical hazards including heavy equipment, moving equipment, vehicle accidents, and inclement weather. There is no record or other indication of unexploded ordnance (UXO) use or disposal in this area, so there does not appear to be any potential to encounter UXO. If additional

tasks or significant hazards are encountered during the work, work will stop and this document will be modified by addendum or field change order to include the additional information. Any changes to the SSHP will be submitted to the SES health and safety manager for approval before they are implemented.

2.1 TASK-SPECIFIC HAZARDS ANALYSIS

Table 2-2 presents task-specific hazards, relevant hazard controls, and required monitoring, if appropriate, for all of the planned site tasks.

Table 2-2 Hazards Analysis

Safety and Health Hazards	Controls	Monitoring
Excavation and Removal of Monitoring Well		
General safety hazards	• Level D modified PPE, buddy system, site-specific training, HAZWOPER training • Contractor will perform this work in accordance with equipment-specific standard safe operating procedures • Site is restricted to authorized personnel • At least two first aid/CPR trained individuals on-site	Daily site inspections
Electrical	• Assure grounding will be utilized for all temporary wiring • GFCIs will be used for portable hand tools	Daily site inspections
Excavation	• Only qualified and experienced personnel will operate heavy equipment. • Workers will be kept at least 10 ft away from heavy equipment during operation. • Barricades/flagging will be erected 6 ft from the edge of the excavation. • All excavation activities will be conducted in accordance with EM 385-1-1, Section 25.	Daily monitoring
Biological hazards (bees, ticks, wasps, snakes, poison ivy)	• Boots, work clothes, taped pant legs as necessary • Insect repellant as necessary	Visual survey
Mosquito-borne diseases (e.g., West Nile Virus, Encephalitis)	• Use commercially available insect repellent containing DEET • Wear long-sleeved shirts and pants	Visual survey
Exposure to chemicals	• Level D modified PPE. Nitrile gloves or equivalent (rated good or excellent for gasoline resistance) at least 4-mil thick will be worn when contact with contaminated soil is possible. Two pairs of gloves will be worn if chemical-resistant clothing is worn. • MSDS labeling and training for any chemicals brought on-site • Medical clearance for hazardous waste work • Wash face and hands upon leaving the exclusion zone. • Periodic area and breathing zone monitoring of contaminant levels. • Employee briefings. • Medical clearance, if respirators are used • Current fit tests, if respirators used	Daily site inspections
Temperature extremes	• Administrative controls (Section 8)	Temperature measurements; heart rate monitoring per Section 8
Noise	• Hearing protection within 25 ft of rig, unless site-specific monitoring indicates noise <85 dBA • See Section 7.2 of SSHP	Daily site safety inspections

Table 2-2 Hazards Analysis (Continued)

Safety and Health Hazards	Controls	Monitoring
Excavation and Removal of Monitoring Well (Continued)		
Post-specific	• All personnel must have a government identification card or temporary vehicle permit • All drivers must have current drivers license • All vehicles must have proof of insurance • Troops have right-of-way. Speed limit 10 mph when near troops	Daily safety inspections
Installation of Soil Borings, Monitoring Wells, ORC® Application, and Potential Free Product Removal		
General safety hazards (rotating machinery, suspended loads, moving equipment, slips, falls)	• Level D modified PPE (Section 5) plus hardhat, buddy system • No employees under lifted loads. EZ around rig; only necessary and experienced personnel within EZ • HAZWOPER training; standard procedures (Section 8.13)	Daily site safety inspections Daily equipment inspections
Noise	• Hearing protection within 25 ft of heavy equipment, unless site-specific monitoring indicates noise <85 dBA	Daily site safety inspections
Fire (fuels)	• Fire extinguishers (serviced annually and inspected monthly) will be present in all fuel use areas • Fuel stored in safety cans with flame arresters • Fire extinguisher rated ≥20B within 50 ft from flammables storage • No ignition sources in fuel storage areas • Fuel storage areas marked with "No Smoking or Open Flame" signs • Bonding (metal to metal contact) during pouring • Gasoline-powered equipment shut down during fueling	Daily site safety inspections
Exposure to chemicals (Table 2-3)	• PPE (Level D modified). [Nitrile gloves or equivalent (rated good or excellent for gasoline resistance) at least 4 mil thick will be worn. When encountering potentially contaminated soil, gloves will be changed every two hours. Face shields will be worn if splashing is a possibility.] • Medical clearance for hazardous waste work • Wash face and hands upon leaving the EZ • MSDS labeling and training for all chemicals brought on site	FID or equivalent for VOCs and colorimetric sampling tubes for specific gases/vapors, such as benzene
Temperature extremes	• Administrative controls (Section 8.14)	Temperature measurements: heart rate/temperature monitoring per Section 8
Water hazards	• No personnel or equipment will be allowed within 30 ft of drainage ditches	Daily safety inspections
Biological hazards (bees, ticks, wasps snakes, poison ivy)	• PPE (boots, work clothes, tape pant legs as needed) • Insect repellent, as necessary • Snake chaps for work in areas with undergrowth	Visual survey

Table 2-2 Hazards Analysis (Continued)

Safety and Health Hazards	Controls	Monitoring
Installation of Soil Borings, Monitoring Wells, ORC® Application, and Potential Free Product Removal (Continued)		
Mosquito-borne diseases (e.g., West Nile Virus, Encephalitis)	• Use commercially available insect repellent containing DEET • Wear long-sleeved shirts and pants	Visual survey
Electric shock	• Identification and clearance of overhead and underground utilities (Section 8)	Visual inspection of all work areas Permits/clearance
Post-specific issues	• All personnel must have a government identification card or a temporary vehicle permit • All drivers must have current drivers license • All vehicles must have proof of insurance • Speed limit 30 mph except where posted otherwise • Troops have right-of-way • Speed limit 10 mph when near troops	Daily safety inspections
Soil/Water Sampling		
General safety hazards (rotating machinery, suspended loads, moving equipment, slips, falls)	• Level D modified PPE (Section 5) plus hardhat, buddy system • No employees under lifted loads • EZ around rig (only necessary and experienced personnel within EZ) • HAZWOPER training; standard procedures (Section 8)	Daily site safety inspections
Noise	• Hearing protection within 25 ft of rig, unless site-specific monitoring indicates noise <85 dBA	Daily site safety inspections
Fire (fuels)	• Fire extinguishers (serviced annually and inspected monthly) will be present in all fuel use areas • Fuel will be stored in safety cans with flame arresters • Fire extinguisher rated ≥20B within 50 ft from flammables storage • No ignition sources in fuel storage areas • Fuel storage areas marked with "No Smoking or Open Flame" signs • Bonding (metal to metal contact) during pouring • Gasoline powered equipment shut down during fueling	Daily site safety inspections
Exposure to chemicals (see Table 2-3)	• PPE (Level D modified) [Nitrile gloves or equivalent (rated good or excellent for gasoline resistance) at least 4 mil thick will be worn. When encountering potentially contaminated soil, gloves will be changed every two hours. Face shields will be worn if splashing is a possibility.] • Medical clearance for hazardous waste work • Wash face and hands upon leaving the EZ • MSDS labeling and training for all chemicals brought on site	FID or equivalent for VOCs and colormetric sampling tubes for specific gases/vapors, such as benzene

Table 2-2 Hazards Analysis (Continued)

Safety and Health Hazards	Controls	Monitoring
Soil/Water Sampling (Continued)		
Temperature extremes	• Administrative controls (Section 8.14)	Temperature measurements: heart rate/ temperature monitoring per Section 8
Biological hazards (bees, ticks, wasps snakes, poison ivy)	• PPE (boots, work clothes, tape pant legs as needed) • Insect repellent, as necessary • Snake chaps for work in areas with undergrowth	Visual survey
Mosquito-borne diseases (e.g., West Nile Virus, Encephalitis)	• Use commercially available insect repellent containing DEET • Wear long-sleeved shirts and pants	Visual survey
Post-specific issues	• All personnel must have a government identification card or a temporary vehicle permit • All drivers must have current drivers license • All vehicles must have proof of insurance • Speed limit 30 mph except where posted otherwise • Troops have right-of-way • Speed limit 10 mph when near troops	Daily safety inspections

≥ = greater than or equal to

CPR = cardiopulmonary resuscitation

dBA = A-weighted decibels

EZ = exclusion zone

FID = flame ionization detector

SSHP = site-specific safety and health plan

VOC = volatile organic compound

HAZWOPER = hazardous waste operations and emergency response

mph = miles per hour

MSDS = material safety data sheet

ORC® = Oxygen Release Compound®

PPE = personal protective equipment

GFCI = ground fault circuit interrupter

2.2 POTENTIAL EXPOSURES

Information on the significant suspected contaminants and chemicals that will be used for the project is contained in Table 2-3. Note that this list does not include all the contaminants that have been detected. Only those contaminants with relatively low exposure limits that are present in relatively high concentrations have been listed in Table 2-3. If additional contaminants or chemicals (that pose new or significantly greater hazards) are identified prior to or during site activities, additional hazards analyses will be provided as an addendum to this document.

Table 2-3 Potential Exposures

Chemical	TLV/PEL/ STEL/IDLH ^a	Properties and Potential Hazards ^b	Exposure Route(s)
Benzene (contaminant)	PEL: 1 ppm TLV: 0.5 ppm OSHA STEL: 5 ppm	- Liquid with aromatic odor; VP: 75 mm; FP: 12°F; IP: 9.24 eV; flammable liquid - Carcinogen, eye and skin irritation, dizziness	Inhalation Ingestion Absorption Contact
Xylene (contaminant)	PEL: 100 ppm TLV: 100 ppm NIOSH STEL: 150 ppm	- Liquid with aromatic odor; VP: 9 mm; FP: 81°F; IP: 8.44 eV; flammable liquid - Eye and skin irritation, dizziness	Inhalation Ingestion Contact
Ethylbenzene (contaminant)	TLV: 100 ppm PEL: 100 ppm	- Liquid with aromatic odor; VP: 7 mm; FP: 55°F; IP: 8.76 eV; flammable liquid - Eye and skin irritation, dizziness, headache	Inhalation Ingestion Contact
Toluene (contaminant)	TLV: 50 ppm PEL: 200 ppm	- Liquid, colorless with sweet pungent odor; VP: 21mm; FP: 40°F; IP: 8.82 eV; flammable liquid - Eye and skin irritation, dizziness, headache	Inhalation Ingestion Absorption
Gasoline (fuel)	TLV: 300 ppm IDLH: NA	- Liquid with aromatic odor; FP: -45°F; flammable liquid - Dizziness, eye irritation, dermatitis	Inhalation Ingestion Contact
Liquinox (used for decontamination)	TLV: NA	- Aqueous liquid, odorless, nonflammable - May cause local irritation to mucus membranes	Ingestion Contact
Diesel fuel	TLV: 100 mg/m ³	- Liquid with aromatic odor; FP: 110°F; combustible liquid - Dizziness, eye irritation, dermatitis	Inhalation Ingestion Contact

^aFrom "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices (ACGIH, 2003) and "NIOSH Pocket Guide to Chemical Hazards" (NIOSH, June 1997)

^bFrom "NIOSH Pocket Guide to Chemical Hazards" (NIOSH, June 1997)

eV = electron volt

°F = degrees Fahrenheit

FP = flash point

IDLH = immediately dangerous to life or health

IP = ionization potential

mm = millimeter

NA = not available

NIOSH = National Institute of Occupational Safety and Health

OSHA = Occupational Safety and Health Administration

PEL = permissible exposure limit

ppm = parts per million

STEL = short-term exposure limit

TLV = threshold limit value

VP = vapor pressure

3. STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

This section presents the lines of authority, responsibilities, and communication procedures related to site safety and health and emergency response. It includes key SES and subcontractor personnel. All fieldwork will be under the supervision of the SES field manager. The SES field manager will oversee normal and emergency work and will perform any required emergency notification. Table 3-1 identifies the individuals who will fill key roles for the project field activities. Please note that the key personnel assigned to the field activity positions presented in Table 3-1 represent those individuals who are expected to participate in the project. Personnel availability, however, will dictate the actual roster of individuals who will perform field activities. In the event that personnel other than those presented in Table 3-1 are assigned to the project, SES will provide the names of those individuals to the USACE, Savannah District, project manager before mobilizing for fieldwork.

Table 3-1 Staff Organization

Position	Name	Telephone
Program Manager	Jim Madaj	865-481-7837
Health and Safety Manager	Clark Roberts, CHMM, CIH, REA	210-490-5877 Cell: 210-863-9445
Project Manager	Jeff Williams	865-481-7837
Field Manager	Dan Bowser	865-481-7837
SSHO	Dan Bowser	865-481-7837
Alternate SSHO	Doug Hawn	865-481-7837

CHMM = Certified Hazardous Materials Manager
CIH = Certified Industrial Hygienist

REA = Registered Environmental Assessor
SSHO = site safety and health officer

3.1 SES PROGRAM MANAGER

The SES program manager is the primary interface with the client and has ultimate responsibility for the project. The program manager provides progress reports and addresses client questions and concerns. In addition, he is responsible for ensuring conformance with the SES S&H program and USACE policies and procedures. Specific responsibilities of the program manager include:

- coordinating with USACE personnel,
- ensuring that project managers satisfy SES and USACE health and safety requirements,
- ensuring that project staff implement the project SSHPs, and
- ensuring that projects have the resources necessary to operate safely.

3.2 SES HEALTH AND SAFETY MANAGER

The SES health and safety manager manages the SES health and safety program. This task includes establishing health and safety policies and procedures, supporting project and office activities, and verifying safe work practices and conditions. The SES health and safety manager is certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene, is a certified

hazardous material manager (CHMM), and has more than 20 years of hazardous waste experience. The specific responsibilities of the health and safety manager include the following:

- coordinating with USACE health and safety personnel,
- reviewing and approving SSHPs,
- approving downgrades in PPE or protective procedures, and
- interfacing with project personnel through routine communication and audit of selected projects.

3.3 SES PROJECT MANAGER

The SES project manager is responsible for overall project execution. The responsibilities of the project manager include the following:

- coordinating with USACE personnel (including reporting accidents and incidents to the USACE, Savannah District, project manager immediately and submitting written reports within 2 working days);
- ensuring implementation of the project SSHP;
- maintaining auditable project documentation of all required records;
- ensuring that a qualified SSHO is designated; and
- maintaining a current copy of the project SSHP.

3.4 SES FIELD MANAGER

The SES field manager is in charge of all SES and subcontractor field activities associated with this project. All SES and subcontractor personnel performing field work on this project must report to the field manager.

The SES field manager will oversee the field activities associated with the project and will be responsible for site accessibility, safety, and quality assurance. The field manager is responsible for enforcing the field requirements of this SSHP. Specific responsibilities of the field manager are the following:

- enforcing compliance with the project SSHP;
- coordinating on-site operations, including subcontractor activities;
- ensuring that subcontractors follow the requirements of this SSHP;
- coordinating and controlling any emergency response actions;
- ensuring that at least two persons currently certified in first aid/cardiopulmonary resuscitation (CPR) are on site during site operations;
- performing (or ensuring) a daily safety inspection and documenting the inspection on the daily safety inspection form; and
- maintaining current copies of the project SSHP; EM 385-1-1, *Safety and Health Requirements Manual* (USACE, November 2003); and the SES S&H Manual (SES, March 2007) on site.

3.5 SES SITE SAFETY AND HEALTH OFFICER

The SES SSHO is responsible for making health and safety decisions, for conducting and/or overseeing specific health and safety activities, and for verifying the effectiveness of the health and safety program. The SSHO's qualifications include, at a minimum, experience with similar projects, knowledge and

understanding of the project SSHP, and the ability to use required monitoring equipment. The SSHO has primary responsibility for:

- implementing and verifying compliance with this SSHP and reporting to the field manager, project manager, and health and safety manager any deviations from anticipated conditions;
- conducting and documenting daily safety inspections;
- stopping work or upgrading protective measures (including protective clothing) if uncontrolled health and safety hazards are encountered (Indications of uncontrolled health and safety hazards include monitoring instrument readings in excess of the established action limits, encountering liquids other than water, and soil staining suggestive of unexpectedly high concentrations of nonvolatile contaminants.);
- authorizing resumption of work following correction of any adverse conditions;
- completing the health and safety debriefing in accordance with SES S&H Manual, Section 7.0, "Tool Box Safety Meetings," included in Appendix G;
- documenting deficiencies identified in the daily inspections and responsible parties, procedures, and timetables for correction;
- ensuring that site personnel have access to this plan and are aware of its provisions;
- conducting a site-specific pre-entry health and safety briefing covering potential chemical and physical hazards, safe work practices, and emergency procedures;
- maintaining on site auditable documentation of
 - material safety data sheets (MSDSs) for applicable materials used at the site (see Appendix B);
 - training for site workers and visitors;
 - calibration/maintenance records for field instruments such as photoionization detectors, flame ionization detectors (FIDs), or combustible gas indicators;
 - environmental and personal exposure monitoring results;
 - notification of accidents/incidents;
 - reports of any chemical overexposure or excessive levels;
 - notification of employees of chemical exposure data; and
 - medical surveillance;
- confirming that all on-site personnel have received the training listed in the training requirements section (Section 4) of this SSHP; and
- issuing respirators, as necessary, and ensuring that all respirator users have received medical clearance.

3.6 SUBCONTRACTOR FIELD MANAGERS

The subcontractor field manager will oversee the field activities of the subcontractor employees. He/she is responsible for enforcing the field requirements of this SSHP and has the following responsibilities:

- ensuring that subcontract personnel follow the requirements of the SSHP and any other applicable safety and health requirements,
- verifying that this SSHP adequately addresses the hazards and controls of the subcontracted work,
- ensuring the safe operation of subcontractor equipment,
- coordinating the on-site operations of subcontract personnel, and
- maintaining any required documentation specific to subcontract operations.

4. TRAINING

Personnel who participate in field activities associated with this project or who enter areas controlled by SES are subject to the training requirements presented in Table 4-1. Field activities include all tasks specified in Section 2 of this plan as well as any unspecified tasks that take place within the work area. Activities such as driving or walking on paved roads, performing paperwork or attending meetings inside routinely occupied buildings, and performing paperwork or similar activities inside office trailers are not subject to these training requirements. Casual visitors who access only the office or staging areas of the support zone are not subject to these training requirements.

Table 4-1 Training Requirements

Training	Worker ^a	Worker ^b	Field Manager and SSHO	Site Visitor ^c
40 – hour HAZWOPER	N	Y	Y	N
HAZWOPER Annual Refresher (8 hours)	N	Y	Y	N
HAZWOPER Supervisor (8 hours)	N	N	Y	N
Hazard Communication	N	Y	Y	N
Hearing Conservation ^d	N/Y	Y	Y	N
Respiratory Protection	N	Y	Y	N
Pre-entry Briefing	Y	Y	Y	Y
Safety Briefing	Y	Y	Y	N
PPE	N	Y	Y	N
First Aid/CPR	2 workers	2 workers	N	N

^aWorkers performing non-intrusive tasks under conditions that present no possibility of exposure to hazardous waste or chemicals. This includes surveyors and USACE personnel that enter the site after closure.

^bWorkers performing tasks inside the SES-controlled areas under conditions that pose a potential risk of exposure to hazardous waste or chemicals. This includes all SES personnel and subcontractors performing work as part of the project.

^cVendors and similar personnel.

^dIf workers are exposed to noise levels above 85 dBA, they must be enrolled in a hearing conservation program.

CPR = cardiopulmonary resuscitation

HAZWOPER = hazardous waste operations and emergency response

N = no

PPE = personal protective equipment

SSHO = site safety and health officer

Y = yes

The following sections present brief summaries of the training requirements. These summaries include a course description and guidance on who should take each course.

4.1 OFF-SITE TRAINING

The 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) course is required for general site workers engaged in hazardous, toxic, and radioactive waste activities that expose or potentially expose them to hazardous substances. Three days of relevant field experience is required in conjunction with this training.

The 24-hour HAZWOPER course is required for on-site workers who are not anticipated to be exposed to hazardous chemicals at or above the permissible exposure limit (PEL). One day of relevant field experience is required in conjunction with this training.

The 8-hour HAZWOPER refresher is required annually to maintain currency in both of the above courses.

HAZWOPER Supervisor training is required for personnel who directly supervise hazardous waste site workers. This is an 8-hour course that must be taken once. The 40-hour course is a prerequisite for this training.

Hazard Communication is required for all site workers. This training is designed to inform personnel of the characteristics of chemicals with which they will be working, the hazards presented by those chemicals, and methods of protection from exposure to the chemicals. This generalized training is supplemented by training on site-specific chemicals.

Hearing Conservation is required on an annual basis for all employees enrolled in a hearing conservation program, as mandated by 29 *Code of Federal Regulations* (CFR) 1910.95. This includes all employees exposed to occupational noise in excess of 85 A-weighted decibels (dBA) as a time-weighted average.

Respiratory Protection is required for all workers who wear respirators. This training requirement is met by taking the 40-hour HAZWOPER course.

4.2 SITE-SPECIFIC TRAINING

On-site personnel must receive site-specific training. Site workers will receive information on site hazards, hazard controls, and emergency procedures. Visitors will receive information that is relevant to the purpose of their visit. Signatures of those attending and the type of briefing must be entered into the field logbook before site access will be granted. Site-specific training will include the following information, as appropriate:

- names of health and safety personnel,
- contents of the project SSHP,
- hazards and symptoms of chemical exposure,
- physical hazards on the site,
- location and availability of the Hazard Communication Program,
- site- and task-specific PPE,
- site-specific respirator training,
- safe work practices,
- safe use of engineering controls and equipment,
- medical surveillance requirements,
- site control measures,
- reporting requirements for spills and emergencies,

- personnel decontamination procedures,
- contingency plans, and
- emergency equipment.

