Health and Safety Plan

North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design

Revision 1

September 10, 2012

AMEC Project Number: 4088115718.4100.1

AMEC Environment & Infrastructure, Inc.
2101 Webster Street, 12th Floor
Oakland, CA 94612

September 10, 2012

Mr. Matt Salazar
United States Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, California 94105

Subject: **Health and Safety Plan**
North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design
AMEC Project 4088115718.4100.1

Dear Mr. Salazar:

AMEC Environment & Infrastructure, Inc. is pleased to submit this Health and Safety Plan for the North Hollywood Operable Unit on behalf of Lockheed Martin Corporation and Honeywell International Inc., to the U.S. Environmental Protection Agency (USEPA), Region IX. This document has been prepared pursuant to the Administrative Settlement Agreement and Order on Consent for Remedial Design dated February 14, 2011 and revised in response to USEPA comments received on August 10, 2012.

If you have any questions regarding this report, please contact Michael Taraszki at (510) 663-3996.

Sincerely,
AMEC Environment & Infrastructure, Inc.

Michael Taraszki, PG, CHG, PMP
Project Manager

Robert Hartwell, PE
Engineering Manager

For Robert Hartwell, PE
with permission

mt/pp/smm
Enclosure

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Health and Safety Plan

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September 10, 2012

IMPORTANT NOTICE

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B Chemical Data Sheets and Material Safety Data Sheets
C Hospital Location Map
D Site Study Area Map
E AMEC Responses to USEPA Comments to the Draft Health and Safety Plan (dated August 10, 2012)

ABBREVIATIONS AND ACRONYMS

µg/L	micrograms per liter
ACGIH	American Conference of Governmental Industrial Hygienists
AMEC	AMEC Environment and Infrastructure, Inc.
Cal/OSHA	California Division of Occupational Safety and Health
CCR	California Code of Regulations
COC	Chemicals of concern
CFR	Code of Federal Regulations
CPR	Cardio Pulmonary Resuscitation
eV	electronvolt
HASP	Health and Safety Plan
Honeywell	Honeywell International, Inc.
HR	Human Resources
HSE	Health, Safety and Environment
HSO	Health and Safety Officer
IDLH	Immediately Dangerous to Life or Health
IP	Ionization Potential
JSA	Job Safety Analyses
LEL	Lower Explosive Limit Percent
mg/kg	milligrams per kilogram
mg/m^3	milligrams per cubic meter
MSDS	Material Safety Data Sheets
NDMA	n-nitrosodimethylamine
NHOU	North Hollywood Operable Unit
NIOSH	The National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
PID	photoionization detector
PPE	personal protection equipment
ppm	parts per million
psi	pounds per square inch
RISE	Respiratory, Ingestion, Skin absorption, Eye absorption
USCG	United States Coast Guard
USEPA	U.S. Environmental Protection Agency

1 SUMMARY INFORMATION

In addition to the site-specific directives of this Health and Safety Plan (HASP), it is understood that each employee bears continuing responsibility for health & safety, both in the office and in the field. Any activity conducted by AMEC Environment and Infrastructure, Inc. (AMEC) personnel, whether it falls under a site-specific HASP or not, is always under the generic safety protocols of the AMEC Integrated Health, Safety and Environment (HSE) Program Manual, available on the AMEC web page (http://ee.amecnet.com/intranet/SHE/docs/Integrated_HSE_Manual.pdf). AMEC field personnel receive 40-hour initial training and 8-hour annual refresher training in compliance with U.S. Occupational Safety and Health Administration (OSHA) regulations (29 Code of Federal Regulations [CFR] 1920.120 and the California Division of Occupational Safety and Heath (Cal/OSHA) "Hazardous Waste Operations and Emergency Response" standard (8 California Code of Regulations [CCR] 5192). Each individual employee is the best sentinel of safety, and AMEC expects this standard of performance at all times. This HASP shall be in conformance with OSHA requirements in Title 29 of the CFR (sections 1910 and 1926), and any other applicable requirement(s).

1.1 Project Description

Project Name:	North Hollywood Operable Unit Second Interim Remedy Groundwater Remediation System Design
Site Address:	11845 Vose Street North Hollywood, CA 91605
Scope of Work:	Drilling – Mud Rotary and Hollow Stem Auger Monitoring Well Installation Groundwater Monitoring Aquifer Tests (72-hour and Slug) Job Safety Analyses (JSA) for these tasks are included in Appendix A
Chemicals:	Volatile Organic Compounds Chromium (hexavalent and total chromium), 1,4-dioxane, 1,2,3-trichloropropane (TCP), and other select emerging chemicals (including perchlorate and n-nitrosodimethylamine [NDMA]) in groundwater and soil (see Section 1.7 for complete list). Material Safety Data Sheets are included in Appendix B
Start Date:	September 10, 2012
Field Work Duration:	12 months

1.2 Project Personnel

Project Position	Name	Office	Cell
Project Manager:	Michael Taraszki, PG, CHG	510-663-3996	510-368-4549
Task Manager: Site Health & Safety (H&S)Coordinator:	Mike Barnes Eileen Bailiff, PG, CEG	510-663-3987 949-574-7506	510-326-1901 949-283-5560
HSE Regional Manager: Office H&S (HSE) Coordinator:	Don Kubik Jr, PG, CIH Lisa Ehlers	510-663-4115 510-663-4259	510-368-6433 510-666-7077
Field Team Leaders:	Eileen Bailiff, PG, CEG Damian Hriciga, PG Sean Culkin, PG	949-574-7506 510-663-3988 510-663-3989	949-283-5560 510-435-7138 510-502-4302

1.3 Physical Hazards

Potential physical hazards at the site include elevated noise levels from the use of heavy equipment, engines, other motors and vehicle traffic; slip, trip and fall hazards; material-handling (back) injuries; heat stress; drill rig failures; and vehicle traffic. Underground or aboveground utilities may pose a hazard during subsurface drilling and excavating.

1.4 Biological Hazards

Biological hazards may be present within the operable unit in the form of animals or poisonous plants. These hazards may be encountered during groundwater sample collection and flow monitoring, aquifer testing, and well installation activities at various locations within the operable unit.

1.5 Chemical Hazards

Chemicals hazards review below were chosen based on the chemical properties, concentrations and distributions previously encountered, and those listed in the U.S. Environmental Protection Agency's (USEPA) Agreement and Order on Consent for Remedial Design.

Hazardous Substances Known or Suspected at Site:

CAS #	CHEMICAL	EXPOSURE LIMITS		LEL %	IP (eV)	KNOWN or EXPECTED CONCENTRATIONS	HEALTH HAZARDS
		Cal/ OSHA	ACGIH			Groundwater (µg/L)	
79-01-6	Trichloroethene (Trichloroethylene, TCE) (ppm)	25/S100/C300/I1,000	10/S25	8	9.45	17,000	*RISE*; Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia ; liver injury; [potential occupational carcinogen]
79-00-5	1, 1, 2 Trichloroethene (ppm)	10/S45/ I100	10	6	11	88.2	*RISE*; SKIN; Irritation eyes, Nose; central nervous system depression; liver, kidney damage; dermatitis; [potential occupational carcinogen]
127-18-4	Tetrachloroethene (PCE, Perchloroethylene) (ppm)	25/S100/C300/ I150	25/S100		9.32	6,100	*RISE*; Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]
75-34-3	Dichloroethane, 1,1- (1,1-Ethylidene dichloride) (ppm)	100/I3,000	100	5.4	11.06	60	*RISE*; Irritation skin; central nervous system depression; liver, kidney, lung damage
107-06-2	Dichloroethane, 1,2- (Ethylene dichloride) (ppm)	1/S2/C200/I50	10	6.2	11.05	107	*RISE*; Irritation eyes, corneal opacity; central nervous system depression; nausea, vomiting; dermatitis; liver, kidney, cardiovascular system damage; [potential occupational carcinogen]
75-35-4	Dichloroethene, 1,1- (Vinylidene chloride, 1,1-dichloroethylene) (ppm)	1	5	6.5	10	86	*RISE*;Irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]
56-23-5	Carbon tetrachloride (ppm)	2/S10/C200/I200	5/S10		11.47	25.7	*RISE*; SKIN; Irritation eyes, skin; central nervous system depression; nausea, vomiting; liver, kidney injury; drowsiness, dizziness, incoordination; [potential occupational carcinogen]
75-09-2	Methylene chloride (Dichloromethane) (mg/m3)	25/S125/I2,300	50	13	11.32	240	*RISE*; Irritation eyes, skin; lassitude (weakness, exhaustion), drowsiness, dizziness; numbness, tingle limbs; nausea; [potential occupational carcinogen]

CAS #	CHEMICAL	EXPOSURE LIMITS		LEL %	IP (eV)	KNOWN or EXPECTED CONCENTRATIONS	HEALTH HAZARDS
		Cal/ OSHA	ACGIH			Groundwater (µg/L)	
96-18-4	1, 2, 3 Trichloropropane (ppm)	I100	10	3.2 (@24 8 F)		170	*RISE;*SKIN; irritation eyes, nose, throat; central nervous system depression; in animals: liver, kidney injury; [potential occupational carcinogen]
123-91-1	1,4 Dioxane (ppm)	25/I500	20	2	9.13	320	*RISE;* SKIN; Irritation eyes, skin, nose, throat; drowsiness, headache; nausea, vomiting; liver damage; kidney failure; [potential occupational carcinogen]
1333-82-0	Chromium (VI) water soluble compounds (mg/m3)	0.05/I15	0.05			140,000	*RISE*; Irritation respiratory system; nasal septum perforation; liver, kidney damage; leukocytosis (increased blood leukocytes), leukopenia (reduced blood leukocytes), eosinophilia; eye injury, conjunctivitis; skin ulcer, sensitization dermatitis; [potential occupational carcinogen]
Varies	Chromium (III) compounds (mg/m3)	0.5/I25	0.5			149,000 (total Cr)	*RISE*; Irritation eyes; sensitization dermatitis
62-75-9	N-Nitrosodimethylamine (NDMA) (ppm)				8.69	5.7	*RISE;SKIN;* Nausea, vomiting, diarrhea, abdominal cramps; headache; fever; enlarged liver, jaundice; decreased liver, kidney, pulmonary function; [potential occupational carcinogen]
none	Perchlorate (in groundwater)	none	none			1,700	*RISE*; Irritant

Notes
CAS – Chemical Abstracts Number
Chemical exposure limit concentrations in:
- ppm – parts per million
- mg/m^3 – milligrams per cubic meter

Exposure Limits – If not specified, exposure limit is the Cal/OSHA PEL or the ACGIH TLV-TWA.
- Cal/OSHA – California Division of Occupational Safety and Health
- PEL – Permissible Exposure Limit
- ACGIH – American Conference of Governmental Industrial Hygienists
- TLV-TWA – Threshold Limit Value - time-weighted average
- Exposure limit preceded by an "S" is a Short Term Exposure Limit, by a "C" is the Ceiling Limit, and by an "I" is the NIOSH IDLH.
- NIOSH – The National Institute for Occupational Safety and Health
- IDLH – Immediately Dangerous to Life or Health

LEL – Lower Explosive Limit in percent
IP – Ionization Potential in electronvolt (eV)
Groundwater concentrations in µg/L – micrograms per liter
Soil concentrations in mg/kg – milligrams per kilogram
RISE - Respiratory, Ingestion, Skin absorption, Eye absorption
Health Hazards:
- Letters in italics represent exposure routes: R – Respiratory; I – Ingestion; S – Skin Absorption; and E – Eye Absorption
- SKIN – Chemical represents a significant skin absorption hazard.

Material Safety Data Sheets (MSDS) for the above chemicals and for chemicals expected to be used on site in course of field work (e.g., fuels for generators) are included in Appendix B. If additional chemicals - not included in the plan - are brought onto the site, the applicable JSA will be modified accordingly, MSDS placed into the field copy of this HASP, and chemical reviewed during tailgate safety meetings.

Based on a review of the properties of the chemical, historical data from the study area, and the proposed scope of work, there appears to be a limited potential for occupational exposure to the chemicals of concern (COCs) with exposures well below the OSHA and Cal/OSHA exposure limits. AMEC will monitor the site conditions and if any variations to the anticipated conditions occur or the established action limits are exceeded (Section 2.2) will stop work and reassess the conditions.

1.6 Emergency Signals Table

Emergency procedures listed in this plan are designed to give the field team instructions in handling medical emergencies, fires and explosions, and excessive emissions during the operational activities. These emergency procedures will be carefully reviewed with the field team during the health and safety training session.

Personnel in the immediate work area (e.g., Exclusion Zone) should remain within sight of the Site Health and Safety Officer (HSO).

Repeated horn blasts will be the emergency signal to indicate that all personnel should leave the Exclusion Zone.

The following standard hand signals will be used when vocal communication is not possible.

Hands gripping throat..... Out of air, can't breathe

Grip partner's wrist or both hands around waist..... Leave area immediately

Hands on top of head ..... Need assistance

Thumbs up..... OK, I am all right, I understand

Thumbs down..... No, negative

1.7 Emergency Telephone Numbers

Ambulance 9-1-1

Fire 9-1-1

Police 9-1-1

Note: AMEC has contacted the Los Angeles Fire Department to confirm that calling 911 from a cell phone will connect to the local emergency dispatcher.

Hospital Pacifica Hospital of the Valley
9449 San Fernando Road.
Sun Valley, California 91352
Telephone Number (818) 767-3310

See Appendix C for the Hospital Location Map and Appendix D for a Site Study Area Map.

Pacifica Hospital of the Valley is located approximately 4 miles north of the site location. Work task sites vary throughout the North Hollywood Operable Unit (NHOU) study area. Assumed starting location for the following driving directions is 11845 Vose Street.

1. Head west on Vose St toward Radford Ave.
2. Turn right onto Laurel Canyon Blvd.
3. Take the 1st left onto Sherman Way
4. Take the ramp onto CA-170 North
5. Take exit 11A for Sheldon Street/I-5 North toward Sacramento
6. Turn left onto Sheldon Street
7. Turn left onto Ilex Ave., medical center is straight ahead

Directions to the hospital, a list of emergency contacts, first-aid equipment, and fire extinguishers will be available on-site at the command station and will be discussed during the safety meeting prior to the start of work. In the event workers are exposed to contaminated soil or water, the following first-aid procedures will be utilized, but not necessarily in the following order:

1. Wash extremities
2. Administer first aid as needed.
3. Give artificial respiration, if needed.
4. Contact emergency personnel as necessary.

1.8 Level of Protection - Modified Level D

Based on a review of the anticipated site hazards, the level of protection at the site will be Modified Level D. Personal Protective Equipment Required:

- Hard hat
- Eye protection (American National Standards Institute approved safety glasses)
- Ear plugs, disposable (if working near motorized drilling/sampling equipment)
- Nitrile Gloves
- Heavy work gloves (as needed)
- Safety boots
- High visibility shirt or vest

Safety Equipment Required:

- First aid kit
- Fire extinguisher (A, B, C type)

Based on the type of work to be performed and chemical hazards that may be encountered, USEPA Level D personal protection equipment (PPE) has been determined to be adequately

protective and suitable for certain tasks in this project. Personal protective equipment requirements for Level D protection is summarized below:

Level D: [NIOSH 85-115]	Steel-toed work boots Hard hat Eye protection (safety glasses, goggles or face shield) Splash aprons (if needed) Gloves – Nitrile

NIOSH, OSHA, U.S. Coast Guard (USCG), USEPA, 1985, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, Publication NIOSH 85-115*, October.

1.9 Plan Purpose and Use

This HASP has been developed to assist site personnel in recognizing, understanding and avoiding potential health and safety hazards that may be present at the site. It was developed for the use of AMEC employees with the understanding that site personnel will have completed the Cal/OSHA required hazardous waste operations training. Therefore, site personnel are expected to be knowledgeable in standard procedures, abbreviations, and acronyms. Compliance with this HASP is required of AMEC personnel who enter site work areas.

Subcontractors are responsible for the development of their health and safety plan and for monitoring their employees' compliance with their own plan.

2 FIELD PROCEDURES

2.1 Site Control Procedures

For purposes of this HASP, "Site" is the subject Site at 11845 Vose Street or any of the off-site well or drilling locations to be visited for sampling or investigation.

It will be necessary for the field team to control access to the field task site. Only persons who meet the training and medical monitoring requirements and who are in possession of the required personal protective equipment will be allowed in the decontamination or hot zones. Prior to the start of the field work, the field supervisor will undertake the following steps, as appropriate, to secure site control:

- Check in with the facility/site representative.
- Place flagging/barricades/stakes/cones/tape to demark the work zones boundaries, to help prevent cross-contamination, and to limit site access points.
- Setup support and decontamination zones (Contaminant Reduction Zone) equipment, materials and supplies.

2.2 Air Monitoring Requirements

Based on the scope of work and the concentrations and distribution of potential COCs, exposure to airborne concentrations of volatile COCs should be limited. To help assure this, site worker breathing zones will be monitored to assure that site workers are not exposed above the regulated permissible exposure limits (PELs).

Based on a review of the COCs and their properties, breathing zone monitoring will be done with a Photoionization Detector (PID) with an 11.7 eV lamp. While work is being done where impacted materials are being disturbed, PID readings will be taken at least every 15 minutes.

The following action levels will be followed.

PID Readings Sustained in breathing zone >1 minute	Actions
<5 ppm	Work continues normally
≥5 ppm	Stop work, leave the immediate area and retest the area a few minutes later. If conditions persist contact health and safety manager for reassessment.

Based on the scope of work, operations are not anticipated to generate airborne dust; therefore, dust monitoring will not be required.

2.3 Pre-Entry Procedures

Prior to entry into the hot zone, the field supervisor will:

- Evaluate site conditions.

- Review route to hospital at it may vary from day to day for specific task site.
- Identify locations for the fire extinguisher, telephone, first aid kit, restrooms, and rest areas.

If restrooms are not available at the site, sanitary facilities may be required, dependent upon field work duration. See California General Industry Safety Orders, Article 9, Sanitation. (http://www.dir.ca.gov/Title8/sb7g2a9.html)

- Hold the daily safety meeting.
- Review locations of emergency equipment (e.g., fire extinguisher etc.).
- Review evacuation signals.
- Pair-off workers to implement the buddy system.

The site safety coordinator is responsible for collecting baseline heart rate values for heat stress monitoring measurements prior to beginning work.

Site personnel are responsible for inspecting equipment, tools, PPE (including respirators) and other materials to be used on the job prior to beginning work.

2.4 Work Limitations

- No eating, drinking, or smoking will be permitted in the hot or decontamination zones.
- Contact lenses should not be worn.
- Facial hair that could interfere with respirator fit will not be permitted.
- Only authorized personnel are to enter the hot or decontamination zones.
- With the exception of limited night-time supervision during the 72-hour pump test, work will be done during daylight hours only.
- Site activities will not be conducted during lightning storms.

2.5 Decontamination Procedures

The field supervisor is responsible for the decontamination of equipment and PPE used at the site according to the procedures outlined in the Phase 1 Pre-Design Investigation Work Plan and below, as applicable. Decontamination activities are to be documented in the daily field logs and maintained in the project file.

2.5.1 Decontamination Zone

A step-off decontamination may be used at this site. The decontamination zone is to be established at a sufficient distance from the drilling or excavation activities to help limit contamination by airborne soil particles and should be located up-gradient and up-wind of the work area, where possible.

2.5.2 Personnel

A modified Level D protection ensemble is deemed appropriate for the off-site sampling activities. The intent is to provide incidental contact protection from soil and sampled

groundwater. While extraordinary decontamination procedures are not necessary in the field, an operative criterion of modified Level D is to avoid taking dirt or any contamination home. Accordingly, diligence to minimize carriage of dirt into vehicles must be practiced, and a change of clothes and a shower should be taken at the end of the work day.

For field investigation drilling and/or well installation that could involve a potential upgrade to Level C respiratory protection, follow the following guidance. Remove overall or Tyvek garment and boots. Place overall into a plastic bag, for cleaning. Wet a clean cloth and wipe boots to remove dust or soil, remove gloves. Remove respirator and respirator cartridges (as applicable). Wipe respirator with clean wet cloth. Place disposable garments and respirator cartridges into properly labelled debris drum at the site. Wash hands and face; take a shower and wash hair as soon as possible after leaving the site.

2.5.3 Equipment

Equipment used at the site, including monitoring instruments and heavy equipment is to be decontaminated, as necessary. For heavy equipment loose dirt will be brushed off with a steel brush or bristle brush. Wash and rinse the equipment with soap and water or pressure-wash the equipment prior to it leaving the site. Instruments will be wiped down with clean soapy cloths and rinsed with wet cloths. Place cloths in debris drum at the site.

2.5.4 Emergency Decontamination

In the event of a life threatening injury or illness, the decontamination for removal of PPE will not typically be undertaken. The PPE is to be removed as quickly as possible and first-aid rendered. If the PPE is significantly soiled and the contaminants would pose an immediate health to others, a quick, gross decontamination effort will be performed prior to the removal of the PPE.

In cases where the injury or illness is not life threatening, a quick decontamination will be performed and the person assisted in the removal of the PPE. First-aid will be rendered after PPE has been removed.

2.5.5 Investigation Derived Wastes

Decontamination rinsate, if any, is to be collected and transferred to drums on site. Decontamination rinsate drums are to be labelled as rinsate awaiting analytical results, with the date, and the name and phone number of the AMEC representative and client representative. Debris drums are to be similarly labelled with PPE and trash indicated as the contents. Once analytical results have been received, the project manager is to evaluate whether the drums are to be managed as hazardous wastes and will coordinate with the client for the proper labelling, transportation and disposal.

3 SAFE WORK PRACTICES

The following sections identify safe work practices for the field activities scheduled at the site. These practices were designed to help field personnel work safely. Although the following practices are intended to incorporate Cal/OSHA requirements, subcontractors and other employers at the site are responsible for complying with applicable Cal/OSHA health and safety requirements, their health and safety plan, and for monitoring the actions of their employees.

Prior to work, subcontractors will submit copies of their health and safety plan and related JSAs to AMEC for review by client.

3.1 Chemical of Concern Avoidance

- Avoid unnecessary direct contact with impacted surfaces, soils or liquids,
- Do not sit, kneel, or lean on impacted surfaces or drums,
- Walk around puddles, or obvious impacted areas,
- Do not place monitoring or other equipment on impacted surfaces.

3.2 Overhead and Underground Utilities

Utility lines, both aboveground and underground, may pose a safety hazard for team members during drilling operations. The presence of underground utilities must be evaluated prior to start-up. Proposed boring/trenching locations shall be marked with white paint, at least 48 hours prior to commencement of work. DigAlert (811 or 800-277-2600 or www.digalert.org) must be contacted at least 48 working hours prior to drilling. The Field Supervisor will be responsible for securing utility clearances and recording DigAlert Ticket number.

In additional to utilizing DigAlert, AMEC will utilize a private locater service to assist in locating utility lines as each drilling location will be cleared to a depth of at least 5 feet by hand augering, air knife or similar device.

Unless under direct supervision by an authorized representative of the owner of the utility, excavation with mechanical equipment shall never be closer than

- 2 feet plus half the diameter of the pipe of a gas distribution line;
- 5 feet plus half the diameter of the pipe of all gas transmission pressure (above 60 pounds per square inch (psi)) facilities and all electrical facilities operating at and above 60 kilovolt; and
- 10 feet plus half the diameter of the pipe of all pressurized sewage, natural gas (above 60 psi), petroleum, hazardous materials pipelines and high-voltage electric supply lines, conductors, or cables.

If a more conservative distance is specified by the utility owner, then the more conservative distance shall apply. Hand digging or other non-destructive excavation technique shall be used within the tolerance zone/hand exposure zone.

Ground disturbance within the tolerance zone/hand expose zone of a buried utility requires that the utility be physically located (i.e. potholed or daylighted) using non-destructive excavation technique. Non-destructive excavation technique include hand digging (using non-pointed tools) laterally or vertically from the tolerance zone and may include vacuum, air or high pressure water techniques. Use of high-pressure air stream to break up and cut soil while using high-flow vacuum system to lift the soil up and out of the excavation area must be agreed upon by the utility owner. Pressure control equipment is required to prevent excessive pressures on the utility line. The maximum pressure to be used at any time during excavation shall be 120 psi. Maintain appropriate distances and not closer than 8 inches between the end of the pressure wand nozzle and the utility and/or the subsoil. The nozzle shall never be inserted into the subsoil while excavating above the utility.

Backfilling shall be performed in a manner to ensure the support of the exposed utility. Backfilling material should be clean fill or granular material free of material injurious to the utility coating and conduit. The owner of the utility shall be notified and provided an opportunity to inspect the utility prior to backfilling.

All existing facility plot plans, utility maps and geophysical survey maps showing the types and locations of utilities present in the project area, will be reviewed and available on site during investigation work.

Whenever possible, avoid working under overhead high voltage lines. The following are minimum clearances for overhead high voltage lines.

Normal Voltage (phase to phase)				Minimum Required Clearance (feet)
more than	750	-	50,000	10
more than	50,000	-	75,000	11
more than	75,000	-	125,000	13
more than	125,000	-	175,000	15
more than	250,000	-	379,000	21
more than	370,000	-	550,000	27
more than	550,000	-	1,000,000	42

(Reference: CCR Title 8, Section 2946, Table II)

If work is to be done near overhead power lines, AMEC will contact the power utility to obtain information of the voltage of the lines.

3.3 Drilling Operations

Physical hazards associated with subsurface drilling operations involve the use of heavy equipment. Both above- and below-ground utility lines present a potential for electrocution if contacted by drilling equipment. Other subsurface obstructions should be located (as possible) before drilling starts. The JSA included in Appendix A further detail on the hazards to be encountered while drilling.

The drilling activities can also involve a number of potential injury/hazardous conditions including, but not limited to, injuries from noise, flying debris, being caught up in machinery, hydraulic failures, airborne particulates, equipment rollover, and other hazards associated with

the transportation and use of drill rigs, especially on uneven ground. To protect site personnel, hard hats, safety footwear, eye protection, and hearing protection are required to be worn in the vicinity of the drill rig. The following steps should be followed to reduce the potential for accidents and injuries associated with drilling:

- The drilling rig should be inspected, maintained, and operated by a fully qualified driller.
- The drilling tools should be kept in their proper places.
- Fire extinguisher should be readily available for use.
- Drill rig will never be moved with the mast up.
- Drill rig will be stabilized to prevent rollover per driller's JSA.

The drillers will verify that all "kill" switches are working and will show other site personnel the location of these switches prior to start of work each day.

3.4 Groundwater Monitoring

Groundwater monitoring (including accessing monitoring wells to measure depths to groundwater or to collect groundwater samples) has the potential for a health or safety related incident to occur due to the variability of the work environment. Repeated stop-and-go driving, property access, water and well sampling location access and unique site hazards makes this a challenging environment to perform work. The JSA included in Appendix A further detail on the hazards to be encountered during groundwater monitoring activities.

- Be alert for unrestrained animals and hazardous sampling locations.
- Check for biohazards.
- Wear appropriate PPE during sampling (gloves, goggles, and safety shoes at a minimum).
- Park vehicle safely or in designated area. Turn off engine, secure parking brake.
- Seatbelts are mandatory whenever the vehicle is in motion, headlights for increased visibility are recommended.

3.5 Heat Stress

Heat stress is a major hazard, especially for workers wearing protective clothing. To avoid heat stress and to comply with California's Heat Illness standard, CCR Title 8 Section 3395. The procedures will be followed:

1. Site workers will be trained in heat illness prevention. Heat illness prevention will be discussed at each tailgate safety meeting.
2. Cool, potable water must be available for all site workers. Water shall be provided in sufficient quantity to provide one quart per employee per hour for drinking for the entire shift. If water supplies at the site run low, all site workers are authorized to stop work and obtain sufficient quantities of water at the employer's expense.
3. At temperatures above 85°F, shade must be provided or shaded areas identified for site workers to take their regular breaks (see below). An air conditioned building or vehicle

may be used for this. At temperatures below 85°F, shade will be provided or identified if requested by site workers.

