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REPORTS

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**Work Plan for Site Investigation of
Thomas #1 Well Site
San Juan County, New Mexico**

July 23, 1991

Prepared for:

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Prepared by:

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Table of Contents

1.0 Purpose	1
2.0 Health And Safety Plan Preparation	2
3.0 Scope of Work - Field Activities	3
3.1 Soil-Vapor Survey	3
3.2 Monitor Well Installation, Development, and Sampling	3
4.0 Reporting	6

List of Figures

Figure

1	Soil-Vapor Grid Thomas #1 Well Site	4
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List of Appendices

Appendix

- A Health And Safety Plan
- B Soil-Vapor Survey Standard Operating Procedure
- C Sampling Standard Operating Procedure

Mobil Exploration and Producing Work Plan for Site Investigation of Thomas #1 Well Site

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1.0 Purpose

Mobil's Thomas # 1 well site in San Juan County, New Mexico may exhibit on-site hydrocarbon contamination. The New Mexico Oil Conservation Division (NMOCD) requested that Mobil undertake a soil-vapor survey and monitor well installation program to determine the severity and extent of any contamination. Geoscience Consultants, Ltd. has been retained by Mobil Exploration and Producing to conduct the investigation proposed herein. The remainder of this document will describe the technical approach for the proposed work.

**Mobil Exploration and Producing
Work Plan for Site Investigation of
Thomas #1 Well Site**

Hygienetics, Inc./Geoscience Consultants, Ltd.

2.0 Health And Safety Plan Preparation

All intrusive operations will be conducted in strict accordance with the site-specific Health and Safety Plan prepared by GCL (appendix A). All on-site personnel actively engaged in site work must read, sign, and agree to adhere to this document. The Health and Safety Plan will remain on site and will be enforced at all times while work is being performed. The anticipated primary level of protection will be Level D.

Mobil Exploration and Producing Work Plan for Site Investigation of Thomas #1 Well Site

Hygienetics, Inc./Geoscience Consultants, Ltd.

3.0 Scope of Work - Field Activities

3.1 Soil-Vapor Survey

The field phase of the project will begin with a soil-vapor survey. We assume that the depth to ground water at the site is greater than 5 feet. GCL's analytical equipment (a Photovac 10S70 portable gas chromatograph) is capable of detecting and quantifying the amounts of benzene, toluene, ethylbenzene, and xylenes (BTEX) present in shallow ground water as well as in soil vapor.

The soil-vapor survey will be performed in a manner similar to that described in the attached Standard Operating Procedure (appendix B). Soil-vapor samples will be collected at locations on a 100-ft grid to define the gross extent of volatile hydrocarbon contamination, if such exists (figure 1). After collecting soil-vapor samples at each location on the 100-foot grid, we will reduce the grid spacing to more clearly define the edge of any soil-vapor plume. A grid spacing of 25 to 50 feet is anticipated at the boundary of any observed plume. It is expected that completion of this phase of the project will require no more than 30 soil-vapor analyses. The survey is scheduled to begin the second week in August 1991.

3.2 Monitor Well Installation, Development, and Sampling

After the results of the soil-vapor survey are evaluated in the field, monitor well locations will be selected. Due to numerous cobbles and boulders observed in the existing on-site monitoring pits and the shallow water table, five drive-point monitor wells will be installed with a hand-held auger and pneumatic hammer. If required, a hollow-stem auger rig will be utilized.

The first well to be installed will be the upgradient well. This well will be located 100 feet north and east of the site boundary. The second well will be located at the downgradient edge of any soil-vapor plume. A water sample will be collected from the second well immediately after installation and analyzed in the field with the portable gas chromatograph. If field analyses suggest that the ground water will meet Water Quality Control Commission (WQCC) standards, two additional downgradient wells will be installed. If the field analysis

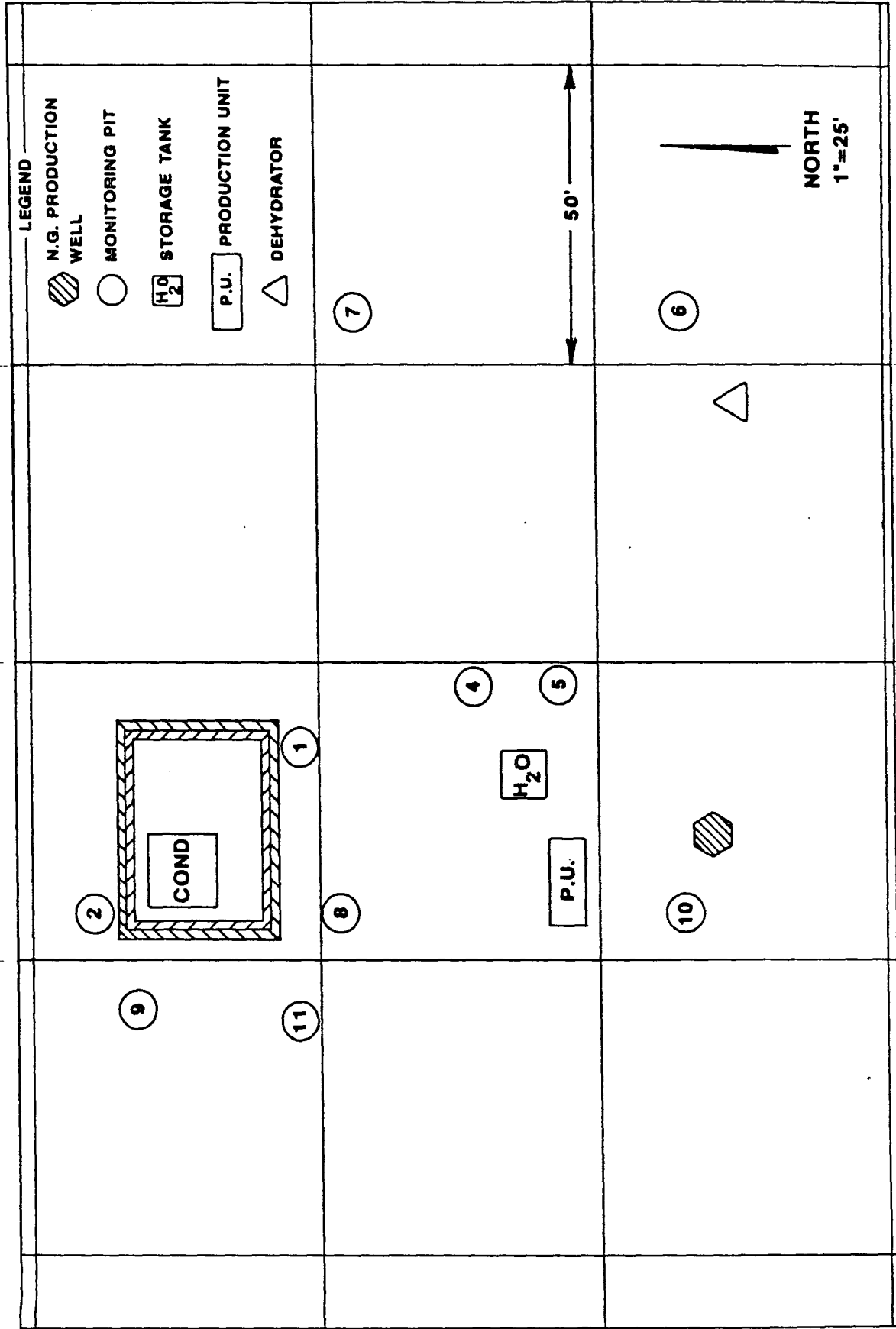


Figure 1
Soil-Vapor Grid Thomas #1 Well Site

Mobil Exploration and Producing Work Plan for Site Investigation of Thomas #1 Well Site

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suggests that the ground water will not meet WQCC standards, two additional wells will be relocated further downgradient, in a location where we anticipate that the WQCC standards are met.

A fifth and final well will be placed in the area of maximum concentration of any identified soil-vapor plume. The purpose of this well is to determine the highest BTEX levels in the center of any potential ground water plume. Each monitor well installed during the field investigations will be designed to permit incorporation into any venting or bioremediation system, if implementation of such proves necessary. The 2-inch diameter drive-point wells will be 0.020 slot galvanized steel with two to three feet of screen above the water table and seven to eight feet below the water table. The wells will be completed subgrade with locking caps, a bentonite plug, and a 2-foot by 2-foot concrete pad.

The installed monitor wells will then be properly developed, water levels will be measured, and the ground water will be sampled for BTEX according to GCL's standard operating procedures, which include strict chain-of-custody procedures (appendix C). All purged water from development and sampling will be disposed of in the produced water storage tank onsite. The installation and sampling of the wells is scheduled to begin following the completion of the soil-vapor survey.

If subsurface conditions prevent installation of drive-point monitor wells and installation by hollow-stem auger rig, the wells will be installed using either a backhoe or a cable tool or mud rotary drilling rig.

**Mobil Exploration and Producing
Work Plan for Site Investigation of
Thomas #1 Well Site**

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4.0 Reporting

Within 30 days of receiving analytical results from the laboratory, GCL will submit to Mobil a report containing;

- Site map with locations of monitor wells
- Monitor well completion diagrams
- Water level map
- Soil-vapor contour map
- Soil-vapor results in tabular form
- Chromatographs
- Table of analytical results from the ground-water sampling
- Recommendations for potential remedial actions or further investigations, if necessary

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Appendix A

Health And Safety Plan

**SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM**

Project Name: Mobil, Thomas #1

Site Name: Thomas #1 Well Site

Date: 7-17-91

Site Address: L-30-29N-11W
San Juan County

Site No:

Work Assignment No.:

Prepared By: Mark Mohorcich

Client Name: Mobil E&P

- ☒ Original HSP
☐ Amendment to Existing Approved HSP
☐ Date Existing Approved HSP
☐ Date Existing Approved Amendment

Objectives: Summarize below. Attach sheet if necessary.