Safety briefings will be held daily before the commencement of work activities and whenever conditions at the site change. These will be conducted by the field manager or SSHO and will be required for all site workers. These briefings will address site-specific safety issues and will be used as an opportunity to refresh workers on specific procedures and controls.

4.3 DOCUMENTATION

Documentation of the required training will be maintained in the on-site project files. This documentation will include copies of personnel training certificates or other verifications, copies of the first aid/CPR certificates, and entries in the project logbook showing the topics covered and signatures of those attending on-site training. Copies of required training documentation for those individuals expected to perform fieldwork during this project are presented in Appendix C of this SSHP.

5. PERSONAL PROTECTIVE EQUIPMENT

PPE requirements for this site are based on the site-specific physical and chemical hazards. In cases in which multiple hazards exist, a combination of protective equipment will be selected so that adequate protection is provided for each hazard. For task-specific equipment, see the hazard/risk analysis section of this SSHP. In accordance with government requirements, SES will maintain two sets of PPE on site for use by government officials during site visits.

5.1 PPE PROGRAM

SES's PPE program is detailed in the SES S&H Manual, Section 15.0, "Personal Protective Equipment Program," included in Appendix G, which meets the requirements of 29 CFR 1910, Subpart I, and EM 385-1-1, Section 5. The level and type of PPE selected for particular tasks are based on the following:

- potential for exposure;
- route of exposure;
- measured or anticipated concentration of contaminant;
- toxicity, reactivity, or other measure of adverse effect; and
- physical hazards.

In situations where the type of chemical and/or concentration is not known, the appropriate protection is selected based on the judgment of the SES health and safety manager until hazards can be evaluated further.

The SSHO may raise or lower the level of PPE worn by workers, depending on the site-specific hazards encountered in the field. Before the level of PPE is lowered, the field manager and the health and safety manager will be contacted and consulted. If site conditions indicate that the level of PPE is not sufficient or work must be stopped, the SSHO will take appropriate action immediately and will contact the site

manager and/or the health and safety manager afterward. Indications for a possible reassessment of PPE selection may include the following:

- commencement of an unplanned phase of work presenting unanticipated hazards,
- working in unplanned temperature extremes,
- evidence of contamination that is unexpected,
- exceeding the action limits of chemical hazards, and
- changing the scope of work so that the degree of contact with contaminants changes.

5.2 TYPES OF EQUIPMENT

This section presents the types of protective clothing and equipment that may be used for this project. Requirements for task-specific protective equipment are presented in the hazards analysis (Table 2-2 of this SSHP). Levels of protection that will be used to protect workers against hazards anticipated at the site are contained in the following list.

Level D (Modified)

- Coveralls/field clothes
- Safety boots
- Safety glasses with side shields
- Hard hat
- Ear plugs
- Nitrile or latex gloves when taking samples or handling contaminated soil
- Leather or similar gloves when handling sharp or abrasive materials

5.3 CLEANING AND STORAGE

If site tasks require the use of chemical protective clothing, re-usable articles will be properly decontaminated before they are reused. Disposable equipment will be discarded in sealed containers and handled as contaminated waste. Unused chemical protective clothing will be stored in clean staging areas until needed.

6. MEDICAL SURVEILLANCE

All employees performing on-site hazardous waste activities will be enrolled in a medical surveillance program in accordance with 29 CFR 1910.120(f) and 1910.134. The purpose of the medical surveillance program is to monitor and assess the workers' health and fitness. Each employee is provided with a summary of his/her medical examination results following each exam.

The frequency of employee medical exams shall occur as follows:

- prior to assignment,
- annually for every covered employee,
- at termination of employment or reassignment, and

- as soon as possible following notification by the employee that he/she has developed signs or symptoms of exposure to a hazardous substance.

Copies of required medical clearances and current fit tests for those employees expected to perform fieldwork during this project are presented in Appendix C of this SSHP.

7. EXPOSURE MONITORING

Assessment of airborne chemical concentrations will be performed as appropriate to ensure that exposures do not exceed acceptable levels. Action levels with appropriate actions have been established for this type of monitoring. In addition, the SSHO may perform or require additional exposure monitoring as conditions dictate. It is not anticipated that site workers will be exposed to contaminants above established action levels, but direct reading instruments will be used for real-time monitoring. The minimum monitoring requirements and action levels are presented in Table 7-1.

Table 7-1 Requirements and Action Limits

Hazard	Area	Frequency	Limit	Action
VOCs	Breathing zone	Upon initial intrusion; at least every 30 minutes afterward	5 ppm 25 ppm 50 ppm	Monitor for benzene Monitor for benzene; increase monitoring to every 15 minutes Evacuate immediate area until levels below 10 ppm
Benzene	Breathing zone	When VOC levels are 25 ppm	0.5 ppm	Evacuate immediate area until benzene below 0.5 ppm
Temperature	General work area	Every 2 hours	> 70°F	Implement administrative controls (Section 8.14)

°F = degrees Fahrenheit

ppm = parts per million

VOC = volatile organic compound

7.1 AIR MONITORING

Periodic air monitoring will be conducted throughout the excavation and well installation phases of this project. The SSHO will use an FID. This instrument is capable of detecting most VOCs with an ionization potential of 15.4 eV or less, and, therefore, should be capable of detecting the contaminants expected on site. Most of the constituents of the fuels anticipated on site have relatively high PELs and relatively low vapor pressures with the exception of benzene; however, benzene is typically a minor constituent (usually less than 1 percent) of the total volatiles in the fuel and historically is detected at much lower concentrations than other constituents such as toluene and ethylbenzene.

Direct readings will be taken in the breathing zone of workers during well-drilling phases of the project and periodically throughout all intrusive activities. If breathing zone concentrations exceed 5 ppm total VOCs, a benzene sample will be taken in the breathing zone. If three consecutive benzene samples are obtained with readings below 0.5 ppm, benzene sampling will be terminated until the next action limit of 25 ppm is reached. If total VOCs reach 25 ppm sustained for 5 minutes, the SSHO will sample the air for

benzene using colormetric detector tubes. If total VOC readings reach a level of 50 ppm, the immediate site will be evacuated until VOC levels return to below 10 ppm. If VOC and/or benzene levels are persistently above the stated action levels, site work will be temporarily halted, and the SSHO will contact the SES health and safety manager for guidance.

7.2 NOISE MONITORING

SES will conduct periodic noise monitoring during operation of heavy equipment such as drill rigs, backhoes, and generators. If noise levels within the established EZ are 85 dBA or greater, hearing protection will be required. Hearing protection with a noise reduction rating (NRR) sufficient to reduce worker exposure below 85 dBA will be used. The minimum NRR for hearing protection used on this project will be 32. Hearing protection with an NRR of 32 should be adequate for noise levels up to 110 dBA. If noise levels exceed 110 dBA, double hearing protection will be required.

8. STANDARD OPERATING PROCEDURES

This section contains general safety rules that apply to all operations conducted by SES and its subcontractors. These requirements apply to all SES projects in general; therefore, there may be some portions that do not apply to this project specifically. The provisions of this plan are mandatory for all on-site employees and visitors.

8.1 GENERAL SAFETY RULES

- Daily safety meetings/briefings will be conducted by the SSHO or field manager, and all field workers are required to attend.
- The SSHO, field manager, or other SES management personnel are responsible for suspending or stopping work in the event of:
 - inadequate safety and health precautions on the part of any site personnel, or
 - potential significant environmental impact as a result of planned activities.
- Personnel will perform only those tasks that they believe they can do safely.
- Personnel will notify the SSHO of any medical conditions that require special consideration.
- Proper workplace housekeeping will be maintained at all times.
- Contact with potentially contaminated materials will be avoided, unless it is directly related to a planned work task.
- All injuries and/or accidents will be reported to the SSHO or field manager immediately.
- All site workers will adhere to a buddy system whenever in the EZ or when otherwise engaged in field activities.
- Horseplay is strictly prohibited on the project site.
- There will be **NO SMOKING** in areas where contact with free product (wells, excavations) is possible.

8.2 PERMITS

SES will obtain or coordinate with the USACE project representative to obtain all necessary permits for the safe execution of this project. At a minimum, these will include excavation permits that must be obtained prior to any intrusive activities.

8.3 CONFINED SPACE ENTRY

Entry into a confined space is not expected during this project; however, in the event confined space entry becomes necessary, it will be performed in accordance with 29 CFR 1910.146, EM 385-1-1, and SES S&H Manual, Section 14.0, "Confined Space Entry," included in Appendix G.

8.4 HOT WORK AND FIRE PROTECTION

No hot work activities are expected during this project.

8.5 ELECTRICAL SAFETY

All electrical work will be conducted in accordance with 29 CFR 1910, Subpart S, EM 385-1-1, Section 11, and SES S&H Manual, Section 5.0, "Electrical Safety Program and Lockout/Tagout," included in Appendix G.

- All portable electrical equipment will be double insulated or grounded and connected through a ground fault circuit interrupter (GFCI).
- Conductive materials will be kept clear of energized power lines.
- Access to areas where high voltage is present will be restricted to authorized personnel.

8.6 EXCAVATION SAFETY

Excavation will be conducted in accordance with 29 CFR 1926, Subpart P, EM 385-1-1, Section 25, and SES S&H Manual, Section 6.0, "Excavation Safety," included in Appendix G.

Prior to opening any excavation, the site will be verified free from underground utilities by contacting the local utility company or appropriate installation personnel. If underground utilities are present, they will be located and protected from damage or movement. Other hazards, such as the potential for UXO, building foundations, or unstable encumbrances, will also be controlled.

Personnel will maintain a distance of at least 3 ft from the edge of trenches deeper than 4 ft. Visual examination of trenches will be done from the ends of the trench rather than the sides. All spoils will be maintained at least 3 ft from the excavation edge.

If personnel must enter excavations greater than 4 ft deep, the requirements of 29 CFR 1926.651 will be applied. This includes daily inspection of the excavation by a competent person and use of either shoring or sloping. Shoring will be accomplished by using an appropriate trench shield or box. If sloping is used as a protective measure, the sides of the excavation will be sloped at a 34 degree angle (1.5:1). Entries

into excavations greater than 4 ft deep will be treated as a permit required, confined space entry and will require testing of the atmosphere for oxygen, flammable gases/vapors, and toxic gases/vapors.

8.7 MACHINE GUARDING

All equipment will be operated with all guards and safety devices provided by the manufacturer in place and in compliance with 29 CFR 1910, Subpart O, and EM 385-1-1, Section 16B. If a guard or device must be removed for servicing or repair, the equipment will be disabled to prevent movement or unexpected energization.

8.8 LOCKOUT/TAGOUT

No Lockout/Tagout activities are expected during this project; however, any non-routine service and maintenance of equipment will be conducted in accordance with 29 CFR 1910.147 and the SES S&H Manual, Section 5.0, "Electrical Safety Program and Lockout/Tagout," included in Appendix G.

8.9 FALL PROTECTION

Workers conducting activities subject to a fall of greater than 4 ft will comply with the requirements of the SES Fall Protection Program found in Section 4.0 of the SES S&H Manual. Workers will be protected by a standard rail or the use of a fall protection device. A standard rail consists of a top rail (42 inches nominal from the working surface), a mid-rail, and supporting posts a minimum of 8 ft apart. The rail shall be capable of safely supporting a force of 200 pounds in any direction. Fall protection devices will consist of a full-body harness and a lanyard attached to an anchorage point capable of withstanding a shock force of 5,400 pounds.

8.10 HAZARD COMMUNICATION

Hazard communication will be governed by 29 CFR 1910.1200, EM 385-1-1, Section 8, and SES S&H Manual, Section 13.0, "Hazard Communication," included in Appendix G. As a minimum, the following actions will be taken.

- All hazardous material containers will be labeled. Labels will include:
 - contents of the container;
 - designation of health, flammability, and reactivity hazards; and
 - name and address of the manufacturer.
- MSDSs for all hazardous materials that are present will be maintained on site.
- Site-specific training will include hazards posed by the materials, protective measures, and emergency procedures.

8.11 ILLUMINATION

Most site field work will be conducted during daylight hours. Field work conducted during non-daylight hours will be identified in the hazard assessment table. Artificial illumination will be used to ensure general work areas are illuminated to a level of at least 10 foot candles.

8.12 SANITATION

- Means for washing hands and faces will be provided at the work site.
- Potable drinking water will be provided in labeled, sanitary dispensers.
- An adequate number of toilet facilities will be provided based on the number of workers.

8.13 DRILL RIG OPERATIONS

General Drilling Practices

- Operating manuals will be present on site for each type of drill rig in use.
- Drill rigs will have at least two functional kill switches. These switches will be inspected on a daily basis to ensure proper operation.
- Drill rigs will be equipped with a functional back-up alarm.
- Drill rigs will be inspected weekly by the driller, and the inspection will be confirmed by the SSHO. (Use the checklist provided in Appendix A.)
- Only the driller, the driller's helper, and critical personnel will be allowed near the moving parts of the drill rig.
- Drill sites will be verified free of underground utilities.
- Drilling crews and personnel who work near the drilling rig will be trained in the location and use of kill switches.
- Work areas and walkways will be maintained and will be free from obstructions.
- Drilling crews will construct a portable decontamination unit for the purpose of cleaning drilling equipment. The unit will consist of a ground mat (plywood) to prevent puncture of the lining. Side walls will be constructed using straw or portable fencing. The floor and side walls will be covered with 6 mil or greater plastic sheeting.

8.14 TEMPERATURE EXTREMES

Hazards associated with temperature extremes will be controlled as required by EM 385-1-1, Section 6, and in accordance with American Council of Government Industrial Hygienists (ACGIH) temperature stress guidelines as detailed in *Threshold Limit Values and Biological Exposure Indices* (ACGIH, 2003). It is the responsibility of the SSHO and crew members to ensure that temperature stress controls are adequate for the conditions and tasks.

8.14.1 Heat Stress

General controls for the prevention of heat stress include making fluids readily available, taking breaks in cool or shaded areas, scheduling work for cooler portions of the day, and providing forced ventilation. Specific requirements include those listed in Table 8-1.

- When ambient temperatures reach 70°F, workers will be encouraged to take unscheduled breaks as needed, in a cooler area.

- If ambient temperatures are expected to exceed 70°F, site-specific training will include heat stress recognition (profuse sweating, reddened complexion, elevated temperature, elevated pulse rate), control, and first aid measures for heat-related illnesses.
- If ambient temperatures exceed 70°F, cool water and electrolyte-replenishing fluids (such as Gatorade) will be readily accessible, and workers will be encouraged to drink frequently.
- When ambient temperatures exceed 70°F, physiological monitoring (body temperature, pulse rate) will be conducted as determined by the SSHO. Physiological monitoring will be performed within 1 minute of stopping work. The action levels and appropriate actions are detailed in Table 8-1.
- When ambient temperatures exceed 70°F, pulse rates and body temperatures will be taken every two hours for workers performing moderate to heavy levels of work.

Table 8-1 Action Levels for Heat Stress Monitoring

Action Levels	Actions
Monitoring results below action level: - pulse rate $\leq$ 110 beats per minute - temperature $\leq$ 99.6°F	Return to work and continue observation for physiological and/or behavioral signs of heat stress.
Monitoring results exceeding action level: - pulse rate $\geq$ 110 beats per minute - body temperature $\geq$ 99.6°F	Rest in cooler area until monitoring results fall below action levels. Remeasure pulse and temperature after 5 minutes.
Monitoring results exceed action levels after 5 minutes of rest: - pulse rate $\geq$ 110 beats per minute - body temperature $\geq$ 99.6°F	Implement additional heat stress control measures such as shading the work area, adjusting the work hours, providing personnel cooling devices, or modifying PPE.

$\geq$ = greater than or equal to
 $\leq$ = less than or equal to

°F = degrees Fahrenheit
PPE = personal protective equipment

8.14.2 Cold Stress

Critical measures in preventing cold stress are wearing adequate clothing and staying dry. The SSHO and field manager will ensure the capability exists to move workers who become wet to a sheltered and warm area. The following steps, which have been adapted from the ACGIH guidelines, will be implemented when working in cold environments.

- If the ambient temperature falls below 40°F, site training will include prevention of cold temperature injuries, cold injury symptoms, and cold injury first aid.
- A heated break area will be provided if ambient temperatures fall below 32°F.
- Breaks will be taken in warm areas at a minimum of every 2 hours when ambient temperatures are below 32°F.
- Workers will be allowed to take unscheduled breaks in warm areas, if needed.
- If the equivalent chill temperature (ambient temperature plus wind factor) is less than -29°F, outdoor work will be discontinued.

9. SITE CONTROL

The SSHO will be responsible for establishing the site control zones, as necessary, around SES-controlled areas that present physical or chemical hazards. Implementation of control zones will minimize the number of workers potentially exposed to hazards and will minimize the spread of possible contamination from the site. The SSHO will monitor the implementation of the site control work rules and will report any deviations from prescribed practice to the field manager or stop work as appropriate.

The exact location of control zones will vary depending on site conditions and work tasks; therefore, it is not possible to predetermine the exact size and location of control zones. SES will attempt to exclude all non-authorized personnel from exclusion and contamination reduction zones. If unauthorized personnel enter and refuse to leave the SES-controlled control zones, work will be stopped and the USACE Technical Manager will be notified.

9.1 EXCLUSION ZONE

The EZ is that area where the greatest potential for exposure to contamination exists. Access to the EZ will be restricted to authorized SES and subcontractor personnel. The perimeter of the EZ will be demarked by barricade tape, rope, or similar marking. The entry and exit locations for the EZ will be appropriately identified.

The standard rules below will apply to all entry into the EZ:

- The SSHO or field manager will approve and log entry into the EZ.
- All personnel entering the EZ will wear the prescribed level of protective clothing.
- All hand-to-mouth contact (food, drink, tobacco, etc.) is prohibited in the EZ.
- All personnel in the EZ will follow the buddy system.

EZs will be established around all drill rigs, areas of heavy equipment use, and all activities where chemical contamination is a potential hazard. At a minimum, the size of the EZ around a drill rig will be at least the height of the mast. The EZ for all other operations will be at least 10 ft in diameter.

9.2 CONTAMINATION REDUCTION ZONE

The CRZ will be established, as necessary, between the EZ and the support zone. The entry and exit points will be visually defined at the perimeter of the zone. Activities that may occur in the CRZ include decontamination of personnel and equipment, replenishment of supplies, and staging of samples or materials.

All personnel entering the CRZ will wear the prescribed level of protection and hand-to-mouth activities will be prohibited.

9.3 SUPPORT ZONE

The support zone is the clean and relatively safe area surrounding the EZ and CRZ. The support zone is limited to the areas of the site associated with the project and generally does not include such areas as

office trailers, roads, and buildings accessible to the public. The primary functions of the support zone are to serve as:

- a staging area for clean equipment and supplies and
- a location for support services.

9.4 SITE COMMUNICATIONS

Field personnel will be capable of contacting other field personnel and outside agencies. Communication on site may be accomplished verbally, using hand signals, or by handheld radios. If the size of the site dictates, portable air horns may be used to signal other site personnel. If telephone service is not readily available, project personnel may be equipped with cellular phones.

10. HYGIENE AND DECONTAMINATION

Specific procedures will be used to control the spread of contamination from the EZ and ensure that workers are sufficiently free of contamination to preclude adverse health effects. These procedures will include the doffing of PPE and personnel decontamination. The SSHO will ensure the construction of decontamination stations, as necessary, and ensure that site personnel follow acceptable decontamination processes. The following sections present the basic requirements for personnel. The SSHO may modify these procedures if improvements are needed.

10.1 LEVEL D MODIFIED DECONTAMINATION

Step 1: Remove disposable gloves and boot covers (if needed)

Gloves and boot covers will be turned inside out and deposited in a designated container.

Step 2: Field Wash

Wash face and hands. This may be accomplished with soap and water.

10.2 LEVEL C DECONTAMINATION

Step 1: Segregated Equipment Drop

Deposit equipment used in the EZ on plastic sheets or in containers with plastic liners.

Step 2: Primary Wash

Wash/rinse gross contaminants from outer boots (or boot covers) and outer gloves. Contain decontamination fluids in a receptacle that can be sealed, or transfer fluids into a sealable container.

Step 3: Remove Outer Boots and Outer Gloves

Remove tape from boot covers and gloves, and then remove outer boots and gloves by turning them inside out and placing them in a designated container.

Step 4: Remove Outer Garment

Remove disposable outer garment and place in a designated container. Garment should be turned inside out during removal.

Step 5: Remove Respiratory Protection and Inner Gloves

Remove the respirator. Remove the cartridges and place them in a designated container and dispose appropriately. Place the respirator in a plastic bag or container for further decontamination. Remove the disposable inner gloves and place them in the designated container.

Step 6: Field Wash

Wash face and hands. This may be accomplished with soap and water or the use of disinfectant towels.

11. EMERGENCY PROCEDURES AND EQUIPMENT

The field manager will be in charge of all SES personnel and subcontractors during emergency situations, and he/she will be responsible for notifying all emergency contacts, including emergency medical services, fire services, the SES project manager, and the SES health and safety manager. In the event of an emergency situation, all SES and subcontractor personnel will participate in a briefing to discuss the event, identify the causes, determine appropriate corrective actions, and evaluate the response.

