Site 89 Monitoring Well Abandonment Work Plan, Marine Corps Base Camp Lejeune - Marine Corps Air Station New River, North Carolina

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CONTRACT:	Comprehensive Long-term Environmental Action—Navy Contract N62470-11-8012, Contract Task Order WE1P

This Work Plan presents the site background and approach for abandoning up to 15 monitoring wells at Site 89. These wells are being considered for abandonment because they are not included in the long-term monitoring well network and they are located within the radius of influence of the air sparging system. The final number of wells for abandonment will be determined based on the results of additional data collection.

1.0 Site Background

Site 89, the former Defense Reutilization and Marketing Office, is located within Operable Unit 16 on Camp Geiger and covers approximately 50 acres (**Figure 1**). The primary contaminants at Site 89 are volatile organic compounds (VOCs) in surficial and upper Castle Hayne groundwater.

Remedies are in place at Site 89 and include the following:

- Air sparging using horizontal directionally drilled (HDD) and vertical wells to treat areas of groundwater with relatively high contaminant concentrations (source area)
- Permeable reactive barriers to treat the downgradient groundwater
- Aerators to treat groundwater discharge to surface water
- Monitored natural attenuation of groundwater and surface water to monitor plume stability and natural attenuation processes
- Land use controls to prevent aquifer use and mitigate exposure to vapor intrusion (**Figure 2**)

The air sparging system was installed in 2013 and includes the following:

- Horizontal air sparging (HAS) well A (HAS-A) with a 700-foot screen installed at 55 feet below ground surface (bgs) within the upper Castle Hayne aquifer
- HAS-B with a 600-foot screen installed at 55 feet bgs within the upper Castle Hayne aquifer
- Three vertical air sparging (VAS) wells, each installed at 84 feet bgs with 2.5-foot micropore screens (**Figure 2**)

The system has been operating since September 25, 2013.

During the first year of operation, HAS-A and HAS-B operated continuously, with the exception of scheduled maintenance and sampling. However, because of daylighting along the alignment of the HDD air sparging wells as shown on **Figure 2**, the airflow to these wells was below design parameters. During the first year of operation, VAS-1, VAS-2, and VAS-3 experienced more downtime than the HDD system because of redevelopment of the wells and air short-circuiting up around the VAS well casings.

After the first year of operation, the air sparging system was optimized to achieve design flow rates. Optimization consisted of installing threaded caps in wells showing pressure and turning off the system, thus allowing the subsurface materials to collapse and heal developed air channels; then, the system was restarted at a lower flow rate with gradual increases. After the implementation of these changes, short-circuiting and daylighting did not appear to be occurring; however, the system is still not operating at design parameters.

2.0 Monitoring Well Selection

Up to eight surficial aquifer wells, two upper Castle Hayne aquifer wells, and five middle Castle Hayne aquifer wells are proposed for abandonment. The 15 monitoring wells, which are shown on **Figure 2**, were selected for consideration because they are not part of the Site 89 long-term monitoring program, and they are located within the air sparging system area. Monitoring well construction information is provided in **Table 1**. Historical data for each monitoring well is provided in **Attachment 1**.

Additional information is required before the path forward can be determined. Each well will be re-sampled during the next scheduled system downtime to determine current VOC concentrations. Each well will be considered for abandonment based on the rationale for abandonment provided in **Table 1**. Wells are shown by aquifer on **Figures 3** through **5**.

3.0 Monitoring Well Abandonment

The monitoring wells will be abandoned by a North Carolina-licensed driller, with oversight provided by CH2M HILL (CH2M) personnel in accordance with the North Carolina Well Construction Standards (NC2C.0100). Before well abandonment, depth-to-water and depth-to-bottom measurements will be collected and recorded. Surface completion (flush mount or stickup) will be removed before well abandonment activities commence.

After wells have been identified for abandonment, each well will be inspected while the air sparging system is operating. If air is observed escaping from around the well, the well will be abandoned by overdrilling. If air is not observed escaping from around the well, the well will be abandoned by grouting in place. Grouting in place is faster, less expensive, and generates less waste than overdrilling; therefore, grouting in place is the preferred abandonment method. However, overdrilling will be conducted where air short-circuiting around the casing is observed.

If workers abandon a well by grouting in place, a bentonite-cement grout slurry (3 percent mix) will be used to properly abandon each monitoring well. The grout slurry will be injected via bottom- or side-discharge tremie pipe from the bottom of the well to the top.

If workers abandon a well by overdrilling, the well riser may be drilled over and removed from the borehole in pieces as the augers are removed from the borehole as borehole cuttings. The diameter of the auger used for the overdrilling should be, at a minimum, the same size or larger than the diameter of the borehole to ensure that all of the well material is removed. The remaining borehole will be sealed with bentonite-cement slurry.

Following well abandonment activities, the North Carolina-licensed driller will submit a Well Abandonment Form to the North Carolina Department of Environmental Quality (NCDEQ). Work will be completed in accordance with the Health and Safety Plan (**Attachment 2**), which will be available onsite during well abandonment activities.

Table

TABLE 1
Monitoring Well Summary
Site 89 Monitoring Well Abandonment Work Plan
MCB Camp Lejeune -
MCAS New River

Well ID	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Surface Completion (stickup/flush)	Aquifer	Well Coordinates (NAD 83 UTM Zone 18 North, meters)		Rationale for Abandonment
						Northing	Easting	
IR89-MW01	13.7	3.3 to 13.3	2	Flush	Surficial	3845975.68	275777.33	No wells in the LTM program are screened within the same aquifer within 100 feet of MW01; however, MW01 is located 40 feet downgradient from MW02 and 60 feet sidegradient from MW03, and screened at the same interval. Therefore, samples will be collected from MW01, MW02, and MW03 to determine current conditions. -- If VOC COC concentrations are below cleanup levels in all three samples, all three wells will be abandoned. -- If VOC COC concentrations are above cleanup levels in one of the three monitoring wells, the other two wells will be abandoned and the remaining well will be considered for inclusion in LTM. -- If VOC COC concentrations are above cleanup levels in two of the three monitoring wells, one well will be retained and considered for inclusion in LTM, based on location and concentration, and the other two wells will be abandoned. -- If VOC COC concentrations are above cleanup levels in all three monitoring wells, MW03 will be retained to provide northern plume delineation, and MW01 and MW02 will be abandoned.
IR89-MW02	14	4 to 14	2	Stickup	Surficial	3845978.51	275764.37	See MW01 for rationale for abandonment.
IR89-MW02IW	40	35 to 40	2	Flush	UCH	3845984.602	275761.399	MW02IW is located west of the horizontal air sparging wells and 15 feet sidegradient from MW52IW, which is in the LTM program and screened at the same interval. A sample will be collected from MW02IW to determine current conditions. If the VOC COC concentrations are the same order of magnitude as or less than concentrations in MW52IW, MW02IW will be abandoned. If VOC COC concentrations are higher, the well will not be abandoned and will be considered for inclusion in LTM.
IR89-MW03	14	4 to 14	2	Stickup	Surficial	3845992.442	275780.785	See MW01 for rationale for abandonment.
IR89-MW03IW	41.5	36.5 to 41.5	2	Flush	UCH	3845988.08	275784.211	MW03IW is located between the two horizontal air sparging wells and 75 feet sidegradient from MW52IW, which is in the LTM program and screened at the same interval. A sample will be collected from MW03IW to determine current conditions. If the VOC COC concentrations are the same order of magnitude as or less than concentrations in MW52IW, MW03IW will be abandoned. If VOC COC concentrations are higher, the well will not be abandoned and will be considered for inclusion in the LTM program.
IR89-MW03DW	70	65 to 70	2	Flush	MCH	3845986.462	275783.559	MW03DW is located between the two horizontal air sparging wells. Although historical samples collected from this well contained no VOC COCs at concentrations exceeding cleanup levels, there are no redundant wells in the LTM program. Therefore, a sample will be collected from MW03DW to determine current conditions. If VOC COC concentrations are below cleanup levels, the well will be abandoned. If any VOC COC is detected at concentrations exceeding cleanup levels, the well will not be abandoned and will be considered for inclusion in the LTM program.

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Well ID	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Surface Completion (stickup/flush)	Aquifer	Well Coordinates (NAD 83 UTM Zone 18 North, meters)		Rationale for Abandonment
						Northing	Easting	
IR89-MW10	15	5 to 15	2	Flush	Surficial	3845920.084	275693.022	MW10 is located west of the horizontal air sparging wells, 100 feet sidegradient from MW82, and 75 feet sidegradient from MW84, both in the LTM Program and screened at the same interval. Seven samples, collected between 1997 and 2011, contained no exceedances of VOC COCs. However, because MW10 is located within the radius of influence of the air sparging wells, a sample will be collected to determine current conditions. If the VOC COC concentrations are the same order of magnitude as or less than concentrations in samples collected from MW82 and MW84, MW10 will be abandoned. If VOC COC concentrations are higher, MW10 will not be abandoned and will be considered for inclusion in LTM.
IR89-MW24IW	25	20 to 25	2	Stickup	Surficial	3845851.079	275691.786	MW24IW is located between the two horizontal air sparging wells and 70 feet sidegradient from MW70, which is in the LTM program and screened at the same interval. MW24IW has been sampled once, in 2011, and no VOC COCs were detected in exceedances of cleanup levels. However, because MW24IW is located within the radius of influence of the air sparging wells, a sample will be collected to determine current conditions. If the VOC COC concentrations are the same order of magnitude as or less than concentrations in MW70, MW24IW will be abandoned. If VOC COC concentrations are higher, MW24IW will not be abandoned and will be considered for inclusion in LTM.
IR89-MW45	23	18 to 23	2	Stickup	Surficial	3845876.13	275754.675	MW45 is located east of the horizontal air sparging wells, 80 feet sidegradient from MW55, and 100 feet sidegradient from MW56, both in the LTM program and screened at the same interval. A sample will be collected from MW45 to determine current conditions. If the VOC COC concentrations are the same order of magnitude as or less than concentrations in MW55 and MW56, MW45 will be abandoned. If VOC COC concentrations are higher, MW45 will not be abandoned and will be considered for inclusion in LTM.
IR89-MW50	25	20 to 25	2	Flush	Surficial	3845990.98	275752.76	MW50 is located west of the horizontal air sparging wells, 70 feet upgradient from MW51, and 60 feet upgradient from MW52, both in the LTM program and screened at the same interval. A sample will be collected from MW50 to determine current conditions. If the VOC COC concentrations are the same order of magnitude as or less than concentrations in MW51 and MW52, MW50 will be abandoned. If VOC COC concentrations are higher, MW50 will not be abandoned and will be considered for inclusion in LTM.
IR89-MW52DW	80	75 to 80	2	Flush	MCH	3845980.048	275765.193	MW52DW is located between the two horizontal air sparging wells. There are no redundant wells currently in the LTM program for MW52DW; therefore, a sample will be collected to determine current conditions. If VOC COC concentrations are below cleanup levels, the well will be abandoned. If any VOC COC is detected at concentrations exceeding cleanup levels, the well will not be abandoned and will be considered for inclusion in LTM.
IR89-MW53DW	71	66 to 71	2	Flush	MCH	3845941.247	275761.609	MW53DW is located between the two horizontal air sparging wells. There are no redundant wells currently in the LTM program for MW53DW; therefore, a sample will be collected to determine current conditions. If VOC COC concentrations are below cleanup levels, the well will be abandoned. If any VOC COC is detected at concentrations exceeding cleanup levels, the well will not be abandoned and will be considered for inclusion in LTM.

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MCAS New River

Well ID	Total Depth (feet bgs)	Screened Interval (feet bgs)	Well Diameter (inches)	Surface Completion (stickup/flush)	Aquifer	Well Coordinates (NAD 83 UTM Zone 18 North, meters)		Rationale for Abandonment
						Northing	Easting	
IR89-MW54	25	20 to 25	2	Flush	Surficial	3845908.34	275772.13	MW54 is located east of the horizontal air sparging wells, 65 feet downgradient from MW44, 90 feet sidegradient from MW08, and 35 feet sidegradient from MW55, all in the LTM program and screened at the same interval. A sample will be collected from MW54 to determine current conditions. If the VOC COC concentrations are the same order of magnitude as or less than concentrations in MW08, MW44, and MW55, MW54 will be abandoned. If VOC COC concentrations are higher, MW54 will not be abandoned and will be considered for inclusion in LTM.
IR89-MW81DW	64	59 to 64	2	Flush	MCH	3845893.59	275715.86	MW81DW is located between the two horizontal air sparging wells. Although historical samples collected from this well contained no VOC COCs at concentrations exceeding cleanup levels, there are no redundant wells in the LTM program. Therefore, a sample will be collected from MW81DW to determine current conditions. If VOC COC concentrations are below cleanup levels, the well will be abandoned. If any VOC COC is detected at concentrations exceeding cleanup levels, the well will not be abandoned and will be considered for inclusion in LTM.
IR89-MW82DW	70	65 to 70	2	Flush	MCH	3845939.798	275715.002	MW82DW is located west of the horizontal air sparging wells. Although historical samples collected from this well contained no VOC COCs at concentrations exceeding cleanup levels, there are no redundant wells in the LTM program. Therefore, a sample will be collected from MW82DW to determine current conditions. If VOC COC concentrations are below cleanup levels, the well will be abandoned. If any VOC COC is detected at concentrations exceeding cleanup levels, the well will not be abandoned and will be considered for inclusion in LTM.

Notes:
bgs = below ground surface
LTM = long-term monitoring
MCH = middle Castle Hayne
UCH = upper Castle Hayne
VOC COC = volatile organic compounds contaminant of concern

Figures

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Legend

- Highways
- Installation Boundary

Land Use Control Boundaries

- Aquifer Use Control Boundary
- Industrial/Non-Industrial Use Control Boundary (Vapor Intrusion)
- Intrusive Activities Control Boundary (Groundwater)

N

0 7,500 15,000 30,000 Feet

1 inch = 15,000 feet

Figure 1
Base Location Map
Site 89 Monitoring Well Abandonment Work Plan
MCB Camp Lejeune and MCAS New River
North Carolina

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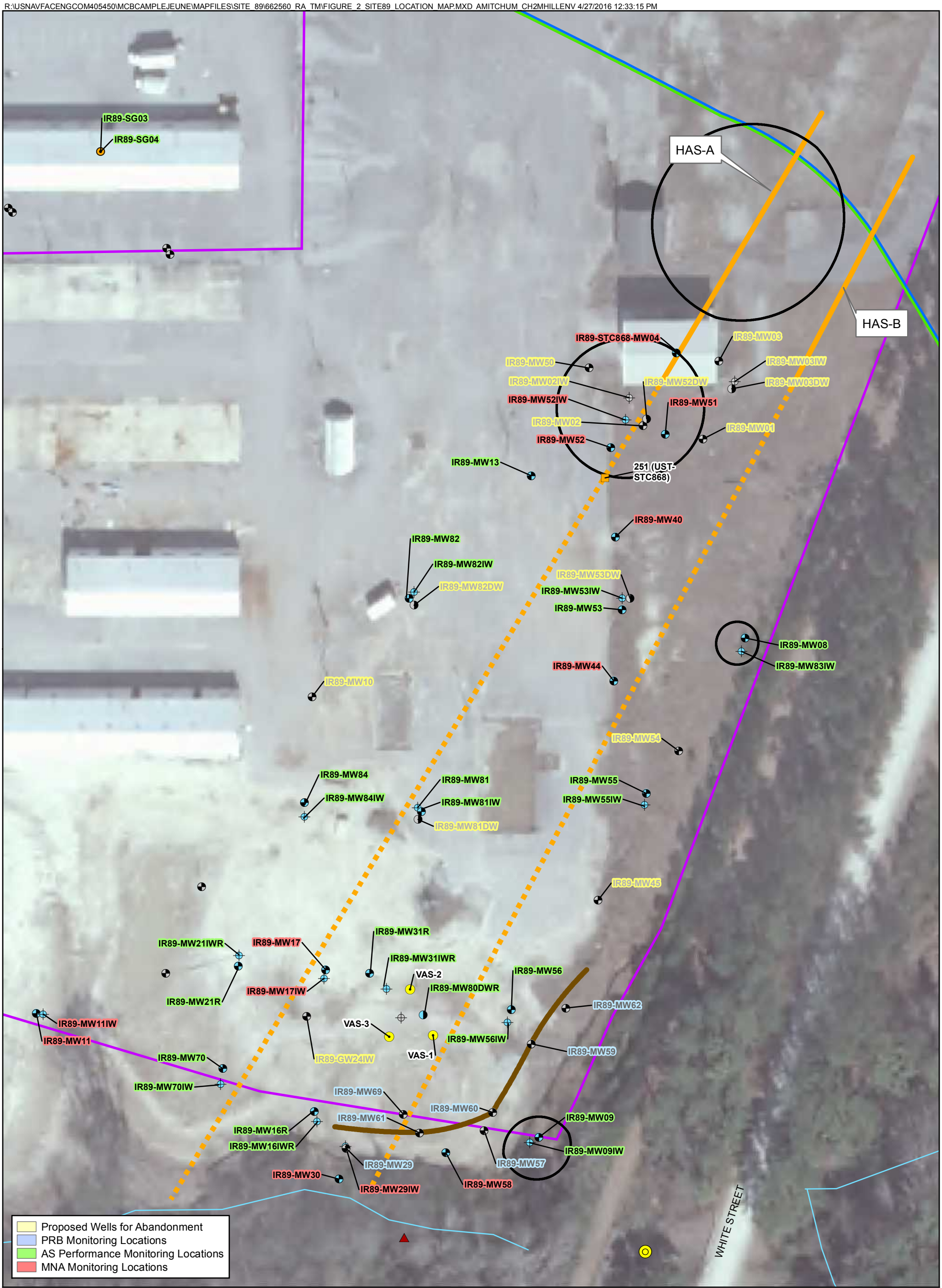

Legend

Monitoring Wells
- Surficial Aquifer
- Upper Castle Hayne Monitoring Well
- Surface Water
- Soil Gas Sample Locations
- Surficial Monitoring Well Not in LTM
- Upper Castle Hayne Monitoring Well Not in LTM
- Middle Castle Hayne Monitoring Well
- Former UST Locations
- Vertical Sparging Points
- Surface Water Aerator Locations

- Horizontal Air Sparging Wells (dash represents screen interval)
- PRB
- Former Defense Reutilization and Marketing Office Area
- Areas of Observed Daylighting

Land Use Control Boundaries
- Industrial/Non-Industrial Use Control Boundary (Vapor Intrusion)
- Intrusive Activities Control Boundary (Groundwater)

N

0 32.5 65 Feet

1 inch = 65 feet

Figure 2
Site 89 Location Map
Site 89 Monitoring Well Abandonment Work Plan
MCB Camp Lejeune and MCAS New River
North Carolina

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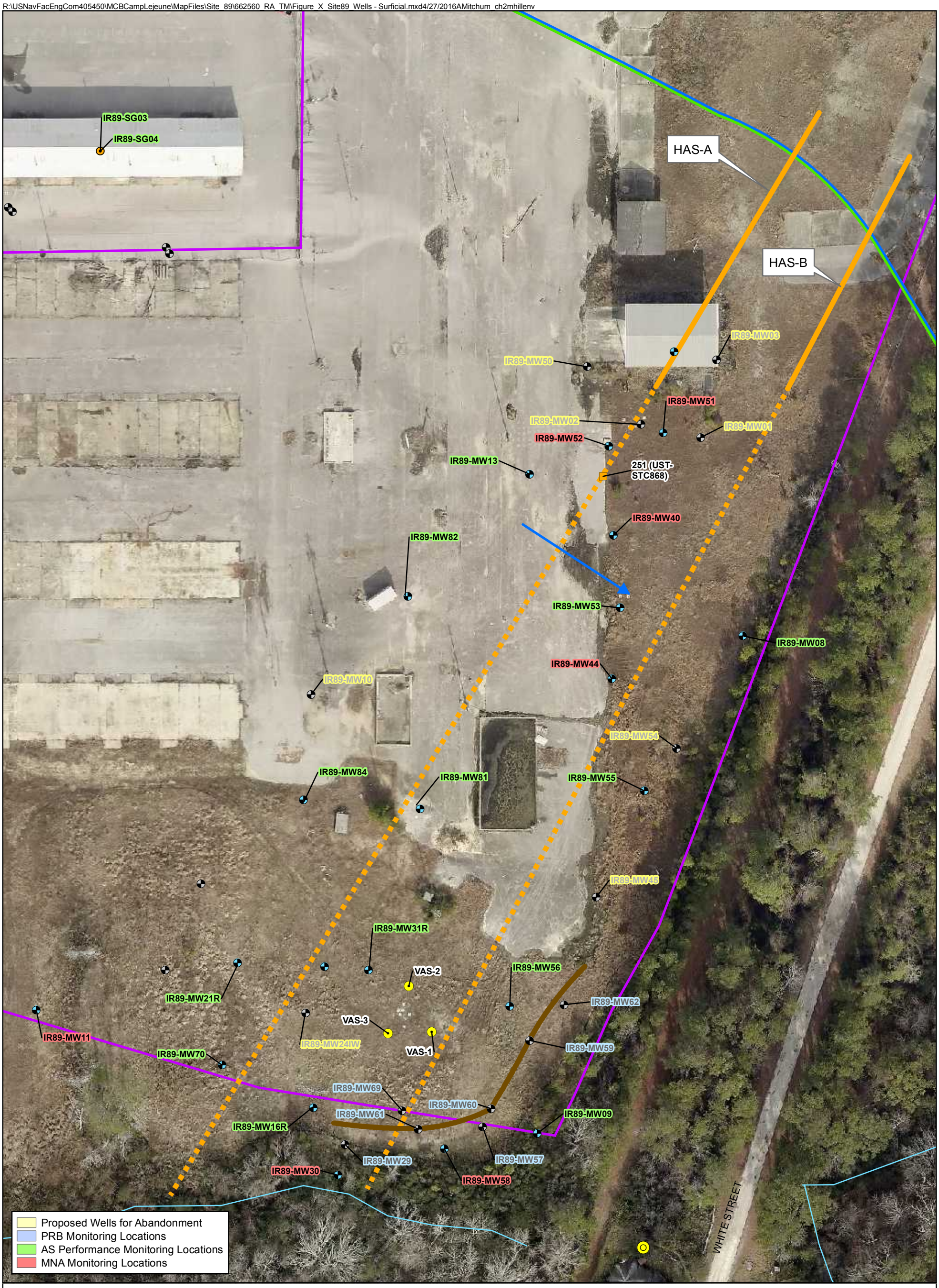

Legend

Monitoring Wells
- Surficial Aquifer
- Soil Gas Sample Locations
- Surficial Monitoring Well Not in LTM
- Former UST Locations
- Vertical Sparging Points
- Surface Water Aerator Locations
- Groundwater Flow Direction

- Horizontal Air Sparging Wells (dash represents screen interval)
- PRB
- Former Defense Reutilization and Marketing Office Area

Land Use Control Boundaries
- Industrial/Non-Industrial Use Control Boundary (Vapor Intrusion)
- Intrusive Activities Control Boundary (Groundwater)

N

0 32.5 65 Feet

1 inch = 65 feet

Figure 3
Site 89 Wells - Surficial
Site 89 Monitoring Well Abandonment Work Plan
MCB Camp Lejeune and MCAS New River
North Carolina

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Legend

Monitoring Wells

- Upper Castle Hayne Monitoring Well
- Soil Gas Sample Locations
- Upper Castle Hayne Monitoring Well Not in LTM
- Former UST Locations
- Vertical Sparging Points
- Surface Water Aerator Locations
- Groundwater Flow Direction
- Horizontal Air Sparging Wells (dash represents screen interval)
- PRB
- Former Defense Reutilization and Marketing Office Area

Land Use Control Boundaries

- Industrial/Non-Industrial Use Control Boundary (Vapor Intrusion)
- Intrusive Activities Control Boundary (Groundwater)

N

0 32.5 65 Feet

1 inch = 65 feet

Figure 4
Site 89 Wells - UCH
Site 89 Monitoring Well Abandonment Work Plan
MCB Camp Lejeune and MCAS New River
North Carolina

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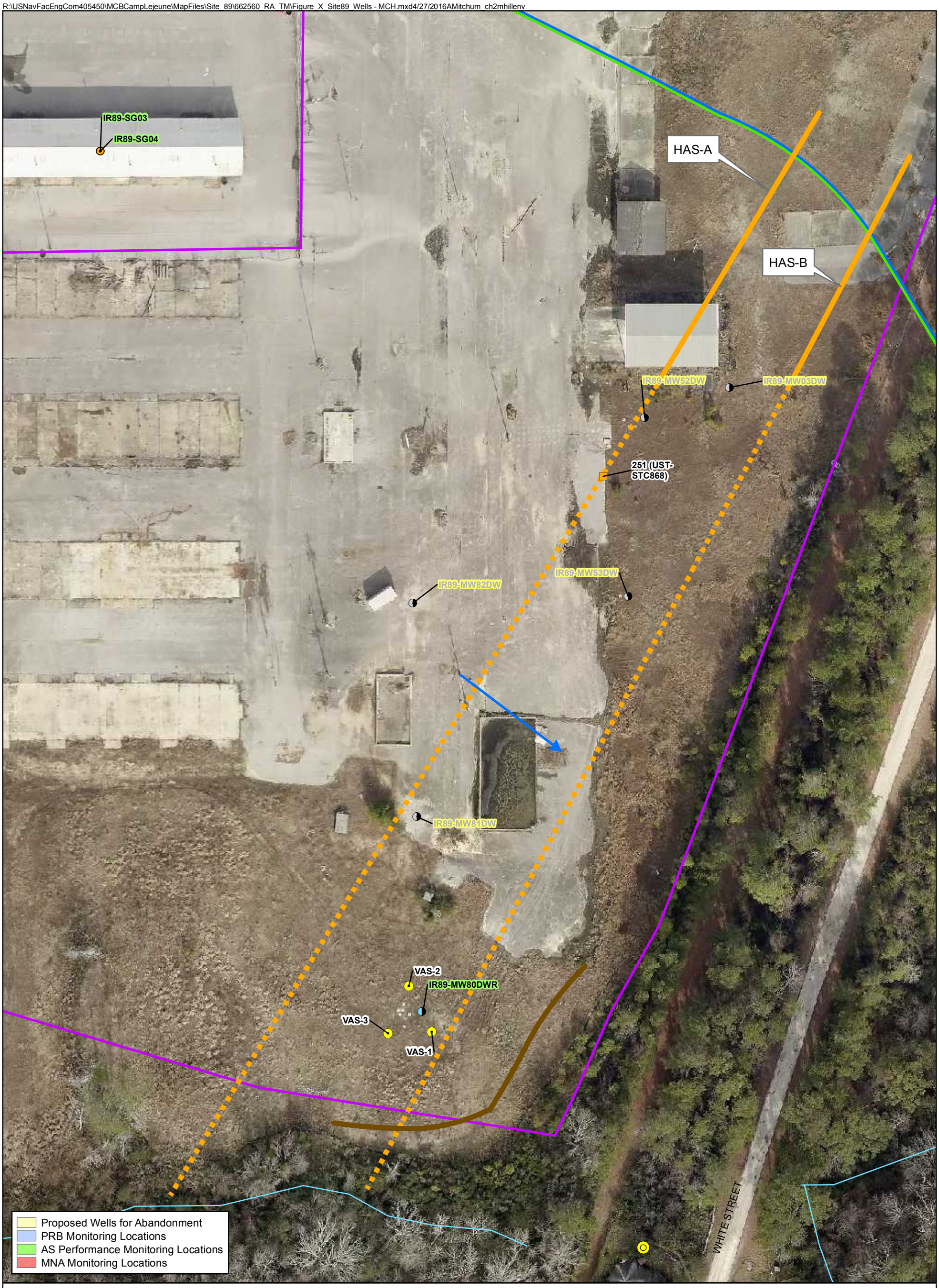

Legend

Monitoring Wells

- Middle Castle Hayne Monitoring Well
- Soil Gas Sample Locations
- Middle Castle Hayne Monitoring Well
- Former UST Locations
- Vertical Sparging Points
- Surface Water Aerator Locations
- Groundwater Flow Direction
- Horizontal Air Sparging Wells (dash represents screen interval)
- PRB
- Former Defense Reutilization and Marketing Office Area

Land Use Control Boundaries

- Industrial/Non-Industrial Use Control Boundary (Vapor Intrusion)
- Intrusive Activities Control Boundary (Groundwater)

N

0 32.5 65 Feet

1 inch = 65 feet

Figure 5
Site 89 Wells - MCH
Site 89 Monitoring Well Abandonment Work Plan
MCB Camp Lejeune and MCAS New River
North Carolina

ch2m

Attachment 1
Historical Monitoring Well Data

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-GW24IW	IR89-MW01							IR89-MW02	
Sample ID	IR89-GW24IW-10D	IR89-MW01-05281997	IR89-MW01-97B-05281997	IR89-GW01-99D-10241999	IR89-GW01-02D-10182002	IR89-MW01-04B	IR89-GW01-06D	IR89-GW01-07A	IR89-GW01-07A2	IR89-GW01-07B
Sample Date	12/15/10	05/28/97	05/28/97	10/24/99	10/18/02	04/16/04	11/19/06	01/04/07	03/14/07	06/05/07
Chemical Name										
Volatile Organic Compounds (UG/L)										
1,1,2,2-Tetrachloroethane	0.5 U	110	110	380	310 D	180	47	74	80	49
1,1,2-Trichloroethane	0.5 U	10 U	10 U	40 U	6	2	1 U	1.1	1 U	0.59 J
1,1-Dichloroethane	NA	10 U	10 U	40 U	25 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	NA	10 U	10 U	40 U	25 U	0.2 J	1 U	1 U	1 U	1 U
1,2-Dichloroethane	NA	10 U	10 U	40 U	25 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethene (total)	NA	74	74	150	300 D	76	NA	NA	NA	NA
2-Butanone	NA	10 U	10 U	40 U	10 U	5 U	5 U	5 U	10 U	10 U
2-Hexanone	NA	10 U	10 U	40 U	10 U	5 U	NA	NA	5 U	5 U
4-Methyl-2-pentanone	NA	10 U	10 U	40 U	10 U	5 U	NA	NA	5 U	5 U
Acetone	NA	10 U	10 U	53	10 U	5 R	25 U	25 U	10 U	10 U
Benzene	NA	10 U	NA	40 U	0.8 J	0.2 J	1 U	1 U	1 U	1 U
Carbon disulfide	NA	10 U	10 U	40 U	25 U	1 U	NA	NA	1 U	1 U
Chloroethane	NA	10 U	10 U	40 U	25 U	2 U	1 U	1 U	2 U	2 U
Chloroform	NA	10 U	10 U	40 U	25 U	1 U	1 U	1 U	1 U	1 U
Chloromethane	NA	10 U	10 U	40 U	25 U	2 U	1 U	1 U	2 U	2 U
cis-1,2-Dichloroethene	0.5 U	NA	NA	NA	190	49	19	37	21	16
Ethylbenzene	NA	10 U	10 U	40 U	0.3 J	1 U	1 U	1 U	1 U	1 U
Isopropylbenzene	NA	NA	NA	NA	NA	NA	1 U	1 U	1 U	0.15 J
m- and p-Xylene	NA	NA	NA	NA	0.3 J	2 U	2 U	2 U	NA	NA
Methyl acetate	NA	NA	NA	NA	NA	NA	NA	NA	1 U	1 U
Methylene chloride	NA	10 U	10 U	40 U	25 U	2 U	2 U	2 U	2 U	2 U
o-Xylene	NA	NA	NA	NA	0.4 J	1 U	1 U	1 U	NA	NA
p-Isopropyltoluene	NA	NA	NA	NA	NA	NA	1 U	1 U	NA	NA
Styrene	NA	10 U	10 U	40 U	25 U	1 U	1 U	1 U	1 U	1 U
Tetrachloroethene	0.5 U	4 J	4 J	22 J	15 J	10	5	9.4	7	5.9
Toluene	NA	10 U	10 U	40 U	7 JB	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	0.5 U	NA	NA	NA	150	27	9.2	16	7.6	6.9
Trichloroethene	0.91 J	67	67	150	190	64	25	45	34	28
Vinyl chloride	1 U	10 U	10 U	40 U	8 J	2 J	1 U	1 U	0.55 J	0.68 J
Xylene, total	NA	10 U	10 U	40 U	0.7 J	3 U	NA	NA	1 U	1 U
TCLP Volatile Organic Compounds (UG/L)										
No Detections	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/L)										
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	10 U	NA	NA	NA	NA
Naphthalene	NA	NA	NA	NA	NA	10 U	1 U	1 U	NA	NA
Total Metals (UG/L)										
Aluminum	NA	NA	NA	NA	NA	1,110	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	2.34 U	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	81.2	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	0.5 J	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	10,900	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	0.8 U	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	1.91 U	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	1,320	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	2.3 J	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	8,250	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	66.6	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	10.8 U	NA	NA	NA	NA
Phosphorus	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-GW24IW	IR89-MW01							IR89-MW02	
Sample ID	IR89-GW24IW-10D	IR89-MW01-05281997	IR89-MW01-97B-05281997	IR89-GW01-99D-10241999	IR89-GW01-02D-10182002	IR89-MW01-04B	IR89-GW01-06D	IR89-GW01-07A	IR89-GW01-07A2	IR89-GW01-07B
Sample Date	12/15/10	05/28/97	05/28/97	10/24/99	10/18/02	04/16/04	11/19/06	01/04/07	03/14/07	06/05/07
Chemical Name										
Potassium	NA	NA	NA	NA	NA	2,490	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	15,400	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	4.6 U	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	4.14 U	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	34	NA	NA	NA	NA
TCLP Metals (UG/L)										
Chromium, TCLP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Metals (UG/L)										
Antimony, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron, Dissolved	NA	NA	NA	NA	NA	1,310	NA	NA	NA	NA
Manganese, Dissolved	NA	NA	NA	NA	NA	67.1	NA	NA	NA	NA
Nickel, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wet Chemistry										
Alkalinity (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ammonia (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride (mg/l)	NA	NA	NA	NA	NA	8.1	NA	NA	NA	NA
Ethane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethane (ug/l)	NA	NA	NA	NA	NA	10 U	NA	NA	NA	NA
Ethene (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethene (ug/l)	NA	NA	NA	NA	NA	10 U	NA	NA	NA	NA
Methane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methane (ug/l)	NA	NA	NA	NA	NA	640	NA	NA	NA	NA
Nitrate (mg/l)	NA	NA	NA	NA	NA	0.05 U	NA	NA	NA	NA
Nitrate/Nitrite (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitric Acid (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite (mg/l)	NA	NA	NA	NA	NA	0.01 J	NA	NA	NA	NA
Orthophosphate (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate (mg/l)	NA	NA	NA	NA	NA	79	NA	NA	NA	NA
Sulfide (mg/l)	NA	NA	NA	NA	NA	0.15 J	NA	NA	NA	NA
Total Kjeldahl nitrogen (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC) (mg/l)	NA	NA	NA	NA	NA	12	NA	NA	NA	NA
Total organic carbon (TOC) (ug/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic nitrogen (TON) (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Wet Chemistry (MG/L)										
Dissolved organic carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dechlorinating Bacteria (GC/ML)										
Dehalococcoides	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-GW24IW	IR89-MW01							IR89-MW02	
Sample ID	IR89-GW24IW-10D	IR89-MW01-05281997	IR89-MW01-97B-05281997	IR89-GW01-99D-10241999	IR89-GW01-02D-10182002	IR89-MW01-04B	IR89-GW01-06D	IR89-GW01-07A	IR89-GW01-07A2	IR89-GW01-07B
Sample Date	12/15/10	05/28/97	05/28/97	10/24/99	10/18/02	04/16/04	11/19/06	01/04/07	03/14/07	06/05/07
Chemical Name										
Functioning Genes (GC/ML)										
VC R-Dase	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Shading indicates detections
NA - Not analyzed
B - Analyte not detected above the level reported in
D - Compound identified in an analysis at a secondary dilution factor
E - Concentration exceeds calibration range of GC/MS instrument (Organic) OR Value is estimated due to matrix interferences (Inorganic)
Exclude
J - Analyte present, value may or may not be accurate or precise
L - Analyte present, value may be biased low, actual value may be higher
R - Unreliable Result
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
UL - Analyte not detected, quantitation limit is probably higher
GC/ML - Gene copies per milliliter
MG/L - Milligrams per liter
UG/L - Micrograms per liter