Conduct a soil-vapor survey, install five drive point monitor wells, and sample these wells after development.

Site Type: Check as many as applicable.

- | | | |
|--|--|--|
| <input checked="" type="checkbox"/> Active | <input type="checkbox"/> Service Station | <input type="checkbox"/> Unknown |
| <input type="checkbox"/> Inactive | <input type="checkbox"/> Refinery | <input checked="" type="checkbox"/> Other: (Specify) |
| <input checked="" type="checkbox"/> Secure | <input type="checkbox"/> Landfill | Natural Gas well |
| <input type="checkbox"/> Unsecured | <input type="checkbox"/> Industrial | |
| <input type="checkbox"/> Enclosed Space | <input type="checkbox"/> Well Field | |

Surrounding Population:

- | | | |
|---|-------------------------------------|--------|
| <input type="checkbox"/> Residential | <input type="checkbox"/> Industrial | Other: |
| <input checked="" type="checkbox"/> Rural | <input type="checkbox"/> Urban | |

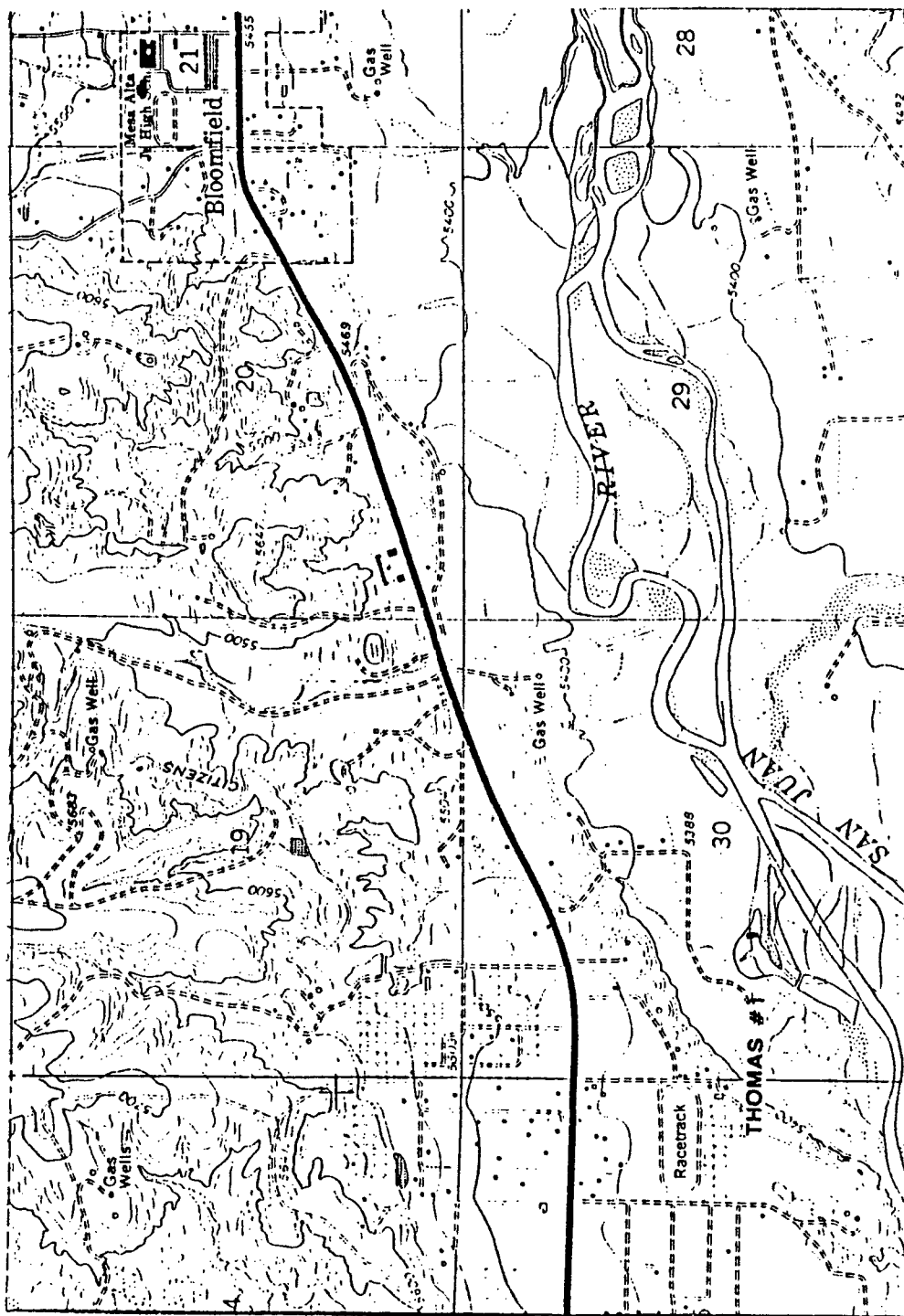
Site Description and Features: Summarize below. Include principal operations and unusual features (containers, dikes, power lines, terrain, etc.). Attach sheet if necessary.

Natural gas production well with a condensate tank and production unit located near the San Juan River bottom.

SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM

This page reserved for site map. Attach sheet if necessary.

Exclusion zone(s), decontamination zone(s), and support zone(s) must be delineated on the site map.



**SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM**

History: Summarize below. In addition to history, include complaints from public, previous agency actions, known exposures or injuries, etc.

Waste Types:

<input checked="" type="checkbox"/> Liquid	<input type="checkbox"/> Sludge	<input type="checkbox"/> Unknown
<input type="checkbox"/> Solid	<input checked="" type="checkbox"/> Gas	<input type="checkbox"/> Other: (Specify)
<input type="checkbox"/> Gasoline		

Waste Characteristics: Check as many as applicable.

<input type="checkbox"/> Corrosive	<input type="checkbox"/> Inert	<input type="checkbox"/> Reactive
<input checked="" type="checkbox"/> Toxic	<input checked="" type="checkbox"/> Volatile	<input type="checkbox"/> Radioactive
<input checked="" type="checkbox"/> Flammable	<input type="checkbox"/> Unknown	<input type="checkbox"/> Other: (Specify)

Hazards of Concern:

<input checked="" type="checkbox"/> Heat Stress - Attach Guidelines	<input checked="" type="checkbox"/> Inorganic Chemicals
<input type="checkbox"/> Cold Stress - Attach Guidelines	<input checked="" type="checkbox"/> Organic Chemicals
<input checked="" type="checkbox"/> Explosion/Flammable	<input checked="" type="checkbox"/> Noise
<input type="checkbox"/> Oxygen Deficient	<input type="checkbox"/> Radiological
<input type="checkbox"/> Biological	<input type="checkbox"/> Other: (Specify)

Principal Disposal Methods and Practices: Summarize below. Also define if underground tanks, transmission lines, pumps have been removed.

Site is an active natural gas production well with suspected hydrocarbon contamination. The extent and concentration of the contamination has not been determined.

**SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM**

Hazardous Materials Summary: Check waste type and estimate amounts by category.

Chemicals: (Amounts/Units)

<input type="checkbox"/> Acids	<input type="checkbox"/> Halogens	<input type="checkbox"/> Cyanides
<input type="checkbox"/> Caustics	<input type="checkbox"/> Metals	<input type="checkbox"/> Phenols
<input type="checkbox"/> Dyes/Inks	<input type="checkbox"/> Pickling Liquors	<input type="checkbox"/> PCBs
<input type="checkbox"/> Cyanides	<input type="checkbox"/> Pesticides	<input type="checkbox"/> Other: (Specify)

Solids: (Amounts/Units)

<input type="checkbox"/> Fly Ash	<input type="checkbox"/> Ferrous Smelter
<input type="checkbox"/> Asbestos	<input type="checkbox"/> Non-ferrous Smelter
<input type="checkbox"/> Milling/Mine Tailings	<input type="checkbox"/> Other: (Specify)

Sludges: (Amounts/Units)

<input type="checkbox"/> Paint Pigments	<input type="checkbox"/> Metals Sludges
<input type="checkbox"/> POTW Sludge	<input type="checkbox"/> Aluminum
<input type="checkbox"/> Other: (Specify)	

Solvents: (Amounts/Units)

<input type="checkbox"/> Halogenated Solvents	<input type="checkbox"/> Other: (Specify)
<input type="checkbox"/> Non-Halogenated Solvents	

Oils: (Amounts/Units)

<input type="checkbox"/> Oily Wastes	<input checked="" type="checkbox"/> Other: (Specify) Hydrocarbons
--------------------------------------	--

Other: (Amounts/Units)

<input type="checkbox"/> Laboratory	<input type="checkbox"/> Radiological
<input type="checkbox"/> Pharmaceutical	<input type="checkbox"/> Municipal
<input type="checkbox"/> Hospital	<input type="checkbox"/> Other: (Specify)

Overall Hazard Evaluation: ☐ High ☒ Medium ☐ Low
☐ Unknown

Justification: All intrusive activity will be performed with pneumatically driven tools. The area is not known to have heavy hydrogen sulfide contamination.