In the event of an accident or incident, the field manager or project manager will notify the USACE, Savannah District, project manager immediately in accordance with EM 385-1-1.

All accidents will be investigated and reported (ENG Form 3394 found in Appendix A) within 24 hours as specified in EM 385-1-1. The accident report will be completed and submitted to the USACE occupational safety and health officer or project manager at the following address:

U.S. Army Corps of Engineers
Savannah District
CESAS-PM-H (Ana Vergara)
100 West Oglethorpe Ave.
Savannah, Georgia 31401-3604

All on-site personnel will be trained in the requirements of this section. The training will include recognition of emergencies, reporting emergencies, and responding to emergencies.

11.1 POTENTIAL EMERGENCIES

11.1.1 Fires

Small quantities of flammable solvents, gasoline, or diesel fuel may be on site. In the event of a fire, the local fire department will be notified immediately. If it is safe to do so, on-site personnel may attempt to extinguish the fire with available fire extinguishers and isolate any adjacent flammable materials. If there is any doubt of the ability of on-site personnel to safely extinguish the fire, all site personnel will evacuate the area. The supervisor or SSHO will provide the fire department with the relevant information when they arrive on site.

11.1.2 Chemical Spills

Potential spills include the release of fuels, solvents, lubricants, or hydraulic fluids. In the event of a spill or leak, the person making the discovery will immediately notify the SSHO or field manager. The field manager will determine if the release poses an environmental or safety risk or if it will exceed the capacity of on-site personnel to control and/or clean up. SES on-site personnel are capable of controlling up to 100 gallons of spilled material. The following SES personnel are trained and certified to wear respirators and perform emergency shutdown should a chemical release so dictate.

Dan Bowser
Jim Madaj

If the release exceeds the ability of on-site personnel to adequately respond, the field manager will notify the local fire department or hazardous material response team.

11.1.3 Medical Emergency

In the event of a medical emergency, the field manager will immediately notify local emergency medical services. At least two first aid/CPR trained personnel will be on site at all times, and these personnel will perform first aid pending release of the injured person to medical personnel. An injured person, who may be contaminated, will be decontaminated to the extent feasible. Decontamination may be by-passed in the event of life-threatening injuries or illnesses.

11.2 EMERGENCY TELEPHONE NUMBERS

Table 11-1 Emergency Contacts – Fort Stewart

Contact	Telephone Number
Fort Stewart Military Police	912-767-2822
Fire Department	911
Police	911
Emergency Medical Services	911
Hospital – Liberty Regional Medical Center	912-369-9400
USACE – Savannah District	912-652-6060
SES – Jim Madaj	865-481-7837
BEESC - Clark Roberts (SES Health and Safety Manager)	210-490-5877 (Cell: 210-863-9445)

These telephone numbers will be posted on site. Before beginning on-site work, the SSHO will post a map showing the location of the hospital and directions to the hospital nearest to the work site.

11.3 EMERGENCY ALERTING

Each work group will have a device capable of generating an audible alarm. These devices will be used to signal project personnel in the event of an emergency.

11.4 EVACUATION

The SSHO or field manager will designate the evacuation routes and assembly areas. All employees will be familiar with these routes and assembly areas.

11.5 EMERGENCY EQUIPMENT

If the SSHO does not feel that on-site personnel can safely handle an emergency situation with the available equipment, the crew will use alternative methods such as allowing a small fire to burn out or evacuating the site. The following emergency equipment will be maintained on-site at all times:

- a first aid kit in an all-weather container; inspected weekly;
- a compressed air horn or vehicle horn;
- an emergency portable eyewash station;
- fire extinguishers;
- a basic spill kit capable of handling or containing a small spill; and
- telephone and/or portable radios.

11.6 LIGHTNING

Under weather conditions conducive for electrical storms in the area, a weather band radio will be monitored continually. If storms are reported within 5 miles of the project site, all work will be suspended and all site workers will exit the site and seek shelter in the company trucks until the threat of lightning has passed.

12. LOGS, REPORTS, AND RECORDKEEPING

A system of logs and reports will be used to document activities related to site safety and health. The SSHO will generate a brief weekly summary of safety and health issues and resolutions. The report will include all injuries, accidents, near-misses, and interpretations of the SSHP.

In addition to the weekly reports, the following documents will be generated and submitted to the USACE, Savannah District, project manager.

- Certification records including copies of the safety and health training, medical clearances, and respirator fit test records for on-site personnel. These records are included in Appendix C of the SSHP and will be kept on site.
- On-site training logs that will include the signatures of the trainer and all attendees. They will also include documentation of pre-entry briefings, safety meetings, and visitor training.
- Safety inspection logs that will include the dates of the inspection, the identity of the person conducting the inspection, the areas inspected, findings, and corrective actions.
- Sign-in log for all employees and visitors. It will contain the names of persons who perform on-site work or visit the site.
- Environmental and personal exposure monitoring/sampling results will be maintained in a log that will contain the monitoring data, location and time, types of work being done, calibration records, and identity of person conducting the monitoring.

13. REFERENCES

ACGIH (American Council of Government Industrial Hygienists), 2003. *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*.

NIOSH (National Institute of Occupational Safety and Health), June 1997. *NIOSH Pocket Guide to Chemical Hazards*.

SES (SpecPro Environmental Services LLC), March 2007. *SpecPro Environmental Services LLC Safety and Health Program Manual*.

USACE (U.S. Army Corps of Engineers), November, 2003. *Safety and Health Requirements Manual (EM-385-1-1)*.

USACE, July 2003. *Safety and Occupational Health Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW) Activities (ER 385-1-92)*.

APPENDIX A

REPORTING FORMS

Drill Rig Checklist
ENG Form 3394
Equipment Daily Inspection Checklist
Tool Box Safety Meetings Documentation Form
Weekly Job Site Checklist

Daily Excavation Inspection Form

Name of Excavation Competent Person:		Date of Inspection:	
Excavation/Trench location:			
Depth:	Width:	Date Opened:	
Soil classification: ☐ A ☐ B ☐ C			
Indicate, by marking the test below, how the classification was made.			
Manual test(s)	Cohesive Unfissured	Cohesive fissured	Granular
a) plasticity			
b) dry strength			
c) thumb penetration			
d) pocket penetrometer			
e) other			
Visual test(s) Do as many as possible	Cohesive Soil		Granular Soil
Spoil pile:	Remains in clumps		Breaks up easily
Trench Side:	Stands vertical for over 2 hours		Sloughs into trench
The excavation is properly (circle one):			
Shored (indicate the type of shoring)	☐ Closed ☐ Open ☐ Wood ☐ Metal		
Sloped/benched (indicate the slope)	☐ Vertical ☐ ½:1 ☐ 1:1 ☐ 1 ½:1 ☐ 2:1		
Excavation Checklist	Morning	Mid-Day	Afternoon
Time:			
Weather:			
Is atmospheric testing required?	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a
Is atmospheric testing done?	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a
Is the spoil pile back 3' from the edge?	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a
Have surface encumbrances been removed?	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a
Are there any signs of sloughing or cave-in?	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a
Is there water accumulation in the bottom?	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a
Any vibration sources near the excavation?	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a
Is there adequate access/egress (ladder, ramp)	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a
Has the soil been disturbed previously?	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a
Sides	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a
Top	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a
If the excavation is over 20 feet deep, has a P.E. design been documented and complied with?	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a	☐ yes ☐ no ☐ n/a



SOLUTIONS TO ENVIRONMENTAL PROBLEMS, INC. DRILL RIG CHECKLIST

Site Name: _____

Equipment Type (Model and Manufacturer): _____

Serial Number: _____ Owner of Rig: _____

Inspection Performed by: _____
(Driller's Signature) (Date)

Checklist Reviewed and Emergency
Shutdown Observed by: _____
(Signature) (Date)

1.0 GENERAL

- 1.1 Check all safety devices that are part of drill rig and can be verified (* see note). Are all devices intact and operating as designed? Yes ☐ No ☐

Emergency Interrupt System

- | | | | |
|------------------|------------------------------|-----------------------------|------------------------------|
| A. Kill Switch 1 | Yes ☐ | No ☐ | N/A ☐ |
| B. Kill Switch 2 | Yes ☐ | No ☐ | N/A ☐ |
| C. Kill Switch 3 | Yes ☐ | No ☐ | N/A ☐ |
| D. Kill Switch 4 | Yes ☐ | No ☐ | N/A ☐ |
| E. Kill Switch 5 | Yes ☐ | No ☐ | N/A ☐ |
| F. Other _____ | Yes ☐ | No ☐ | N/A ☐ |
| G. Other _____ | Yes ☐ | No ☐ | N/A ☐ |
| H. Other _____ | Yes ☐ | No ☐ | N/A ☐ |

* Note: All safety devices not otherwise listed in this checklist should be identified for each drill rig at the beginning of each project and subsequently checked at each inspection. Testing of all safety devices must be observed by health and safety personnel. List only safety devices that can be checked without disassembly or without rendering the device ineffective. This checklist does not cover United States Department of Transportation requirements.

- 1.2 Is the proper type and capacity of fire extinguisher(s) present properly charged, and inspected? Yes ☐ No ☐ N/A ☐

- 1.3 Is rig properly grounded? Yes ☐ No ☐ N/A ☐

- | | | | | |
|------|---|------------------------------|-----------------------------|------------------------------|
| 1.4 | Are rig and mast a safe distance from electrical lines? | Yes ☐ | No ☐ | N/A ☐ |
| 1.5 | Can mast be raised without encountering overhead obstruction? | Yes ☐ | No ☐ | N/A ☐ |
| 1.6 | Have spill prevention materials been placed under rig (i.e. plastic sheeting)? | Yes ☐ | No ☐ | N/A ☐ |
| 1.7 | Is a spill kit present? | Yes ☐ | No ☐ | N/A ☐ |
| 1.8 | Is the safe operating zone/exclusion zone posted (minimum radius at least equal to height of raised drill mast)? | Yes ☐ | No ☐ | N/A ☐ |
| 1.9 | Do all modifications made to the drill rig permit it to operate in a safe manner and allow the drill to operate within the manufacturer's specifications? | Yes ☐ | No ☐ | N/A ☐ |
| 1.10 | Are moving parts (excluding cathead) properly guarded? | Yes ☐ | No ☐ | N/A ☐ |
| 1.11 | Are all exhaust pipes, which could come into contact with personnel during normal operations properly guarded? | Yes ☐ | No ☐ | N/A ☐ |
| 1.12 | Are tank(s) and lines free of leakage? | Yes ☐ | No ☐ | N/A ☐ |
| 1.13 | Have all normal or manufacturer-recommended maintenance activities been performed at the appropriate frequency? | Yes ☐ | No ☐ | N/A ☐ |
| 1.14 | Are walking and standing surfaces, steps, rungs, etc. free of substances (excess grease, oil, or mud) that could create a hazard? | Yes ☐ | No ☐ | N/A ☐ |

2.0 CONTROL MECHANISMS

Are all control mechanisms and gauges on the drill rig functional and free of grease, oil and ice (checked while running)?

Yes ☐	No ☐	N/A ☐
------------------------------	-----------------------------	------------------------------

3.0 HYDRAULICS AND PNEUMATICS

Note: The mast should be lowered during the completion of this section to allow inspection of portions of the lifting mechanisms normally out of reach during operation.

- 3.1 Do all hydraulic reservoirs have proper fluid levels? Yes ☐ No ☐ N/A ☐
- 3.2 Are hydraulic and/or pneumatic systems in good condition and functioning correctly (checked while running)? Yes ☐ No ☐ N/A ☐

4.0 LIFTING MECHANISMS

Note: The mast should be lowered during the completion of this section to allow inspection of portions of the lifting mechanisms normally out of reach during operation.

- 4.1 Have all wires, ropes, cables, and lines that are kinked, worn, corroded, cracked, bent, crushed, frayed, stretched, birdcaged, or otherwise damaged been replaced and the defective equipment removed from the site? Yes ☐ No ☐ N/A ☐
- 4.2 Have all wires, ropes, cables, and lines been wrapped around winch drums without excessive pinching or binding? Yes ☐ No ☐ N/A ☐
- 4.3 Are all pulleys undamaged & functional? Yes ☐ No ☐ N/A ☐
- 4.4 Are all clips, clamps, clevises, hooks or other hardware used to rig wires, ropes, cables, or lines undamaged and attached properly? Yes ☐ No ☐ N/A ☐
- 4.5 Do all eyes formed in wires, ropes, cables, or lines attached to the rig use a thimble to retain the shape of the eye? Yes ☐ No ☐ N/A ☐
- 4.6 Do all hooks have functioning safety gates/latches? Yes ☐ No ☐ N/A ☐

5.0 NONCONFORMING ITEMS

- 5.1 When did the last operation checklist inspection take place for this drill rig at this site?
Date: _____

5.2 Have any nonconforming items been carried over from the last inspection? List any items and dates of original nonconformance.

A. _____

Date: _____

B. _____

Date: _____

C. _____

Date: _____

D. _____

Date: _____

Any nonconforming items must be documented in the following remarks section and reported to the field operations manager for the project prior to operating the drill rig. Reference all remarks to the item numbers noted above.

Remarks:

(For Safety Staff only)		REPORT NO.	EROC CODE	UNITED STATES ARMY CORPS OF ENGINEERS ACCIDENT INVESTIGATION REPORT (For Use of this Form See Help Menu and USACE Suppl to AR 385-40)		REQUIREMENT CONTROL SYMBOL: CEEC-S-8(R2)	
1. ACCIDENT CLASSIFICATION							
PERSONNEL CLASSIFICATION		INJURY/ILLNESS/FATAL		PROPERTY DAMAGE		MOTOR VEHICLE INVOLVED	
GOVERNMENT VILIAN ☐ MILITARY		☐		☐ FIRE INVOLVED ☐ OTHER		☐	
☐ CONTRACTOR		☐		☐ FIRE INVOLVED ☐ OTHER		☐	
☐ PUBLIC		☐ FATAL ☐ OTHER				☐	
2. PERSONAL DATA							
a. Name (Last, First, MI)		b. AGE	c. SEX ☐ MALE ☐ FEMALE	d. SOCIAL SECURITY NUMBER			e. GRADE
f. JOB SERIES/TITLE		g. DUTY STATUS AT TIME OF ACCIDENT ☐ ON DUTY ☐ TDY ☐ OFF DUTY		h. EMPLOYMENT STATUS AT TIME OF ACCIDENT ☐ ARMY ACTIVE ☐ ARMY RESERVE ☐ VOLUNTEER ☐ PERMANENT ☐ FOREIGN NATIONAL ☐ SEASONAL ☐ TEMPORARY ☐ STUDENT ☐ OTHER (Specify)			
3. GENERAL INFORMATION							
a. DATE OF ACCIDENT (month/day/year)		b. TIME OF ACCIDENT (Military time) hrs		c. EXACT LOCATION OF ACCIDENT		d. CONTRACTOR'S NAME (1) PRIME: (2) SUBCONTRACTOR:	
e. CONTRACT NUMBER ☐ CIVIL WORKS ☐ MILITARY ☐ OTHER (Specify)		f. TYPE OF CONTRACT ☐ CONSTRUCTION ☐ SERVICE ☐ A/E ☐ DREDGE ☐ OTHER (Specify)		g. HAZARDOUS/TOXIC WASTE ACTIVITY ☐ SUPERFUND ☐ DERP ☐ IRP ☐ OTHER (Specify)			
4. CONSTRUCTION ACTIVITIES ONLY (Fill in line and corresponding code number in box from list - see help menu)							
a. CONSTRUCTION ACTIVITY (CODE) #				b. TYPE OF CONSTRUCTION EQUIPMENT (CODE) #			
INJURY/ILLNESS INFORMATION (Include name on line and corresponding code number in box for items e, f & g - see help menu)							
a. VERITY OF ILLNESS/INJURY (CODE) #				b. ESTIMATED DAYS LOST		c. ESTIMATED DAYS HOSPITALIZED	
e. BODY PART AFFECTED (CODE) # PRIMARY SECONDARY				g. TYPE AND SOURCE OF INJURY/ILLNESS (CODE) # TYPE SOURCE			
f. NATURE OF ILLNESS / INJURY (CODE) #				d. ESTIMATED DAYS RESTRICTED DUTY			
6. PUBLIC FATALITY (Fill in line and correspondence code number in box - see help menu)							
a. ACTIVITY AT TIME OF ACCIDENT (CODE) #				b. PERSONAL FLOATION DEVICE USED? ☐ YES ☐ NO ☐ N/A			
7. MOTOR VEHICLE ACCIDENT							
a. TYPE OF VEHICLE ☐ PICKUP/VAN ☐ AUTOMOBILE ☐ TRUCK ☐ OTHER (Specify)		b. TYPE OF COLLISION ☐ SIDE SWIPE ☐ HEAD ON ☐ REAR END ☐ BROADSIDE ☐ ROLL OVER ☐ BACKING ☐ OTHER (Specify)		c. SEAT BELTS		USED NOT USED NOT AVAILABLE	
				(1) FRONT SEAT			
				(2) REAR SEAT			
8. PROPERTY/MATERIAL INVOLVED							
a. NAME OF ITEM		b. OWNERSHIP				c. \$ AMOUNT OF DAMAGE	
(1)							
(2)							
(3)							
9. VESSEL/FLOATING PLANT ACCIDENT (Fill in line and correspondence code number in box from list - see help menu)							
a. TYPE OF VESSEL/FLOATING PLANT (CODE) #				b. TYPE OF COLLISION/MISHAP (CODE) #			
ACCIDENT DESCRIPTION (Use additional paper, if necessary)							
See attached page.							

10.

ACCIDENT DESCRIPTION *(Continuation)*

13a.

DIRECT CAUSE *(Continuation)*

13b.

INDIRECT CAUSES (Continuation)

14.

ACTION(S) TAKEN, ANTICIPATED, OR RECOMMENDED TO ELIMINATE CAUSE(S) (Continuation)

Date: _____ Supervisor/Crew Leader: _____
 Topic: _____ Job Location: _____
 Accident Investigation Review: _____

Supervisor/Crew Leader: _____

Job Location: _____

Job Hazards Review:

New Business:

[illegible]

Weekly Job Site Inspection Checklist

Project Name: _____

Inspection Date: _____

Project Supervisor: _____

DESCRIPTION	YES	N/A	NO	IF NO, WHY?
1.0 Project Administration: 1926, Subpart C				
1.1 OSHA and other required posters/sign posted				
1.2 Do all employees meet the required training level?				
1.3 Was a pre-job safety meeting held?				
1.4 Are toolbox meetings conducted and documented?				
2.0 Housekeeping: 1926, Subpart C				
2.1 General orderliness of the site acceptable?				
2.2 Passageways and walkways clear?				
2.3 Containers with lids provided for trash?				
3.0 Medical Services and First Aid: 1926, Subpart D				
3.1 One employee on site with current CPR/First Aid?				
3.2 First Aid Kit provided and properly stocked?				
3.3 Emergency communication numbers available?				
4.0 Sanitation, 1926, Subpart D				
4.1 Adequate supply of drinking water provided?				
5.0 Hazard Communication				
5.1 Is a hazardous material inventory available?				
5.2 Are MSDSs available for all hazardous materials on site?				
5.3 Are all containers properly labeled?				
5.4 Have all employees been trained?				
6.0 Personal Protective Equipment: 1926, Subpart E				
6.1 Are approved hard hats worn by all personnel?				
6.2 In eye and face protection provided and used as needed?				
6.3 Are full body harnesses with dual shock absorbing lanyards provided?				
6.4 Are employees tied off 100% of the time if over six feet?				
6.5 Are employees wearing gloves when required?				
6.6 Are employees dressed in appropriate work clothing?				
6.7 Are employees wearing proper boots?				
6.8 Is all equipment inspected regularly and maintained in a safe and sanitary condition?				

7.0	Fire Protection and Prevention: 1926, Subpart F				
7.1	Is the necessary fire fighting equipment provided?				
7.2	Are No Smoking signs posted within 50 feet of flammable liquids?				
7.3	Are combustible or flammable materials stored, dispensed, and used properly?				
8.0	Signs and Signals				
8.1	Are warning signs properly posted and visible?				
8.2	Is the construction area properly posted?				
9.0	Handling and Storage: 1926, Subpart H				
9.1	Is material stacked, racked, blocked, or otherwise secured to prevent falling or collapse?				
9.2	Are correct lifting methods used?				
9.3	Is all rigging equipment properly used and inspected?				
9.4	Is the Crane Operator certified and trained?				
10.0	Tools – Hand and Power: 1926, Subpart I				
10.1	Proper tools being used for the job?				
10.2	Proper inspection and maintenance of tools?				
10.3	Tools and cords in good condition & free of defects?				
10.4	All mechanical safeguards in place?				
10.5	Ground fault protection being utilized?				
11.0	Electrical: 1926, Subpart K				
11.1	Adequate wiring, well-insulated, no frayed cords?				
11.2	Are extension wires 3-prong and designed for rough usage?				
12.0	Others				
12.1	Are environmentally sensitive areas, equipment, or storage clearly identified and controlled?				