At temperatures greater than 95°F, the following additional procedures will be followed:

1. Ensure that there is effective communication between all site workers.
2. Closely observe all site workers for signs of heat stress. Each site worker will observe and if signs of heat stress are identified, work will stop and situation will be assessed.
3. Encourage more frequent drink of water and taking of rest breaks in the shade.
4. Close observe any worker who is not from the work area. Acclimatization can take up to 14 days.

3.5.1 Heat Stress Illnesses

Heat stress illnesses include:

- **Heat Stroke**—a life threatening situation in which the victim's body temperature control system, which produces sweating to cool the body, stops working. Body temperature can rise quickly to levels that can cause brain damage and death.
- **Heat Exhaustion**—a less dangerous condition that results from loss of body fluids. This fluid loss causes blood flow to decrease in vital organs, resulting in a form of shock. In addition, sweat does not evaporate properly due to high humidity, layers of clothing, or PPE, resulting in inadequate cooling of the body. Heat exhaustion can quickly turn into heat stroke.
- **Heat Cramps**—muscular spasms with pain, due to the loss of electrolytes through sweating. These cramps usually involve the abdomen, legs, or arms and usually occur several hours after the physical exertion has stopped.
- **Heat Rash**—commonly referred to as “prickly heat rash.” Small, red, fluid filled blisters. Caused by excessive moisture and chafing clothing.

Preventing heat stress illnesses is particularly important because once someone suffers from a heat stress illness, that person may be predisposed to additional injuries. The signs, symptoms and first aid for heat stress illnesses are listed below.

Forms of Heat Stress	Signs/Symptoms	First Aid
Heat Stroke	Hot, red skin Constricted (small) pupils High body temperature Unusually dry skin	Call 911, immediately and care for shock. Immerse in cool water or wrap in wet towels. Give NOTHING by mouth.
Heat Exhaustion	Cool, pale, moist skin Heavy sweating Normal body temperature Dilated (large) pupils Headache, nausea, dizziness, vomiting	Move to cool area. Have victim lie down, elevating feet by 1 to 1½ feet. Loosen clothing. Apply wet towels. Call 911 or transport to medical facility. Give glass of water every 15 minutes, prior to or during transport.

Forms of Heat Stress	Signs/Symptoms	First Aid
Heat Cramps	Muscular pain, aches	If symptoms occur on the job, move to cool place and give glass of water or electrolyte solution every 15 minutes.

3.5.2 Heat Stress Monitoring

Ambient temperatures at the Site are expected to range from 70°F to greater than 90ºF. When temperature exceeds 70ºF, frequent breaks will be taken in shaded areas. Cool water or electrolyte replenishment solution will be available on site. Sufficient amounts of drink should be taken frequently to replace fluid loss. Coveralls will be unzipped or removed during breaks. When protective clothing must be worn, the suggested guidelines for ambient temperature and maximum work periods from the *NIOSH/OSHA/USCG/USEPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* are:

Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers[a]

Adjusted Temperature[b]	Normal work Ensemble[c]	Impermeable Ensemble[d]
90 ºF (32.2 ºC) or above	After each 45 minutes of work	After each 15 minutes of work
87.5 - 90.0 ºF(30.8 - 32.2 C)	After each 60 minutes of work	After each 30 minutes of work
82.5 - 87.5 ºF(28.1 - 30.8ºC)	After each 90 minutes of work	After each 60 minutes of work
77.5 - 82.5 ºF(25.3 - 28.1ºC)	After each 120 minutes of work	After each 90 minutes of work
72.5 - 77.5 ºF(22.5 - 25.3ºC)	After each 150 minutes of work	After each 120 minutes of work

Notes:
[a] For work levels of 250 kilocalories/hour.
[b] Calculate the adjusted air temperature (ta adj) from the measured air temperature (ta) by using this equation: ta adj ºF=ta ºF + (13 x % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow (100 % sunshine = no cloud cover and a sharp distinct shadow; 0 percent sunshine = no shadows).
[c] A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.
[d] Impermeable Ensemble includes Tyvek and Saranex coveralls and rubber boots.

Pulse rates and oral temperatures may be monitored as early as possible in the rest period. If the pulse rate exceeds 100 beats per minute or temperature exceeds 99ºF at the beginning of the rest period, the work cycle will shorten by one-third.

3.6 Biological Hazards

Insects are the most likely biological hazard to be encountered and the most unpredictable. Wasps and vespids (yellow-jackets) may nest in structures that protect them from the elements or directly in the ground. Red ants (fire-ants) are typically ground dwellers and will usually clear a patch of ground around the opening to their nest. Be aware of where you are standing. Watch for high concentrations of insect activity as it may alert you to a nearby nesting location. Warmer temperatures will increase their activity. Increased noise and vibration will generally cause agitation.

- Learn to recognize the Black Widow spider, its web and habits. This is the most likely poisonous spider to be contacted in California.

- Use insect repellent containing DEET to avoid contact with ticks, mosquitoes, and other insects (disease carriers or poisonous), as necessary. Use a non spray repellent to minimize potential contamination of field samples.
- Deer ticks are very small and may carry Lyme disease. If you believe you have encountered a deer tick, retain it on a piece of moist paper towel between two pieces of tape and submit it to a county health facility for proper identification and determination of disease potential.
- Avoid contact with rodents because they frequently are hosts to fleas, which can carry typhus and the plague. Rodent urine may also contain spirochetes harmful to human health (hantavirus).
- Wear protective clothing (heavy work gloves, long sleeves) when reaching into enclosed spaces with limited visibility.
- Avoid encounters with biting and stinging insects.

3.7 Safe Driving Practices

During the conduct of off-site well sampling, vehicle travel is necessary. In addition to the safe driving practices specified in the Integrated HSE Program Manual it is required that the vehicle be stocked with a fire extinguisher and first aid kit.

4 EMERGENCY PROCEDURES & INCIDENT REPORTING

4.1 Non-Emergency Incident

Steps 1 & 2 must be completed – before seeking medical attention other then the local first aid

1. Report the situation to your immediate supervisor AND safety coordinator (all incidents with the clear starting event should be reported within 1 hour of occurrence)
2. Call WorkCare 24/7 Hotline: (888) II-XPRTS or (888) 449-7787
3. WorkCare will assess the situation telephonically and determine whether the incident requires medical attention. During this process, the WorkCare will perform the following duties:
   - Explain the process to the caller
   - Determine the nature of the concern
   - Provide appropriate medical advice to the caller
   - Determine appropriate path forward with the caller
   - Maintain appropriate medical confidentiality
   - Help caller to execute path forward, including referral to the appropriate local medical facility
   - Send an email notification to the corporate safety contact
4. Within 2 Hours of the incident inform verbally (direct contact is required) contact Don Kubik - (510) 663-4100 (office); (510) 368-6433 (cell) - HSE Regional Manager, AMEC - Oakland, CA
5. Local HSE Coordinator to complete the initial Incident Report within 24 hours and forward it to the Corporate HSE Department
6. Corporate Human Resources (HR) to complete Worker's Compensation Insurance notifications
7. Corporate HSE to conduct further incident investigation and communicate as needed

Note: These procedures are only for AMEC employees.

4.2 Medical Emergencies

In the event of a medical emergency, the following procedures should be used.

1. Remove injured or exposed person(s) from immediate danger if possible.
2. Perform emergency eyewash and shower if necessary.
3. Evacuate other on-site personnel to a safe place in an upwind direction until it is safe for work to resume.
4. If serious injury or life-threatening condition exists, call:

911 - Paramedics, fire department, police
Hospital emergency room

i. Clearly describe location, injury and conditions to dispatcher/hospital. Designate a person to direct emergency equipment to the injured person(s).

1. Provide first aid if necessary. Remove contaminated clothing only if this can be done without endangering the injured person.
2. Call the project manager and/or project HSO
3. Immediately implement steps to prevent recurrence of the accident
4. Once medical attention is sought and provided, the supervisor must contact WorkCare 24/7 Hotline: (888) II-XPRTS or (888) 449-7787
5. WorkCare will be responsible for performing the following duties:
   - Contact the treating physician
   - Inform the physician of the injury/illness
   - Request to be consulted on treatment
   - Determine appropriateness of treatment
   - Request copies of all medical records from medical facility
   - Remind the treating physician of the care management philosophy
   - Send an email update to the Corporate Safety contact
     1. IMMEDIATELY after contacting WorkCare inform verbally (direct contact is required) contact Don Kubik - (510) 663-4100 (office); (510) 368-6433 (cell) - HSE Regional Manager, AMEC - Oakland, CA
     2. Notify the local HSE coordinator and Safety Committee worker representative (if applicable) to complete initial investigation with the Supervisor
     3. Local HSE Coordinator to complete the initial Incident Report within 24 hours
     4. Corporate HR to complete Worker's Compensation Insurance notifications
     5. Corporate HSE to conduct further incident notifications, investigation and develop internal communications

5 TRAINING AND MEDICAL MONITORING

5.1 Training

5.1.1 Hazardous Waste Operations Training

Site personnel are required to be current in the appropriate level of hazardous waste operations training as required by the Cal/OSHA "Hazardous Waste Operations and Emergency Response" standard (8 CCR 5192). Additionally, site personnel will also be current with other required training including hazard communication, blood borne pathogens, heat illness prevention, fire extinguisher use, etc.

5.1.2 First-Aid/CPR Training

At least one on-site field person will be current in First Aid and Cardio Pulmonary Resuscitation (CPR) training. Only persons current in CPR/First Aid training are to render first aid at the site.

5.1.3 Equipment Training

Only trained, qualified persons are to operate equipment at the site. Equipment operators must be current in any equipment or activity specific training as required by Title 8 Section 1510 and other Cal/OSHA requirements. Subcontractors will provide documentation of training along with their HASPs and JSAs.

5.1.4 Site Safety Meetings

The Site H&S Coordinator or their designee will conduct daily safety meetings before field personnel begin work and when additional personnel or visitors arrive. The meetings are to be attended by all field personnel. The purpose of the meetings is to review pertinent information on site hazards, protective measures, or changes in scope of work and should include a discussion on the following:

- Description of the tasks and their potential hazards,
- Coordination of site activities,
- Identification of methods and precautions to prevent injuries,
- Emergency planning,
- Modification(s) to the HASP (if any), and
- Input from field personnel on H&S issues pertaining to site activities (if any).

The attendees' signatures acknowledging receipt and understanding of the HASP and their agreement to comply will be collected on the first day of work. Additional meetings will be documented in the daily field logs, identifying the meeting attendees. Field logs are to be kept in the project files.

5.2 Medical Surveillance

All AMEC project site personnel shall participate in the AMEC medical surveillance program, which includes annual audiometric and physical examinations for employees involved in hazardous waste or materials projects. It requires that all such personnel have medical clearance before being issued a respirator and participating in field activities. Frequency of medical examinations which complies with 29 CFR § 1910.120(f3) is required as follows:

1. prior to performing field work;
2. at least once every 12 months;
3. at termination of employment;
4. upon occurrence of possible overexposure;
5. more frequently if deemed necessary by a physician and;
6. retention of medical records and personnel monitoring data for a period of time specified in 8 CFR § 3204 (d).

6 CONTINGENCY PLAN AND EMERGENCY EVACUATION PLAN

At least one person trained in first aid and CPR will be present on site at all times. First aid and blood borne pathogen supplies shall be available at the site at all times. At a minimum, a five-person, first aid kit will available in the AMEC vehicle. Personnel shall be informed of the location of such supplies during the tailgate safety meeting.

6.1 Emergencies

Anticipated emergencies include:

- First aid - cuts, bruises, fractures, strains
- Electrical contact
- Earthquake
- Fire/explosion
- Electrical storms or rainstorms

6.2 Evacuation Procedures and Assembly Point

In the event of a life-threatening emergency such as a fire, or electrical storm, the AMEC Emergency Coordinator will notify all personnel to leave the site. Emergency communication will be done by cell phone, yelling and/or by hand signals.

All personnel will stop what they are doing, secure the area for safety reasons, immediately leave the work area and assemble at the AMEC vehicle or a pre-established location that is upwind of the Site in a safe location.

The AMEC Emergency Coordinator will conduct a head count of all site personnel. If personnel are unaccounted for, the Emergency Coordinator will yell and sound the vehicle horn three times to get their attention. The Emergency Coordinator will then proceed to conduct a systematic search of the immediate area if it is safe to do so.

6.3 Emergency Response and Notification of Releases

A cell phone will be present in the AMEC vehicle at the site for emergency notifications. After the initial emergency or evacuation is under control and personnel are safe, the Emergency Coordinator will notify 911 to request emergency assistance if necessary. After this call has been made, the Emergency Coordinator will notify the Project Manager and the HSO.

If any action of occurrence during the performance of Work causes or threatens a release of Waste Material at the NHOU that constitutes an emergency situation or may present an immediate threat to public health or welfare or the environment, AMEC field personnel will take appropriate actions to prevent, abate, or minimize such release or threat of release, and will immediately notify the Project Manager. The AMEC project manger will notify the USEPA's Project Manager, or, if the Project Manager is unavailable, USEPA's Alternate Project Manager. If neither of these persons is available, the AMEC Project Manager will notify the Duty Officer in

USEPA Region IX's Emergency Response, Preparedness, and Prevention Branch, at (800) 300-2193.

In addition, in the event of any release of a hazardous substance from the NHOU, AMEC field personnel will immediately notify the National Response Center at (800) 424-8802. AMEC will submit a written report to USEPA within seven days after each release, setting forth the events that occurred and the measures taken, or to be taken, to mitigate any release or endangerment caused or threatened by the release and to prevent the reoccurrence of such a release. Cal/OSHA will be notified immediately within 8 hours if a serious injury has occurred that requires hospitalization or causes death.

6.4 Response to First Aid Emergencies

If an injury occurs that requires first aid or additional medical care, the person responding to the scene will do the following prior to offering first aid:

- ASSESS THE SCENE. The responder shall not enter the accident area if it endangers his/her life.
- CALL FOR HELP. The responder shall notify the Emergency Coordinator or other persons by yelling or other means communication.
- SELF TREAT. If the injured person is conscious and can do so, the injured person shall be instructed to treat themselves and if needed be assisted to do so without exposing the responder to blood borne pathogen contact.
- BLOOD BORNE PATHOGEN PPE. The person responding shall put on protective equipment including gloves, eye protection, booties, coveralls, and/or mouth protector as needed to protect themselves from Blood Borne Pathogens.
- RESPONSIBLE RESPONSE. The person responding shall not treat or attempt to treat a person beyond that level that they are confident and have been trained to do so.
- ABCs: The person responding will follow the standard procedures for responding to first aid emergencies including CALLING FOR HELP, checking airway, breathing and checking cardiac conditions including bleeding.

If an outside agency has been called to render aid:

- A person will be stationed at the street to guide the emergency crew to the scene of the accident or the incident command station.
- The Emergency Coordinator will brief the emergency responders on the nature of the accident and of health and safety hazards present on site.
- If the injured person has been contaminated by a chemical, the Emergency Coordinator will advise response personnel of the nature and toxicity of the chemical.
- Site personnel will assist the response personnel as directed.

After a first aid emergency has occurred the responder(s) under the direction of the Emergency Coordinator or Site Supervisor shall notify the HSO. The HSO with the Project Manager shall conduct an incident investigation. If a potential exposure to a Blood Borne Pathogen has occurred, those expose will be offered preventative Hepatitis B shots.

Response to electrical contact:

- If a piece of equipment comes in contact with electrical equipment or lines, the operator shall remain on the equipment and not try to escape the equipment until the electrical equipment is de-energized and it is verified that the electrical equipment is de-energized.
- Personnel in the area that are not affected shall assess the scene to determine if it is safe to respond.
- If the electricity is still “live”, it is not considered safe to respond, unless the employee is trained to do so safely.
- The electricity shall be turned off, or the circuit de-energized, before a response is executed.
- If the electricity cannot be de-energized, only qualified personnel using insulated tools and clothing shall attempt a response.
- A response shall not be attempted until it is safe to do so.

6.5 Response to Earthquake

Site personnel shall evacuate immediately and assemble at the AMEC vehicle if it is safe to do so. If it is not safe to assemble at the AMEC vehicle, the Emergency Coordinator shall direct the assembly point. The Site will be assessed to determine if it is safe to continue work. The Site Project Manager and HSO will be notified and conferred with prior to re-entering the Site.

6.6 Response to Fire/Explosion

If a fire occurs, personnel shall assess the size and nature of the fire. AMEC site personnel have not been trained to fight or extinguish fires and they are not required to do so.

If it is safe to do so, personnel may extinguish the fire with a fire extinguisher. If it is not safe to extinguish with a fire extinguisher, or the employee is not so trained, the site will be evacuated and the Fire Department will be called.

If an explosion occurs, site personnel will evacuate to the AMEC vehicle or other upwind unaffected location. The Emergency Coordinator shall assess the site for safety and administer first aid as necessary. The fire department will be called. After the fire department is called, the Emergency Coordinator shall notify the Project Manager and the HSO, as soon as the Site is stabilized and it is safe to do so.

6.7 Response to Electrical Storms and Rainstorms

Site activities will be halted during an electrical storm, and all Site personnel shall seek shelter. If rains occur, it shall be up to the Emergency Coordinator to determine if the conditions are safe for employees to continue working. If site activities are halted for any reason, the Project Manager and HSO shall be notified immediately.

If an electrical storm is moving in, abandon the well and lower the mast well before the storm is in the immediate vicinity.

7 ASSIGNMENT OF RESPONSIBILITIES

7.1 Project Manager

The project manager has the responsibility for: 1) determining whether field personnel have had and are current in the requisite training, 2) determining whether field personnel are current in their medical examinations, and 3) having a HASP developed for and available at the project site. He/she is to provide a copy of the HASP to all AMEC employees who may work at this site, for their review prior to their arrival at the site.

In order to comply with the provisions of the Cal/OSHA Hazard Communication Standard (8 CCR 5194) if a subcontractor employed by AMEC will be present on site, the project manager is required to provide the subcontractor with a copy of this HASP prior to the start of the project. The HASP will serve to provide information to the subcontractor on the potential chemical hazards and material safety data sheets at the site, and any control measures implemented.

7.2 Field Supervisor

The field supervisor has ultimate responsibility for directing fieldwork practices and activities at the site. He/she is responsible for utilizing the buddy system while at the site, obtaining and having available equipment or other materials specified in this HASP, and at remote job sites, for communicating daily with the project manager. In the event that a separate site H&S coordinator is not designated for the site, field implementation of the HASP requirements, as identified below, becomes his/her responsibility.

7.3 Site Health and Safety Coordinator

The Site H&S coordinator is responsible for the field implementation of the HASP requirements. This includes daily communicating of specific requirements to site personnel and consulting with the field supervisor, project manager, office health and safety manager, and health and safety consultant on H&S requirements or issues.

7.4 Site Personnel

Site personnel are responsible for reading, understanding and complying with the HASP. They are responsible for notifying the field supervisor or H&S coordinator of unsafe conditions or activities, incidents, injuries, and chemical exposures.

Field personnel are responsible for continuously monitoring their buddy and site conditions to help limit incidents to site personnel and the risk that fieldwork will endanger off-site persons.

7.5 Office Health and Safety Coordinator

The Office H&S Coordinator (also known as the HSE Coordinator) is responsible for assisting in implementing the applicable requirements of the Integrated HSE Program Manual within the office or project.

Site Personnel Sign-Off Sheet

By initialling and dating this form, the listed individual acknowledges that he/she has read, understands, and will comply with the requirements of this Health and Safety Plan.

Name	Date	Initials

APPENDIX A

Job Safety Analysis

Job Safety Analysis Form

Groundwater Monitoring

Job Safety Analyses Form

Job Title: Groundwater Sampling

Applicable ES&H Procedures:
2.9.A - Hazardous Waste Operations and Emergency Response Program
2.9.C - Respiratory Protection Program
2.9.D - Personal Protective Equipment Program
2.9.19 - Electrical Safety
2.14.1 - Flammable and Combustible Liquids
2.14.5 - Collection of Field Samples

Other Referenced JSAs:
- Mobilization/Demobilization and Site Preparation
- Field Work General
- Insect Stings and Bites
- Gasoline
- Working with Preservatives

Key Work Steps	Hazards/Potential Hazards	Safe Practices
1. Mobilization	1A) See JSA Mobilization/Demobilization/Site Preparation	1A) See JSA Mobilization/Demobilization/Site Preparation
2. General Site Hazards	2A) See JSA Field Work - General	2A) See JSA Field Work - General
	2B) Chemical exposure	2B) Chemical Exposure ▪ Read HASP and determine air monitoring and PPE needs.
3. Calibrate monitoring equipment	3A) Exposure to calibration gases	3A) Exposure to calibration gases ▪ Review equipment manuals ▪ Calibrate in a clean, well ventilated area
4. Opening the well cap, taking water level readings	4A) Contact with poisonous plants or the oil from poisonous plants	4A) Contact with poisonous plants or the oil from those plants: ▪ Look for signs of poisonous plants and avoid. ▪ Ensure all field workers can identify the plants. Mark identified poisonous plants with spray paint if working at a fixed location. ▪ Wear PPE as described in the HASP. ▪ Do not touch any part of your body/clothing. ▪ Always wash gloves before removing them. ▪ Discard PPE in accordance with the HASP. ▪ Use commercially available products such as Ivy Block or Ivy Wash as appropriate.
	4B) Contact with biting insects (i.e., spiders, bees, etc.) which may have constructed a nest in the well cap/well.	4B) Contact with stinging/biting insects ▪ Discuss the types of insects expected at the Site and be able to identify them. ▪ Look for signs of insects in and around the well. ▪ Wear Level of PPE as described in the HASP. At a minimum, follow guidelines in the JSA "Insects Stings and Bites." ▪ If necessary, wear protective netting over your head/face. ▪ Avoid contact with the insects if possible. ▪ Inform your supervisor and the Site Health and Safety Supervisor if you have any allergies to insects and insect bites. Make sure you have identification of your allergies with you at all times and appropriate response kits if applicable. ▪ Get medical help immediately if you are bitten by a black widow or brown recluse, or if you have a severe reaction to any spider bite or bee sting.

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	4C) Exposure to hazardous Inhalation and contact with hazardous substances (VOC contaminated groundwater/ soil); liquid splash; flammable atmospheres.	4C) Exposure to hazardous substances ▪ Wear PPE as identified in HASP. ▪ Review hazardous properties of site contaminants with workers before sampling operations begin ▪ Immediately monitor breathing zone after opening well to determine exposure and verify that level of PPE is adequate – see Action Levels in HASP ▪ Monitor headspace in well. After the initial headspace reading (if required by the Work Plan), allow the well to vent for several minutes before obtaining water level and before sampling. ▪ When decontaminating equipment wear additional eye/face protection over the safety glasses such as a face shield.
	4D) Back strain due to lifting bailers or pumps and from moving equipment to well locations	4D) Back strain ▪ Use mechanical aids when possible, if mechanical aids are not available, use two person lifts for heavy items. ▪ Use proper lifting techniques
	4E) Foot injuries from dropped equipment	4E) Foot Injuries ▪ Be aware when moving objects, ensure you have a good grip when lifting and carrying objects. ▪ Do not carry more than you can handle safely ▪ Wear Steel toed boots
5. Collecting water samples	5A) Fire/Explosion/Contamination hazard from refueling generators	5A) Fire/Explosion/Contamination hazard from refueling generators ▪ Turn the generator off and let it cool down before refueling ▪ Segregate fuel and other hydrocarbons from samples to minimize contamination potential ▪ Transport fuels in approved safety containers. The use of containers other than those specifically designed to carry fuel is prohibited ▪ See JSA for Gasoline use
	5B) Electrocution	5B) Electrocution ▪ A ground fault circuit interrupter (GFCI) device must protect all AC electrical circuits. ▪ Use only correctly grounded equipment. Never use three-pronged cords which have had the third prong broken off. ▪ Make sure that the electrical cords from generators and power tools are not allowed to be in contact with water ▪ Do not stand in wet areas while operating power equipment ▪ Always make sure all electrically-powered sampling equipment is in good repair. Report any problems so the equipment can be repaired or replaced. ▪ When unplugging a cord, pull on the plug rather than the cord. ▪ Never do repairs on electrical equipment unless you are both authorized and qualified to do so.
	5C) Exposure to contaminants	5C) Exposure to Contaminants ▪ Stand up wind when sampling ▪ Monitor breathing zone with appropriate monitoring equipment (see HASP) ▪ Wear chemical resistant PPE as identified in HASP ▪ See section 4C) under Safe Practices above
	5D) Infectious water born diseases	5D) Infectious water born diseases ▪ Wear chemical resistant gloves and other PPE – as identified in HASP ▪ Prevent water from contacting skin ▪ Wash exposed skin with soap and water ASAP after sampling event ▪ Ensure that all equipment is adequately decontaminated using a 10% bleach solution

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	5E) Exposure to water preservatives	5E) Exposure to water preservatives ▪ Work in a well ventilated area, upwind of samples ▪ Wear chemical resistant PPE as identified in HASP ▪ When preserving samples always add acid to water, avoid the opposite. ▪ See JSA Working with Preservatives

Identify Hazards and PPE

Complete the checklists for hazard identification and PPE requirements. Information from the RA and applicable permits are included in this section.