Fire/Explosion Potential: ☐ High ☐ Medium ☒ Low
☐ Unknown

Justification: Monitoring pits that were dug in the area, at the same depth that the proposed work will be, did not expose free product

Background Review: ☐ Complete ☒ Incomplete

SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM

Known Site Contaminant: Benzene

Highest Concentration Observed: Unknown
(specify units and media)

Contaminant Data:

BENZENE

Fire and Explosion Hazard:

FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. (USCG, 1985)

Protective Clothing:

Avoid breathing vapors. Keep upwind. Wear boots, protective gloves, and goggles. Do not handle broken packages without protective equipment. Wash away any material with copious amounts of water or soap and water which may have contacted the body. ((C)AAR, 1986)

Health Hazards:

VAPOR: Irritating to eyes, nose and throat. If inhaled, will cause headache, difficult breathing, or loss of consciousness. LIQUID: Irritating to skin and eyes. Harmful if swallowed. (USCG, 1985)

General Description:

Benzene is a clear colorless liquid with a characteristic aromatic odor. It is used to make other chemicals, as a solvent, and as a gasoline additive. It has a flash point of 12 °F., and solidifies at 42 °F. It is lighter than water and insoluble in water. Its vapors are heavier than air. ((C)AAR, 1986)

Fire Fighting Procedures:

Do not extinguish fire unless flow can be stopped. Use water in flooding quantities as fog. Solid streams of water may spread fire. Cool all affected containers with flooding quantities of water. Apply water from as far a distance as possible. Use foam, carbon dioxide or dry chemical. ((C)AAR, 1986)

Spill Cleanup:

Keep sparks, flames, and other sources of ignition away. Keep material out of water sources and sewers. Build dikes to contain flow as necessary. Attempt to stop leak if without hazard. Use water spray to knock-down vapors. Land spill: Dig a pit, pond, lagoon, holding area to contain liquid or solid material. Dike surface flow using soil, sand bags, foamed polyurethane, or foamed concrete. Absorb bulk liquid with fly ash, cement powder, sawdust, or commercial sorbents. Apply fluorocarbon-water foam to diminish vapor and fire hazard. Water spill: Use natural barriers or oil spill control booms to limit spill motion. Use surface active agent (e.g., detergent, soaps, alcohols) to compress and thicken spilled material. Inject "universal" gelling agent to solidify encircled spill and increase effectiveness of booms. If dissolved, apply activated carbon at ten times the spilled amount in region of 10 ppm or greater concentration. Remove trapped material with suction hoses. Use mechanical dredges or lifts to remove immobilized masses of pollutants and precipitates. Air spill: Apply water spray or mist to knock down vapors. ((C)AAR, 1986)

First Aid:

If this chemical comes in contact with the eyes, immediately wash the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately. Contact lenses

SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM

should not be worn when working with this chemical. If this chemical comes in contact with the skin, promptly wash the contaminated skin with soap and water. If this chemical penetrates through the clothing, promptly remove the clothing and wash the skin with soap and water. Get medical attention promptly. If a person breathes in large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible. If this chemical has been swallowed, get medical attention immediately. (NIOSH, 1987)

Warning Concentration (ppm or mg/m³): 4.68 ppm

Exposure Limits/Guidelines:

OSHA PEL:	1 ppm (mg/m ³)
NIOSH REL:	Carcinogenic 0.1 ppm (mg/m ³)
ACGIH TLV-TWA:	10 ppm
IDLH:	2,000 ppm

Photoionization Potential: 9.24 eV

**SITE HEALTH AND SAFETY PLAN FORM
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Known Site Contaminant: Toluene

Highest Concentration Observed: Unknown
(specify units and media)

Contaminant Data:

TOLUENE

Fire and Explosion Hazard:

FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back. (USCG, 1985)

Protective Clothing:

Avoid breathing vapors. Keep upwind. Wear boots, protective gloves, and goggles. Do not handle broken packages without protective equipment. Wash away any material which may have contacted the body with copious amounts of water or soap and water. ((C)AAR, 1986)

Health Hazards:

VAPOR: Irritating to eyes, nose and throat. If inhaled, will cause nausea, vomiting, headache, dizziness, difficult breathing, or loss of consciousness. **LIQUID:** Irritating to skin and eyes. If swallowed, will cause nausea, vomiting or loss of consciousness. (USCG, 1985)

General Description:

Toluene is a clear colorless liquid with a characteristic aromatic odor. It is used in aviation and automotive fuels, as a solvent for many materials, and to make other chemicals. It has a flash point of 40 °F. It is lighter than water and insoluble in water. Its vapors are heavier than air. ((C)AAR, 1986)

Fire Fighting Procedures:

Do not extinguish fire unless flow can be stopped. Use water in flooding quantities as fog. Solid streams of water may spread fire. Cool all affected containers with flooding quantities of water. Apply water from as far a distance as possible. Use foam, carbon dioxide or dry chemical. ((C)AAR, 1986)

Spill Cleanup:

Keep sparks, flames, and other sources of ignition away. Keep material out of water sources and sewers. Build dikes to contain flow as necessary. Attempt to stop leak if without hazard. Use water spray to knock-down vapors. Land spill: Dig a pit, pond, lagoon, holding area to contain liquid or solid material. Dike surface flow using soil, sand bags, foamed polyurethane, or foamed concrete. Absorb bulk liquid with fly ash, cement powder, sawdust, or commercial sorbents. Apply "universal" gelling agent to immobilize spill. Apply fluorocarbon-water foam to diminish vapor and fire hazard. Water spill: Use natural barriers or oil spill control booms to limit spill motion. Use surface active agent (e.g. detergent, soaps, alcohols) to compress and thicken spilled material. Inject "universal" gelling agent to solidify encircled spill and increase effectiveness of booms. If dissolved, apply activated carbon at ten times the spilled amount in region of 10 ppm or greater concentration. Remove trapped material with suction hoses. Use mechanical dredges or lifts to remove immobilized masses of pollutants and precipitates. Air spill: Apply water spray or mist to knock down vapors. ((C)AAR, 1986)

First Aid:

**SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM**

If this chemical comes in contact with the eyes, immediately wash the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately. Contact lenses should not be worn when working with this chemical. If this chemical comes in contact with the skin, promptly wash the contaminated skin with soap and water. If this chemical penetrates through the clothing, promptly remove the clothing and wash the skin with soap and water. Get medical attention promptly. If a person breathes in large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible. If this chemical has been swallowed, get medical attention immediately. (NIOSH, 1987)

Warning Concentration (ppm or mg/m³): 0.17 ppm

Exposure Limits/Guidelines:

OSHA PEL:	100 ppm
NIOSH REL:	100 ppm
ACGIH TLV-TWA:	100 ppm
IDLH:	2000 ppm

Photoionization Potential: 8.82 eV

**SITE HEALTH AND SAFETY PLAN FORM
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Known Site Contaminant: Ethylbenzene

Highest Concentration Observed: Unknown
(specify units and media)

Contaminant Data:

ETHYL BENZENE

Fire and Explosion Hazard:

FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Irritating vapors are generated when heated. Vapor is heavier than air and may travel considerable distance to the source of ignition and flash back. (USCG, 1985)

Protective Clothing:

Avoid breathing vapors. Keep upwind. Wear boots, protective gloves, and goggles. Do not handle broken packages without protective equipment. Wash away any material which may have contacted the body with copious amounts of water or soap and water. ((C)AAR, 1986)

Health Hazards:

VAPOR: Irritating to eyes, nose and throat. If inhaled, will cause dizziness or difficult breathing.

LIQUID: Will burn skin and eyes. Harmful if swallowed. (USCG, 1985)

General Description:

Ethyl benzene is a clear colorless liquid with an aromatic odor. It is used as a solvent and to make other chemicals. It has a flash point of 59 °F. It is lighter than water and insoluble in water. Its vapors are heavier than air. ((C)AAR, 1986)

Fire Fighting Procedures:

Do not extinguish fire unless flow can be stopped. Use water in flooding quantities as fog. Solid streams of water may spread fire. Cool all affected containers with flooding quantities of water. Apply water from as far a distance as possible. Use foam, carbon dioxide or dry chemical. ((C)AAR, 1986)

Spill Cleanup:

Keep sparks, flames, and other sources of ignition away. Keep material out of water sources and sewers. Build dikes to contain flow as necessary. Attempt to stop leak if without hazard. Use water spray to knock-down vapors. Land spill: Dig a pit, pond, lagoon, holding area to contain liquid or solid material. Dike surface flow using soil, sand bags, foamed polyurethane, or foamed concrete. Absorb bulk liquid with fly ash, cement powder, sawdust, or commercial sorbents. Apply "universal" gelling agent to immobilize spill. Apply fluorocarbon-water foam to diminish vapor and fire hazard. Water spill: Use natural barriers or oil spill control booms to limit spill motion. Use surface active agent (e.g. detergent, soaps, alcohols) to compress and thicken spilled material. Inject "universal" gelling agent to solidify encircled spill and increase effectiveness of booms. If dissolved, apply activated carbon at ten times the spilled amount in region of 10 ppm or greater concentration. Remove trapped material with suction hoses. Use mechanical dredges or lifts to remove immobilized masses of pollutants and precipitates. Air spill: Apply water spray or mist to knock down vapors. ((C)AAR, 1986)

First Aid:

SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM

If this chemical comes in contact with the eyes, immediately wash the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately. Contact lenses should not be worn when working with this chemical. If this chemical comes in contact with the skin, flush the contaminated skin with water promptly. If this chemical penetrates the clothing, immediately remove the clothing and flush the skin with water promptly. If irritation persists after washing, get medical attention. If a person breathes in large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible. If this chemical has been swallowed, get medical attention immediately. (NIOSH, 1987)

Warning Concentration (ppm or mg/m³): N/A

Exposure Limits/Guidelines:

OSHA PEL:	100 ppm
NIOSH REL:	100 ppm
ACGIH TLV-TWA:	N/A
IDLH:	2000 ppm

Photoionization Potential: 8.76 eV

**SITE HEALTH AND SAFETY PLAN FORM
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Known Site Contaminant: Xylene

Highest Concentration Observed: Unknown
(specify units and media)