Supervisor Signature: _____

Date: _____

APPENDIX B

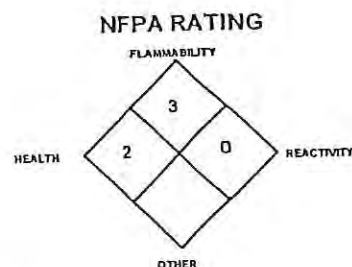
MATERIAL SAFETY DATA SHEETS

Benzene
Ethylbenzene
Toluene
Xylene
Methyl Tertbutyl Ether
Petroleum Crude Oil



MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards



PART I What is the material and what do I need to know in an emergency?

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS:

BENZENE - C₆H₆

Document Number: 001062

PRODUCT USE:

For general analytical/synthetic chemical uses.

SUPPLIER/MANUFACTURER'S NAME:

AIRGAS INC.

ADDRESS:

259 N. Radnor-Chester Road

Suite 100

Radnor, PA 19087-5283

1-610-687-5253

BUSINESS PHONE:

CHEMTREC: 1-800-424-9300

EMERGENCY PHONE:

International: 703-527-3887 (Call Collect)

DATE OF PREPARATION:

May 14, 1997

SECOND REVISION:

January 16, 1998

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA		IDLH ppm	OTHER
			TLV ppm	STEL ppm	PEL ppm	STEL ppm		
BENZENE	71-43-2	99.9%	0.5, A1 (Confirmed Human Carcinogen)	2.5, A1 (Confirmed Human Carcinogen)	1	5	500	NIOSH REL: 0.1 ppm TWA; 1 ppm STEL OSHA: 1 ppm TWA; 5 ppm STEL OSHA Action Level: 0.5 ppm EPA-A; IARC-1; MAK-A1; NIOSH-X; NTP-1; OSHA- X;

NE = Not Established

C = Ceiling Limit

See Section 16 for Definitions of Terms Used

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Benzene is a colorless, flammable, toxic liquid with a characteristic aromatic odor. Benzene is a confirmed human carcinogen and a possible human mutagen. Inhalation of vapors of Benzene can cause serious, permanent damage to the blood system. Skin and eye contact can be irritating. This liquid is very flammable; vapors are heavier than air and may travel long distances to source of ignition and flashback. If involved in a fire Benzene will decompose to produce toxic gases (e.g., carbon monoxide, carbon dioxide, irritating aldehydes and ketones). Persons responding to fires or emergencies involving Benzene must have adequate fire protection and wear personal protective equipment to protect against the significant health hazards posed by Benzene.

SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE: Benzene is a serious poison by all routes of exposure. The symptoms of each route of exposure are described below.

INHALATION: The immediate symptoms of inhalation of vapors of Benzene are due to the initial excitation, followed by depression of the central nervous system. Central nervous system symptoms include drowsiness, headache, nausea, incoordination and unconsciousness, that can lead to death in severe cases. Other symptoms of acute overexposure to vapors of Benzene can include transient euphoria, ataxia (incoordination of voluntary muscular movements), vertigo, tinnitus, substernal pain, cough, hoarseness and general irritation of the nose, throat and respiratory tract, confusion, stupefaction and coma. In cases of severe overexposure (as may occur in a confined space, or other poorly ventilated areas, or if large volumes are used or released), tremors, convulsions and death, due to respiratory paralysis or circulatory collapse can occur within minutes to several hours following exposure. Reversible liver and kidney effects have been reported after exposure to Benzene. The effects associated with various levels of Benzene vapors are as follows:

CONCENTRATION

Brief (10 minute) up to 25 ppm:
50-150 ppm:

20,000 (for 5-10 min):

SYMPTOM OF EXPOSURE

No symptoms.
Exhilaration, headache, tiredness,
nose and throat irritation.
Collapse and death

One of the most significant health effects associated with Benzene is the potential for blood system disorders which develop after long-term exposures to relatively low vapor concentrations. There are reports that exposure to low levels (10 ppm) over an extended time period (24 weeks) of Benzene vapors can damage the bone marrow and blood systems. This damage can result in the development of serious health disorders (including anemia and leukemia). Adverse effects on the immune system have also been reported. Refer to "Other Health Effects" in this section for further information.

CONTACT WITH SKIN or EYES: Contact with the skin can cause irritation and redness. Repeated or prolonged contact can also cause dermatitis, resulting in dry, itchy, cracked skin as Benzene is a defatting agent, removing oils from the skin. Contact with the vapors of Benzene and the eyes will be irritating. Direct contact of the liquid with the eyes can cause irritation, pain; prolonged contact may result in tissue damage.

SKIN ABSORPTION: Benzene poisoning through skin contact has been reported, although skin absorption is not considered as significant a route of exposure as via inhalation or ingestion. Symptoms of absorption may be similar to those described in "Ingestion".

INGESTION: Ingestion of Benzene will cause a burning sensation in the mouth and stomach, nausea, vomiting, excess salivation and vomiting of blood. Benzene is readily absorbed into the body following ingestion exposures, producing symptoms of central nervous system depression and other symptoms similar to those described in "Inhalation". If ingested, Benzene presents a potential aspiration hazard. Aspiration of even small amounts of Benzene into the lungs can result in immediate pulmonary edema (a potentially fatal accumulation of fluid in the lungs), chemical pneumonitis and hemorrhage of pulmonary tissue.

INJECTION: Injection is not anticipated to be a significant route of overexposure for Benzene. If Benzene is "injected" (as may occur through punctures by contaminated, sharp objects), symptoms described in "Inhalation" can occur.

HAZARDOUS MATERIAL INFORMATION SYSTEM			
HEALTH		(BLUE)	2
FLAMMABILITY		(RED)	3
REACTIVITY		(YELLOW)	0
PROTECTIVE EQUIPMENT			X
EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8

For routine industrial applications

See Section 16 for Definition of Ratings

3. HAZARD IDENTIFICATION (Continued)

OTHER HEALTH EFFECTS: The chief target organ affected by serious Benzene exposure is the blood and bone marrow system. Chronic Benzene exposure eventually leads to pancytopenia (abnormal decrease of all three formed elements of the blood; hemoglobin, disease-fighting leukocytes and blood-clotting thrombocytes), followed by thrombocytopenia (problems with the blood-clotting properties of the blood) and anemia. These syndromes can lead to sudden, overwhelming infections. After exposure to Benzene, bleeding from the nose, gums, or mucous membranes and development of small bruises can occur. Benzene is a confirmed human carcinogen and can produce forms of leukemia. Direct contact with the liquid with mucous membranes will result in the development of hemorrhagic lesions.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Overexposure to may cause the health effects described on the following page.

ACUTE: Acute inhalation overexposure to Benzene will initially act as a narcotic, possibly leading to coma in extreme cases. Following exposure to high concentrations, victims may be unconscious, and if exposure continues, death can follow from respiratory failure and circulatory collapse. Contact with the skin can cause irritation and dermatitis. Contact with the eyes is irritating, causing burning and watering of the eyes. Ingestion of Benzene will cause gastric distress, hemorrhage and possible severe depression of the central nervous system. Aspiration of Benzene into the lungs, following ingestion, can result in severe damage to the lungs; death may result.

CHRONIC: Chronic exposure to Benzene causes serious damage to the health by all routes of exposure. Chronic oral and inhalation exposure causes severe effects on the blood system, including damage to the bone marrow, leading to a decrease in production or changes to the cells of hemoglobin, hematocrit, red and white blood cells. Effects can occur with an exposure level as low as 10 ppm for 24 weeks. Benzene also causes harmful changes to the immune system, decreasing the production of mature B- and T- white blood cells. Benzene is a confirmed human carcinogen, which can produce Hodgkin's Disease, leukemia and lymphomas by inhalation. Human mutation data are reported for Benzene. See Section 11 (Toxicological Information) for further information. Symptoms of chronic exposure by most routes can be delayed for months to years after exposure has ceased.

TARGET ORGANS: Respiratory system, central nervous system, blood and immune systems, bone marrow, heart, liver, kidneys, skin, eyes, and reproductive system.

PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO BENZENE WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. If necessary, a Self-Contained Breathing Apparatus should be worn.

INHALATION: If vapors, mists, or sprays of Benzene are inhaled, remove victim to fresh air. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation if necessary. Remove or cover gross contamination to avoid exposure to rescuers.

SKIN EXPOSURE: If Benzene contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek medical attention if any adverse reaction occurs.

EYE EXPOSURE: If Benzene or its vapors enter the eyes, open victim's eyes while under gentle running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Victim must seek immediate medical attention.

INGESTION: If Benzene is swallowed, CALL PHYSICIAN OR POISON CONTROL CENTER FOR MOST CURRENT INFORMATION. If professional advice is not available, do not induce vomiting. Victim should drink milk, egg whites, or large quantities of water. If vomiting occurs naturally, have victim lean forward to reduce risk of aspiration. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow.

Victims of chemical exposure must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Physicians should refer to "Recommendations to Physicians" in Section 11 (Toxicological Information). Take copy of label and MSDS to health professional with victim.

5. FIRE-FIGHTING MEASURES

FLASH POINT, (Closed Cup): -11°C (12°F)

AUTOIGNITION TEMPERATURE: 498°C (928°F)

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): 1.3%

Upper (UEL): 7.1%

FIRE EXTINGUISHING MATERIALS:

Water Spray: YES (for cooling only) Carbon Dioxide: YES

Foam: YES

Dry Chemical: YES

Halon: YES

Other: Any "B" Class.

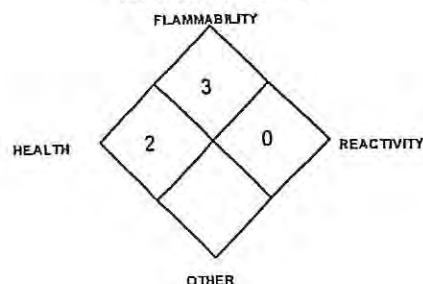
UNUSUAL FIRE AND EXPLOSION HAZARDS: Benzene is a Class IB flammable liquid and presents a serious fire hazard to firefighters. Due to the low flash point, vapors can form explosive mixtures with air, at room temperature. When involved in a fire, this material may decompose and produce toxic gases (e.g., carbon monoxide, carbon dioxide, irritating aldehydes and ketones). The vapors of Benzene are heavier than air and may spread long distances; distant ignition and flash-back are possible. Benzene can float on water; therefore, water contaminated with Benzene can spread the flammable liquid and can spread fire. Containers of Benzene, when involved in fire, may rupture or burst in the heat of the fire.

Explosion Sensitivity to Mechanical Impact: Not sensitive.

Explosion Sensitivity to Static Discharge: Benzene can accumulate static charge by flow or agitation; vapors can be ignited by static discharge.

SPECIAL FIRE-FIGHTING PROCEDURES: In the event of fire, cool containers of Benzene with water to prevent failure. Use a water spray or fog to reduce or direct vapors. Water may not be effective in actually extinguishing a fire involving Benzene, due to its low flash point. Stop the leak or discharge, if possible. For small releases, if it is not possible to stop the leak, and it does not endanger personnel, let the fire burn itself out. Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment, including chemical resistant clothing. Large fires should be fought from a distance with an unmanned hose holder or monitor nozzles. If Benzene is involved in a fire, fire runoff water should be contained to prevent possible environmental damage. If necessary, decontaminate fire-response equipment with soap and water solution. For large releases, consider evacuation. Refer to the North American Emergency Response Guidebook (Guide #130) for additional guidance.

NFPA RATING



See Section 16 for Definition of Ratings

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Evacuate immediate area. Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a release, clear the affected area, protect people, and respond with trained personnel.

Minimum Personal Protective Equipment should be Level B: triple-gloves (rubber gloves and nitrile gloves, over latex gloves), chemical resistant suit and boots, hard-hat, and Self-Contained Breathing Apparatus. Monitor the surrounding area for combustible vapor levels. Combustible vapor levels must be below 10% of the LEL for Benzene (LEL = 1.3%) before personnel are permitted to enter the area. If necessary, ventilate area.

Monitoring should be done for the levels of Benzene and oxygen. Colorimetric tubes are available to detect the presence of Benzene. Levels of Benzene should be below levels listed in Section 2 (Composition and Information on Ingredients) and the atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus.

Eliminate all sources of ignition before clean-up operations begin. Use non-sparking tools. Absorb spilled liquid with activated carbon, polypads or other suitable absorbent materials. Prevent material from entering sewer or confined spaces. Decontaminate the area thoroughly. Place all spill residue in an appropriate container and seal. If necessary, decontaminate spill-response equipment with soap and water solution. Dispose of in accordance with Federal, State, and local hazardous waste disposal regulations (see Section 13, Disposal Considerations).

THIS IS AN EXTREMELY FLAMMABLE, TOXIC LIQUID: Protection of all personnel and the area must be maintained. All responders must be adequately protected from exposure.

PART III *How can I prevent hazardous situations from occurring?*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting Benzene ON YOU or IN YOU. Wash hands after handling chemicals. Do not eat or drink while handling this material. Remove contaminated clothing immediately.

Note: Refer to the OSHA Benzene Standard (29 CFR 1910.1028) for specific requirements associated with the use of Benzene. The Action Level for Benzene is 0.5 ppm as an 8-hour, time-weighted average. In workplaces where employees are exposed above the Action Level, the OSHA requirements for monitoring, establishment of regulated areas, methods of compliance, respiratory protection, emergency response protocol, medical surveillance, training and record keeping must be followed.

STORAGE AND HANDLING PRACTICES: Entrances to regulated areas (as defined by the OSHA Benzene Standard) must be posted with signs which reads as follows:

DANGER
BENZENE
CANCER HAZARD
FLAMMABLE- NO SMOKING
AUTHORIZED PERSONNEL ONLY

All employees who handle this material should be trained to handle it safely. Avoid breathing vapors or mists generated by Benzene. Use in a well-ventilated location. Cylinders of Benzene must be properly labeled. If Benzene is used in other types of containers, only use portable containers and dispensing equipment (faucet, pump, drip can) approved for flammable liquids.

Store cylinders of Benzene in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Do not allow area where cylinders are stored to exceed 52°C (125°F). Material should be stored in secondary containers, or in a diked area, as appropriate. Store containers away from incompatible chemicals. Keep container tightly closed when not in use. Storage areas should be made of fire-resistant materials. Inspect all incoming containers before storage, to ensure containers are properly labeled and not damaged. Refer to NFPA 30, Flammable and Combustible Liquids Code, for additional information on storage.

Empty containers may contain residual flammable liquid or vapors. Therefore, empty containers should be handled with care. Do not expose "empty" containers to welding touches, or any other source of ignition.

SPECIAL PRECAUTIONS FOR HANDLING CYLINDERS: Protect cylinders of Benzene against physical damage. If appropriate, cylinders should be stored in an up-right position. Cylinders should be firmly secured to prevent falling or being knocked over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Never tamper with pressure relief devices in valves and cylinders. Electrical equipment should be non-sparking or explosion proof. The following rules are applicable to situations in which cylinders are being used:

Before Use: If appropriate, move cylinders with a suitable hand-truck. Do not drag, slide or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap in-place until cylinder is ready for use.

During Use: Use designated CGA fittings and other support equipment. Do not use adapters. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Use check valve or trap in discharge line to prevent hazardous backflow into the cylinder. Do not use oils or grease on gas-handling fittings or equipment.

After Use: Close main cylinder valve. Replace valve protection cap. Mark empty cylinders "EMPTY".

NOTE: Use only DOT or ASME code containers. Earth-ground and bond all lines and equipment associated with Benzene. Close valve after each use and when empty. Cylinders must not be recharged except by or with the consent of owner. For additional information refer to the Compressed Gas Association Bulletin SB-2 "Oxygen Deficient Atmospheres".

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Always use Benzene in areas where adequate ventilation is provided. Decontaminate equipment using soapy water before maintenance begins. Collect all rinsates and dispose of according to applicable Federal, State, or local procedures.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation. Use a mechanical fan or vent area to outside. Where appropriate, use a non-sparking, grounded ventilation system separate from other exhaust ventilation systems. Ensure eyewash/safety shower stations are available near areas where Benzene is used.

RESPIRATORY PROTECTION: Maintain exposure levels of Benzene below the levels listed in Section 2 (Composition and Information on Ingredients) and oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection if Benzene levels exceed exposure limits and if oxygen level is below 19.5% or during emergency response to a release of Benzene. If respiratory protection is required, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), or equivalent State standards. The following NIOSH respiratory protection recommendations are for Benzene.

CONCENTRATION

RESPIRATORY EQUIPMENT

At Concentrations Above the NIOSH REL, or Where there is no REL, at any Detectable Concentration: Positive-pressure, full facepiece SCBA or positive pressure, full-facepiece Supplied Air Respirator (SAR) with an auxiliary positive pressure SCBA.

Escape:

Gas mask with organic vapor cartridge or escape-type SCBA should be used.

The IDLH concentration for Benzene is 500 ppm. The carcinogenic effects of Benzene were not considered by NIOSH in determination of the IDLH.

NOTE: In areas which exceed the OSHA Action Level of Benzene, the respirator selection guidelines in the Benzene Standard [29 CFR 1910.1028 (g)] apply.

EYE PROTECTION: Splash goggles or safety glasses. Face-shields should be worn if contact with the liquid is anticipated.

HAND PROTECTION: Wear leather gloves for handling of cylinders of Benzene. Wear chemically impervious gloves appropriate for Benzene for industrial use. Gloves should have a resistance to breakthrough greater than 8 hours, such as polyvinyl alcohol, Baricade™ or Responder™. Butyl rubber, natural rubber, neoprene, nitrile rubber, or polyethylene, polyvinyl chloride, Saranex™, Chemrel™ are not recommended. Use triple gloves for spill response (see Section 6, Accidental Release Measures).

BODY PROTECTION: Use body protection appropriate for task. An impervious, full-body, encapsulating suit may be necessary for some operations involving Benzene. Safety shoes are recommended when handling cylinders.

9. PHYSICAL and CHEMICAL PROPERTIES

RELATIVE VAPOR DENSITY (air = 1): 2.7

SPECIFIC GRAVITY (@ 68°F (20°C) (water = 1): 0.877

SOLUBILITY IN WATER @ 77°F (25°C): 180 mg/mL

EVAPORATION RATE (diethyl ether = 1): 2.8

ODOR THRESHOLD: 97 ppm (detection); 97 ppm (recognition)

LOG COEFFICIENT WATER/OIL DISTRIBUTION: Log P (ocl) = 1.18-1.9; 2.13; 2.15

VAPOR PRESSURE @ 68°F (20°C): 75 mm Hg; 10 kPa

pH: Not applicable.

FREEZING/MELTING POINT: 5.5°C (42°F)

BOILING POINT: 80°C (176°F)

SPECIFIC VOLUME: Not applicable.

EXPANSION RATIO: Not applicable.

APPEARANCE AND COLOR: Colorless, flammable liquid, with a characteristic aromatic hydrocarbon odor.

HOW TO DETECT THIS SUBSTANCE (warning properties): The odor of Benzene is not a good warning property as the odor threshold is above the TLV.

10. STABILITY and REACTIVITY

STABILITY: Normally stable.

DECOMPOSITION PRODUCTS: If Benzene is involved in a fire, it may ignite to yield toxic fumes of carbon monoxide, carbon dioxide, irritating aldehydes and ketones.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Benzene becomes spontaneously flammable in the presence of sodium peroxide and potassium peroxide. Benzene can explode on contact with chromic anhydride, permanganic acid and chlorine.

10. STABILITY and REACTIVITY (Continued)

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE (Continued): Benzene can react vigorously with oxidizing materials. Benzene may react violently or explosively with risk of fire with nitric acid, ozone, diborane, interhalogens (e.g., bromine trifluoride, bromine pentafluoride, chlorine trifluoride, iodine pentafluoride, iodine heptafluoride), dioxygen difluoride, dioxygenyl tetrafluoroborate, permanganic acid, peroxodisulfuric acid, peroxomonosulfuric acid. Benzene will react with nitryl perchlorate, causing a slight explosion and flash. Benzene will react vigorously with uranium hexafluoride. Benzene will attack rubber and plastics.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Avoid contact with incompatible materials, sparks, flame static discharge and other sources of ignition. Avoid exposing cylinders to extremely high temperatures, which could cause the cylinders to rupture or burst.

PART III *How can I prevent hazardous situations from occurring?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following information is available for Benzene.