Standard Hazards			
☐ Falling Objects	☐ Slips and trips	☐ Pinch points	☐ Rotating equipment
☐ Falls	☐ Power equipment/tools	☐ Elevated work surfaces	☐ _____

Eye Hazards			
☐ Particulates	☒ Liquid splashes	☐ Welding Arc	☐ _____

Hearing Hazards			
☒ None	☐ Impact noise	☐ High frequency noise	☐ High ambient noise

Respiratory Hazards						
☐ None	☐ Dust/particulates	☐ Organic Vapors	☐ Acid Gases	☐ Radon	☐ Asbestos	☐ Be, Hg, Cr, Pb
☐ Oxygen deficient	☐ Welding fumes	☐ Aerosols/Particulates	☐ _____			

Chemical Hazards			
☐ None	☐ Organic solvents	☐ Reactive metals	☐ PCBs
☐ Acids / bases	☐ Oxidizers	☐ Volatiles / Semi-volatiles	☐ _____

Environmental Hazards					
☐ None	☒ Temperature extremes: ☐ Cold ☐ Heat	☐ Wet location	☐ Explosive vapors	☐ Confined space	☐ Engulfment Hazard
☒ Bio hazards (poisonous plants, insects, animals, animal droppings, mold, fungus, etc.)				☐ _____	

Electrical Hazards					
☐ None	☐ Overhead utilities	☐ Underground utilities	☐ Hidden utilities	☒ Energized equip/circuits	☒ Wet location

Fire Hazards			
☐ None	☐ Cutting, welding, or grinding generated sparks or heat sources	☐ Flammable materials present	☐ Oxygen enriched location

Ergonomic Hazards					
☐ None	☒ Lifting	☒ Bending	☐ Twisting	☒ Pulling/tugging	☒ Repetitive motion
Computer Use in the:	☐ Office	☐ Field	☐ _____		

Radiological Hazards							
☒ None	☐ Loose contamination	☐ Fixed Contamination	☐ Airborne contamination	☐ Radiation	☐ Radon		
☐ Alpha	☐ Beta	☐ Gamma/X-rays	☐ Neutron	☐ EMF	☐ Criticality	☐ Tritium	☐ TRU
☐ Depleted Uranium	☐ Enriched Uranium	☐ _____	☐ _____				

Other Hazards
☐

Completed by: _____ Date: _____

PPE and Monitoring Requirements

Standard PPE					
☒ Hard Hat	☒ Safety shoes	☒ Safety glasses	☐ Boot Covers	☐ Rubber Boots	☐ High Visibility Vest

Eye and Face Protection				
☐ Welding glasses	☐ Welding helmet	☐ Face shield	☐ Chemical goggles	☐ Welding screens

Hearing Protection			
☐ Ear plugs	☐ Ear Muffs	☐ Ear plugs and muffs	☐ Other _____

Respiratory Protection					
☐ None	☒ Upgrade Only	☐ Full Face APR	☐ Half Face APR	Cart. Type _____	☐ PAPR
☐ Airline respirator		☐ SCBA	☐ Dust mask	☐ _____	

Protective Clothing				
☐ Tyvek® coveralls	☒ Poly-coated Tyvek® Coveralls	☐ Saranex® Coveralls	☐ Fully encapsulating suit	☐ Apron
☐ Cotton coveralls	☐ Modesty Clothing	☐ Fire resistant clothing	☐ Other _____	

Hand Protection				
☐ None	☐ Cotton gloves	☐ Leather gloves	☐ Cut-resistant gloves	☐ Glove liners
Outer Gloves				
☒ Nitrile	☐ Viton®	☐ Butyl	☐ Neoprene	☐ Other _____
Inner Gloves				
☐ Nitrile	☒ Vinyl	☐ Latex	☐ Other _____	

Other Required PPE			
☐ Personal Flotation Device	☐ Waders _____	☐ _____	☐ _____

Monitoring Requirements				
☐ Oxygen	☐ Flammable gases/vapors	☒ Toxic Gas/vapors	☐ Hydrogen Sulfide	Carbon Monoxide
☐ Asbestos	☐ Full time IH coverage	☐ Part time IH coverage	☐ Be, Hg, Cr, Pb	
☐ Metals Specify: _____				
☒ Organic Vapors Specify: _____				
☐ None	☐ TLD required	☐ CAM	☐ Radon	
☐ Full time RCT coverage	☐ Part time RCT coverage	☐ Radioactive air particulates	☐ Other _____	
☐ Other _____		☐ Other _____		

PPE and monitoring requirements completed by: _____ Date: _____

Job Safety Analysis Form

JSA Preparation Team

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Effective Date From: _____ through _____

Approval Signatures

Job Supervisor	Date	LHSR	Date	RSO	Date
ES&H Manager	Date	Project Manager	Date	Other	Date

Pre-Job Brief Attendance Sheet

Documents included in this briefing: _____

Date of Briefing: _____

Print/Type Name	Signature	Employee Number

Briefing presented by: _____ **Signature:** _____

Job Safety Analysis Form

Drilling – Pre-Ground Disturbance and Clearance Activities

Job Safety Analyses - HASP Format

Job Title: Drilling – Pre-ground Disturbance and Clearance Activities

Minimum Recommended PPE*: Steel Toed, Slip Resistant Boots; Safety Glasses; Face Shield (if danger to face due to flying particles); Leather and/or Nitrile Gloves; High visibility vest; Hard Hat; Hearing Protection; Insulated Gloves (if hand digging to identify underground electrical lines)

*See HASP for all required PPE

Key Work Steps	Hazards/Potential Hazards	Safe Practices
1. All Pre-Ground Disturbance Clearance Activities including Site Inspection, Subsurface Features Mark-out, Removal of Surface Cover and Ground Clearance	1A) Slips/Trips/Falls	1A) Slips/Trips/Falls ▪ Keep work area free of excess material and debris ▪ Remove all trip hazards by keeping materials/objects organized and out of walkways ▪ Keep work surfaces dry when possible ▪ Wear appropriate PPE (see HASP) including non-slip rubber boots if working on wet or slick surfaces ▪ Install rough work surface covers where possible ▪ Stay aware of footing and do not run
	1B) Heat/Cold Stress	1B) Heat/Cold Stress ▪ Take breaks if feeling faint or overexerted ▪ Consume adequate food/beverages (water, sports drinks) ▪ If possible, adjust work schedule to avoid temperature extremes
	1C) Biological Hazards: Insects, Snakes, Wildlife, Vegetation	1C) Biological Hazards: Insects, Snakes, Wildlife, Vegetation ▪ See JSA – Insect Bites and Stings ▪ Inspect work areas when arrive at site to identify hazard(s) ▪ Use insect repellant if observe mosquitoes/gnats ▪ Survey site for presence of biological hazards and maintain safe distance ▪ Wear appropriate PPE including leather gloves, long sleeves and pants, and snake chaps as warranted by site conditions
	1D) Traffic (including pedestrian)	1D) Traffic (including pedestrian) ▪ Notify attendant or site owner/manager of work activities and location ▪ Use cones, signs, flags or other traffic control devices as outlined in the Traffic Control Plan ▪ Set up exclusion zone surrounding work area using cones, signs, flags or other traffic control devices ▪ Wear appropriate PPE including high visibility clothing such as reflective vest ▪ Inspect area behind vehicle prior to backing and use spotter
	1E) Fire/Explosion	1E) Fire/Explosion ▪ Post No Smoking signs around work area ▪ Establish designated smoking area away from work area ▪ Ensure type ABC, 20-lb, fully charged fire extinguisher on-site and within inspection period ▪ As site conditions/activities warrant, establish Hot Work Permit including air monitoring using direct-reading, real-time instruments such as LEL/O meter (see HASP) ▪ Stop work if hazardous conditions (explosive atmosphere) are identified

Job Safety Analyses - HASP Format

Job Title: Drilling – Pre-ground Disturbance and Clearance Activities

Key Work Steps	Hazards/Potential Hazards	Safe Practices
2. Ambient Air Monitoring	2A) Vapors	2A) Vapors ▪ Approach area where vapors are suspected from upwind direction and stay upwind/crosswind of from potential sources of vapors (use flagging or similar device to indicate wind direction) ▪ See HASP for monitoring requirements and action limits
	2B) Ineffective Air Monitoring	2B) Ineffective Air Monitoring ▪ Ensure personnel using have been trained on instrument use ▪ Calibrate instrument prior to use
3. Breaking-Up and Removing Asphalt/ Concrete Cover by Saw Cutting or with Heavy Equipment	3A) Heavy Equipment Movement	3A) Heavy Equipment Movement ▪ Heavy equipment should be equipped with back-up alarm or use horn when backing ▪ Do not allow personnel to stand within the swing radius of equipment booms/arms when equipment is in operation ▪ Stay clear of operating equipment and heavy equipment when moving ▪ When approaching heavy equipment, approach should be made from
	3B) Suspended Loads	3B) Suspended Loads ▪ Do not walk under suspended loads ▪ Wear appropriate PPE including hard hat
	3C) Ignition Sources	3C) Ignition Sources ▪ Ensure electrical equipment properly grounded ▪ Apply water as necessary to address surface sparking potential ▪ Equip heavy equipment with non-sparking bucket/blade
	3D) High Noise Levels	3D) High Noise Levels ▪ Hearing protection required when working around operating equipment if levels are suspected to be >85 dBA (if have to yell to person at a dist of 3 ft to be heard, likely exceeding 85 dBA).
	3E) Airborne Particulates and Debris Dust From Concrete Sawing	3E) Airborne Particulates and Debris ▪ Use water as necessary to control dust in area ▪ Wear appropriate PPE including face shield or safety glasses with side shields, dust mask, leather gloves and long sleeves ▪ Wet Cutting methods will be used. ▪ If wet methods do not control dusts, wear appropriate N95 dust mask or half face respirator with HEPA filter.
	3F) Heavy Material Lifting	3F) Heavy Material Lifting ▪ Use heavy equipment to lift ▪ Do not lift or move heavy materials (greater than 50 lbs) without adequate assistance ▪ Bend and lift with legs and arms, keeping back straight ▪ Wear appropriate PPE including leather gloves, long sleeves and pants, and steel-toed boots

Job Safety Analyses - HASP Format

Job Title: Drilling – Pre-ground Disturbance and Clearance Activities

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	3G) Impact to Subsurface Lines	3G) Impact to Subsurface Lines ▪ Ensure all underground features have been identified in area per ▪ Subsurface Clearance Protocol (SCP) prior to start of activities
	3H) Equipment Rollover	3H) Equipment Rollover ▪ If soil appears unstable, the soil should be assessed by a qualified ▪ professional engineer to ensure safe conditions with implementation of design control measures prior to start of work
	3I) Heavy Equipment Movement	3I) Heavy Equipment Movement ▪ Heavy equipment should be equipped with back-up alarm ▪ When approaching heavy equipment, approach should be made from the front ensuring eye contact is made with operator
	3J) Physical Injury from Managing Equipment	3J) Physical Injury from Managing Equipment ▪ Take breaks if feeling faint or overexerted
	3K) Ignition Sources	3K) Ignition Sources ▪ Ensure equipment properly bonded and grounded ▪ Use sufficient hose so that equipment does not have to be located in critical zone ▪ Apply water as necessary to address sparking potential if equipment ▪ comes in contact with rocks/buried objects ▪ Equip heavy equipment with non-sparking bucket/blade
	3L) High Noise Levels	3L) High Noise Levels ▪ Hearing protection required when working around operating equipment if levels are suspected to be >85 dBA (if have to yell to person at a dist of 3 ft to be heard, likely exceeding 85 dBA).
	3M) Airborne Debris	3M) Airborne Debris ▪ Wear appropriate PPE including leather gloves, long sleeves and pants, and face shield or safety glasses with side shields (see HASP)
	3N) Vapors and Airborne Particulates 3O) Impact to Underground Lines/Tanks	3N) Vapors and Airborne Particulates ▪ Monitor air concentrations using direct-reading, real-time instruments such as OVM and Dräger tubes (See HASP for monitoring equipment and action limits) ▪ Stop work if hazardous conditions (explosive atmosphere, O2 deficient atmosphere) identified until precautions are taken (See HASP) ▪ Wear appropriate PPE including dust masks and respirators (See HASP) 3O) Impact to Underground Lines/Tanks ▪ Ensure underground features in area have been identified to extent possible per SCP (line locators, drawing review,) ▪ Wear insulating gloves or stand on insulating mat when advancing hand tools

Job Safety Analyses - HASP Format

Job Title: Drilling – Pre-ground Disturbance and Clearance Activities

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	3P) Open Excavation	3P) Open Excavation ▪ Personnel should stay at least two feet away from edge ▪ Install orange construction fence or temporary chain link fence around excavated area if to be left unattended
4. Solid Waste Management / Disposal	4A) Vapors and Airborne Particulates	4A) Vapors and Airborne Particulates ▪ Monitor air concentrations using direct-reading, real-time instruments such as OVM and Dräger tubes (See HASP for required monitoring instruments and action limits) ▪ Stop work if hazardous conditions (explosive atmosphere, O2 deficient atmosphere) identified until precautions are taken (See HASP) ▪ Wear appropriate PPE including safety glasses with side shields, dust masks and respirators (See HASP)
	4B) Contaminated Materials and Container Pinch Points	4B) Contaminated Materials and Container Pinch Points ▪ Wear appropriate PPE including nitrile and leather gloves (See HASP) ▪ Position hands/fingers to avoid pinching/smashing/crushing when
	4C) Heavy Materials and Container Lifting/Moving	4C) Heavy Materials and Container Lifting/Moving ▪ Do not lift or move heavy containers without assistance ▪ Use proper bending/lifting techniques by lifting with arms and legs and not with back ▪ If possible, use powered lift truck, drum cart, or other mechanical means to move containers ▪ Take breaks if feeling faint or overexerted ▪ Spot drums in storage area prior to filling ▪ Wear appropriate PPE including leather gloves and steel-toed boots ▪ (See HASP)

Job Safety Analysis Form

Land Based Drilling

Job Safety Analyses – Rotary Drilling

Job Title: Land Based Drilling

Minimum PPE: High visibility vest , hard hat, steel-toed boots, safety glasses, hearing protection, gloves (leather/kevlar)

Key Work Steps	Hazards/Potential Hazards	Safe Practices
1. Hauling drill rig to/on site	1A) Malfunction of vehicle/equipment	1A) Drivers shall perform a pre-operational check of truck/equipment, read and be familiar with any operator's manual. ▪ Report all needed repairs promptly. ▪ Operators shall not use defective/unsafe equipment.
	1B) Wreck of haul truck	1B) Drive defensively ▪ All drivers shall have proper license. ▪ Supervisors shall verify that drivers are capable and qualified on each type of equipment before allowing the equipment to be used unsupervised. ▪ Keep wind shields, windshield wipers, side mirrors and side windows clean ▪ Drivers shall conduct a pre-operation vehicle safety check ▪ Drivers shall plan ahead to minimize or eliminate the need for backing. Always check to the rear before backing and use an observer (spotter) when available. If an observer is not available, the driver shall walk around the vehicle to make sure rear is clear prior to backing. (Get out and look) ▪ Seat belts shall be worn when driving by driver and passengers. ▪ Choose the safest location possible to park equipment. Avoid parking in blind spots of other equipment. ▪ Driver is to be sure the back-up alarm is working ▪ Adjust vehicle speed for load and weather. ▪ Operators should always check and be sure of load height. ▪ When operating a vehicle off the roadway, be aware of possible hidden objects in the grass and unstable terrain. ▪ The mast shall always be in a lowered position when moving the drill rig. ▪ Never allow anyone between truck and trailer when backing to hook trailer ▪ Make sure tilt beds or ramps are secured before putting trailer in use ▪ Perform periodic checks of equipment on long trips to assure the load is secure. ▪ Do not leave equipment unattended with the engine running. Shut off engine and set the parking brake when equipment is not in use. ▪ Operator must do a walk around prior to operating equipment.
2. Mounting and dismounting rig to load/unload	2A) Fall while mounting and dismounting equipment	2A) When mounting and dismounting equipment, use steps and handhold. Do not jump from vehicle.
3. Loading/unloading of equipment, establish safe work zone for loading, unloading and work at the site	3A) Crush and pinch points created when loading/unloading equipment, dangerous traffic conditions	3A) Crush and pinch points created when loading/unloading equipment ▪ Be aware of crushing and pinching hazards when loading, unloading and fastening down equipment. ▪ Make sure cargo is properly loaded, secured and covered using only approved chain and load binders. Check for loose material on bed and trailer. Secure loose material. ▪ Wear protective equipment consistent with the hazard (hard hats, safety glasses, gloves, safety shoes, etc.) ▪ Hook/unhook on stable ground with the trailer secure. ▪ Have a plan for appropriate traffic control before going to site ▪ Set control, secure work area first, minimize traffic disruption ▪ Inspect work zone regularly for conformance when in use, promptly remove control at end of work day/shift
4. Rig equipment operation.	4A) Crushing injuries, slip trips and falls, material under stress, power	4A) Rig equipment operation. ▪ Before use, inspect cable, chain or wire for wear and replace if

Job Safety Analyses – Rotary Drilling

Job Title: Land Based Drilling

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	equipment operations, utility lines, overhead loads, flying particles, rope or cable blocks, equipment limitations, lifting and pinch points	necessary. ▪ Observe OSHA guidelines for use of cable clamps, safety latches, chains and slings. ▪ Know rated capacity of chain, cable or wire rope being used and never exceed the rating. ▪ Avoid overloading and sudden jerks. ▪ Wear appropriate personal protective equipment with the hazard, including hard hats, safety glasses, gloves and safety shoes. ▪ Check loads to be lifted for balance and have the rigging inspected to ensure a safe and balanced condition exists. ▪ Do not allow employees to stand or work under suspended loads. ▪ Awkward loads shall have taglines attached to control the load. ▪ Review signals and operator communications with crew. Only one person shall direct the operator. ▪ Review the area for utility lines, tree limbs and other overhead hazards. Work no closer than 30 feet to active overhead power lines. Follow OSHA guidelines. ▪ Personnel working tag lines shall review the area for slipping, tripping and falling hazards. If not possible to eliminate the hazards, take precautions to avoid them.
5. Stabilize rig with hydraulic jack/pads	5A)	5A) Crushing injuries, slip, trip, fall hazards and potential back injuries. ▪ Use proper lifting techniques. ▪ Ensure jack is rated for weight/operation with safe limits ▪ Assure that area is clear of personnel and obstacles. ▪ Place pads under jacks to prevent them from sinking into the ground.
6. Start/operate drill rig	6A) Moving machinery parts, buried and overhead utilities, drill rod stacking, lifting, winching, cathead operations, moving equipment, noise, adverse weather conditions, animals, slippery surfaces, uneven terrain, poisonous plants/snakes/insects and overhead hazards	6A) Moving machinery parts, buried and overhead utilities, drill rod stacking, lifting, winching, cathead operations, moving equipment, noise, adverse weather conditions, animals, slippery surfaces, uneven terrain, poisonous plants/snakes/insects and overhead hazards ▪ Wear appropriate personal protective equipment consistent with the hazard (hard hat, safety glasses, leather gloves, safety shoes, etc.) ▪ Avoid contact with rotating equipment ▪ Use Lockout Tagout procedures if mechanical service is needed, Driller controls keys or ignition source to rig at all times. ▪ When cathead is in use, assure a safe travel path for the rope by using proper techniques. Avoid standing on the rope. ▪ Observe and stay clear of overhead powerlines by 30 feet. - In transit with no load and boom lowered, the equipment clearance shall be a minimum of 4 feet for voltage less than 50kV and 10 feet for voltages over 50kV up to and including 345kV and 16 feet for voltages up to and including 750kV. - A person shall be designated to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means. - Have underground utility lines properly located and marked prior to drilling. Work no closer than 5 feet to buried utilities. ▪ Employees on foot must use extreme caution to stay clear of operating equipment. Always establish eye contact with the operator before approaching the equipment. ▪ Be aware of drop-offs, uneven ground and potential hidden objects which may cause loss of control when maneuvering drill rigs or create unstable drill set-ups. In heavily wooded area, scout to locate hidden objects. ▪ Drill rod stacking must not exceed a length of 1.5 times the height of the tower. ▪ Be aware of poisonous plants, insects, snakes, animals and animal waste products and carcasses. Wear long sleeve shirts, gloves, and

Job Safety Analyses – Rotary Drilling

Job Title: Land Based Drilling

Key Work Steps	Hazards/Potential Hazards	Safe Practices
		high top boots when hazards cannot be avoided. Proper first aid supplies, insect repellents shall accompany field crews. ▪ Be alert to conditions that can lead to slippery surfaces. Examples: high groundwater resulting in muddy soils brought to the surface by augers and the utilization of bentonite drilling fluid. ▪ Inspect all cables and clamps prior to winching operation. Stand clear of winching operations. ▪ Use proper lifting techniques. Get help or use lifting equipment. ▪ Suspend drilling operations during electrical storms ▪ Be aware of overhead hazards which may come in contact with the drill rig, when moving or setting up equipment. ▪ Complete a daily operations checklist to ensure that equipment is working properly. Make special note of emergency kill switches.
	6B) Contaminated soils, buried power or gas lines, landfills and containment of spills	6B) Be aware of potential contaminated soils and water, prepare for containment of spills ▪ During drilling operations, always be aware of the possibility of encountering potentially hazardous materials, such as petroleum hydrocarbons, herbicides, pesticides, chemical manufacturing by-products or solid waste materials. ▪ In the event that any unknown or questionable materials are encountered, then the drilling operations are to be suspended immediately until further instructions are received from supervision. ▪ Do not handle any suspected contaminated materials unless trained to do so and proper protective methods are followed. ▪ During drilling operations, always be aware of the possibility of striking an unlocated or improperly located gas or power line. ▪ In the event a buried utility line is struck, drilling operations are to be suspended **immediately**. - If the utility line is electric, keep personnel at least 10 feet from all metal surfaces connected with the drill rig. - If the utility is gas, then the area is to be evacuated and secured. Immediate notification to the utility company is MANDATORY. ▪ In the event of a gas or oil spill, the proper authorities are to be contacted immediately so that containment operations can be implemented. Maintain supply of spill-containment materials.
7. Assemble casing/rods, attach bit to rods	7A) Falling casing/rods; bit coming loose drill string	7A) Tighten all joints ▪ Use personal protective equipment such as gloves, safety glasses, hard hat and safety shoes. ▪ Be aware of hand and finger positions when inserting holding pin ▪ Use proper lifting techniques. Lift load with your legs not employees back. If load is over 50 pounds use a two man lift, if repetitive motion is required use two man teams to lessen load weight. Do not twist while carrying load, Do not carry anything to block your vision. When lifting load from ground stand close to the load, bend at your knees not your back, keep 12A cont) load balanced, watch out for pinch points (doorways, machines, etc), face the way you will be moving. Avoid lifting loads from high places, do not reach and pull loads from rear cargo area of truck to avoid strain. Do not access cargo area with muddy boots to avoid slip.
8. Start drill by lever operations	8A) Operation of wrong lever	8A) Label levers as to their operation and review equipment manual.
9. Maintain proper bit drill speed with down hole pressure speed.	9A) Unstable rig from improper speed of drill string	9A) Use of trained drill rig personnel and follow equipment manual specification.
10. Tripping rods in/out of hole; sampling, breaking-down rods at completion	10A) (reference item #7)	10A) (reference item #7)

Job Safety Analyses – Rotary Drilling

Job Title: Land Based Drilling

Key Work Steps	Hazards/Potential Hazards	Safe Practices
of boring		
11. Demobilizing equipment offsite.	11A) Reference item # 1	11A) Reference item #1.
12. Hypothermia	12A) Cold Stress	12A) Check weather prior to on-water activities; wear adequate clothing and gloves, if appropriate, for weather, rain wear where appropriate due to water spray to remain dry; maintain body temperature; recognize and treat any medical condition by calling 911 (or local emergency number) at once.
13. Hyperthermia	13A) Heat stress	13A) Check weather prior to work activities; Know signs/symptoms of heat-related illnesses: monitor yourself and coworkers; Block out direct sun or other heat sources; Use cooling fans/air-conditioning; rest regularly; Drink lots of water, about 1 cup every 15 minutes; Wear light weight, light colored, loose-fitting clothes, Avoid alcohol, caffeinated drinks, or heavy meals. Call 911 (or local emergency number) at once.
14. Rig Maintenance and repair	14A) Pinch Points 14B) Burns 14C) Improper use of tools causing injury 14D) Slips trip falls 14E) Crushing Injuries	Stop work. Contact site manager and prepare JSA (or STA) prior to proceeding with work.
15. Moving rig (land holes)	15A) Working around traffic 15B) Rig becoming unstable when moving across soft or slippery surfaces or slopes	15A) Review travel route prior to move 15A) Develop traffic control plan if required 15B) Identify travel limits (maximum slope) for rig 15B) Limit travel to stay within rig limits 15B) If travel route is too steep or not stable do one of the following; improve route, use an alternate route, or use a different rig suitable for the conditions. 15B) If using tarps for spill control, place tarps after the rig is on jacks, and remove the tarp prior to lowering the rig on the jacks. 15B) Do not move the rig across tarps.
16. Environmental Conditions	16A) Accidental Release	16A) Plastic sheeting or tarps shall be placed under the rig after it has been jacked up and stabilized. The tarp should be fastened to the rig so as to contain accidental spills or leaks from the rig and prevent the fluids from entering the ground. Please refer to item 15 above for risks associated with using a tarp beneath the rig. 16A) Prior to each use, the tarp shall be inspected for signs of wear, rips or tears, or other conditions that may hinder its intended use for spill containment. The site manager shall be contacted if these conditions are observed, and the tarp shall be replaced as appropriate.

APPENDIX B

Chemical Data Sheets and Material Safety Data Sheets

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives. Protecting People. Saving Money through Prevention.

Search the Pocket Guide

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Enter search terms separated by spaces.

Ethylene dichloride

Synonyms & Trade Names 1,2-Dichloroethane; Ethylene chloride; Glycol dichloride

CAS No. 107-06-2	**RTECS No.** KI0525000 (/niosh-rtecs/KI802C8.html)	**DOT ID & Guide** 1184 131 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=131)
Formula $ClCH_2CH_2Cl$	**Conversion** 1 ppm = 4.05 mg/m3	**IDLH** Ca [50 ppm] See: 107062 (/niosh/idlh/107062.html)

Exposure Limits **NIOSH REL** : Ca TWA 1 ppm (4 mg/m3) ST 2 ppm (8 mg/m3) See Appendix A (nengapdxa.html) See Appendix C (nengapdxc.html) (Chloroethanes) **OSHA PEL** † (nengapdxg.html) : TWA 50 ppm C 100 ppm 200 ppm [5-minute maximum peak in any 3 hours]	**Measurement Methods** **NIOSH** 1003 (/niosh/docs/2003-154/pdfs/1003.pdf) ; **OSHA** 3 (http://www.osha.gov/dts/sltc/methods/organic/org003/org003.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html)

Physical Description Colorless liquid with a pleasant, chloroform-like odor. [Note: Decomposes slowly, becomes acidic & darkens in color.]

MW: 99.0	**BP:** 182° F	**FRZ:** -32°F	**Sol:** 0.9%	**VP:** 64 mmHg	**IP:** 11.05 eV
Sp.Gr: 1.24	**Fl.P:** 56° F	**UEL:** 16%	**LEL:** 6.2%		

Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.

Incompatibilities & Reactivities Strong oxidizers & caustics; chemically-active metals such as magnesium or aluminum powder, sodium & potassium; liquid ammonia [Note: Decomposes to vinyl chloride & HCl above 1112°F.]

Exposure Routes inhalation, ingestion, skin absorption, skin and/or eye contact

Symptoms irritation eyes, corneal opacity; central nervous system depression; nausea, vomiting; dermatitis; liver, kidney, cardiovascular system damage; [potential occupational carcinogen]

Target Organs Eyes, skin, kidneys, liver, central nervous system, cardiovascular system

Cancer Site [in animals: forestomach, mammary gland & circulatory sys cancer]

Personal Protection/Sanitation (See protection codes (protect.html)) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contaminated **Remove:** When wet (flammable)	**First Aid** (See procedures (firstaid.html)) **Eye:** Irrigate immediately **Skin:** Soap wash promptly **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Change: No recommendation
Provide: Eyewash, Quick drench

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection (pgintrod.html#mustread)

See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0250 (/niosh/ipcsneng/neng0250.html)
See MEDICAL TESTS: 0104 (/niosh/docs/2005-110/nmed0104.html)

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Centers for Disease Control and Prevention 1600 Clifton Rd. Atlanta, GA 30333, USA
800-CDC-INFO (800-232-4636) TTY: (888) 232-6348, New Hours of Operation 8am-8pm ET/Monday-Friday
Closed Holidays - cdcinfo@cdc.gov

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Enter search terms separated by spaces.

1,1-Dichloroethane

Synonyms & Trade Names Asymmetrical dichloroethane; Ethylidene chloride; 1,1-Ethylidene dichloride

CAS No. 75-34-3	**RTECS No.** KI0175000 (/niosh-rtecs/KI2AB98.html)	**DOT ID & Guide** 2362 130 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=130)
Formula $CHCl_2CH_3$	**Conversion** 1 ppm = 4.05 mg/m3	**IDLH** 3000 ppm See: 75343 (/niosh/idlh/75343.html)
Exposure Limits **NIOSH REL** : TWA 100 ppm (400 mg/m3) See Appendix C (nengapdxc.html) (Chloroethanes) **OSHA PEL** : TWA 100 ppm (400 mg/m3)		**Measurement Methods** **NIOSH** 1003 (/niosh/docs/2003-154/pdfs/1003.pdf) ; **OSHA** 7 (http://www.osha.gov/dts/sltc/methods/organic/org001/org001.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html)

Physical Description Colorless, oily liquid with a chloroform-like odor.

MW: 99.0	**BP:** 135° F	**FRZ:** -143° F	**Sol:** 0.6%	**VP:** 182 mmHg	**IP:** 11.06 eV
Sp.Gr: 1.18	**Fl.P:** 2° F	**UEL:** 11.4%	**LEL:** 5.4%		

Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.