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW02								
Sample ID	IR89-MW01-08C	IR89-GW01-10D	IR89-GW02-99B-04221999	IR89-MW02-07011999	IR89-MW02-99C-07011999	IR89-GW02-99D-10271999	IR89-GW02-00B-04192000	IR89-GW02-02B-04192002	IR89-GW02-02D-10172002
Sample Date	09/28/08	12/14/10	04/22/99	07/01/99	07/01/99	10/27/99	04/19/00	04/19/02	10/17/02
Chemical Name									
Volatile Organic Compounds (UG/L)									
1,1,2,2-Tetrachloroethane	72	22	30,000	4,600 D	4,600 D	26,000	40,000 D	30,000 E	14,000 D
1,1,2-Trichloroethane	1.1 J	0.36 J	1,200 U	210	210	1,000 U	150	1,000 U	74 J
1,1-Dichloroethane	1.6 U	NA	1,200 U	25 U	25 U	1,000 U	5 U	250 U	250 U
1,1-Dichloroethene	1.6 U	NA	1,200 U	25 U	25 U	1,000 U	27	1,000 U	29
1,2-Dichloroethane	NA	NA	1,200 U	25 U	25 U	1,000 U	5 U	1,000 U	250 U
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	9,300	14,000	21,000	14,000 D
2-Butanone	7.8 U	NA	650 J	250 U	250 U	1,000 U	10 U	10 U	10 U
2-Hexanone	NA	NA	2,500 U	250 U	250 U	1,000 U	10 U	10 UJ	10 U
4-Methyl-2-pentanone	NA	NA	2,500 U	250 U	250 U	1,000 U	10 U	10 UJ	10 U
Acetone	7.8 U	NA	2,200 J	500 R	500 R	1,000 U	10 U	10 U	10 U
Benzene	1.6 U	NA	NA	25 U	25 U	1,000 U	5 U	5 U	250 U
Carbon disulfide	1.6 U	NA	1,200 U	25 U	25 U	1,000 U	5 U	250 U	250 U
Chloroethane	NA	NA	1,200 U	50 U	50 U	1,000 U	5 U	5 UJ	250 U
Chloroform	1.6 U	NA	1,200 U	25 U	25 U	1,000 U	5 U	5 U	250 U
Chloromethane	NA	NA	1,200 U	50 U	50 U	1,000 U	5 U	5 U	250 U
cis-1,2-Dichloroethene	38	4	7,300	8,800	8,800	NA	13,000	10,000 E	9,300
Ethylbenzene	1.6 U	NA	1,200 U	25 U	25 U	1,000 U	5 U	250 U	1 J
Isopropylbenzene	1.6 U	NA	NA	NA	NA	NA	NA	NA	NA
m- and p-Xylene	3.1 U	NA	NA	NA	NA	NA	NA	NA	100 U
Methyl acetate	1.6 U	NA	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	1.6 U	NA	2,900 B	120 U	120 U	1,000 U	5 U	250 U	250 U
o-Xylene	1.6 U	NA	NA	NA	NA	NA	NA	NA	1 U
p-Isopropyltoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	1.6 U	NA	1,200 U	25 U	25 U	1,000 U	5 U	250 U	250 U
Tetrachloroethene	11	2 J	1,200 U	130	130	1,000 U	170	170 J	120 J
Toluene	1.6 U	NA	1,200 U	25 U	25 U	1,000 U	3 J	3 J	5 J
trans-1,2-Dichloroethene	22	0.72 J	3,800	4,600	4,600	NA	6,100 D	7,400	5,100 D
Trichloroethene	52	7.8	7,100	9,200	9,200	6,600	10,000 D	9,000	6,500 D
Vinyl chloride	1.1 J	1 U	530 J	720	720	1,000 U	830 D	1,400 E	1,500
Xylene, total	1.6 U	NA	3,800 U	50 U	50 U	1,000 U	5 U	250 U	250 U
TCLP Volatile Organic Compounds (UG/L)									
No Detections	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/L)									
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (UG/L)									
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	1,880	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	32.4	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW02								
Sample ID	IR89-MW01-08C	IR89-GW01-10D	IR89-GW02-99B-04221999	IR89-MW02-07011999	IR89-MW02-99C-07011999	IR89-GW02-99D-10271999	IR89-GW02-00B-04192000	IR89-GW02-02B-04192002	IR89-GW02-02D-10172002
Sample Date	09/28/08	12/14/10	04/22/99	07/01/99	07/01/99	10/27/99	04/19/00	04/19/02	10/17/02
Chemical Name									
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA
TCLP Metals (UG/L)									
Chromium, TCLP	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Metals (UG/L)									
Antimony, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wet Chemistry									
Alkalinity (mg/l)	10 U	NA	NA	NA	NA	NA	NA	NA	NA
Ammonia (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon (mg/l)	NA	NA	9.6	NA	NA	NA	NA	NA	NA
Chloride (mg/l)	7.3 JD	NA	NA	NA	NA	NA	NA	92	95 J
Ethane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethane (ug/l)	0.3 J	NA	120	NA	NA	NA	17	14	11
Ethene (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethene (ug/l)	0.2 J	NA	16	NA	NA	NA	94	95	110
Methane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methane (ug/l)	92 BD	NA	1,200	NA	NA	NA	1,100 D	750	660
Nitrate (mg/l)	0.25 U	NA	NA	NA	NA	NA	0.05 U	NA	NA
Nitrate/Nitrite (mg/l)	NA	NA	NA	NA	NA	NA	NA	0.05 U	0.07
Nitric Acid (mg/l)	NA	NA	0.15	NA	NA	NA	NA	NA	NA
Nitrite (mg/l)	0.25 U	NA	NA	NA	NA	NA	NA	NA	NA
Orthophosphate (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate (mg/l)	41 D	NA	85.2	NA	NA	NA	70	120 J	100
Sulfide (mg/l)	1 U	NA	NA	NA	NA	NA	NA	NA	1 U
Total Kjeldahl nitrogen (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC) (mg/l)	11.8	NA	NA	NA	NA	NA	25	NA	NA
Total organic carbon (TOC) (ug/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic nitrogen (TON) (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Wet Chemistry (MG/L)									
Dissolved organic carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dechlorinating Bacteria (GC/ML)									
Dehalococcoides	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW02								
Sample ID	IR89-MW01-08C	IR89-GW01-10D	IR89-GW02-99B-04221999	IR89-MW02-07011999	IR89-MW02-99C-07011999	IR89-GW02-99D-10271999	IR89-GW02-00B-04192000	IR89-GW02-02B-04192002	IR89-GW02-02D-10172002
Sample Date	09/28/08	12/14/10	04/22/99	07/01/99	07/01/99	10/27/99	04/19/00	04/19/02	10/17/02
Chemical Name									
Functioning Genes (GC/ML)									
VC R-Dase	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Shading indicates detections
NA - Not analyzed
B - Analyte not detected above the level reported in
D - Compound identified in an analysis at a secondary dilution factor
E - Concentration exceeds calibration range of GC/MS instrument (Organic) OR Value is estimated due to matrix interferences (Inorganic)
Exclude
J - Analyte present, value may or may not be accurate or precise
L - Analyte present, value may be biased low, actual value may be higher
R - Unreliable Result
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
UL - Analyte not detected, quantitation limit is probably higher
GC/ML - Gene copies per milliliter
MG/L - Milligrams per liter
UG/L - Micrograms per liter

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW02										
Sample ID	IR89-GW02-03B	IR89-GW02-03B-04122003	IR89-GW02-03D	IR89-GW02-03D-10252003	IR89-MW02-04B	IR89-GW02-05D	IR89-GW02-06D	IR89-GW02-07A	IR89-GW02-07A2	IR89-GW02-07B	IR89-MW02-08C
Sample Date	04/12/03	04/12/03	10/25/03	10/25/03	04/21/04	12/02/05	11/20/06	01/04/07	03/14/07	06/05/07	09/28/08
Chemical Name											
Volatile Organic Compounds (UG/L)											
1,1,2,2-Tetrachloroethane	18,000	18,000	10,000	10,000 DJ	2,100	21,000	14,000 J	13,000	10,000	8,500	3,000
1,1,2-Trichloroethane	110 J	110 J	94	94	21	120 J	69 J	540	77	58 J	29 J
1,1-Dichloroethane	500 U	500 U	5 U	5 U	1 U	130 U	1 U	1 U	50 U	100 U	100 U
1,1-Dichloroethene	500 U	500 U	24	24	11	130 UJ	20 J	21	21 J	100 U	100 U
1,2-Dichloroethane	500 U	500 U	2 J	2 J	1 U	130 U	1.7 J	9.1	50 U	100 U	NA
1,2-Dichloroethene (total)	17,000	17,000	12,000	12,000 D	2,300	NA	NA	NA	NA	NA	NA
2-Butanone	1,000 U	1,000 U	25 U	25 U	1,000 R	1,300 U	5 U	17	500 U	1,000 U	500 U
2-Hexanone	1,000 U	1,000 U	25 U	25 U	5 U	1,300 U	NA	NA	250 U	500 U	NA
4-Methyl-2-pentanone	1,000 U	1,000 U	25 U	25 UJ	5 U	1,300 U	NA	NA	250 U	500 U	NA
Acetone	1,000 U	1,000 U	25 U	25 U	1,000 R	1,300 U	25 U	25 U	500 U	1,000 U	500 U
Benzene	500 U	500 U	2 J	2 J	0.7 J	130 U	1 U	1.4	50 U	100 U	100 U
Carbon disulfide	500 U	500 U	5 U	5 U	1 U	130 U	NA	NA	50 U	100 U	380
Chloroethane	500 U	500 U	5 U	5 U	2 U	130 U	1 U	1 U	100 U	200 U	NA
Chloroform	500 U	500 U	0.7 J	0.7 J	1 U	130 U	1 U	1 U	6 J	100 U	100 U
Chloromethane	500 U	500 U	5 U	5 U	2 U	130 U	1 U	1 U	100 U	200 U	NA
cis-1,2-Dichloroethene	11,000	11,000	7,900	7,900 D	1,600	7,300 J	8,200 J	10,000	10,000	9,400	5,000
Ethylbenzene	500 U	500 U	0.2 J	0.2 J	1 U	130 U	1 U	1.6	50 U	100 U	100 U
Isopropylbenzene	NA	NA	NA	NA	NA	130 U	1 U	1 U	50 U	100 U	100 U
m- and p-Xylene	500 U	500 U	10 U	10 U	2 U	NA	2 U	2 U	NA	NA	200 U
Methyl acetate	NA	NA	NA	NA	NA	130 U	NA	NA	50 U	100 U	100 U
Methylene chloride	500 U	500 U	5 U	5 U	2 U	130 U	2 U	2 U	190	200 U	100 U
o-Xylene	500 U	500 U	5 U	5 U	1 U	NA	1 U	1 U	NA	NA	100 U
p-Isopropyltoluene	NA	NA	NA	NA	NA	NA	1 U	1.3	NA	NA	NA
Styrene	500 U	500 U	5 U	5 U	1 U	130 U	1 U	1.6	50 U	100 U	100 U
Tetrachloroethene	130 J	130 J	96	96	21	100 J	54 J	86	62	41 J	100 U
Toluene	500 U	500 U	2 J	2 J	0.6 J	130 U	1.5 J	4.2	50 U	100 U	100 U
trans-1,2-Dichloroethene	6,300	6,300	4,500	4,500 D	780	4,100 J	3,900 J	4,200	4,000	3,300	1,800
Trichloroethene	7,500	7,500	5,000	5,000 D	990	5,500	4,100 J	3,100	3,800	2,800	920
Vinyl chloride	1,400	1,400	1,000	1,000 D	410	760	670 J	860	1,600	1,200	1,100
Xylene, total	500 U	500 U	15 U	15 U	3 U	130 U	NA	NA	50 U	100 U	100 U
TCLP Volatile Organic Compounds (UG/L)											
No Detections	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/L)											
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	10 U	NA	NA	NA	NA	NA	NA
Naphthalene	NA	NA	NA	NA	10 U	NA	1 U	1.8	NA	NA	NA
Total Metals (UG/L)											
Aluminum	NA	NA	NA	NA	27.3 U	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	2.34 U	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	79.4	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	0.27 U	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	62,600	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	0.8 U	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	1.91 U	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	11,400	NA	NA	NA	NA	NA	631,000
Lead	NA	NA	NA	NA	1.7 U	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	13,900	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	89.5	NA	NA	NA	NA	NA	686
Nickel	NA	NA	NA	NA	10.8 U	NA	NA	NA	NA	NA	NA
Phosphorus	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW02										
Sample ID	IR89-GW02-03B	IR89-GW02-03B-04122003	IR89-GW02-03D	IR89-GW02-03D-10252003	IR89-MW02-04B	IR89-GW02-05D	IR89-GW02-06D	IR89-GW02-07A	IR89-GW02-07A2	IR89-GW02-07B	IR89-MW02-08C
Sample Date	04/12/03	04/12/03	10/25/03	10/25/03	04/21/04	12/02/05	11/20/06	01/04/07	03/14/07	06/05/07	09/28/08
Chemical Name											
Potassium	NA	NA	NA	NA	3,360	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	17,400	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	4.09 U	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	4.14 U	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	4.2 J	NA	NA	NA	NA	NA	NA
TCLP Metals (UG/L)											
Chromium, TCLP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Metals (UG/L)											
Antimony, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron, Dissolved	NA	NA	NA	NA	9,540	NA	NA	NA	NA	NA	NA
Manganese, Dissolved	NA	NA	NA	NA	90.9	NA	NA	NA	NA	NA	NA
Nickel, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wet Chemistry											
Alkalinity (mg/l)	NA	NA	NA	NA	NA	25.1	NA	NA	NA	NA	103
Ammonia (mg/l)	NA	NA	NA	NA	0.33	NA	NA	NA	NA	NA	NA
Carbon (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride (mg/l)	87	87	63	63	38	72.3	NA	NA	NA	NA	69 D
Ethane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethane (ug/l)	24	24	24	24	27	2	NA	NA	NA	NA	30
Ethene (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethene (ug/l)	120	120	100	100	58	14	NA	NA	NA	NA	93
Methane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methane (ug/l)	1,100	1,100	1,900	1,900	2,100	67 L	NA	NA	NA	NA	110 BD
Nitrate (mg/l)	NA	NA	NA	NA	0.05 U	0.05 U	NA	NA	NA	NA	0.25 U
Nitrate/Nitrite (mg/l)	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA
Nitric Acid (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite (mg/l)	NA	NA	NA	NA	0.05 U	0.05 U	NA	NA	NA	NA	0.25 U
Orthophosphate (mg/l)	NA	NA	NA	NA	0.05 U	NA	NA	NA	NA	NA	NA
Sulfate (mg/l)	150	150 J	80	80	120	74.8	NA	NA	NA	NA	26 D
Sulfide (mg/l)	1 U	1 UJ	1 U	1 U	0.46 J	1 U	NA	NA	NA	NA	0.4 J
Total Kjeldahl nitrogen (mg/l)	NA	NA	NA	NA	0.5	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC) (mg/l)	NA	NA	NA	NA	8.2	NA	NA	NA	NA	NA	18
Total organic carbon (TOC) (ug/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic nitrogen (TON) (mg/l)	NA	NA	NA	NA	0.17 J	NA	NA	NA	NA	NA	NA
Dissolved Wet Chemistry (MG/L)											
Dissolved organic carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dechlorinating Bacteria (GC/ML)											
Dehalococcoides	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW02										
Sample ID	IR89-GW02-03B	IR89-GW02-03B-04122003	IR89-GW02-03D	IR89-GW02-03D-10252003	IR89-MW02-04B	IR89-GW02-05D	IR89-GW02-06D	IR89-GW02-07A	IR89-GW02-07A2	IR89-GW02-07B	IR89-MW02-08C
Sample Date	04/12/03	04/12/03	10/25/03	10/25/03	04/21/04	12/02/05	11/20/06	01/04/07	03/14/07	06/05/07	09/28/08
Chemical Name											
Functioning Genes (GC/ML)											
VC R-Dase	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Shading indicates detections
NA - Not analyzed
B - Analyte not detected above the level reported in
D - Compound identified in an analysis at a secondary dilution factor
E - Concentration exceeds calibration range of GC/MS instrument (Organic) OR Value is estimated due to matrix interferences (Inorganic)
Exclude
J - Analyte present, value may or may not be accurate or precise
L - Analyte present, value may be biased low, actual value may be higher
R - Unreliable Result
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
UL - Analyte not detected, quantitation limit is probably higher
GC/ML - Gene copies per milliliter
MG/L - Milligrams per liter
UG/L - Micrograms per liter

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW02		IR89-MW02IW						
Sample ID	IR89-GW02-10D	IR89-GW02D-10D	IR89-GW02IW-99D-10261999	IR89-GW02IWD-99D-10261999	IR89-GW02IW-02B-04192002	IR89-GW02IW-02D-10172002	IR89-GW02IW-03B	IR89-GW02IW-03B-04122003	IR89-GW02IW-03D
Sample Date	12/13/10	12/13/10	10/26/99	10/26/99	04/19/02	10/17/02	04/12/03	04/12/03	10/25/03
Chemical Name									
Volatile Organic Compounds (UG/L)									
1,1,2,2-Tetrachloroethane	4.6	4.4	50	54	180	5 U	5 U	5 U	5 U
1,1,2-Trichloroethane	2.3	2.6	10 U	10 U	25 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane	NA	NA	10 U	10 U	25 U	5 U	5 U	5 U	5 U
1,1-Dichloroethene	NA	NA	10 U	10 U	3 J	1 J	2 J	2 J	2 J
1,2-Dichloroethane	NA	NA	10 U	10 U	25 U	5 U	5 U	5 U	5 U
1,2-Dichloroethene (total)	NA	NA	160	150	190	160	220	220	240
2-Butanone	NA	NA	10 U	12	10 U	10 U	10 U	10 U	25 U
2-Hexanone	NA	NA	10 UJ	10 UJ	10 UJ	10 U	10 U	10 U	25 U
4-Methyl-2-pentanone	NA	NA	10 U	10 U	10 UJ	10 U	10 U	10 U	25 U
Acetone	NA	NA	10 U	33 U	10 U	10 U	10 U	10 U	25 U
Benzene	NA	NA	10 U	10 U	25 U	5 U	5 U	5 U	5 U
Carbon disulfide	NA	NA	10 U	10 U	25 U	5 U	5 U	5 U	5 U
Chloroethane	NA	NA	10 U	10 U	25 U	5 U	5 U	5 U	5 U
Chloroform	NA	NA	10 U	10 U	25 U	5 U	5 U	5 U	5 U
Chloromethane	NA	NA	11	8 J	25 U	5 U	5 U	5 U	5 U
cis-1,2-Dichloroethene	92	96	NA	NA	150	130	180	180	200
Ethylbenzene	NA	NA	10 U	10 U	25 U	5 U	5 U	5 U	5 U
Isopropylbenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA
m- and p-Xylene	NA	NA	NA	NA	NA	2 U	5 U	5 U	10 U
Methyl acetate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	NA	NA	10 U	10 U	25 U	5 U	5 U	5 U	5 U
o-Xylene	NA	NA	NA	NA	NA	1 U	5 U	5 U	5 U
p-Isopropyltoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	10 U	10 U	25 U	5 U	5 U	5 U	5 U
Tetrachloroethene	0.5 UJ	0.5 UJ	10 U	10 U	25 U	5 U	5 U	5 U	5 U
Toluene	NA	NA	10 U	10 U	25 U	5 U	5 U	5 U	5 U
trans-1,2-Dichloroethene	28	30	NA	NA	38	33	44	44	48
Trichloroethene	3.7	3.2	130	120	450 E	96	120	120	170
Vinyl chloride	130	140	10 U	10 U	3	5	5	5	6
Xylene, total	NA	NA	10 U	10 U	25 U	5 U	5 U	5 U	15 U
TCLP Volatile Organic Compounds (UG/L)									
No Detections	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/L)									
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (UG/L)									
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW02		IR89-MW02IW						
Sample ID	IR89-GW02-10D	IR89-GW02D-10D	IR89-GW02IW-99D-10261999	IR89-GW02IWD-99D-10261999	IR89-GW02IW-02B-04192002	IR89-GW02IW-02D-10172002	IR89-GW02IW-03B	IR89-GW02IW-03B-04122003	IR89-GW02IW-03D
Sample Date	12/13/10	12/13/10	10/26/99	10/26/99	04/19/02	10/17/02	04/12/03	04/12/03	10/25/03
Chemical Name									
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA
TCLP Metals (UG/L)									
Chromium, TCLP	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Metals (UG/L)									
Antimony, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wet Chemistry									
Alkalinity (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ammonia (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride (mg/l)	NA	NA	NA	NA	10	10 J	10	10	10
Ethane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethane (ug/l)	NA	NA	NA	NA	10 U	10 U	10 U	10 U	10 U
Ethene (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethene (ug/l)	NA	NA	NA	NA	10 U	10 U	10 U	10 U	10 U
Methane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methane (ug/l)	NA	NA	NA	NA	14	13	19	19	16
Nitrate (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite (mg/l)	NA	NA	NA	NA	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Nitric Acid (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Orthophosphate (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate (mg/l)	NA	NA	NA	NA	18 J	13	13	13 J	16
Sulfide (mg/l)	NA	NA	NA	NA	NA	1 U	2	2 J	1 U
Total Kjeldahl nitrogen (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC) (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC) (ug/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic nitrogen (TON) (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Wet Chemistry (MG/L)									
Dissolved organic carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dechlorinating Bacteria (GC/ML)									
Dehalococcoides	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW02		IR89-MW02IW						
Sample ID	IR89-GW02-10D	IR89-GW02D-10D	IR89-GW02IW-99D-10261999	IR89-GW02IWD-99D-10261999	IR89-GW02IW-02B-04192002	IR89-GW02IW-02D-10172002	IR89-GW02IW-03B	IR89-GW02IW-03B-04122003	IR89-GW02IW-03D
Sample Date	12/13/10	12/13/10	10/26/99	10/26/99	04/19/02	10/17/02	04/12/03	04/12/03	10/25/03
Chemical Name									
Functioning Genes (GC/ML)									
VC R-Dase	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Shading indicates detections
NA - Not analyzed
B - Analyte not detected above the level reported in
D - Compound identified in an analysis at a secondary dilution factor
E - Concentration exceeds calibration range of GC/MS instrument (Organic) OR Value is estimated due to matrix interferences (Inorganic)
Exclude
J - Analyte present, value may or may not be accurate or precise
L - Analyte present, value may be biased low, actual value may be higher
R - Unreliable Result
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
UL - Analyte not detected, quantitation limit is probably higher
GC/ML - Gene copies per milliliter
MG/L - Milligrams per liter
UG/L - Micrograms per liter

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW02IW							IR89-MW03	
Sample ID	IR89-GW02IW-03D-10252003	IR89-MW02IW-04B	IR89-MW02IWD-04B	IR89-GW02IW-05D	IR89-MW02IW-08C	IR89-GW02IW-10D	IR89-GW02IW-11D	IR89-GW03-99B-04221999	IR89-GW03-99D-10271999
Sample Date	10/25/03	04/21/04	04/21/04	12/02/05	09/27/08	12/13/10	12/06/11	04/22/99	10/27/99
Chemical Name									
Volatile Organic Compounds (UG/L)									
1,1,2,2-Tetrachloroethane	5 UJ	1 U	0.2 J	8.4 U	0.5 UJ	0.5 U	1 U	44	15
1,1,2-Trichloroethane	5 U	1 U	1 U	8.4 U	0.5 U	0.5 U	1 U	2 J	10 U
1,1-Dichloroethane	5 U	1 U	1 U	8.4 U	0.5 U	NA	NA	5 U	10 U
1,1-Dichloroethene	2 J	1	2	8.4 UJ	2.3 J	NA	NA	5 U	10 U
1,2-Dichloroethane	5 U	1 U	1 U	8.4 U	NA	NA	NA	5 U	10 U
1,2-Dichloroethene (total)	240 D	300	280	NA	NA	NA	NA	NA	51
2-Butanone	25 U	10 R	10 R	84 U	2.5 U	NA	NA	10 U	10 U
2-Hexanone	25 U	5 U	5 U	84 U	NA	NA	NA	10 U	10 U
4-Methyl-2-pentanone	25 UJ	5 U	5 U	84 U	NA	NA	NA	10 U	10 U
Acetone	25 U	10 R	10 R	84 U	2.5 U	NA	NA	10 U	6 J
Benzene	5 U	1 U	1 U	8.4 U	0.13 J	NA	NA	NA	10 U
Carbon disulfide	5 U	1 U	1 U	8.4 U	0.5 U	NA	NA	5 U	10 U
Chloroethane	5 U	2 U	2 U	8.4 U	NA	NA	NA	5 U	10 U
Chloroform	5 U	1 U	1 U	8.4 U	0.5 U	NA	NA	5 U	10 U
Chloromethane	5 U	2 U	2 U	8.4 U	NA	NA	NA	5 U	10 U
cis-1,2-Dichloroethene	200 D	230	170	200 J	53	87	140	66	NA
Ethylbenzene	5 U	1 U	1 U	8.4 U	0.5 U	NA	NA	5 U	10 U
Isopropylbenzene	NA	NA	NA	8.4 U	0.5 U	NA	NA	NA	NA
m- and p-Xylene	10 U	2 U	2 U	NA	1 U	NA	NA	NA	NA
Methyl acetate	NA	NA	NA	8.4 U	0.5 U	NA	NA	NA	NA
Methylene chloride	5 U	2 U	2 U	8.4 U	0.5 U	NA	NA	5 U	10 U
o-Xylene	5 U	1 U	1 U	NA	0.18 J	NA	NA	NA	NA
p-Isopropyltoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	5 U	1 U	1 U	8.4 U	0.5 U	NA	NA	5 U	10 U
Tetrachloroethene	5 U	1 U	1 U	8.4 U	0.5 U	0.5 UJ	1 U	6	10 U
Toluene	5 U	1 U	1 U	8.4 U	0.5 U	NA	NA	5 U	10 U
trans-1,2-Dichloroethene	48	47	44	37 J	5 J	0.37 J	12	33	NA
Trichloroethene	170 D	190	140	190	14 J	2.4	90	66	31
Vinyl chloride	6	8	7	4.6 J	34	67	50	5	10 U
Xylene, total	15 U	3 U	3 U	8.4 U	0.18 J	NA	NA	15 U	10 U
TCLP Volatile Organic Compounds (UG/L)									
No Detections	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/L)									
bis(2-Ethylhexyl)phthalate	NA	10 U	10 U	NA	NA	NA	NA	NA	NA
Naphthalene	NA	10 U	10 U	NA	NA	NA	NA	NA	NA
Total Metals (UG/L)									
Aluminum	NA	17.9 U	17.9 U	NA	NA	NA	NA	NA	NA
Antimony	NA	2.34 U	2.34 U	NA	NA	NA	NA	NA	NA
Barium	NA	14.8	13	NA	NA	NA	NA	NA	NA
Beryllium	NA	0.27 U	0.27 U	NA	NA	NA	NA	NA	NA
Calcium	NA	84,000	80,500	NA	NA	NA	NA	NA	NA
Chromium	NA	0.8 U	0.8 U	NA	NA	NA	NA	NA	NA
Copper	NA	1.91 U	1.91 U	NA	NA	NA	NA	NA	NA
Iron	NA	412	385	NA	66.4 B	NA	1,320 D	NA	NA
Lead	NA	1.7 U	1.7 U	NA	NA	NA	NA	NA	NA
Magnesium	NA	2,110	2,030	NA	NA	NA	NA	NA	NA
Manganese	NA	28.5	25.2	NA	12.6	NA	69.1	NA	NA
Nickel	NA	10.8 U	10.8 U	NA	NA	NA	NA	NA	NA
Phosphorus	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW02IW							IR89-MW03	
Sample ID	IR89-GW02IW-03D-10252003	IR89-MW02IW-04B	IR89-MW02IWD-04B	IR89-GW02IW-05D	IR89-MW02IW-08C	IR89-GW02IW-10D	IR89-GW02IW-11D	IR89-GW03-99B-04221999	IR89-GW03-99D-10271999
Sample Date	10/25/03	04/21/04	04/21/04	12/02/05	09/27/08	12/13/10	12/06/11	04/22/99	10/27/99
Chemical Name									
Potassium	NA	896 J	1,060	NA	NA	NA	NA	NA	NA
Sodium	NA	8,600	8,180	NA	NA	NA	NA	NA	NA
Thallium	NA	4.09 U	4.09 U	NA	NA	NA	NA	NA	NA
Vanadium	NA	4.14 U	4.14 U	NA	NA	NA	NA	NA	NA
Zinc	NA	4.3 J	7.1 J	NA	NA	NA	NA	NA	NA
TCLP Metals (UG/L)									
Chromium, TCLP	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Metals (UG/L)									
Antimony, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron, Dissolved	NA	340	360	NA	NA	NA	NA	NA	NA
Manganese, Dissolved	NA	25	24.3	NA	NA	NA	NA	NA	NA
Nickel, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wet Chemistry									
Alkalinity (mg/l)	NA	NA	NA	229	197	NA	240	NA	NA
Ammonia (mg/l)	NA	0.1 U	0.1 U	NA	NA	NA	NA	NA	NA
Carbon (mg/l)	NA	NA	NA	NA	NA	NA	NA	4.7	NA
Chloride (mg/l)	10	9.8	9.9	7.47	10 U	NA	11	NA	NA
Ethane (mg/l)	NA	NA	NA	NA	NA	NA	0.00135 J	NA	NA
Ethane (ug/l)	10 U	10 U	10 U	2 U	0.1 J	NA	NA	1 U	NA
Ethene (mg/l)	NA	NA	NA	NA	NA	NA	0.00829	NA	NA
Ethene (ug/l)	10 U	10 U	10 U	2 U	0.9 J	NA	NA	2 U	NA
Methane (mg/l)	NA	NA	NA	NA	NA	NA	0.0926	NA	NA
Methane (ug/l)	16	19	18	4 L	10 B	NA	NA	210	NA
Nitrate (mg/l)	NA	0.05 U	0.05 U	0.05 U	1.1 D	NA	NA	NA	NA
Nitrate/Nitrite (mg/l)	0.05 U	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA
Nitric Acid (mg/l)	NA	NA	NA	NA	NA	NA	NA	0.05 U	NA
Nitrite (mg/l)	NA	0.05 U	0.05 U	0.05 U	0.25 U	NA	NA	NA	NA
Orthophosphate (mg/l)	NA	0.21	0.21	NA	NA	NA	NA	NA	NA
Sulfate (mg/l)	16	17	18	16.7	24 JD	NA	350 D	61.7	NA
Sulfide (mg/l)	1 U	0.31 J	0.61 J	1 U	1 U	NA	1 U	NA	NA
Total Kjeldahl nitrogen (mg/l)	NA	0.15 J	0.25 U	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC) (mg/l)	NA	1	1	NA	1.48 J	NA	2.7	NA	NA
Total organic carbon (TOC) (ug/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic nitrogen (TON) (mg/l)	NA	0.13 J	0.25 U	NA	NA	NA	NA	NA	NA
Dissolved Wet Chemistry (MG/L)									
Dissolved organic carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dechlorinating Bacteria (GC/ML)									
Dehalococcoides	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW02IW							IR89-MW03	
Sample ID	IR89-GW02IW-03D-10252003	IR89-MW02IW-04B	IR89-MW02IWD-04B	IR89-GW02IW-05D	IR89-MW02IW-08C	IR89-GW02IW-10D	IR89-GW02IW-11D	IR89-GW03-99B-04221999	IR89-GW03-99D-10271999
Sample Date	10/25/03	04/21/04	04/21/04	12/02/05	09/27/08	12/13/10	12/06/11	04/22/99	10/27/99
Chemical Name									
Functioning Genes (GC/ML)									
VC R-Dase	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Shading indicates detections
NA - Not analyzed
B - Analyte not detected above the level reported in
D - Compound identified in an analysis at a secondary dilution factor
E - Concentration exceeds calibration range of GC/MS instrument (Organic) OR Value is estimated due to matrix interferences (Inorganic)
Exclude
J - Analyte present, value may or may not be accurate or precise
L - Analyte present, value may be biased low, actual value may be higher
R - Unreliable Result
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
UL - Analyte not detected, quantitation limit is probably higher
GC/ML - Gene copies per milliliter
MG/L - Milligrams per liter
UG/L - Micrograms per liter