Contaminant Data:

XYLENE

Fire and Explosion Hazard:

Flammable/combustible material; may be ignited by heat, sparks or flames. Vapors may travel to a source of ignition and flash back. Container may explode in heat of fire. Vapor explosion hazard indoors, outdoors or in sewers. Runoff to sewer may create fire or explosion hazard. (DOT, 1984)

Protective Clothing:

Avoid breathing vapors. Keep upwind. Wear boots, protective gloves, and goggles. Do not handle broken packages without protective equipment. Wash away any material which may have contacted the body with copious amounts of water or soap and water. ((C)AAR, 1986)

Health Hazards:

May be poisonous if inhaled or absorbed through skin. Vapors may cause dizziness or suffocation. Contact may irritate or burn skin and eyes. Fire may produce irritating or poisonous gases. Runoff from fire control or dilution water may cause pollution (DOT, 1984)

General Description:

Xylene is a clear colorless liquid with a characteristic aromatic odor. It is used as a solvent for paints and adhesives, and to make other chemicals. It has a flash point of 81-90 °F. It is lighter than water and insoluble in water. Its vapors are heavier than air. ((C)AAR, 1986)

Fire Fighting Procedures:

Do not extinguish fire unless flow can be stopped. Use water in flooding quantities as fog. Solid streams of water may spread fire. Cool all affected containers with flooding quantities of water. Apply water from as far a distance as possible. Use foam, carbon dioxide or dry chemical. ((C)AAR, 1986)

Spill Cleanup:

Keep sparks, flames, and other sources of ignition away. Keep material out of water sources and sewers. Build dikes to contain flow as necessary. Attempt to stop leak if without hazard. Use water spray to knock-down vapors. Land spill: Dig a pit, pond, lagoon, holding area to contain liquid or solid material. Dike surface flow using soil, sand bags, foamed polyurethane, or foamed concrete. Absorb bulk liquid with fly ash, cement powder, sawdust, or commercial sorbents. Apply "universal" gelling agent to immobilize spill. Apply fluorocarbon-water foam to diminish vapor and fire hazard. Water spill: Use natural barriers or oil spill control booms to limit spill motion. Use surface active agent (e.g. detergent, soaps, alcohols) to compress and thicken spilled material. Inject "universal" gelling agent to solidify encircled spill and increase effectiveness of booms. If dissolved, apply activated carbon at ten times the spilled amount in region of 10 ppm or greater concentration. Remove trapped material with suction hoses. Use mechanical dredges or lifts to remove immobilized masses of pollutants and precipitates. Air spill: Apply water spray or mist to knock down vapors. ((C)AAR, 1986)

First Aid:

SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM

If this chemical comes in contact with the eyes, immediately wash the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately. Contact lenses should not be worn when working with this chemical. If this chemical comes in contact with the skin, promptly wash the contaminated skin with soap and water. If this chemical penetrates through the clothing, promptly remove the clothing and wash the skin with soap and water. Get medical attention promptly. If a person breathes in large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible. If this chemical has been swallowed, get medical attention immediately. (NIOSH, 1987)

Warning Concentration (ppm or mg/m³): No information available

Exposure Limits/Guidelines:

OSHA PEL:

NIOSH REL:

ACGIH TLV-TWA:

IDLH:

Photoionization Potential:

**SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM**

Known Site Contaminant: Hydrogen Sulfide

Highest Concentration Observed: Unknown
(specify units and media)

Contaminant Data:

HYDROGEN SULFIDE

Fire and Explosion Hazard:

A very flammable gas. Compound is heavier than air and may travel a considerable distance to source of ignition and flash back. It forms explosive mixtures with air over a wide range. Also reacts explosively with bromine pentafluoride, chlorine trifluoride, nitrogen triiodide, nitrogen trichloride, oxygen difluoride, and phenyl diazonium chloride. Avoid physical damage to containers; sources of ignition; storage near nitric acid, strong oxidizing materials, and corrosive liquids or gases. Incompatible with metals. When heated to decomposition, it emits highly toxic fumes of oxides of sulfur. (EPA, 1986)

Protective Clothing:

Wear positive pressure breathing apparatus and special protective clothing. (EPA, 1986)

Health Hazards:

Exposure to very high concentrations causes immediate death. Also death or permanent injury may occur after very short exposure to small quantities. It acts directly upon the nervous system resulting in paralysis of respiratory centers. Signs and Symptoms of Exposure: Contact with eyes causes painful conjunctivitis, sensitivity to light, tearing, and clouding of vision. Inhalation of low concentrations causes a runny nose with a loss of smelling sense, labored breathing, and shortness of breath. Direct contact with skin causes pain and redness. Other symptoms of exposure include profuse salivation, nausea, vomiting, diarrhea, giddiness, headache, dizziness, confusion, rapid breathing, rapid heart rate, sweating, weakness, sudden collapse, unconsciousness and death due to respiratory paralysis. (EPA, 1986)

General Description:

Hydrogen sulfide is a colorless gas having the odor of rotten eggs. It is shipped as a liquefied gas under its own vapor pressure. One's sense of smell becomes rapidly fatigued in atmospheres containing hydrogen sulfide and hence cannot be counted on to warn of the continued presence of the gas. Contact with the liquid can cause frostbite. The gas is heavier than air and a flame can flash back to the source of leak very easily. Under fire conditions cylinders and tank cars may violently rupture and rocket. It is soluble in water. ((C)AAR, 1986)

Fire Fighting Procedures:

For small fires let burn unless leak can be stopped immediately. For large fires, use water spray, fog or foam. Stop flow of gas. Use water to keep fire-exposed containers cool and to protect men effecting the shut-off. Move container from fire area. Stay away from ends of tanks. Withdraw immediately in case of rising sound from venting safety device or any discoloration on tank due to fire. Cool containers with water using unmanned device until well after fire is out. (EPA, 1986)

Spill Cleanup:

Keep sparks, flames, and other sources of ignition away. Keep material out of water sources and sewers. Attempt to stop leak if without hazard. Use water spray to knock-down vapors. Land spill:

**SITE HEALTH AND SAFETY PLAN FORM
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Dike surface flow using soil, sand bags, foamed polyurethane, or foamed concrete. Absorb bulk liquid with fly ash or cement powder. Neutralize with agricultural lime (slaked lime), crushed limestone, or sodium bicarbonate. Water spill: Neutralize with agricultural lime (slaked lime), crushed limestone, or sodium bicarbonate. Air spill: Apply water spray or mist to knock down vapors. Vapor knockdown water is corrosive or toxic and should be diked for containment. ((C)AAR, 1986)

First Aid:

Move victim to fresh air; call emergency medical care. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes. Keep victim quiet and maintain normal body temperature. Effects may be delayed; keep victim under observation. (EPA, 1986)

Warning Concentration (ppm or mg/m³): 0.0047 ppm

Exposure Limits/Guidelines:

OSHA PEL:	10 ppm
NIOSH REL:	10 ppm
ACGIH TLV-TWA:	10 ppm
IDLH:	300 ppm

Photoionization Potential: 10.46 eV

**SITE HEALTH AND SAFETY PLAN FORM
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	Task A	Task B	Task C	Task D
Task Description				
Specific Technique/ Site Location	Soil Vapor Survey	Monitor Well Installation	H ₂ O Development and Sampling	
Specialized Medical Surveillance	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes
Required	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> No	<input type="checkbox"/> No
Specialized Training	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes
Required	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> No	<input type="checkbox"/> No
Type	<input checked="" type="checkbox"/> Intrusive <input type="checkbox"/> Non-Int.	<input checked="" type="checkbox"/> Intrusive <input type="checkbox"/> Non-Int.	<input checked="" type="checkbox"/> Intrusive <input type="checkbox"/> Non-Int.	<input type="checkbox"/> Intrusive <input type="checkbox"/> Non-Int.
Level of Protection (Primary)	D	D	D	
Contingency	Level C	Level C	Level C	

Schedule

Site Personnel and Responsibilities (Include Subcontractors)

Name	Firm	Health Clearance	Responsibilities	Task
Mark Mohorcich	GCL	Yes	Work Assignment Manager	A,B,C
Paul Eberly	GCL	Yes	Health and Safety Officer	A,B,C

**SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM**

Protective Equipment: Specify by Task. Indicate type and/or material, as necessary.

Task **All** **Level:** **D** **Modified** **Yes [X]** **No []**

Respiratory: ☐ **Not Needed**

- ☐ SCBA, Airline:
- ☐ APR:
- ☐ Cartridge: organic vapor
(contingency)
- ☐ Escape Mask:
- ☐ Other:

Prot. Clothing: ☐ **Not Needed**

- ☐ Encapsulating Suit:
- ☐ Splash Suit:
- ☐ Apron:
- ☐ Tyvek Coverall
- ☐ Saranex Coverall
- ☒ Coverall:
- ☐ Other:

Head and Eye: ☐ **Not Needed**

- ☒ Safety Glasses:
- ☐ Face Shield:
- ☐ Goggles:
- ☒ Hard Hat:
- ☐ Other:

Boots: ☐ **Not Needed**

- ☒ Boots: Steel Toe
- ☐ Overboots:

Other: Specify below.

Gloves: ☐ **Not Needed**

- ☒ Undergloves: Latex
- ☒ Gloves: Leather
- ☐ Overgloves:

Ear plugs

**SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM**

Monitoring Equipment: Specify by task. Indicate type as necessary.