Incompatibilities & Reactivities Strong oxidizers, strong caustics

Exposure Routes inhalation, ingestion, skin and/or eye contact

Symptoms irritation skin; central nervous system depression; liver, kidney, lung damage

Target Organs Skin, liver, kidneys, lungs, central nervous system

Personal Protection/Sanitation (See protection codes (protect.html)) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contaminated **Remove:** When wet (flammable) **Change:** No recommendation	**First Aid** (See procedures (firstaid.html)) **Eye:** Irrigate immediately **Skin:** Soap flush promptly **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations

NIOSH/OSHA

Up to 1000 ppm:
(APF = 10) Any supplied-air respirator

Up to 2500 ppm:
(APF = 25) Any supplied-air respirator operated in a continuous-flow mode

Up to 3000 ppm:
(APF = 50) Any self-contained breathing apparatus with a full facepiece
(APF = 50) Any supplied-air respirator with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection (pgintrod.html#mustread)

See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0249 (/niosh/ipcsneng/neng0249.html)

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Trichloroethylene

Synonyms & Trade Names Ethylene trichloride, TCE, Trichloroethene, Trilene

CAS No. 79-01-6	**RTECS No.** KX4550000 (/niosh-rtecs/KX456D70.html)	**DOT ID & Guide** 1710 160 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=160)
Formula $ClCH=CCl_2$	**Conversion** 1 ppm = 5.37 mg/m3	**IDLH** Ca [1000 ppm] See: 79016 (/niosh/idlh/79016.html)

Exposure Limits **NIOSH REL** : Ca See Appendix A (nengapdxa.html) See Appendix C (nengapdxc.html) **OSHA PEL** † (nengapdxg.html) : TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)	**Measurement Methods** **NIOSH** 1022 (/niosh/docs/2003-154/pdfs/1022.pdf) , 3800 (/niosh/docs/2003-154/pdfs/3800.pdf) ; **OSHA** 1001 (http://www.osha.gov/dts/sltc/methods/mdt/mdt1001/1001.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html)

Physical Description Colorless liquid (unless dyed blue) with a chloroform-like odor.

MW: 131.4	**BP:** 189° F	**FRZ:** -99°F	**Sol:** 0.1%	**VP:** 58 mmHg	**IP:** 9.45 eV
Sp.Gr: 1.46	**Fl.P:** ?	UEL (77°F): 10.5%	LEL(77° F): 8%		

Combustible Liquid, but burns with difficulty.

Incompatibilities & Reactivities Strong caustics & alkalis; chemically-active metals (such as barium, lithium, sodium, magnesium, titanium & beryllium)

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]

Target Organs Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system

Cancer Site [in animals: liver & kidney cancer]

Personal Protection/Sanitation (See protection codes (protect.html)) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contaminated	**First Aid** (See procedures (firstaid.html)) **Eye:** Irrigate immediately **Skin:** Soap wash promptly

Remove: When wet or contaminated **Change:** No recommendation **Provide:** Eyewash, Quick drench	**Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection (pgintrod.html#mustread)

See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0081 (/niosh/ipcsneng/neng0081.html) See MEDICAL TESTS: 0236 (/niosh/docs/2005-110/nmed0236.html)

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Tetrachloroethylene

Synonyms & Trade Names Perchlorethylene, Perchloroethylene, Perk, Tetrachlorethylene

CAS No. 127-18-4	**RTECS No.** KX3850000 (/niosh-rtecs/KX3ABF10.html)	**DOT ID & Guide** 1897 160 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=160)
Formula $Cl_2C{=}CCl_2$	**Conversion** 1 ppm = 6.78 mg/m3	**IDLH** Ca [150 ppm] See: 127184 (/niosh/idlh/127184.html)

Exposure Limits **NIOSH REL** : Ca Minimize workplace exposure concentrations. See Appendix A (nengapdxa.html) **OSHA PEL** † (nengapdxg.html) : TWA 100 ppm C 200 ppm (for 5 minutes in any 3-hour period), with a maximum peak of 300 ppm	**Measurement Methods** **NIOSH** 1003 (/niosh/docs/2003-154/pdfs/1003.pdf) ; **OSHA** 1001 (http://www.osha.gov/dts/sltc/methods/mdt/mdt1001/1001.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html)

Physical Description Colorless liquid with a mild, chloroform-like odor.

MW: 165.8	**BP:** 250° F	**FRZ:** -2° F	**Sol:** 0.02%	**VP:** 14 mmHg	**IP:** 9.32 eV
Sp.Gr: 1.62	**Fl.P:** NA	**UEL:** NA	**LEL:** NA		

Noncombustible Liquid, but decomposes in a fire to hydrogen chloride and phosgene.

Incompatibilities & Reactivities Strong oxidizers; chemically-active metals such as lithium, beryllium & barium; caustic soda; sodium hydroxide; potash

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]

Target Organs Eyes, skin, respiratory system, liver, kidneys, central nervous system

Cancer Site [in animals: liver tumors]

Personal Protection/Sanitation (See protection codes (protect.html)) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contaminated **Remove:** When wet or contaminated	**First Aid** (See procedures (firstaid.html)) **Eye:** Irrigate immediately **Skin:** Soap wash promptly **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Change: No recommendation
Provide: Eyewash, Quick drench

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection (pgintrod.html#mustread)

See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0076 (/niosh/ipcsneng/neng0076.html) See MEDICAL TESTS: 0179 (/niosh/docs/2005-110/nmed0179.html)

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Vinylidene chloride

Synonyms & Trade Names 1,1-DCE; 1,1-Dichloroethene; 1,1-Dichloroethylene; VDC; Vinylidene chloride monomer; Vinylidene dichloride

CAS No. 75-35-4	**RTECS No.** KV9275000 (/niosh-rtecs/KV8D8678.html)	**DOT ID & Guide** 1303 130P (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=130&poly=1) (inhibited)
Formula $CH_2=CCl_2$	**Conversion**	**IDLH** Ca [N.D.] See: IDLH INDEX (/niosh/idlh/intridl4.html)
Exposure Limits **NIOSH REL** : Ca See Appendix A (nengapdxa.html) **OSHA PEL** † (nengapdxg.html) : none		**Measurement Methods** **NIOSH** 1015 (/niosh/docs/2003-154/pdfs/1015.pdf) ; **OSHA** 19 (http://www.osha.gov/dts/sltc/methods/organic/org019/org019.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html)

Physical Description Colorless liquid or gas (above 89°F) with a mild, sweet, chloroform-like odor.

MW: 96.9	**BP:** 89° F	**FRZ:** -189° F	**Sol:** 0.04%	**VP:** 500 mmHg	**IP:** 10.00 eV
Sp.Gr: 1.21	**Fl.P:** -2°F	**UEL:** 15.5%	**LEL:** 6.5%		

Class IA Flammable Liquid: Fl.P. below 73°F and BP below 100°F.

Incompatibilities & Reactivities Aluminum, sunlight, air, copper, heat [Note: Polymerization may occur if exposed to oxidizers, chlorosulfonic acid, nitric acid, or oleum. Inhibitors such as the monomethyl ether of hydroquinone are added to prevent polymerization.]

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]

Target Organs Eyes, skin, respiratory system, central nervous system, liver, kidneys

Cancer Site [in animals: liver & kidney tumors]

Personal Protection/Sanitation (See protection codes (protect.html)) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contaminated **Remove:** When wet (flammable) **Change:** No recommendation **Provide:** Eyewash, Quick drench	**First Aid** (See procedures (firstaid.html)) **Eye:** Irrigate immediately **Skin:** Soap flush immediately **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection (pgintrod.html#mustread)

See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0083 (/niosh/ipcsneng/neng0083.html)

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Carbon tetrachloride

Synonyms & Trade Names Carbon chloride, Carbon tet, Freon® 10, Halon® 104, Tetrachloromethane

CAS No. 56-23-5	**RTECS No.** FG4900000 (/niosh-rtecs/FG4AC4A0.html)	**DOT ID & Guide** 1846 151 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=151)
Formula CCl_4	**Conversion** 1 ppm = 6.29 mg/m³	**IDLH** Ca [200 ppm] See: 56235 (/niosh/idlh/56235.html)
Exposure Limits **NIOSH REL** : Ca ST 2 ppm (12.6 mg/m³) [60-minute] See Appendix A (nengapdxa.html) **OSHA PEL** † (nengapdxg.html) : TWA 10 ppm C 25 ppm 200 ppm (5-minute maximum peak in any 4 hours)		**Measurement Methods** **NIOSH** 1003 (/niosh/docs/2003-154/pdfs/1003.pdf) ; **OSHA** 7 (http://www.osha.gov/dts/sltc/methods/organic/org001/org001.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html)

Physical Description Colorless liquid with a characteristic ether-like odor.

MW: 153.8	**BP:** 170° F	**FRZ:** -9° F	**Sol:** 0.05%	**VP:** 91 mmHg	**IP:** 11.47 eV
Sp.Gr: 1.59	**Fl.P:** NA	**UEL:** NA	**LEL:** NA		

Noncombustible Liquid

Incompatibilities & Reactivities Chemically-active metals such as sodium, potassium & magnesium; fluorine; aluminum [Note: Forms highly toxic phosgene gas when exposed to flames or welding arcs.]

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms irritation eyes, skin; central nervous system depression; nausea, vomiting; liver, kidney injury; drowsiness, dizziness, incoordination; [potential occupational carcinogen]

Target Organs central nervous system, eyes, lungs, liver, kidneys, skin

Cancer Site [in animals: liver cancer]

Personal Protection/Sanitation (See protection codes (protect.html)) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contaminated **Remove:** When wet or contaminated **Change:** No recommendation **Provide:** Eyewash, Quick drench	**First Aid** (See procedures (firstaid.html)) **Eye:** Irrigate immediately **Skin:** Soap wash immediately **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection (pgintrod.html#mustread)

See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0024 (/niosh/ipcsneng/neng0024.html)
See MEDICAL TESTS: 0041 (/niosh/docs/2005-110/nmed0041.html)

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1,1,2-Trichloroethane

Synonyms & Trade Names Ethane trichloride, β-Trichloroethane, Vinyl trichloride

CAS No. 79-00-5	**RTECS No.** KJ3150000 (/niosh-rtecs/KJ3010B0.html)	**DOT ID & Guide**
Formula $CHCl_2CH_2Cl$	**Conversion** 1 ppm = 5.46 mg/m3	**IDLH** Ca [100 ppm] See: 79005 (/niosh/idlh/79005.html)
Exposure Limits **NIOSH REL** : Ca TWA 10 ppm (45 mg/m3) [skin] See Appendix A (nengapdxa.html) See Appendix C (nengapdxc.html) (Chloroethanes) **OSHA PEL** : TWA 10 ppm (45 mg/m3) [skin]		**Measurement Methods** **NIOSH** 1003 (/niosh/docs/2003-154/pdfs/1003.pdf) ; **OSHA** 11 (http://www.osha.gov/dts/sltc/methods/organic/org011/org011.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html)

Physical Description Colorless liquid with a sweet, chloroform-like odor.

MW: 133.4	**BP:** 237° F	**FRZ:** -34°F	**Sol:** 0.4%	**VP:** 19 mmHg	**IP:** 11.00 eV
Sp.Gr: 1.44	**Fl.P:** ?	**UEL:** 15.5%	**LEL:** 6%		

Combustible Liquid, forms dense soot.

Incompatibilities & Reactivities Strong oxidizers & caustics; chemically-active metals (such as aluminum, magnesium powders, sodium & potassium)

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms irritation eyes, nose; central nervous system depression; liver, kidney damage; dermatitis; [potential occupational carcinogen]

Target Organs Eyes, respiratory system, central nervous system, liver, kidneys

Cancer Site [in animals: liver cancer]

Personal Protection/Sanitation (See protection codes (protect.html)) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contaminated **Remove:** When wet or contaminated **Change:** No recommendation **Provide:** Eyewash, Quick drench	**First Aid** (See procedures (firstaid.html)) **Eye:** Irrigate immediately **Skin:** Soap wash promptly **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection (pgintrod.html#mustread)

See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0080 (/niosh/ipcsneng/neng0080.html)
See MEDICAL TESTS: 0235 (/niosh/docs/2005-110/nmed0235.html)

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Methylene chloride

Synonyms & Trade Names Dichloromethane, Methylene dichloride		
CAS No. 75-09-2	**RTECS No.** PA8050000 (/niosh-rtecs/PA7AD550.html)	**DOT ID & Guide** 1593 160 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=160)
Formula CH_2Cl_2	**Conversion** 1 ppm = 3.47 mg/m³	**IDLH** Ca [2300 ppm] See: 75092 (/niosh/idlh/75092.html)
Exposure Limits **NIOSH REL** : Ca See Appendix A (nengapdxa.html) **OSHA PEL** : [1910.1052] TWA 25 ppm ST 125 ppm		**Measurement Methods** **NIOSH** 1005 (/niosh/docs/2003-154/pdfs/1005.pdf) , 3800 (/niosh/docs/2003-154/pdfs/3800.pdf) ; **OSHA** 59 (http://www.osha.gov/dts/sltc/methods/organic/org059/org059.html) , 80 (http://www.osha.gov/dts/sltc/methods/organic/org080/org080.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html)

Physical Description Colorless liquid with a chloroform-like odor. [Note: A gas above 104°F.]

MW: 84.9	**BP:** 104° F	**FRZ:** -139°F	**Sol:** 2%	**VP:** 350 mmHg	**IP:** 11.32 eV
Sp.Gr: 1.33	**Fl.P:** ?	**UEL:** 23%	**LEL:** 13%		

Combustible Liquid

Incompatibilities & Reactivities Strong oxidizers; caustics; chemically-active metals such as aluminum, magnesium powders, potassium & sodium; concentrated nitric acid

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms irritation eyes, skin; lassitude (weakness, exhaustion), drowsiness, dizziness; numb, tingle limbs; nausea; [potential occupational carcinogen]

Target Organs Eyes, skin, cardiovascular system, central nervous system

Cancer Site [in animals: lung, liver, salivary & mammary gland tumors]

Personal Protection/Sanitation (See protection codes (protect.html)) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contaminated **Remove:** When wet or contaminated **Change:** No recommendation **Provide:** Eyewash, Quick drench	**First Aid** (See procedures (firstaid.html)) **Eye:** Irrigate immediately **Skin:** Soap wash promptly **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations

(See Appendix E) (nengapdxe.html)

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection (pgintrod.html#mustread)

See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0058 (/niosh/ipcsneng/neng0058.html)
See MEDICAL TESTS: 0148 (/niosh/docs/2005-110/nmed0148.html)

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1,2,3-Trichloropropane

Synonyms & Trade Names Allyl trichloride, Glycerol trichlorohydrin, Glyceryl trichlorohydrin, Trichlorohydrin

CAS No. 96-18-4	**RTECS No.** TZ9275000 (/niosh-rtecs/TZ8D8678.html)	**DOT ID & Guide**
Formula $CH_2ClCHClCH_2Cl$	**Conversion** 1 ppm = 6.03 mg/m3	**IDLH** Ca [100 ppm] See: 96184 (/niosh/idlh/96184.html)
Exposure Limits **NIOSH REL** : Ca TWA 10 ppm (60 mg/m3) [skin] See Appendix A (nengapdxa.html) **OSHA PEL** † (nengapdxg.html) : TWA 50 ppm (300 mg/m3)		**Measurement Methods** **NIOSH** 1003 (/niosh/docs/2003-154/pdfs/1003.pdf) ; **OSHA** 7 (http://www.osha.gov/dts/sltc/methods/organic/org001/org001.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html)

Physical Description Colorless liquid with a chloroform-like odor.

MW: 147.4	**BP:** 314°F	**FRZ:** 6°F	**Sol:** 0.1%	**VP:** 3 mmHg	**IP:** ?
Sp.Gr: 1.39	**Fl.P:** 160°F	UEL (302° F): 12.6%	LEL(248° F): 3.2%		

Class IIIA Combustible Liquid: Fl.P. at or above 140°F and below 200°F.

Incompatibilities & Reactivities Chemically-active metals, strong caustics & oxidizers

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms irritation eyes, nose, throat; central nervous system depression; in animals: liver, kidney injury; [potential occupational carcinogen]

Target Organs Eyes, skin, respiratory system, central nervous system, liver, kidneys

Cancer Site [in animals: forestomach, liver & mammary gland cancer]

Personal Protection/Sanitation (See protection codes (protect.html)) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contaminated **Remove:** When wet or contaminated **Change:** No recommendation **Provide:** Eyewash, Quick drench	**First Aid** (See procedures (firstaid.html)) **Eye:** Irrigate immediately **Skin:** Soap wash **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-

demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection (pgintrod.html#mustread)

See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0683 (/niosh/ipcsneng/neng0683.html) See MEDICAL TESTS: 0238 (/niosh/docs/2005-110/nmed0238.html)

Page last reviewed: April 4, 2011
Page last updated: November 18, 2010
Content source: National Institute for Occupational Safety and Health (NIOSH) Education and Information Division

Centers for Disease Control and Prevention 1600 Clifton Rd. Atlanta, GA 30333, USA
800-CDC-INFO (800-232-4636) TTY: (888) 232-6348, New Hours of Operation 8am-8pm ET/Monday-Friday
Closed Holidays - cdcinfo@cdc.gov

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives. Protecting People. Saving Money through Prevention.

Search the Pocket Guide

SEARCH

Enter search terms separated by spaces.

Dioxane

Synonyms & Trade Names Diethylene dioxide; Diethylene ether; Dioxan; p-Dioxane; 1,4-Dioxane

CAS No. 123-91-1	**RTECS No.** JG8225000 (/niosh-rtecs/JG7D80E8.html)	**DOT ID & Guide** 1165 127 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx?guide=127)
Formula $C_4H_8O_2$	**Conversion** 1 ppm = 3.60 mg/m3	**IDLH** Ca [500 ppm] See: 123911 (/niosh/idlh/123911.html)

Exposure Limits **NIOSH REL** : Ca C 1 ppm (3.6 mg/m3) [30-minute] See Appendix A (nengapdxa.html) **OSHA PEL** † (nengapdxg.html) : TWA 100 ppm (360 mg/m3) [skin]	**Measurement Methods** **NIOSH** 1602 (/niosh/docs/2003-154/pdfs/1602.pdf) ; **OSHA** 7 (http://www.osha.gov/dts/sltc/methods/organic/org001/org001.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html)

Physical Description Colorless liquid or solid (below 53°F) with a mild, ether-like odor.

MW: 88.1	**BP:** 214° F	**FRZ:** 53° F	**Sol:** Miscible	**VP:** 29 mmHg	**IP:** 9.13 eV
Sp.Gr: 1.03	**Fl.P:** 55° F	**UEL:** 22%	**LEL:** 2.0%		

Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.

Incompatibilities & Reactivities Strong oxidizers, decaborane, triethynyl aluminum

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms irritation eyes, skin, nose, throat; drowsiness, headache; nausea, vomiting; liver damage; kidney failure; [potential occupational carcinogen]

Target Organs Eyes, skin, respiratory system, liver, kidneys

Cancer Site [in animals: lung, liver & nasal cavity tumors]

Personal Protection/Sanitation (See protection codes (protect.html)) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contaminated **Remove:** When wet (flammable) **Change:** No recommendation **Provide:** Eyewash, Quick drench	**First Aid** (See procedures (firstaid.html)) **Eye:** Irrigate immediately **Skin:** Water wash promptly **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection (pgintrod.html#mustread)

See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0041 (/niosh/ipcsneng/neng0041.html)
See MEDICAL TESTS: 0090 (/niosh/docs/2005-110/nmed0090.html)

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SEARCH

Enter search terms separated by spaces.

N-Nitrosodimethylamine

Synonyms & Trade Names Dimethylnitrosamine; N,N-Dimethylnitrosamine; DMNA; N-Methyl-N-nitroso-methanamine; NDMA; N-Nitroso-N,N-dimethylamine

CAS No. 62-75-9	**RTECS No.** IQ0525000 (/niosh-rtecs/IQ802C8.html)	**DOT ID & Guide**
Formula $(CH_3)_2N_2O$	**Conversion**	**IDLH** Ca [N.D.] See: IDLH INDEX (/niosh/idlh/intridl4.html)
Exposure Limits **NIOSH REL** : Ca See Appendix A (nengapdxa.html) **OSHA PEL** : [1910.1016] See Appendix B (nengapdxb.html)		**Measurement Methods** **NIOSH** 2522 (/niosh/docs/2003-154/pdfs/2522.pdf) ; **OSHA** 38 (http://www.osha.gov/dts/sltc/methods/organic/org038/org038.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html)

Physical Description Yellow, oily liquid with a faint, characteristic odor.

MW: 74.1	**BP:** 306° F	**FRZ:** ?	**Sol:** Soluble	**VP:** 3 mmHg	**IP:** 8.69 eV
Sp.Gr: 1.005	**Fl.P:** ?	**UEL:** ?	**LEL:** ?		

Combustible Liquid

Incompatibilities & Reactivities Strong oxidizers [Note: Should be stored in dark bottles.]

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms nausea, vomiting, diarrhea, abdominal cramps; headache; fever; enlarged liver, jaundice; decreased liver, kidney, pulmonary function; [potential occupational carcinogen]

Target Organs Liver, kidneys,lungs

Cancer Site [in animals; lung, kidney, liver & nasal cavity tumors]

Personal Protection/Sanitation (See protection codes (protect.html)) **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contaminated/Daily **Remove:** When wet or contaminated **Change:** Daily **Provide:** Eyewash, Quick drench	**First Aid** (See procedures (firstaid.html)) **Eye:** Irrigate immediately **Skin:** Soap wash immediately **Breathing:** Respiratory support **Swallow:** Medical attention immediately

Respirator Recommendations
(See Appendix E) (nengapdxe.html)

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:
(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:
(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.
Click here (pgintrod.html#nrp) for information on selection of N, R, or P filters.
Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection (pgintrod.html#mustread)

See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0525 (/niosh/ipcsneng/neng0525.html)
See MEDICAL TESTS: 0167 (/niosh/docs/2005-110/nmed0167.html)

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Closed Holidays - cdcinfo@cdc.gov

International Chemical Safety Cards

SODIUM PERCHLORATE

ICSC: 0715

Sodium perchlorate
Perchloric acid, sodium salt
Inenat
$NaClO_4$
Molecular mass: 122.4

ICSC # 0715
CAS # 7601-89-0
RTECS # SC9800000
UN # 1502
EC # 017-010-00-6
October 20, 1999 Validated

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Not combustible but enhances combustion of other substances. Many reactions may cause fire or explosion. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks, and NO smoking. NO contact with flammable substances.	In case of fire in the surroundings: water in large amounts, water spray .
EXPLOSION		Do NOT expose to friction or shock.	In case of fire: keep drums, etc., cool by spraying with water. Combat fire from a sheltered position.
EXPOSURE		PREVENT DISPERSION OF DUST!	
•INHALATION	Cough. Sore throat.	Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
•SKIN	Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap. >
•EYES	Redness. Pain.	Safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
•INGESTION		Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into sealable containers; if appropriate, moisten first	Separated from combustible and reducing substances. See Chemical	O symbol

to prevent dusting. Wash away remainder with plenty of water. Do NOT absorb in saw-dust or other combustible absorbents. Personal protection: P2 filter respirator for harmful particles.	Dangers. Well closed.	Xn symbol R: 9-22 S: 2-13-22-27 UN Hazard Class: 5.1 UN Packing Group: II

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0715

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities (C) IPCS CEC 1994. No modifications to the International version have been made except to add the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

International Chemical Safety Cards

SODIUM PERCHLORATE

ICSC: 0715

I M P O R T A N T D A T A	**PHYSICAL STATE; APPEARANCE:** WHITE HYGROSCOPIC CRYSTALS OR POWDER. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** The substance decomposes on heating producing toxic fumes (chlorine , chloroxides). The substance is a strong oxidant and reacts with combustible and reducing materials causing fire and explosion hazard. **OCCUPATIONAL EXPOSURE LIMITS:** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its aerosol and by ingestion. **INHALATION RISK:** Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed. **EFFECTS OF SHORT-TERM EXPOSURE:** The substance irritates the eyes, the skin and the respiratory tract. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** The substance may have effects on the blood , resulting in formation of methaemoglobin. (See Notes).
PHYSICAL PROPERTIES	Melting point (decomposes): 482°C Density: 2.0 g/cm³	Solubility in water: very good
ENVIRONMENTAL DATA		

N O T E S

Other melting points: sodium perchlorate monohydrate: 130°C. Will turn shock-sensitive if contaminated with organic substances. Specific treatment is necessary in case of poisoning with this substance; the appropriate means with instructions must be available. Rinse contaminated clothes (fire hazard) with plenty of water. The recommendations on this Card also apply to Sodium perchlorate monohydrate. Depending on the degree of exposure, periodic medical examination is suggested. Card has been partly updated in October 2005. See section Emergency Response.

Transport Emergency Card: TEC (R)-51S1502 or 51GO2-I+II+III

NFPA Code: H 2; F 0; R 2; ox

ADDITIONAL INFORMATION

ICSC: 0715 **SODIUM PERCHLORATE**

(C) IPCS, CEC, 1994

IMPORTANT LEGAL NOTICE:	Neither NIOSH, the CEC or the IPCS nor any person acting on behalf of NIOSH, the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. The only modifications made to produce the U.S. version is inclusion of the OSHA PELs, NIOSH RELs and NIOSH IDLH values.

MATERIAL SAFETY DATA SHEET
Review Date: 04/29/2003

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

PRODUCT: GN LS Diesel 2

MSDS NUMBER: 400535M - 3
PRODUCT CODE(S): 00429

MANUFACTURER ADDRESS: Motiva Enterprises LLC, P.O. Box 4540, Houston, TX. 77210-4540

TELEPHONE NUMBERS
Spill Information: (877) 242-7400
Health Information: (877) 504-9351
MSDS Assistance Number: (877) 276-7285

SECTION 2 PRODUCT/INGREDIENTS

CAS#	CONCENTRATION	INGREDIENTS
Mixture	100 %weight	#2 Diesel
68814-87-9	0 - 99.99 %weight	Full Range Straight Run Middle Distillate
64741-59-9	0 - 39.99 %weight	Light Catalytic Cracked Distillate
71-43-2	0.01 - 0.64 %weight	Benzene
7704-34-9	0 - 0.04 %weight	Sulfur

NOTE: H2S is a naturally occuring constituent in the petroleum stream and is not added separately to the product.

SECTION 3 HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW
Appearance & Odor: Bright and clear liquid (Tax Exempt Diesels - pale red liquid). Oil-type odor.
Health Hazards: Hydrogen sulfide (H2S), an extremely flammable and toxic gas, may be present. Causes severe skin irritation. Toxic and har
Physical Hazards: Combustible Liquid.
NFPA Rating (Health, Fire, Reactivity): 2, 2, 0
Hazard Rating: Least - 0 Slight - 1 Moderate - 2 High - 3 Extreme - 4

Inhalation:
In applications where vapors (caused by high temperature) or mists (caused by mixing or spraying) are created, breathing may cause a mild bu

Eye Irritation:
If irritation occurs, a temporary burning sensation, minor redness, swelling, and/or blurred vision may result.

Skin Contact:
Severely irritating to the skin causing pain, redness and swelling. Other adverse effects not expected from brief skin contact.

Ingestion:
This material may be harmful or fatal if swallowed. Ingestion may result in vomiting; aspiration (breathing) of vomitus into lungs must be

Other Health Effects:
Carcinogenic in animal tests. It is probable that the material causes cancer in laboratory animals.
Material may release hydrogen sulfide (H2S), a highly toxic and extremely flammable gas, when heated to 180 Degrees F or higher. H2S can ca
Refer to Section 11, Toxicological Information, for specific information on the following effects:

Signs and Symptoms:
Irritation as noted above. Aspiration pneumonitis may be evidenced by coughing, labored breathing and cyanosis (bluish skin); in severe cas

For additional health information, refer to section 11.

SECTION 4 FIRST AID MEASURES

Inhalation:
Vaporization of H2S that has been trapped in clothing can be dangerous to rescuers. Maintain respiratory protection to avoid contamination

Skin:
Remove contaminated clothing. Flush with large amounts of water for at least 15 minutes and follow by washing with soap if available. If r

Eye:
Flush eyes with plenty of water while holding eyelids open. Rest eyes for 30 minutes. If redness, burning, blurred vision or swelling occu

Ingestion:
DO NOT take internally. In general no treatment is necessary unless large quantities are swallowed, however, get medical advice. Have vi

Note to Physician:
If more than 2.0ml/kg body weight has been ingested and vomiting has not occurred, emesis should be induced with supervision. Keep victim's

---

SECTION 5 FIRE FIGHTING MEASURES

Flash Point [Method]: >125 °F/>51.67 °C [Closed Cup]
Autoignition Temperature: 500 °F/260 °C
Flammability in Air: 0.5 - 4.4 %volume

Extinguishing Media:
Material will float and can be re-ignited on surface of water. Use water fog, 'alcohol foam', dry chemical or carbon dioxide (CO2) to extin

Fire Fighting Instructions:
CAUTION! COMBUSTIBLE. Clear fire area of all non-emergency personnel. Do not enter confined fire space without full bunker gear (helmet w

---

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures:
CAUTION! COMBUSTIBLE. Eliminate potential sources of ignition. Handling equipment must be bonded and grounded to prevent sparking.