Skin-Rabbit, adult 15 mg/24 hours open Mild irritation effects

Skin-Rabbit, adult 20 mg/24 hours Moderate irritation effects

Eye effects-Rabbit, adult 88 mg Moderate irritation effects

Eye effects-Rabbit, adult 2 mg/24H Severe irritation effects

oms-Human: lymphocyte 5 μ mol/L

Microsomal Mutagenicity Assay-Mouse: embryo 2500 mg/L

Oral-Mouse TDLo: 6500 mg/kg (female 8-12 days post):

Reproductive effects Teratogenesis, Carcinogenesis, and Mutagenesis

Inhalation-Mouse TCLo: 5 ppm (female 6-15 days post): Teratogenic effects

Inhalation-Man TCLo: 200 mg/m³/78 weeks -intermittent: Carcinogenic effects, Blood effects

Inhalation-Human TCLo: 10 ppm/8 hours /10 years-intermittent: Carcinogenic effects, Blood effects

Oral-Rat TDLo: 52 g/kg/52 weeks - intermittent: Carcinogenic effects

Inhalation-Rat TCLo: 1200 ppm/6 hours/10 weeks - intermittent: Equivocal tumorigenic agent

Oral-Mouse TDLo :18,250 mg/kg/2 years - continuous: Carcinogenic effects

Inhalation-Human TC :8 ppb/4 weeks- intermittent: Carcinogenic effects, Blood effects

Inhalation-Dog, adult LCLo: 146,000 mg/

Inhalation-Cat, adult LCLo: 170,000 mg/m³

Inhalation-Human TC: 10 mg/m³ 3/11 years- intermittent: Carcinogenic effects, Blood effects

Inhalation-Mouse TCLo: 300 ppm/6 hours/16 weeks-intermittent: Equivocal tumorigenic agent

Skin-Mouse TDLo: 1200 g/kg/49 weeks - intermittent: Neoplastic effects

Intraperitoneal-Mouse TDLo: 1200 mg/kg/8 weeks - intermittent: Neoplastic effects

Inhalation-Man TC: 150 ppm/11 years - intermittent: Carcinogenic effects, Blood effects

Inhalation-Mouse TC :1200 ppm/6 hours/10 weeks - intermittent: Equivocal tumorigenic agent

Oral-Mouse TD: 2400 mg/kg/8 weeks - intermittent: Neoplastic effects

Inhalation-Mouse TC: 300 ppm/6 hours/16 weeks intermittent: Carcinogenic effects

Inhalation-Human LCLo :2 pph/5 minutes

Oral-Man LDLo: 50 mg/kg

Inhalation-Human LCLo: 20,000 ppm/5

Inhalation-Man TCLo: 150 ppm/1 year - intermittent: Blood effects

Inhalation-Human TCLo: 100 ppm

Intravenous-Rabbit, adult LDLo :88 mg/kg

Inhalation-Human LCLo: 65 mg/m³/5 years: Blood effects

Oral-Rat LD50: 3306 mg/kg

Inhalation-Rat LC50: 10,000 ppm/7 hours

Intraperitoneal-Rat LD50 :2890 μ g/kg

Oral-Mouse LD50: 4700 mg/kg

Inhalation-Mouse LC50: 9980 ppm

Intraperitoneal-Mouse LD50: 340 mg/kg

Oral-Dog, adult LDLo: 2000 mg/kg

Subcutaneous-Mouse TDLo 600 mg/kg/17 weeks - intermittent: Equivocal tumorigenic agent

Parenteral-Mouse TDLo: 670 mg/kg/19 weeks - intermittent: Equivocal tumorigenic agent

Inhalation-Human TC: 150 ppm/15 minutes /8 years - intermittent: Carcinogenic effects, Blood effects

Oral-Rat TD: 52 g/kg/1 years - intermittent: Carcinogenic effects

Oral-Rat TD: 10 g/kg/52 weeks - intermittent: Carcinogenic effects

Inhalation-Man TC :600 mg/m³/4 years - intermittent: Carcinogenic effects, Blood effects

Additional Information on Benzene: Because of the chronic toxicity effects associated with Benzene, additional information is provided, as follows:

EFFECTS ON THE BLOOD AND BLOOD-FORMING ORGANS: Extensive studies have conclusively proven that oral and inhalation exposure to benzene causes severe effects on the blood system, including damaging the bone marrow where new blood cells are formed. Most studies report a decrease in hemoglobin, hematocrit, red and white blood cells, platelets and/or changes in the cells. Effects of varying severity have been demonstrated with both intermittent and continuous exposures to concentrations as low as 10 ppm for 24 weeks.

EFFECTS ON THE IMMUNE SYSTEM: Studies have also conclusively shown that benzene causes harmful changes to the immune system which protects the body from disease. Benzene has decreased the number of mature B- and T-lymphocytes (white blood cells which produce disease-fighting antibodies). Exposure of mice to 300 ppm for 6 to 23 weeks resulted in a decrease in the number of mature B- and T-lymphocytes. Rats and mice exposed orally to 25 to 200 mg/kg/day for 2 years had significantly reduced white blood cells and lymphocytes.

11. TOXICOLOGICAL INFORMATION (Continued)

SUSPECTED CANCER AGENT: Benzene is listed as follows:

BENZENE: ACGIH-A2 (Suspected Human Carcinogen); EPA-A (Human Carcinogen); IARC-1 (Carcinogenic to Humans); MAK-A1 (Capable of Inducing Malignant Tumors/Experience with Humans); NIOSH-X (Carcinogen); NTP-1 (Known to be a Carcinogen); OSHA-X (Carcinogen); Cal-OSHA (Carcinogen).

IRRITANCY OF PRODUCT: Benzene is irritating to the skin, eyes, and other contaminated tissue.

SENSITIZATION OF PRODUCT: Benzene is not known to cause respiratory system or skin sensitization in humans. Cardiac sensitization to stimulants (e.g., epinephrine, ephedrine) is a possible result of severe or chronic overexposure.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Benzene on the human reproductive system.

Mutagenicity: Human mutation data are available for Benzene. These data were obtained from individuals who were exposed at levels which produced changes in the blood system.

Embryotoxicity: Benzene is not reported to cause embryotoxic effects in humans.

Teratogenicity: Benzene is not reported to cause teratogenic effects in humans. Teratogenic data are available from clinical studies involving test animals exposed to relatively high doses of Benzene. Fetotoxic effects (e.g., reduced birth weight and/or minor skeletal variations) were observed at exposures above 50 ppm.

Reproductive Toxicity: Data on reproductive effects on ovaries and testes are available from clinical studies involving test animals exposed to relatively high doses of Benzene. These data were obtained at doses which caused toxic effects on other organs.

*A **mutagen** is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An **embryotoxin** is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A **teratogen** is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A **reproductive toxin** is any substance which interferes in any way with the reproductive process.*

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing blood system disorders, respiratory conditions, central nervous, liver, kidney, and cardio-vascular conditions may be aggravated by severe or chronic overexposure to Benzene. Skin disorders may also be aggravated by exposures to Benzene.

RECOMMENDATIONS TO PHYSICIANS: The following guidelines are derived from "Clinical Toxicology of Commercial Chemical Products" (5th edition, 1984).

- Check for signs of impending pulmonary edema.
- Because of the aspiration hazard, avoid emetic drugs, whenever practical.
- For overexposures in which emesis is advisable: If the patient is not drowsy, comatose, or in respiratory difficulty, induce vomiting. If necessary, as an alternative treatment, remove Benzene from the stomach via gastric lavage. One or two ounces of mineral oil may be instilled and left in the stomach at the completion of lavage.
- Avoid epinephrine because of its possible adverse effect on the sensitized myocardium. Avoid all digestible fats, oils and alcohol, which may promote the absorption of Benzene in the intestinal system.
- If eyes or skin are affected, wash thoroughly and apply a bland analgesic ointment.
- Because of the possibility of ventricular fibrillation, monitor the ECG continuously and be prepared to administer external cardiac massage.

Refer to the OSHA Benzene Standard [29 CFR 1910.1028; paragraph(i) and Appendix C] for specific information on Medical Surveillance requirements (i.e. for the general physical exam, medical history, specific tests, and re-examination protocol).

BIOLOGICAL EXPOSURE INDICES (BEIs): The following Biological Exposure Indices (BEIs) are currently applicable for Benzene.

BIOLOGICAL EXPOSURE INDICES (BEIs) for Benzene are as follows:		
CHEMICAL DETERMINANT	SAMPLING TIME	BEI
BENZENE • Total phenol in urine • Benzene in exhaled air: - mixed-exhaled - end-exhaled	• End of shift • Prior to next shift	• 50 mg/g creatinine • 0.08 ppm • 0.12 ppm

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: Benzene will be degraded over time into other organic compounds. The following environmental data are available for Benzene.

BENZENE: K_{OW} = 2.13. Water Solubility = 1791 mg/L. BCF (*Anguilla japonica*, eels) = 3.5. BCF (*Clupea harengus* Pallas, pacific herring) = 4.4. BCF (goldfish) = 4.3. BCF, benzene = 24 (estimated). If benzene is released into the soil, it will be volatilized near the surface or it will leach to the groundwater. No degradation of benzene (BOD) was reported in coarse-filtered Lake Superior harbor water incubated at 21°C for 12 days. In the marine eco-system, biodegradation occurs from 2 days to 2 weeks in the summer and spring, respectively. The half-life of Benzene in estuarine water was 6 days, as measured by $^{14}\text{CO}_2$ produced. Biodegradation half-lives of 28 and 16 days were reported in die-away tests for degradation of up to 3.2 UL/L benzene using groundwater and Lester River water, respectively, under aerobic conditions. In a base-rich para-brownish soil, 20 ppm benzene was 24% degraded in one week, 44% in 5 weeks and 47% in 10 weeks. It is not expected to adsorb to sediment nor bioconcentrate in aquatic organisms.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Benzene may be harmful or fatal to contaminated plant and animal life (especially if large quantities of Benzene are released). Refer to Section 11 (Toxicology Information). Additional information is available on the effects of Benzene on plants as follows:

Benzene is lethal to plants at high concentrations (GT 15600 ppm in air) and short (30 minutes) exposure times. In all species studied recovery was complete upon removal from exposure to sub-lethal concentrations.

Plant growth and rooting is stimulated by aqueous solutions of low benzene concentrations (0.01-0.10 saturated). Aqueous solutions containing high concentrations (0.10-0.15% Benzene) inhibit growth and interfere with metabolism and cell division.

EFFECT OF CHEMICAL ON AQUATIC LIFE: Benzene can be harmful or fatal to contaminated aquatic plant and animal life. Benzene floats on water, and can potentially form slicks which are capable of creating oxygen-deprived waterways which can contaminate coastal and shore life. The following aquatic toxicity data are available for Benzene.

LC₁₀₀ (*Tetrahymena pyriformis*, ciliate) = 12.8 mmol/L/24 hours
LC₅₀ (*Palaemonetes pugio*, grass shrimp) = 27 ppm/96 hours
LC₅₀ (*Cancer magister*, crab larvae, stage 1) = 108 ppm/96 hours
LC₅₀ (*Crangon franciscorum*, shrimp) = 20 ppm/96 hours
LC₅₀ (*Poecilia reticulata*, guppy) = 63 ppm/14 days
LC₅₀ (*Morone saxatilis*, bass) = 5.8 to 10.9 ppm/96 hours
LC₅₀ (*Salmo trutta*, brown trout yearling) = 12 mg/L/1-hour
LC₅₀ (*Ambystoma mexicana*, mexican axototl salamander, 3-4 weeks after hatching) = 370 mg/L/48 hours
LC₅₀ (clawed toad, 3-4 weeks after hatching) = 190 mg/L/48 hours
LD₅₀ (*Carassius auratus*, goldfish) = 46 mg/L/24-hours
LD₅₀ (*Lepomis macrochirus*, bluegill sunfish) = 60 mg/L/2-hours

LC (*Daphnia magna*) highest no adverse level = 98 mg/L
Effect level (blue crab) = 1 mg/L
EC₅₀ (freshwater green algae, *Ankistrodesmus falcatus*) = 310 mg (3.97 mmol/L)
Photosynthetic carbon fixation (*Selenastrum capricornutum*) = 100, 95, 84, 5; for 24 hour exposure to 0, 10, 100 or 1000 mg Benzene/L
Growth inhibition (*Chlorella vulgaris*) = significant for 25-1744 ppm Benzene
Light saturated photosynthesis relative rates (*Nitzschia palea*, freshwater diatom) = 100, 61, 38, 13; exposure for 2 hours to 0, 175, 350, 520 mg Benzene/L
Growth inhibition (*Skeletonema costatum*) = at 20 mg/L

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Return cylinders with residual product to Airgas Inc. Do not dispose of locally.

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

<u>PROPER SHIPPING NAME:</u>	Benzene
<u>HAZARD CLASS NUMBER and DESCRIPTION:</u>	3 (Flammable Liquid)
<u>UN IDENTIFICATION NUMBER:</u>	UN 1114
<u>PACKING GROUP:</u>	PG II
<u>DOT LABEL(S) REQUIRED:</u>	Flammable Liquid
<u>NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996):</u>	130

MARINE POLLUTANT: Benzene is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above information for the preparation of Canadian Shipments. Also, there is an additional Hazard Class: 9.2 (Substance Hazardous to the Environment).

15. REGULATORY INFORMATION

U.S. SARA REPORTING REQUIREMENTS: Benzene is subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows:

COMPONENT	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
Benzene	NO	YES	YES

U.S. SARA THRESHOLD PLANNING QUANTITY: Not applicable.

U.S. CERCLA REPORTABLE QUANTITIES (RQ): 10 lb; RCRA Code = U019.

CANADIAN DSL/NDL INVENTORY STATUS: Benzene is on the DSL Inventory.

U.S. TSCA INVENTORY STATUS: Benzene is listed on the TSCA Inventory.

OTHER U.S. FEDERAL REGULATIONS: Benzene is subject to the requirements of CFR 29 1910.1028, the OSHA Benzene Standard. The Action Level for Benzene is 0.5 ppm as an 8-hour, time-weighted average under this regulation. The EPA is promulgating water regulations for certain volatile synthetic organic chemicals. Specifically, this notice promulgates a maximum contaminant level for Benzene at 0.005 mg/L. Benzene is not listed in Appendix A as a highly hazardous chemical, per 29 CFR 1910.119: Process Safety Management of Highly Hazardous Chemicals. Under this regulation, however, any process that involves a flammable liquid on-site, in one location, in quantities of 10,000 lbs (4,553 kg) or greater is covered under this regulation unless it is used as a fuel.

U.S. STATE REGULATORY INFORMATION: Benzene is covered under specific State regulations, as denoted below:

Alaska - Designated Toxic and Hazardous Substances: Benzene.	Minnesota - List of Hazardous Substances: Benzene.	Pennsylvania - Hazardous Substance List: Benzene.
California - Permissible Exposure Limits for Chemical Contaminants: Benzene.	Missouri - Employer Information/Toxic Substance List: Benzene.	Rhode Island - Hazardous Substance List: Benzene.
Florida - Substance List: Benzene.	New Jersey - Right to Know Hazardous Substance List: Benzene.	Texas - Hazardous Substance List: Benzene.
Illinois - Toxic Substance List: Benzene.	North Dakota - List of Hazardous Chemicals, Reportable Quantities: Benzene.	West Virginia - Hazardous Substance List: Benzene.
Kansas - Section 302/313 List: Benzene.		Wisconsin - Toxic and Hazardous Substances: Benzene.
Massachusetts - Substance List: Benzene.		
Michigan Critical Materials Register: Benzene.		

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Benzene is listed on the California Proposition 65 Lists. **WARNING:** Benzene is known to the State of California to cause cancer.

LABELING: DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR CAN CAUSE FLASH FIRE. FLASH POINT = -11°C (12°F). HARMFUL IF INHALED. HARMFUL OR FATAL IF SWALLOWED. PROLONGED OR REPEATED SKIN CONTACT MAY DRY SKIN AND CAUSE IRRITATION. CAN CAUSE CENTRAL NERVOUS SYSTEM EFFECTS. CHRONIC EXPOSURE MAY CAUSE LEUKEMIA AND CAN CAUSE ADVERSE EFFECTS ON THE BLOOD SYSTEM, LIVER, KIDNEYS, REPRODUCTIVE SYSTEM. CAN CAUSE DEATH IF TOO MUCH IS BREATHED. ASPIRATION HAZARD IF SWALLOWED - CAN ENTER LUNGS AND CAUSE DAMAGE. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation. Avoid contact with skin and clothing. Avoid exposure to vapor. Wash thoroughly after handling. **FIRST-AID:** In case of contact, immediately flush skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if irritation develops or persists. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of fire, use water fog, foam, dry chemical, or CO₂. In case of spill: Absorb spill with inert materials (e.g. activated carbon, dry sand). Flush residual spill with water. Consult Material Safety Data Sheet for additional information.

CANADIAN WHMIS SYMBOLS: Class B2: Flammable Liquid.
Class D2A/D2B: Material Causing Other Toxic Effects



16. OTHER INFORMATION

PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, Inc.
9163 Chesapeake Drive, San Diego, CA 92123-1002
619/565-0302

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. AIRGAS, Inc. assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, AIRGAS, Inc. assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number which uniquely identifies each constituent. It is used for computer-related searching.

EXPOSURE LIMITS IN AIR:

ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. TLV - Threshold Limit Value - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour Time Weighted Average (TWA), the 15-minute Short Term Exposure Limit, and the Instantaneous Ceiling Level (C). Skin absorption effects must also be considered.

OSHA - U.S. Occupational Safety and Health Administration. PEL - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register, 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order.

IDLH - Immediately Dangerous to Life and Health - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury. The DFG - MAK is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. NIOSH is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (OSHA). NIOSH issues exposure guidelines called Recommended Exposure Levels (RELs). When no exposure guidelines are established, an entry of NE is made for reference.

HAZARD RATINGS:

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: Health Hazard: 0 (minimal acute or chronic exposure hazard); 1 (slight acute or chronic exposure hazard); 2 (moderate acute or significant chronic exposure hazard); 3 (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); 4 (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: 0 (minimal hazard); 1 (materials that require substantial pre-heating before burning); 2 (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); 3 (Class IB and IC flammable liquids with flash points below 38°C [100°F]); 4 (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]). Reactivity Hazard: 0 (normally stable); 1 (material that can become unstable at elevated temperatures or which can react slightly with water); 2 (materials that are unstable but do not detonate or which can react violently with water); 3 (materials that can detonate when initiated or which can react explosively with water); 4 (materials that can detonate at normal temperatures or pressures).

NATIONAL FIRE PROTECTION ASSOCIATION: Health Hazard: 0 (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); 1 (materials that on exposure under fire conditions could cause irritation or minor residual injury); 2 (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); 3 (materials that can on short exposure could cause serious temporary or residual injury); 4 (materials that under very short exposure causes death or major residual injury).

NATIONAL FIRE PROTECTION ASSOCIATION (Continued): Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (NFPA). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: LD₅₀ - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; LC₅₀ - Lethal Concentration (gases) which kills 50% of the exposed animals; ppm concentration expressed in parts of material per million parts of air or water; mg/m³ concentration expressed in weight of substance per volume of air; mg/kg quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: IARC - the International Agency for Research on Cancer; NTP - the National Toxicology Program; RTECS - the Registry of Toxic Effects of Chemical Substances; OSHA and CAL/OSHA. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. Other measures of toxicity include TDLo, the lowest dose to cause a symptom and TCLo, the lowest concentration to cause a symptom; TD₀, LDLo, and LD₀, or TC, TCo, LCLo, and LCo, the lowest dose (or concentration) to cause lethal or toxic effects. BEI - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. Ecological Information: EC is the effect concentration in water.

REGULATORY INFORMATION:

This section explains the impact of various laws and regulations on the material. EPA is the U.S. Environmental Protection Agency. WHMIS is the Canadian Workplace Hazardous Materials Information System. DOT and TC are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (SARA); the Canadian Domestic/Non-Domestic Substances List (DSL/NDL); the U.S. Toxic Substance Control Act (TSCA); Marine Pollutant status according to the DOT; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund); and various state regulations.

MATERIAL SAFETY DATA SHEET

SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MATHESON TRI-GAS, INC.
959 ROUTE 46 EAST
PARSIPPANY, NEW JERSEY 07054-0624

EMERGENCY CONTACT:
CHEMTREC 1-800-424-9300
INFORMATION CONTACT:
973-257-1100

SUBSTANCE: ETHYL BENZENE

TRADE NAMES/SYNONYMS:
MTG MSDS 185; BENZENE, ETHYL-; EB; PHENYLETHANE; ETHYLBENZENE; ETHYLBENZOL;
ALPHA-METHYLTOLUENE; UN 1175; C8H10; MAT08780

CHEMICAL FAMILY: hydrocarbons, aromatic

CREATION DATE: Jan 24 1989
REVISION DATE: Dec 15 2003

SECTION 2 COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: ETHYL BENZENE
CAS NUMBER: 100-41-4
PERCENTAGE: 100

SECTION 3 HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=3 REACTIVITY=0



EMERGENCY OVERVIEW:

COLOR: colorless

PHYSICAL FORM: liquid

ODOR: aromatic odor

MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, eye irritation, aspiration hazard, central nervous system depression, suspect cancer hazard (in animals)

PHYSICAL HAZARDS: Flammable liquid and vapor. Vapor may cause flash fire.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: irritation (possibly severe), chest pain, difficulty breathing, headache, drowsiness, dizziness, loss of coordination, coma

LONG TERM EXPOSURE: irritation, headache, drowsiness, emotional disturbances, cancer

SKIN CONTACT:

SHORT TERM EXPOSURE: irritation (possibly severe)

LONG TERM EXPOSURE: irritation

EYE CONTACT:

SHORT TERM EXPOSURE: irritation (possibly severe)

LONG TERM EXPOSURE: irritation

INGESTION:

SHORT TERM EXPOSURE: nausea, vomiting, stomach pain, aspiration hazard

LONG TERM EXPOSURE: no information on significant adverse effects

SECTION 4 FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get immediate medical attention. Thoroughly clean and dry contaminated clothing and shoes before reuse. Destroy contaminated shoes.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: Contact local poison control center or physician immediately. Never make an unconscious person vomit or drink fluids. When vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.

NOTE TO PHYSICIAN: For inhalation, consider oxygen. For ingestion, consider gastric lavage and activated charcoal slurry.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. Vapor/air mixtures are explosive above flash point. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Electrostatic discharges may be generated by flow or agitation resulting in ignition or explosion.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Water may be ineffective.