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW03						IR89-MW03DW		
Sample ID	IR89-GW03-00B-04192000	IR89-GW03-02B-10172002	IR89-MW03-04B	IR89-GW03-05D	IR89-MW03-08C	IR89-GW03-10D	IR89-MW03DW-05281997	IR89-MW03DW-97B-05281997	IR89-GW03DW-02D-10182002
Sample Date	04/19/00	10/17/02	04/16/04	12/02/05	09/25/08	12/14/10	05/28/97	05/28/97	10/18/02
Chemical Name									
Volatile Organic Compounds (UG/L)									
1,1,2,2-Tetrachloroethane	10	9	4	0.59	2.3	0.5 U	10 U	10 U	5 U
1,1,2-Trichloroethane	5 U	5 U	0.4 J	0.31 J	1.6	0.5 U	10 U	10 U	5 U
1,1-Dichloroethane	5 U	5 U	1 U	0.5 U	0.5 U	NA	10 U	10 U	5 U
1,1-Dichloroethene	5 U	5 U	0.4 J	0.24 J	1.5	NA	10 U	10 U	5 U
1,2-Dichloroethane	5 U	5 U	1 U	0.5 U	NA	NA	10 U	10 U	5 U
1,2-Dichloroethene (total)	25	20	30	NA	NA	NA	10 U	10 U	5 U
2-Butanone	10 U	10 U	5 U	5 U	2.5 U	NA	10 U	10 U	10 U
2-Hexanone	10 U	10 U	5 U	5 U	NA	NA	10 U	10 U	10 U
4-Methyl-2-pentanone	10 U	10 U	5 U	5 U	NA	NA	10 U	10 U	10 U
Acetone	10 U	10 U	5 R	5 U	2.5 UJ	NA	10 U	10 U	10 U
Benzene	5 U	5 U	1 U	0.5 U	0.5 U	NA	10 U	NA	5 U
Carbon disulfide	5 U	5 U	1 U	0.5 U	0.19 J	NA	10 U	10 U	5 U
Chloroethane	5 U	5 U	2 U	0.5 U	NA	NA	10 U	10 U	5 U
Chloroform	5 U	5 U	1 U	0.5 U	0.5 U	NA	10 U	10 U	5 U
Chloromethane	5 U	5 U	2 U	0.5 U	NA	NA	10 U	10 U	5 U
cis-1,2-Dichloroethene	18	14	22	12 J	40	0.92 J	NA	NA	5 U
Ethylbenzene	5 U	5 U	1 U	0.5 U	0.5 U	NA	10 U	10 U	5 U
Isopropylbenzene	NA	NA	NA	0.5 U	0.5 U	NA	NA	NA	NA
m- and p-Xylene	NA	2 U	2 U	NA	1 U	NA	NA	NA	2 U
Methyl acetate	NA	NA	NA	0.5 U	0.5 UJ	NA	NA	NA	NA
Methylene chloride	5 U	5 U	2 U	0.5 U	0.5 U	NA	10 U	10 U	5 U
o-Xylene	NA	1 U	1 U	NA	0.5 U	NA	NA	NA	1 U
p-Isopropyltoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	5 U	5 U	1 U	0.5 U	0.5 U	NA	10 U	10 U	5 U
Tetrachloroethene	5 U	4 J	2	1.5 J	4.2	0.5 U	10 U	10 U	5 U
Toluene	5 U	5 U	1 U	0.5 U	0.5 U	NA	10 U	10 U	5 U
trans-1,2-Dichloroethene	7	6	9	2.6 J	7.5	0.5 U	NA	NA	5 U
Trichloroethene	20	25	18	13	29	1.8	10 U	10 U	0.5 J
Vinyl chloride	2 U	2 U	1 J	0.87	5.8	1 U	10 U	10 U	2 U
Xylene, total	5 U	5 U	3 U	0.5 U	0.5 U	NA	10 U	10 U	5 U
TCLP Volatile Organic Compounds (UG/L)									
No Detections	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/L)									
bis(2-Ethylhexyl)phthalate	NA	NA	10 U	NA	NA	NA	80	80	NA
Naphthalene	NA	NA	10 U	NA	NA	NA	10 U	10 U	NA
Total Metals (UG/L)									
Aluminum	NA	NA	143 J	NA	NA	NA	33.5 U	33.5 U	NA
Antimony	NA	NA	2.34 U	NA	NA	NA	2.2	NA	NA
Barium	NA	NA	23.9	NA	NA	NA	4.8	NA	NA
Beryllium	NA	NA	0.27 U	NA	NA	NA	0.3 U	NA	NA
Calcium	NA	NA	54,200	NA	NA	NA	33,200	33,200	NA
Chromium	NA	NA	0.8 U	NA	NA	NA	0.5 U	NA	NA
Copper	NA	NA	2.4 J	NA	NA	NA	0.8 U	NA	NA
Iron	NA	NA	80.9 J	NA	1,230	NA	477 J	477 J	NA
Lead	NA	NA	1.7 U	NA	NA	NA	1.4 U	NA	NA
Magnesium	NA	NA	2,630	NA	NA	NA	4,390	4,390	NA
Manganese	NA	NA	3.5 J	NA	5.7 B	NA	34.9	34.9	NA
Nickel	NA	NA	10.8 U	NA	NA	NA	0.83	NA	NA
Phosphorus	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW03						IR89-MW03DW		
Sample ID	IR89-GW03-00B-04192000	IR89-GW03-02B-10172002	IR89-MW03-04B	IR89-GW03-05D	IR89-MW03-08C	IR89-GW03-10D	IR89-MW03DW-05281997	IR89-MW03DW-97B-05281997	IR89-GW03DW-02D-10182002
Sample Date	04/19/00	10/17/02	04/16/04	12/02/05	09/25/08	12/14/10	05/28/97	05/28/97	10/18/02
Chemical Name									
Potassium	NA	NA	2,380	NA	NA	NA	9,810 J	9,810 J	NA
Sodium	NA	NA	4,080	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	4.09 U	NA	NA	NA	3 U	NA	NA
Vanadium	NA	NA	4.14 U	NA	NA	NA	1.1	NA	NA
Zinc	NA	NA	4.6 U	NA	NA	NA	0.4 UJ	0.4 UJ	NA
TCLP Metals (UG/L)									
Chromium, TCLP	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA
Dissolved Metals (UG/L)									
Antimony, Dissolved	NA	NA	NA	NA	NA	NA	NA	2.2	NA
Barium, Dissolved	NA	NA	NA	NA	NA	NA	NA	4.8	NA
Iron, Dissolved	NA	NA	5.05 U	NA	NA	NA	NA	NA	NA
Manganese, Dissolved	NA	NA	1.6 J	NA	NA	NA	NA	NA	NA
Nickel, Dissolved	NA	NA	NA	NA	NA	NA	NA	0.83	NA
Vanadium, Dissolved	NA	NA	NA	NA	NA	NA	NA	1.1	NA
Wet Chemistry									
Alkalinity (mg/l)	NA	NA	NA	202	163	NA	NA	NA	NA
Ammonia (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride (mg/l)	NA	NA	3.4	1.24	7.5 JD	NA	NA	NA	NA
Ethane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethane (ug/l)	9.6 U	NA	10 U	2 U	2 U	NA	NA	NA	NA
Ethene (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethene (ug/l)	9 U	NA	10 U	2 U	2 U	NA	NA	NA	NA
Methane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methane (ug/l)	20	NA	82	1 UL	13 B	NA	NA	NA	NA
Nitrate (mg/l)	0.05	NA	0.05 U	0.05 U	0.25 U	NA	NA	NA	NA
Nitrate/Nitrite (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitric Acid (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite (mg/l)	0.05 U	NA	0.05 U	0.05 U	0.25 U	NA	NA	NA	NA
Orthophosphate (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate (mg/l)	61	NA	23	22.9	32 D	NA	NA	NA	NA
Sulfide (mg/l)	NA	NA	1.6	1 U	1 U	NA	NA	NA	NA
Total Kjeldahl nitrogen (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC) (mg/l)	8	NA	3.6	NA	3.64 J	NA	NA	NA	NA
Total organic carbon (TOC) (ug/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic nitrogen (TON) (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Wet Chemistry (MG/L)									
Dissolved organic carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dechlorinating Bacteria (GC/ML)									
Dehalococcoides	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW03						IR89-MW03DW		
Sample ID	IR89-GW03-00B-04192000	IR89-GW03-02B-10172002	IR89-MW03-04B	IR89-GW03-05D	IR89-MW03-08C	IR89-GW03-10D	IR89-MW03DW-05281997	IR89-MW03DW-97B-05281997	IR89-GW03DW-02D-10182002
Sample Date	04/19/00	10/17/02	04/16/04	12/02/05	09/25/08	12/14/10	05/28/97	05/28/97	10/18/02
Chemical Name									
Functioning Genes (GC/ML)									
VC R-Dase	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Shading indicates detections
NA - Not analyzed
B - Analyte not detected above the level reported in
D - Compound identified in an analysis at a secondary dilution factor
E - Concentration exceeds calibration range of GC/MS instrument (Organic) OR Value is estimated due to matrix interferences (Inorganic)
Exclude
J - Analyte present, value may or may not be accurate or precise
L - Analyte present, value may be biased low, actual value may be higher
R - Unreliable Result
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
UL - Analyte not detected, quantitation limit is probably higher
GC/ML - Gene copies per milliliter
MG/L - Milligrams per liter
UG/L - Micrograms per liter

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW03DW					IR89-MW03IW			
Sample ID	IR89-MW03DW-04B	IR89-GW03DW-05D	IR89-MW03DW-08C	IR89-GW03DW-10D	IR89-GW03DW-11D	IR89-MW03IW-05281997	IR89-MW03IW-97B-05281997	IR89-GW03IW-99B-04221999	IR89-GW03IW-99D-10271999
Sample Date	04/16/04	12/02/05	09/25/08	12/14/10	12/06/11	05/28/97	05/28/97	04/22/99	10/27/99
Chemical Name									
Volatile Organic Compounds (UG/L)									
1,1,2,2-Tetrachloroethane	1 U	0.5 U	0.5 U	0.5 U	1 U	10 U	10 U	25 U	20 U
1,1,2-Trichloroethane	1 U	0.5 U	0.5 U	0.5 U	1 U	10 U	10 U	25 U	20 U
1,1-Dichloroethane	1 U	0.5 U	0.5 U	NA	NA	10 U	10 U	25 U	20 U
1,1-Dichloroethene	1 U	0.5 UJ	0.5 U	NA	NA	10 U	10 U	25 U	20 U
1,2-Dichloroethane	1 U	0.5 U	NA	NA	NA	10 U	10 U	25 U	20 U
1,2-Dichloroethene (total)	2 U	NA	NA	NA	NA	300	300	NA	330
2-Butanone	5 U	5 U	2.5 U	NA	NA	10 U	10 U	50 U	20 U
2-Hexanone	5 U	5 U	NA	NA	NA	10 U	10 U	50 U	20 U
4-Methyl-2-pentanone	5 U	5 U	NA	NA	NA	10 U	10 U	50 U	20 U
Acetone	5 R	5 U	2.5 UJ	NA	NA	10 U	10 U	45 J	25
Benzene	1 U	0.5 U	0.5 U	NA	NA	10 U	NA	NA	20 U
Carbon disulfide	1 U	0.5 U	0.5 U	NA	NA	10 U	10 U	25 U	20 U
Chloroethane	2 U	0.5 U	NA	NA	NA	10 U	10 U	25 U	20 U
Chloroform	1 U	0.5 U	0.5 U	NA	NA	10 U	10 U	25 U	20 U
Chloromethane	2 U	0.5 U	NA	NA	NA	10 U	10 U	25 U	20 U
cis-1,2-Dichloroethene	0.2 J	0.5 UJ	0.5 U	0.79 J	1 U	NA	NA	220	NA
Ethylbenzene	1 U	0.5 U	0.5 U	NA	NA	10 U	10 U	25 U	20 U
Isopropylbenzene	NA	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA
m- and p-Xylene	2 U	NA	1 U	NA	NA	NA	NA	NA	NA
Methyl acetate	NA	0.5 U	0.5 UJ	NA	NA	NA	NA	NA	NA
Methylene chloride	2 U	0.5 U	0.5 U	NA	NA	10 U	10 U	11 J	20 U
o-Xylene	1 U	NA	0.5 U	NA	NA	NA	NA	NA	NA
p-Isopropyltoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	1 U	0.5 U	0.5 U	NA	NA	10 U	10 U	25 U	20 U
Tetrachloroethene	1 U	0.5 U	0.5 U	0.5 UJ	1 U	10 U	10 U	25 U	20 U
Toluene	1 U	0.5 U	0.5 U	NA	NA	10 U	10 U	25 U	20 U
trans-1,2-Dichloroethene	1 U	0.5 UJ	0.5 U	0.41 J	1 U	NA	NA	51	NA
Trichloroethene	1 U	0.5 U	0.5 U	0.66 J	1 U	400	400	310	340
Vinyl chloride	2 U	0.5 U	0.5 U	1 U	1 U	10 U	10 U	25 U	20 U
Xylene, total	3 U	0.5 U	0.5 U	NA	NA	10 U	10 U	75 U	20 U
TCLP Volatile Organic Compounds (UG/L)									
No Detections	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/L)									
bis(2-Ethylhexyl)phthalate	10 U	NA	NA	NA	NA	64	64	NA	NA
Naphthalene	10 U	NA	NA	NA	NA	10 U	10 U	NA	NA
Total Metals (UG/L)									
Aluminum	19.1 J	NA	NA	NA	NA	36.4 U	36.4 U	NA	NA
Antimony	2.34 U	NA	NA	NA	NA	1.9 U	NA	NA	NA
Barium	2.1 J	NA	NA	NA	NA	22.1	NA	NA	NA
Beryllium	0.27 U	NA	NA	NA	NA	0.3 U	NA	NA	NA
Calcium	30,400	NA	NA	NA	NA	92,800	92,800	NA	NA
Chromium	0.8 U	NA	NA	NA	NA	0.5	NA	NA	NA
Copper	1.91 U	NA	NA	NA	NA	0.8 U	NA	NA	NA
Iron	676	NA	653	NA	534	394 J	394 J	NA	NA
Lead	1.7 U	NA	NA	NA	NA	1.4 U	NA	NA	NA
Magnesium	4,650	NA	NA	NA	NA	2,210	2,210	NA	NA
Manganese	39.2	NA	37.3	NA	37.2	20.8	20.8	NA	NA
Nickel	10.8 U	NA	NA	NA	NA	0.7 U	NA	NA	NA
Phosphorus	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW03DW					IR89-MW03IW			
Sample ID	IR89-MW03DW-04B	IR89-GW03DW-05D	IR89-MW03DW-08C	IR89-GW03DW-10D	IR89-GW03DW-11D	IR89-MW03IW-05281997	IR89-MW03IW-97B-05281997	IR89-GW03IW-99B-04221999	IR89-GW03IW-99D-10271999
Sample Date	04/16/04	12/02/05	09/25/08	12/14/10	12/06/11	05/28/97	05/28/97	04/22/99	10/27/99
Chemical Name									
Potassium	7,790	NA	NA	NA	NA	1,170 J	1,170 J	NA	NA
Sodium	130,000	NA	NA	NA	NA	8,160	8,160	NA	NA
Thallium	5.6 U	NA	NA	NA	NA	3 U	NA	NA	NA
Vanadium	4.14 U	NA	NA	NA	NA	1.1	NA	NA	NA
Zinc	12.6 U	NA	NA	NA	NA	0.4 UJ	0.4 UJ	NA	NA
TCLP Metals (UG/L)									
Chromium, TCLP	NA	NA	NA	NA	NA	NA	0.5	NA	NA
Dissolved Metals (UG/L)									
Antimony, Dissolved	NA	NA	NA	NA	NA	NA	1.9 U	NA	NA
Barium, Dissolved	NA	NA	NA	NA	NA	NA	22.1	NA	NA
Iron, Dissolved	611	NA	NA	NA	NA	NA	NA	NA	NA
Manganese, Dissolved	37.9	NA	NA	NA	NA	NA	NA	NA	NA
Nickel, Dissolved	NA	NA	NA	NA	NA	NA	0.7 U	NA	NA
Vanadium, Dissolved	NA	NA	NA	NA	NA	NA	1.1	NA	NA
Wet Chemistry									
Alkalinity (mg/l)	NA	264	278	NA	290	NA	NA	NA	NA
Ammonia (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon (mg/l)	NA	NA	NA	NA	NA	NA	NA	3.2	NA
Chloride (mg/l)	74	88.9	82 D	NA	82	NA	NA	NA	NA
Ethane (mg/l)	NA	NA	NA	NA	0.00196 U	NA	NA	NA	NA
Ethane (ug/l)	10 U	2 U	2 U	NA	NA	NA	NA	1 U	NA
Ethene (mg/l)	NA	NA	NA	NA	0.00271 U	NA	NA	NA	NA
Ethene (ug/l)	10 U	2 U	2 U	NA	NA	NA	NA	2 U	NA
Methane (mg/l)	NA	NA	NA	NA	0.0256	NA	NA	NA	NA
Methane (ug/l)	26	3 L	5 B	NA	NA	NA	NA	2 U	NA
Nitrate (mg/l)	0.05 U	0.05 U	0.25 U	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitric Acid (mg/l)	NA	NA	NA	NA	NA	NA	NA	0.13	NA
Nitrite (mg/l)	0.05 U	0.05 U	0.25 U	NA	NA	NA	NA	NA	NA
Orthophosphate (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate (mg/l)	7.4	6.74	8.7 JD	NA	9.1	NA	NA	19.7	NA
Sulfide (mg/l)	1 U	1 U	1 U	NA	1 U	NA	NA	NA	NA
Total Kjeldahl nitrogen (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC) (mg/l)	1.5	NA	1.47 J	NA	1.9	NA	NA	NA	NA
Total organic carbon (TOC) (ug/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic nitrogen (TON) (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Wet Chemistry (MG/L)									
Dissolved organic carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dechlorinating Bacteria (GC/ML)									
Dehalococcoides	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW03DW					IR89-MW03IW			
Sample ID	IR89-MW03DW-04B	IR89-GW03DW-05D	IR89-MW03DW-08C	IR89-GW03DW-10D	IR89-GW03DW-11D	IR89-MW03IW-05281997	IR89-MW03IW-97B-05281997	IR89-GW03IW-99B-04221999	IR89-GW03IW-99D-10271999
Sample Date	04/16/04	12/02/05	09/25/08	12/14/10	12/06/11	05/28/97	05/28/97	04/22/99	10/27/99
Chemical Name									
Functioning Genes (GC/ML)									
VC R-Dase	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Shading indicates detections
NA - Not analyzed
B - Analyte not detected above the level reported in
D - Compound identified in an analysis at a secondary dilution factor
E - Concentration exceeds calibration range of GC/MS instrument (Organic) OR Value is estimated due to matrix interferences (Inorganic)
Exclude
J - Analyte present, value may or may not be accurate or precise
L - Analyte present, value may be biased low, actual value may be higher
R - Unreliable Result
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
UL - Analyte not detected, quantitation limit is probably higher
GC/ML - Gene copies per milliliter
MG/L - Milligrams per liter
UG/L - Micrograms per liter

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW03IW							IR89-MW10	
Sample ID	IR89-GW03IW-00B-04192000	IR89-GW03IW-02D-10172002	IR89-MW03IW-04B	IR89-GW03IW-05D	IR89-MW03IW-08C	IR89-GW03IW-10D	IR89-GW03IW-11D	IR89-GW10-99D-10241999	IR89-GW10-01C-07012001
Sample Date	04/19/00	10/17/02	04/16/04	12/02/05	09/25/08	12/14/10	12/06/11	10/24/99	07/01/01
Chemical Name									
Volatile Organic Compounds (UG/L)									
1,1,2,2-Tetrachloroethane	5 U	2 J	1 U	13 U	13 U	0.5 U	5 Exclude	20 U	10 J
1,1,2-Trichloroethane	5 U	25 U	1 U	13 U	13 U	0.5 U	5 Exclude	20 U	10 U
1,1-Dichloroethane	5 U	25 U	1 U	13 U	13 U	NA	NA	20 U	10 U
1,1-Dichloroethene	5 U	25 U	2	13 U	20	NA	NA	20 U	10 U
1,2-Dichloroethane	5 U	25 U	1 U	13 U	NA	NA	NA	20 U	10 U
1,2-Dichloroethene (total)	310	540	280	NA	NA	NA	NA	220	NA
2-Butanone	10 U	10 U	5 U	130 U	63 U	NA	NA	20 U	10 U
2-Hexanone	10 U	10 U	5 U	130 U	NA	NA	NA	20 UJ	10 U
4-Methyl-2-pentanone	10 U	10 U	5 U	130 U	NA	NA	NA	20 U	10 U
Acetone	10 U	10 U	25 R	130 U	63 U	NA	NA	20 U	10 U
Benzene	5 U	25 U	0.1 J	13 U	13 U	NA	NA	20 U	10 U
Carbon disulfide	5 U	25 U	1 U	13 U	13 U	NA	NA	20 U	10 U
Chloroethane	5 U	25 U	2 U	13 U	NA	NA	NA	20 U	10 U
Chloroform	5 U	25 U	1 U	13 U	13 U	NA	NA	20 U	10 U
Chloromethane	5 U	25 U	2 U	13 U	NA	NA	NA	20 U	10 U
cis-1,2-Dichloroethene	240 D	430 D	240	280	320	140	240	NA	61
Ethylbenzene	5 U	25 U	1 U	13 U	13 U	NA	NA	20 U	10 U
Isopropylbenzene	NA	NA	NA	13 U	13 U	NA	NA	NA	10 U
m- and p-Xylene	NA	10 U	2 U	NA	25 U	NA	NA	NA	NA
Methyl acetate	NA	NA	NA	13 U	13 U	NA	NA	NA	10 U
Methylene chloride	5 U	4 J	2 U	13 U	19 U	NA	NA	20 U	10 U
o-Xylene	NA	1 U	1 U	NA	13 U	NA	NA	NA	NA
p-Isopropyltoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	5 U	25 U	1 U	13 U	13 U	NA	NA	20 U	10 U
Tetrachloroethene	5 U	25 U	1 U	13 U	13 U	0.5 UJ	5 Exclude	20 U	3 J
Toluene	5 U	25 U	1 U	13 U	13 U	NA	NA	20 U	10 U
trans-1,2-Dichloroethene	56	130	76	64	54	26	44	NA	5 J
Trichloroethene	34 D	330	240	260	29	2.8	5 Exclude	270	88
Vinyl chloride	4	8 J	8	4.5 J	53	35	120	20 U	10 U
Xylene, total	5 U	25 U	3 U	13 U	13 U	NA	NA	20 U	10 U
TCLP Volatile Organic Compounds (UG/L)									
No Detections	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/L)									
bis(2-Ethylhexyl)phthalate	NA	NA	10 U	NA	NA	NA	NA	NA	NA
Naphthalene	NA	NA	10 U	NA	NA	NA	NA	NA	NA
Total Metals (UG/L)									
Aluminum	NA	NA	17.9 U	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	2.34 U	NA	NA	NA	NA	NA	NA
Barium	NA	NA	29.8	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	0.27 U	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	87,000	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	0.8 U	NA	NA	NA	NA	NA	NA
Copper	NA	NA	1.91 U	NA	NA	NA	NA	NA	NA
Iron	NA	NA	376	NA	528	NA	1,430 D	NA	NA
Lead	NA	NA	1.7 U	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	2,410	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	27.7	NA	50.5	NA	92.2	NA	NA
Nickel	NA	NA	10.8 U	NA	NA	NA	NA	NA	NA
Phosphorus	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW03IW							IR89-MW10	
Sample ID	IR89-GW03IW-00B-04192000	IR89-GW03IW-02D-10172002	IR89-MW03IW-04B	IR89-GW03IW-05D	IR89-MW03IW-08C	IR89-GW03IW-10D	IR89-GW03IW-11D	IR89-GW10-99D-10241999	IR89-GW10-01C-07012001
Sample Date	04/19/00	10/17/02	04/16/04	12/02/05	09/25/08	12/14/10	12/06/11	10/24/99	07/01/01
Chemical Name									
Potassium	NA	NA	1,100	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	10,400	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	5.1 J	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	4.14 U	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	13.3 U	NA	NA	NA	NA	NA	NA
TCLP Metals (UG/L)									
Chromium, TCLP	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Metals (UG/L)									
Antimony, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron, Dissolved	NA	NA	271	NA	NA	NA	NA	NA	NA
Manganese, Dissolved	NA	NA	24.5	NA	NA	NA	NA	NA	NA
Nickel, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wet Chemistry									
Alkalinity (mg/l)	NA	NA	NA	243	238	NA	270	NA	NA
Ammonia (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride (mg/l)	NA	NA	10	7.75	15 D	NA	11	NA	NA
Ethane (mg/l)	NA	NA	NA	NA	NA	NA	0.00196 U	NA	NA
Ethane (ug/l)	9.6 U	NA	10 U	2 U	0.2 J	NA	NA	NA	NA
Ethene (mg/l)	NA	NA	NA	NA	NA	NA	0.00271 U	NA	NA
Ethene (ug/l)	9 U	NA	10 U	2 U	0.4 J	NA	NA	NA	NA
Methane (mg/l)	NA	NA	NA	NA	NA	NA	0.0457	NA	NA
Methane (ug/l)	20	NA	20	3 L	4 B	NA	NA	NA	NA
Nitrate (mg/l)	0.05 U	NA	0.05 U	0.05 U	0.25 U	NA	NA	NA	NA
Nitrate/Nitrite (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitric Acid (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite (mg/l)	NA	NA	0.05 U	0.05 U	0.25 U	NA	NA	NA	NA
Orthophosphate (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate (mg/l)	20	NA	16	19.6	190 D	NA	310 D	NA	NA
Sulfide (mg/l)	NA	NA	1 U	1 U	1 U	NA	1 U	NA	NA
Total Kjeldahl nitrogen (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC) (mg/l)	5	NA	0.93 J	NA	1.3 J	NA	2.7	NA	NA
Total organic carbon (TOC) (ug/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic nitrogen (TON) (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Wet Chemistry (MG/L)									
Dissolved organic carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dechlorinating Bacteria (GC/ML)									
Dehalococcoides	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW03IW							IR89-MW10	
Sample ID	IR89-GW03IW-00B-04192000	IR89-GW03IW-02D-10172002	IR89-MW03IW-04B	IR89-GW03IW-05D	IR89-MW03IW-08C	IR89-GW03IW-10D	IR89-GW03IW-11D	IR89-GW10-99D-10241999	IR89-GW10-01C-07012001
Sample Date	04/19/00	10/17/02	04/16/04	12/02/05	09/25/08	12/14/10	12/06/11	10/24/99	07/01/01
Chemical Name									
Functioning Genes (GC/ML)									
VC R-Dase	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Shading indicates detections
NA - Not analyzed
B - Analyte not detected above the level reported in
D - Compound identified in an analysis at a secondary dilution factor
E - Concentration exceeds calibration range of GC/MS instrument (Organic) OR Value is estimated due to matrix interferences (Inorganic)
Exclude
J - Analyte present, value may or may not be accurate or precise
L - Analyte present, value may be biased low, actual value may be higher
R - Unreliable Result
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
UL - Analyte not detected, quantitation limit is probably higher
GC/ML - Gene copies per milliliter
MG/L - Milligrams per liter
UG/L - Micrograms per liter