Wear appropriate personal protective equipment when cleaning up spills. Refer to Section 8.

Spill Management:
Shut off source of leak if safe to do so. Dike and contain spill.

FOR LARGE SPILLS: Remove with vacuum truck or pump to storage/salvage vessels.

FOR SMALL SPILLS: Soak up residue with an absorbent such as clay, sand or other suitable material. Place in non-leaking container and seal

Reporting:
CERCLA: Product is covered by EPA's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) petroleum exclusion. Rele

CWA: This product is an oil as defined under Section 311 of EPA's Clean Water Act (CWA). Spills into or leading to surface waters that cause

---
SECTION 7 HANDLING AND STORAGE

Precautionary Measures:
CAUTION! COMBUSTIBLE. Do not breathe material. Keep container closed. Use only with adequate ventilation. Avoid heat, open flames, incl

Material may release hydrogen sulfide (H2S), a highly toxic and extremely flammable gas, when heated to 180 Degrees F or higher. H2S may co

Handling:
Surfaces that are sufficiently hot may ignite liquid material.

Storage:
Keep liquid and vapor away from heat, sparks and flame. Extinguish pilot lights, cigarettes and turn off other sources of ignition prior to

Container Warnings:
Keep containers closed when not in use. Containers, even those that have been emptied, can contain explosive vapors. Do not cut, drill, gr

---
SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

Benzene ACGIH TLV TWA: 0.5 ppmv STEL: 2.5 ppmv Notation: Skin
Benzene OSHA PEL TWA: 1 ppmv STEL: 5 ppmv
Diesel Fuel, as total hydrocarbons ACGIH TLV TWA: 100 mg/m3

Carbon dioxide ACGIH - TLV TWA: 5000 ppmm STEL: 30000 ppmm
Carbon dioxide OSHA - PEL STEL: 30000 ppmm
Carbon dioxide OSHA - PEL_IS TWA: 10000 ppmm
Carbon monoxide OSHA - PEL TWA: 35 ppmv Ceiling: 200 ppmv
Carbon monoxide Combustion

EXPOSURE CONTROLS
Adequate explosion-proof ventilation to control airborne concentrations.

PERSONAL PROTECTION
Personal protective equipment (PPE) selections vary based on potential exposure conditions such as handling practices, concentration and ven

Eye Protection:
Chemical Goggles - If liquid contact is likely., or Safety glasses with side shields

Skin Protection:
Use protective clothing which is chemically resistant to this material. Selection of protective clothing depends on potential exposure cond

Published literature, test data and/or glove and clothing manufacturers indicate the best protection is provided by:
Neoprene, or Nitrile Rubber
Respiratory Protection:
If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, an approved respirato

Types of respirator(s) to be considered in the selection process include:
Supplied-Air Respirator. Air-Purifying Respirator for Organic Vapors. Self-contained breathing apparatus for use in environments with unkn

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SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance & Odor: Bright and clear liquid (Tax Exempt Diesels - pale red liquid). Oil-type odor.
Substance Chemical Family: Petroleum Hydrocarbon, Fuel Oil
Appearance: Bright and clear liquid (Tax Exempt Diesels - pale red liquid).

Auto Ignition Temperature: 500 °F

Flammability in Air: 0.5 - 4.4 %volume

Flash Point: > 125 °F [Closed Cup]

Specific Gravity: 0.85 Typical

Stability: Stable

Vapor Pressure: 0.02 mmHg Typical [Calculated]

Viscosity: 1.9 - 4.1 cSt @ 40 °C

SECTION 10 REACTIVITY AND STABILITY

Stability:
Material is stable under normal conditions.

Conditions to Avoid:
Avoid heat and open flames.

Materials to Avoid:
Avoid contact with strong oxidizing agents.

Hazardous Decomposition Products:

Thermal decomposition products are highly dependent on combustion conditions. A complex mixture of airborne solids, liquids and gases will

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SECTION 11 TOXICOLOGICAL INFORMATION

Acute Toxicity
Dermal LD50 > 5 ml/kg(Rabbit) OSHA: Non-Toxic Based on similar material(s)
Eye Irritation Non-Irritating [Rabbit] OSHA: Non-Irritating Based on similar material(s)
Oral LD50 9 ml/kg(Rat) OSHA: Non-Toxic Based on similar material(s)
Skin Irritation Extremely irritating [Rabbit] OSHA: Irritating Based on similar material(s)
Carcinogenicity Classification
#2 Diesel
NTP: No IARC: No ACGIH: No OSHA: No
Benzene
NTP: Yes IARC: Carcinogen (1) ACGIH: A1 OSHA: Yes
Light Catalytic Cracked Distillate
NTP: No IARC: Possible Carcinogen (2B) ACGIH: No OSHA: No
Carcinogenicity
Related materials have caused the development of skin tumors in lifetime mouse skin painting studies. However, these tumors have a long late

Genotoxicity
A closely related component (Hydrodesulfurized Middle Distillate) did not cause detectable mutations in two different in vivo (live animal)

SECTION 12 ECOLOGICAL INFORMATION

Environmental Impact Summary:
There is no ecological data available for this product.

SECTION 13 DISPOSAL CONSIDERATIONS

RCRA Information:

Under RCRA, it is the responsibility of the user of the material to determine, at the time of the disposal, whether the material meets RCRA

SECTION 14 TRANSPORT INFORMATION

US Department of Transportation Classification

Proper Shipping Name: Diesel Fuel
Identification Number: NA1993
Hazard Class/Division: Combustible Liquid
Packing Group: III

Hazardous Substance/Material RQ: Benzene / 1546.2005 lbs

Oil: This product is an oil under 49CFR (DOT) Part 130. If shipped by rail or highway in a tank with a capacity of 3500 gallons or more, it

Emergency Response Guide #128

International Air Transport Association
Hazard Class/Division: 3 (Flammable Liquid)
Identification Number: UN1202
Packing Group: III
Proper Shipping Name: Diesel Fuel

International Maritime Organization Classification
Hazard Class/Division: 3 (Flammable Liquid)
Identification Number: UN1202
Packing Group: III
Proper Shipping Name: Diesel Fuel

SECTION 15 REGULATORY INFORMATION

FEDERAL REGULATORY STATUS

OSHA Classification:
Product is hazardous according to the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Ozone Depleting Substances (40 CFR 82 Clean Air Act):
This material does not contain nor was it directly manufactured with any Class I or Class II ozone depleting substances.

Superfund Amendment & Reauthorization Act (SARA) Title III:

SARA Extremely Hazardous Substances (302/304):
Hydrogen sulfide RQ 100 lbs Reportable Spill => 711013 lbs or 100334 gal

SARA Hazard Categories (311/312):

Immediate Health:YES Delayed Health:YES Fire:YES Pressure:NO Reactivity:NO

SARA Toxic Release Inventory (TRI) (313):
Benzene

Toxic Substances Control Act (TSCA) Status:
This material is listed on the EPA/TSCA Inventory of Chemical Substances.

Other Chemical Inventories:
Australian AICS, Canadian DSL, European EINECS, Korean Inventory,

State Regulation
The following chemicals are specifically listed by individual states; other product specific health and safety data in other sections of the

California Safe Drinking Water and Toxic Enforcement Act (Proposition 65).
WARNING: This product contains a chemical(s) known to the State of California to cause cancer.

WARNING: This product contains a chemical(s) known to the State of California to cause birth defects or other reproductive harm.

New Jersey Right-To-Know Chemical List:
Benzene (71-43-2) 0.01 - 0.64 %weight Carcinogen
Benzene (71-43-2) 0.01 - 0.64 %weight Mutagen
Light Cat Cracked Distillate 0 - 39.99 %weight Mutagen

Pennsylvania Right-To-Know Chemical List:
Benzene (71-43-2) 0.01 - 0.64 %weight Spec Haz Sub/Env Hazardous

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SECTION 16 OTHER INFORMATION

Revision#: 3
Review Date: 04/29/2003
Revision Date: 04/29/2003
Revisions since last change (discussion): This Material Safety Data Sheet (MSDS) has been newly reviewed to fully comply with the guidance c

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SECTION 17 LABEL INFORMATION

READ AND UNDERSTAND MATERIAL SAFETY DATA SHEET BEFORE HANDLING OR DISPOSING OF PRODUCT. THIS LABEL COMPLIES WITH THE REQUIREMENTS OF THE OS

PRODUCT CODE(S): 00429

GN LS Diesel 2

WARNING!

COMBUSTIBLE LIQUID! MAY BE FATAL IF INHALED. CAUSES SEVERE SKIN IRRITATION. ASPIRATION HAZARD IF SWALLOWED - CAN ENTER LUNGS AND CAUSE DA
Refer to Section 11, Toxicological Information, for specific information on the following effects:

Precautionary Measures:
Avoid heat and open flames. Hydrogen Sulfide and other hazardous vapors may evolve and collect in the headspace of storage tanks or other e

FIRST AID
Inhalation: DO NOT attempt to rescue victim unless proper respiratory protection is worn. Vaporization of H2S that has been trapped in clo
Skin Contact: Remove contaminated clothing. Flush with large amounts of water for at least 15 minutes and follow by washing with soap if a
Eye Contact: Flush eyes with plenty of water while holding eyelids open. Rest eyes for 30 minutes. If redness, burning, blurred vision or
Ingestion: DO NOT take internally. If vomiting occurs spontaneously, keep head below hips to prevent aspiration. Have victim rinse mout

FIRE

In case of fire, Use water fog, 'alcohol foam', dry chemical or carbon dioxide (CO2) to extinguish flames. Do not use a direct stream of
SPILL OR LEAK
Dike and contain spill.
FOR LARGE SPILLS: Remove with vacuum truck or pump to storage/salvage vessels.

FOR SMALL SPILLS: Soak up residue with an absorbent such as clay, sand or other suitable material. Place in non-leaking container and seal

CONTAINS: Full Range Straight Run Middle Distillate, 68814-87-9; Light Catalytic Cracked Distillate, 64741-59-9; Benzene, 71-43-2; Sulfur, 7

NFPA Rating (Health, Fire, Reactivity): 2, 2, 0

TRANSPORTATION

US Department of Transportation Classification

Proper Shipping Name:	Diesel Fuel
Identification Number:	NA1993
Hazard Class/Division:	Combustible Liquid
Packing Group:	III

Hazardous Substance/Material RQ: Benzene / 1546.2005 lbs

Oil: This product is an oil under 49CFR (DOT) Part 130. If shipped by rail or highway in a tank with a capacity of 3500 gallons or more, it

Emergency Response Guide #128

California Safe Drinking Water and Toxic Enforcement Act (Proposition 65).
WARNING: This product contains a chemical(s) known to the State of California to cause cancer.

WARNING: This product contains a chemical(s) known to the State of California to cause birth defects or other reproductive harm.

Name and Address
Motiva Enterprises LLC
P.O. Box 4540
Houston, TX 77210-4540

ADMINISTRATIVE INFORMATION
MANUFACTURER ADDRESS: Motiva Enterprises LLC, P.O. Box 4540, Houston, TX. 77210-4540

THE INFORMATION CONTAINED IN THIS DATA SHEET IS BASED ON THE DATA AVAILABLE TO US AT THIS TIME, AND IS BELIEVED TO BE ACCURATE BASED UPON TH

TO DETERMINE THE APPLICABILITY OR EFFECT OF ANY LAW OR REGULATION WITH RESPECT TO THE PRODUCT, YOU SHOULD CONSULT WITH YOUR LEGAL ADVISOR OR

44156-11800-100R-04/05/2005

CHEVRON -- UNLEADED GASOLINE, CPS201110 -- 9130-00N018990

========== Product Identification ==========

Product ID:UNLEADED GASOLINE, CPS201110
MSDS Date:03/06/1991
FSC:9130
NIIN:00N018990
MSDS Number: CFZGX
=== Responsible Party ===
Company Name:CHEVRON
Box:4054
City:RICHMOND
State:CA
ZIP:94804
Country:US
Info Phone Num:800-582-3835
Emergency Phone Num:800-582-3835
CAGE:0AHD1
=== Contractor Identification ===
Company Name:CHEVRON ENVIRONMENTAL HEALTH CENTER INC
Address:15299 SAN PABLO AVE
Box:4054
City:RICHMOND
State:CA
ZIP:94804
Country:US
Phone:800-582-3835
CAGE:0AHD1

========== Composition/Information on Ingredients ==========

Ingred Name:ING 12:BE EPIGENETIC PROCESS UNIQUE TO FEMALE MOUSE. INHAL
EXPOS TO WHOLE GAS VAP ALSO CAUSED KIDNEY DMG & (ING 14)
RTECS #:9999999ZZ

Ingred Name:ING 13:EVENTUALLY KIDNEY CANCER IN MALE RATS. NOTE:TOLUENE
APPEARS ON NAVY LIST OF OCCUP CHEM REPRO HAZS. SEEK (ING 15)
RTECS #:9999999ZZ

Ingred Name:ING 14:CONSULTATION FROM APPROP HLTH PROFESSIONALS
CONCERNING LATEST HAZ LIST INFO & SAFE HNDLG & EXPOS INFO (ING 16)
RTECS #:9999999ZZ

Ingred Name:ING 15:. FOR MORE COMPLETE INFORMATION, CONTACT NEHC .
RTECS #:9999999ZZ

Ingred Name:FIRST AID PROC:OBTAINED, THEN TAKE PERS & PROD CNTNR TO
NEAREST MED EMER TREATMENT CENTER/HOSPITAL. NOTE TO MD: (ING 18)
RTECS #:9999999ZZ

Ingred Name:ING 17:INGESTION OF THIS PRODUCT OR SUBSEQUENT VOMITING CAN
RESULT IN ASPIRATION WHICH CAN CAUSE PNEUMONITIS.
RTECS #:9999999ZZ

Ingred Name:SPILL PROC:REPORTING SPILLS OF THIS MATL THAT COULD REACH
ANY SURF WATERS. TOLL FREE NUMBER FOR U.S. COAST GUARD(ING 20)
RTECS #:9999999ZZ

Ingred Name:ING 19:NATIONAL RESPONSE CENTER IS (800) 424-8802.
RTECS #:9999999ZZ

Ingred Name:WASTE DISP METH:CONTAM MATLS IN DISPOSABLE CNTNRS & DISPOSE
OF IN A MANNER CONSISTENT W/APPLIC REGS. CONT LOC (ING 22)
RTECS #:9999999ZZ

Ingred Name:ING 21:ENVIRONMENTAL OR HEALTH AUTHORITIES FOR APPROVED
DISPOSAL OF THIS MATERIAL.
RTECS #:9999999ZZ

Ingred Name:ING 11:LIVER TUMORS IN FEMALE MICE. MECHANISM OF THIS
RESPONSE IS STILL BEING INVESTIGATED BUT IT IS THOUGHT TO (ING 13)
RTECS #:9999999ZZ

Ingred Name:GASOLINE
CAS:8006-61-9
RTECS #:LX3300000
Fraction by Wt: 100%
OSHA PEL:300 PPM
ACGIH TLV:300 PPM;500 STEL

Ingred Name:BENZENE, ETHYL-; (ETHYLBENZENE) (SARA 313)
CAS:100-41-4
RTECS #:DA0700000
Fraction by Wt: <1.4%
OSHA PEL:100 PPM
ACGIH TLV:100 PPM;125 STEL
EPA Rpt Qty:1000 LBS
DOT Rpt Qty:1000 LBS

Ingred Name:P-XYLENE; (P-DIMETHYLBENZENE) (SARA 313) (CERCLA)
CAS:106-42-3
RTECS #:ZE2625000
Fraction by Wt: <0.9%
OSHA PEL:100 PPM
ACGIH TLV:100 PPM;150 STEL
EPA Rpt Qty:1000 LBS
DOT Rpt Qty:1000 LBS

Ingred Name:M-XYLENE; (M-DIMETHYLBENZENE) (SARA 313) (CERCLA)
CAS:108-38-3
RTECS #:ZE2275000
Fraction by Wt: <4.6%
OSHA PEL:100 PPM
ACGIH TLV:100 PPM;150 STEL
EPA Rpt Qty:1000 LBS
DOT Rpt Qty:1000 LBS

Ingred Name:O-XYLENE; (O-DIMETHYLBENZENE) (SARA 313) (CERCLA)
CAS:95-47-6
RTECS #:ZE2450000
Fraction by Wt: <2.2%
OSHA PEL:100 PPM
ACGIH TLV:100 PPM;150 STEL
EPA Rpt Qty:1000 LBS
DOT Rpt Qty:1000 LBS

Ingred Name:TOLUENE (SARA 313) (CERCLA)
CAS:108-88-3

RTECS #:XS5250000
Fraction by Wt: <6.5%
OSHA PEL:200 PPM
ACGIH TLV:50 PPM, S
EPA Rpt Qty:1000 LBS
DOT Rpt Qty:1000 LBS

Ingred Name:HEXANE; (N-HEXANE) (CERCLA)
CAS:110-54-3
RTECS #:MN9275000
Fraction by Wt: <3%
OSHA PEL:500 PPM
ACGIH TLV:50 PPM
EPA Rpt Qty:1 LB
DOT Rpt Qty:1 LB

Ingred Name:CYCLOHEXANE (SARA 313) (CERCLA)
CAS:110-82-7
RTECS #:GU6300000
Fraction by Wt: <2.4%
OSHA PEL:300 PPM
ACGIH TLV:300 PPM
EPA Rpt Qty:1000 LBS
DOT Rpt Qty:1000 LBS

Ingred Name:METHYL TERT-BUTYL ETHER (SARA 313) (CERCLA)
CAS:1634-04-4
RTECS #:KN5250000
Fraction by Wt: <15%
OSHA PEL:N/K
ACGIH TLV:N/K
EPA Rpt Qty:1 LB
DOT Rpt Qty:1 LB

Ingred Name:BENZENE (SARA 313) (CERCLA). OSHA PEL:1 PPM TWA; 5 PPM STEL
(MFR).
CAS:71-43-2
RTECS #:CY1400000
Fraction by Wt: <4.9%
OSHA PEL:SEE INGREDIENT
ACGIH TLV:10 PPM
EPA Rpt Qty:10 LBS
DOT Rpt Qty:10 LBS

Ingred Name:SUPDAT:(CALLED ASPIR). CAN CAUSE SEV INJURY TO LUNGS &
DEATH. LIFETIME INHAL OF WHOLE GAS VAP HAS CAUSED INCR (ING 12)
RTECS #:9999999ZZ

========== Hazards Identification ==========

LD50 LC50 Mixture:LD50:(ORAL,RAT) >5 ML/KG.
Routes of Entry: Inhalation:YES Skin:YES Ingestion:YES
Reports of Carcinogenicity:NTP:YES IARC:YES OSHA:YES
Health Hazards Acute and Chronic:EYE CONT:SLIGHTLY IRRIT & COULD CAUSE
PRLNG (DAYS) IMPAIRMENT OF VISION. SIGNS & SYMPS MAY INCL PAIN,
TEARS, SWELL, REDNESS & BLURRED VISION. VAPS, FUMES/SPRAY MIST
COULD ALSO CAUSE SIMILAR SIGNS & SY MPS. SKIN IRRIT:RPTD CONT MAY
CAUSE SKIN TO CRACK/DRY FROM DEFAT ACTION. INHAL:SLIGHTLY TOX.
TARGET (EFTS OF OVEREXP)
Explanation of Carcinogenicity:BENZENE:IARC MONOGRAPHS, SUPP, VOL 7, PG

120, 1987:GRP 1. NTP 7TH ANNUAL RPT ON CARCINS, 1994:KNOWN TO BE (SUPP DATA)
Effects of Overexposure:HLTH HAZ:ORGAN:NERV SYS. CONCS >1000 PPM MAY CAUSE CNS EFTS SUCH AS HDCH, DIZZ, LOSS OF APPETITE, WEAK & LOSS OF COORD. CONCS >5000 PPM MAY CAUSE LOSS OF CONSCIOUSNESS, COMA & DEATH. INGEST:SLIGHTLY T OX IF SWALLOWED. TARGET ORGAN:NERV SYS.SIGNS & SYMPS OF CNS EFTS MAY INCL HDCH, DIZZ, LOSS OF APPETITE, WEAK & (SUPDAT)
Medical Cond Aggravated by Exposure:NONE SPECIFIED BY MANUFACTURER.

First Aid Measures

First Aid:EYES:FLUSH IMMED W/FRESH WATER FOR AT LST 15 MINS WHILE HOLDING LIDS OPEN. REMOVE CONT LENSES IF WORN. IF IRRIT PERSISTS, SEE MD. SKIN:WASH THORO W/SOAP & WATER. REMOVE & WASH CONTAM CLTHG. INHAL:MOVE TO FRESH AIR. IF ANY EFTS CONTINUE, SEE MD. INGEST:GIVE WATER/MILK TO DRINK & TELEPHONE FOR MED ADVICE. DO NOT MAKE PERS VOMIT UNLESS DIRECTED TO DO SO BY MED PERS. IF MED ADVICE CANNOT BE (ING 17)

Fire Fighting Measures

Flash Point Method:PMCC
Flash Point:<-49F,<-45C
Lower Limits:1.4%
Upper Limits:7.6%
Extinguishing Media:FIRE FIGHTING FOAM:ALCOHOL RESISTANT TYPE (AR). AFFF, CO*2, DRY CHEMICAL.
Fire Fighting Procedures:USE NIOSH APPROVED SCBA & FULL PROTECTIVE EQUIPMENT .
Unusual Fire/Explosion Hazard:EXTREME FIRE HAZ. LIQ VERY QUICKLY EVAPS, EVEN AT LOW TEMPS & FORMS VAP (FUMES) WHICH CAN CATCH FIRE & BURN W/EXPLO VIOLENCE. INVISIBLE VAP SPREADS (SUPP DATA)

Accidental Release Measures

Spill Release Procedures:ELIM ALL SOURCES OF IGNIT. CLEAN UP SPILLS IMMED, OBSERVING PRECS IN PROT EQUIP SECTION. MATL IS CONSIDERED TO BE WATER POLLUTANT & RELS SHOULD BE PREVENTED FROM CONTAM SOIL & WATER & FROM ENTERING DR AINAGE & SEWER SYS. U.S.A. REGS REQ (ING 19)
Neutralizing Agent:NONE SPECIFIED BY MANUFACTURER.

Handling and Storage

Handling and Storage Precautions:USE ONLY AS MOTOR FUEL. DO NOT USE FOR CLEANING, PRESS APPLIANCE FUEL/ANY OTHER SUCH USE. USE ONLY IN WELL VENTED AREA. KEEP OUT OF REACH OF CHILDREN.
Other Precautions:DO NOT USE/STORE NEAR FLAME, SPKS/HOT SURFS. KEEP CNTNR CLSD. DO NOT TRANSFER LIQ TO UNLABELED CNTNR. DO NOT WELD, HEAT/DRILL CNTNR. REPLACE CAP/BUNG. EMPTIED CNTNR STILL CNTNS HAZ/EXPLO VAP/LIQ. READ & OBSERVE ALL PRECS ON PROD LABEL.

Exposure Controls/Personal Protection

Respiratory Protection:NO SPECIAL PROTECTION IS NORMALLY REQUIRED. HOWEVER, IF OPERATING CONDITIONS CREATE AIRBORNE CONCENTRATIONS WHICH EXCEED RECOMMENDED EXPOSURE STANDARDS, USE OF A NIOSH APPROVED RESPIRATOR IS REQUIRED.
Ventilation:USE ONLY IN WELL VENTILATED AREAS.

Protective Gloves:IMPERVIOUS GLOVES .
Eye Protection:ANSI APPROVED CHEM WORKERS GOGGS .
Other Protective Equipment:ANSI APPROVED EYE WASH FOUNTAIN & DELUGE SHOWER . CONTACT CAN BE MINIMIZED BY WEARING PROTECTIVE CLOTHING.
Work Hygienic Practices:NONE SPECIFIED BY MANUFACTURER.
Supplemental Safety and Health
EXPLO HAZ:EASILY & CAN BE SET ON FIRE BY MANY SOURCES SUCH AS PILOT LIGHTS, WELDING EQUIP & ELEC MOTORS & SWITCHES. EXPLAN OF CARCIN:CARCIN. OSHA REGULATED:29 CFR 1910.1028. HUMAN:MYELOID LEUKEMIA, HO DGKINS DISEASE, LYMPHOMA. EFTS OF OVEREXP:LOSS OF COORD. SUBSTANCE CAN DIRECTLY ENTER LUNGS IF IT IS SWALLOWED (ING 11)

Physical/Chemical Properties

Boiling Pt:B.P. Text:>77F,>25C
Vapor Pres:5-15 @100F
Vapor Density:3-4
Spec Gravity:0.7-0.8
Solubility in Water:INSOLUBLE
Appearance and Odor:ORANGE TO BRONZE LIQUID.
Percent Volatiles by Volume:>99

Stability and Reactivity Data

Stability Indicator/Materials to Avoid:YES
MAY REACT W/STRONG OXIDIZING AGENTS, SUCH AS CHLORATES, NITRATES, PEROXIDES, ETC.
Stability Condition to Avoid:NEVER SIPHON GASOLINE BY MOUTH.
Hazardous Decomposition Products:NORMAL COMBUSTION FORMS CARBON DIOXIDE & WATER VAPOR; INCOMPLETE COMBUSTION CAN PRODUCE CARBON MONOXIDE.

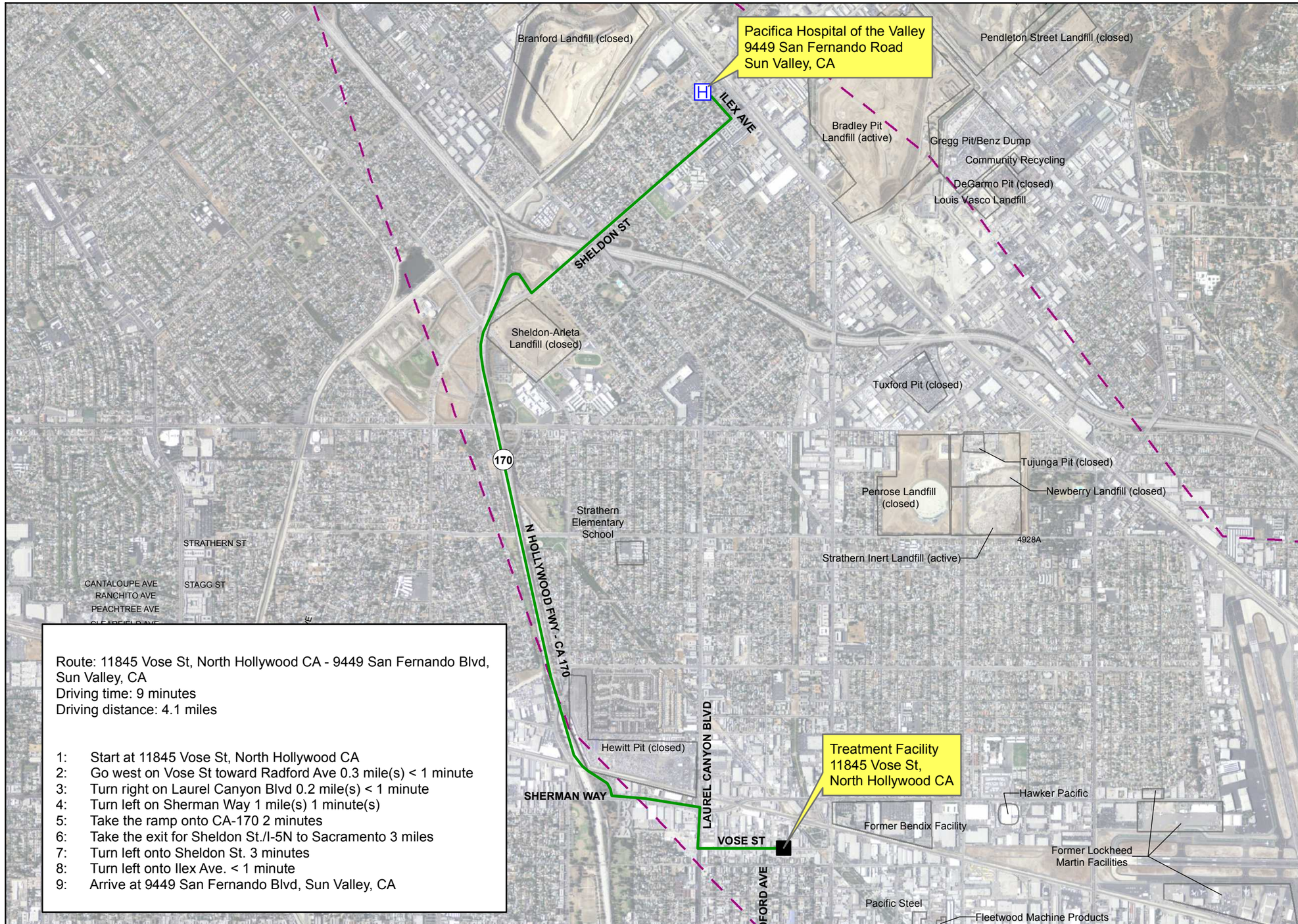
Disposal Considerations

Waste Disposal Methods:DISP MUST BE I/A/W FED, STATE & LOC REGS . CLEAN UP SM SPILLS USING APPROP TECHNIQUES SUCH AS SORBENT MATLS/PUMPING. WHERE FEASIBLE & APPROP, REMOVE CONTAM SOIL. FOLLOW PRESCRIBED PROCS FOR REPO RTING & RESPONDING TO LGR RELS. PLACE (ING 21)

Disclaimer (provided with this information by the compiling agencies): This information is formulated for use by elements of the Department of Defense. The United States of America in no manner whatsoever, expressly or implied, warrants this information to be accurate and disclaims all liability for its use. Any person utilizing this document should seek competent professional advice to verify and assume responsibility for the suitability of this information to their particular situation.