Instrument	Task	Action Guidelines
Combustible Gas Indicator with Hydrogen Sulfide detector	A	0-10%LEL No explosion hazard.
	B	10-25% LEL Potential explosion hazard; notify SHSC.
	C	>25%LEL Explosion hazard; interrupt task/evacuate.
		21.0%O ₂ Oxygen normal.
		<21.0%O ₂ Oxygen Deficient; notify SHSC.
		<19.5%O ₂ Interrupt task/evacuate.

Comments (Includes schedules of use)

☐ Not Needed

Use on scan mode to detect hydrogen sulfide and combustible gas. If hydrogen sulfide exceeds 10 ppm, evacuate area, proceed when levels drop below 5 ppm.

Instrument	Task	Action Guidelines
Radiation Survey Meter		3 x Background: Notify HSM.
		>2mR/hr: Establish REZ.

Comments (Includes schedules of use)

☒ Not Needed

Instrument	Task	Action Guidelines
Photoionization Detector	A	Specify: If breathing space is 5 ppm, stop work and let ventilate. If breathing space will not ventilate below 5 ppm after 15 minutes, then upgrade to air purifying respirator with organic vapor cartridge. If levels exceed 50 ppm when wearing respirator, evacuate and allow vapors to dissipate.
	B	
	C	
	<input type="checkbox"/> 11.7 ev	
	<input checked="" type="checkbox"/> 10.2 ev	
	<input type="checkbox"/> 9.8 ev	
	<input type="checkbox"/> ev	

Type:

Comments (Includes schedules of use)

☐ Not Needed

**SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM**

Monitoring Equipment: Specify by task. Indicate type as necessary.
(Continued)

Instrument	Task	Action Guidelines
-------------------	-------------	--------------------------

Flame Ionization
Detector

Specify:

Type:

Comments (Includes schedules of use)

☒ Not Needed

Instrument	Task	Action Guidelines
-------------------	-------------	--------------------------

Detector Tubes/
Monitor

Specify:

Type:

Type:

Comments (Includes schedules of use)

☒ Not Needed

Instrument	Task	Action Guidelines
-------------------	-------------	--------------------------

Other

Specify:

Specify:

Comments (Includes schedules of use)

☐ Not Needed

**SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM**

Decontamination Procedures

Personal Decontamination

Summarize below and/or attach diagram.

Wash hands with liquinox and rinse with DI H₂O prior to hand/mouth contact.
Dispose of gloves at site.

[] Not Needed

Containment and Disposal Method:

Disposal in the produced water storage tank onsite

Sampling Equipment Decontamination

Summarize below and/or attach diagram.

Liquinox wash
DI H₂O rinse
Methanol rinse
DI H₂O rinse and air dry if non-disposable bailers are used

[] Not Needed

Containment and Disposal Method:

Disposal in the produced water storage tank onsite

Heavy Equipment Decontamination

Summarize below and/or attach diagram.

[X] Not Needed

Containment and Disposal Method:

**SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM**

Emergency Contacts

Site Water Supply

Site Telephone None

Site Radio None

Site Other (Specify)

USEPA Environmental Response Team N/A

Emergency Contacts

Regional Health and Safety Supervisor Heather Swisher

Project/Site Manager Mark Mohorcich

Site Health and Safety Coordinator

EPA Contact

GCL Home Office - Albuquerque, NM (505) 842-0001

GCL Health and Safety Manager

Other (Specify)

State Environmental Agency

State Spill Contractor

Fire Department 911

Police Department 911

State Police 911

Health Department 911

Poison Control Center 911

Medical Emergency

Hospital Name: San Juan Regional

Phone: (505) 599-6100
Emergency Rm.

Hospital Address: 801 West Maple St.
Farmington, NM

24-Hour Ambulance: 911 **Phone:**

Route to Hospital: Highway 64 west to Lake St., north on Lake to Maple

Distance: (Attach Map) ≈15 Mi.

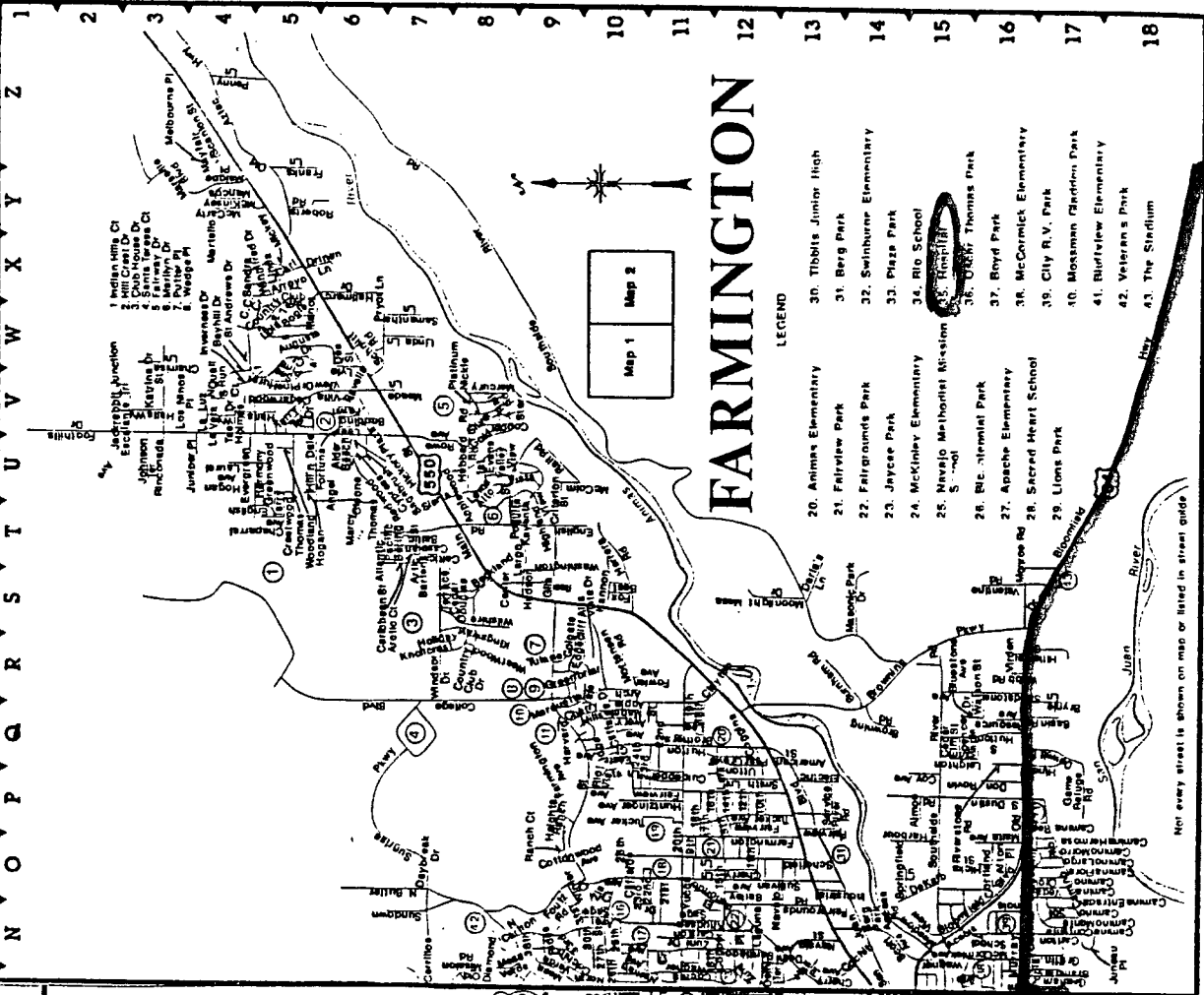
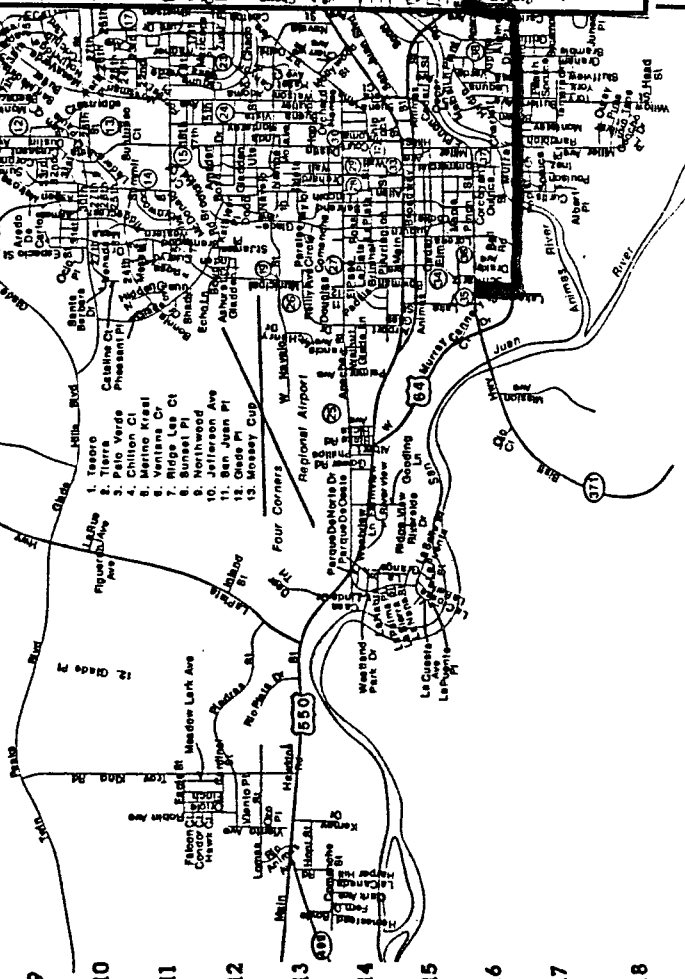
1 A B C D E F G H I J K L M N