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW10									
Sample ID	IR89-GW10-02B-04192002	IR89-GW10-02D-10182002	IR89-GW10-03B	IR89-GW10-03B-04122003	IR89-GW10-03D	IR89-GW10-03D-10252003	IR89-MW10-04B	IR89-GW10-05D	IR89-MW10-08C	IR89-GW10-10D
Sample Date	04/19/02	10/18/02	04/12/03	04/12/03	10/25/03	10/25/03	04/16/04	12/03/05	09/26/08	12/14/10
Chemical Name										
Volatile Organic Compounds (UG/L)										
1,1,2,2-Tetrachloroethane	31 J	38	18	18	22	22 R	40	37	92	46
1,1,2-Trichloroethane	5 U	10 U	0.6 J	0.6 J	1 J	1 R	1	1.3 J	1.3 J	0.7 J
1,1-Dichloroethane	5 U	10 U	5 U	5 U	5 U	5 R	1 U	5 U	3.1 U	NA
1,1-Dichloroethene	5 U	10 U	5 U	5 U	5 U	5 R	1 U	5 U	3.1 U	NA
1,2-Dichloroethane	5 U	10 U	5 U	5 U	5 U	5 R	1 U	5 U	NA	NA
1,2-Dichloroethene (total)	44	29	15	15	44	44 R	34	NA	NA	NA
2-Butanone	10 U	10 U	10 U	10 U	25 U	25 R	5 U	50 U	16 U	NA
2-Hexanone	10 UJ	10 U	10 U	10 U	25 U	25 R	5 U	50 U	NA	NA
4-Methyl-2-pentanone	10 UJ	10 U	10 U	10 U	25 U	25 R	5 U	50 U	NA	NA
Acetone	10 U	10 U	10 U	10 U	25 U	25 R	5 R	50 U	16 U	NA
Benzene	5 U	10 U	5 U	5 U	5 U	5 R	1 U	5 U	3.1 U	NA
Carbon disulfide	5 U	10 U	5 U	5 U	5 U	5 R	1 U	5 U	3.1 U	NA
Chloroethane	5 U	10 U	5 U	5 U	5 U	5 R	2 U	5 U	NA	NA
Chloroform	5 U	2 J	0.4 J	0.4 J	1 JB	1 R	1	5 U	3.1 U	NA
Chloromethane	5 UJ	10 U	5 U	5 U	5 U	5 R	2 U	5 U	NA	NA
cis-1,2-Dichloroethene	35	21	13	13	39	39 R	30	29	25	44
Ethylbenzene	5 U	10 U	5 U	5 U	5 U	5 R	1 U	5 U	3.1 U	NA
Isopropylbenzene	NA	NA	NA	NA	NA	NA	NA	5 U	3.1 U	NA
m- and p-Xylene	NA	2 U	5 U	5 U	10 U	10 R	2 U	NA	6.3 U	NA
Methyl acetate	NA	NA	NA	NA	NA	NA	NA	5 U	3.1 U	NA
Methylene chloride	5 U	4 J	5 U	5 U	5 U	5 R	2 U	5 U	3.1 U	NA
o-Xylene	NA	1 U	5 U	5 U	5 U	5 R	1 U	NA	3.1 U	NA
p-Isopropyltoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	5 U	10 U	5 U	5 U	5 U	5 R	1 U	5 U	3.1 U	NA
Tetrachloroethene	16	16	2 J	2 J	9	9 R	6	5 U	3.7	2.4 J
Toluene	5 U	10 U	5 U	5 U	5 U	5 R	1 U	5 U	3.1 U	NA
trans-1,2-Dichloroethene	8	5 J	2 J	2 J	6	6 R	4	4.2 J	2.8 J	5.5
Trichloroethene	180 J	180 B	35	35	140	140 R	85	95	56	75
Vinyl chloride	2 U	2 U	2 U	2 U	0.7 J	0.7 R	2 U	5 U	3.1 U	1 U
Xylene, total	5 U	10 U	5 U	5 U	15 U	15 R	3 U	5 U	3.1 U	NA
TCLP Volatile Organic Compounds (UG/L)										
No Detections	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/L)										
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	10 U	NA	NA	NA
Naphthalene	NA	NA	NA	NA	NA	NA	10 U	NA	NA	NA
Total Metals (UG/L)										
Aluminum	NA	NA	NA	NA	NA	NA	646	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	2.34 U	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	127	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	0.27 U	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	12,100	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	0.8 U	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	1.91 U	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	63.8 J	NA	187	NA
Lead	NA	NA	NA	NA	NA	NA	1.7 U	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	6,000	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	50.8	NA	35	NA
Nickel	NA	NA	NA	NA	NA	NA	10.8 U	NA	NA	NA
Phosphorus	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW10									
Sample ID	IR89-GW10-02B-04192002	IR89-GW10-02D-10182002	IR89-GW10-03B	IR89-GW10-03B-04122003	IR89-GW10-03D	IR89-GW10-03D-10252003	IR89-MW10-04B	IR89-GW10-05D	IR89-MW10-08C	IR89-GW10-10D
Sample Date	04/19/02	10/18/02	04/12/03	04/12/03	10/25/03	10/25/03	04/16/04	12/03/05	09/26/08	12/14/10
Chemical Name										
Potassium	NA	NA	NA	NA	NA	NA	1,660	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	21,900	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	5.8 U	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	4.14 U	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	1.44 U	NA	NA	NA
TCLP Metals (UG/L)										
Chromium, TCLP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Metals (UG/L)										
Antimony, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron, Dissolved	NA	NA	NA	NA	NA	NA	5.05 U	NA	NA	NA
Manganese, Dissolved	NA	NA	NA	NA	NA	NA	50.5	NA	NA	NA
Nickel, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wet Chemistry										
Alkalinity (mg/l)	NA	NA	NA	NA	NA	NA	NA	10 U	10 U	NA
Ammonia (mg/l)	NA	NA	NA	NA	NA	NA	0.1 U	NA	NA	NA
Carbon (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride (mg/l)	17	17	14	14	17	17	16	10.6	13 D	NA
Ethane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethane (ug/l)	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.04 J	0.1 J	NA
Ethene (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethene (ug/l)	10 U	10 U	10 U	10 U	10 U	10 U	10 U	2 U	2 U	NA
Methane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methane (ug/l)	10 U	12	10 U	10 U	10 U	10 U	10 U	1 UL	0.3 JB	NA
Nitrate (mg/l)	NA	NA	NA	NA	NA	NA	6.7	4.46	3.9 D	NA
Nitrate/Nitrite (mg/l)	6.3	5.7	4.8	4.8	5.9	5.9	6.5	NA	NA	NA
Nitric Acid (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite (mg/l)	NA	NA	NA	NA	NA	NA	0.5 U	0.05 U	0.25 U	NA
Orthophosphate (mg/l)	NA	NA	NA	NA	NA	NA	0.0054 J	NA	NA	NA
Sulfate (mg/l)	86 J	69	57	57 J	69	69	47	48.1	64 D	NA
Sulfide (mg/l)	NA	1 U	2	2 J	1 U	1 U	0.75 J	1 U	1 U	NA
Total Kjeldahl nitrogen (mg/l)	NA	NA	NA	NA	NA	NA	0.25 U	NA	NA	NA
Total organic carbon (TOC) (mg/l)	NA	NA	NA	NA	NA	NA	1	NA	1.69 J	NA
Total organic carbon (TOC) (ug/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic nitrogen (TON) (mg/l)	NA	NA	NA	NA	NA	NA	0.25 U	NA	NA	NA
Dissolved Wet Chemistry (MG/L)										
Dissolved organic carbon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dechlorinating Bacteria (GC/ML)										
Dehalococcoides	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW10									
Sample ID	IR89-GW10-02B-04192002	IR89-GW10-02D-10182002	IR89-GW10-03B	IR89-GW10-03B-04122003	IR89-GW10-03D	IR89-GW10-03D-10252003	IR89-MW10-04B	IR89-GW10-05D	IR89-MW10-08C	IR89-GW10-10D
Sample Date	04/19/02	10/18/02	04/12/03	04/12/03	10/25/03	10/25/03	04/16/04	12/03/05	09/26/08	12/14/10
Chemical Name										
Functioning Genes (GC/ML)										
VC R-Dase	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Shading indicates detections
NA - Not analyzed
B - Analyte not detected above the level reported in
D - Compound identified in an analysis at a secondary dilution factor
E - Concentration exceeds calibration range of GC/MS instrument (Organic) OR Value is estimated due to matrix interferences (Inorganic)
Exclude
J - Analyte present, value may or may not be accurate or precise
L - Analyte present, value may be biased low, actual value may be higher
R - Unreliable Result
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
UL - Analyte not detected, quantitation limit is probably higher
GC/ML - Gene copies per milliliter
MG/L - Milligrams per liter
UG/L - Micrograms per liter

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW10	IR89-MW45									IR89-MW50	
Sample ID	IR89-GW10D-10D	IR89-GW45-05D	IR89-GW45-P-05D	IR89-GW45-06D	IR89-GW45-07A	IR89-GW45-07A2	IR89-GW45-07B	IR89-MW45-08C	IR89-GW45-10D	IR89-GW45-11A	IR89-GW50-06D	IR89-GW50-07A
Sample Date	12/14/10	12/01/05	12/01/05	12/29/06	01/26/07	03/27/07	06/27/07	09/27/08	12/14/10	01/18/11	11/20/06	01/04/07
Chemical Name												
Volatile Organic Compounds (UG/L)												
1,1,2,2-Tetrachloroethane	43	13 U	13 U	1.1	2 U	1 U	1 U	14 U	5 Exclude	NA	82	38
1,1,2-Trichloroethane	0.81 J	13 U	13 U	1 U	2 U	1 U	1 U	14 U	5 Exclude	NA	1.1	2.2
1,1-Dichloroethane	NA	13 U	13 U	1 U	2 U	1 U	1 U	14 U	NA	NA	1 U	1 U
1,1-Dichloroethene	NA	4.6 J	4.3 J	4.5	5.7	1.7	0.52 J	21	NA	NA	3.3	10
1,2-Dichloroethane	NA	13 U	13 U	1 U	2 U	1 U	1 U	14 U	NA	NA	1 U	1 U
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone	NA	130 U	130 U	5 U	10 U	10 U	10 U	69 U	NA	NA	5 U	5 U
2-Hexanone	NA	130 U	130 U	NA	NA	5 U	5 U	69 U	NA	NA	NA	NA
4-Methyl-2-pentanone	NA	130 U	130 U	NA	NA	5 U	5 U	69 U	NA	NA	NA	NA
Acetone	NA	130 U	130 U	25 U	50 U	10 U	1.8 J	69 U	NA	NA	25 U	25 U
Benzene	NA	13 U	13 U	1 U	2 U	0.16 J	0.16 J	14 U	NA	NA	1 U	1 U
Carbon disulfide	NA	13 U	13 U	NA	NA	1 U	1 U	14 U	NA	NA	NA	NA
Chloroethane	NA	13 U	13 U	1 U	2 U	2 U	2 U	14 U	NA	NA	1 U	1 U
Chloroform	NA	13 U	13 U	1 U	2 U	1 U	1 U	14 U	NA	NA	1.2	1 U
Chloromethane	NA	13 U	13 U	1 U	2 U	2 U	2 U	14 U	NA	NA	1 U	1 U
cis-1,2-Dichloroethene	45	300	280 J	430	350	120	21	970	530	NA	710	1,700
Ethylbenzene	NA	13 U	13 U	1 U	2 U	1 U	1 U	14 U	NA	NA	1 U	1 U
Isopropylbenzene	NA	13 U	13 U	1 U	2 U	1 U	1 U	31 R	NA	NA	1 U	1 U
m- and p-Xylene	NA	NA	NA	2 U	4 U	NA	NA	28 U	NA	NA	2 U	2 U
Methyl acetate	NA	13 U	13 U	NA	NA	2.2	1 U	31 R	NA	NA	NA	NA
Methylene chloride	NA	13 U	13 U	2 U	4 U	2 U	2 U	14 U	NA	NA	2 U	2 U
o-Xylene	NA	NA	NA	1 U	2 U	NA	NA	14 U	NA	NA	1 U	1 U
p-Isopropyltoluene	NA	NA	NA	1 U	2 U	NA	NA	NA	NA	NA	1 U	1 U
Styrene	NA	13 U	13 U	1 U	2 U	1 U	1 U	14 U	NA	NA	1 U	1 U
Tetrachloroethene	2.4 J	13 U	13 U	1 U	2 U	1 U	1 U	19	3.9 J	NA	2.9	7.5
Toluene	NA	13 U	13 U	1 U	2 U	1 U	1 U	14 U	NA	NA	1 U	1 U
trans-1,2-Dichloroethene	5.5	18	14 J	11	8.6	1.9	0.49 J	210	87 J	NA	260	560
Trichloroethene	74	480	380	28	12	0.29 J	1 U	610	170 J	NA	490	680
Vinyl chloride	1 U	6.7 J	5.5 J	13	130	92	48	52	42 J	NA	29	120
Xylene, total	NA	13 U	13 U	NA	NA	1 U	1 U	14 U	NA	NA	NA	NA
TCLP Volatile Organic Compounds (UG/L)												
No Detections	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/L)												
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	NA	NA	NA	1 U	2 U	NA	NA	NA	NA	NA	1 U	1 U
Total Metals (UG/L)												
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	18,600	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	485	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW10	IR89-MW45									IR89-MW50	
Sample ID	IR89-GW10D-10D	IR89-GW45-05D	IR89-GW45-P-05D	IR89-GW45-06D	IR89-GW45-07A	IR89-GW45-07A2	IR89-GW45-07B	IR89-MW45-08C	IR89-GW45-10D	IR89-GW45-11A	IR89-GW50-06D	IR89-GW50-07A
Sample Date	12/14/10	12/01/05	12/01/05	12/29/06	01/26/07	03/27/07	06/27/07	09/27/08	12/14/10	01/18/11	11/20/06	01/04/07
Chemical Name												
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TCLP Metals (UG/L)												
Chromium, TCLP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Metals (UG/L)												
Antimony, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wet Chemistry												
Alkalinity (mg/l)	NA	224	NA	NA	NA	NA	NA	241	NA	NA	NA	NA
Ammonia (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride (mg/l)	NA	9.55	NA	NA	NA	NA	NA	16 D	NA	NA	NA	NA
Ethane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethane (ug/l)	NA	2 U	0.05 U	NA	NA	NA	NA	0.1 J	NA	NA	NA	NA
Ethene (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethene (ug/l)	NA	2 U	0.2 U	NA	NA	NA	NA	3	NA	NA	NA	NA
Methane (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methane (ug/l)	NA	4	4 L	NA	NA	NA	NA	42 BD	NA	NA	NA	NA
Nitrate (mg/l)	NA	0.05 U	NA	NA	NA	NA	NA	0.59 D	NA	NA	NA	NA
Nitrate/Nitrite (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitric Acid (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite (mg/l)	NA	0.05 U	NA	NA	NA	NA	NA	0.25 U	NA	NA	NA	NA
Orthophosphate (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate (mg/l)	NA	27.6	NA	NA	NA	NA	NA	100 D	NA	NA	NA	NA
Sulfide (mg/l)	NA	1 U	NA	NA	NA	NA	NA	1 U	NA	NA	NA	NA
Total Kjeldahl nitrogen (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC) (mg/l)	NA	NA	NA	19	30	7.8	1.3 J	1.27 J	NA	1.8	NA	NA
Total organic carbon (TOC) (ug/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic nitrogen (TON) (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Wet Chemistry (MG/L)												
Dissolved organic carbon	NA	NA	NA	NA	NA	8.2	1.4 J	NA	NA	NA	NA	NA
Dechlorinating Bacteria (GC/ML)												
Dehalococcoides	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW10	IR89-MW45									IR89-MW50	
Sample ID	IR89-GW10D-10D	IR89-GW45-05D	IR89-GW45-P-05D	IR89-GW45-06D	IR89-GW45-07A	IR89-GW45-07A2	IR89-GW45-07B	IR89-MW45-08C	IR89-GW45-10D	IR89-GW45-11A	IR89-GW50-06D	IR89-GW50-07A
Sample Date	12/14/10	12/01/05	12/01/05	12/29/06	01/26/07	03/27/07	06/27/07	09/27/08	12/14/10	01/18/11	11/20/06	01/04/07
Chemical Name												
Functioning Genes (GC/ML)												
VC R-Dase	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
Shading indicates detections
NA - Not analyzed
B - Analyte not detected above the level reported in
D - Compound identified in an analysis at a secondary dilution factor
E - Concentration exceeds calibration range of GC/MS instrument (Organic) OR Value is estimated due to matrix interferences (Inorganic)
Exclude
J - Analyte present, value may or may not be accurate or precise
L - Analyte present, value may be biased low, actual value may be higher
R - Unreliable Result
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
UL - Analyte not detected, quantitation limit is probably higher
GC/ML - Gene copies per milliliter
MG/L - Milligrams per liter
UG/L - Micrograms per liter

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW50				IR89-MW52DW	IR89-MW53DW	IR89-MW54					
Sample ID	IR89-GW50-07A2	IR89-GW50-07B	IR89-MW50-08C	IR89-GW50-10D	IR89-GW52DW-11D	IR89-GW53DW-11D	IR89-GW54-06D	IR89-GW54-07A	IR89-GW54-07A2	IR89-GW54-07B	IR89-MW54-08C	IR89-GW54-10D
Sample Date	03/14/07	06/05/07	09/27/08	12/13/10	12/07/11	12/07/11	11/18/06	01/03/07	03/15/07	06/07/07	09/28/08	12/14/10
Chemical Name												
Volatile Organic Compounds (UG/L)												
1,1,2,2-Tetrachloroethane	6.3	190	31 U	0.5 U	3.6	1 U	20	1.1	0.16 J	0.17 J	2.5 U	0.5 U
1,1,2-Trichloroethane	2 U	4.1 J	31 U	0.5 U	1 U	1 U	1 U	1 U	1 U	1 U	2.5 U	0.5 U
1,1-Dichloroethane	2 U	0.75 J	31 U	NA	NA	NA	1 U	1 U	1 U	1 U	2.5 U	NA
1,1-Dichloroethene	20	26	48	NA	NA	NA	2.7	3.6	6	0.76 J	2.9	NA
1,2-Dichloroethane	2 U	5 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA
1,2-Dichloroethene (total)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone	20 U	50 U	160 U	NA	NA	NA	5 U	14	10 U	10 U	13 U	NA
2-Hexanone	10 U	25 U	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA
4-Methyl-2-pentanone	10 U	25 U	NA	NA	NA	NA	NA	NA	5 U	5 U	NA	NA
Acetone	11 J	50 U	160 U	NA	NA	NA	25 U	25 U	10 U	10 U	13 U	NA
Benzene	2 U	5 U	31 U	NA	NA	NA	1 U	1 U	0.18 J	1 U	2.5 U	NA
Carbon disulfide	2 U	5 U	31 U	NA	NA	NA	NA	NA	1 U	1 U	2.5 U	NA
Chloroethane	4 U	10 U	NA	NA	NA	NA	1 U	1 U	2 U	2 U	NA	NA
Chloroform	2 U	5 U	31 U	NA	NA	NA	1 U	1 U	1 U	1 U	2.5 U	NA
Chloromethane	4 U	10 U	NA	NA	NA	NA	1 U	1 U	2 U	2 U	NA	NA
cis-1,2-Dichloroethene	2,100	910	1,400	160	1.1	13	260	600	130	24	57	0.5 U
Ethylbenzene	2 U	5 U	31 U	NA	NA	NA	1 U	1 U	1 U	1 U	2.5 U	NA
Isopropylbenzene	2 U	5 U	31 U	NA	NA	NA	1 U	1 U	1 U	1 U	2.5 U	NA
m- and p-Xylene	NA	NA	63 U	NA	NA	NA	2 U	2 U	NA	NA	5 U	NA
Methyl acetate	2 U	5 U	31 U	NA	NA	NA	NA	NA	1 U	1 U	2.5 U	NA
Methylene chloride	4 J	10 U	31 U	NA	NA	NA	2 U	2 U	2 U	2 U	2.5 U	NA
o-Xylene	NA	NA	31 U	NA	NA	NA	1 U	1 U	NA	NA	2.5 U	NA
p-Isopropyltoluene	NA	NA	NA	NA	NA	NA	1 U	8.4	NA	NA	NA	NA
Styrene	2 U	5 U	31 U	NA	NA	NA	1 U	1 U	1 U	1 U	2.5 U	NA
Tetrachloroethene	1 J	0.79 J	31 U	0.5 U	1 U	1 U	1.9	1 U	0.25 J	1 U	2.5 U	0.5 U
Toluene	2 U	5 U	31 U	NA	NA	NA	1 U	1 U	1 U	1 U	2.5 U	NA
trans-1,2-Dichloroethene	150	210	360	24	1 U	4.6	16	14	7	1.6	3.5	0.5 U
Trichloroethene	230	210	380	35	2.1	75	320	3	140	3.8	79	0.5 U
Vinyl chloride	120	120	330	6	1 U	0.73 J	4.1	4.7	61	50	9.8	0.55 J
Xylene, total	2 U	5 U	31 U	NA	NA	NA	NA	NA	1 U	1 U	2.5 U	NA
TCLP Volatile Organic Compounds (UG/L)												
No Detections	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/L)												
bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	NA	NA	NA	NA	NA	NA	1 U	1 U	NA	NA	NA	NA
Total Metals (UG/L)												
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	2,090	NA	177	1,030 D	NA	NA	NA	NA	9,040	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	598	NA	23.3	27	NA	NA	NA	NA	179	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus	NA	NA	NA	NA	NA	NA	100 U	188	140	180	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW50				IR89-MW52DW	IR89-MW53DW	IR89-MW54					
Sample ID	IR89-GW50-07A2	IR89-GW50-07B	IR89-MW50-08C	IR89-GW50-10D	IR89-GW52DW-11D	IR89-GW53DW-11D	IR89-GW54-06D	IR89-GW54-07A	IR89-GW54-07A2	IR89-GW54-07B	IR89-MW54-08C	IR89-GW54-10D
Sample Date	03/14/07	06/05/07	09/27/08	12/13/10	12/07/11	12/07/11	11/18/06	01/03/07	03/15/07	06/07/07	09/28/08	12/14/10
Chemical Name												
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TCLP Metals (UG/L)												
Chromium, TCLP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Metals (UG/L)												
Antimony, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium, Dissolved	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wet Chemistry												
Alkalinity (mg/l)	NA	NA	266	NA	380	240	25	420	236	307	322	NA
Ammonia (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloride (mg/l)	NA	NA	21 D	NA	230 D	52	15	17	12	12	12 D	NA
Ethane (mg/l)	NA	NA	NA	NA	0.00196 U	0.00264	NA	NA	NA	NA	NA	NA
Ethane (ug/l)	NA	NA	0.5 J	NA	NA	NA	NA	NA	1.1	1.7	4	NA
Ethene (mg/l)	NA	NA	NA	NA	0.00271 U	0.00448	NA	NA	NA	NA	NA	NA
Ethene (ug/l)	NA	NA	5	NA	NA	NA	NA	NA	35	72	0.7 J	NA
Methane (mg/l)	NA	NA	NA	NA	0.0107	0.05	NA	NA	NA	NA	NA	NA
Methane (ug/l)	NA	NA	30 B	NA	NA	NA	NA	NA	78	310	1,300 BD	NA
Nitrate (mg/l)	NA	NA	0.25 U	NA	NA	NA	NA	NA	0.1 U	0.1 U	0.25 U	NA
Nitrate/Nitrite (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitric Acid (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrite (mg/l)	NA	NA	0.25 U	NA	NA	NA	NA	NA	0.25 U	0.25 U	0.25 U	NA
Orthophosphate (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfate (mg/l)	NA	NA	150 D	NA	200 D	6.3	38	5 U	18.4	4	9.9 JD	NA
Sulfide (mg/l)	NA	NA	1 U	NA	1 U	1 U	NA	NA	NA	NA	1 U	NA
Total Kjeldahl nitrogen (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic carbon (TOC) (mg/l)	NA	NA	5.96	NA	18	6.8	3.2	34	1.3 J	6.9	1.42 J	NA
Total organic carbon (TOC) (ug/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total organic nitrogen (TON) (mg/l)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Wet Chemistry (MG/L)												
Dissolved organic carbon	NA	NA	NA	NA	NA	NA	NA	NA	1.4 J	7.2	NA	NA
Dechlorinating Bacteria (GC/ML)												
Dehalococcoides	NA	NA	NA	NA	NA	19	NA	NA	NA	NA	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW50				IR89-MW52DW	IR89-MW53DW	IR89-MW54					
Sample ID	IR89-GW50-07A2	IR89-GW50-07B	IR89-MW50-08C	IR89-GW50-10D	IR89-GW52DW-11D	IR89-GW53DW-11D	IR89-GW54-06D	IR89-GW54-07A	IR89-GW54-07A2	IR89-GW54-07B	IR89-MW54-08C	IR89-GW54-10D
Sample Date	03/14/07	06/05/07	09/27/08	12/13/10	12/07/11	12/07/11	11/18/06	01/03/07	03/15/07	06/07/07	09/28/08	12/14/10
Chemical Name												
Functioning Genes (GC/ML)												
VC R-Dase	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA

Notes:
Shading indicates detections
NA - Not analyzed
B - Analyte not detected above the level reported in
D - Compound identified in an analysis at a secondary dilution factor
E - Concentration exceeds calibration range of GC/MS instrument (Organic) OR Value is estimated due to matrix interferences (Inorganic)
Exclude
J - Analyte present, value may or may not be accurate or precise
L - Analyte present, value may be biased low, actual value may be higher
R - Unreliable Result
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
UL - Analyte not detected, quantitation limit is probably higher
GC/ML - Gene copies per milliliter
MG/L - Milligrams per liter
UG/L - Micrograms per liter

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW81DW	IR89-MW82DW
Sample ID	IR89-GW81DW-11D	IR89-GW82DW-11D
Sample Date	12/08/11	12/08/11
Chemical Name		
Volatile Organic Compounds (UG/L)		
1,1,2,2-Tetrachloroethane	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U
1,1-Dichloroethane	NA	NA
1,1-Dichloroethene	NA	NA
1,2-Dichloroethane	NA	NA
1,2-Dichloroethene (total)	NA	NA
2-Butanone	NA	NA
2-Hexanone	NA	NA
4-Methyl-2-pentanone	NA	NA
Acetone	NA	NA
Benzene	NA	NA
Carbon disulfide	NA	NA
Chloroethane	NA	NA
Chloroform	NA	NA
Chloromethane	NA	NA
cis-1,2-Dichloroethene	1 U	1 U
Ethylbenzene	NA	NA
Isopropylbenzene	NA	NA
m- and p-Xylene	NA	NA
Methyl acetate	NA	NA
Methylene chloride	NA	NA
o-Xylene	NA	NA
p-Isopropyltoluene	NA	NA
Styrene	NA	NA
Tetrachloroethene	1 U	1 U
Toluene	NA	NA
trans-1,2-Dichloroethene	1 U	1 U
Trichloroethene	1 U	1 U
Vinyl chloride	1 U	1 U
Xylene, total	NA	NA
TCLP Volatile Organic Compounds (UG/L)		
No Detections	NA	NA
Semivolatile Organic Compounds (UG/L)		
bis(2-Ethylhexyl)phthalate	NA	NA
Naphthalene	NA	NA
Total Metals (UG/L)		
Aluminum	NA	NA
Antimony	NA	NA
Barium	NA	NA
Beryllium	NA	NA
Calcium	NA	NA
Chromium	NA	NA
Copper	NA	NA
Iron	752	496
Lead	NA	NA
Magnesium	NA	NA
Manganese	42.9	41
Nickel	NA	NA
Phosphorus	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW81DW	IR89-MW82DW
Sample ID	IR89-GW81DW-11D	IR89-GW82DW-11D
Sample Date	12/08/11	12/08/11
Chemical Name		
Potassium	NA	NA
Sodium	NA	NA
Thallium	NA	NA
Vanadium	NA	NA
Zinc	NA	NA
TCLP Metals (UG/L)		
Chromium, TCLP	NA	NA
Dissolved Metals (UG/L)		
Antimony, Dissolved	NA	NA
Barium, Dissolved	NA	NA
Iron, Dissolved	NA	NA
Manganese, Dissolved	NA	NA
Nickel, Dissolved	NA	NA
Vanadium, Dissolved	NA	NA
Wet Chemistry		
Alkalinity (mg/l)	230	280
Ammonia (mg/l)	NA	NA
Carbon (mg/l)	NA	NA
Chloride (mg/l)	12	51
Ethane (mg/l)	0.00196 U	0.00196 U
Ethane (ug/l)	NA	NA
Ethene (mg/l)	0.00271 U	0.00271 U
Ethene (ug/l)	NA	NA
Methane (mg/l)	0.579 Exclude	0.0416
Methane (ug/l)	NA	NA
Nitrate (mg/l)	NA	NA
Nitrate/Nitrite (mg/l)	NA	NA
Nitric Acid (mg/l)	NA	NA
Nitrite (mg/l)	NA	NA
Orthophosphate (mg/l)	NA	NA
Sulfate (mg/l)	0.82 J	2.6 J
Sulfide (mg/l)	1 U	1 U
Total Kjeldahl nitrogen (mg/l)	NA	NA
Total organic carbon (TOC) (mg/l)	2.6	4.6
Total organic carbon (TOC) (ug/l)	NA	NA
Total organic nitrogen (TON) (mg/l)	NA	NA
Dissolved Wet Chemistry (MG/L)		
Dissolved organic carbon	NA	NA
Dechlorinating Bacteria (GC/ML)		
Dehalococcoides	NA	NA

Attachment 1
Historical Data
Site 89 Monitoring Well Abandonment Work Plan
Marine Corps Base Camp Lejeune -
Marine Corps Air Station New River

Station ID	IR89-MW81DW	IR89-MW82DW
Sample ID	IR89-GW81DW-11D	IR89-GW82DW-11D
Sample Date	12/08/11	12/08/11
Chemical Name		
Functioning Genes (GC/ML)		
VC R-Dase	NA	NA

Notes:
Shading indicates detections
NA - Not analyzed
B - Analyte not detected above the level reported in
D - Compound identified in an analysis at a secondary dilution factor
E - Concentration exceeds calibration range of GC/MS instrument (Organic) OR Value is estimated due to matrix interferences (Inorganic)
Exclude
J - Analyte present, value may or may not be accurate or precise
L - Analyte present, value may be biased low, actual value may be higher
R - Unreliable Result
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
UL - Analyte not detected, quantitation limit is probably higher
GC/ML - Gene copies per milliliter
MG/L - Milligrams per liter
UG/L - Micrograms per liter

Attachment 2
Health and Safety Plan

Health and Safety Plan
Installation Restoration Program
Long-term Monitoring at
Sites 03, 06, 35, 36, 49, 69, 73, 78, 82, 86, 89, and 93

Marine Corps Base Camp Lejeune
North Carolina

Contract Task Order WE2H

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Virginia Beach, Virginia

Emergency Contacts

24-hour CH2M HILL Injury Reporting– 1-866-893-2514
24-hour CH2M HILL Serious Incident Reporting Contact – 720-286-4911

Medical Emergency: 911 **Local Ambulance #:** 910-451-9111 **Base Ambulance #:** 910-451-3004	**CH2M HILL- Medical Consultant** WorkCare Dr. Peter Greaney M.D. 300 S. Harbor Blvd, Suite 600 Anaheim, CA 92805 800-455-6155/866-893-2514 714-978-7488
Fire/Spill Emergency: 911 Facility Fire Response #: 910-451-9111	**CH2M HILL Director – Health, Safety, Security & Environment** Name: Andy Strickland/DEN Cell: 720-480-0685 Office: 720-286-2393
Security & Police – 911 Base Security #: 910-451-2555	**CH2M HILL Responsible Health and Safety Manager (RHSM)** Name: Carl Woods Phone: 513-319-5771
Utilities Emergency Phone Numbers Water: Contact base EMD Gas: Contact base EMD Electric: Contact base EMD	**CH2M HILL Human Resources Department** Phone: Employee Connect toll-free number 1-877-586-4411 (U.S. and Canada)
CH2M HILL Project Manager Name: Monica Fulkerson/CLT Phone: 704-544-5177	**CH2M HILL Worker's Compensation** Contact Market HR dept. to have form completed
CH2M HILL Safety Coordinator (SC) Name: Bridget Berglind/CLT Phone: 704-544-4047	**Media Inquiries Corporate Strategic Communications** Name: John Corsi Phone: (720) 286-2087
CH2M HILL Project Environmental Manager Name: Hope Wilson/ATL Phone: Work: 678-530-4226 Cell: 678-656-5411	**Automobile Accidents** Rental: Mary Ellegood-Oberts/DEN: 720-286-2291 CH2M HILL owned vehicle: Linda George/DEN: 720-286-2057
Federal Express Dangerous Goods Shipping Phone: 800/238-5355	**CHEMTEL (hazardous material spills)** Phone: 800/255-3924
Facility Alarms: TBD None	**Evacuation Assembly Area(s):** TBD
Facility/Site Evacuation Route(s): To be determined	

Directions and MAP to Local Hospital

Nearest On-Base hospital:

Base Naval Hospital (only to be used in extreme emergency)
Building NH100
100 Brewster Blvd.
Camp Lejeune, NC 28547
Phone: (910) 451-4840, (910) 451-4841, (910) 451-4842

Local hospital:

Onslow County Memorial Hospital
317 Western Boulevard
Jacksonville, NC 28546
Phone: (910) 577-2240

Local ambulance service:

Base Ambulance: (910) 451-3004
(910) 451-3005

Public Ambulance: (910) 451-9111

Directions to the Base Naval Hospital (Building NH100)
(nearest hospital; only to be used in an extreme emergency)

1. Proceed north towards Highway 24.
2. Turn left onto Brewster Boulevard (heading west)
3. Continue on Brewster Boulevard until intersection with the driveway to the Naval Hospital.
4. Turn onto Hospital driveway, and proceed to emergency room.

Directions to Onslow County Memorial Hospital:

1. From Holcomb Boulevard, exit Base through main gate.
2. Follow Highway 24 west until intersecting with Western Boulevard.
3. Turn right onto Western Boulevard.
4. The Onslow County Memorial Hospital is on the left, approximately 2 miles (fifth stop light) from Highway 24.
5. Follow the signs to the emergency room.

Site 35
Onslow Memorial Hospital
Jacksonville
Site 89 & 93
Site 36
Midway Park
New River MCAs
Sites 6 & 82
Site 49
Site 78
Base Naval Hospital
Marine Corps Base, Camp Lejeune
Site 73
Site 69
Stones Bay
Onslow Bay
Sneads Ferry
Western Blvd
Lejeune Blvd
Piney Green Rd
Dawson Cabin Rd
Ocean Hwy
Sneads Ferry Rd
Pony Farm Rd
Swansboro Rd
258
24
53
172

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- E&N Market HSSE Handbook
- Project Forms/Templates
- Fact Sheets
- Project Activity Self-Assessment Checklists
- CH2M HILL AHAs
- Site 35 Traffic Control Figure and Notes

Approval

This Health and Safety Plan (HSP) has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific project and site conditions and identified scope(s) of work and must be amended if those conditions or scope(s) of work change.

By approving this HSP, the Responsible Health and Safety Manager (RHSM) certifies that the personal protective equipment has been selected based on the project-specific hazard assessment.