APPENDIX C

Hospital Location Map



Route: 11845 Vose St, North Hollywood CA - 9449 San Fernando Blvd, Sun Valley, CA
Driving time: 9 minutes
Driving distance: 4.1 miles

1: Start at 11845 Vose St, North Hollywood CA
2: Go west on Vose St toward Radford Ave 0.3 mile(s) < 1 minute
3: Turn right on Laurel Canyon Blvd 0.2 mile(s) < 1 minute
4: Turn left on Sherman Way 1 mile(s) 1 minute(s)
5: Take the ramp onto CA-170 2 minutes
6: Take the exit for Sheldon St./I-5N to Sacramento 3 miles
7: Turn left onto Sheldon St. 3 minutes
8: Turn left onto Ilex Ave. < 1 minute
9: Arrive at 9449 San Fernando Blvd, Sun Valley, CA

EXPLANATION

- Hospital (Pacifica Hospital of the Valley)
- NHOU Treatment Facility
- Hospital Route
- Study Area Features
- Approximate Boundary San Fernando Valley Investigation Area 1

Aerial Photograph: DigitalGlobe, June 2009

DRAWN: TJH	PROJECT NO: 4088115718		
REV:	SCALE: AS SHOWN		
CHECKED: MSB	APPROVED: MDT		
DATE: 9/2012	DATE: 9/2012		

amec

Phase I Pre-Design Investigation Health and Safety Plan
North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design

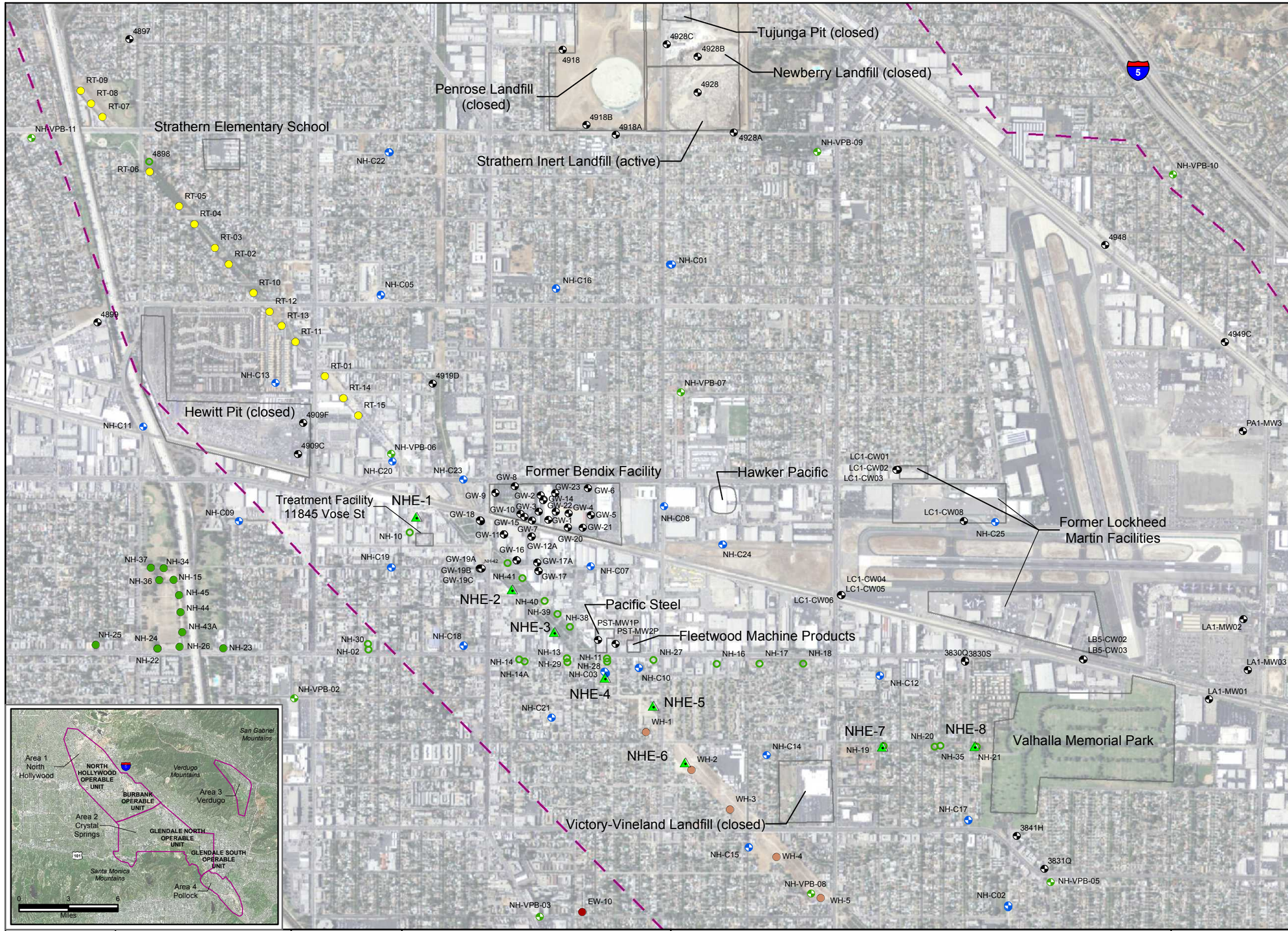
Hospital Location Map

APPENDIX C

Wednesday, September 05, 2012 11:16:38 AM
P:\4088\115718_NHOU\GIS\Projects\HASP\AppxC-HospRoute.mxd

APPENDIX D

Site Study Area Map



EXPLANATION

- NHOU Extraction Well

PRODUCTION WELLS

- Erwin Well Field
- North Hollywood Well Field (West)
- North Hollywood Well Field (East)
- Rinaldi-Toluca Well Field
- Whitnall Well Field

MONITORING WELLS

- NHOU Monitoring Well
- North Hollywood Vertical Profile Boring Monitoring Well
- Facility Monitoring Wells
- Study Area Features
- Approximate Boundary San Fernando Valley Investigation Area 1

N

0 1,500 3,000
Feet

Aerial Photograph: DigitalGlobe, June 2009

DRAWN: TJH	PROJECT NO: 4088115718		
REV:	SCALE: AS SHOWN		
CHECKED: MSB	APPROVED: MDT		
DATE: 9/2012	DATE: 9/2012		

amec

Phase I Pre-Design Investigation Health and Safety Plan
North Hollywood Operable Unit
Second Interim Remedy
Groundwater Remediation System Design

Site Study Area Map

APPENDIX **D**

Wednesday, September 05, 2012 11:44:46 AM
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APPENDIX E

AMEC Responses to USEPA Comments to the Draft Work Plan,
Phase I Pre-Design Investigation (dated August 10, 2012)

10 September 2012

Mr. Matt Salazar
U.S. Environmental Protection Agency
75 Hawthorne Street
San Francisco, CA 94105

Re: AMEC Responses to EPA Comments (dated August 10, 2012)
"Draft Work Plan, Phase I Pre-Design Investigation, North Hollywood Operable Unit, Second Interim Remedy" and the *"Remedial Design Quality Assurance Project Plan, North Hollywood Operable Unit, Second Interim Remedy Groundwater Remediation System Design"*

Dear Mr. Salazar:

This letter has been prepared to respond to final comments that USEPA provided to the following documents on August 10, 2012:

- *Draft Work Plan, Phase I Pre-Design Investigation, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design* (AMEC, April 13, 2012)
- *Draft Sampling and Analysis Plan, Phase I Pre-Design Investigation, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design* (AMEC, April 13, 2012)
- *Health and Safety Plan, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design* (AMEC, April 13, 2012)
- *Remedial Design Quality Assurance Project Plan, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design* (AMEC, May 14, 2012).

A response follows each comment provided by the USEPA and each document has been revised accordingly.

It is imperative to recognize that development of the Groundwater Management Plan, as a required Institutional Control in the ROD, remains a critical element of the Second Interim Remedy. All Phase I Pre-Design Investigation activities have been based on the expectation that the USEPA and LADWP will develop a Groundwater Management Plan that will not only be a notification of planned pumping, but also will provide a "decision-making process to address any potential conflicts between the LADWP's pumping plans and the performance of the remedy". The Groundwater Management Plan was included in the ROD as an Institutional Control to ensure that production well pumping does not negatively impact the performance of the Second Interim Remedy. The current schedule reflects the need for an agreement to proceed on the Groundwater Management Plan prior to the installation of the proposed piezometers under the Phase 1 Pre-Design Investigation and the preparation of the Groundwater Modeling Memo.

AMEC Environment & Infrastructure, Inc.
1330 Broadway, Suite 1702
Oakland, California 94612
Tel (510) 451-1001
Fax (510) 451-3465
amec.com

Should you have questions regarding our responses to EPA comments, please feel free to call me at (510) 663-3996 to discuss.

Sincerely,
AMEC Engineering & Infrastructure, Inc.

Michael Taraszki, PG, CHG, PMP
Project Manager

Robert Hartwell, PE
Engineering Manager

w/permission

Attachments:

Attachment A — USEPA Comments on the *Draft Work Plan, Phase I Pre-Design Investigation, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design* and the *Remedial Design Quality Assurance Project Plan, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design (August 10, 2012)*

WORK PLAN

1. **General comment:** The Work Plan is well written and indicates a comprehensive understanding of both the available site data and the data gaps in the NHOU. Conduct of the work proposed in the Work Plan (and SAP) will improve the conceptual site model for the NHOU and provide important hydrogeologic data required for RD of the Second Interim Remedy.

As stated in Section 2.4 of the Work Plan, "The overall objective of the Phase I Pre-Design Investigation is to fill critical data gaps identified as necessary for the Second Interim Remedy design to meet RAOs…" And Section 4 of the Work Plan states that a second phase of investigation would only be performed "if it is determined that insufficient data exist (at that time) to fill critical data gaps associated with the Second Interim Remedy and comply with RAOs and meet CDPH 97-005 requirements." However, actions that might fill some of the "critical data gaps" identified in the Final Data Gap Analysis report (pages 5-14 and 5-15) prepared by AMEC (dated March 14, 2012) are not proposed in this Work Plan. Specifically, critical data gaps 4, 5, 6, 8, and 9 listed on pages 5-14 and 5-15 of the Final Data Gap Analysis report seem to be unaddressed, or only partly addressed, by the activities listed in the Work Plan. It seems that either some of the data gaps identified in the Final Data Gap Analysis report are no longer deemed critical, or will simply not be addressed by the proposed Phase I investigation and will be addressed in some other manner. Please revise the Work Plan to provide more clarity regarding which of the critical data gaps are addressed by each proposed field activity, and which critical data gaps are not addressed in the proposed Phase I investigation (together with an explanation of why not, and how they will be addressed in the future). Our comments and/or recommendations for filling these data gaps are summarized below, but could be modified depending on additional information provided by the respondents:

- **Critical Data Gap 4** ("existing monitoring well network insufficient to characterize vadose zone and groundwater conditions beneath known and potential source areas"): The Work Plan should show critical areas for further investigation on a map, or at least describe how the need for further characterization in the vicinity of the "known and potential source areas" would be evaluated and conducted during a Phase II data gaps investigation. The area southwest of NHOU extraction wells NHE-2 and NHE-3, where high concentrations of VOCs and hexavalent chromium have been detected, but are poorly delineated, seems to be of primary concern. It is not clear how the data collection activities described in the Work Plan would fill this data gap or aid in further delineating contaminant concentrations in this particular area. We recommend that at least two new monitoring wells be installed in this area as part of the Phase I investigation.

  AMEC Response: As shown on Figure 6-1 in the Final Data Gap Analysis (AMEC, March, 14, 2012), two groundwater monitoring wells have been considered for installation in this area. However, as described in that document and in the Phase I Pre-Design Investigation Work Plan, additional monitoring wells (whether at the locations illustrated on Figure 6-1 or elsewhere) will be considered following the evaluation of data collected as part of Phase I sampling and testing. Depth-discrete analytical data and accurate groundwater elevations from existing monitoring wells are anticipated to be particularly useful in

supporting that assessment. Should it be determined that additional are needed, the number (if any) and location(s) of additional monitoring wells will be determined and installed and sampled as part of the Phase II Pre-Design Investigation.

- **Critical Data Gap 5** ("objective projections of pumping and recharge volumes, including beyond year 2015, are not yet available"): The Work Plan should state that addressing this data gap does not require field activity; rather, discussions are ongoing (presumably) with LADWP and the ULARA Watermaster to develop improved and updated projections of future pumping and recharge volumes.

  AMEC Response: Comment acknowledged. The ULARA Watermaster has affirmed that the projections included in his annual Pumping and Spreading reports have been provided by associated municipalities and are presumed to be accurate. AMEC anticipates that forthcoming discussions between the EPA and various stakeholders will clarify how these projections correspond with the 2007 Stipulated Agreement. Table 2-1 has been incorporated into the Final Work Plan to provide further clarification.

- **Critical Data Gap 6** ("performance monitoring wells have not been installed and monitored"): It is unclear whether the proposed piezometers in the Work Plan constitute some or all of the needed performance monitoring wells that comprise this critical data gap. The Work Plan should clarify whether the planned piezometers are expected to address this data gap by themselves, or if installation of additional performance monitoring wells is anticipated to be required in the future, to complete the RD. If so, then the Work Plan should describe how and when decisions about the need for additional performance monitoring wells will be made.

  AMEC Response: Proposed piezometers adjacent to NHE-3, NHE-5, and NHE-7 will provide empirical data that will be used to verify, calibrate, and refine the numerical groundwater flow model as needed to support the design of the Second Interim Remedy. It is not anticipated that additional piezometers will be needed to achieve this objective.

- **Critical Data Gap 8** ("available analytical data are insufficient to evaluate A-Zone and, potentially, B-Zone groundwater quality within the future NHOU capture zone to meet CDPH 97-005 requirements"): The Work Plan should define whether this is still considered to be a critical data gap, and describe how and when it will be addressed.

  AMEC Response: This remains a critical data gap; the Work Plan has been revised to specify that additional data beyond those included in the Phase I Pre-Design Investigation will be required to address CDPH 97-005 requirements. AMEC anticipates that specific groundwater samples (within the anticipated NHOU capture zone) will be collected after the groundwater flow model has been refined and calibrated such that the Second Interim Remedy capture area can be more accurately estimated and monitoring wells within that area (from the A-Zone and B-Zone) can be identified. This sampling activity would be integrated into the current NHOU sampling program, to the extent possible, and would not comprise a Phase II Pre-Design Investigation. Table 2-1 has been incorporated into the Final Work Plan to provide further clarification.

- **Critical Data Gap 9** ("vertical conduits throughout the NHOU study area have not been sufficiently evaluated"): The Work Plan includes investigative activities to evaluate existing monitoring wells as potential vertical conduits for contaminant migration; however, it does not include plans to evaluate existing inactive production wells. Inactive production wells appear to pose a greater threat of vertical contaminant migration, due to their number, long screens, and large diameter. The Work Plan should describe how and when this part of Critical Data Gap 9 will be addressed (e.g., will it be addressed as part of a future Phase II investigation, and are there any conditions on which such an investigation would depend).

  AMEC Response: Figure 4-3 of the Final Data Gap Analysis report shows the locations of probable and suspected vertical conduits at inactive and active municipal production wells. Inspection and/or elimination of vertical conduits at inactive production wells (in particular) is the responsibility of the well owner. This responsibility has been clarified in the additional table and text of the Work Plan (see our response to Comment #5); however, we cannot speculate as to exactly when this critical data gap may be addressed. Honeywell and Lockheed Martin expect that the USEPA will participate in activities required to get well owners, including LADWP, to address the issue of closing vertical conduits at inactive and active supply wells to facilitate the success of the Second Interim Remedy. Table 2-1 has been incorporated into the Final Work Plan to provide further clarification.

2. **Table of Contents page iii, Table, Figures, and Appendix sections:** The title provided in the table of contents for Table 3-1 is different from the title actually on Table 3-1. The titles for Figure 3-1 and Appendix A are similarly inconsistent with the titles given in the table of contents. Please make the titles listed in the table of contents consistent with the actual titles of the corresponding tables, figures, and appendices.

AMEC Response: Comment acknowledged. The table of contents has been revised to correctly match table and figure titles.

3. **Section 2.2, Project Background, page 2-3, first full paragraph:** This paragraph paraphrases the key remedial action objectives (RAOs) and relates them to the specific work scope items in the Agreement and Order on Consent (AOC). However, the second sentence in this paragraph focuses exclusively on the second RAO for the NHOU Second Interim Remedy. We recommend that this sentence be modified to also accommodate the fourth remedial action objective (RAO), which is to achieve improved hydraulic containment to inhibit horizontal and vertical contaminant migration in groundwater from the more highly contaminated areas and depths of the aquifer to the less contaminated areas and depths of the aquifer, including the southeast portion of the NHOU near the Erwin and Whitnall production well fields. We assume that this RAO influences the AOC work scope items, as well as the scope of work for the activities described in the Work Plan.

AMEC Response: The second sentence has been modified to acknowledge other production well fields as suggested. Otherwise, please note that the RAOs are represented in full on the previous page and that this paragraph, including the focus on the Rinaldi-Toluca well field, stems from the Record of Decision, Section 2.8, page 2-19.

4. **Section 2.3, Previous Investigations, page 2-4, fourth paragraph:** The second-to-last sentence in this paragraph states "However, it was concluded that existing data are

insufficient to proceed with a Second Interim Remedy…" We recommend that the sentence be modified to state which entity came to that conclusion, and provide a reference to a document where that conclusion is stated (perhaps the Draft or Final Data Gap Analysis report prepared by AMEC).

AMEC Response: This was the conclusion of AMEC as part of the Final Data Gap Analysis report and has been additionally referenced in the Work Plan for clarity.

5. **Section 2.4, Phase I Pre-Design Investigation Objectives, page 2-5, bullets 1 through 6:** It is difficult to directly compare these bulleted "specific objectives" of the Phase I Pre-Design Investigation to the "critical data gaps" listed in the Final Data Gaps Analysis report (prepared by AMEC, dated March 14, 2012, see pages 5-14 and 5-15). We recommend adding a table to the Work Plan that lists the critical data gaps provided in the Final Data Gaps Analysis report and then lists the corresponding specific objectives of the Phase I Pre-Design Investigation in an adjacent column. Such a table would allow easier comparison of critical data gaps to objectives of the upcoming investigation, and possibly aid in identification of redundancies or additional needs.

AMEC Response: AMEC has included Table 2-1 in the Work Plan to explicitly reference each task item to a data gap identified in the Final Data Gap Analysis report. This table describes how each data gap will be addressed by the tasks outlined in the Phase I Pre-Design Investigation, or if and when each may be addressed in a subsequent investigation.

6. **Section 2.4, Phase I Pre-Design Investigation Objectives, page 2-5, bullet 7:** This bullet states that a specific objective of the Phase I Pre-Design Investigation is to "Assess whether sufficient data exist to proceed with designing the Second Interim Remedy…" We recommend adding a discussion in this document or the SAP (and referencing such a location within bullet 7) that describes the process and people who will make such an assessment.

AMEC Response: Text comprising this bullet has been modified to include a reference to a section within the Work Plan that will outline the AMEC's decision processes regarding determining data sufficiency for the Second Interim Remedy design.

7. **Section 3.3.2, Aquifer Testing, page 3-5, first paragraph of section:** The second sentence of this paragraph states that "…the vertical extent of capture cannot be determined because pressure responses at depths below the existing NHOU extraction wells does not exist" (sic). We recommend revising this sentence to clarify that *measurements* of pressure responses at depths below the extraction wells do not exist.

AMEC Response: Comment acknowledged. Text has been revised as suggested.

8. **Section 3.3.2, Aquifer Testing, page 3-5:** During the planned aquifer testing, wells NHE-3, -5, and -7 will alternately be turned off and on, and pumped at different rates during the step-discharge tests. CDPH is concerned that these changes in the relative pumping rates at each extraction well will change the concentrations of contaminants entering the existing NHOU treatment system, particularly 1,4-dioxane and chromium, which are not removed by air stripping. Furthermore, well NHE-5 has not been pumped (or sampled) in several years, so there is substantial uncertainty regarding water quality at this well at present. An evaluation of estimated combined influent concentrations entering the NHOU treatment system during each distinct phase of the planned pumping tests should be provided, indicating the anticipated concentrations of chromium and 1,4-dioxane. This could be accomplished for wells NHE-3 and NHE-7 using a spreadsheet-

based mixing cell calculation, based on anticipated flow rates and recent concentration data. Well NHE-5 should be sampled in advance of the pumping tests to obtain more recent contaminant concentration data and overdue Title 22 monitoring data, in order to complete such an evaluation Results may indicate that treatment or an alternative disposal method is required to ensure that the water sent to the distribution system meets MCLs and NLs, since the NHOU treatment plant does not remove chromium and 1,4-dioxane. This evaluation should be included in the work plan or provided under separate cover at least six weeks before the aquifer testing commences, to provide adequate time for EPA and CDPH review.

AMEC Response: Anticipated influent water quality will be included in an Appendix B to the Work Plan to evaluate potential changes in hexavalent chromium and 1,4-dioxane concentrations as a result of pumping NHE-5, based on historical and recent NHE extraction well pumping performance and the anticipated pumping rate of NHE-5 during the 72-hour pumping test. Based on our preliminary calculations, increasing the influent hexavalent chromium concentration to above 5 µg/L would require concentrations at NHE-5 to exceed 20 µg/L, which is far higher than historical data at this well or nearby NHE wells. Similarly, increasing the influent 1,4-dioxane concentration to above 1 µg/L would require concentrations at NHE-5 to also exceed concentrations higher than historical data at this well or nearby NHE wells. This is consistent with the relatively low pumping rate expected from NHE-5 compared to the overall treatment system (approximately 10 percent).

As such, there appears to be little cause for concern regarding impacts to water quality as a result of pumping NHE-5. However, AMEC supports the concept of utilizing additional hexavalent chromium and 1,4-dioxane data from the NHOU extraction wells, as obtained by LADWP, to support the Phase I Pre-Design Investigation and the Second Interim Remedy design.

9. **Section 3.3.2.1, Monitoring Well Testing, page 3-6:** The second sentence of this paragraph states that "…the resulting hydraulic conductivity values (from slug testing) will be incorporated into the groundwater flow model…" We recommend revising this sentence to state that the resulting hydraulic conductivity values from slug testing will be used to guide development of the hydraulic conductivity matrix in the model. Forcing results of slug tests, which focus on local aquifer properties near the well or boring being tested, into the model may degrade numerical model representativeness of the physical system at the site, rather than improve it.

AMEC Response: Comment acknowledged. Text has been revised as suggested.

10. **Section 4, Data Management, Data Evaluation, and Reporting, page 4-2:** The last sentence of the first full paragraph on this page states that "This report (following the Phase I investigation) will evaluate Phase I data and will recommend that a Phase II Pre-Design Investigation be performed if it is determined that insufficient data exist to fill critical data gaps associated with the Second Interim Remedy and comply with RAOs and meet CDPH 97-005 requirements." As noted in Comment 1, above, some of the critical data gaps described in the Final Data Gap Analysis report are not addressed by the activities proposed in the Work Plan. Therefore, it seems certain that insufficient data will exist to fill those critical data gaps. Please revise so the Work Plan provides a better explanation of why some previously "critical" data gaps may no longer need to be filled.

AMEC Response: See responses to previous comments and, in particular, our response to Comment #5.

SAMPLING AND ANALYSIS PLAN

1. **General comment:** The SAP directly incorporates components of a Quality Assurance Project Plan (QAPP); a stand-alone QAPP is not included. We have no objections to this approach. However, at several locations the SAP text, figures, and Field Sampling Plans (FSPs) refer to "the QAPP." We recommend that these document components refer to the SAP, rather than the non-existent (at the time of submittal) QAPP.

AMEC Response: Comment acknowledged. References to "the QAPP" have been revised to "the SAP" for consistency and clarity**.**

2. **Figures:** Figures within the SAP and FSPs do not have consistent title blocks. Some title blocks reference the QAPP, Work Plan, etc. We recommend updating the figure title blocks for consistency.

AMEC Response: Figures with inconsistent title blocks have been revised accordingly.

3. **Table 2-1:** Several discrepancies associated with this table are noted below, and need to be corrected. Similar corrections will also need to be made for Tables A-3 and B-2 located in the appropriate appendices:

> a) The table lists EPA Method 8260 as the analytical method to be used for analysis of volatile organic compounds. A more suitable method for analysis of potential drinking water is EPA Method 524.2. The SAP should provide an explanation (perhaps as part of development of data quality objectives) regarding why EPA Method 8260 analysis is appropriate for some or all samples to be obtained under this SAP.
>
> **AMEC Response:** Previous sampling of monitoring wells in the NHOU have been analyzed using EPA Test Method 8260 and this information will be incorporated into the SAP to justify the continued use of this method over EPA Test Method 524.2, unless lower method detection limits warrant the use of EPA Test Method 524.2 (e.g., 1,1,1-TCA).
>
> b) For perchlorate by EPA Method 331, the sample container is listed as "100 mL Sanitized," but no container type (e.g. polyethylene) is listed.
>
> **AMEC Response:** Comment acknowledged. The container type has been added.
>
> c) The column heading marked "MDL" lists a number of values related to each method. This heading implies that the values listed are the achievable method detection limits for each method. However, the values directly correlate with the performance standards listed in Section 2.3.2, page 2-7. Heading either needs to be changed to "Performance Standard," or the actual, achievable MDLs for each method need to be added instead.
>
> **AMEC Response:** Actual, achievable MDLs are lab-specific in most cases. AMEC has updated the SAP with the MDL values provided by the analytical laboratory selected to perform these analyses.

4. **Table 2-2:** Several discrepancies associated with this table are noted below, and need to be corrected. Similar corrections will also need to be made for Table A-2 located in the appropriate appendix:

a) The Acceptance Criteria listed for the Temperature blank (under Accuracy, Field) is less than 4 degrees centigrade. However, Table 2-1 lists the appropriate temperature preservation for each method as 4 ± 2 degrees centigrade.