FARMINGTON

Not every street is named on map or listed in street guide

LEGEND

- 1. Lions Wilderness Park
- 2. Country Club Elementary
- 3. Breckland Hills Park
- 4. San Juan College
- 5. Sun Valley Park
- 6. Highland View Park
- 7. Kiwanis (30th St) Park
- 8. Heights Junior High
- 9. College Heights Park
- 10. Mesa Verde Elementary
- 11. College Heights Christian Academy
- 12. Leders Del Norte Elementary
- 13. Chilian Park
- 14. Farmington High
- 15. Brookside Park
- 16. Hermosa Junior High
- 17. Northeast Elementary
- 18. Christian Heritage
- 19. Catholic Academy



FARMINGTON

LEGEND

- 20. Animas Elementary
- 21. Fairview Park
- 22. Fairgrounds Park
- 23. Jaycee Park
- 24. McKinley Elementary
- 25. Navajo Methodist Mission School
- 26. Bic. Memorial Park
- 27. Apache Elementary
- 28. Sacred Heart School
- 29. Lions Park
- 30. Tibbitts Junior High
- 31. Berg Park
- 32. Swinburner Elementary
- 33. Plaza Park
- 34. Big School
- 35. O'Neil Thomas Park
- 36. Boyd Park
- 37. McCormick Elementary
- 38. City R.V. Park
- 39. Mossman Gardens Park
- 40. Birdview Elementary
- 41. Veterans Park
- 42. The Stadium

Not every street is shown on map or listed in street guide

**SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM**

Contingency Plans: Summarize below.

Monitor activities with HNu, Hydrogen Sulfide meter, and CGI and field observations and upgrade if necessary.

Site Health and Safety Plan Approvals

Prepared By:

Mark Mohorcich


Date: 7-17-91

SHSC Signature:



Date: 7/10/91

HSM Signature:



Date: 7/18/91

**SITE HEALTH AND SAFETY PLAN FORM
GCL HEALTH AND SAFETY PROGRAM**

Signature Page

This Health and Safety Plan is to be read by all site workers, including subcontractors and visiting regulatory personnel.

I have read, understand, and agree to comply with the provisions of the attached Health and Safety Plan and agree to comply with the provisions the Health and Safety Plan for work activities on this project.

PRINTED NAME

SIGNATURE

DATE

0569/THOMAS.H&S

Heat Stress Guidelines Health and Safety Plan Attachment

Hygienetics, Inc./Geoscience Consultants, Ltd.

Heat stress may be significantly increased by the use of protective clothing which decreases the body's ability to regulate temperature and increases the amount of energy required to perform work. Heat stroke is potentially fatal and can progress rapidly.

Preventive measures include:

- force fluids early in the work period
- acclimatize workers
- wear long cotton underwear to prevent direct contact with protective clothing and to aid in evaporation of sweat
- work in cooler portions of the day
- use mobil showers, fans, etc.
- provide shelter
- rotate workers who use impervious clothing
- maintain good hygiene, change damp clothing

Types of Heat Illness

Heat Rash

Heat Rash is a mild red rash caused by heat, humidity, and chafing clothes. It reduces the body's ability to tolerate heat. Treat by keeping the skin as dry as possible, decreasing the time in protective clothing, and the use of powder to absorb moisture.

Heat Cramps

Heat cramps are painful cramps in the large voluntary muscles caused by the loss of body fluids. Treat by removing the victim to a cool area, loosen clothing, and have the patient drink 1-2 cups of water immediately and every 20 minutes until recovered. Prevent by consuming 1-2 gallons per day during hot work.

Heat Exhaustion

Heat exhaustion is characterized by pale clammy, moist skin, excessive perspiration, and extreme weakness. The pulse may be weak and rapid with shallow breathing. Vomiting, headache, and dizziness may also occur. Heat exhaustion is also caused by the loss of body fluids and should be treated by cooling the victim, replacing fluids as for heat cramps, and laying the victim with the feet elevated.

Heat Stress Guidelines Health and Safety Plan Attachment

Hygienetics, Inc./Geoscience Consultants, Ltd.

Heat Stroke

Heat stroke is the most serious type of heat injury which occurs when the body's heat regulating mechanism is overwhelmed and fails. It can lead to death or brain damage if not treated rapidly and aggressively. Symptoms are hot red dry skin, no perspiration, confusion, nausea, dizziness, strong rapid pulse, and coma or unconsciousness. Rapid cooling of the body and immediate medical treatment should be initiated immediately if heat stroke is suspected.

Monitoring for Heat Stress

Heat stress can be prevented by monitoring for signs and conditions that have the potential to cause heat illnesses. Monitoring should be conducted if the ambient temperature is above 70° F and workers are in level A, B or C ppe.

Heart Rate

Heart rate should be measured at the beginning of a rest period. If it exceeds 110 beats per minute the next work period should be decreased by 33%. If the HR exceeds 100 beats per minute at the beginning of the next rest period, the following work period should be shortened by 33%.

Body Water Loss

Body water loss can be measured by weighing a worker at the beginning and end of a work shift, preferably the worker should be nude. The difference should be 1.5% or less. If it exceeds 1.5%, additional fluids should be consumed.

Oral Temperature

Oral temperature can be taken at the beginning of the rest period and should not exceed 99° F. If it does, decrease the next work period by 33%. As with the HR, if it exceeds 99.7° at the beginning of the next rest period the following work period should be shortened by 33%.

Tympanic Temperature

Tympanic temperature can be measured directly with a personal monitor that can alarm the worker if there has been a significant rise in core temperature.

Heat Stress Guidelines Health and Safety Plan Attachment

Hygienetics, Inc./Geoscience Consultants, Ltd.

Adjusted Temperature Work/Rest Schedule

The work/rest schedule can be adjusted using the following guideline:

adjusted temperature (F)	active work time (min/hr) using B/C level ppe
75 or less	50
80	40
85	30
90	20
95	10
100	0

calculate the adjusted temperature:

$$T(\text{adjusted}) = T(\text{actual}) + (13 \times \text{fraction sunshine})$$

Measure the air temperature with a standard thermometer. Estimate the fraction of sunshine by judging what percent the sun is out: 100% sunshine = no cloud cover = 1.0; 50% sunshine = 50% cloud cover = 0.5; 0% sunshine = full cloud cover = 0.0.

H&S/HEATSTRS.GID

General Field Work Rules and Safety Regulations

Hygienetics, Inc./Geoscience Consultants, Ltd.

During hazardous waste site investigations, good work habits are important to the prevention of undue exposure to contaminants and to maintain a safe working environment. One of the simplest methods of preventing undue exposures is the development of good personal hygiene habits. These should include the thorough washing of hands and face upon leaving the contamination reduction zone and before eating, drinking, or smoking, all of which should take place only in the support zone. Personnel should change clothes and shower immediately following each work shift.

In addition, the following general safety rules will be obeyed during GCL field activities, obtain annual physical exam

- In the event of intrusive activities, utility companies shall be informed of proposed work prior to the initiation of the actual operation. Determinations shall be made of the existence of underground installations, and if these are near the area to be drilled, the concerned utility shall clearly delineate their locations.
- Plan site activities thoroughly ahead of time: Enter the site only to get to a designated point by a designated route for a specific purpose.
- No contact lenses are to be worn. Contact lenses can absorb chemicals and can become coated with low concentrations of dust which may irritate the eye.
- Always observe the buddy system: Never enter or exit a site alone, and never work alone in an isolated area.
- All individuals must go through specified decontamination procedures.
- Always maintain contact with site health and safety personnel.
- Decontaminate clothing (such as gloves and boots) which has contacted known sources of contamination at the site.
- Keep track of weather conditions and wind direction.
- Never climb over or under refuse or obstacles.
- Never assume that a situation is as safe as it appears to be.

General Field Work Rules and Safety Regulations

Hygienetics, Inc./Geoscience Consultants, Ltd.

- Be alert to any unusual behavior on the part of other team members which might indicate distress, disorientation, or other ill effects.
- Any open wounds must be covered with an air-tight bandage; ideally, someone with an open wound should not enter the site.
- If possible, excessively dusty conditions will be kept to a minimum by the use of a waster spray. However, the use of a full face air purifying respirator with particulate cartridge for both dust and organic vapors during soil intrusive activities may be necessary. See Site Health and SAFety Plan for details on protective equipment.
- No one shall be permitted to eat, drink, or smoke on the site and all personnel shall thoroughly wash hands with soap and water before doing any of these activities off site.
- Wet weather operations will require that disposable rainsuits be worn by all personnel.
- At the end of each day, disposable clothing shall be removed and disposed of in a doubled heavy duty plastic bags. These will be placed in a secure contaminated waste storage area.
- All work operations on site shall cease at sunset unless proper auxiliary light has been provided and approved.
- All personnel shall attend a safety meeting prior to beginning work on site. They will sigh a form stating their understanding of site hazards and agreement to abide by provisions of the Site Health and Safety Plan.

H&S/HSP.ATC

EMPLOYEE INJURY/EXPOSURE INCIDENT REPORT

REM V Medical Monitoring Program

Attach a narrative summary of the incident, as appropriate.