Original Plan

Original Plan Written by: Stephen Brand **Date**: 07/03/2014

RHSM Approval: Rick Cavil, CSP **Date**: 07/24/2014

Project Manager Approval: Monica L Sulderson **Date:** 11/24/2014

Revisions:

Revisions Made By: David Seed **Date:** 04/20/2015

Description of Revisions to Plan:

Added Pore Water and Groundwater Sampling at Site 49. Updated the FY2015 HASP to include the Site 49 sampling activities as well.

Revisions Approved By: Carl Woods **Date:** 04/27/2015

Revisions Made By: David Seed **Date:** 9/30/15

Description of Revisions to Plan:

Incorporated Site 35 NCDOT Traffic Control Language and Map to the HSP.

Revisions Approved By: Carl Woods **Date:** 10/26/15

SECTION 1

Applicability

This HSP applies to:

- All CH2M HILL staff, including subcontractors and tiered subcontractors of CH2M HILL working on the site
- All visitors to CH2M HILL construction or remediation sites in the custody of CH2M HILL (including visitors from the Client, the Government, the public, and other staff of any CH2M HILL company).

In addition, Subcontractors and tiered subcontractors shall also follow any of their company HSE programs, and site-specific HSPs and AHAs.

This HSP does not apply to the third-party contractors, their workers, their subcontractors, their visitors, or any other persons not under the direct control or custody of CH2M HILL.

This HSP defines the procedures and requirements for the health and safety of CH2M HILL staff and visitors when they are physically on the work site. The work site includes the project area (as defined by the contract documents) and the project offices, trailers, and facilities thereon.

This HSP will be kept onsite during field activities and will be reviewed as necessary. The HSP will be revised as project activities or conditions change or when supplemental information becomes available. The HSP adopts, by reference, the CH2M HILL Enterprise-wide Core Standards and Standard Operating Procedures (SOPs), as appropriate. In addition, applicable requirements contained in the Environment and Nuclear (E&N) Market (E&NM) Health, Safety, Security, and Environment (HSSE) Handbook (Handbook) will be implemented. The Handbook is attached to this HSP. The HSP may adopt procedures from the project Work Plan and any governing regulations. If there is a contradiction between this HSP and any governing regulation, the more stringent and protective requirement shall apply.

All CH2M HILL staff and subcontractors must sign the employee sign-off form (Attached to this HSP) to acknowledge review of this document. Copies of the signature page will be maintained onsite by the Safety Coordinator (SC).

SECTION 2

General Project Information

2.1 Project Information and Background

Project Number:	659587.PP.WP	**Project/Site Name:**	IRP MCIEAST-MCB CAMLEJ Camp Lejeune LTM at sites 03, 06, 35, 36, 49, 69, 73, 78, 82, 86, 89, and 93.
Client:	NAVFAC Atlantic	**Site Address:**	Camp Lejeune, NC 28542
CH2M HILL Project Manager:	Monica Fulkerson/CLT	**CH2M HILL Office:**	Charlotte, NC
Date HSP Prepared:	04-20-2015, Updated 10/26/15	**Date(s) of Site Work:**	October 2015 to October 2016

2.2 Site Background, Setting, and Map

There are nine operable units (OUs) that are included in the LTM program: OU 1, Site 78; OU 2, Sites 6 and 82; OU 6, Site 36; OU10, Site 35; OU12, Site 3; OU14, Site 69; OU16, Site 89 and 93; OU20, Site 86; and OU21, Site 73.

2.2.1 OU 1, Site 78

OU 1 (HPIA) is located approximately one mile east of the New River and two miles south of State Route 24. Site 78 is bordered by Holcomb Boulevard to the west, Sneads Ferry Road to the north, Louis Street to the east, and the Main Service Road to the south. Site 78 covers approximately 590 acres comprised of maintenance shops, warehouses, painting shops, printing shops, auto body shops, and other small industrial facilities. The site is relatively flat and the majority of the site area is paved (e.g., roadways, parking lots, loading dock areas, and storage lots); however, there are many small lawn areas associated with individual buildings within the site and along lengthy stretches of roadways. Recreational ball fields and a parade ground are located in the southwest corner of the site. The HPIA, constructed in the late 1930s, was the first developed area at MCB Camp Lejeune. Due to the industrial nature of the Site, spills and leaks have occurred over the operational period of the site.

2.2.2 OU 2, Sites 6 and 82

OU 2 is located approximately two miles east of the New River and two miles south of State Route 24. OU 2 is a predominantly flat area with sharp a drop-off in elevation near the banks of Wallace Creek, at the northern end of Site 82 and near Bear Head Creek, in the wooded area south of Lot 201. Site 6 is bounded by Site 82 to the north, by Piney Green Road to the east, by Site 9 to the south, and by Holcomb Boulevard to the west. Site 82 is bordered by Wallace Creek to the north, by Piney Green Road to the east, by Holcomb Boulevard to the west, and by Site 6 to the south.

Site 6 covers an area of approximately 177 acres that incorporates Storage Lots 201 and 203, a wooded area between the storage lots, and a ravine. Historically, Site 6 was used for disposal and storage of wastes and supplies, including pesticides, transformers containing polychlorinated biphenyls (PCBs), solvents, electrolytes, and waste oils. Currently, Lot 201 is used to store military equipment, vehicles, hydraulic oils, and other “non-hazardous” supplies. Lot 203 is no longer an active storage area.

Site 82, the Piney Green Road Volatile Organic Compound (VOC) site, encompasses approximately 30 acres and is predominantly covered by woodlands. This site was identified as a result of the 1986 site assessment at Site 6 and from the 1992 Site Inspection. The site is randomly littered with debris including spent ammunition casings, and empty or rusted drums. Some of the drums were marked as “lubrication oil” and “anti-freeze”.

2.2.3 OU 6, Site 36

OU 6 is located within the northwest portion of the Base, to the south and east of Camp Geiger, which is situated directly north of MCAS New River and approximately three miles southwest of the City of Jacksonville. Site 36, the Camp Geiger Dump Area, is located approximately 1,000 feet east of Camp Geiger and 500 feet west of the New River, adjacent to the Camp Geiger Sewage Treatment Plant. Site 36 encompasses nearly 20 acres and is comprised primarily of open fields and wooded areas.

Site 36 was reported to have been used for the disposal of municipal wastes and mixed industrial wastes including trash, waste oils, solvents, and hydraulic fluids that were generated at MCAS New River. The dump was active from the late 1940s to the late 1950s.

2.2.4 OU10, Site 35

OU 10 (Site 35), formerly the Camp Geiger Fuel Farm, primarily refers to five former 15,000-gallon above ground storage tanks (ASTs) and associated distribution equipment, situated just north of the intersection of Fourth Street and 'G' Street. The Fuel Farm was in operation from 1945 until 1995. The ASTs were installed in 1945 as part of the original Camp Geiger construction. The ASTs were originally used to store No. 6 fuel oil, but were subsequently converted for storage of gasoline, diesel fuel, and kerosene. The ASTs supplied fuel to an adjacent dispensing pump. In 1995, the Fuel Farm was decommissioned and dismantled to make way for construction of the US Highway 17 Bypass.

During the active life of the fuel farm, several releases of fuel are reported to have occurred. During 1957 and 1958, a release was reported in an underground distribution line, which resulted in the loss of thousands of gallons of fuel, and apparently migrated towards Brinson Creek. The leak appeared to have occurred as a result of damage to a dispensing pump. Interceptor trenches were excavated and the captured fuel was ignited and burned. In April 1990, Camp Geiger personnel discovered fuel (believed to be gasoline or diesel fuel) within the unnamed drainage channels north of the fuel farm. The source of the fuel spill was believed to be an unauthorized discharge from a tanker truck. Clean-up required excavation and disposal of more than 20 cubic yards of soil. During subsequent phases of investigation of the petroleum contamination, chlorinated VOCs were also detected, although a source was not identified.

2.2.5 OU 12, Site 3

Site 3 is the former location of a creosote plant that was in operation from 1951 to 1952 to supply treated lumber for the construction of the MCIEAST-MCB CAMLEJ Railroad. The site is undeveloped, with relatively level grassy areas and unpaved roads and railroad tracks with wooded areas along the eastern boundary. The most frequently detected organic contaminants at site 3 were polycyclic aromatic hydrocarbons (PAHs). In addition to PAHs, fuel constituents including benzene, was detected in soil and groundwater at Site 3. Currently, groundwater contamination consists of isolated areas of SVOCs within the surficial and UCH aquifers at concentrations in exceedance of cleanup levels. COCs include Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzofuran, and naphthalene.

2.2.6 OU 14, Site 69

The site is a 14-acre portion of land known as the Installation Restoration (IR) Site 69/ Operable Unit (OU) 14 (Rifle Range Chemical Dump). From 1950 to 1976, IR Site 69 was used for the trench disposal of chemical wastes, including polychlorinated biphenyls (PCBs), solvents, and pesticides. IR Site 69 also has a suspected history of chemical agent (CA) disposal. Fifty 55-gallon drums of mustard or nerve agent were allegedly buried in two trenches at Site 69 in the 1950s; however, no other record of chemical agent use or storage at Camp Lejeune has been documented.

Investigation conducted at Site 69 to date have focused on non-CA contaminants including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), PCBs, metals, and pesticides. From 1984 to 1986, Environmental Science and Engineering Inc. (ESE) performed a Confirmation Study of Site 69, which included installation of eight monitoring wells (IR69-GW01 through IR69-GW08), collection of groundwater from the eight wells, and collection of three surface water and two sediment samples. Samples were analyzed for PCBs,

pesticides, VOCs, metals (mercury), and residual chlorine. Groundwater from monitoring wells IR69-GW02 through IR69-GW05 contained elevated levels of VOCs (DCE, TCE, VC) above NC GW standards.

In 1990 a chain link fence was erected to restrict access to the disposal area. However, review of historical aerial photography, specifically from 1964, suggests that an area of historical disposal may lie to the north of the fenced area.

In 1991, ESE conducted a Supplemental Characterization, which included the collection of eight groundwater samples, seven surface water samples, and seven sediment samples. The results of these studies revealed that shallow groundwater exhibited levels of volatile organic compounds (VOCs) above NC GW standards in the southern portion of the site. Surface water samples obtained from on-site standing water in low-lying areas of the site revealed the same constituents as were detected in shallow groundwater, but at much lower concentrations. However, the VOC 1,2-Dichloroethene was present in elevated levels (410 ppb) in the intermittent surface water of the south-central portion of Site 69.

From January 1994 through April 1996, RI field investigation activities by Michael J. Baker Inc. (Baker) were conducted in five stages in order to characterize the nature and extent of contamination. A total of 29 shallow soil borings and nine subsurface soil borings were completed to characterize soil quality; two geophysical surveys were conducted to identify subsurface anomalies; and a total of eight shallow, six upper zone Castle Hayne, three intermediate zone Castle Hayne, and three deep zone Castle Hayne monitoring wells were installed (IR-GW09 through IR-GW15). Five rounds of groundwater samples were collected from various monitoring wells and via “hydropunch” technique. Samples were analyzed for VOCs, semi-volatile organic compounds (SVOCs), pesticides, PCBs, inorganics, and chemical surety compounds. The analytical results indicated that groundwater in the shallow aquifer as well as in the upper and intermediate portions of the Castle Hayne aquifer under the former disposal area have been impacted by VOCs (primarily 1,2-dichlorethene [DCE]). Based on groundwater concentrations and the results of the geophysical survey, which identified metallic debris in the subsurface, the source of the VOCs appeared to be associated with buried waste near well cluster 69-GW15. However, the true location of source material remained unconfirmed due to the suspected presence of buried chemical agent. Surface water samples indicated that on-site ponded water in the southern portion of the site has been impacted with VOCs; however, off-site surface water and sediment samples indicated the New River, Everett Creek, and an unnamed tributary north of the site had not been impacted by site activities. Additionally, acetophenone, a chemical surety compound, was detected in several surface soil samples, and on-site and drainage sediment samples. Baker concluded that the presence of acetophenone was attributable to training activities using “riot gas.”

Long-Term Monitoring (LTM) of the site began in April 1998 on a semi-annual basis in order to assess plume stability and monitor seasonal changes. Groundwater samples are collected from eight shallow monitoring wells screened in the surficial aquifer, six deep monitoring wells screened in the upper zone of the Castle Hayne aquifer, and one deep monitoring well screened deeper in the Castle Hayne aquifer. Groundwater samples collected under this program are analyzed for VOCs and natural attenuation indicator parameters (NAIP).

Groundwater contamination associated with Site 69 is dominated by the VOC *cis*-1,2-DCE, and is most prevalent in the shallow aquifer in the central and southern portion of the Site. The highest VOC concentrations have historically been detected in a monitoring well screened within the upper zone of the Castle Hayne aquifer (Well 69-GW15IW). During RI activities, VOCs were detected in a limited area in the intermediate zone of the Castle Hayne aquifer; however only one well in the intermediate zone was monitored as part of the LTM program, and VOC concentrations have historically been below detection limits.

Chlorobenzene has historically been detected in two monitoring wells (69-GW03 and 69-GW15 in the southeastern portion of site). The chlorobenzene concentration in 69-GW15 has been slowly decreasing since the October 2001 LTM event; however concentrations remain significantly above the NCWQS of 50 µg/L. The chlorobenzene concentration in 69-GW03 has remained relatively constant since the October 1999 LTM event; however the concentrations are below the NCWQS.

Historical LTM data indicates that limited reductive dechlorination is occurring in monitoring wells 69-GW15, 69-GW02, and 69-GW03. This is evidenced by the slow decrease in concentration of the parent products (1,1,2,2-PCA, tetrachloroethene [PCE], and TCE) coupled with the fairly steady concentration of the daughter products (DCE and vinyl chloride [VC]) over time.

In June 2000, an Interim Record of Decision (IROD) was issued to address the human health and ecological risks due to VOCs in groundwater and human safety risks due to buried CA. Institutional controls and monitored natural attenuation (MNA) were the selected remedial actions, which are required to remain in effect until the remedial goals have been achieved or the IROD is superseded by a Final ROD. The remedial actions included: implementing a groundwater monitoring program targeting the VOCs of concern; conducting groundwater monitoring of inorganics and chemical surety compounds in select wells; and implementing land use and aquifer use controls (shallow and Castle Hayne aquifers) to prevent site access, control intrusive activities, and prevent future use of the aquifers.

Site 69 is located within Munitions Response (MR) Site UXO-02.The Final Range Identification and Preliminary Range Assessment states that the UXO-02 range “appears on a range map circa 1973 and no information has been found to describe its use.” Site UXO-02 appears as an “unknown UXO contaminated area” in subsequent range overlay maps starting in 1987 (USACE, 2001). Plate 4, the 1946 Range overlay map, indicates mortar range “L-2” was established in a 1945 Camp Training Order . However, by March 1946, it was disestablished and no longer used for firing live ammunition. Based upon the range designations and use at other similar ranges on MCB Camp Lejeune, 60 millimeter (mm) and 81 mm mortar (high explosive [HE], white phosphorus, illumination) may have been fired on Mortar Range “L-2” (USACE, 2001). Mortar Range “L-2” had its firing position along the southern boundary of UXO-02 with impact trajectories due north into the New River. Additional information about Site UXO-02 can be found in *Site Specific Work Plan Addendum for Preliminary Assessment/Site Inspection Site UXO-02, Unnamed Explosives Range, ASR #2.201* (CH2M HILL, 2009).

The area is primarily wooded and bordered on the west side by the New River.

2.2.7 OU 16, Sites 89 and 93

Site 89 is one of two sites within Operable Unit 16 and is located southeast of the intersection of “G” and Eighth Streets of MCB Camp Lejeune. Site 93 is the other site of the Operable Unit 16 and is located immediately west of Site 89. Site 89 consists of a fenced area of the DRMO that is generally covered by gravel and asphalt and was used primarily for staging and storage of equipment, vehicles and supplies. Heavily wooded areas are present east and south of the fenced area of Site 89. A housing unit for MCB Camp Lejeune is located southeast of Site 89. Edwards Creek is located west and south of the fenced area of Site 89 and flows east through the wooded and marshy area east of the Site 89. The Base Motor Pool operated on Site 89 until approximately 1988. Historical records indicated that the Base Motor Pool had used chemical materials that included acetone, trichloroethene (TCE), and 2-butanone (methyl-ethyl-ketone [MEK]). A 550-gallon steel underground storage tank (UST) was installed at the site in 1983 to store waste oil, but was later removed in 1993. In addition, fuel bladders (mobile storage tanks) that ranged in size from 600 gallons to 20,000 gallons were stored within the DRMO until their disposal.

Site 93 is located in the Camp Geiger section of Camp Lejeune. Site 93 is located near Building TC-942 at the intersection of Ninth and “E” Streets. The site area is relatively flat and covered by asphalt, gravel and grass. The eastern portion of the site is wooded and slopes gently toward Edwards Creek. Ground surface elevations are approximately 5 to 20 feet above mean seal level (msl) in the vicinity of the site.

Site 93 contains several areas of contamination that have been investigated under the underground storage tank (UST) Investigation Program starting in 1995 and the Installation Restoration (IR) Program in 1996. Originally, the focus of the site investigation was on a small area near the southwest corner of Building TC-942 that formerly contained a 550-gallon UST used to store waste oil. This UST was removed in 1993. Subsequent investigations have revealed several contaminant plumes throughout the site, spanning from the original UST to the barracks area.

2.2.8 OU 20, Site 86

Site 86, located within OU 20, on MCAS New River is bordered by Campbell Street to the north, Curtis Road to the east, White Street to the west, and the MCAS New River Flight Line to the south OU 20. Site 86 was used from 1954 to 1986 as a storage area for petroleum products (#6 fuel oil and waste oil) in three 25,000 gallon ASTs. The tanks were emptied in 1988, and removed in 1992. Site 86 now includes SWMU 303/318, where CVOCs were identified in the groundwater from an undetermined source. Current COCs: benzene, TCE, PCE, cis-1,2-DEC, and VC. The site is relatively level with a slight slope toward the New River. Approximately half of site 86 is located on an active military flight line with multiple areas of limited or restricted access. Approximately half of the site is an open grassy area.

Potential sources of contamination at Site 86 include the following: the AST area which housed three 25,000-gallon ASTs from 1954 to 1992; the helicopter wash pad which operated until 2001; several hangars used for aircraft maintenance; SWMU 303, which consisted of two former steel ASTs; SWMU 318, which consisted of a concrete, multi-chambered oil/water separator associated with the helicopter wash pad; a gas station/garage still in use; and UST AS-510 located near the footprints of three buildings formerly used for activities, including a steam power plant and waste storage. Current COCs consist of: Benzene; TCE; PCE; cis-1,2-DCE; and VC.

2.2.9 OU 21, Site 73

OU 21, Site 73 encompasses the Amphibious Vehicle Maintenance Facility located in the Courthouse Bay Area. Site 73 is roughly bounded by State Route 172 (Sneads Ferry Road) to the north, Courthouse Bay to the south and unnamed tributaries to Courthouse Bay to the east and west.

The Amphibious Vehicle Maintenance Facility (Site 73) began operations in 1946 and remains active. Site 73 consists of numerous buildings, ASTs, underground storage tanks (USTs), vehicle wash racks, and oil/water separators. Active USTs and former USTs locations are present within the fenced area surrounding Building A47 and in the vicinity of Buildings A1, A2, and A10. Non-petroleum type wastes generated during maintenance activities are currently handled at active Hazmat Storage Areas located across the site.

Maintenance activities between 1946 and 1977 reportedly included discharging used motor oil and battery acid directly to the ground surface northeast of the Building A3.

2.2.10 OU 23, Site 49

Site 49, is the Former Marine Corps Air Station Suspected Minor Dump Site. Site 49 was originally identified in the Initial Assessment Study (IAS) completed in 1983 by Water and Air Research, Inc. (WAR) as a potential minor dump site where minor quantities of paint or paint-related waste was disposed of. The dates of operation are unknown. The Site encompasses approximately 2 acres of wooded land along 800 feet of the New River. A steel building (AS810) currently used for the storage of miscellaneous industrial materials is located approximately 50 feet from the northeast boundary.

A licensed map of the project work area is attached at the end of section 2.

2.3 Description of Tasks

Below is a description of the tasks covered by this plan. Any additions or changes in scope will require a revision to this HSP; see Change Management below.

Scope of work covered by this HSP includes:

- Groundwater sampling at LTM sites
- Subcontractor screening Site 69 wells for list of chemical warfare agents (CA). This work has been subcontracted to Edgewood Chemical Biological Center (Army specialty CA group). They will screen wells for list of CA common at the time frame of the anecdotal evidence of CA drum burial. If CA or breakdown products are identified, the job will shut down. If no CA identified, the wells can be sampled using appropriate PPE.

- Groundwater sampling at site 69, possible CA, though none detected in previous 2010 sampling by ECBC. No other CA sampling data available.
- Surface water and pore water sampling
- Utility clearance for MW installation.
- Potential monitoring well installation and development at various sites depending on results of LTM sampling.
- Installation and development of 5 monitoring wells at site 69. The proposed monitoring well installation locations vary from 330 feet to 860 feet downgradient of the suspected disposal area. Evaluation of site conditions indicated that the average linear groundwater seepage velocities in the surficial aquifer and upper Castle Hayne aquifer are 56 feet/year (feet/yr) and 2 feet/yr, respectively. Consequently, potential releases of CA that may have occurred after the completion of the March 2010 sampling event (the most recent event, where CA was analyzed for and not detected by ECBC prior to sampling) would conservatively require more than 5 years to reach the closest proposed drilling locations. Based on the proposed locations of the new monitoring wells, onsite CA monitoring will not be required for the monitoring well installation activities scheduled in 2014.
- Vapor intrusion port sampling

2.4 Change Management

Changes to this HSP shall be documented and approved by the CH2M HILL Responsible Health and Safety Manager for the project. The following are examples of changes that may require a revision to the plan:

- Change in CH2M HILL staff;
- New subcontractor to perform work;
- New chemicals brought to site for use;
- Change in scope or addition of new tasks;
- Change in contaminants of concern (COCs) or change in concentrations of COCs; and
- New hazards or hazards not previously identified that are not addressed in this HSP.

2.5 Changes to Health and Safety Plans

Changes to the HSP shall be documented and accepted by using the Health and Safety Field Change Request (FCR) form (included in Attachments) or by resubmitting a revised HSP for acceptance. A revised HSP should be produced when a large number of changes (e.g., 15 or more not including AHAs) using FCRs has been employed. The CH2M HILL Project Manager (PM) and RHSM shall be responsible for the review and acceptance of the FCR, and the RHSM will maintain an FCR log of approved changes. Field Change Requests are not required for safety-related changes that a Safety Coordinator (SC) or RHSM would normally make in the field, such as upgrade or downgrade to PPE within pre-established action levels, expansion or reduction of work control zones based on air monitoring results, and similar changes made within the operating parameters of the HSP. The field copy of the HSP shall be kept up to date by annotating the appropriate section (i.e., update to AHA) to indicate that an FCR is in effect; copies of FCRs should be kept with the HSP. The FCR number must be referenced in the HSP and available for review.

2.6 Daily Safety Meetings and Pre-Task Safety Plans

Safety meetings are to be held with all project personnel in attendance to review the hazards, controls, and required procedures/AHAs that apply for each day's activities, as well as any environmental issues, requirements and/or best management practices:

- Everyone involved in the day's work needs to sign a sign-in form to show they've had a briefing/attended a meeting.

- Pre-Task Safety Plans (PTSPs) serve the same purpose as general safety meetings, but the PTSPs are completed by individual crews to focus on those hazards posed by their specific work.
- For smaller crews, or if there is just one activity, the PTSP is often used as a means to document the overall Safety Meeting.

A copy of the PTSP and Daily Safety Meeting sign-in sheet is included as an Attachment.

2.7 Subcontractor HSSE Chartering Meeting

A subcontractor HSSE chartering meeting shall be held with subcontractors performing field work on the project. The purpose of the meeting is to discuss and agree on key HSSE requirements on a project, and to emphasize and reinforce CH2M HILL expectations for subcontractor HSSE performance. The target audience includes key CH2M HILL project staff with HSSE responsibilities (e.g., PM, RHSM, SC, Field Team Leader (FTL)) and key Subcontractor staff (e.g., project manager, supervisors, designated field HSSE contact, drill team leads, foreman). For small scale projects (e.g., small drill crew and limited CH2M HILL staff), all the subcontractor crew members should attend if available. The meeting should be held prior to mobilization with enough time to ensure that HSSE issues identified can be addressed prior to the start of work. The meeting can be held over the phone or in person depending on project needs. An example agenda can be found in the E&NM Program Element Guideline, "Subcontractor HSSE Chartering Meeting."

SECTION 3

Project Organization and Responsibilities

A full description of responsibilities, including Employee Responsibilities and Authority, can be found in the Handbook, Section 3, "Roles and Responsibilities."

3.1 Client

Contact Name:	David Cleland/NAVFAC
Phone:	757-322-4851
Facility Contact Name:	Charity Delaney, Patricia Vanture
Phone:	Charity Delaney 910-451-9385, Patricia Vanture 910-451-9641

3.2 CH2M HILL

Project Manager:	
PM Name:	Betsy Reid
Office:	RAL
Telephone number:	919-760-1751
Cellular Number:	540-308-5210

Environmental Manager:	
EM Name:	Hope Wilson
Office:	ATL
Telephone number:	678-530-4226
Cellular Number:	678-656-5411

Responsible Health and Safety Manager:	
RHSM Name:	Carl Woods
Office:	CIN
Telephone number:	513-889-5771
Cellular Number:	513-319-5771

Safety Coordinator:	
RHSM Name:	David Seed
Office:	RAL
Telephone number:	919-760-1770
Cellular Number:	919-673-3002

Safety Coordinator	
SC Name:	Micheal Tekle
Office:	CLT
Telephone number:	704-544-4040
Cellular Number:	605-415-224

Safety Coordinator:	
SC Name:	Bridget Berglind
Office:	CLT
Telephone number:	704-544-4047
Cellular Number:	864-630-0437

3.3 CH2M HILL Subcontractors

Subcontractor:	
Contact Name:	Driller TBD
Telephone number:	
Cellular Number:	

Subcontractor:	
Contact Name:	Driller TBD
Telephone number:	
Cellular Number:	

Subcontractor: Edgewood Chemical Biological Center (ECBC)	
Contact Name:	Steve Norman
Telephone number:	410-436-8428
Cellular Number:	

Subcontractor:	
Contact Name:	Steve Norman
Telephone number:	410-436-8428
Cellular Number:	

This HSP does not cover contractors that are contracted directly to the client or the owner. CH2M HILL is not responsible for the health and safety or means and methods of the client contractor's work, and we must never assume such responsibility through our actions (such as advising on health and safety issues).

SECTION 4

Standards of Conduct

All individuals associated with this project must work injury-free and drug-free and must comply with the standards of conduct stated in the Handbook (Section 4, “Standards of Conduct”), comply with all requirements of this HSP, and Subcontractors must also comply with the safety requirements of the Subcontractor HSP. Forms related to Subcontractor Safety (i.e., Observation Hazard Form and Stop Work Order Form) are attached to this HSP.

SECTION 5

Project Hazard Analysis

A health and safety risk analysis (Table 1) has been completed for this project. Specific project activities are listed in Table 1 with a designation of who performs the task, CH2M HILL (C) or Subcontractor (S). An Activity Hazard Analysis has been developed for each project activity. AHAs prepared for CH2M HILL activities are included as an attachment to this HSP.

CH2M HILL subcontractors are required to provide AHAs specific to their scope of work on the project for acceptance by CH2M HILL prior to the start of work. Each subcontractor shall submit AHAs for their field activities, as defined in their scope of work, along with their project-specific safety plan and procedures. Additions or changes in field activities, equipment, tools, or material used to perform work or hazards not addressed in existing AHAs requires either a new AHA to be prepared or an existing AHA to be revised.

TABLE 1
Health and Safety Risk Analysis Table

Associated Hazard Section / Project Activity	GW, Pore, and SW Sampling	MW Installation	VI Sampling	Utility clearance
General Hazards – Refer to General Hazards and Controls in HSSE Handbook, Section 7.				
Driving Safety	C	C,S	C	C,S
Field Vehicles	C	C,S	C	C,S
Fire Prevention		S		
General Practices and Housekeeping	C	C,S	C	C,S
Hazard Communication	C	C,S	C	C,S
Knife Use		S		
Manual Lifting	C	C,S	C	S
Shipping and Transportation of Hazardous Waste		C		
Project-Specific Hazards – Refer to HSSE Handbook, Section 8.				
Crystalline Silica		S		
Drilling		S		
Drum and Portable Tank Handling		C,S		
Drum Sampling Safety	C	C		
Groundwater Sampling/Water Level Measurements	C	C,S		
Hand and Power Tools	C	C,S	C	S
MEC/MMPEH/Munitions Response	C	C,S	C	C,S
Portable Generators	C	C,S	C	
Pressurized Lines/Equipment		S		
Pressure Washing Operations		S		
Traffic Control	C	C,S	C	C,S
Utilities (overhead)		S		
Utilities (underground)		S		

TABLE 1
Health and Safety Risk Analysis Table

Associated Hazard Section / Project Activity	GW, Pore, and SW Sampling	MW Installation	VI Sampling	Utility clearance
Physical Hazards – Refer to Physical Hazards in HSSE Handbook, Section 9				
Noise		C,S		
Ultraviolet Light exposure (sunburn)	C	C,S	C	C,S
Temperature Extremes	C	C,S	C	C,S
Biological Hazards – Refer to Biological Hazards in HSSE Handbook, Section 10, and the additional project-specific controls in this plan.				
Bees and Other Stinging Insects	C	C,S	C	C,S
Coyotes	C	C,S	C	C,S
Fire Ants	C	C,S	C	C,S
Mosquito Bites	C	C,S	C	C,S
Poison Ivy, Oak and Sumac	C	C,S	C	C,S
Snakes	C	C,S	C	C,S
Spiders – Brown Recluse and Black Widow	C	C,S	C	C,S
Ticks	C	C,S	C	C,S

Notes:

C – Hazard section applicable to CH2M HILL personnel

S – Hazard section applicable to Subcontractor personnel

SECTION 6

Hazards and Controls

Safe work practices and hazard control measures to reduce or eliminate potential hazards as identified in Table 1 are stated in the Handbook, Sections 7-10, the associated CH2M HILL SOP, and are addressed in project AHAs. Any additional project-specific control measures, or those hazards requiring additional emphasis, are identified in the following sections.

Always consult the appropriate CH2M HILL Enterprise SOP to ensure all requirements are implemented. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the RHSM for clarification.

6.1 Physical Hazards and Controls

Heat stress is a potential issue at these sites. Follow Handbook guidelines, conduct pulse monitoring as specified.

6.2 Biological Hazards and Controls

Alligators and/or crocodiles are found in the southeastern United States, including Florida; eastern Texas; Louisiana; southern Georgia, Alabama, and Mississippi; coastal North and South Carolina; the southeastern corner of Oklahoma; and southern tip of Arkansas.

Primarily alligators are found in freshwater habitats and crocodiles in coastal estuaries (they are better at expelling salt from the water). Other differences include their coloring; alligators are black while crocodiles tend to be an olive green. The main way to tell the difference is by the shapes of their snouts. Alligators have a blunt "U" shaped nose while crocodiles have a more pointed "A" shaped nose.

Onset of warm weather is when alligators and crocodiles start getting active. Alligators and crocodiles may have come to associate people with food supply because, although the practice is discouraged, they are sometimes fed by people or people may dump fish scraps or other food into bodies of water. Sometimes, alligators come out of the water to bask in the sun or move between wetlands. In many cases, if left alone, these alligators will eventually move on to areas away from people.

Generally, alligators less than four feet in length are not large enough to be dangerous unless handled.

Other precautions to take include:

- Be aware of the possibility of alligators when you are in or near fresh or brackish water. Bites may occur when people do not pay close enough attention to their surroundings when working or recreating near water.
- If you encounter an alligator, move slowly away in the direction you came in order not to make it feel threatened. If you discover baby alligators or nests, immediately move away from the area to avoid an encounter with the mother alligator that will defend her young. Alligators can move quickly for short bursts.
- Alligators are most active between dusk and dawn. Therefore, avoid working in these areas at night.
- Leave alligators alone. Many states' laws prohibit killing, harassing or possessing alligators. Handling even small alligators can result in injury.
- If you are attacked, fight back aggressively so the alligator will let you go.

Ticks are plentiful at these LTM sites. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray only outside of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks. Poison ivy may also be an issue at some of these LTM sites. Be able to identify and avoid it.

6.3 Chemical Hazards and Controls

Several sites have COCs in GW at concentrations above the exposure limit. Use the specified 11.7 Ev Multirae to monitor the breathing zone around wells when first removing the well cap, and during sampling. Notify RHSM if upgrade is required prior to upgrading.

Site 69 has anecdotal evidence for chemical agent (CA) burial. The wells were sampled in 2010, with no detections of CA or their degradation products. Site 69 wells will be initially screened by Edgewood Chemical Biological Center (ECBC) (Army center for CA). ECBC will collect instantaneous readings with monitoring equipment, and if no detections, ship samples off to their specialty lab for analysis for CA or breakdown products. If none detected, wells can be approached and sampled by CH2MHILL samplers. CH2MHILL oversight will stay out of exclusion zone while ECBC is working.