AMEC Response: To be consistent with Table 2-1 and the National Guideline, the Acceptance Criteria listed for the Temperature blank (under Accuracy, Field) has been revised to "4 ± 2 degrees centigrade".

b) The Acceptance Criteria for Method blanks (under Accuracy, Laboratory) is listed as "No compounds should be detected in the laboratory method blanks." Does this statement imply that all compounds should be detected below the laboratory's MDL, or below the laboratory's reporting limit?

AMEC Response: This statement means that no compound should be detected above its respective Reporting limit in the Method blanks.

c) The Acceptance Criterion for Preparation blanks (under Accuracy, Laboratory) is listed as "%R less than compound specific limit". This criterion is better suited for Laboratory Control Samples (LCS) than the blanks. The similar criteria listed for Method blanks should be used for Preparation blanks.

AMEC Response: Comment acknowledged. Text has been revised as suggested.

5. **Acronyms**: Many acronyms were: 1) not captured in the abbreviations and acronyms list, 2) not defined with the first time use, 3) defined multiple times throughout the SAP, or 4) not used after being defined. Please ensure that the SAP (and appendices) undergoes a comprehensive review to appropriately capture and correct all acronyms and callouts. In addition, the definition of the acronym COC should be determined and used consistently throughout the SAP (e.g. chemical of concern, contaminant of concern, constituent of concern). Finally, the definition of the acronym CSM should be determined and used consistently throughout the SAP (e.g. conceptual site model vs. site conceptual model).

AMEC Response: Comment acknowledged. Acronyms and abbreviations have been properly defined and introduced throughout the revised documents.

6. **Emerging Chemicals:** The SAP is inconsistent when referencing and listing what is considered an emerging chemical (e.g. hexavalent chromium, 1,4-dioxane, 1, 2, 3-trichloropropane, perchlorate, and n-nitrosodimethylamine). In addition, the term "emerging chemical" should replace the term "new chemical" when used within the SAP.

AMEC Response: Text has been revised to be consistent with Attachment 4 in Appendix A (Scope of Work) of the Administrative Settlement Agreement and Order on Consent for Remedial Design (AOC; EPA, 2011).

7. **Section 1.0 Introduction, page 1-1:** In the first paragraph, please add the reference USEPA, 2011, after the AOC callout.

AMEC Response: The citation has been included as suggested.

8. **Section 2.0 Project Management, page 2-1:** A "Project Method Performance Objectives" bullet should be added after the "Project Data Quality Objectives (DQOs) and criteria for measurement of data" bullet for consistency of summarizing the subsections within Section 2.0.

AMEC Response: A new fifth bullet titled "Method Performance Objectives has been included as suggested

9. **Section 2.1.3.5 Role/Responsibility of Data Reviewer, page 2-2:** One of the roles listed for the Data Reviewer is performing data validation according to the National Functional Guidelines. However, later in this same section, and in Section 5.1, paragraph 3, the SAP indicates that data validation will be performed by a qualified third party data validator, independent from AMEC. Will the Data Reviewer perform some portion of the data validation, or will all of the validation be performed by third party? Some additional clarification is needed to better describe the role of the Data Reviewer in regards to data validation.

AMEC Response: As specified in the AOC, a qualified third party will perform primary data validation. AMEC's Data Manger (as clarified in our response to Comment #15) will verify that data validation procedures were followed and completed. SAP text has been revised accordingly.

10. **Section 2.2, page 2-3:** What is the back-up plan if NHE 1 and 5 cannot be made operational?

AMEC Response: The context of this comment cannot be determined because there is no reference to NHE-1 and NHE-5 in this section or page of the SAP.

11. **Section 2.2.3 Impacts to NHOU Groundwater, page 2-4 and 2-5:** We recommend listing the eight NHOU extraction wells earlier in this section so that when reference is made to the shutdown of NHE-2 later in the section, the reader understands the well is affiliated with the NHOU Extraction and Treatment System.

AMEC Response: Comment acknowledged. Text has been modified accordingly.

12. **Section 2.2.3 Impacts to NHOU Groundwater, page 2-5:** Last paragraph, line 6; we recommend deleting the term "NHOU treatment system" and replacing with the term "NHOU Extraction and Treatment System". Consider making this a global change.

AMEC Response: Comment acknowledged. Text has been revised through the document as appropriate.

13. **Section 2.3.1 Potential Measurements, page 2-6:** In the second paragraph, line 2, 1,2,3-TCP should be added to the list of chemicals identified for analysis. In addition, this paragraph refers to total alkalinity while Table 2-1 makes reference to alkalinity. Finally, this paragraph refers to pH and specific conductance; however, Table 2-1 does not list these parameters for analysis. We recommend modifying the text to improve the consistency within this section and with Table 2-1.

AMEC Response: Comment acknowledged. Text has been revised accordingly.

14. **Section 2.3.2 Applicable Technical Quality Standards and Criteria, page 2-7:** We recommend replacing "TCP" with "1,2,3-TCP" for consistency and clarity, in this section and elsewhere in the document as appropriate to consistently abbreviate 1,2,3-trichloropropane.

AMEC Response: Comment acknowledged. Text has been revised accordingly.

15. **Section 2.7.2 Laboratory Records, page 2-14, third paragraph:** This paragraph indicates that the AMEC Data Manager will have the responsibility for obtaining and tracking GeoTracker deliverables. However, the AMEC Data Manager's roles and responsibilities are not outlined in Section 2.1.3.

AMEC Response: The "Data Reviewer" title in Section 2.1.3 has been revised to "Data Manager" and throughout this document.

16. **Section 3.2.1 Groundwater Sample Collection and Flow Monitoring, page 3-4:** In the first paragraph, line 8, we believe that 1,2,3-TCP should be added to the list of chemicals identified for analysis, consistent with Table 2-1.

AMEC Response: Comment acknowledged. Text has been revised accordingly.

17. **Section 3.2.1 Groundwater Sample Collection and Flow Monitoring, page 3-4:** The second and third paragraphs state that vertical flow logs and groundwater level measurements will be obtained from "select existing piezometers." The activities may be performed at monitoring wells, not piezometers, and if so, the text should be modified accordingly.

AMEC Response: Table C-1 lists the monitoring wells planned for vertical profiling. Text has been revised accordingly.

18. **Section 6.0 References, page 6-1:** The USEPA Guidance on Systematic Planning Using the Data Quality Objectives Process is listed twice, once as 2006 and the other as 2006a. We recommend that one of these duplicate references be deleted, and that corresponding references to this document within the body of the report be modified accordingly.

AMEC Response: Comment acknowledged. The "USEPA, 2006" reference listed in Section 6 has been deleted; citations within the text correctly refer to USEPA, 2006a.

19. **Appendix A, Table A-3:** If results of groundwater quality sampling are planned for use to support a CDPH policy 97-005 evaluation, the following analytical methods are recommended by CDPH as being more suitable for drinking water analysis than those listed in Table A-3:

a) 1,2,3-trichloropropane (TCP): CDPH SRL "low" method (http://www.cdph.ca.gov/certlic/drinkingwater/Pages/123TCPanalysis.aspx)

b) 1,4-dioxane: EPA Method 522

c) Nitrosodimethylamine: EPA method 521; in addition, CDPH recommends analyzing for all nitrosamines

d) Perchlorate: EPA method 314 (false positives can occur using this method—a backup analytical method using a mass-spectrometer-based analysis is recommended if positive results are detected in excess of the State MCL)

AMEC Response: As mentioned in our response to the Work Plan General Comment #1, additional samples separate from the Phase I Pre-Design Investigation are anticipated to be needed to address CDPH 97-005 requirements and proposed analytical methods are considered appropriate to address RAOs. However, AMEC has reviewed the methods recommended by CDPH and has incorporated them into the SAP tables as appropriate.

20. **Appendix A, Section A1.0 Introduction, page A1-1:** In the second paragraph, line 4, we recommend adding the term "Phase I" in front of the term "Pre-Design Investigation." This change can be carried into the introduction for Appendix B and C as well.

AMEC Response: Text has been revised accordingly.

21. **Appendix A, Section A1.3 Responsible Agency, page A1-1:** For consistency with Appendix B and C, we recommend adding "Region IX" to the end of the sentence.

AMEC Response: Text has been revised accordingly.

22. **Appendix A, Section A1.4 Project Organization, page A1-2:** Based on our understanding of the Work Plan, Eileen Bailiff is the Field Team Leader for Groundwater Sampling and Monitoring, rather than Sean Culkin. Please clarify.

AMEC Response: Comment acknowledged. Eileen Bailiff will be identified as the Field Team Leader in Appendix A as stated in the Work Plan.

23. **Appendix A, Section A1.5 Statement of the Specific Problem, page A1-2:** We recommend revising the first bullet to read as follows (bold text indicates new text for consideration): "Analytical data are insufficient to delineate the lateral and vertical distribution and temporal variability of COCs **in the NHOU study area with respect to the A-Zone and B-Zone** and to define the necessary target capture area." This change can also be made to Section A3.2, page A3-2 under "State the Problem".

AMEC Response: Text has been revised accordingly in Sections A1.5 and A3.2.

24. **Appendix A, Section A1.5 Statement of the Specific Problem, page A1-2:** We recommend updating the second bullet to read as follows (bold text indicates new text for consideration): "Groundwater elevation data are not surveyed to a common elevation datum to verify and clarify groundwater flow directions **and gradients in some locations**." This change can also be made to Section A3.2, page A3-2 under "State the Problem".

AMEC Response: Text has been revised accordingly.

25. **Appendix A, Section A2.1 Site or Sampling Area Description, page A2-1:** We recommend revising the first sentence within the second paragraph, as the description of the system is already provided in the operational history section, as follows: "The NHOU Extraction and Treatment System and associated well field network is located in the San Fernando groundwater basin." We don't believe the author intended to claim that the NHOU groundwater production well system consists of eight extraction wells, etc. This change can be carried into the same description within Appendix B and C as well.

AMEC Response: Text in Appendices A, B, and C has been revised accordingly.

26. **Appendix A, Section A2.2 Operational History, page A2-1:** We recommend revising the first sentence of this paragraph as follows: "The NHOU Extraction and Treatment System, which was constructed between 1987 and 1989, consists of eight groundwater extraction wells (NHE-1 through NHE-8), a collector line, and a central treatment system consisting of an air-stripping treatment system to remove VOCs from extracted groundwater, two activated carbon units to remove VOCs from the air stream, a chlorination system, and ancillary equipment." This change can be carried into the same description within Appendix B and C as well.

In addition, in the last sentence, we recommend deleting "(sans NHE-1)" and adding the following sentences to the end of the paragraph for consistency with Appendix B: "As of June 2011, six of the eight extraction wells remain in service. NHE-1 has never operated as part of the NHOU system and NHE-5 has not operated since 2008." This change can be carried into the same description within Appendix C as well.

AMEC Response: Text in Appendices A, B, and C has been revised accordingly.

27. **Appendix A, Section A2.3 Previous Investigations/Regulatory Involvement, page A2-2:** The reference to USEPA, 2009a is not found in the reference list. Please add the correct reference.

AMEC Response: The Second Interim Remedy Record of Decision has been included in Section 6.0 and the citation here has been revised to "USEPA, 2009".

28. **Appendix A, Section A2.4 Geological and Hydrogeological Information, page A2-2:** We recommend including a reference for the Data Gap Analysis report (e.g. AMEC, 2012a). This change can be carried into the same section within Appendix B and C as well.

AMEC Response: Comment acknowledged. A citation has been inserted and Section 6.0 has been revised accordingly.

29. **Appendix A, Section A2.5 Environmental and/or Human Impact, page A2-2:** In line 8, we recommend adding "1,2,3-" in front of "TCP". This change can be carried into the same section within Appendix B and C as well.

AMEC Response: Text has been revised accordingly.

30. **Appendix A, Section A3.1 Project Task and Problem Definition, page A3-1:** We recommend adding the following text to the end of the fifth task: "and to further evaluate the potential utilization of the well (which has never operated as part of the NHOU Extraction and Treatment System) as part of the Second Interim Remedy."

In addition, is a seventh task justified for addition to the SAP related to NH-10, per the Work Plan (i.e. "At least two depth-discrete samples will be collected from the upper perforation zones of production well NH-10 during a single monitoring event to evaluate groundwater quality in the A-Zone and B-Zones at that location.")?

AMEC Response: Groundwater samples proposed to be collected from NHE-1 are intended to assess groundwater quality at this location and will not pertain to the evaluation of whether this well could be utilized as an extraction well as part of the Second Interim Remedy. The need for an extraction well at this location will be based, in part, on analytical results from the proposed samples and from numerical model simulation results that will be presented and discussed in the Groundwater Modeling Memorandum.

Similarly, there is no need for a seventh task because the fifth task was specifically written to account for sampling at NH-10 (i.e., "…obtain…groundwater quality samples and groundwater elevation measurement near the NHE-1 extraction well…"). NH-10 is near NHE-1 and, although not specifically mentioned, proposed sampling activities at that location are accounted for in Table A-1, as the comment acknowledges.

31. **Appendix A, Section A3.2 Data Quality Objectives (DQOs), page A3-3:** Step 6, Item "a", we recommend including a reference for the Data Gap Analysis report (i.e. AMEC, 2012a).

AMEC Response: Comment acknowledged. A citation has been inserted and Section 6.0 has been revised accordingly.

32. **Appendix A, Section A5.1 Analyses** Narrative**, page A5-1:** Table A-1 lists 29 monitoring wells that will be sampled semiannually. Reference to 30 monitoring wells in this paragraph should be updated.

AMEC Response: Section A5.1 intentionally refers to "approximately 30 wells" to acknowledge potential problems associated with accessing proposed monitoring wells. Text has not been revised.

33. **Appendix A, Section A8.0 Disposal of Residual Materials, page A8-1:** We recommend that AMEC verify whether the reference to Appendix A-2 in the third paragraph should actually be to Appendix A-1, and that this be corrected if necessary.

AMEC Response: Text has been revised accordingly.

34. **Appendix A, Section A8.0 Disposal of Residual Materials, page A8-2:** The bullets under the statement "The following steps will be followed for document retention:" do not correspond with the same bullets in Appendix B, Section B8.3 Waste Profiling and Documentation with respect to who sends, signs, and receives the profiles and manifests. We recommend revising Appendix A or B, as appropriate.

AMEC Response: Comment acknowledged. Section B8.3 has been updated to include Lockheed Martin in the profiling and manifesting process.

35. **Appendix A, Section A9.1.1 Daily Field Records, page 9-1:** We recommend that the first paragraph add reference to Appendix A-1 at the end of the second sentence.

AMEC Response: Text has been revised accordingly.

36. **Appendix A, Section A9.1.1 Daily Field Records, page 9-1:** We recommend that the sixth bullet be updated to read as follows: "Sample media (e.g., groundwater) **and depth of collection.**"

AMEC Response: This information will be recorded on either the Daily Field Record or activity-specific data form as listed near the bottom of page 9-1. Text has not been revised.

37. **Appendix A, Section A9.1.2 Activity-Specific Forms, page A9-2 and Section A9.3 Sample Chain-of-Custody Forms, page A9-3:** Please provide a sample chain of custody form in Appendix A-1.

AMEC Response: A sample chain-of-custody form was inadvertently omitted from the draft SAP and has been included in the revised SAP**.**

38. **Appendix A, Section A11.0 Field Variances, page A11-1:** Please add the following text after the second sentence for consistency with Appendix B: "The AMEC Project Manager will notify the USEPA of major modifications or variances to the field program." Please modify the text in Appendix B to the previous statement. The same change can be made to this section in Appendix C.

AMEC Response: Text has been revised accordingly.

39. **Appendix A, Section A13.0 References, page A13-1:** We recommend updating the reference list and/or deleting those references that are not used within Appendix A.

AMEC Response: Comment acknowledged. Unused citations have been deleted as appropriate.

40. **Appendix B, Section B1.5, page B1-2:** We recommend updating the first bullet to read as follows (bold text indicates new text for your consideration): "Performance monitoring well **and piezometers** have not been installed and monitored to demonstrate the size and shape of the existing NHOU extraction well capture area, **specifically with regard to the A-Zone and B-Zone.**"

AMEC Response: Text has been revised accordingly.

41. **Appendix B, Section B1.6 Schedule, page B1-2:** In the second line, we recommend deleting the word "sampling" and replacing with the phrase "drilling and piezometer installation". It is hard to tell whether this Field Sampling Plan is supposed to cover drilling, sampling, or both.

AMEC Response: Text has been revised accordingly.

42. **Appendix B, Section B2.1 Site Description, page B2-1:** Second paragraph, in addition to listing Figure B-2, it would also be appropriate to list Figures B-4 and B-6.

AMEC Response: Text has been revised accordingly.

43. **Appendix B, Section B3.1 Project Task and Problem Definition, page B3-1:** Line 6, reference to Figures B-3, B-5, and B-7 should be corrected to reference Figures B-2, B-4, and B-6 instead. Line 8, reference to Figures B-4, B-6, and B-8 should be corrected to reference Figures B-3, B-5, and B-7 instead.

AMEC Response: Text has been revised accordingly.

44. **Appendix B, Section B3.2 Data Quality Objectives (DQOs), page B3-2:** We recommend adding an item to the second step: "h) Do the NHOU extraction wells need to be deepened to meet RAOs?"

AMEC Response: We respectfully disagree with the recommendation, which refers to an objective within the Second Interim Remedy Record of Decision. That objective does not pertain to the design and location of performance monitoring wells (or piezometers), which is the subject of Appendix B of the SAP. Whether or not NHOU extraction wells may need to be deepened will be one of several actions considered as part of the Groundwater Modeling Memorandum.

45. **Appendix B, Section B3.2 Data Quality Objectives (DQOs), page B3-3:** The following figure references should be corrected in the fourth step: Items a), c), and e) – Figure B-3 should be updated to call out Figure B-2 instead, and Figure B-8 should be updated to call out Figure B-7 instead.

AMEC Response: Text has been revised accordingly.

46. **Appendix B, Section B3.2 Data Quality Objectives (DQOs), page B3-3:** Sixth step, item "a", should include reference to the Data Gap Analysis report (e.g. AMEC, 2012a).

AMEC Response: Text has been revised accordingly.

47. **Appendix B, Section B3.5 Data Management and Assessment Oversight, page B3-6:** Last paragraph, this section makes reference to a Data Usability Evaluation and Field QA/QC submittal. This submittal may need to be referenced in Appendix A as well.

AMEC Response: Text has been revised accordingly.

48. **Appendix B, Section B4 Sampling Rationale, page B4-1:** Second paragraph, line 7 – Reference to Table B-1 should be updated to reference Table B-2 instead.

AMEC Response: Text has been revised accordingly.

49. **Appendix B, Section B6.7 Piezometer Installation, page B6-4:** First paragraph, figure references in the first line on this page should be updated from B-4, B-6, and B-8 and corrected to reference Figures B-3, B-5, and B-7.

AMEC Response: Text has been revised accordingly.

50. **Appendix B, Section B6.8.2 Post-Development Groundwater Sampling, page B6-5:** Reference to Table B-3 should be updated to reference Table B-2 instead.

AMEC Response: Text has been revised accordingly.

51. **Appendix B, Section B9.3 Sample Chain-Of-Custody Forms, page B9-3:** First paragraph, consider changing reference from Appendix B-2 to Appendix B-1.

AMEC Response: Text has been revised accordingly.

52. **Appendix B, Section B13.0 References, page B13-1:** Suggest updating reference list and/or deleting those references that are not used within Appendix B.

AMEC Response: Comment acknowledged. Unused references have been deleted as appropriate.

53. **Appendix C, Section C1.6 Schedule, page C1-2:** In the first sentence, suggest deleting the phrase “in multiple sampling events” and replace with the word “testing”. In the second sentence, suggest deleting the word “sampling” and replacing with the word “testing”.

AMEC Response: Text has been revised accordingly.

54. **Appendix C, Section C2.1 Site or Sampling Area Description, page C2-1:** All references to Figures A-1 or A-2 should be updated to reference Figures C-1 or C-2, respectively.

AMEC Response: Text has been revised accordingly.

55. **Appendix C, Section C2.4 Geological and Hydrogeological Information, page C2-2:** Line 3, suggest adding the phrase “and testing” after the word “sampling”.

AMEC Response: Text has been revised accordingly.

56. **Appendix C, Section C3.1 Project Task and Problem Definition, page C3-1:** Suggest updating the first item to read as follows: “Slug tests will be performed at 12 monitoring wells screened primarily in either the A-Zone or B-Zone to estimate hydraulic parameters. These data will be used to estimate hydraulic conductivity values as simulated in the current groundwater flow model to define the NHOU extraction well capture zone.”

AMEC Response: The text and Table C-1 have been corrected to cite the 14 monitoring wells as are discussed in the Phase I Pre-Design Investigation Work Plan.

57. **Appendix C, Section C3.1 Project Task and Problem Definition, page C3-1:** Suggest updating the second item to read as follows (bold text indicates new text for

consideration): "Perform aquifer pumping tests at three NHE extraction wells (NHE-3, NHE-5, and NHE-7) **while monitoring the response to the pumping test in 10 observation wells** to estimate well efficiency and A-Zone hydraulic parameters.

AMEC Response: Text has been revised accordingly.

58. **Appendix C, Section C3.1 Project Task and Problem Definition, page C3-1:** In the third paragraph, suggest updating the first sentence to read as follows (bold text indicates new text for consideration): "Aquifer tests at NHE wells will consist of a step drawdown test **to evaluate extraction well performance** followed by a constant discharge test **with corresponding recovery tests**."

AMEC Response: Text has been revised accordingly.

59. **Appendix C, Section C3.2 Data Quality Objectives (DQOs), page C3-2:** In Step 2, suggest updating the lettering of the items. In Step 3, part "b", line 1, clarify which "NHE" well is referred to, and suggest adding "as well as other existing monitoring wells" to the end of the line (before "as listed in Table C-1").

AMEC Response: Text has been revised as appropriate in Steps 2 and 3.

60. **Appendix C, Section C3.2 Data Quality Objectives (DQOs), page C3-3:** In step 7, delete reference to analytical methodologies as sampling and analysis will not occur as part of this FSP.

AMEC Response: "Analytical methodologies" refers to the analytical methods that will used to evaluate the aquifer test drawdown data. The first sentence of step 7a) has been revised to state "Aquifer test locations, number of observation wells, and aquifer test evaluation methodologies are proposed herein."

61. **Appendix C, Section C6.4 Decontamination Procedures, page C6-12:** At the end of the first paragraph, suggest correcting the acronym FSA to the acronym FSP. At the end of this paragraph, suggest referencing Appendix A of the SAP.

AMEC Response: Text has been revised accordingly.

62. **Appendix C, Section C13.0 References, page C13-1:** Suggest updating reference list and/or deleting those references that are not used within Appendix C.

AMEC Response: Comment acknowledged. Unused references have been deleted as appropriate.

HEALTH AND SAFETY PLAN

1. **Section 1.5, Table in "Chemical Hazards," page C1-3:** The current Threshold Limit Value for TCE is 10 ppm; the table should be clarified or corrected accordingly.

AMEC Response: Text has been revised accordingly.

2. **Appendix E, Job Safety Analyses, Pre-ground Disturbance and Clearance Activities:** If saw cutting of concrete or asphalt, the Job Safety Analysis may not adequately address use of respiratory protection for dust, or physical controls for use of a chop saw. We recommend that the authors of the HASP consider expanding this discussion if saw cutting is anticipated.

AMEC Response: Text has been revised accordingly.

Remedial Design QUALITY ASSURANCE PROJECT PLAN

1. **Distribution List:** The name of Ms. Acharya (DTSC) appears to be misspelled, and the street address for Mr. Lindquist (CH2M HILL) should be 2525 Airpark Drive (not 2625). Other errors may be present that delay delivery of this or future documents in a timely manner. We recommend that AMEC review and, if necessary, update their distribution list.

AMEC Response: AMEC has reviewed the distribution list and made corrections to Ms. Acharya's name and Mr. Lindquist's street address. Ms. Acharya and Mr. Lindquist were correctly included on the e-mail notification regarding the report's availability for their review. All required document deliveries for this project have consistently been made in a timely manner to the distribution list specified in the AOC.

2. **Section 2.2, Project Delivery, page 2-4, first and second paragraphs:** It appears that the terms "design/bid/build" and "design/build" may have been inadvertently transposed in the first and second paragraphs. This is not a critical issue from a regulatory perspective, but may lead to confusion if the RD QAPP is forwarded to potential construction bidders in the future. We recommend that this potential transposition be checked and corrected, if appropriate.

AMEC Response: AMEC has reviewed the terms noted above and has determined that they were used correctly in the text describing project delivery methods. Text has been added to further clarify the difference in the two delivery methods to prevent future confusion.

3. **Section 4.3.8, Procedures for Records Retention, page 4-7, first paragraph:** This paragraph states that various records will be filed and retained, but does not state the period of retention nor that it is consistent with the Records Retention section of the AOC. We recommend that the RD QAPP include the duration for records retention and maintenance of files on a SharePoint site.

AMEC Response: AMEC has revised Section 4.3.8 to make it consistent with the records retention section of the AOC.

ATTACHMENT A

USEPA Comments on the *Draft Work Plan, Phase I Pre-Design Investigation, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design* and the *Remedial Design Quality Assurance Project Plan, North Hollywood Operable Unit Second Interim Remedy, Groundwater Remediation System Design (August 10, 2012)*

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 9
75 Hawthorne Street
San Francisco, California

August 10, 2012

Michael Taraszki
AMEC for Honeywell and Lockheed
1330 Broadway Street, Ste 1702
Oakland, CA 94612

RE: Comments on *"Draft Work Plan, Phase I Pre-Design Investigation, North Hollywood Operable Unit, Second Interim Remedy Groundwater Remediation System Design"* and the *" Remedial Design Quality Assurance Project Plan, North Hollywood Operable Unit, Second Interim Remedy Groundwater Remediation System Design"*

Dear Mr. Taraszki:

EPA has reviewed the above-referenced document, and provides the following comments in the attached file. These comments should be addressed and resubmitted with the final drafts of the above referenced documents, which are due **thirty days** from the date of this letter.

The attached comments are comprehensive, and the following agencies/firms commented or had an opportunity to comment, in addition to EPA:

- the Los Angeles Department of Water and Power (LADWP)
- the Upper Los Angeles River Area (ULARA) Watermaster
- the Los Angeles Regional Water Quality Control Board (Regional Board)
- CH2M HILL, consultant to EPA

Please include a separate letter which addresses each of the general and major comments specifically, and indicates how the responses to the comments have been incorporated into the final.

Please let me know if you have any questions.

Sincerely,

Matt Salazar
EPA Project Manager

The review focused on significant technical issues; we have not commented on typographical or grammatical errors except where such errors may lead to confusion on technical issues. Following are our comments on these submittals.

Work Plan

1. **General comment:** The Work Plan is well written and indicates a comprehensive understanding of both the available site data and the data gaps in the NHOU. Conduct of the work proposed in the Work Plan (and SAP) will improve the conceptual site model for the NHOU and provide important hydrogeologic data required for RD of the Second Interim Remedy.