NAME _____

SOCIAL SECURITY NUMBER _____

OFFICE LOCATION _____

DATE OF REPORT _____

SITE NAME _____ TASK/PHASE _____

INCIDENT TYPE: Possible Exposure () Exposure () Injury ()

DATE OF INCIDENT _____ TIME _____

LOCATION _____

SITE CONDITIONS AT TIME OF INCIDENT:

Temperature _____ Wind Speed & Direction _____

Humidity _____ Cloud Cover _____

Precipitation _____ Other _____

TYPE OF EXPOSURE/INJURY:

MATERIAL EXPOSED TO (chemical compound name, physical state, etc.):

NATURE OF EXPOSURE/INJURY (parts of body exposed/injured, etc.):

MEDICAL CARE RECEIVED (when, where, by whom):

HAS EXPOSURE/INJURY RESULTED IN:

Death () Permanent Disability () Temporary Disability ()
Loss of Work Time () Other () Explain: _____

OTHER INDIVIDUAL INVOLVED/AFFECTED

WITNESSES:

POSSIBLE CAUSE OF INJURY/EXPOSURE:

EMPLOYEE INJURY/EXPOSURE INCIDENT REPORT (Cont'd)

WERE OPERATIONS CONDUCTED USING APPROVED HEALTH & SAFETY PLAN?

YES () Reference _____

NO () Explain _____

WAS INJURY/EXPOSURE DUE TO FAILURE OF PROTECTIVE EQUIPMENT?

NO () YES () Explain _____

HAS HSO BEEN NOTIFIED? NO () YES ()

Employee Signature _____ Date _____

HSO COMMENTS

ACTIONS REQUIRED

HSO _____ Date _____
PHYSICIAN'S COMMENTS

Physician _____ Date _____
ACTIONS COMPLETED

HSO _____ Date _____

Appendix B

**Soil-Vapor Survey
Standard Operating Procedure**

Procedures For Soil-Vapor Sampling Analysis

1.0 PURPOSE

The purpose of this document is to describe and illustrate the methods and procedures used in sampling and analyzing shallow subsurface soil vapor for various contamination evaluations.

2.0 SCOPE

A shallow soil-vapor survey is commonly a rapid and cost-effective method for estimating the areal extent of a known spill involving hydrocarbons or other volatile constituents. Shallow soil-vapor investigations are also used to determine the presence or absence of specific constituents in the subsurface at sites where spills or leaks may have occurred but have not been identified.

3.0 PROCEDURES

The equipment needed and steps to be followed when sampling for soil vapors are presented in this.

3.1 Equipment and Supplies

- Necessary equipment at all sites will include
 - Probes (3/4" I.D. steel pipe, schedule 20 or similar)
 - Drive points
 - Adapters
 - Floor jack (2-ton capacity)
 - Pipe clamp
 - Pipe wrenches
 - Pipe cutter
 - Pipe reamer
 - Portable gas chromatograph (GC) (Photovac), syringes and other necessary GC supplies (kit)
 - Calculator
 - Internal tank filling adapter
 - Vacuum pump (battery operated)
 - Pneumatic/slide hammer
 - Polyethylene tubing
 - Rubber hose

- Battery pack for GC
- Zero-grade air cylinders
- Two Laptop Computers
- Extension Cords
- Metal Detector
- Optional equipment and supplies needed at some sites:
 - Rotary hammer with bit
 - Generator
 - Brunton compass and tape measure
 - Steam cleaner
 - Sand and asphalt or concrete patching material
- Safety equipment (required):
 - Hard Hats
 - Coveralls
 - Gloves
 - Safety Glasses
 - Steel-toed Boots

3.2 Steps For Sampling Soil Vapors

- Review area to be surveyed as outlined in the workplan. During field operations, record surface characteristics (ie: paved or unpaved) at all vapor sampling locations.
- Divide the survey area into an appropriate grid. This grid may be expanded, contracted, or refined as the survey progresses. Number the points as field work progresses so expansion of the grid will be consistently numbered.
- Be sure all sampling equipment, including probes, vacuum adapters, points, and pneumatic/slide hammer (inside and outside), is thoroughly steam cleaned prior to use.
- Prior to soil sampling, an "air sample" of the ambient air should be analyzed with the GC. Be sure the air sample is collected a good distance away from or upwind of any running vehicle or other source if hydrocarbon emissions (20 to 30 feet away from the survey site should be sufficient).
- Next, collect a "field blank" to be analyzed prior to sampling. Connect a clean probe with point and adapter attached to the vacuum pump, and

collect a sample of ambient air. This procedure will provide background data for the ambient air passing through a probe.

- If it is necessary to drill through concrete or asphalt, a rotary hammer will be used. If there is no electrical outlet available, a generator will be used (generator must be positioned downwind of probes) to supply power for rotary hammer.
- Insert the drive point into the base of the probe. Using clean, small gauge steel wire, secure the point to the probe (so it won't fall out during insertion into hole).
- Remove the lift plate from the floor jack and place the hole in lifting arm of the jack over the drilled hole.
- Insert the probe through the hole in the jack's lifting arm and then insert the probe into the drilled hole or the soil surface.
- Place the pneumatic/slide hammer over the top of the probe and drive probe to the target depth. Except when establishing vertical profiles, target depth of 5 feet is used. Remove the pneumatic/slide hammer.
- After driving the probe, promptly place an adapter over it and connect adapter to the vacuum pump.
- Place the pipe clamp around the probe at the lifting arm of the jack. Tighten the clamp. Turn the jack handle clockwise to activate the hydraulics. Use the jack to retract the probe 1 to 3 inches immediately before sampling, in order to achieve free air flow.
- When the chemist is ready to take the sample, activate the vacuum pump. Evacuate approximately 5 probe volumes of soil vapor before sampling. Evacuation time of the probe can be approximated by checking the vacuum reading on the pump gauge.

<u>Vacuum Pump Gage Reading</u> <u>(Inches Hg)</u>	<u>Evacuation Time</u> <u>(Seconds)</u>
2 - 5	30
5 - 10	45
10 - 15	60
15 - 17	90

Note: Vacuum pressures above 17 in. Hg indicate that you have a clogged probe, a very tight formation, or water. If there is a possibility that the probe has reached shallow ground water, be sure water is not evacuated and passed into the vacuum pump. If vacuum pressures are above 17 in. Hg, the pump will not collect a good soil-vapor sample. The probe should be retracted several inches to achieve free air flow or removed completely and examined for obstructions.

- After the evacuation time is satisfied, insert a clean syringe through the flexible latex (self-sealing) tubing at the top of the adapter. Flush the syringe 3 times with soil-vapor while the evacuation pump is running. Turn the evacuation pump off and immediately withdraw a 2 cc vapor sample and close the mini-enert valve on the syringe.
- A portable gas chromatograph (Photovac Model 10S70) will be used to analyze soil-vapor samples. Draw 10 to 500 ul aliquots of vapor from the probe evacuation lines using a gas-tight syringe, and inject the vapor into the gas chromatograph. Analyze the sample for the compounds of interest. Carrier gas flow rate should be set to 5 to 10 ml/min; column temperature should be set to 30 to 40 C. Vary instrument sensitivity, sample volume, and dilution factors in response to subsurface conditions to achieve comparable results. Calibrate the portable gas chromatograph daily prior to initiation of analyses in the field. Syringe blanks (uncontaminated atmospheric air) and field blanks (atmospheric air drawn through probes and adaptors) should be analyzed as a QA/QC measure.

Validate instrument performance through analysis of a TCE standard once for each set of three soil-vapor analyses.

Store data on floppy disk using laptop computer No. 1. Reduce data (using Lotus 1-2-3) using laptop computer No. 2.

- With the pipe clamp still tightened around the probe, extract the probe. The jack can be reset by turning the handle counterclockwise. This will allow the lifting arm to drop, and the pipe clamp can be loosened and lowered.
- After extraction, the probe and adaptor should be set aside in a designated area. This will prevent confusing clean equipment with used equipment.

- For each soil-vapor point, items from table 3-1 will be entered in the field log book.
- Steam clean all probes and adapters before reusing them.
- After review of field data, results should be submitted to data management for processing and mapping.

Appendix C

**Sampling
Standard Operating Procedure**

December 23, 1987

Procedures for Purging and Sampling Wells

1.0 Purpose

To describe the Standard Operating Procedures SOP for purging and sampling wells.

2.0 Scope

This document describes procedures to be used in purging and sampling wells for determination of water quality and potential contamination. The procedures described in this document are consistent with the requirements of all Federal regulations, and are specifically designed to comply with ground water monitoring requirements under RCRA.

3.0 Procedures

3.1 Preparations for Sampling

Before proceeding to the field area, be sure that all necessary equipment and supplies are on hand. To the extent possible, all equipment and supplies should be decontaminated in the laboratory before proceeding to the field area. Equipment decontamination procedures are described in a separate SOP.

Equipment and supplies needed for collecting representative ground water samples include:

- An electronic water-level sounder or steel tape and chalk,
- Distilled water and wash bottles,
- Brushes and laboratory soap,

- Heavy plastic bags,
- Paper towels or clean rags,
- Zip-lock plastic bags,
- Rubber gloves,
- Several 500 ml beakers,
- A submersible pump (at some sites there is a dedicated pump for each well) with appropriate attachments to enable purging and sampling the well,
- A hose to direct pump discharge several feet away from the well, and containers for discharge if it is contaminated,
- Plastic sheet film,
- A graduated bucket,
- A bottom-filling teflon or stainless steel bailer with sufficient cord and/or cable,
- All necessary sample containers with the appropriate volume of preservatives added to the containers by the laboratory,
- pH meter,
- Thermometers,
- Specific conductance meter,
- Field log book and sample forms,
- Ice and ice chest for samples,
- Strapping tape and shipping labels,

- Waterproof marking pen,
- Chain-of-Custody labels,
- Watch or stopwatch for use in determining pumping rates.

A nearby location of a steam cleaner is desirable in order to avoid long delays for cleaning of equipment, if necessary, between sampling of individual wells.