6.4 Additional Project-Specific Hazard Controls

Sites 69 and 82 are parts of larger IR sites that contain munitions and explosives of concern/material potentially presenting an explosive hazard (MEC/MPPEH). However, no know MEC/MPPEH has been found or is expected at sites 69 and 82. UXO avoidance support will not be necessary, however follow the Handbook for avoidance, and 3R training is required when working on these two sites.

6.4.1 Avoidance of MEC and/or MPPEH

(Reference CH2M HILL, SOP HSE-610, Explosives Usage and Munitions Response)

If work will be conducted on a government/military facility or ex-government/military facility; area currently or previously used as a range; or if military munitions, MEC, or unexploded ordnance (UXO) are associated with the scope of work or location immediately contact the CH2MHILL Central Point of Contact for Explosives Usage and Munitions Response. The following will be required prior to any field work:

- Setting up a conference call with all required personnel to conduct a basic safety risk assessment over the phone.
- Providing written directions detailing job-specific requirements and what actions to take to ensure safety during the work.
- "3R Training" will be required for all affected project personnel. This training teaches personnel to Recognize, Retreat, and Report.
- Immediately Stop Work (RECOGNIZE).

RECOGNIZE: Do not disturb or move the item, as munitions can become very unstable over time. It can detonate with movement or sometimes due to ground vibration or a stray electro-magnetic source. MEC/MPPEH can be present in all shapes, sizes colors or as items not normally considered a hazard (i.e. flares, soil with propellant etc). It must also be recognized that exposure to weather and time can alter or remove identification markings.

1) **Secure area/location** where the MEC/MPPEH item is discovered **(RETREAT)**.

RETREAT*: Stop and secure any operating equipment to the extent possible. Mark the general area/location of the MEC/MPPEH hazard with tape, colored cloth, or colored ribbon. If available, attach the marker to a branch, structure or other existing object so that it is about 3 ft (.9 m) off the ground and visible from all approaches. Place the marker no closer than the point where you first recognized the MEC/MPPEH hazard and DO NOT drive stakes into the ground or otherwise disturb the surface. Leave by the same route you entered the area if possible. Clear site of all workers and secure from unauthorized entry.*

Do not transmit any radio/cellular phone frequencies unless maximum fragmentation distances separation distances are established for the suspected type of MPPEH/MEC discovered. Signals transmitted from items such as cell phones, short-wave radios, single side-band radios or other communications and navigation devices may detonate the MPPEH/MEC item.

2) Immediately make notification to the CH2M HILL Project Manager (REPORT).

***REPORT**: Once area has been evacuated, appropriate notifications shall be made immediately. Provide as much information as possible, including location, approximate size, shape, color, and any other distinguishing features such as nomenclature or wiring, fins, etc.*

6.4.2 Traffic Control (Site 35)

A portion of the groundwater sampling and gauging at Site 35 is to be conducting within the Highway 17 Bypass ROW. Access in and around this area is controlled by the North Carolina Department of Transportation (NCDOT) and requires a site-specific traffic control plan (**Attachment A**) provided and implemented by CH2M. Procedures specified in the ENBG HSE Handbook (Section 8.54- Traffic Control) will be implemented as necessary.

All workers will be required to wear high visibility reflective vests while working in this area and while performing traffic control in and around the Highway 17 Bypass ROW. Traffic control will include erection of temporary work area working signs and installation of work zone barrels within two feet of the edge of the pavement. The signs and barrels will be installed after 0900 and removed before 1500 each work day, so that morning and evening traffic flow is not affected. No work will be performed within ten feet of the edge of the highway pavement. CH2M employee vehicles will also be parked more than ten feet from the pavement. NCDOT has agreed to allow access to this area only between the hours of 0900 and 1500 Monday through Friday; all work is to cease before and after these hours of operation within the ROW. Removal of remediation-derived waste (RDW) must also fall between the specified hours.

SECTION 7

Hazard Communication

As indicated in Section 7 of the Handbook, under “Hazard Communication,” the hazard communication (HazCom) coordinator (the SC or qualified designee) must perform the following (additional HazCom duties are outlined in the Handbook):

- Complete an inventory of chemicals brought on site by CH2M HILL using the chemical inventory form included as an attachment to this HSP;
- Confirm that an inventory of chemicals brought on site by CH2M HILL subcontractors is available;
- Before or as the chemicals arrive on site, obtain a Safety Data Sheet (SDS) for each hazardous chemical and include on the chemical inventory sheet (attached to this HSP) and add the SDS to the SDS attachment section of this HSP;
- Give employees required chemical-specific HazCom training using the chemical-specific training form included as an attachment to this HSP.

SECTION 8

Contaminants of Concern

The table below summarizes the potential contaminants of concern (COC) and their occupational exposure limit and signs and symptoms of exposure. The table also includes the maximum concentration of each COC and the associated location and media that was sampled (groundwater, soil boring, surface soil). These concentrations were used to determine engineering and administrative controls described in the "Project-Specific Hazard Controls" section of this HSP, as well as PPE and site monitoring requirements.

The table below summarizes the potential contaminants of concern (COC) and occupational exposure limit/signs and symptoms of exposure for IR Sites 6/82, 35, 36, 49, 69, 73, 78, 86, 89, and 93. The table also includes the maximum groundwater concentration and location of each COC. These concentrations were used to determine engineering and administrative controls described in the "Project-Specific Hazard Controls" section of this HSP, as well as PPE and site monitoring requirements.

Site 3 - Contaminants of Concern					
Contaminant	**Location and Maximum[a] Concentration (ug/L)**	**Exposure Limit [b]**	**IDLH[c]**	**Symptoms and Effects of Exposure**	**PIP[d] (eV)**
Benzo(a)anthracene	GW: IR03-MW02IW 0.305	0.1 mg/m^3 (coal tar pitch volatiles)	80 Ca	dermatitis, bronchitis, [potential occupational carcinogen]	9.24

Footnotes:

[a] Specify sample-designation and media: GW (Groundwater), PW (Pore Water)

[b] Appropriate value of permissible exposure limit (PEL), recommended exposure limit (REL), or threshold limit value (TLV) listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown;

eV = electron volt; mg/kg = milligram per kilogram; mg/m3 = milligrams per cubic meter; ug/m3 = micrograms per cubic meter

Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of PPE.	Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of respiratory protection when other forms of control do not reduce the potential for exposure.	Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

Site 6 and 82 Contaminants of Concern					
Contaminant	Location and Maximum[a] Concentration (µg/L)	Exposure Limit (ppm)[b]	IDLH (ppm)[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Benzene	GW: IR06-MW69LCH 9.9[1]	1 Ca	500 Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
Ethylbenzene	GW: IR06-MW47 28J[3]	100	800	irritation eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma	8.76
1,2 dichrloroethane	GW: IR82-MW17UCH 13J	50	50 Ca	irritation eyes, corneal opacity; central nervous system depression; nausea, vomiting; dermatitis; liver, kidney, cardiovascular system damage;	11.05
Chlorobenzene	GW: IR06-MW80 3,500[1]	75	1,000	Eye, skin, and nose irritation; drowsiness; central nervous system depression	9.07
Chloromethane	GW: IR06-GW34 22J[1]	100	2000 Ca	dizziness, nausea, vomiting; visual disturbance, stagger, slurred speech, convulsions, coma; liver, kidney damage; liquid: frostbite; reproductive, teratogenic effects;	11.28
Chloroform	GW: IR06SRW01 29[4]	50 Ca	500 Ca	Eye and skin irritant; dizziness, mental dullness, nausea, confusion, headache; fatigue; anes, enlarged liver	11.42
1,1,2,2-Tetrachloroethane	GW: IR82-MW16 8,700[1]	5 Ca	100 Ca	nausea, vomiting, abdominal pain; tremor fingers; jaundice, hepatitis, liver tenderness; dermatitis; leukocytosis (increased blood leukocytes); kidney damage	11.10
1,1,2 Trichloroethane	GW: IR82-MW13 120J [1]	10 Ca	100 Ca	irritation eyes, nose; central nervous system depression; liver, kidney damage; dermatitis;	11.00
Trichloroethene	GW: IR82-MW17UCH 40,000[1]	100	1000	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
Tetrachloroethene	GW: IR06-GW34 4,000[1]	100	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
cis 1,2 DCE	GW: IR82-MW17LCH 14,000[1]	ND	Ca (N.L.)	irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis	10.00
trans 1,2 DCE	GW: IR82-MW17LCH 3,400[1]	200	1000 Ca	irritation eyes, respiratory system; central nervous system depression	9.65
1,1 dichloroethene	GW: IR06-GW49IW 770[1]	NA	Ca	irritation eyes, skin, throat; dizziness, headache, nausea,	10.00

Site 6 and 82 Contaminants of Concern					
Contaminant	Location and Maximum[a] Concentration (µg/L)	Exposure Limit (ppm)[b]	IDLH (ppm)[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
				dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis;	
1,2 dichloropropane	GW: IR06-GW43DW 1.32J[2]	75	400 Ca	irritation eyes, skin, respiratory system; drowsiness, dizziness; liver, kidney damage; in animals: central nervous system depression	10.87
1,4 dichlorobenzene	GW: IR06-SRW03 3.4J[3]	75	150 Ca	Eye irritation, swelling periorbital (situated around the eye); profuse rhinitis; headache, anorexia, nausea, vomiting; weight loss, jaundice, cirrhosis; in animals: liver, kidney injury	8.98

Footnotes:

[1] October 2012 OU2 Supplemental Investigation analytical data

[2] March 2013 LTM analytical data

[3] 2005 analytical data

[4] 2003 analytical data

[a] Specify sample-designation and media: GW (Groundwater)

[b] Appropriate value of permissible exposure limit (PEL), recommended exposure limit (REL), or threshold limit value (TLV) listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

eV = electron volt

mg/kg = milligram per kilogram

mg/m3 = milligrams per cubic meter

ug/m3 = micrograms per cubic meter

Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of PPE.	Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of respiratory protection when other forms of control do not reduce the potential for exposure.	Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

Site 35 Contaminants of Concern					
Contaminant	Location and Maximum[a] Concentration (December 2013) (µg/L)	Exposure Limit (ppm)[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Benzene	GW: IR35-MW87IW 8.34[1]	1	500 Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
1,1,2,2-PCA	GW: IR35-MW32 6.7[3]	5	100 Ca	nausea, vomiting, abdominal pain; tremor fingers; jaundice, hepatitis, liver tenderness; dermatitis; leukocytosis (increased blood leukocytes); kidney damage; [potential occupational carcinogen]	11.10
TCE	GW: IR35-MW91IW 16.5[1]	10	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
PCE	GW: IR35-MW86IW 0.264[2]	25	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
cis 1,2 DCE	GW: IR35-MW87IW 40.4[1]	ND	Ca (N.L.)	irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]	10.00
Trans 1,2 DCE	GW: IR35-MW87IW 3.49[1]	200	1000 Ca	irritation eyes, respiratory system; central nervous system depression	9.65
VC	GW: IR35-MW90IW 48.7[1]	1	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99

Footnotes:

[1] Data from FY2013 LTM

[2] Data from February 2011

[3] Data from May 2008-1,1,2,2 PCA not detected in groundwater since this event

[a] Specify sample-designation and media: GW (Groundwater)

[b] Appropriate value of permissible exposure limit (PEL), recommended exposure limit (REL), or threshold limit value (TLV) listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

eV = electron volt

mg/kg = milligram per kilogram

mg/m3 = milligrams per cubic meter

ug/m3 = micrograms per cubic meter

Site 35 Contaminants of Concern		
Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of PPE.	**Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of respiratory protection when other forms of control do not reduce the potential for exposure.	**Other:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

Site 36 Contaminants of Concern					
Contaminant	Location and Maximum[a] Concentration (µg/L)	Exposure Limit (ppm)[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Benzene	GW: IR36-GW21IW 15J[2] SW: ND	1	500 Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
1,1 DCA	GW: ND SW: ND	100	3000	irritation skin; central nervous system depression; liver, kidney, lung damage	11.06
1,1 DCE	GW: IR35-MW90IW 0.26J[1] SW: ND	1	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99
1,1,2,2-PCA	GW:IR36-GW21IW 6.551 SW: ND	5	100 Ca	nausea, vomiting, abdominal pain; tremor fingers; jaundice, hepatitis, liver tenderness; dermatitis; leukocytosis (increased blood leukocytes); kidney damage; [potential occupational carcinogen]	11.10
TCE	GW: IR36-GW10IW 33.91 SW: ND	10	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
PCE	GW: IR36-MW21IW 0.53J[1] SW: ND	25	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
cis 1,2 DCE	GW: IR36-MW10IW 0.9[1] SW: ND	ND	Ca (N.L.)	irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]	10.00
trans 1,2 DCE	GW:IR36-MW10IW 1.56J[1] SW: ND	200	1000 Ca	irritation eyes, respiratory system; central nervous system depression	9.65
VC	GW:IR36-GW10IW 0.904J[1] SW: ND	1	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99

Site 36 Contaminants of Concern					
Contaminant	Location and Maximum[a] Concentration (µg/L)	Exposure Limit (ppm)[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)

Footnotes:

[1] Data from FY2012 LTM

[2] Data from August 2006

[a] Specify sample-designation and media: GW (Groundwater) SW (Surface Water)

[b] Appropriate value of permissible exposure limit (PEL), recommended exposure limit (REL), or threshold limit value (TLV) listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

eV = electron volt

mg/kg = milligram per kilogram

mg/m3 = milligrams per cubic meter

ug/m3 = micrograms per cubic meter

Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of PPE.	Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of respiratory protection when other forms of control do not reduce the potential for exposure.	Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

Site 49 - Contaminants of Concern					
Contaminant	Location and Maximum[a] Concentration	Exposure Limit (ppm)[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Benzene	GW: IR49-MW01 1[1] PW: ND	1	500 Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
1,1,2,2-PCA	GW: IR49-MW01 1[1] PW: IR49-PW01 0.19J	5	100 Ca	Nausea, vomiting, abdominal pain; tremor fingers; jaundice, hepatitis, liver tenderness; dermatitis; leukocytosis (increased blood leukocytes); kidney damage	11.10
1,1,2 TCA	GW: IR49-TW07 1.35 PW: ND	10	10 Ca	Irritation eyes, nose; central nervous system depression; liver, kidney damage; dermatitis	11.00
PCE	GW: IR49-TW07 1.33[2] PW: ND	25	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
TCE	GW: IR49-MW01 100[1] PW: IR49-PW01 1.1	10	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
cis 1,2 DCE	GW: IR49-MW01 70[1] PW: IR49-PW01 2.5	NA	Ca (N.L.)	irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]	10.00
trans-1,2-DCE	GW: IR49-MW01 0.28J[1] PW: IR49-PW01 1.9	200	1000 Ca	irritation eyes, respiratory system; central nervous system depression	9.65
1,2-DCA	GW: IR49-TW07 0.62J[2] PW: ND	50	200 Ca	Irritation eyes, corneal opacity; central nervous system depression; nausea, vomiting; dermatitis; liver, kidney, cardiovascular system damage;	11.05
Vinyl Chloride	GW: IR49-MW01 2[1] PW: IR49-PW01 0.3	1	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99

Footnotes:

[1] Data from 2012 RI/FS

[2] Data from 2009 PASI

[a] Specify sample-designation and media: GW (Groundwater), PW (Pore Water)

[b] Appropriate value of permissible exposure limit (PEL), recommended exposure limit (REL), or threshold limit value (TLV) listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

eV = electron volt; mg/kg = milligram per kilogram; mg/m3 = milligrams per cubic meter; ug/m3 = micrograms per cubic meter

Site 49 - Contaminants of Concern		
Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of PPE.	Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of respiratory protection when other forms of control do not reduce the potential for exposure.	Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

Site 69 - Contaminants of Concern					
Contaminant	Location and Maximum[a] Concentration	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
1,2-Dichloroethane	GW:IR69-GW15IW 0.019 ppm	1 ppm	50 ppm	irritation eyes, corneal opacity; central nervous system depression; nausea, vomiting; dermatitis; liver, kidney, cardiovascular system damage; [potential occupational carcinogen]	11.05
1,1,2,2-Tetrachloroethane	GW: IR69-GW02 0.01 ppm	1 ppm	100 Ca	Nausea, vomiting, abdominal pain, finger tremors, jaundice, hepatitis, liver tenderness, monocytosis, kidney damage, dermatitis	11.10
Trichloroethylene (TCE)	GW:IR69-GW15IW 0.1 ppm	50 ppm	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
Vinyl Chloride	GW: IR69-GW15IW 5.5 ppm	1 ppm	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99
L	UK	0.003 mg/m^3	0.23 mg/m^3	Blister agent (vesicant) that causes severe, delayed burns to the eyes, skin, and respiratory tract.	NA
H / HD	UK	0.0004 mg/m^3	0.7 mg/m^3	Blister agent (vesicant) that causes severe, delayed burns to the eyes, skin, and respiratory tract.	NA
GB / GA / GD	UK	0.00003 mg/m^3	0.1 mg/m^3	Miosis, runny nose, shortness of breath, localized sweating, nausea, apnea, convulsions, unconsciousness, death	NA

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), S (Surface Soil), SL (Sludge), SW (Surface Water).

[b] Appropriate value of TWA (8 hr worker) listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.	Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.	Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

Site 73 - Contaminants of Concern					
Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Benzene	GW:IR73-MW65DW 6.18	1	500 Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
TCE	GW:IR73-MW26IW 2.06	50	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
cis 1,2 DCE	GW:IR73-MW27DW 230J	ND	Ca (N.L.)	irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis;	10.00
trans-1,2-DCE	GW:IR73-MW65DW 6.8	200	1000 Ca	irritation eyes, respiratory system; central nervous system depression	9.65
1,1 DCE	GW:<0.5	25	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), S (Surface Soil), SL (Sludge), SW (Surface Water).

[b] Appropriate value of TWA (8 hr worker) listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.	Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.	Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

Site 78 - Contaminants of Concern					
Contaminant	Location and Maximum[a] Concentration (µg/L)	Exposure Limit (ppm)[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Benzene	GW:IR78GW53 218	1	500 Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
Ethylbenzene	GW:IR78GW60 801	100	800	Eye, skin, and mucous membrane irritation; headache; dermatitis; narcotic; coma	8.76
Toluene	GW:IR78-RW15 668	20	500	Eye and nose irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, excessive tearing, nervousness, muscle fatigue, paresthesia, dermatitis, liver and kidney damage	8.82
Xylenes	GW:IR78-GW60 3500	100	900	Irritated eyes, skin, nose, and throat; dizziness; excitement; drowsiness; incoherence; staggering gait; corneal vacuolization; anorexia; nausea; vomiting; abdominal pain; dermatitis	8.56
Isopropylbenzene	GW:IR78-GW60 47.2	50	900	irritation eyes, skin, mucous membrane; dermatitis; headache, narcosis, coma	8.75
1,2 dibromo-3-chloropropane	<0.5	0.001	N.D. Ca	Irritant to eyes, nose, and throat, drowsiness, nausea, vomiting, pulmonary edema, liver, kidney, sterility	?
Methylene chloride	<0.5	125	2300 Ca	irritation eyes, skin; lassitude (weakness, exhaustion), drowsiness, dizziness; numb, tingle limbs; nausea	11.32
PCE	GW:IR78-GW73 14.8	25	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
TCE	GW:IR78-GW60 60.2	50	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
cis 1,2 DCE	GW:IR78-GW42 293	ND	Ca (N.L.)	irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]	10.00

Site 78 - Contaminants of Concern					
Contaminant	**Location and Maximum[a] Concentration (µg/L)**	**Exposure Limit (ppm)[b]**	**IDLH[c]**	**Symptoms and Effects of Exposure**	**PIP[d] (eV)**
trans-1,2-DCE	GW:IR78-GW42 1.59	200	1000 Ca	irritation eyes, respiratory system; central nervous system depression	9.65
1,1 DCA	GW:IR78-GW42 112	100	3000	irritation skin; central nervous system depression; liver, kidney, lung damage	
1,1 DCE	GW:IR78-GW42 5.94	25	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32

Footnotes:

[a] Specify sample-designation and media: GW (Groundwater)

[b] Appropriate value of TWA (8 hr worker) listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.	Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.	Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

Site 86 - Contaminants of Concern					
Contaminant	Location and Maximum[a] Concentration (ug/L)	Exposure Limit [b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Benzene	GW:IR86-MW52 11 [1]	1 ppm	500 ppm ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
PCE	GW:IR86-MW10IW 190 [2]	25	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
TCE	GW:IR86-MW42IW 330 [2]	50	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
cis-1,2-DCE	GW:IR86-MW15IW 350 [2]	ND	Ca (N.L.)	irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]	10.00
VC	GW:IR86OMW55IW 76 [1]	1	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99

Footnotes:

[1] Data from 2012 RI/FS

[2] Data from 2009 PASI

[a] Specify sample-designation and media: GW (Groundwater), PW (Pore Water)

[b] Appropriate value of permissible exposure limit (PEL), recommended exposure limit (REL), or threshold limit value (TLV) listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

eV = electron volt; mg/kg = milligram per kilogram; mg/m3 = milligrams per cubic meter; ug/m3 = micrograms per cubic meter

Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of PPE.	Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of respiratory protection when other forms of control do not reduce the potential for exposure.	Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

Site 89 - Contaminants of Concern					
Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit (ppm)[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
1,1,2,2 PCA	GW: IR89-GW80DWR 8.9[1]	1	100 Ca	Nausea, vomiting, abdominal pain, finger tremors, jaundice, hepatitis, liver tenderness, monocytosis, kidney damage, dermatitis	11.10
1,1,2 TCA	GW: IR89-GW53 0.15[1]	10	10 Ca	Irritation eyes, nose; central nervous system depression; liver, kidney damage; dermatitis	11
TCE	GW: IR89-GW53 15.5[1]	50	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
PCE	GW: IR89-GW53 0.11[1]	25	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
cis 1,2 DCE	GW: IR89-MW09 20.0[1]	ND	Ca (N.L.)	irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]	10.00
trans-1,2-DCE	GW: IR89-MW56 1.75[1]	200	1000 Ca	irritation eyes, respiratory system; central nervous system depression	9.65
VC	GW: IR89-MW09 3.35[1]	1	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99

Footnotes:

[1] Data from March 2014

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), S (Surface Soil), SL (Sludge), SW (Surface Water).

[b] Appropriate value of TWA (8 hr worker) listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.	Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.	Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

Site 93 - Contaminants of Concern					
Contaminant	Location and Maximum[a] Concentration (µg/L)	Exposure Limit (ppm)[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
1,1,2,2 PCA	<0.5	1	100 Ca	Nausea, vomiting, abdominal pain, finger tremors, jaundice, hepatitis, liver tenderness, monocytosis, kidney damage, dermatitis	11.10
TCE	GW:IR93-MW06 21.8	50	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
PCE	GW:IR93-MW11 1.23	25	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
cis 1,2 DCE	GW:IR93-MW06 333	ND	Ca (N.L.)	Irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]	10.00
trans-1,2-DCE	GW:IR93-MW06 72.6	200	1000 Ca	Irritation eyes, respiratory system; central nervous system depression	9.65
1,2 DCE	GW:IR93-MW06 406	50	200 Ca	Irritation eyes, corneal opacity; central nervous system depression; nausea, vomiting; dermatitis; liver, kidney, cardiovascular system damage;	11.05
VC	GW:IR93-MW06 14	1	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), S (Surface Soil), SL (Sludge), SW (Surface Water).

[b] Appropriate value of TWA (8 hr worker) listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.	Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.	Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

SECTION 9

Site Monitoring

(Reference CH2M HILL SOP HSE-207, Exposure Monitoring for Airborne Chemical Hazards)

For each task listed in the table below, perform the associated monitoring ensuring the equipment is calibrated daily according to the manufacturer's recommendations. Use the Daily Site Monitoring Form (or equivalent) to document the calibration and the readings taken. Retain area monitoring readings with project records.

Exposure records (breathing zone and personal air sampling) must be preserved for the duration of employment plus thirty years. Copies of all project exposure records (e.g., copies of Daily Site Monitoring form or field logbook pages where breathing zone readings are recorded along with associated calibration) shall be sent to the Sector Safety Program Assistant (SPA) for retention and also maintained in the project files.

Subcontractors are responsible for monitoring and performing integrated personal sampling for their employees as documented in their HSP or, if permitted, according to the table below.

9.1 Direct Reading Monitoring Specifications

Instrument	Tasks	Action Levels[a]	Action to be Taken when Action Level reached	Frequency [b]	Calibration
Toxic Gas Monitor: MultiRAE Plus with 11.7eV lamp (VOCs, O_2, LEL, CO,, H_2S)	All intrusive Activities, GW sampling, MW drilling, development	< 1 ppm 1 to 10 ppm > 10 ppm	Level D Level C – Collect reading with colorimetric indicator tube for Benzene and Vinyl Chloride Evacuate work area and contact HSM	Initially and periodically during task	Daily
Detector Tube: Benzene specific 0.5/c (0.5 to 10 ppm range) with pre-tube, or equivalent	When PID readings are sustained above 1 ppm	<0.5 ppm 0.5-1 ppm >1 ppm	Level D Level C Evacuate work area and contact HSM	Initially and periodically when PID/FIB >1 ppm	Not applicable
Colorimetric Tube: Vinyl chloride specific (0.5 to 30 ppm range) with pre-tube, or equivalent	When PID readings are sustained above 1 ppm	<0.5 ppm 0.5 ppm	Level D Evacuate work area and contact HSM	Initially and periodically when PID/FID >1 ppm	Not applicable
Noise-Level Monitor [d]	Drilling	<85 dB(A) 85-120 dB(A) 120 dB(A)	No action required Hearing protection required Stop; re-evaluate	Initially and periodically during task	Daily
Heat Stress Monitor - Refer to Flow Chart Below ☐ Ambient Temperature ☐ Heat Index ☐ WBGT ☐ Physiological ☒ Pulse ☐ Temperature	All tasks	Refer to the Handbook for the type of monitoring conducted.	Refer to the Handbook for the type of monitoring conducted.	When Heat Index reaches criteria.	

Notes:

[a] Action levels apply to sustained breathing-zone measurements above background.

[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate.

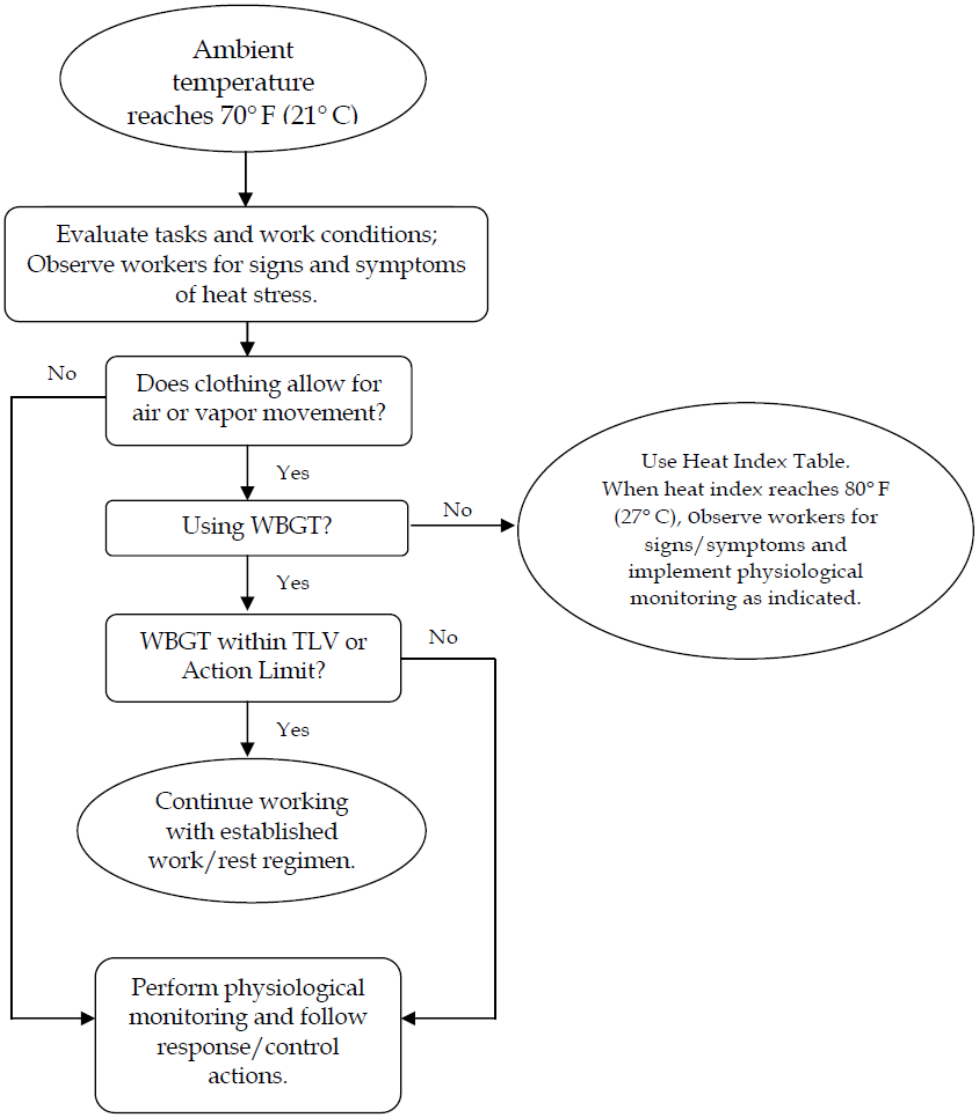
[c] If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry.

[d] Noise monitoring and audiometric testing also required.

9.2 Heat Stress Monitoring Flow Chart

Use the flow chart below and refer to the applicable protocol in Section 9 of the Handbook for heat stress monitoring.

Thermal Stress Monitoring Flow Chart



SECTION 10

Personal Protective Equipment

(Reference CH2M HILL- SOP HSE-117, Personal Protective Equipment, and Section 11 of the Handbook)

10.1 Required Personal Protective Equipment

PPE must be worn by employees when actual or potential hazards exist and engineering controls or administrative practices cannot adequately control those hazards.

A PPE assessment has been conducted by the RHSM based on project tasks (see PPE specifications below). Verification and certification of assigned PPE by task is completed by the RHSM that approved this plan. Refer to the Handbook, Section 11, “Personal Protective Equipment,” for requirements on the use, care, and maintenance of PPE.

The table below outlines PPE to be used according to task based on project-specific hazard assessment. If a task other than the tasks described in this table needs to be performed, contact the RHSM so this table can be updated.

Project-Specific Personal Protective Equipment Requirements [a]				
Task	**Level**	**Body**	**Head**	**Respirator [b]**
Surveying, utility location	D	☒ Work clothes (sleeved shirt, long pants) ☐ Cotton Coveralls ☒ Safety-toed Boots ☐ Gloves (leather) ☒ Bug out suit if ticks prevalent ☒ Other: (specify) Snake chaps when walking in knee high or higher vegetation.	☒ ANSI Z89.1 Hardhat [c] ☒ ANSI Z87.1 Safety glasses ☐ Hearing protection [d]	None required
GW, Pore, and SW Sampling, MW installation, development	Modified D	☒ Work clothes ☐ Cotton coveralls ☒ ANSI/ISEA 107-2010 high visibility vest (drilling) ☒ Safety-toed boots ☒ Safety-toed rubber boots (can be deconned in a boot wash) SW sampling if necessary) ☐ Outer boot covers ☒ Inner surgical-style nitrile ☐ Outer chemical-resistant nitrile gloves. ☐ Other: (specify)	☒ ANSI Z89.1 Hardhat [c] (drilling) ☒ ANSI Z87.1 Safety glasses ☒ Hearing protection[d]	None required
Initial headspace readings of monitoring wells at Site 69 oversight not to enter EZ, but to observe at a distance. ECBC doing all initial headspace readings. Presence of CA requires emergency decon and cessation of work	CWM specific C	☐ Uncoated Tyvek ☒ Tyvek F or equivalent ☒ ANSI/ISEA 107-2010 high visibility vest if drilling ☒ Safety-toed boots and covers, or ☒ Safety-toed rubber boots (can be deconned in a boot wash) ☒ Outer boot covers ☒ Inner surgical-style nitrile ☒ Outer chemical-resistant butyl gloves. ☐ Other: (specify)	☒ ANSI Z89.1 Hardhat [c] ☒ ANSI Z87.1 Safety glasses ☒ Hearing protection[d]	☒ Full-face MSA Millenium or equivalent air-purifying respirator ☒ Cartridges [e]: CBRN or equivalent.
Tasks requiring upgrade based on air monitoring– contact RHSM prior to any upgrade	C	☐ Uncoated Tyvek ☒ Polycoated Tyvek ☒ ANSI/ISEA 107-2010 high visibility vest if drilling ☒ Safety-toed boots ☐ Safety-toed rubber boots (can be deconned in a boot wash) ☐ Outer boot covers ☒ Inner surgical-style nitrile ☐ Outer chemical-resistant nitrile gloves. ☐ Other: (specify)	☒ ANSI Z89.1 Hardhat [c] ☒ ANSI Z87.1 Safety glasses ☒ Hearing protection[d]	☒ Full-face MSA Ultratwin or equivalent air-purifying respirator ☒ Cartridges [e]: GME H or equivalent

Project-Specific Personal Protective Equipment Requirements [a]				
Task	**Level**	**Body**	**Head**	**Respirator [b]**
Equipment decontamination if using pressure washer	Modified D with splash protection	☐ Polycoated Tyvek ☒ Rain Suit ☐ ANSI/ISEA 107-2010 high visibility vest ☒ Safety-toed boots ☒ Safety-toed rubber boots (can be deconned in a boot wash) ☐ Outer boot covers ☐ Inner surgical-style nitrile ☒ Outer chemical-resistant nitrile gloves. ☐ Other: (specify)	☒ ANSI Z89.1 Hardhat [c] ☒ ANSI Z87.1 Safety glasses ☐ Hearing protection[d] ☒ Face shield ☐ Chemical goggles	None required.