FLASH POINT: 59 F (15 C) (CC)
LOWER FLAMMABLE LIMIT: 0.8%
UPPER FLAMMABLE LIMIT: 6.7%
AUTOIGNITION: 810 F (432 C)
FLAMMABILITY CLASS (OSHA): IB

SECTION 6 ACCIDENTAL RELEASE MEASURES

AIR RELEASE:

Reduce vapors with water spray. Stay upwind and keep out of low areas.

SOIL RELEASE:

Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal. Absorb with sand or other non-combustible material.

WATER RELEASE:

Cover with absorbent sheets, spill-control pads or pillows. Neutralize. Collect with absorbent into suitable container. Absorb with activated carbon. Remove trapped material with suction hoses. Collect spilled material using mechanical equipment.

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

SECTION 7 HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Protect from physical damage. Store outside or in a detached building. Store with flammable liquids. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Grounding and bonding required. Keep separated from incompatible substances.

SECTION 8 EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

ETHYL BENZENE:

100 ppm (435 mg/m³) OSHA TWA
125 ppm (543 mg/m³) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
100 ppm ACGIH TWA
125 ppm ACGIH STEL
100 ppm (435 mg/m³) NIOSH recommended TWA 10 hour(s)
125 ppm (545 mg/m³) NIOSH recommended STEL

VENTILATION: Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.

800 ppm

Any chemical cartridge respirator with organic vapor cartridge(s).

Any air-purifying respirator with a full facepiece and an organic vapor canister.

Any powered, air-purifying respirator with organic vapor cartridge(s).

Any supplied-air respirator.

Any self-contained breathing apparatus with a full facepiece.

Escape -

Any air-purifying respirator with a full facepiece and an organic vapor canister.

Any appropriate escape-type, self-contained breathing apparatus.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid

COLOR: colorless

ODOR: aromatic odor

MOLECULAR WEIGHT: 106.17

MOLECULAR FORMULA: C-H3-C-H2-C6-H5

BOILING POINT: 277 F (136 C)

FREEZING POINT: -139 F (-95 C)

VAPOR PRESSURE: 7.1 mmHg @ 20 C

VAPOR DENSITY (air=1): 3.66

SPECIFIC GRAVITY (water=1): 0.8670

WATER SOLUBILITY: 0.015%

PH: Not available

VOLATILITY: 100%

ODOR THRESHOLD: 140 ppm

EVAPORATION RATE:

VISCOSITY: 0.64 cP @ 25 C

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

SOLVENT SOLUBILITY:

Soluble: alcohol, ether, benzene, sulfur dioxide, carbon tetrachloride
Insoluble: ammonia

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.

INCOMPATIBILITIES: acids, bases, oxidizing materials, combustible materials

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: oxides of carbon

POLYMERIZATION: Will not polymerize.

SECTION 11 TOXICOLOGICAL INFORMATION

ETHYL BENZENE:

IRRITATION DATA:

15 mg/24 hour(s) open skin-rabbit mild; 500 mg eyes-rabbit severe

TOXICITY DATA:

17800 ul/kg skin-rabbit LD50; 3500 mg/kg oral-rat LD50

CARCINOGEN STATUS: IARC: Human Inadequate Evidence, Animal Sufficient Evidence, Group 2B;

ACGIH: A3 -Animal Carcinogen

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Moderately Toxic: ingestion

Slightly Toxic: dermal absorption

TARGET ORGANS: central nervous system

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: kidney disorders, liver disorders, respiratory disorders, skin disorders and allergies

TUMORIGENIC DATA: Available.

MUTAGENIC DATA: Available.

REPRODUCTIVE EFFECTS DATA: Available.

ADDITIONAL DATA: May cross the placenta.

SECTION 12 ECOLOGICAL INFORMATION

FATE AND TRANSPORT:

KOW: 154170.05 (log = 5.196) (estimated from water solubility)

KOC: 44668.36 (log = 4.657) (estimated from water solubility)

HENRY'S LAW CONSTANT: 6.6×10^{-3} atm-m³/mol

BIOCONCENTRATION: 36.39 (estimated from water solubility)

AQUATIC PROCESSES: 2.6730095 hours (River Model: 1 m deep, 1 m/s flow, 3 m/s wind)

ENVIRONMENTAL SUMMARY: Relatively non-persistent in the environment. Not expected to leach through the soil or the sediment. Accumulates very little in the bodies of living organisms. Highly volatile from water.

SECTION 13 DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001.

SECTION 14 TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:

PROPER SHIPPING NAME: Ethylbenzene

ID NUMBER: UN1175

HAZARD CLASS OR DIVISION: 3

PACKING GROUP: II

LABELING REQUIREMENTS: 3



CANADIAN TRANSPORTATION OF DANGEROUS GOODS:

SHIPPING NAME: Ethylbenzene

UN NUMBER: UN1175

CLASS: 3

PACKING GROUP/RISK GROUP: II

SECTION 15 REGULATORY INFORMATION

U.S. REGULATIONS:

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):

ETHYL BENZENE: 1000 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):

ACUTE: Yes

CHRONIC: Yes

FIRE: Yes

REACTIVE: No
SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):
ETHYL BENZENE

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:
California Proposition 65: Not regulated.

CANADIAN REGULATIONS:
WHMIS CLASSIFICATION: B2.

NATIONAL INVENTORY STATUS:
U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

CANADA INVENTORY (DSL/NDL): Not determined.

SECTION 16 OTHER INFORMATION

MSDS SUMMARY OF CHANGES

SECTION 12 ECOLOGICAL INFORMATION

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NFPA 704 (Section 16)

AMERADA HESS CORPORATION**MATERIAL SAFETY DATA SHEET****Methyl tert-Butyl Ether (MTBE)****MSDS No. 9922****1. CHEMICAL PRODUCT and COMPANY INFORMATION** (rev. Apr-98)

Amerada Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs):
COMPANY CONTACT (business hours):

CHEMTREC (800) 424-9300
Corporate Safety (732) 750-6000

SYNONYMS: 2-methoxy-2-methyl propane; Methyl t-butyl ether; MTBE; t-butyl methyl ether

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and INFORMATION ON INGREDIENTS (rev. Sep-94)

INGREDIENT NAME	EXPOSURE LIMITS	CONCENTRATION
		PERCENT BY WEIGHT
Methyl-tertiary butyl ether (MTBE) CAS NUMBER: 1634-04-4	OSHA PEL-TWA/STEL: None established ACGIH TLV-TWA: 40 ppm, A3	> 97%

MTBE (C₅H₁₂O) is used as an octane booster and oxygenate for unleaded gasoline.

3. HAZARDS IDENTIFICATION (rev. Apr-98; Tox-98)**EMERGENCY OVERVIEW**
DANGER!

EXTREMELY FLAMMABLE - EYE AND MUCOUS MEMBRANE IRRITANT - EFFECTS CENTRAL NERVOUS SYSTEM - HARMFUL OR FATAL IF SWALLOWED - ASPIRATION HAZARD

High fire hazard. Keep away from heat, spark, open flame, and other ignition sources.

Contact may cause eye, skin and mucous membrane irritation. Avoid prolonged breathing of vapors or mists. Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headache, intoxication), and respiratory system effects.

If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs).

EYES

Contact with the eye may cause slight to mild irritation.

SKIN

Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

INGESTION

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting, and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest and death may occur.

INHALATION

Excessive exposure may cause irritation to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

AMERAD HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Methyl tert-Butyl Ether (MTBE)

MSDS No. 9922

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY

This product has produced cancer, developmental and systemic toxicity in laboratory animals following repeated exposure. The significance of these results to human exposures has not been determined – see Section 11, Toxicological Information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash) conditions. Chronic respiratory disease, or pre-existing central nervous system disorders may be aggravated by exposure.

4. FIRST AID MEASURES

(rev. Apr-98; Tox-98)

EYES

In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION

Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

5. FIRE FIGHTING MEASURES

(rev. Nov-96)

FLAMMABLE PROPERTIES:

FLASH POINT:	-14 °F (-25 °C)
AUTOIGNITION TEMPERATURE:	AP 815 °F (435 °C)
OSHA/NFPA FLAMMABILITY CLASS:	1B (flammable liquid)
LOWER EXPLOSIVE LIMIT (%):	1.6
UPPER EXPLOSIVE LIMIT (%):	8.4

FIRE AND EXPLOSION HAZARDS

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

This product burns with a blue flame which is often less visible than gasoline or other petroleum hydrocarbons flames.

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO₂, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam suitable for polar solvents. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Methyl tert-Butyl Ether (MTBE)

MSDS No. 9922

Firefighting foam suitable for polar solvents is recommended - refer to NFPA 11 "Low Expansion Foam."

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES (rev. Apr-98)

ACTIVATE FACILITY SPILL CONTINGENCY or EMERGENCY PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE (rev. Apr-98)

HANDLING PRECAUTIONS

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents."

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Methyl tert-Butyl Ether (MTBE)

MSDS No. 9922

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION (rev. Nov-96)

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile or neoprene are recommended. Chemical protective clothing such as of E.I. DuPont Tychem®, Barricade®, or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION

A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

Refer to OSHA 29 CFR 1910.134, ANSI Z88.2-1992, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection.

9. PHYSICAL and CHEMICAL PROPERTIES (rev. Sep-94)

APPEARANCE

A clear, water-like liquid

ODOR

A sweet, ether-like odor.

ODOR THRESHOLD

Odor detectable at 0.05 ppm and recognizable at 0.13 ppm. Highly odorous.

BASIC PHYSICAL PROPERTIES

BOILING POINT:	131 °F (55 °C)
VAPOR PRESSURE:	7.8 PSI @ 100 °F (38 °C)
VAPOR DENSITY (air = 1):	3.1
SPECIFIC GRAVITY (H ₂ O = 1):	0.74
EVAPORATION RATE:	ND - probably high
PERCENT VOLATILES:	100 %
SOLUBILITY (H ₂ O):	AP 5% @ 68 °F (20 °C)

10. STABILITY and REACTIVITY (rev. Sep-94)

STABILITY: Stable. Hazardous polymerization will not occur.

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Methyl tert-Butyl Ether (MTBE)

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CONDITIONS TO AVOID

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources.

INCOMPATIBLE MATERIALS

Keep away from strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide, non-combusted hydrocarbons (smoke), irritating aldehydes and ketones, and other toxic vapors.

11. TOXICOLOGICAL PROPERTIES (rev. Apr-98)

ACUTE EFFECTS

Acute Dermal:	LD50 (rabbit): >10 g/kg	Eye Irritation (rabbits): mild to moderate
Acute Inhalation:	LC50 (rat): 35,000 ppm	Dermal irritation (rabbit): slight
Acute Oral:	LD50 (rat): 4.0 ml/kg	Dermal Sensitization: negative

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenic: IARC: NO NTP: NO OSHA: NO ACGIH: A3 (animal carcinogen)
MTBE has demonstrated some evidence of developmental toxicity in animal models.

MUTAGENICITY (genetic effects)

MTBE was positive in a single mutagenicity study following activation.

12. ECOLOGICAL INFORMATION (rev. Apr-98)

Keep out of sewers, drainage and waterways. Report spills and releases, as applicable, under Federal and State regulations. If released, MTBE will be expected to exhibit fairly high mobility in soil, and therefore may leach into groundwater. Refer to API Publication 4497, "Cost-Effective, Alternative Treatment Technologies For Reducing the Concentrations of Ethers and Alcohols in Groundwater."

13. DISPOSAL CONSIDERATIONS (rev. Apr-98)

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION (rev. Sep-94)

PROPER SHIPPING NAME:	Methyl tert-butyl ether
HAZARD CLASS AND PACKING GROUP:	3, PG II
DOT IDENTIFICATION NUMBER:	UN 2398
DOT SHIPPING LABEL:	FLAMMABLE LIQUID

15. REGULATORY INFORMATION (rev. Nov-96)

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, to state and/or local reporting requirements. This product and/or its constituents may also be subject to other regulations at the federal, state and/or local level. Consult those regulations applicable to your facility / operation. Consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow-up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

MTBE is a CERCLA hazardous substance and as such is subject to CERCLA and SARA federal reporting requirements. Reportable Quantity (pounds): 1000

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Methyl tert-Butyl Ether (MTBE)

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SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

INGREDIENT NAME	CONCENTRATION PERCENT BY WEIGHT
Methyl-tertiary butyl ether (MTBE) CAS NUMBER: 1634-04-4	> 97

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 2 (Flammable Liquid)
Class D, Division 2, Subdivision B (Toxic by other means)

16. OTHER INFORMATION (rev. Nov-96)

NFPA® HAZARD RATING

HEALTH:	1	Slight
FIRE:	3	High
REACTIVITY:	0	Negligible

HMIS® HAZARD RATING

HEALTH:	1*	Slight
FIRE:	3	Serious
REACTIVITY:	0	Negligible

* Chronic

SUPERSEDES MSDS DATED: 11/21/96

ABBREVIATIONS:

AP = Approximately < = Less than > = Greater than
N/A = Not Applicable N/D = Not Determined ppm = parts per million

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists	NTP	National Toxicology Program
AIHA	American Industrial Hygiene Association	OPA	Oil Pollution Act of 1990
ANSI	American National Standards Institute (212)642-4900	OSHA	U.S. Occupational Safety & Health Administration
API	American Petroleum Institute 202)682-8000	PEL	Permissible Exposure Limit (OSHA)
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act	RCRA	Resource Conservation and Recovery Act
DOT	U.S. Department of Transportation [General Info: (800)467-4922]	REL	Recommended Exposure Limit (NIOSH)
EPA	U.S. Environmental Protection Agency	SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
HMIS	Hazardous Materials Information System	SCBA	Self-Contained Breathing Apparatus
IARC	International Agency For Research On Cancer	SPCC	Spill Prevention, Control, and Countermeasures
MSHA	Mine Safety and Health Administration	STEL	Short-Term Exposure Limit (generally 15 minutes)
NFPA	National Fire Protection Association (617)770-3000	TLV	Threshold Limit Value (ACGIH)
NIOSH	National Institute of Occupational Safety and Health	TSCA	Toxic Substances Control Act
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)	TWA	Time Weighted Average (8 hr.)
		WEEL	Workplace Environmental Exposure Level (AIHA)
		WHMIS	Canadian Workplace Hazardous Materials Information System

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Methyl tert-Butyl Ether (MTBE)

MSDS No. 9922

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

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Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: MAPLLC PETROLEUM CRUDE OIL
MARATHON MSDS NO: 0110MAR019



1. Chemical Product and Company Information

2. Composition / Information on Ingredients

3. Hazards Identification

4. First Aid Measures

5. Fire Fighting Measures

6. Accidental Release Measures

7. Handling and Storage

8. Exposure Control / Personal Protection

9. Physical and Chemical Properties

10. Stability and Reactivity

11. Toxicological Information

12. Ecological Information

13. Disposal Considerations

14. Transportation Information

15. Regulatory Information

16. Other Information

1. CHEMICAL PRODUCT AND COMPANY INFORMATION

PRODUCT NAME:

MAPLLC PETROLEUM CRUDE OIL

SYNONYMS:

CRUDE OIL, MAPLLC; MAPLLC CRUDE OIL;
MAPLLC PETROLEUM CRUDE OIL; PETROLEUM
CRUDE OIL, MAPLLC

CHEM FAMILY: PETROLEUM HYDROCARBON

CHEM FORMULA: COMPLEX MIXTURE

PRODUCT CODE: NONE

MANUFACTURER / DISTRIBUTOR:

MARATHON ASHLAND PETROLEUM LLC
539 SOUTH MAIN STREET
FINDLAY OH 45840

EMERGENCY PHONE NUMBERS:

(877) 627-5463
(800) 424-9300

MSDS INFORMATION: (419) 421-3070

MSDS REVISION DATE: 06/11/1998

INFORMATION SUPPLIED BY: CRAIG M. PARKER

MANAGER, TOXICOLOGY AND PRODUCT SAFETY

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2. COMPOSITION / INFORMATION ON INGREDIENTS

PRODUCT INFORMATION:

MAPLLC PETROLEUM CRUDE OIL (CAS # 8002-05-9) IS A/AN
COMPLEX MIXTURE OF PARAFFINS, CYCLOPARAFFINS AND AROMATIC
HYDROCARBONS. CAN CONTAIN MINOR AMOUNTS OF SULFUR, NITROGEN, AND
OXYGEN COMPOUNDS AS WELL AS TRACE AMOUNTS OF HEAVY METALS SUCH AS
NICKEL, VANADIUM AND LEAD. COMPOSITION VARIES DEPENDING ON SOURCE OF
CRUDE.

PERCENT RANGE	CAS NUMBER
---------------	------------

COMPONENTS:

PETROLEUM CRUDE OIL	98.00-100.00	8002-05-9
TOLUENE	0.00- 5.00	108-88-3
XYLENE	0.00- 5.00	1330-20-7
HYDROGEN SULFIDE	0.00- 4.00	7783-06-4
SULFUR COMPOUNDS	0.00- 3.00	MIXTURE
NORMAL HEXANE	0.00- 3.00	110-54-3
BENZENE	0.00- 2.00	71-43-2

EXPOSURE GUIDELINES

LIMIT	TYPE	SOURCE
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PRODUCT:

MAPLLC PETROLEUM CRUDE OIL	NONE ESTABLISHED
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COMPONENTS:

PETROLEUM CRUDE OIL	NONE ESTABLISHED
TOLUENE	50.00 PPM 8 HR TWA ACGIH
	100.00 PPM 8 HR TWA OSHA*
	150.00 PPM STEL OSHA*

* THE MANUFACTURER HAS VOLUNTARILY ELECTED TO REFLECT EXPOSURE LIMITS CONTAINED IN OSHA'S 1989 AIR CONTAMINANTS STANDARD IN ITS MSDS'S, EVEN THOUGH CERTAIN OF THOSE EXPOSURE LIMITS WERE VACATED IN 1992.

XYLENE	100.00 PPM 8 HR TWA ACGIH
	150.00 PPM STEL ACGIH
	100.00 PPM 8 HR TWA OSHA*
	150.00 PPM STEL OSHA*

* THE MANUFACTURER HAS VOLUNTARILY ELECTED TO REFLECT EXPOSURE LIMITS CONTAINED IN OSHA'S 1989 AIR CONTAMINANTS STANDARD IN ITS MSDS'S, EVEN THOUGH CERTAIN OF THOSE EXPOSURE LIMITS WERE VACATED IN 1992.

HYDROGEN SULFIDE	10.00 PPM 8 HR TWA ACGIH
	15.00 PPM STEL ACGIH
	10.00 PPM 8 HR TWA OSHA*
	15.00 PPM STEL OSHA*

* THE MANUFACTURER HAS VOLUNTARILY ELECTED TO REFLECT EXPOSURE LIMITS CONTAINED IN OSHA'S 1989 AIR CONTAMINANTS STANDARD IN ITS MSDS'S, EVEN THOUGH CERTAIN OF THOSE EXPOSURE LIMITS WERE VACATED IN 1992.

SULFUR COMPOUNDS

NONE ESTABLISHED

NORMAL HEXANE

50.00 PPM
500.00 PPM

8 HR TWA ACGIH
8 HR TWA OSHA

BENZENE

.50 PPM
2.50 PPM
1.00 PPM
5.00 PPM

8 HR TWA ACGIH
STEL ACGIH
8 HR TWA OSHA
STEL OSHA

OSHA ACTION LEVEL 0.50 PPM (8 HR TWA)

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3. HAZARDS IDENTIFICATION

***** EMERGENCY OVERVIEW *****

PETROLEUM CRUDE OIL IS AMBER TO BLACK IN COLOR DEPENDING ON THE SOURCE. SOUR CRUDE POSSESSES A ROTTEN EGG OR SULFUR ODOR. CRUDE OIL IS A VOLATILE AND EXTREMELY FLAMMABLE LIQUID AND VAPORS MAY CAUSE FLASH FIRES. KEEP AWAY FROM HEAT, FLAME AND SOURCES OF IGNITION. CRUDE OIL CAN CONTAIN TOXIC LEVELS OF HYDROGEN SULFIDE VAPORS THAT ACCUMULATE IN THE VAPOR SPACES OF STORAGE AND TRANSPORT COMPARTMENTS. THESE VAPORS CAUSE EYE, SKIN, AND RESPIRATORY TRACT IRRITATION AND ASPHYXIATION. CRUDE OIL CAN ALSO CONTAIN SIGNIFICANT CONCENTRATIONS OF BENZENE WHICH HAS BEEN SHOWN TO CAUSE CANCER OR BE TOXIC TO BLOOD-FORMING ORGANS. IF SWALLOWED, THE VOLATILE COMPONENTS OF CRUDE OIL MAY GET SUCKED INTO THE LUNGS (ASPIRATED) AND CAUSE LUNG DAMAGE OR EVEN DEATH.

OSHA WARNING LABEL:

DANGER!
FLAMMABLE LIQUID
MAY VENT HARMFUL CONCENTRATIONS OF HYDROGEN SULFIDE (H₂S) GAS WHICH CAN CAUSE RESPIRATORY IRRITATION AND ASPHYXIATION.
CONTAINS BENZENE WHICH MAY CAUSE CANCER OR BE TOXIC TO BLOOD-FORMING ORGANS.
ASPIRATION (INADVERTENT SUCTION) OF LIQUID INTO THE LUNGS CAN PRODUCE CHEMICAL PNEUMONIA OR EVEN DEATH.