3.2 Determine Water Level and Test for "Floaters" and "Sinkers"

Using an electronic sounder ("water level probe") or other suitable device, measure the depth to water (DTW) in the well. If approximate total depth (TD) of the well is not known, it will also be necessary to measure total depth with the sounder. If approximate total depth is known, defer the measurement until after sampling has been completed. Use of the electronic sounder is described in a separate SOP. If the presence of floating or sinking immiscible phases is known or suspected, they must be evaluated and sampled before purging or other sampling.

After determining the water level and total depth, coat the electronic sounder's tape with an indicator paste which changes color when exposed to organic chemicals. Apply the paste in a thin layer over a 1-foot interval at the bottom of the tape, and over a 1- to 2-foot interval including the tape measurement corresponding to the water level elevation above the bottom of the well. Lower the sounder into the well so that it reaches the bottom of the well, and the upper paste zone spans the water level.

Withdraw the tape, and observe whether the indicator paste has changed color (refer to the manufacturer's instructions for the color change to be anticipated). If floating or sinking phases are present, they must be sampled before purging the well. Instructions for sampling "floaters" and "sinkers" are included in the following section.

3.3 Collection of "Floaters" and "Sinders"

3.3.1 *Collection of Light Immiscibles (Floaters)*

The approach to collection of floaters is dependent on the depth to the surface of the floating layer and the thickness of that layer. The thickness of the layer can be determined by using an interface probe, which indicates the depths to both top and bottom of the layer.

If the thickness of the floater is two feet or greater, a bottom valve bailer is the equipment of choice. Slowly lower the bailer until contact is made with the floater surface and lower the bailer to a depth less than that of the floater/water interface depth as determined by preliminary measures with the interface probe.

When thickness of the floating layer is less than 2 feet but the depth to the surface of the floating layer is less than about 15 feet, a peristaltic pump can be used to collect a sample.

When the thickness of the floating layer is less than two feet and the depth to the surface of the floating layer is beyond the effective "reach" of a peristaltic pump (greater than 25 feet), a bailer must be modified to allow filling only from the top. Disassemble the bailer's bottom check valve and insert a piece of two-inch diameter Teflon sheet between the ball and ball seat to seal off the bottom valve. Remove the ball from the top check valve, thus allowing the sample to enter from the top. To overcome buoyancy when the bailer is lowered into the floater, place a length of one-inch stainless steel pipe on the retrieval line above the bailer (this pipe may have to be notched to allow sample entry if the pipe remains within the top of the bailer). Lower the device, carefully measuring the depth to the surface of the floating layer, until the top of the bailer is level with the top of the floating layer. Lower the bailer an additional one-half thickness of the floating layer and collect sample. This technique is the most effective method of collection if the floater consists of only a few inches of materials.

3.3.2 *Collection of Heavy Immiscibles (Sinkers)*

The best method for collection of sinkers is use of a double check valve bailer. The key to collection is controlled, slow lowering and raising of the bailer to and from the bottom of the well. Collection methods when using a bailer are equivalent to those described above.

3.4 Determine the Volume of Water to be Purged from the Well

This normally is at least 3 casing volumes, determined as follows:

- Measure the true inside diameter of the casing, using a steel tape or ruler; convert to feet.
- Find the true inside radius (r) of the casing by dividing the diameter by 2.
- Determine 1 casing volume in cubic feet (V_c) by calculating:

$$V_c = 3.14 \times (r)^2 \times (TD - DTW).$$

- Determine 1 casing volume in gallons by multiplying $V_c \times (7.48 \text{ gals/ft}^3)$.
- Multiply by 3 to determine total volume of water to be pumped from the well.

The exception to this standard (other than program requirements) is in the case of low yield wells. When purging low yield wells, pump the well once to dryness. Samples should be collected as soon as the well recovers. When full recovery exceeds three hours, samples should be collected as soon as sufficient water volume is available.

3.5 Purge the Well

Currently, standards allow for four options for purging wells. They are:

- Teflon or stainless steel bailers
- Existing dedicated equipment - Use of these devices must be approved by On-Site Representatives.
- Peristaltic pumps - Use of these devices, suitable for shallow wells only, must be approved by the On-Site Representative.

- Positive displacement bladder pump, capable of being completely disassembled and cleaned before use in each well.

At no time during purging should the evacuation rate be high enough to cause the ground water to cascade back into the well thus causing excessive aeration and potential stripping of volatile constituents.

The actual volume of purged water can be measured by several acceptable methods.

- When bailers are used to purge, the actual volume of each bailer's contents can be measured using a calibrated bucket.
- If a pump is used for purging, the pump rate can be determined by using a bucket and stopwatch, and the duration of pumping timed until the necessary volume is purged. A totalizing flow meter may be used, if available.

Monitor the pH, temperature, and specific conductance of the water purged to ensure that these parameters have stabilized by the time 3 casing volumes have been withdrawn. If stabilization has not been achieved at that time, continue purging until it is achieved.

3.6 Disposal of Purged Water

Dispose of pumped water in a manner which poses no threat of contamination to any surface or ground water in the vicinity. If the water is determined to be hazardous, it must be contained and disposed of according to appropriate regulations.

3.7 Initial Sampling for Field Parameters

Begin sampling by withdrawing water from the well in accordance with the procedures of section 3.8. Place the first water withdrawn in a 500 ml or larger flask or beaker which has been properly cleaned, then rinsed 3 times with the well water being recovered. Use this sample for field measurement of temperature, specific conductance, and pH. Procedures for these field measurements are described in a separate SOP document.

3.8 Sample Collection

3.8.1 General Considerations

The technique used to withdraw a ground water sample from a well should be selected based on a consideration of the parameters which will be analyzed. To ensure the ground water samples' representativeness, it is important to avoid physically altering or chemically contaminating the samples during collection, withdrawal, and containerization.

The preferred sampling device for all parameters is a double check valve stainless steel or Teflon bailer.

To the extent possible, no sampling device constructed of or containing neoprene, PVC, Tygon, silicone, polyethylene, or Viton will be used to collect ground-water samples.

In some cases, it may be necessary to use equipment already in the well to collect samples. This is particularly true of high volume, deep wells (>150 feet) where purging pumps are ineffective, and bailing is impractical. If existing equipment must be used, determine the make and model of the pump and check with the manufacturer concerning component construction materials.

General sampling procedures include the following:

- Clean sampling equipment should not be placed directly on the ground. Use a drop cloth or feed line from clean reels. If reels are used, avoid placing contaminated lines back on reels.
- Lower sampling equipment slowly into the well to avoid degassing of the water and damage to the equipment.
- If bailer cable is to be decontaminated and reused, it must be Teflon-coated or made of stainless steel. Braided polypropylene is also acceptable.
- Check the operation of bailer check valve assemblies to confirm free operation.

- Purging pump flow rates should be adjusted to eliminate intermittent or pulsed flow. The settings should be determined during the purging operations. Flow rate should be less than 100 ml/minute when sampling for volatile organic compounds (VOC's).
- Samples should be collected and containerized in the order of the parameters volatilization sensitivity. Table 3-1 lists the preferred collection order for some common ground-water parameters.

3.8.2 Collection of Volatile Organics Samples (VOAs)

VOAs should be collected from the first bailer removed from the well after purging, immediately following collection of the sample for field analyses. The most effective means of controlled collection of the sample is by employing two people. One person should retrieve the bailer from the well and place the bottom over a VOA container (40 ml septum vial) held by the second person. The second person should insert the Teflon bottom emptying device into the bailer, bring the vial to tip of the bottom emptying device, and tilt the vial to approximately 60° from the vertical.

Delivery of the sample from the bailer down the edge of the vial is accomplished when the person holding the bailer slowly opens the top check valve with a Teflon, glass, or stainless steel insert. As the vial is filled, the second person should return it to the vertical position.

Fill the septum vial until it is just overflowing. Cap the vial and invert. If a bubble exists, discard and repeat. Do not reopen the vial and add additional sample.

If a sampling pump is used, reduce the flow to less than 100 ml per minute prior to sample collection.

3.9 Containers

Collect and preserve all samples in approved containers and by the standard methods described in the Sampling and Analysis Plan for the project. The specific containers and preservatives used for each analyte may vary among laboratories. The standard methods of the laboratory selected for analysis will be followed in each project Sampling and Analysis

Plan. Handle all samples in accordance with the procedures described in the SOP documents "Procedures for Packing and Shipping of Samples" and "Chain-of-Custody Procedures."

3.10 Final Field Analyses

Immediately after collection of all samples required in the Sampling and Analysis Plan, collect a final sample for field analyses, as described in Section 3.7 above. The purpose of these repeat analyses is to check for possible changes in water quality during the time of sampling. Samples used for field analyses should be discarded when the analyses are complete (see table 3-1).

Table 3-1

Preferred Order of Sample Collection

1. Volatile organics (VOA)
2. Purgeable organic carbon (POC)
3. Purgeable organic halogens (POX)
4. Extractable organics
5. Total metals
6. Dissolved metals
7. Total organic carbon (TOC)
8. Total organic halogens (TOX)
9. Phenols
10. Cyanide
11. Sulfate and chloride
12. Nitrate and ammonia
13. Radionuclides

3.11 Measure Total Depth of Well

After collection and preservation of all samples and completion of final field analyses, measure depth to bottom of the well, using the electronic sounder. Use of the sounder is described in a separate SOP.

4.0 References

U.S. Code of Federal Regulations, 1983, 40 CFR 264.97.

U.S. Environmental Protection Agency, 1986a, RCRA Ground-Water Monitoring Technical Enforcement Guidance Document, p. 97-114.

U.S. Environmental Protection Agency, 1986b, Test Methods for Evaluating Solid Waste: EPA Report SW-846; Volume I: Physical/Chemical Methods.

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