Reasons for Upgrading or Downgrading Level of Protection (with approval of the RHSM)	
Upgrade[f]	**Downgrade**
• Request from individual performing tasks. • Change in work tasks that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels in the “Site Monitoring” section exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decrease the hazard. • Change in work task that will reduce contact with hazardous materials.

Notes:

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.

[b] No facial hair that would interfere with respirator fit is permitted.

[c] Hardhat and splash-shield areas are to be determined by the SC.

[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet (1 meter) or less without shouting.

[e] See cartridge change-out schedule.

[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the RHSM, and an SC qualified at that level is present.

SECTION 11

Worker Training and Qualification

11.1 CH2M HILL Worker Training

(Reference CH2M HILL SOP HSE-110, Training, and Section 12 of the Handbook)

The following training is required for CH2M HILL personnel working onsite. Copies of training will either be available onsite, or readily available from the CH2M HILL HandS training database system. Refer to Section 12 of the Handbook for a description of HAZWOPER-related and Safety Coordinator training.

Required CH2M HILL Worker Training	CH2M HILL Task or Equipment-Specific Training (if performing task)
☒ 40-hour HAZWOPER Training	☐ Aerial Lift Operator Training
☒ 8-hour HAZWOPER Refresher	☐ Confined Space Entry Training
☒ 3-day HAZWOPER OJT	☐ Excavation Safety Training
☒ CH2M HILL HSP Training	☐ Fall Protection (site-specific)
☒ CH2M HILL E&NM HSSE Handbook	☐ Forklift Operator
☒ CH2M HILL AHAs	☒ Hazard Communication
☐ Subcontractor HSP	☐ On-Track Railroad Safety Training
☐ 10-hour OSHA Construction Safety Training	☐ NFPA 70E Training (energized electrical safety training)
☒ At least one SC-HW (refer to worker category for all applicable training needed)	☐ Qualified Earthmoving Equipment Operator
☐ HWW (refer to worker category for all applicable training needed)	☐ Scaffold Training
☐ At least one SC-C (refer to worker category for all applicable training needed)	☐ Other (specify):
☐ Other (specify)	☐ Other (specify):
Project-Specific Required (VO) Training	
☒ 3R Munitions Safety Awareness Training	☐ Hand Safety Training
☐ Arsenic Training	☐ Hydrogen Sulfide Hazard Recognition Training
☐ Asbestos Awareness Training	☐ Ionizing Radiation Training
☐ Bear Awareness Training	☐ Lead Exposure Training
☒ Benzene Training	☐ Lockout/Tagout Training
☐ Cadmium Training	☐ Manual Lifting Training
☐ Chromium Training	☐ Methylene Chloride Training
☐ Confined Space Awareness Training	☐ Noise Training
☐ Drum Handling Training	☐ Radio Frequency Safety Awareness
☐ Electrical Safety Training	☐ Railroad Safety On-line Training
☐ Excavation Safety Training	☒ Respirators Level C Training if upgrade required
☐ Fall Protection Training	☐ Stairways and Ladders
☐ Formaldehyde Training	☐ Traffic Safety Training
☐ Drum Handling Training	☒ Vinyl Chloride Training

11.2 Subcontractor Worker Training

The following training is required for Subcontractor personnel working onsite. Copies of training shall be available onsite.

	Required Subcontractor Worker Training		Subcontractor Task or Equipment-Specific Training (required if performing this work)
☒	40-hour HAZWOPER Training	☐	Aerial Lift Operator Training
☒	8-hour HAZWOPER Refresher	☐	Asbestos Competent Person
☒	8-hour HAZWOPER Supervisor	☐	Asbestos Training (Supervisor, Worker)
☒	3-day HAZWOPER OJT	☐	Confined Space Entry Training
☒	CH2M HILL HSP Training	☐	Certified Crane Operator
☒	Subcontractor AHAs	☐	Crane Assembly/Disassembly Competent Person
☒	Subcontractor HSP (if not under CH2M HILL plan)	☐	Demolition Competent Person
☐	10-hour OSHA Construction Safety Training	☐	Excavation Competent Person
☐	30-hour OSHA Construction Safety Training	☐	Fall Protection (site-specific)
☐	Respiratory Protection Training	☐	Flagger Training
☒	CH2M HILL E&NM HSSE Handbook	☐	Forklift Operator
☒	First Aid/CPR/BBP – at least 2 people	☐	Hazard Communication
☐	Other (specify)	☐	Ladder Safety Training
		☐	Lead Training
		☐	Lockout/Tagout Training
		☐	On-Track Railroad Safety Training
		☐	NFPA 70E Training (energized electrical safety training)
		☒	Qualified Drill Rig Operator
		☐	Qualified Earthmoving Equipment Operator
		☐	Qualified Rigger
		☐	Qualified Crane Signaler
		☐	Scaffold Training
		☐	Other (specify):

The designation of **competent person** is a specific position of authority for a particular activity with defined roles and responsibilities and, in some cases, requisite qualifications. The Subcontractor must designate a qualified competent person for the following tasks, and supporting documentation (e.g. training documentation, resume of experience, activity competent person designation is granted for, etc.) must be available for CH2M HILL review upon request.

Subcontractor Tasks Requiring a Competent Person			
☐	Excavation Competent Person	☐	Lead Competent Person
☐	Asbestos Competent Person	☒	Other: Drill rig operator
☐	Scaffolding Competent Person	☐	Other:
☐	Crane Competent Person	☐	Other:

11.3 HAZWOPER-Exempted Tasks

The following tasks are not within the scope of the HAZWOPER standard so HAZWOPER training is not required for workers performing these tasks:

Task	Task
Surveying	
Utility clearance	

SECTION 12

Medical Surveillance and Qualification

(Reference CH2M HILL SOP HSE-113, Medical Surveillance, and Section 13 of the Handbook)

The following medical surveillance is required for CH2M HILL and subcontractor personnel working onsite. Copies of physician's medical opinion will either be available onsite, or for CH2M HILL staff, readily available from the CH2M HILL HandS training database system. Refer to Section 13 of the Handbook for a description of HAZWOPER, respirator user, and hearing conservation medical surveillance.

General Required Medical Surveillance	Job or Activity-Specific Medical Surveillance (required if performing this work)
☒ HAZWOPER Medical Clearance	☐ Noise
☒ Respirator Medical Clearance	☐ Baseline Blood Lead
	☐ Asbestos Medical Clearance
	☐ Other (specify):

Personnel or Tasks Not Requiring Medical Surveillance
Surveying,
Utility clearance

SECTION 13

Site-Control Plan

(Reference CH2M HILL SOP HSE-218, Hazardous Waste Operations, and Section 14 of the Handbook)

Site control is established to prevent the spread of contamination throughout the site and to ensure that only authorized individuals are permitted into potentially hazardous areas. Task-specific control measures are listed below. **Use of the Buddy System will be implemented unless a Working Alone protocol has been established and approved as indicated in Sections 5 and 6 above.**

Site Control for General Work Area(s)					
☒	Perimeter fencing	Location: Site 69 initial well screening	☐	Barricades	Location:
☒	Signage	Location: EZ boundary	☐	Other: _____	Location:
☐	Traffic control devices	Location:	☐	Other: _____	Location:

Location	Site Control Procedure for initial well screening (discuss important elements such as signs, barricades, briefings, qualifications, required supplies and equipment, sign-in/out logs, etc.)
Support Zone	Drinking water and vehicles for shade, sign in/out log
Contamination Reduction Zone	Personnel decon station, disposable PPE trash bags, respirator wash station.
Exclusion Zone	Required sampling supplies, ECBC air monitoring equipment including real-time Miniature Continuous Air Monitoring Systems (MINICAMS), and a Depot Area Air Monitoring System (DAAMS)

SECTION 14

Decontamination

(Reference CH2M HILL SOP HSE-218, Hazardous Waste Operations, and Section 15 of the Handbook)

Refer to the Handbook, Section 15, "Decontamination," for a complete description of decontamination activities and diagrams of typical decontamination areas. Decontamination areas will be established for work in potentially contaminated areas to prevent the spread of contamination. Decontamination areas should be located upwind of the exclusion zone where possible and should consider any adjacent or nearby projects and personnel. No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones.

All contaminated material generated through the personnel and equipment decontamination processes (e.g., contaminated disposable items, gross debris, liquids, sludges) will be properly containerized and labeled, stored at a secure location, and disposed in accordance with project plans.

No significant surface contamination anticipated. Decon of down hole sampling equipment and drill equipment.

Type of Decon		Activity	Equipment	Process/Protocol
Personnel	☒	All sampling, drilling, well installation, development	☐ Tubs/brushes for boot/glove wash ☐ Solids disposal bag or drum (used PPE) ☐ Liquid disposal drum (decon water)	☐ Boot wash/rinse ☒ PPE disposal (no decon) ☐ PPE waste area identified ☐ Other: _____
Personnel	☒	Site 69 initial well screening	☐ Tubs/brushes for boot/glove wash ☒ Solids disposal bag or drum (used PPE) ☒ Liquid disposal drum (decon water)	☐ Boot wash/rinse ☐ PPE disposal (no decon) ☐ PPE waste area identified ☒ Other: Respirator wash
Equipment	☒	Sampling equipment	☐ Table for equipment decon/staging ☐ Decon pad for vehicles ☐ Pressure Washer ☒ PPE used during decon ☐ Decon supplies (brushes, brooms) ☒ Containers/method to capture decon water and or sludge	☒ Equipment wiped/cleaned before leaving CRZ for Site 69 initial well screening ☐ Vehicle tires dry deconned prior to leaving site ☐ Vehicle tires washed prior to leaving site ☐ Other: _____
Equipment	☒	Drill equipment	☐ Table for equipment decon/staging ☐ Decon pad for vehicles ☒ Pressure Washer ☐ PPE used during decon ☐ Decon supplies (brushes, brooms) ☒ Containers/method to capture decon water and or sludge	☐ Equipment wiped/cleaned before leaving CRZ ☐ Vehicle tires dry deconned prior to leaving site ☐ Vehicle tires washed prior to leaving site ☐ Other: _____

14.1 Decontamination During Medical Emergencies

Standard personnel decontamination practices will be followed whenever possible. For emergency life saving first aid and/or medical treatment, normal decontamination procedures may need to be abbreviated or omitted. In this situation, site personnel shall accompany contaminated victims to advise emergency response personnel on potential contamination present and proper decontamination procedures.

Outer garments may be removed if they do not cause delays, interfere with treatment, or aggravate the problem. Protective clothing can be cut away. If the outer garments cannot be safely removed, a plastic barrier between

the individual and clean surfaces should be used to help prevent contaminating the inside of ambulances or medical personnel. Outer garments can then be removed at the medical facility.

SECTION 15

Communications

A primary and backup means of communication for field crews have been established as described below:

Type of Communication	Primary Means	Backup Means
Communication between field crew	☒ Voice ☐ Radio ☐ Phone	☐ Voice ☐ Radio ☒ Phone
Communication with Office crew	☐ Radio ☒ Phone	☐ Radio ☒ Phone
Communication with Fire and Emergency Services	☐ Radio ☒ Phone	☐ Radio ☒ Phone

SECTION 16

Required Facilities and Equipment

The following facilities and equipment are required and used for safe completion of work:

Facility	Type	Location
☒ Emergency Eyewash	Bottles	Field vehicle
☒ First aid kit/supplies	Kit	Field vehicle
☒ Fire extinguishers	10lb/20lb	Field Vehicles or on Drill Rig
☒ Spill Kit(s)	Oil clean up pads	On drill rig or support truck
☒ Potable Water	Bottled water	Field vehicle
☒ Shade/rest area	Either pop up canopy or field vehicle	Canopy near work area, or shade in field vehicle

SECTION 17

Emergency Response Plan

(Reference CH2M HILL SOP HSE-106, Emergency Planning, and Section 16 of the Handbook)

Personnel responsible for coordinating emergency situations during site activity are identified below. The Emergency Contacts Page is at the front of this Plan. A site map showing assembly points and directions to the authorized medical facility is attached. Documented rehearsal and critique of this plan is required at least once during the task, or more often as necessary.

Responsibility	Name	Phone Number(s)
Emergency Response Coordinator (ERC)	Bridget Berglind	704-544-4047
Alternate ERC	David Seed	919-875-4311 X51770
Type (desk or field) and frequency of rehearsal	Desktop rehearsal, but test drive route to hospital prior to job.	

If an emergency situation develops which requires evacuation of the work area, the following steps shall be implemented.

Evacuation Step	Methods and comments:
Notify affected workers	Voice notification, or phone if on another site
Evacuate to safe location	Evacuate site to designated location
Assemble and account for workers	
Notify Supervisor/Manager	Call SSC, PM, RHSM (Rick Cavil), occupational nurse number
Complete incident report	Complete report as soon as possible, but at least within 24 hours.

Potential emergency situations and response actions are identified below.

In case of:	Response actions:
Injury or illness	Provide necessary first aid, seek treatment if necessary, as soon as possible, contact occupational nurse number, SSC, PM, RHSM
Chemical exposure	Decon affected employee, seek medical treatment if necessary, contact SSC, PM< RHSM, occupational nurse number 1-866-893-2514
Fire or explosion	Evacuate site to designated location, call 911, Provide necessary first aid, seek treatment if necessary, as soon as possible, contact occupational nurse number 1-866-893-2514, SSC, PM, RHSM
Adverse weather	If dangerous weather seek shelter as appropriate.
Heat Stroke	Call 911, have a designee give location and directions to ambulance service if needed. If CH2M HILL employee, call occupational physician at 1-866-893-2514.
Material spill or release	Appropriate spill response materials for all chemicals must be present at the job site. Only qualified (by training and previous experience) who have proper PPE and equipment available shall provide spill response operations, when safe to do so.

Evacuation Signals:	Meaning:
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

In the event of a **large quantity spill** notify emergency services. Personnel discovering a spill shall (only if safe to do so):

- Stop or contain the spill immediately (if possible) or note source. Shut off the source (e.g., pump, treatment system) if possible. If unsafe conditions exist, then leave the area, call emergency services, inform nearby personnel, notify the site supervisors, and initiate incident reporting process. The SC shall be notified immediately;
- Extinguish sources of ignition (flames, sparks, hot surfaces, cigarettes);
- Clear personnel from the spill location and barricade the area;
- Use available spill control equipment in an effort to ensure that fires, explosions, and releases do not occur, recur, or spread;
- Use sorbent materials to control the spill at the source;
- Construct a temporary containment dike of sorbent materials, cinder blocks, bricks or other suitable materials to help contain the spill;
- Attempt to identify the character, exact source, amount, and extent of the released materials. Identification of the spilled material should be made as soon as possible so that the appropriate cleanup procedure can be identified;
- Contact the RHSM and Project EM in the event of a spill or release immediately so evaluation of reportable quantity requirements and whether agency reporting is required;
- Assess possible hazards to human health or the environment as a result of the release, fire or explosion; and
- Follow incident notification, reporting, and investigation section of this plan.

SECTION 18

Incident Notification, Reporting, and Investigation

(Reference Section 16 of the Handbook for complete definitions and protocol)

18.1 Incident Notification

All employees and subcontractors' employees shall immediately report any incident (including "near misses,") in which they are involved or witness to their supervisor.

The CH2M HILL or Subcontractor supervisor, upon receiving an incident report, shall inform his immediate superior and the CH2M HILL SC.

The SC shall immediately report the following information to the RHSM and PM by phone and e-mail:

- Project Name and Site Manager;
- Date and time of incident;
- Description of incident;
- Extent of known injuries or damage;
- Level of medical attention; and
- Preliminary root cause/corrective actions

If the incident was an environmental permit issue (potential permit non-compliance, other situation that result in a notice of violation) or a spill or release, contact the Project EM immediately so evaluation of reportable quantity requirements and whether agency reporting is required.

18.2 Drug and Alcohol Testing for CH2M HILL Employees

As required by CH2M HILL Policy 810, U.S. Employees are subject to post-incident and reasonable suspicion drug and alcohol testing. The Employee must submit to drug and alcohol testing if the supervisor has a reasonable suspicion, and when any of the following occur:

- Work-related injury in which the Company reasonably believes (under the Reasonable Suspicion provisions in the Policy) that drug and/or alcohol use is a contributing factor;
- Incident resulting in property damage over USD$500 as determined by the Company;
- Injury on or in Company Property/Workplace (to Employee or third parties) involving the Employee's use of heavy machinery as determined by the Company;
- Incident considered to be a serious near-miss injury that occurs in the field or in the office as determined by the Company and where the Company reasonably believes (under the Reasonable Suspicion provisions in the Policy) that drug and/or alcohol use is a contributing factor to the serious near miss injury;
- Other circumstances as dictated by Employee Relations; or
- An Employee contributes to any of the above.

Refer to the E&NM HSSE Handbook and CH2M HILL Policy 810 for additional information and specific requirements.

18.3 Drug and Alcohol Testing for Subcontractors

The drug and alcohol testing requirements stated above apply to subcontractors when required by the subcontract.

18.4 HITS System and Incident Report Form

The SC shall complete an entry into the Hours and Incident Tracking System (HITS) database system located on CH2M HILL's Virtual Office (or if VO not available, use the hard copy Incident Report Form and Root Cause Analysis Form and forward it to the RHSM) within 24 hours and finalize those forms within 3 calendar days.

18.5 Injury Management/Return-to-Work (for US/Puerto Rico based CH2M HILL Staff Only)

In the event of an injury, or potential injury (i.e., involvement in motor vehicle collision with no apparent injury; a puncture wound with no bleeding or apparent infection, etc.), the following actions shall be taken:

- Employee informs their supervisor.
- Employee calls the Injury Management Program toll free number 1-866-893-2514 immediately and speaks with the Occupational Injury Nurse. This number is operable 24 hours per day, 7 days a week. **Employees are encouraged to enter this phone number into their cell phones prior to starting field work.**
- Supervisor ensures employee immediately calls the Injury Management Program number. Supervisor makes the call with the injured worker or for the injured worker, if needed.
- Nurse assists employee with obtaining appropriate medical treatment, as necessary schedules clinic visit for employee (calls ahead, and assists with any necessary follow up treatment). The supervisor or SC accompanies the employee if a clinic visit is necessary to ensure that employees receive appropriate and timely care.
- Supervisor or SC completes the HITS entry or Incident Report Form immediately (within 24 hours) and forwards it to the Project Manager and RHSM.
- Nurse notifies appropriate CH2M HILL staff by e-mail (supervisor, Health & Safety, Human Resources, Workers' Compensation).
- Nurse communicates and coordinates with and for employee on treatment through recovery.
- Supervisor ensures suitable duties are identified and available for injured or ill workers who are determined to be medically fit to return to work on transitional duty (temporary and progressive).
- Supervisor ensures medical limitations prescribed (if any) by physician are followed until the worker is released to full duty.

18.6 Serious Incident Reporting Requirements

Serious incidents include the following:

- Work related death, or life threatening injury or illness of a CH2M HILL employee, subcontractor, or member of the public;
- Kidnap or missing person;
- Acts or threats of terrorism;
- Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 in damage; or
- Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community or the environment.

If an incident meets the "Serious Incident" criteria, the Project Manager is to immediately contact the Crisis Manager at 720-286-4911, then follow the standard incident reporting procedure.

SECTION 19

Inspections

19.1 Project Activity Self-Assessment Checklists

The following self-assessment checklists are required when the task or exposure is initiated and weekly thereafter. The checklists shall be completed by the SC or other CH2M HILL representative and maintained in project files.

- Drilling
- Hand and Power Tools
- Lifting
- PPE
- Vinyl Chloride

19.2 Safe Behavior Observations

The SC or designee shall perform at least one SBO each week per field team for any field work performed by subcontractors or when there are at least two CH2M HILL personnel performing field work.

E-mail completed forms to:

- Federal Sector: CH2M HILL ES FED Safe Behavior Observation

19.3 Agency Inspections

If a Federal or local agency (e.g., OSHA, local water board, EPA) announces it will be performing inspection, either announced or unannounced, refer to Attachment-Target Zero Bulletin on Agency Inspections. Contact the PM, RHSM and EM as soon as you receive notice.

SECTION 20

Records and Reports

Refer to the Handbook, Section 19, “Records and Reports,” for a complete description of HSE recordkeeping requirements. Below are examples of records that must be maintained as the project progresses:

- Exposure records includes air monitoring data (including calibration records), SDSs, exposure modeling results
- Training records
- Respiratory fit test records
- Incident reports, investigations and associated back-up information
- Federal or state agency inspection records
- HSE audits and assessments
- Confined space entry permits
- Waste profiles
- Agency submittals
- Equipment inspections
- Equipment maintenance
- Emergency equipment inspection records
- SBOs
- Self-assessment checklists
- Daily Safety Meeting Sign-In forms/PTSPs
- Waste analytical data
- Manifests
- Reports and certifications

SECTION 21

Employee Signoff Form

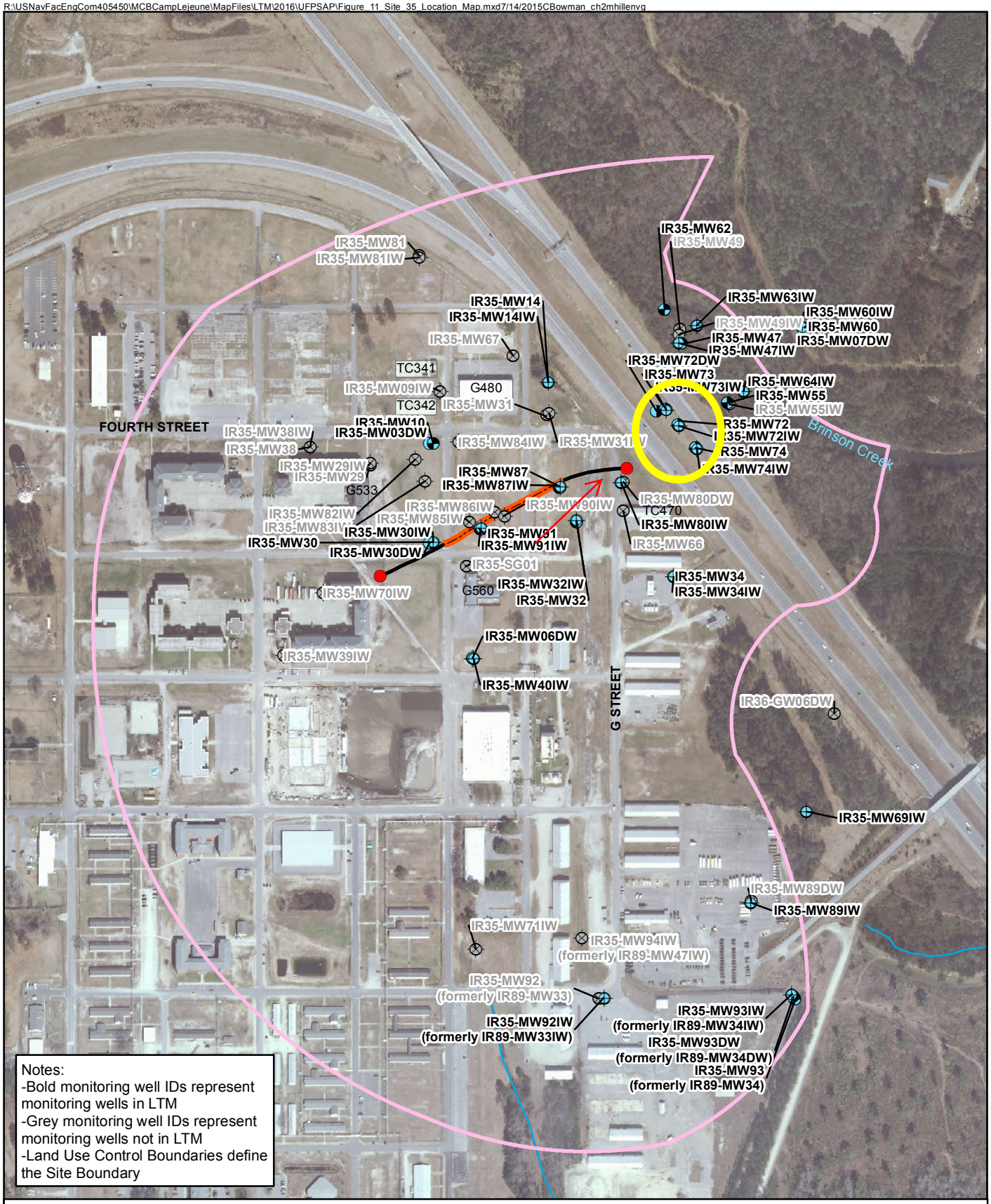
EMPLOYEE SIGNOFF FORM
Health and Safety Plan

The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: Camp Lejeune 2015 LTM **Project Number:** 659587

EMPLOYEE NAME (Please print)	EMPLOYEE SIGNATURE	COMPANY	DATE

R:\USNavFacEngCom405450\MCBCampLejeune\MapFiles\LTM\2016\UFPSAP\Figure_11_Site_35_Location_Map.mxd7/14/2015CBowman_ch2mhillenvg



Notes:
-Bold monitoring well IDs represent monitoring wells in LTM
-Grey monitoring well IDs represent monitoring wells not in LTM
-Land Use Control Boundaries define the Site Boundary

Legend

Monitoring Wells
- Surficial Aquifer
- Upper Castle Hayne Aquifer
- Middle Castle Hayne Aquifer
- Surficial Aquifer - not in LTM
- Upper Castle Hayne Aquifer - not in LTM
- Middle Castle Hayne Aquifer - not in LTM
- Soil Gas Well - not in LTM

- Horizontal Air Sparge Well and Screened Interval
- Surface Water Centerline

Land Use Control Boundaries
- Aquifer Use Control Boundary

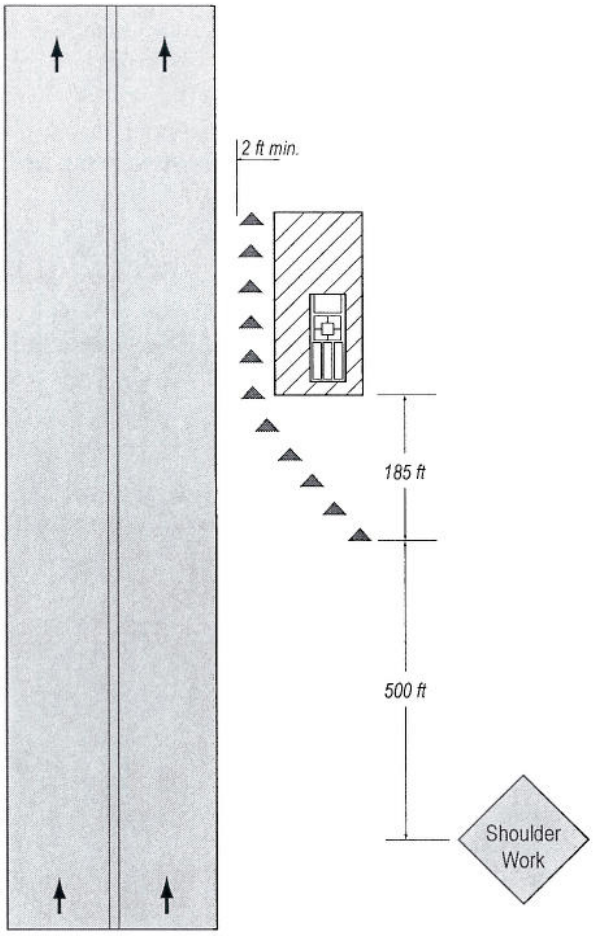
N

0 250 500 Feet

1 inch = 500 feet

Figure 11
Site 35 Location Map
Long-Term Monitoring
Sampling and Analysis Plan
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL.



NOTES

1. For operations of 60 minutes or less, all signs and channelizing devices may be eliminated if a vehicle with an activated rotating or strobe light is used.

2. For low-speed (35 MPH or less) conditions, a 200-foot sign spacing may be used. For speeds of 40 to 50 MPH a 350-foot sign spacing may be used.

3. "Utility Work Ahead", "Road Work Ahead", or Worker symbol signs may be used instead of the "Shoulder Work" sign.

4. For work performed on a **paved shoulder** at least 8 feet wide, an additional general warning sign (e.g. "Road Work Ahead") should be used in advance of the "Shoulder Work" sign.

5. Highway 17 Bypass posted speed is 55 MPH.

6. Proper channeling devices and spacing of channeling devices are in accordance with Manual of Uniform Traffic Control Devices- Millenium Edition.

7. Reference- Institute for Transportation Research and Education, North Carolina State University- Centennial Campus
   Campus Box 8601
   Raleigh, North Carolina 27

Traffic Control Plan
Shoulder Work (2-15 ft From Edge of Pavement)
Operable Unit No. 10- Site 35
MCB, Camp Lejeune, North Carolina

AGVIQ CH2M HILL

Tick-Borne Pathogens — A Fact Sheet

Most of us have heard of Lyme disease or Rocky Mountain Spotted Fever (RMSF), but there are actually six notifiable tick-borne pathogens that present a significant field hazard. In some areas, these account for more than half of our serious field incidents. The following procedures should be applied during any field activity—even in places that are predominantly paved with bordering vegetation.

Hazard Recognition

An important step in controlling tick related hazards is understanding how to identify ticks, their habitats, their geographical locations, and signs and symptoms of tick-borne illnesses.

Tick Identification

There are five varieties of hard-bodied ticks that have been associated with tick-borne pathogens. These include:

- Deer (Black Legged) Tick (eastern and pacific varieties)
- Lone Star Tick
- Dog Tick
- Rocky Mountain Wood Tick

These varieties and their geographical locations are illustrated on the following page.

Tick Habitat

In eastern states, ticks are associated with deciduous forest and habitat containing leaf litter. Leaf litter provides a moist cover from wind, snow, and other elements. In the north-central states, is generally found in heavily wooded areas often surrounded by broad tracts of land cleared for agriculture.

On the Pacific Coast, the bacteria are transmitted to humans by the western black-legged (deer) tick and habitats are more diverse. For this region, ticks have been found in habitats with forest, north coastal scrub, high brush, and open grasslands. Coastal tick populations thrive in areas of high rainfall, but ticks are also found at inland locations.

Illnesses and Signs & Symptoms

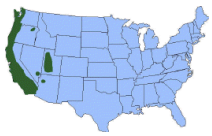
There are six notifiable tick-borne pathogens that cause human illness in the United States. These pathogens may be transmitted during a tick bite—normally hours after attachment. The illnesses, presented in approximate order of most common to least, include:

- Lyme (bacteria)
- RMSF (bacteria)
- Ehrlichiosis (bacteria)
- STARI (Southern Tick-Associated Rash Illness) (bacteria)
- Tularemia (Rabbit Fever) (bacteria)
- Babesia (protozoan parasite)

Symptoms will vary based on the illness, and may develop in infected individuals typically between 3 and 30 days after transmission. Some infected individuals will not become ill or may develop only mild symptoms. These illnesses present with some or all of the following signs & symptoms: fever, headache, muscle aches, stiff neck, joint aches, nausea, vomiting, abdominal pain, diarrhea, malaise, weakness, small solid, ring-like, or spotted rashes. The bite site may be red, swollen, or develop ulceration or lesions. For Lyme disease, the bite area will sometimes resemble a target pattern. A variety of long-term symptoms may result if the illness is left untreated, including debilitating effects and death.

Distribution of Deer

Deer



Distribution of Pacific Deer

From Left: adult

Distribution of Lone

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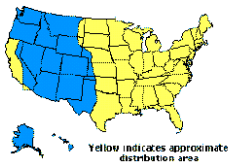

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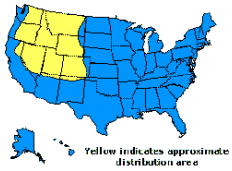


Hazard Control

The methods for controlling exposure to ticks include, in order of most- to least-preferred:

- Avoiding tick habitats and ceasing operations in heavily infested areas
- Reducing tick abundance through habitat disruption or application of acracide
- Personal protection through use of repellants and protective clothing
- Frequent tick inspections and proper hygiene

Vaccinations are not available and preventative antibiotic treatment after a bite is generally not recommended.