POTENTIAL HEALTH EFFECTS

EYE:

LIQUID OR VAPOR CONTACT MAY RESULT IN SLIGHT EYE IRRITATION.

SKIN:

PROLONGED AND REPEATED LIQUID CONTACT CAN CAUSE DERMATITIS, FOLLICULITIS OR OIL ACNE.

INHALATION:

VAPORS AND FUMES CAN CAUSE RESPIRATORY AND NASAL IRRITATION. SEE SECTIONS 7 AND 11 REGARDING THE TOXICITY AND POSSIBLE FORMATION/ACCUMULATION OF HYDROGEN SULFIDE GAS.

INGESTION:

MAY BE TOXIC BY INGESTION. ASPIRATION (INADVERTENT SUCTION) OF LIQUID OF THE LIGHT HYDROCARBON FRACTION INTO THE LUNG CAN PRODUCE CHEMICAL PNEUMONITIS, PULMONARY EDEMA/HEMORRHAGE AND EVEN DEATH.

CARCINOGEN LISTING:

THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC) HAS DETERMINED THAT THERE IS SUFFICIENT EVIDENCE FOR THE CARCINOGENICITY OF CRUDE OIL IN HUMANS. LIFETIME SKIN PAINTING STUDIES WITH DIFFERENT WHOLE CRUDE OILS HAVE PRODUCED TUMORS IN ANIMALS FOLLOWING PROLONGED AND REPEATED SKIN CONTACT. IARC HAS DETERMINED THAT THERE IS LIMITED EVIDENCE FOR THE CARCINOGENICITY OF CRUDE OIL IN ANIMALS.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

PREEXISTING SKIN, EYE AND RESPIRATORY DISORDERS MAY BE AGGRAVATED BY EXPOSURE TO COMPONENTS OF THIS PRODUCT.

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4. FIRST AID MEASURES

EYE:

FLUSH EYES WITH LARGE AMOUNTS OF WATER FOR AT LEAST 15 MINUTES. IF SYMPTOMS OR IRRITATION OCCUR, CALL A PHYSICIAN.

SKIN:

WASH WITH SOAP AND LARGE AMOUNTS OF WATER. REMOVE CONTAMINATED CLOTHING. IF SYMPTOMS OF IRRITATION OCCUR, CALL A PHYSICIAN.

INHALATION:

IF AFFECTED, MOVE PERSON TO FRESH AIR. IF BREATHING IS DIFFICULT, ADMINISTER OXYGEN. IF NOT BREATHING OR IF NO HEARTBEAT, GIVE ARTIFICIAL RESPIRATION OR CARDIOPULMONARY RESUSCITATION (CPR). IMMEDIATELY CALL A PHYSICIAN. IF SYMPTOMS OF IRRITATION OCCUR WITH ANY EXPOSURE, CALL A PHYSICIAN.

INGESTION:

INGESTION NOT LIKELY. IF SWALLOWED, DO NOT INDUCE VOMITING AND DO NOT GIVE LIQUIDS. IMMEDIATELY CALL A PHYSICIAN.

NOTES TO PHYSICIAN:

NO DATA AVAILABLE.

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FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES:

FLASH POINT:	20-100 F
AUTOIGNITION TEMP:	NO DATA AVAILABLE
EXPLOSIVE LIMITS (% BY VOLUME IN AIR)	
LOWER:	NO DATA AVAILABLE
UPPER:	NO DATA AVAILABLE

FIRE AND EXPLOSION HAZARDS:

THIS MATERIAL HAS BEEN DETERMINED TO BE A FLAMMABLE LIQUID. VAPORS MAY TRAVEL ALONG THE GROUND OR BE MOVED BY VENTILATION AND IGNITED BY MANY SOURCES SUCH AS PILOT LIGHTS, SPARKS, ELECTRIC MOTORS, STATIC DISCHARGE, OR OTHER IGNITION SOURCES AT LOCATIONS DISTANT FROM MATERIAL HANDLING. FLASHBACK MAY OCCUR ALONG VAPOR TRAIL. FOR ADDITIONAL FIRE RELATED INFORMATION, SEE NFPA 30 OR NORTH AMERICAN EMERGENCY RESPONSE GUIDE 115.

EXTINGUISHING MEDIA:

CLASS B FIRE EXTINGUISHING MEDIA SUCH AS CO₂, DRY CHEMICAL OR WATER SPRAY CAN BE USED. FIRE FIGHTING SHOULD BE ATTEMPTED ONLY BY THOSE WHO ARE ADEQUATELY TRAINED AND EQUIPPED WITH PROPER PROTECTIVE EQUIPMENT.

SPECIAL FIRE FIGHTING INSTRUCTIONS:

AVOID USING STRAIGHT WATER STREAMS. WATER SPRAY AND FOAM (AFFF/ATC) MUST

BE APPLIED CAREFULLY TO AVOID FROTHING. AVOID EXCESSIVE APPLICATION. WATER CAN BE USED TO COOL EXPOSED SURFACES FROM AS FAR A DISTANCE AS POSSIBLE. KEEP RUN-OFF WATER OUT OF SEWERS AND WATER SOURCES.

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6. ACCIDENTAL RELEASE MEASURES

ISOLATE AND EVACUATE AREA. SHUT OFF SOURCE IF SAFE TO DO SO. ADVISE NATIONAL RESPONSE CENTER (800-424-8802) IF SUBSTANCE HAS ENTERED A WATERWAY. NOTIFY LOCAL HEALTH AND POLLUTION CONTROL AGENCIES, IF APPROPRIATE. CONTAIN LIQUID WITH SAND OR SOIL. RECOVER AND RETURN FREE LIQUID TO PROPER CONTAINERS. USE SUITABLE ABSORBENT MATERIALS SUCH AS VERMICULITE, SAND, OR CLAY TO CLEAN UP RESIDUAL LIQUIDS.

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7. HANDLING AND STORAGE

COMPLY WITH ALL APPLICABLE OSHA, NFPA AND CONSISTENT LOCAL REQUIREMENTS. USE APPROPRIATE GROUNDING AND BONDING PRACTICES. STORE IN PROPERLY CLOSED CONTAINERS THAT ARE APPROPRIATELY LABELED AND IN A COOL, WELL-VENTILATED AREA. DO NOT EXPOSE TO HEAT, OPEN FLAME, OXIDIZERS OR OTHER SOURCES OF IGNITION. DO NOT CUT, DRILL, GRIND OR WELD ON EMPTY CONTAINERS SINCE THEY MAY CONTAIN EXPLOSIVE RESIDUES.

HARMFUL CONCENTRATIONS OF HYDROGEN SULFIDE (H₂S) GAS CAN ACCUMULATE IN EXCAVATIONS AND LOW-LYING AREAS AS WELL AS THE VAPOR SPACE OF STORAGE AND BULK TRANSPORT COMPARTMENTS. STAY UPWIND AND VENT OPEN HATCHES BEFORE UNLOADING. AVOID SKIN CONTACT. EXERCISE GOOD PERSONAL HYGIENE INCLUDING REMOVAL OF SOILED CLOTHING AND PROMPT WASHING WITH SOAP AND WATER.

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8. EXPOSURE CONTROL / PERSONAL PROTECTION

ENGINEERING CONTROLS:

LOCAL OR GENERAL EXHAUST REQUIRED IN ENCLOSED AREAS OR WITH INADEQUATE VENTILATION.

PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION:

NOT NORMALLY REQUIRED FOR ROUTINE OPERATIONS. SUPPLIED AIR RESPIRATORS

SHOULD BE USED IF OPERATING CONDITIONS CREATE AIRBORNE CONCENTRATIONS WHICH EXCEED EXPOSURE LIMITS FOR ANY INDIVIDUAL COMPONENTS (INCLUDING H₂S). OBSERVE RESPIRATOR PROTECTION FACTOR CRITERIA CITED IN ANSI Z88.2. SELF-CONTAINED BREATHING APPARATUS SHOULD BE USED FOR FIRE FIGHTING.

SKIN PROTECTION:

NEOPRENE OR NITRILE GLOVES TO PREVENT SKIN CONTACT.

EYE PROTECTION:

NO SPECIAL EYE PROTECTION IS NORMALLY REQUIRED. WHERE SPLASHING IS POSSIBLE, WEAR SAFETY GLASSES WITH SIDE SHIELDS.

OTHER PROTECTIVE EQUIPMENT:

USE EXPLOSION-PROOF EQUIPMENT.

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9. PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT:	100-1000 F
MELTING POINT:	NO DATA AVAILABLE
SPECIFIC GRAVITY (H ₂ O=1):	0.8-1.0
PACKING DENSITY (KG/M ³):	NO DATA AVAILABLE
% SOLUBILITY IN WATER:	NEGLIGIBLE
VAPOR DENSITY (AIR=1):	NO DATA AVAILABLE
VAPOR PRESSURE:	0-724 MMHG
PH INFORMATION:	NO DATA AVAILABLE
% VOLATILES BY VOL:	NO DATA AVAILABLE
EVAPORATION RATE:	NO DATA AVAILABLE
APPEARANCE:	AMBER TO BLACK VISCOUS LIQUID
ODOR:	MILD OR ROTTEN EGG ODOR
ODOR THRESHOLD (PPM):	NO DATA AVAILABLE

ADDITIONAL PROPERTIES:

DENSITY: 6.6-8.2 LBS/GALLON

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10. STABILITY AND REACTIVITY

STABILITY:

THE MATERIAL IS STABLE AT 70 F, 760MM PRESSURE.

CONDITIONS TO AVOID:

EXCESSIVE HEAT, SOURCES OF IGNITION.

HAZARDOUS DECOMPOSITION PRODUCTS:

CARBON MONOXIDE, HYDROGEN SULFIDE, ALDEHYDES, AROMATIC, OTHER HYDROCARBONS.

INCOMPATIBLE MATERIALS:

STRONG OXIDIZING AGENTS SUCH AS CHLORATES, NITRATES, PEROXIDES.

HAZARDOUS POLYMERIZATION:

WILL NOT OCCUR.

CONDITIONS TO AVOID:

NO DATA AVAILABLE.

ADDITIONAL COMMENTS:

NO DATA AVAILABLE.

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11. TOXICOLOGICAL INFORMATION

LIFETIME SKIN PAINTING STUDIES IN ANIMALS WITH CRUDE OIL FRACTIONS HAVE PRODUCED WEAK TO MODERATE CARCINOGENIC ACTIVITY FOLLOWING PROLONGED AND REPEATED EXPOSURE. WASHING THE ANIMALS' SKIN WITH SOAP AND WATER BETWEEN APPLICATIONS GREATLY REDUCES TUMOR FORMATION.

REPEATED DERMAL APPLICATION OF TWO DIFFERENT CRUDE OILS IN RATS PRODUCED SYSTEMIC TOXICITY IN BLOOD, LIVER, THYMUS AND BONE MARROW. REPEATED DERMAL APPLICATION TO PREGNANT RATS PRODUCED MATERNAL TOXICITY AND FETAL DEVELOPMENTAL TOXICITY.

HYDROGEN SULFIDE CONCENTRATIONS WILL VARY SIGNIFICANTLY DEPENDING ON THE SOURCE AND SULFUR CONTENT OF THE CRUDE. SWEET CRUDES (<0.5% SULFUR) MAY CONTAIN TOXICOLOGICALLY SIGNIFICANT LEVELS OF HYDROGEN SULFIDE IN THE VAPOR SPACES OF BULK STORAGE TANKS AND TRANSPORT COMPARTMENTS. CONCENTRATIONS OF H₂S AS LOW AS 10 PPM OVER AN 8 HOUR WORKSHIFT MAY CAUSE EYE OR THROAT IRRITATION. PROLONGED BREATHING OF 50-100 PPM H₂S VAPORS CAN PRODUCE SIGNIFICANT EYE AND RESPIRATORY IRRITATION. SOUR CRUDES COMMONLY CONTAIN

EXTREMELY HIGH CONCENTRATIONS OF H₂S (500-70,000 PPM) IN THE VAPOR SPACES OF BULK STORAGE VESSELS. EXPOSURE TO 250-600 PPM FOR 15-30 MINUTES CAN PRODUCE HEADACHE, DIZZINESS, NERVOUSNESS, STAGGERING GAIT, NAUSEA AND PULMONARY EDEMA OR BRONCHIAL PNEUMONIA. CONCENTRATIONS >1,000 PPM WILL CAUSE IMMEDIATE UNCONSCIOUSNESS AND DEATH THROUGH RESPIRATORY PARALYSIS.

SUMMARY OF HEALTH EFFECT DATA ON CRUDE OIL COMPONENTS:

THIS PRODUCT MAY CONTAIN BENZENE AT A LEVEL OF >0.1%. REPEATED OR PROLONGED EXPOSURE TO BENZENE AT CONCENTRATIONS IN EXCESS OF THE TLV MAY CAUSE SERIOUS INJURY TO BLOOD-FORMING ORGANS. SIGNIFICANT CHRONIC EXPOSURE TO BENZENE VAPOR HAS BEEN REPORTED TO PRODUCE VARIOUS BLOOD DISORDERS, RANGING FROM ANEMIA TO CANCER (DIFFERENT FORMS OF LEUKEMIA) IN MAN. BENZENE PRODUCED TUMORS IN RATS AND MICE IN LIFETIME CHRONIC TOXICITY STUDIES, BUT THE RESPONSE HAS NOT BEEN CONSISTENT ACROSS SPECIES, STRAIN, SEX OR ROUTE OF EXPOSURE. ANIMAL STUDIES ON BENZENE HAVE DEMONSTRATED IMMUNE TOXICITY, CHROMOSOMAL ABERRATIONS, TESTICULAR EFFECTS AND ALTERATIONS IN REPRODUCTIVE CYCLES AND EMBRYO/FETOTOXICITY, BUT NOT TERATOGENICITY.

THIS PRODUCT MAY CONTAIN HEXANE AT A LEVEL OF >1.0%. STUDIES IN LABORATORY ANIMALS HAVE PRODUCED SYSTEMIC TOXICITY IN BLOOD, SPLEEN AND LUNGS. FETOTOXICITY HAS BEEN OBSERVED AT HEXANE CONCENTRATIONS THAT PRODUCED MATERNAL TOXICITY. LONG TERM EXPOSURE TO HIGH CONCENTRATIONS OF HEXANE HAS BEEN SHOWN TO CAUSE TESTICULAR EFFECTS AND NERVOUS SYSTEM DAMAGE.

THIS PRODUCT MAY CONTAIN TOLUENE AT A LEVEL OF >1.0%. DELIBERATE INHALATION OF HIGH CONCENTRATIONS OF TOLUENE HAS BEEN SHOWN TO CAUSE LIVER, KIDNEY AND BRAIN DAMAGE AND CENTRAL NERVOUS SYSTEM EFFECTS. EXCESSIVE TOLUENE EXPOSURE MAY CAUSE CARDIAC SENSITIZATION AND POSSIBLE HEARING LOSS. EXPOSURE TO PREGNANT RATS AND MICE DURING GESTATION TO TOLUENE PRODUCED SOME MATERNAL AND DEVELOPMENTAL TOXICITY. DECREASED LEARNING CAPABILITY AND DEFICITS IN OPERANT BEHAVIOR HAVE BEEN OBSERVED IN ANIMALS EXPOSED TO TOLUENE ABOVE THE TLV.

THIS PRODUCT MAY CONTAIN XYLENE AT A LEVEL OF >1.0%. GROSS OVEREXPOSURE IN HUMANS TO XYLENES HAS BEEN REPORTED TO CAUSE LUNG, LIVER, KIDNEY, HEART AND BRAIN DAMAGE AS WELL AS NEUROLOGIC DISTURBANCES. EXCESSIVE XYLENE EXPOSURE MAY CAUSE CARDIAC SENSITIZATION. LABORATORY ANIMALS EXPOSED TO HIGH DOSES OF XYLENE SHOWED EVIDENCE OF HEARING LOSS AND EFFECTS IN LIVER, KIDNEYS, LUNGS, SPLEEN, HEART AND ADRENALS. EXPOSURE TO PREGNANT ANIMALS DURING GESTATION TO SIGNIFICANT CONCENTRATIONS OF XYLENE PRODUCED MATERNAL, FETAL AND DEVELOPMENTAL TOXICITY. REPEATED INHALATION OF HIGH XYLENE CONCENTRATIONS HAVE SHOWN BEHAVIORAL CHANGES IN ANIMALS AND MAN.

COMPONENTS OF CRUDE OIL DO NOT PRESENT A SIGNIFICANT HEALTH RISK IN THE CONCENTRATIONS PRESENT IN CRUDE OIL AT EXPOSURES NOT EXCEEDING THE EXPOSURE LIMITS STATED IN SECTION 2.

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12. ECOLOGICAL INFORMATION

COATING ACTION OF OIL CAN DESTROY BIRDS, PLANKTON, ALGAE AND FISHES. KEEP OUT OF ALL BODIES OF WATER AND SEWAGE DRAINAGE SYSTEMS.

13. DISPOSAL CONSIDERATIONS

THIS PRODUCT AS SUPPLIED IS NOT SPECIFICALLY LISTED AS AN EPA RCRA HAZARDOUS WASTE ACCORDING TO FEDERAL REGULATIONS (40 CFR 261-271). HOWEVER, WHEN DISCARDED OR DISPOSED OF, IT MAY MEET THE CRITERIA OF AN "IGNITABLE" HAZARDOUS WASTE. THIS PRODUCT COULD ALSO CONTAIN BENZENE AT >0.5 PPM AND COULD EXHIBIT THE CHARACTERISTICS OF "TOXICITY" AS DETERMINED BY THE TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP). THIS MATERIAL COULD ALSO BECOME A HAZARDOUS WASTE IF MIXED OR CONTAMINATED WITH A LISTED HAZARDOUS WASTE. IT IS THE RESPONSIBILITY OF THE USER TO DETERMINE IF DISPOSAL MATERIAL IS HAZARDOUS ACCORDING TO FEDERAL, STATE AND LOCAL REGULATIONS.

14. TRANSPORTATION INFORMATION

49 CFR 172.101:

PROPER SHIPPING NAME:	PETROLEUM CRUDE OIL
DOT CLASSIFICATION:	3
DOT IDENTIFICATION NUMBER:	UN 1267
PACKING GROUP:	PG II

15. REGULATORY INFORMATION

THE FOLLOWING REGULATIONS APPLY TO THIS PRODUCT:

OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200):

THIS PRODUCT HAS BEEN EVALUATED AND DETERMINED TO BE HAZARDOUS AS DEFINED IN OSHA'S HAZARD COMMUNICATION STANDARD.

EPA TOXIC SUBSTANCES CONTROL ACT (40 CFR PART 710):

THIS PRODUCT AND/OR ITS COMPONENTS ARE LISTED ON THE TSCA CHEMICAL INVENTORY.

EPA SARA TITLE III SUPERFUND AMENDMENTS & REAUTHORIZATION ACT - EMERGENCY PLANNING & COMMUNITY RIGHT-TO-KNOW ACT OF 1986.

EXTREMELY HAZARDOUS SUBSTANCES (40 CFR PART 355):

THIS PRODUCT CONTAINS THE FOLLOWING COMPONENT(S) IDENTIFIED ON APPENDIX A AND B OF THE EXTREMELY HAZARDOUS SUBSTANCE LIST (AT A LEVEL OF 1% OR GREATER IF HAZARDOUS; 0.1% OR GREATER IF CARCINOGENIC):

---COMPONENT---	REPORTABLE ---QUANTITY (LBS)---	THRESHOLD PLANNING ---QUANTITY (LBS)---
HYDROGEN SULFIDE	100	500

EMERGENCY RELEASE NOTIFICATIONS (40 CFR PART 355):

THIS PRODUCT CONTAINS THE FOLLOWING COMPONENT(S) IDENTIFIED EITHER AS AN EXTREMELY HAZARDOUS SUBSTANCE (40 CFR 355) OR A CERCLA HAZARDOUS SUBSTANCE (40 CFR 302) WHICH IN CASE OF A SPILL OR RELEASE MAY BE SUBJECT TO EMERGENCY RELEASE REPORTING REQUIREMENTS:

HYDROGEN SULFIDE (REPORTING QUANTITY = 100 LBS)

MATERIAL SAFETY DATA SHEET REQUIREMENTS (40 CFR PART 370):

THE FOLLOWING EPA HAZARD CATEGORIES APPLY TO THIS PRODUCT:

IMMEDIATE (ACUTE) HEALTH HAZARD
 DELAYED (CHRONIC) HEALTH HAZARD
 FIRE HAZARD

MSDS'S OR A LIST OF MSDS'S AND THEIR HAZARDS (SEE EPA HAZARD CATEGORIES ABOVE) MAY BE REQUIRED TO BE SUBMITTED TO THE STATE EMERGENCY RESPONSE COMMISSION (SERC), LOCAL EMERGENCY PLANNING COMMITTEE (LEPC) AND LOCAL FIRE DEPARTMENT (LFD).

IN ADDITION, A TIER II OR TIER I FORM MAY BE REQUIRED TO BE SUBMITTED ANNUALLY TO THE SERC, LEPC AND LFD IF APPLICABLE THRESHOLD REPORTING QUANTITIES ARE EXCEEDED. CURRENT FEDERAL THRESHOLDS ARE:

10,000 POUNDS OR MORE OF AN OSHA HAZARDOUS SUBSTANCE
 OR
 500 POUNDS OR THE THRESHOLD PLANNING QUANTITY, WHICHEVER IS LESS, OF AN EXTREMELY HAZARDOUS SUBSTANCE.