   As stated in Section 2.4 of the Work Plan, "The overall objective of the Phase 1 Pre-Design Investigation is to fill critical data gaps identified as necessary for the Second Interim Remedy design to meet RAOs…" And Section 4 of the Work Plan states that a second phase of investigation would only be performed "if it is determined that insufficient data exist (at that time) to fill critical data gaps associated with the Second Interim Remedy and comply with RAOs and meet CDPH 97-005 requirements." However, actions that might fill some of the "critical data gaps" identified in the Final Data Gap Analysis report (pages 5-14 and 5-15) prepared by AMEC (dated March 14, 2012) are not proposed in this Work Plan. Specifically, critical data gaps 4, 5, 6, 8, and 9 listed on pages 5-14 and 5-15 of the Final Data Gap Analysis report seem to be unaddressed, or only partly addressed, by the activities listed in the Work Plan. It seems that either some of the data gaps identified in the Final Data Gap Analysis report are no longer deemed critical, or will simply not be addressed by the proposed Phase 1 investigation and will be addressed in some other manner. Please revise the Work Plan to provide more clarity regarding which of the critical data gaps are addressed by each proposed field activity, and which critical data gaps are not addressed in the proposed Phase 1 investigation (together with an explanation of why not, and how they will be addressed in the future). Our comments and/or recommendations for filling these data gaps are summarized below, but could be modified depending on additional information provided by the respondents:

   - **Critical Data Gap 4** ("existing monitoring well network insufficient to characterize vadose zone and groundwater conditions beneath known and potential source areas"): The Work Plan should show critical areas for further investigation on a map, or at least describe how the need for further characterization in the vicinity of the "known and potential source areas" would be evaluated and conducted during a Phase II data gaps investigation. The area southwest of NHOU extraction wells NHE-2 and NHE-3, where high concentrations of VOCs and hexavalent chromium have been detected, but are poorly delineated, seems to be of primary concern. It is not clear how the data collection activities described in the Work Plan would fill this data gap or aid in further delineating contaminant concentrations in this particular area. We recommend that at least two new monitoring wells be installed in this area as part of the Phase 1 investigation.

   - **Critical Data Gap 5** ("objective projections of pumping and recharge volumes, including beyond year 2015, are not yet available"): The Work Plan should state that addressing this data gap does not require field activity; rather, discussions are ongoing (presumably) with LADWP and the ULARA Watermaster to develop improved and updated projections of future pumping and recharge volumes.

- **Critical Data Gap 6** ("performance monitoring wells have not been installed and monitored"): It is unclear whether the proposed piezometers in the Work Plan constitute some or all of the needed performance monitoring wells that comprise this critical data gap. The Work Plan should clarify whether the planned piezometers are expected to address this data gap by themselves, or if installation of additional performance monitoring wells is anticipated to be required in the future, to complete the RD. If so, then the Work Plan should describe how and when decisions about the need for additional performance monitoring wells will be made.
- **Critical Data Gap 8** ("available analytical data are insufficient to evaluate A-Zone and, potentially, B-Zone groundwater quality within the future NHOU capture zone to meet CDPH 97-005 requirements"): The Work Plan should define whether this is still considered to be a critical data gap, and describe how and when it will be addressed.
- **Critical Data Gap 9** ("vertical conduits throughout the NHOU study area have not been sufficiently evaluated"): The Work Plan includes investigative activities to evaluate existing monitoring wells as potential vertical conduits for contaminant migration; however, it does not include plans to evaluate existing inactive production wells. Inactive production wells appear to pose a greater threat of vertical contaminant migration, due to their number, long screens, and large diameter. The Work Plan should describe how and when this part of Critical Data Gap 9 will be addressed (e.g., will it be addressed as part of a future Phase II investigation, and are there any conditions on which such an investigation would depend).

2. **Table of Contents page iii, Table, Figures, and Appendix sections:** The title provided in the table of contents for Table 3-1 is different from the title actually on Table 3-1. The titles for Figure 3-1 and Appendix A are similarly inconsistent with the titles given in the table of contents. Please make the titles listed in the table of contents consistent with the actual titles of the corresponding tables, figures, and appendices.

3. **Section 2.2, Project Background, page 2-3, first full paragraph:** This paragraph paraphrases the key remedial action objectives (RAOs) and relates them to the specific work scope items in the Agreement and Order on Consent (AOC). However, the second sentence in this paragraph focuses exclusively on the second RAO for the NHOU Second Interim Remedy. We recommend that this sentence be modified to also accommodate the fourth remedial action objective (RAO), which is to achieve improved hydraulic containment to inhibit horizontal and vertical contaminant migration in groundwater from the more highly contaminated areas and depths of the aquifer to the less contaminated areas and depths of the aquifer, including the southeast portion of the NHOU near the Erwin and Whitnall production well fields. We assume that this RAO influences the AOC work scope items, as well as the scope of work for the activities described in the Work Plan.

4. **Section 2.3, Previous Investigations, page 2-4, fourth paragraph:** The second-to-last sentence in this paragraph states "However, it was concluded that existing data are insufficient to proceed with a Second Interim Remedy…" We recommend that the sentence be modified to state which entity came to that conclusion, and provide a reference to a document where that conclusion is stated (perhaps the Draft or Final Data Gap Analysis report prepared by AMEC).

5. **Section 2.4, Phase 1 Pre-Design Investigation Objectives, page 2-5, bullets 1 through 6:** It is difficult to directly compare these bulleted "specific objectives" of the Phase 1 Pre-Design Investigation to the "critical data gaps" listed in the Final Data Gaps Analysis report (prepared by AMEC, dated March 14, 2012, see pages 5-14 and 5-15). We recommend adding a table to the Work Plan that lists the critical data gaps provided in the Final Data Gaps Analysis report and then

lists the corresponding specific objectives of the Phase 1 Pre-Design Investigation in an adjacent column. Such a table would allow easier comparison of critical data gaps to objectives of the upcoming investigation, and possibly aid in identification of redundancies or additional needs.

6. **Section 2.4, Phase 1 Pre-Design Investigation Objectives, page 2-5, bullet 7:** This bullet states that a specific objective of the Phase 1 Pre-Design Investigation is to "Assess whether sufficient data exist to proceed with designing the Second Interim Remedy…" We recommend adding a discussion in this document or the SAP (and referencing such a location within bullet 7) that describes the process and people who will make such an assessment.

7. **Section 3.3.2, Aquifer Testing, page 3-5, first paragraph of section:** The second sentence of this paragraph states that "…the vertical extent of capture cannot be determined because pressure responses at depths below the existing NHOU extraction wells does not exist" (sic). We recommend revising this sentence to clarify that *measurements* of pressure responses at depths below the extraction wells do not exist.

8. **Section 3.3.2, Aquifer Testing, page 3-5:** During the planned aquifer testing, wells NHE-3, -5, and -7 will alternately be turned off and on, and pumped at different rates during the step-discharge tests. CDPH is concerned that these changes in the relative pumping rates at each extraction well will change the concentrations of contaminants entering the existing NHOU treatment system, particularly 1,4-dioxane and chromium, which are not removed by air stripping. Furthermore, well NHE-5 has not been pumped (or sampled) in several years, so there is substantial uncertainty regarding water quality at this well at present. An evaluation of estimated combined influent concentrations entering the NHOU treatment system during each distinct phase of the planned pumping tests should be provided, indicating the anticipated concentrations of chromium and 1,4-dioxane. This could be accomplished for wells NHE-3 and NHE-7 using a spreadsheet-based mixing cell calculation, based on anticipated flow rates and recent concentration data. Well NHE-5 should be sampled in advance of the pumping tests to obtain more recent contaminant concentration data and overdue Title 22 monitoring data, in order to complete such an evaluation Results may indicate that treatment or an alternative disposal method is required to ensure that the water sent to the distribution system meets MCLs and NLs, since the NHOU treatment plant does not remove chromium and 1,4-dioxane. This evaluation should be included in the work plan or provided under separate cover at least six weeks before the aquifer testing commences, to provide adequate time for EPA and CDPH review.

9. **Section 3.3.2.1, Monitoring Well Testing, page 3-6:** The second sentence of this paragraph states that "…the resulting hydraulic conductivity values (from slug testing) will be incorporated into the groundwater flow model…" We recommend revising this sentence to state that the resulting hydraulic conductivity values from slug testing will be used to guide development of the hydraulic conductivity matrix in the model. Forcing results of slug tests, which focus on local aquifer properties near the well or boring being tested, into the model may degrade numerical model representativeness of the physical system at the site, rather than improve it.

10. **Section 4, Data Management, Data Evaluation, and Reporting, page 4-2:** The last sentence of the first full paragraph on this page states that "This report (following the Phase 1 investigation) will evaluate Phase 1 data and will recommend that a Phase 2 Pre-Design Investigation be performed if it is determined that insufficient data exist to fill critical data gaps associated with the Second Interim Remedy and comply with RAOs and meet CDPH 97-005 requirements." As noted in Comment 1, above, some of the critical data gaps described in the Final Data Gap Analysis report are not addressed by the activities proposed in the Work Plan. Therefore, it seems certain that insufficient data will exist to fill those critical data gaps. Please revise so the Work Plan

provides a better explanation of why some previously "critical" data gaps may no longer need to be filled.

SAP

1. **General comment:** The SAP directly incorporates components of a Quality Assurance Project Plan (QAPP); a stand-alone QAPP is not included. We have no objections to this approach. However, at several locations the SAP text, figures, and Field Sampling Plans (FSPs) refer to "the QAPP." We recommend that these document components refer to the SAP, rather than the non-existent (at the time of submittal) QAPP.

2. **Figures:** Figures within the SAP and FSPs do not have consistent title blocks. Some title blocks reference the QAPP, Work Plan, etc. We recommend updating the figure title blocks for consistency.

3. **Table 2-1:** Several discrepancies associated with this table are noted below, and need to be corrected. Similar corrections will also need to be made for Tables A-3 and B-2 located in the appropriate appendices:

   a) The table lists EPA Method 8260 as the analytical method to be used for analysis of volatile organic compounds. A more suitable method for analysis of potential drinking water is EPA Method 524.2. The SAP should provide an explanation (perhaps as part of development of data quality objectives) regarding why EPA Method 8260 analysis is appropriate for some or all samples to be obtained under this SAP.

   b) For perchlorate by EPA Method 331, the sample container is listed as "100 mL Sanitized," but no container type (e.g. polyethylene) is listed.

   c) The column heading marked "MDL" lists a number of values related to each method. This heading implies that the values listed are the achievable method detection limits for each method. However, the values directly correlate with the performance standards listed in Section 2.3.2, page 2-7. Heading either needs to be changed to "Performance Standard," or the actual, achievable MDLs for each method need to be added instead.

4. **Table 2-2:** Several discrepancies associated with this table are noted below, and need to be corrected. Similar corrections will also need to be made for Table A-2 located in the appropriate appendix:

   a) The Acceptance Criteria listed for the Temperature blank (under Accuracy, Field) is less than 4 degrees centigrade. However, Table 2-1 lists the appropriate temperature preservation for each method as 4 ± 2 degrees centigrade.

   b) The Acceptance Criteria for Method blanks (under Accuracy, Laboratory) is listed as "No compounds should be detected in the laboratory method blanks." Does this statement imply that all compounds should be detected below the laboratory's MDL, or below the laboratory's reporting limit?

   c) The Acceptance Criterion for Preparation blanks (under Accuracy, Laboratory) is listed as "%R less than compound specific limit". This criterion is better suited for Laboratory Control

Samples (LCS) than the blanks. The similar criteria listed for Method blanks should be used for Preparation blanks.

5. **Acronyms**: Many acronyms were: 1) not captured in the abbreviations and acronyms list, 2) not defined with the first time use, 3) defined multiple times throughout the SAP, or 4) not used after being defined. Please ensure that the SAP (and appendices) undergoes a comprehensive review to appropriately capture and correct all acronyms and callouts. In addition, the definition of the acronym COC should be determined and used consistently throughout the SAP (e.g. chemical of concern, contaminant of concern, constituent of concern). Finally, the definition of the acronym CSM should be determined and used consistently throughout the SAP (e.g. conceptual site model vs. site conceptual model).

6. **Emerging Chemicals:** The SAP is inconsistent when referencing and listing what is considered an emerging chemical (e.g. hexavalent chromium, 1,4-dioxane, 1, 2, 3-trichloropropane, perchlorate, and n-nitrosodimethylamine). In addition, the term "emerging chemical" should replace the term "new chemical" when used within the SAP.

7. **Section 1.0 Introduction, page 1-1:** In the first paragraph, please add the reference USEPA, 2011, after the AOC callout.

8. **Section 2.0 Project Management, page 2-1:** A "Project Method Performance Objectives" bullet should be added after the "Project Data Quality Objectives (DQOs) and criteria for measurement of data" bullet for consistency of summarizing the subsections within Section 2.0.

9. **Section 2.1.3.5 Role/Responsibility of Data Reviewer, page 2-2:** One of the roles listed for the Data Reviewer is performing data validation according to the National Functional Guidelines. However, later in this same section, and in Section 5.1, paragraph 3, the SAP indicates that data validation will be performed by a qualified third party data validator, independent from AMEC. Will the Data Reviewer perform some portion of the data validation, or will all of the validation be performed by third party? Some additional clarification is needed to better describe the role of the Data Reviewer in regards to data validation.

10. **Section 2.2, page 2-3:** What is the back-up plan if NHE 1 and 5 cannot be made operational?

11. **Section 2.2.3 Impacts to NHOU Groundwater, page 2-4 and 2-5:** We recommend listing the eight NHOU extraction wells earlier in this section so that when reference is made to the shutdown of NHE-2 later in the section, the reader understands the well is affiliated with the NHOU Extraction and Treatment System.

12. **Section 2.2.3 Impacts to NHOU Groundwater, page 2-5:** Last paragraph, line 6; we recommend deleting the term "NHOU treatment system" and replacing with the term "NHOU Extraction and Treatment System". Consider making this a global change.

13. **Section 2.3.1 Potential Measurements, page 2-6:** In the second paragraph, line 2, 1,2,3-TCP should be added to the list of chemicals identified for analysis. In addition, this paragraph refers to total alkalinity while Table 2-1 makes reference to alkalinity. Finally, this paragraph refers to pH and specific conductance; however, Table 2-1 does not list these parameters for analysis. We recommend modifying the text to improve the consistency within this section and with Table 2-1.

14. **Section 2.3.2 Applicable Technical Quality Standards and Criteria, page 2-7:** We recommend replacing "TCP" with "1,2,3-TCP" for consistency and clarity, in this section and elsewhere in the document as appropriate to consistently abbreviate 1,2,3-trichloropropane.

15. **Section 2.7.2 Laboratory Records, page 2-14, third paragraph:** This paragraph indicates that the AMEC Data Manager will have the responsibility for obtaining and tracking GeoTracker deliverables. However, the AMEC Data Manager's roles and responsibilities are not outlined in Section 2.1.3.

16. **Section 3.2.1 Groundwater Sample Collection and Flow Monitoring, page 3-4:** In the first paragraph, line 8, we believe that 1,2,3-TCP should be added to the list of chemicals identified for analysis, consistent with Table 2-1.

17. **Section 3.2.1 Groundwater Sample Collection and Flow Monitoring, page 3-4:** The second and third paragraphs state that vertical flow logs and groundwater level measurements will be obtained from "select existing piezometers." The activities may be performed at monitoring wells, not piezometers, and if so, the text should be modified accordingly.

18. **Section 6.0 References, page 6-1:** The USEPA Guidance on Systematic Planning Using the Data Quality Objectives Process is listed twice, once as 2006 and the other as 2006a. We recommend that one of these duplicate references be deleted, and that corresponding references to this document within the body of the report be modified accordingly.

19. **Appendix A, Table A-3:** If results of groundwater quality sampling are planned for use to support a CDPH policy 97-005 evaluation, the following analytical methods are recommended by CDPH as being more suitable for drinking water analysis than those listed in Table A-3:

    a) 1 ,2,3-trichloropropane (TCP): CDPH SRL "low" method (http://www.cdph.ca.gov/certlic/drinkingwater/Pages/123TCPanalysis.aspx)

    b) 1,4-dioxane: EPA Method 522

    c) Nitrosodimethylamine: EPA method 521; in addition, CDPH recommends analyzing for all nitrosamines

    d) Perchlorate: EPA method 314 (false positives can occur using this method—a backup analytical method using a mass-spectrometer-based analysis is recommended if positive results are detected in excess of the State MCL)

20. **Appendix A, Section A1.0 Introduction, page A1-1:** In the second paragraph, line 4, we recommend adding the term "Phase 1" in front of the term "Pre-Design Investigation." This change can be carried into the introduction for Appendix B and C as well.

21. **Appendix A, Section A1.3 Responsible Agency, page A1-1:** For consistency with Appendix B and C, we recommend adding "Region IX" to the end of the sentence.

22. **Appendix A, Section A1.4 Project Organization, page A1-2:** Based on our understanding of the Work Plan, Eileen Bailiff is the Field Team Leader for Groundwater Sampling and Monitoring, rather than Sean Culkin. Please clarify.

23. **Appendix A, Section A1.5 Statement of the Specific Problem, page A1-2:** We recommend revising the first bullet to read as follows (bold text indicates new text for consideration): "Analytical data are insufficient to delineate the lateral and vertical distribution and temporal variability of COCs **in the NHOU study area with respect to the A-Zone and B-Zone** and to define the necessary target capture area." This change can also be made to Section A3.2, page A3-2 under "State the Problem".

24. **Appendix A, Section A1.5 Statement of the Specific Problem, page A1-2:** We recommend updating the second bullet to read as follows (bold text indicates new text for consideration):

"Groundwater elevation data are not surveyed to a common elevation datum to verify and clarify groundwater flow directions **and gradients in some locations**." This change can also be made to Section A3.2, page A3-2 under "State the Problem".

25. **Appendix A, Section A2.1 Site or Sampling Area Description, page A2-1:** We recommend revising the first sentence within the second paragraph, as the description of the system is already provided in the operational history section, as follows: "The NHOU Extraction and Treatment System and associated well field network is located in the San Fernando groundwater basin." We don't believe the author intended to claim that the NHOU groundwater production well system consists of eight extraction wells, etc. This change can be carried into the same description within Appendix B and C as well.

26. **Appendix A, Section A2.2 Operational History, page A2-1:** We recommend revising the first sentence of this paragraph as follows: "The NHOU Extraction and Treatment System, which was constructed between 1987 and 1989, consists of eight groundwater extraction wells (NHE-1 through NHE-8), a collector line, and a central treatment system consisting of an air-stripping treatment system to remove VOCs from extracted groundwater, two activated carbon units to remove VOCs from the air stream, a chlorination system, and ancillary equipment." This change can be carried into the same description within Appendix B and C as well.

    In addition, in the last sentence, we recommend deleting "(sans NHE-1)" and adding the following sentences to the end of the paragraph for consistency with Appendix B: "As of June 2011, six of the eight extraction wells remain in service. NHE-1 has never operated as part of the NHOU system and NHE-5 has not operated since 2008." This change can be carried into the same description within Appendix C as well.

27. **Appendix A, Section A2.3 Previous Investigations/Regulatory Involvement, page A2-2:** The reference to USEPA, 2009a is not found in the reference list. Please add the correct reference.

28. **Appendix A, Section A2.4 Geological and Hydrogeological Information, page A2-2:** We recommend including a reference for the Data Gap Analysis report (e.g. AMEC, 2012a). This change can be carried into the same section within Appendix B and C as well.

29. **Appendix A, Section A2.5 Environmental and/or Human Impact, page A2-2:** In line 8, we recommend adding "1,2,3-" in front of "TCP". This change can be carried into the same section within Appendix B and C as well.

30. **Appendix A, Section A3.1 Project Task and Problem Definition, page A3-1:** We recommend adding the following text to the end of the fifth task: "and to further evaluate the potential utilization of the well (which has never operated as part of the NHOU Extraction and Treatment System) as part of the Second Interim Remedy."

    In addition, is a seventh task justified for addition to the SAP related to NH-10, per the Work Plan (i.e. "At least two depth-discrete samples will be collected from the upper perforation zones of production well NH-10 during a single monitoring event to evaluate groundwater quality in the A-Zone and B-Zones at that location.")?

31. **Appendix A, Section A3.2 Data Quality Objectives (DQOs), page A3-3:** Step 6, Item "a", we recommend including a reference for the Data Gap Analysis report (i.e. AMEC, 2012a).

32. **Appendix A, Section A5.1 Analyses** Narrative**, page A5-1:** Table A-1 lists 29 monitoring wells that will be sampled semiannually. Reference to 30 monitoring wells in this paragraph should be updated.

33. **Appendix A, Section A8.0 Disposal of Residual Materials, page A8-1:** We recommend that AMEC verify whether the reference to Appendix A-2 in the third paragraph should actually be to Appendix A-1, and that this be corrected if necessary.

34. **Appendix A, Section A8.0 Disposal of Residual Materials, page A8-2:** The bullets under the statement "The following steps will be followed for document retention:" do not correspond with the same bullets in Appendix B, Section B8.3 Waste Profiling and Documentation with respect to who sends, signs, and receives the profiles and manifests. We recommend revising Appendix A or B, as appropriate.

35. **Appendix A, Section A9.1.1 Daily Field Records, page 9-1:** We recommend that the first paragraph add reference to Appendix A-1 at the end of the second sentence.

36. **Appendix A, Section A9.1.1 Daily Field Records, page 9-1:** We recommend that the sixth bullet be updated to read as follows: "Sample media (e.g., groundwater) **and depth of collection.**"

37. **Appendix A, Section A9.1.2 Activity-Specific Forms, page A9-2 and Section A9.3 Sample Chain-of-Custody Forms, page A9-3:** Please provide a sample chain of custody form in Appendix A-1.

38. **Appendix A, Section A11.0 Field Variances, page A11-1:** Please add the following text after the second sentence for consistency with Appendix B: "The AMEC Project Manager will notify the USEPA of major modifications or variances to the field program." Please modify the text in Appendix B to the previous statement. The same change can be made to this section in Appendix C.

39. **Appendix A, Section A13.0 References, page A13-1:** We recommend updating the reference list and/or deleting those references that are not used within Appendix A.

40. **Appendix B, Section B1.5, page B1-2:** We recommend updating the first bullet to read as follows (bold text indicates new text for your consideration): "Performance monitoring well **and piezometers** have not been installed and monitored to demonstrate the size and shape of the existing NHOU extraction well capture area, **specifically with regard to the A-Zone and B-Zone.**"

41. **Appendix B, Section B1.6 Schedule, page B1-2:** In the second line, we recommend deleting the word "sampling" and replacing with the phrase "drilling and piezometer installation". It is hard to tell whether this Field Sampling Plan is supposed to cover drilling, sampling, or both.

42. **Appendix B, Section B2.1 Site Description, page B2-1:** Second paragraph, in addition to listing Figure B-2, it would also be appropriate to list Figures B-4 and B-6.

43. **Appendix B, Section B3.1 Project Task and Problem Definition, page B3-1:** Line 6, reference to Figures B-3, B-5, and B-7 should be corrected to reference Figures B-2, B-4, and B-6 instead. Line 8, reference to Figures B-4, B-6, and B-8 should be corrected to reference Figures B-3, B-5, and B-7 instead.

44. **Appendix B, Section B3.2 Data Quality Objectives (DQOs), page B3-2:** We recommend adding an item to the second step: "h) Do the NHOU extraction wells need to be deepened to meet RAOs?"

45. **Appendix B, Section B3.2 Data Quality Objectives (DQOs), page B3-3:** The following figure references should be corrected in the fourth step: Items a), c), and e) – Figure B-3 should be updated to call out Figure B-2 instead, and Figure B-8 should be updated to call out Figure B-7 instead.

46. **Appendix B, Section B3.2 Data Quality Objectives (DQOs), page B3-3:** Sixth step, item "a", should include reference to the Data Gap Analysis report (e.g. AMEC, 2012a).

47. **Appendix B, Section B3.5 Data Management and Assessment Oversight, page B3-6:** Last paragraph, this section makes reference to a Data Usability Evaluation and Field QA/QC submittal. This submittal may need to be referenced in Appendix A as well.

48. **Appendix B, Section B4 Sampling Rationale, page B4-1:** Second paragraph, line 7 – Reference to Table B-1 should be updated to reference Table B-2 instead.

49. **Appendix B, Section B6.7 Piezometer Installation, page B6-4:** First paragraph, figure references in the first line on this page should be updated from B-4, B-6, and B-8 and corrected to reference Figures B-3, B-5, and B-7.

50. **Appendix B, Section B6.8.2 Post-Development Groundwater Sampling, page B6-5:** Reference to Table B-3 should be updated to reference Table B-2 instead.

51. **Appendix B, Section B9.3 Sample Chain-Of-Custody Forms, page B9-3:** First paragraph, consider changing reference from Appendix B-2 to Appendix B-1.

52. **Appendix B, Section B13.0 References, page B13-1:** Suggest updating reference list and/or deleting those references that are not used within Appendix B.

53. **Appendix C, Section C1.6 Schedule, page C1-2:** In the first sentence, suggest deleting the phrase "in multiple sampling events" and replace with the word "testing". In the second sentence, suggest deleting the word "sampling" and replacing with the word "testing".

54. **Appendix C, Section C2.1 Site or Sampling Area Description, page C2-1:** All references to Figures A-1 or A-2 should be updated to reference Figures C-1 or C-2, respectively.

55. **Appendix C, Section C2.4 Geological and Hydrogeological Information, page C2-2:** Line 3, suggest adding the phrase "and testing" after the word "sampling".

56. **Appendix C, Section C3.1 Project Task and Problem Definition, page C3-1:** Suggest updating the first item to read as follows: "Slug tests will be performed at 12 monitoring wells screened primarily in either the A-Zone or B-Zone to estimate hydraulic parameters. These data will be used to estimate hydraulic conductivity values as simulated in the current groundwater flow model to define the NHOU extraction well capture zone."

57. **Appendix C, Section C3.1 Project Task and Problem Definition, page C3-1:** Suggest updating the second item to read as follows (bold text indicates new text for consideration): "Perform aquifer pumping tests at three NHE extraction wells (NHE-3, NHE-5, and NHE-7) **while monitoring the response to the pumping test in 10 observation wells** to estimate well efficiency and A-Zone hydraulic parameters.

58. **Appendix C, Section C3.1 Project Task and Problem Definition, page C3-1:** In the third paragraph, suggest updating the first sentence to read as follows (bold text indicates new text for consideration): "Aquifer tests at NHE wells will consist of a step drawdown test **to evaluate extraction well performance** followed by a constant discharge test **with corresponding recovery tests**."

59. **Appendix C, Section C3.2 Data Quality Objectives (DQOs), page C3-2:** In Step 2, suggest updating the lettering of the items. In Step 3, part "b", line 1, clarify which "NHE" well is referred to, and suggest adding "as well as other existing monitoring wells" to the end of the line (before "as listed in Table C-1").

60. **Appendix C, Section C3.2 Data Quality Objectives (DQOs), page C3-3:** In step 7, delete reference to analytical methodologies as sampling and analysis will not occur as part of this FSP.

61. **Appendix C, Section C6.4 Decontamination Procedures, page C6-12:** At the end of the first paragraph, suggest correcting the acronym FSA to the acronym FSP. At the end of this paragraph, suggest referencing Appendix A of the SAP.

62. **Appendix C, Section C13.0 References, page C13-1:** Suggest updating reference list and/or deleting those references that are not used within Appendix C.

HASP

1. **Section 1.5, Table in "Chemical Hazards," page C1-3:** The current Threshold Limit Value for TCE is 10 ppm; the table should be clarified or corrected accordingly.

2. **Appendix E, Job Safety Analyses, Pre-ground Disturbance and Clearance Activities:** If saw cutting of concrete or asphalt, the Job Safety Analysis may not adequately address use of respiratory protection for dust, or physical controls for use of a chop saw. We recommend that the authors of the HASP consider expanding this discussion if saw cutting is anticipated.

Remedial Design QAPP

1. **Distribution List:** The name of Ms. Acharya (DTSC) appears to be misspelled, and the street address for Mr. Lindquist (CH2M HILL) should be 2525 Airpark Drive (not 2625). Other errors may be present that delay delivery of this or future documents in a timely manner. We recommend that AMEC review and, if necessary, update their distribution list.

2. **Section 2.2, Project Delivery, page 2-4, first and second paragraphs:** It appears that the terms "design/bid/build" and "design/build" may have been inadvertently transposed in the first and second paragraphs. This is not a critical issue from a regulatory perspective, but may lead to confusion if the RD QAPP is forwarded to potential construction bidders in the future. We recommend that this potential transposition be checked and corrected, if appropriate.

3. **Section 4.3.8, Procedures for Records Retention, page 4-7, first paragraph:** This paragraph states that various records will be filed and retained, but does not state the period of retention nor that it is consistent with the Records Retention section of the AOC. We recommend that the RD QAPP include the duration for records retention and maintenance of files on a SharePoint site