NOTE: THRESHOLDS MAY VARY ACCORDING TO LOCAL AND STATE REGULATIONS.

TOXIC CHEMICAL RELEASE REPORTING (40 CFR PART 372):

THIS PRODUCT CONTAINS THE FOLLOWING COMPONENT(S) (AT A LEVEL OF 1% OR GREATER IF HAZARDOUS; 0.1% OR GREATER IF CARCINOGENIC) THAT MAY BE SUBJECT TO REPORTING ON THE TOXIC RELEASE INVENTORY (TRI) FORM R:

---COMPONENT---	---CAS NUMBER---
BENZENE	71-43-2
TOLUENE	108-88-3
XYLENE	1330-20-7
HEXANE	110-54-3

STATE AND COMMUNITY RIGHT-TO-KNOW REGULATIONS:

THIS MATERIAL MAY BE REGULATED BY LOUISIANA'S RIGHT-TO-KNOW LAW (REGULATORY STATUTE 30:2361).

16. OTHER INFORMATION

NFPA CLASSIFICATION

HEALTH: 1
FIRE: 3
REACTIVITY: 0
OTHER: -

HMIS CLASSIFICATION

HEALTH: 1
FIRE: 3
REACTIVITY: 0
PERSONAL PROTECTION: *

HAZARD RATING

0 - LEAST
1 - SLIGHT
2 - MODERATE
3 - HIGH
4 - EXTREME

COMMENTS:

- * SEE SECTION 8 FOR GUIDANCE IN SELECTION OF PERSONAL PROTECTIVE EQUIPMENT.

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Updated: Friday, June 29, 2001

MATERIAL SAFETY DATA SHEET

SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MATHESON TRI-GAS, INC.
959 ROUTE 46 EAST
PARSIPPANY, NEW JERSEY 07054-0624

EMERGENCY CONTACT:
CHEMTREC 1-800-424-9300
INFORMATION CONTACT:
973-257-1100

SUBSTANCE: TOLUENE

TRADE NAMES/SYNONYMS:

MTG MSDS 134; METHYLBENZENE; TOLUOL; METHYLBENZOL; PHENYLMETHANE;
METHACIDE; RCRA U220; UN 1294; C7H8; MAT23590; RTECS XS5250000

CHEMICAL FAMILY: hydrocarbons, aromatic

CREATION DATE: Jan 24 1989
REVISION DATE: Mar 19 2003

SECTION 2 COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: TOLUENE
CAS NUMBER: 108-88-3
PERCENTAGE: 100.0

SECTION 3 HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0



EMERGENCY OVERVIEW:

COLOR: colorless

PHYSICAL FORM: liquid

ODOR: distinct odor

MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, eye irritation, aspiration hazard, central nervous system depression, nerve damage

PHYSICAL HAZARDS: Flammable liquid and vapor. Vapor may cause flash fire.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: irritation, metallic taste, nausea, headache, drowsiness, symptoms of drunkenness, tingling sensation, dilated pupils, kidney damage, liver damage, nerve damage

LONG TERM EXPOSURE: ringing in the ears, stomach pain, chest pain, irregular heartbeat, fainting, menstrual disorders, blood disorders, liver enlargement, paralysis, reproductive effects, brain damage, coma

SKIN CONTACT:**SHORT TERM EXPOSURE:** irritation**LONG TERM EXPOSURE:** same as effects reported in short term exposure**EYE CONTACT:****SHORT TERM EXPOSURE:** irritation (possibly severe), tearing**LONG TERM EXPOSURE:** same as effects reported in short term exposure**INGESTION:****SHORT TERM EXPOSURE:** same as effects reported in short term inhalation, aspiration hazard**LONG TERM EXPOSURE:** reproductive effects

SECTION 4 FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: Aspiration hazard. DO NOT induce vomiting. If vomiting occurs, keep head lower than hips to help prevent aspiration. Get immediate medical attention. Give artificial respiration if not breathing.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive. Electrostatic discharges may be generated by flow or agitation resulting in ignition or explosion.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Water may be ineffective.

FLASH POINT: 39 F (4 C) (CC)

LOWER FLAMMABLE LIMIT: 1.2%

UPPER FLAMMABLE LIMIT: 7.1%

AUTOIGNITION: 896 F (480 C)
FLAMMABILITY CLASS (OSHA): IB

SECTION 6 ACCIDENTAL RELEASE MEASURES

AIR RELEASE:

Reduce vapors with water spray. Stay upwind and keep out of low areas.

SOIL RELEASE:

Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal. Absorb with sand or other non-combustible material. Collect with absorbent into suitable container.

WATER RELEASE:

Absorb with activated carbon. Collect spilled material using mechanical equipment. Cover with absorbent sheets, spill-control pads or pillows. Apply detergents, soaps, alcohols or another surface active agent. Remove trapped material with suction hoses. Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Keep out of water supplies and sewers.

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

SECTION 7 HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Protect from physical damage. Store outside or in a detached building. Store with flammable liquids. Keep separated from incompatible substances. Grounding and bonding required. Store in a tightly closed container. Store in a cool, dry place.

SECTION 8 EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

TOLUENE:

200 ppm OSHA TWA

300 ppm OSHA ceiling

500 ppm OSHA peak 10 minute(s)

100 ppm (377 mg/m³) OSHA TWA (vacated by 58 FR 35338, June 30, 1993)

150 ppm (565 mg/m³) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)

50 ppm ACGIH TWA (skin)

100 ppm (375 mg/m³) NIOSH recommended TWA 10 hour(s)

150 ppm (560 mg/m³) NIOSH recommended STEL

VENTILATION: Provide local exhaust ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.

500 ppm

Any chemical cartridge respirator with organic vapor cartridge(s).

Any powered, air-purifying respirator with organic vapor cartridge(s).

Any air-purifying respirator with a full facepiece and an organic vapor canister.

Any supplied-air respirator.

Any self-contained breathing apparatus with a full facepiece.

Escape -

Any air-purifying respirator with a full facepiece and an organic vapor canister.

Any appropriate escape-type, self-contained breathing apparatus.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid

APPEARANCE: clear

COLOR: colorless

ODOR: distinct odor

MOLECULAR WEIGHT: 92.14

MOLECULAR FORMULA: C₆H₅C-H₃

BOILING POINT: 232 F (111 C)

FREEZING POINT: -139 F (-95 C)

VAPOR PRESSURE: 22 mmHg @ 20 C

VAPOR DENSITY (air=1): 3.14

SPECIFIC GRAVITY (water=1): 0.8669

WATER SOLUBILITY: 0.05% @ 20 C

PH: Not available

VOLATILITY: 100%

ODOR THRESHOLD: 10-15 ppm

EVAPORATION RATE: 2.24 (butyl acetate=1)

VISCOSITY: 0.560 mPa.s @ 25 C

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

SOLVENT SOLUBILITY:

Soluble: alcohol, ether, benzene, acetone, ligroin, chloroform, acetic acid, carbon disulfide

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.

INCOMPATIBILITIES: halogens, combustible materials, acids, oxidizing materials, metal salts

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: oxides of carbon, hydrocarbons

POLYMERIZATION: Will not polymerize.

SECTION 11 TOXICOLOGICAL INFORMATION

TOLUENE:**IRRITATION DATA:**

300 ppm eyes-human; 435 mg skin-rabbit mild; 500 mg skin-rabbit moderate; 20 mg/24 hour(s) skin-rabbit moderate; 870 ug eyes-rabbit mild; 2 mg/24 hour(s) eyes-rabbit severe; 100 mg/30 second(s) rinsed eyes-rabbit mild; 250 ul/24 hour(s) skin-pig mild

TOXICITY DATA:

49 gm/m³/4 hour(s) inhalation-rat LC50; 14100 ul/kg skin-rabbit LD50; 636 mg/kg oral-rat LD50

CARCINOGEN STATUS: IARC: Human Inadequate Evidence, Animal Evidence Suggesting Lack of Carcinogenicity, Group 3; ACGIH: A4 -Not Classifiable as a Human Carcinogen

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Moderately Toxic: ingestion

Slightly Toxic: inhalation, dermal absorption

TARGET ORGANS: nervous system

MUTAGENIC DATA: Available.

REPRODUCTIVE EFFECTS DATA: Available.

ADDITIONAL DATA: Alcohol may enhance the toxic effects. Stimulants such as epinephrine may induce ventricular fibrillation.

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY DATA:

FISH TOXICITY: 8110 ug/L 96 hour(s) LC50 (Mortality) Coho salmon, silver salmon (*Oncorhynchus kisutch*)

INVERTEBRATE TOXICITY: 6000 ug/L 48 hour(s) EC50 (Immobilization) Water flea (*Daphnia magna*)

ALGAL TOXICITY: 9400 ug/L 8 hour(s) EC50 (Growth) Green algae (*Selenastrum capricornutum*)

FATE AND TRANSPORT:

BIOCONCENTRATION: 1716 ug/L 6 hour(s) BCF (Residue) Water flea (*Daphnia magna*) 1.5 ug/L

SECTION 13 DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): U220.

SECTION 14 TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:

PROPER SHIPPING NAME: Toluene

ID NUMBER: UN1294

HAZARD CLASS OR DIVISION: 3

PACKING GROUP: II

LABELING REQUIREMENTS: 3



CANADIAN TRANSPORTATION OF DANGEROUS GOODS:

SHIPPING NAME: Toluene

UN NUMBER: UN1294

CLASS: 3

PACKING GROUP/RISK GROUP: II

SECTION 15 REGULATORY INFORMATION

U.S. REGULATIONS:

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):

TOLUENE: 1000 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):

ACUTE: Yes

CHRONIC: Yes

FIRE: Yes

REACTIVE: No

SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):

TOLUENE

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:

California Proposition 65:

Known to the state of California to cause the following:

TOLUENE

Developmental toxicity (Jan 01, 1991)

CANADIAN REGULATIONS:

WHMIS CLASSIFICATION: BD2

NATIONAL INVENTORY STATUS:

U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

CANADA INVENTORY (DSL/NDL): Not determined.

SECTION 16 OTHER INFORMATION

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Material Safety Data Sheet

LA1669
Xylene

Revision Date: 02/24/2001 Date of Printing: 04/26/2002

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Id: LA1669
Product Name: Xylene
Synonyms: Xylol Dimethylbenzene.
Chemical Family: Hydrocarbon
Application: Chemical intermediate.

Distributed By: Vopak Canada Ltd. Vopak USA.
Van Horne Way 6100 Carillon Point
Richmond, BC Kirkland, WA 98003
V6X 1W5 USA.

Prepared By: The Safety, Health and Environment Department of Vopak Canada Ltd.

Emergency Telephone Number (CHEMTREC): (800) 424-9300

Telephone number for non-emergency questions concerning MSDS(Canada): (604) 303-2565
Vopak USA, Inc. Corporate Office Number: (425) 889-3400

2. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous Components:

Ingredients	Percent	LD50s and LC50s Route & Species:
Xylene, Mixture Of Isomers 1330-20-7	60-100	Inhalation LC50 Rat : 5000 ppm/4H Oral LD50 Rat : 4300 mg/kg Dermal LD50 Rabbit : >1700 mg/kg
Ethyl Benzene 100-41-4	10-30	Oral LD50 Rat : 3500 mg/kg Dermal LD50 Rabbit : 17800 uL/kg

Notes: No additional remark.

3. HAZARDS IDENTIFICATION

Potential Acute Health Effects:

Eye Contact:
Skin Contact:

Vapours are moderately irritating to the eyes.
Causes moderate skin irritation.

Inhalation:

Vapours are moderately irritating to the respiratory passages. The liquid when accidentally aspirated into the lungs can cause severe inflammation of the lung. In rare cases may sensitize heart muscle causing heart arrhythmia. Solvent abusers exposed to high doses of aromatic solvents (e.g. toluene/xylene) show signs of hearing loss as well as damage to the brain, liver and kidney. Excessive exposure during pregnancy may be hazardous to the developing fetus.

Ingestion:

Harmful if swallowed.

4. FIRST AID MEASURES

Eye Contact:

Flush eyes with water for at least 15 minutes while holding eyelids open. Seek immediate medical attention.

Skin Contact:

Flush affected skin with gently flowing water for at least 20 minutes and remove contaminated clothing while rinsing. Wash contaminated skin with mild soap and water for 15 minutes. Obtain medical attention immediately.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Guard against aspiration into lungs by having the individual turn on to their left side. Get immediate medical attention. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs.

Notes To Physician:

The main hazard following accidental ingestion is aspiration of the liquid into the lungs producing chemical pneumonitis. If more than 2.0 mL/kg has been ingested, vomiting should be induced with supervision. If symptoms such as loss of gag reflex, convulsions or unconsciousness occur before vomiting, gastric lavage with a cuffed endotracheal tube should be considered.

5. FIRE FIGHTING MEASURES

Flash Point (C):

>24 (F): >75

Flash Point Method:

Tag Closed Cup

Autoignition Temperature (C):

527 (F): 980

Flammable Limits in Air - Lower (%):

1.1

Flammable Limits in Air - Upper (%):

7

Extinguishing Media:**Special Exposure Hazards:**

Dry chemical. Carbon dioxide Foam Water mist
Vapour forms a flammable / explosive mixture with air between upper and lower flammable limits. Vapours may travel along ground and flashback along vapour trail may occur. Do not use water except as a fog. Product will float and can be reignited on surface of water. Containers exposed to intense heat from fires should be cooled with water to prevent vapour pressure build-up which could result in container rupture. Container areas exposed to direct flame contact should be cooled with large quantities of water as needed to prevent weakening of container structure. Always stay away from ends of containers due to explosive potential. Fight fire from maximum distance. Do not enter confined fire space without adequate protective clothing and an approved positive pressure self-contained breathing apparatus.

Special Protective Equipment:

Fire fighters should wear full protective clothing, including self-contained breathing equipment.

NFPA RATINGS FOR THIS PRODUCT ARE: HEALTH 2, FLAMMABILITY 3, REACTIVITY 0

HMIS RATINGS FOR THIS PRODUCT ARE: HEALTH 2, FLAMMABILITY 3, REACTIVITY 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures: Restrict access to unprotected personnel. Wear appropriate protective equipment.

Environmental Precautionary Procedure for Cleaning/Absorption: Prevent from entering sewers, waterways or low areas. Consult local authorities. Eliminate all ignition sources. Isolate spill and stop leak where safe. Try to work upwind of spill. Avoid direct contact with material. Saturated clothing should be immediately removed to avoid flammability hazard. Wear appropriate breathing apparatus (if applicable) and protective clothing. Dike and contain land spills; contain water spills by booming. Use water fog to knock down vapours; contain runoff. For large spills, remove by mechanical means and place in containers. For small spills, collect with non-combustible sorbent. Flush area with water to remove trace residue.

7. HANDLING AND STORAGE

Handling: Flammable. Do not cut, drill, grind, weld or perform similar operations on or near containers. Vapours may accumulate and travel to distant ignition sources and flashback. Empty containers may contain hazardous product residues. Fixed equipment as well as transfer containers and equipment should be grounded to prevent accumulation of static charge. Hot surfaces may be sufficient to ignite liquid even in the absence of sparks or flames. Extinguish pilot lights, cigarettes and turn off other sources of ignition prior to use and until all vapours are gone. Do not pressurize drum containers to empty them. Avoid breathing vapours and prolonged or repeated contact with skin. Launder contaminated clothing prior to reuse. Use good personal hygiene. Air-dry contaminated clothing in a well ventilated area before laundering.

Storage: Store in a cool, dry, well ventilated area, away from heat and ignition sources. Use explosion-proof ventilation to prevent vapour accumulation.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls: For personnel entry into confined spaces (i.e. bulk storage tanks) a proper confined space entry procedure must be followed including ventilation and testing of tank atmosphere. Local ventilation recommended where mechanical ventilation is ineffective in controlling airborne concentrations below the recommended occupational exposure limit. Concentrations in air should be maintained below lower explosive limit at all times or below the recommended threshold limit value if unprotected personnel are involved. Make up air should always be supplied to balance air exhausted (either generally or locally). Electrical and mechanical equipment should be explosion-proof. Mechanical ventilation is recommended for all indoor situations to control fugitive emissions.

Respiratory Protection: If exposure exceeds occupational exposure limits, use an appropriate NIOSH-approved respirator. Use a NIOSH-approved chemical cartridge respirator with organic vapour cartridges or use a NIOSH-approved supplied-air respirator. For high airborne concentrations, use a NIOSH -approved supplied-air respirator, either self-contained or airline breathing apparatus, operated in positive pressure mode.

Gloves: Impervious gloves. Polyvinyl gloves. Viton gloves.

Skin Protection: Impervious gloves (viton, polyvinyl alcohol) should be worn at all times when handling this product. In confined spaces or where the risk of skin exposure is much higher, impervious clothing should be worn.

Eyes: Chemical safety goggles and or full face shield to protect eyes and face, if product is handled such that it could be splashed into eyes.

Other Personal Protection Data: Ensure that eyewash stations and safety showers are proximal to the work-station location.

Hazardous Components:

Ingredients	Percent	ACGIH 2000 - Time Weighted Averages	OSHA - Vacated PELs - Time Weighted Averages
Xylene, Mixture Of Isomers 1330-20-7	60-100	100 ppm TWA	100 ppm TWA; 435 mg/m ³ TWA
Ethyl Benzene 100-41-4	10-30	100 ppm TWA	100 ppm TWA; 435 mg/m ³ TWA

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Colourless
Odor:	Sweet Aromatic Odour
pH:	Not Available.
Specific Gravity:	0.871
Boiling Point (C):	137 - 143 (F): 278 - 289
Freezing Point (C):	>-48 (F): >-54
Vapor Pressure:	>5 mm Hg
Vapor Density:	3.7
% Volatile by Volume:	Not Available.
Evaporation Rate:	0.72
Solubility:	Negligible water solubility. Soluble in organic solvents.
VOCs (lbs/gallon):	Not Available.
Viscosity:	Not Available.
Molecular Weight:	106.2

10. STABILITY AND REACTIVITY

Chemical Stability:	Stable
Hazardous Polymerization:	Will not occur
Conditions to Avoid:	Avoid excessive heat, open flames and all ignition sources.
Materials to Avoid:	Strong oxidizing agents.
Hazardous Decomposition Products:	Carbon monoxide. Carbon dioxide.
Additional Information:	Xylene will attack some forms of plastics, rubber and coatings.

11. TOXICOLOGICAL INFORMATION

Principle Routes of Exposure	
Ingestion:	Harmful if swallowed.
Skin Contact:	Causes moderate skin irritation.
Inhalation:	Vapours are moderately irritating to the respiratory passages. The liquid when accidentally aspirated into the lungs can cause severe inflammation of the lung. In rare cases may sensitize heart muscle causing heart arrhythmia. Solvent abusers exposed to high doses of aromatic solvents (e.g. toluene/xylene) show signs of hearing loss as well as damage to the brain, liver and kidney. Excessive exposure during pregnancy may be hazardous to the developing fetus.
Eye Contact:	Vapours are moderately irritating to the eyes.
Aggravated Conditions:	Pre-existing eye, skin and respiratory disorders may be aggravated by exposure to this product.
Carcinogenicity Comment:	No additional information available.
Other:	Prolonged exposures to high vapour concentration can cause headache, dizziness, nausea, blurred vision and central nervous system depression. Prolonged and repeated contact with the skin can cause defatting and drying of the skin resulting in skin irritation

and dermatitis.

Acute Test:

Acute Oral LD50:

Acute Dermal LD50:

Acute Inhalation LC50:

Primary Irritation Effect:

Carcinogenicity:

Not Available.

Not Available.

Not Available.

Causes skin and eye irritation. Respiratory disorders.

This product contains ethylbenzene. Ethylbenzene has been shown to cause cancer in laboratory animals. Toxicity tests carried out for chronic effects and mutagenicity have been negative.

Xylene, Mixture Of Isomers 60-100 1330-20-7
IARC - Group 3 (not classifiable)

Listed

Ethyl Benzene 10-30 100-41-4
IARC - Group 2B (Possibly carcinogenic)

Listed

Hazardous Components:

Ingredients	Percent	ACGIH 2000 - Carcinogens
Xylene, Mixture Of Isomers 1330-20-7	60-100	A4 - Not Classifiable as a Human Carcinogen
Ethyl Benzene 100-41-4	10-30	Not listed.

Genotoxicity:

Reproductive/Developmental

Toxicity:

Teratogenicity:

Embryotoxicity:

Not Available.

Not Available.

Not Available.

High exposures to xylene in some animal studies, often at levels toxic to the mother, affected embryo/fetal development. The significance of this finding to humans is not known.

Toxicity tests carried out for chronic effects and mutagenicity have been negative.

Mutagenicity:

12. ECOLOGICAL INFORMATION

Mobility:

Persistence:

Bioaccumulative:

Ecotoxicological Information:

Ecotoxicity - Fish Species Data

Acute Crustaceans Toxicity:

Ecotoxicity - Freshwater Algae Data

Chemical Fate Information:

Other Information:

Not Available.

Not Available.

Not Available.

Not Available.

Not Available.

Not Available.

Not Available.

Do not allow product or runoff from fire control to enter storm or sanitary sewers, lakes, rivers, streams or public waterways. Block off drains and ditches. Spill areas must be cleaned and restored to original condition or to the satisfaction of authorities. May be harmful to aquatic life.