Avoidance and Reduction of Ticks

To the extent practical, tick habitats should be avoided. In areas with significant tick infestation, consider stopping work and withdrawing from area until adequate tick population control can be achieved. Stopping and withdrawing should be considered as seriously as entering an area without proper energy control or with elevated airborne contaminants—tick-borne pathogens present risk of serious illness!

In areas where significant population density or infestation exists, tick reduction should be considered. Tick reduction can be achieved by disrupting tick habitats and/or direct population reduction through the use of tick-toxic pesticides (Damminix, Dursban, Sevin, etc.).

Habitat disruption may include only simple vegetative maintenance such as removing leaf litter and trimming grass and brush. Tick populations can be reduced by between 72 and 100 percent when leaf litter alone is removed. In more heavily infested areas, habitat disruption may include grubbing, tree trimming or removal, and pesticide application (Damminix, Dursban, Sevin, etc.). This approach is practical in smaller, localized areas or perimeter areas that require occasional access. Habitat controls are to be implemented with appropriate health and safety controls, in compliance with applicable environmental requirements, and may be best left to the property owner or tenant or to a licensed pesticide vendor. Caution should be exercised when using chemical repellents or pesticides in or around areas where environmental or industrial media samples will be collected for analysis.

Personal Protection

After other prevention and controls are implemented, personal protection is still necessary to control exposure to ticks. Personal protection must include all of the following steps:

- So that ticks may be easily seen, wear light-colored clothing. Full-body New Tyvek (paper-like disposable coveralls) may also be used
- To prevent ticks from getting underneath clothing tuck pant legs into socks or tape to boots
- Wear long-sleeved shirts, a hat, and high boots
- Apply DEET repellent to exposed skin or clothing per product label
- Apply permethrin repellent to the outside of boots and clothing before wearing, per product label
- Frequently check for ticks and remove from clothing
- At the end of the day, search your entire body for ticks (particularly groin, armpits, neck, and head) and shower
- To prevent pathogen transmission through mucous membranes or broken/cut skin, wash or disinfect hands and/or wear surgical-style nitrile gloves any time ticks are handled

Pregnant individuals and individuals using prescription medications should consult with their physician and/or pharmacists before using chemical repellents. Because human health effects may not be fully known, use of chemical repellents should be kept to a minimum frequency and quantity.

Always follow manufacturers' use instructions and precautions. Wash hands after handling, applying, or removing protective gear and clothing. Avoid situations such as hand-to-face contact, eating, drinking, and smoking when applying or using repellents.

Remove and wash clothes per repellent product label. Chemical repellents should not be used on infants and children.

Vaccinations are generally not available for tick-borne pathogens. Although production of the LYMErix™ Lyme disease vaccination has been ceased, vaccination may still be considered under specific circumstances and with concurrence from the consulting physician.

Tick Check

A tick check should be performed after field survey before entering the field vehicle (you do not want to infest your field vehicle with ticks). Have your field partner check your back; the backs of your legs, arms, and neck; and your hairline. Shake off clothing as thorough as possible before entering the vehicle. Once the field day is complete, repeat this procedure and perform a thorough self check.

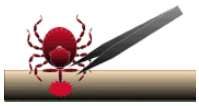
If a tick has embedded itself into the skin, remove the tick as described below.

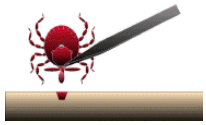
Tick Removal

1. Use the tick removal kit obtained through the CH2M HILL Milwaukee warehouse, or a fine-tipped tweezers or shield your fingers with a tissue, paper towel, or nitrile gloves.

Tick Bites\Tick Remover.pdf

2. Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. If this happens, remove mouthparts with tweezers. Consult your healthcare provider if infection occurs.





3. Avoid squeezing, crushing or puncturing the body of the tick because its fluids (saliva, hemolymph, gut contents) may contain infectious organisms. Releasing these organisms to the outside of the tick's body or into the bite area may increase the chance of infectious organism transmission.

4. Do not handle the tick with bare hands because infectious agents may enter through mucous membranes or breaks in the skin. This precaution is particularly directed to individuals who remove ticks from domestic animals with unprotected fingers. Children, elderly persons, and immunocompromised persons may be at greater risk of infection and should avoid this procedure.

5. After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.

6. Should you wish to save the tick for identification, place it in a plastic bag, with the date of the tick bite, and place in your freezer. It may be used at a later date to assist a physician with making an accurate diagnosis (if you become ill).

Note: Folklore remedies such as petroleum jelly or hot matches do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release

additional saliva, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided. In addition, a number of tick removal devices have been marketed, but none are better than a plain set of fine tipped tweezers.

First-Aid and Medical Treatment

Tick bites should always be treated with first-aid. Clean and wash hands and disinfect the bite site after removing embedded tick. Individuals previously infected with Lyme disease does not confer immunity—re-infection from future tick bites can occur even after a person has contracted a tick-borne disease.

The employee should contact the Injury Management/Return To Work provider (IMRTW), WorkCare using the toll-free number 866-893-2514 to report the tick bite. WorkCare will follow-up with each CH2M Hill employee who reports a tick bite and is at risk of developing Lyme disease by monitoring for symptoms up to 45 days, and will refer the employee to a medical provider for evaluation and treatment as necessary.

2013 Vehicle Accident Guidance—ESBG

Remember that if you a **renting** a non-CH2M HILL owned vehicle (short-term rental) in the U.S., you should carry the insurance card from the state where your driver's license is issued.

If you operate a **fleet vehicle**, carry the insurance card where the vehicle is registered.

For ALL Vehicles if you are in an accident:

1. If you are injured, call 911 for emergency medical treatment or 1-866-893-2514 to contact the CH2M HILL Occupational Nurse/Physician for minor injuries. If you feel you have not been injured, contact the RHSM for guidance on whether calling the CH2M HILL Occupation Nurse/Physician is applicable.

2. **Call the Police--**For any vehicle accident/damage, it is recommended that the local police (or site security/emergency services if working on a client site that provides such services) be called to determine if a report needs to be filed. In some instances, a report may not be required (during accident alerts, or in public parking lots). Document that the authorities were called and follow up with any guidance they give you. State requirements vary. If a report is filed, obtain a copy.

3. Notify Supervisor, (and PM/RHSM if working on a project site)

4. Complete a HITS report on the VO.

Additional Steps

To report an auto accident, and before a claim can be taken by telephonic reporting, have available your name (the company name alone is no longer accepted, a driver's name must be provided even for fender benders), location of accident and your office address if different than the accident location, business group and project number. A claim cannot be taken without your name, address, business group and your project number. By location the state where the accident occurred, and which office you are aligned to, i.e., accident occurs in Idaho, but you are out of the Denver office. Advise the claim recorder the accident occurred in ID, but that your office location is Denver. This will assist the claim intake person in identifying location coding for the claims.

Auto accidents involve two different sections of an Auto policy:

1) Liability to others due to Bodily Injury and Property Damage

2) Physical Damage - Comprehensive and Collision - damage to the vehicle CH employee is driving

CH2M Hill has Liability coverage for any auto - our policy will respond on either a primary or excess basis.

Refer to the table below for additional notifications to make based on the type of accident experienced and vehicle being used.

Liability - Bodily Injury or Property Damage to Others

Scenario	Which Coverage Responds	What to do if in an accident
CH2M Hill fleet, pool or project vehicle - long term lease - lower 48	CH2M Hill - Primary	Contact Broadspire (1-800-753-6737); Jennifer Rindahl/DEN (720-286-2449); Linda George/DEN (720-286-2057)
CH2M Hill fleet, pool or project vehicle - long term lease - Alaska (North Slope)	CH2M Hill - Primary	Contact Jennifer Rindahl/DEN (720-286-2449)
Client vehicle driven by CH2M Hill employee	Client's auto policy unless client has made CH2M Hill responsible for vehicle	Contact Broadspire (1-800-753-6737); Contact Jennifer Rindahl/DEN (720-286-2449); contact client;
Short term lease (30 days or less)	Rental car company if rented through Enterprise, Budget or Hertz; CH2M Hill excess	Contact Broadspire (1-800-753-6737); Contact local branch of rental car company where vehicle leased (ERAC includes 24 hour roadside assistance) and Jennifer Rindahl/DEN (720-286-2449)
Short term lease (30 days or less)	CH2M Hill - Primary if rented through company other than our national agreements; $100,000 deductible	Contact Broadspire (1-800-753-6737); Contact rental car company and Jennifer Rindahl/DEN (720-286-2449)
Personal vehicle used on business	Employee's personal auto policy; CH2M Hill on an excess basis	Contact personal auto insurance company; contact Jennifer Rindahl/DEN (720-286-2449)

Physical Damage - damage to vehicle CH employee was driving

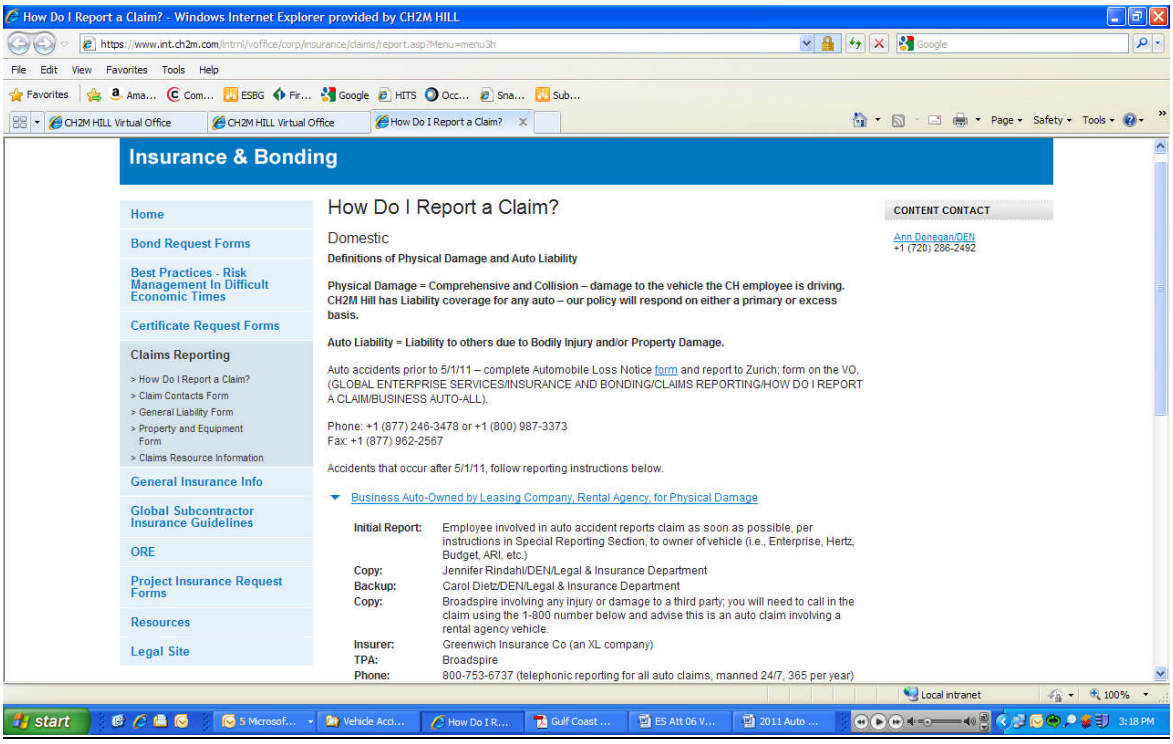
Scenario	Which Coverage Responds	What to do if in an accident
CH2M Hill fleet, pool or project vehicle - long term lease - lower 48	CH2M Hill ONLY if vehicle is scheduled on policy - $5,000 deductible	Contact Broadspire (1-800-753-6737); Jennifer Rindahl/DEN (720-286-2449); Linda George/DEN (720-286-2057)
CH2M Hill fleet, pool or project vehicle - long term lease - Alaska (North Slope)	CH2M Hill Equipment Schedule if scheduled on policy	Contact Jennifer Rindahl/DEN (720-286-2449)
CH2M Hill fleet, pool or project vehicle - long term lease	ARI if physical damage coverage purchased - $500 deductible	Contact Jennifer Rindahl/DEN 720.286.2449; call ARI at 1-800-221-1645 give them Client Code and ARI fleet vehicle number; and notify Linda George/DEN - Fleet Coordinator - 720-286-2057
Client vehicle CH2M Hill Employee is driving	Client's auto policy unless client has made CH2M Hill contractually responsible for vehicle	Contact Jennifer Rindahl/DEN (720-286-2449); contact client; contact Broadspire (1-800-753-6737)
Short term lease (30 days or less) using corporate VISA	VISA if corporate credit card used and vehicle is not a pickup, truck, cargo van or used off-road	Contact VISA - 1-800-847-2911 or http://www.visa.com/eclaim
Short term lease (30 days or less) through Enterprise (ERAC) and vehicle is used off-road and physical damage coverage included when vehicle leased	ERAC up to $3,000 in damage; CH2M Hill's coverage is excess	Notify Rental Car Company; contact Jennifer Rindahl/DEN (720-286-2449) if damage over $5,000
Short term lease (30 days or less) did **not** use corporate VISA	CH2M Hill - $5,000 deductible (project responsibility)	Contact Broadspire (1-800-753-6737); Contact Jennifer Rindhal/DEN 720-286-2449; contact VISA - 1-800-847-2911 or http://www.visa.com/eclaim
Personal vehicle used on business	CH will reimburse the amount of the deductible carried on the employee's policy up to $500 whichever is less	Contact Jennifer Rindahl/DEN (720-286-2449); contact client; contact Broadspire (1-800-753-6737)

Details for reporting a claim on the CH2M Hill VO are accessed by going to the VO home page and clicking:

GLOBAL ENTERPRISE SERVICES/INSURANCE & BONDING/CLAIMS REPORTING

HOW DO I REPORT A CLAIM TAB or access the following URL:

https://www.int.ch2m.com/intrnl/voffice/corp/insurance/claims/report.asp?Menu=menu3h



How Do I Report a Claim? - Windows Internet Explorer provided by CH2M HILL

https://www.int.ch2m.com/intrnl/voffice/corp/insurance/claims/report.asp?Menu=menu3h

Insurance & Bonding

- Home
- Bond Request Forms
- Best Practices - Risk Management In Difficult Economic Times
- Certificate Request Forms
- Claims Reporting
  - > How Do I Report a Claim?
  - > Claim Contacts Form
  - > General Liability Form
  - > Property and Equipment Form
  - > Claims Resource Information
- General Insurance Info
- Global Subcontractor Insurance Guidelines
- ORE
- Project Insurance Request Forms
- Resources
- Legal Site

How Do I Report a Claim?

Domestic

Definitions of Physical Damage and Auto Liability

Physical Damage = Comprehensive and Collision – damage to the vehicle the CH employee is driving. CH2M Hill has Liability coverage for any auto – our policy will respond on either a primary or excess basis.

Auto Liability = Liability to others due to Bodily Injury and/or Property Damage.

Auto accidents prior to 5/1/11 – complete Automobile Loss Notice form and report to Zurich; form on the VO, (GLOBAL ENTERPRISE SERVICES/INSURANCE AND BONDING/CLAIMS REPORTING/HOW DO I REPORT A CLAIM/BUSINESS AUTO-ALL).

Phone: +1 (877) 246-3478 or +1 (800) 987-3373
Fax: +1 (877) 962-2567

Accidents that occur after 5/1/11, follow reporting instructions below.

Business Auto-Owned by Leasing Company, Rental Agency, for Physical Damage

Initial Report:	Employee involved in auto accident reports claim as soon as possible, per instructions in Special Reporting Section, to owner of vehicle (i.e., Enterprise, Hertz, Budget, ARI, etc.)
Copy:	Jennifer Rindahl/DEN/Legal & Insurance Department
Backup:	Carol Dietz/DEN/Legal & Insurance Department
Copy:	Broadspire involving any injury or damage to a third party; you will need to call in the claim using the 1-800 number below and advise this is an auto claim involving a rental agency vehicle.
Insurer:	Greenwich Insurance Co (an XL company)
TPA:	Broadspire
Phone:	800-753-6737 (telephonic reporting for all auto claims, manned 24/7, 365 per year)

CONTENT CONTACT

Ann Donegan/DEN
+1 (720) 286-2492

For Personally Owned Vehicles (POVs):

CH2M HILL does not provide auto insurance for POVs, it is responsibility of the owner. If you are in a vehicle accident conducting company business, contact the police as above, supervisor, and 911 or CH2M HILL's occupational nurse/physician as stated above. Complete a HITS report. Contact Jennifer Rindahl/DEN for assistance for meeting personal insurance deductibles (up to $500) with proof of insurance and deductible.

If using your POV for extended project use, notify the PM to make sure a rental car is not needed. Check your insurance policy for guidance on using the POV for business use.

Additional Resources:

Claims Resource Manual

TARGET ZERO BULLETIN

Subject: HSSE Agency Inspections (OSHA, EPA, DOT, State Health Department)

Do you know what YOU would do if an agency inspector arrived at your site unannounced? Recently, a State Occupational Safety and Health Administration (OSHA) inspector made an unannounced visit to one of our Federal project sites. OSHA, U.S. Environmental Protection Agency (EPA), and authorized state or local agencies have authority to inspect any facility that is subject to health, safety, and environmental legislation. Inspections may be announced or unannounced. This particular inspector indicated that the project was targeted for an inspection because the work was funded by the American Recovery and Reinvestment Act (ARRA).

Enterprise Standard Operating Procedure (SOP) HSE-201, *Agency Inspections and Communications,* describes the responsibilities, procedures, and requirements associated with inspections conducted by external regulatory agencies, as well as the methods for communicating information to key individuals. This Target Zero Bulletin is a brief summary of what to do in the event of an agency inspection at your site. Refer to the SOP for more specific guidance.

Notification of Inspections

- If the inspection is an announced regulatory agency inspection, the Project Manager (PM) should notify the Responsible Health and Safety Manager (RHSM) and Responsible Environmental Manager (REM) well in advance of the inspection.
- If an unannounced agency inspector visits one of our projects, Field personnel must immediately notify the project Emergency Response Coordinator (ERC). Typically the ERC is the Safety Coordinator (SC).
- The ERC must immediately notify the RHSM/REM, as appropriate, of unannounced inspections, or designate someone to call the RHSM/REM. The RHSM/REMs can provide guidance to the field staff and PM.

Inspector Credential Verification

- Upon arrival, the ERC must request the inspector to provide official credentials. Record the inspector's name and office phone number or obtain the inspector's business card.
- The inspector shall sign the visitors log and be given a site-specific health, safety, and environmental protection briefing.
- The inspector shall meet any site access requirements associated with security clearances, specialized training, and medical monitoring. The CH2M HILL representative shall verify that the inspector possesses these requirements; access will only be granted to those areas where appropriate access requirements are met. Some inspectors have the authority to gain access to any work area at any time, such as an inspector with a search warrant. In these cases, we can stop work operations as necessary to protect the safety of the inspector(s).

Opening Conference

- The CH2M HILL Project Manager, ERC, RHSM, or REM, and the inspector shall determine attendees for the opening conference. The RHSM (for OSHA and other worker health and safety inspections) or REM (for environmental inspections) shall join the opening conference via conference call.
- The inspector shall inform CH2M HILL of the purpose of the inspection and provide a copy of the complaint, if applicable.

- The inspector shall outline the scope of the inspection, including employee interviews conducted in private, physical inspection of the workplace and records, possible referrals, discrimination complaints, and the closing conference(s).

Requests for OSHA Logs

- An OSHA inspector may request to review the project OSHA Injury/Illness log, better known as the OSHA 300 Log. Contact your RHSM for assistance in obtaining the OSHA 300 Log.
- Field projects with a continuous duration of one year or longer are considered to be separate establishments and are required to maintain an OSHA 300 log specific to the project. The project OSHA 300 log should be maintained onsite and kept current.
- Recordable injuries and illnesses sustained on field projects less than one year in duration are maintained on the CH2M HILL office log where the injured employee is based.

The Inspection

- The scope of the inspection shall be limited to that indicated by the inspector in the opening conference. The inspector shall be escorted to relevant areas only. The ERC or other designated by the RHSM or REM must accompany the inspector during the inspection.
- Ensure that the inspection is limited to the scope that the inspector disclosed during the opening conference. The ERC should always take notes which identify: areas inspected, machinery or equipment and materials examined, employees or other persons interviewed, and photographs taken by the inspector.
- The inspector will observe safety, health, and environmental conditions and practices and document the inspection process. The inspector may also take photos and instrument readings, examine records, collect air samples, measure noise levels, survey existing engineering controls, and monitor employee exposure to toxic vapors, gases, and dusts.
- CH2M HILL should gather duplicate information (photographs, readings, samples) in the same manner and condition as the inspector. If the equipment needed to take duplicate samples is not onsite, ask the inspector if the sampling can wait until the equipment is available. If samples are taken, request a description of the tests that the agency intends to perform on the samples and request results as soon as they are available.
- Employees may be questioned during the inspection tour. The employee can refuse to speak to an inspector, can speak to the inspector with a company representative (including management) present, or can speak to the inspector privately. It is CH2M HILL policy that employees who wish to speak to the inspector are not discriminated against, intimidated, or otherwise mistreated for exercising their rights during compliance inspections.
- Copies of documents should not be provided to the inspector without the approval of the RHSM or REM or Legal Insurance Department (LID). **DO NOT** voluntarily release documents. Respond only to inspection team requests.
- During the course of the inspection, the inspector may point out violations. For each violation, the CH2M HILL representative should ask the inspector to discuss possible corrective action. Where possible, violations detected by the inspector should be corrected immediately and noted by the inspector as corrected.
- For those items which cannot be corrected immediately, an action plan shall be formulated for timely correction. In any instance, employees exposed to hazards shall be removed from the area.

Closing Conference

After the inspection, a closing conference is normally held as follows:

- The CH2M HILL PM, ERC, RHSM or REM shall be involved via conference call in the closing conference, at a minimum;
- The inspector shall describe the apparent violations found during the inspection and other pertinent issues as deemed necessary by the inspector. CH2M HILL shall be advised of their rights to participate in any subsequent conferences, meetings or discussions. Any unusual circumstances noted during the closing conference shall be documented by the ERC;
- The inspector shall discuss violations observed during the inspection and indicate for which violations a citation and a proposed penalty may be issued or recommended;
- The ERC shall request receipts for all samples and approved documents photocopied by the inspector, request a photocopy of the inspector's photograph log, and request a copy of the final inspection report; and
- Any documentation from an agency inspection must be transmitted immediately to the RHSM or REM, and LID.

Unannounced regulatory agency inspections may happen at any time on our projects -

Get your RHSM/REM and PM involved immediately if an Inspector arrives

CH2MHILL

ACTIVITY HAZARD ANALYSIS

Date:	Task Risk Assessment Code (RAC):
Project:	L = Low
Site Supervisor:	E = Extremely High Risk
Site Safety Coordinator:	H = High Risk
HSM Review/Approval:	M = Moderate Risk
Job/Activity: **Description of the work**:	

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

TYPES OF POTENTIAL ENERGY:

1	2	3	4	5	6	7	8	9	10
BIOLOGICAL	CHEMICAL	ELECTRICAL	GRAVITY	MECHANICAL	MOTION	PRESSURE	RADIATION	SOUND	TEMPERATURE

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)

Equipment to be used (List equipment to be used in the work activity)	**Inspection Requirements** (List inspection requirements for the work activity)	**Training Requirements** (List training requirements including hazard communication)

CH2MHILL

ACTIVITY HAZARD ANALYSIS

	PRINT NAME	SIGNATURE	
Supervisor Name:	_____	_____	**Date/Time:**_____
Safety Coordinator Name:	_____	_____	**Date/Time:**_____
Employee Name(s):	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____

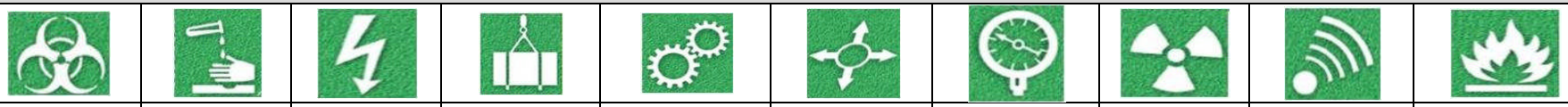
CH2MHILL

ACTIVITY HAZARD ANALYSIS

Date: 6-10-14	Task Risk Assessment Code (RAC): M
Project: Camp Lejeune LTM MW installation, development	L = Low
Site Supervisor: Bridget Berglind	E = Extremely High Risk
Site Safety Coordinator: Bridget Berglind	H = High Risk
HSM Review/Approval:	M = Moderate Risk
Job/Activity: MW installation, and development **Description of the work**:	

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

TYPES OF POTENTIAL ENERGY:



1	2	3	4	5	6	7	8	9	10
BIOLOGICAL	CHEMICAL	ELECTRICAL	GRAVITY	MECHANICAL	MOTION	PRESSURE	RADIATION	SOUND	TEMPERATURE

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
Complete HSP, AHA review Complete Pre-Task Safety Plan Complete Drilling Self Assessment checklist (for observing drilling only)	Vehicle congestion, traffic flow/control, access difficulties, visibility hazards working around heavy equipment	Motion	• Wear proper PPE as specified in HSP including safety glasses with side shields, hard hat, hearing protection, safety boots, work gloves, and high visibility traffic vest. • Determine appropriate locations for drill rig and support vehicles and ensure that roadways are clear for travel • Use cones, barricades, or caution tape as necessary to identify and control site boundaries and access.

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
Confirm list of soil borings/wells to be installed, determine locations and route to be taken. Review, inspect and locate safety equipment incl. Fire extinguisher, first aid kit, insect repellant, PPE, etc.	Remote areas, biohazards associated with wells in remote areas. Weather related issues (heat and/or cold stress).	Electrical, Biological, Temperature	• Check area for rig accessibility (i.e. clearances, solid ground). Verify a minimum of 10 feet of clearance during transit for 50kV line, check drill protocol for clearances. • Staff should understand and be able to recognize the signs and/or symptoms of cold and hot weather related illnesses. • Watch for animal hazards in wooded and high grassy areas (i.e. snakes, rabid raccoons, etc.). • Follow the biological hazard precautions, guidelines, and fact sheets in the HSP for ticks,, rodents, spiders, snakes, bees/wasps, poison ivy/oak/sumac, etc. • If near waterways watch for snakes, slippery surfaces, uneven walkways. Wear sturdy, steel-toe boots. • Wear and use proper clothing and sprays to protect against ticks, mosquitoes, poison ivy, and other biological hazards. • Personnel should dress appropriately for ambient temperatures which would include but not limited to dry layered clothing. • For cold weather, work schedules should be adjusted to provide sufficient break periods in a heated area • For hot weather, work schedules may need to be adjusted to provide time intervals for replenishing fluids. • Review/Inspect safety equipment prior to starting work. Ensure fire extinguisher, spill kit, eye wash unit, and first aid kits are at the location.
B. Oversight: Mobilize to drilling/DPT location, drill	Contact, caught, fall, and driving hazards. Exertion-heavy lifting.	Electrical, Mechanical, Gravity	• Check well locations for underground and overhead utilities.

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
set up, set up decon area for augers/cores	Striking or coming into contact with buried or overhead utilities may potentially expose personnel to hazards including high voltage, electricity, natural gas, industrial wastewater, and raw sewage. Unstable rig issues with incorrect setup. MEC/MPPEH		• All locations will be marked with paint, Utility location service will be notified at least 72 hours before beginning work, Work will not proceed until underground utilities have been cleared also by 3rd party. • Observe rig mast set up, so no contact with overhead obstacles. Don't stand directly behind rig when driller raising mast. • Ensure that all overhead utilities are at least 20 feet away from the mast of the drilling rig • Wear high visibility traffic vests. • Ensure that all heavy equipment has reverse alarms. • Check the fire extinguisher on drill rig to verify inspection and charge. • Know where the kill switch is located on the drill rig in case an emergency shut-down is necessary, make sure driller tests it daily, prior to start of work. • Remain alert and attentive to location of and movement of all drilling equipment. • MEC/MPPEH not anticipated at this site, but follow 3R training since you are on a military base. • When setting up geologist's work station, set it to face drill rig, and at least one mast length away to prevent falling tooling/pipe contact.
	Fire/explosion/Spill Hazards associated with drill rig	Temperature	• Have spill materials and 20-lb ABC fire extinguisher in the area. • Keep ignition sources away from the work area. • No smoking in the area and set-up zones large enough to keep public at safe distance.
Open or cut concrete, asphalt, or soil at soil boring or well location.	Noise, dust from cutting	Biological	• Review drillers AHA applicable to this task.

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
			• Confirm driller is suppressing dust, and/or avoiding and/or using PPE
Require driller Hand dig to 5 feet bgs in areas where suspected utilities may be but not showing on utility surveys.	Striking or coming into contact with buried or overhead utilities may potentially expose personnel to hazards including high voltage, electricity, natural gas, industrial wastewater, and raw sewage.	Electrical, Chemical, Temperature	Review drillers AHA applicable to this task.
C. Oversight: Begin Drilling/ Soil Boring	Exposure to loud noise, flying debris, dust, chemical contamination, and entanglement with rotating equipment,. Exposure to overhead suspended loads	Mechanical, Sound, Gravity	• Do not allow the drill rig to be running when the driller is not present. • If an obstruction is encountered, suspend work and determine what it is. If it cannot be determined, contact client or project representative—location may have to be moved. • Stay away from moving rotating parts (i.e. augers, drill drive shaft) • All personnel will know the location and operation of the kill/emergency shut off switch. Have driller verify kill switch is working before each daily use of drill. • Air monitoring will be performed in breathing zone in accordance with site HSP. Action levels will be followed per site HSP. • Wear proper PPE: safety glasses with side shields, hard hat, safety boots, high visibility safety vest, leather and/or chemical resistant gloves, hearing protection, if necessary, and coveralls or tyvek if there is potential for contacting potentially contaminated soil or ground water. • Personnel conducting oversight duties shall wear hearing protection if it is not possible to communicate with another person standing next to you using your normal voice. Minimum NRR 25 dB

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
			• Use good housekeeping practices, ensure the driller is keeping the work area clear of trip hazards, especially hoses, piping, tools, and bags. • Ensure water does not accumulate in the drilling area. Designate a specific area to place all soil cuttings, try to place the cuttings in a location that is outside of the general work flow • Be aware of the symptoms of associated with heat- and cold-related physical disorders and do not ignore them. • Wear appropriate field clothing, including layers and rain gear in cold weather • Do NOT stand or walk beneath suspended loads.
Oversight of installation of well (Riser, screen, sand pack, and bentonite) and manway/concrete pad	Slips, Trips, Fall Hazards	Gravity	• Make sure work area is clean, pick up all tools, sweep up all soil, and maintain walkways.
Well Development	Chemical exposure, Lifting hazards	Chemical, Gravity	• Conduct air monitoring in breathing zone in accordance with site HSP. Follow action levels in HSP and stop work if action levels are exceeded. Contact HSM as needed. Appropriately containerize purge water and use mechanical means to move drums (drum dolly, lift gate, etc.) or pump water directly into container in back of truck, then transport and pump water into final container.
D. Preparation to mob to next drilling location or leave site.	Contact, Caught, Striking equipment/materials	Electrical, Gravity, Motion	• Ensure an observer is watching the lowering of the drill rig mast so no lines or overhead obstacles are contacted. • Prior to lowering rig off of outriggers make sure all tools and personnel are clear of the drill rig.

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
			• Wear proper PPE (hard hat, safety glasses with side shield, hearing protection (while rig is operational) steel toe boots, leather work gloves. • Prior to driving to next location make sure auger racks are in. Recommend ensuring all equipment are secured. • While rig is moving on site have spotters verify clearance so no overhead obstacles are contacted and no obstacles are hit while backing or if vision is obstructed. • Properly remove PPE and wash hands and face, no smoking, drinking, eating in the work area, EZ or CRZ.
Oversight Decontamination of drill rig, augers, bits (as necessary, based on site contaminants)	High noise levels Slip, trip, & fall Wet condtions cold stress	Sound, Motion, Gravity, Chemical	• Hearing protection required if noise levels may exceed 85 dBa (minimum 25 dB NRR plugs or muffs) • Inspect pressure washer before use and confirm deadman switch fully operational • Be aware of potential slip and trip hazards such as wet surfaces and hoses. • Contain all decon water and dispose of properly • Properly dispose of decontamination water and PPE is designated areas. • Become familiarized with the detergent (i.e. Alconox) MSDS before beginning decontamination.
Take down work area (cones, flags, barricades)	Traffic which includes being struck by pedestrian or other vehicles. Pedestrian traffic trying to cross work area- slips, trips, falls Damage to equipment. Injury to other personnel.	Motion, Gravity	• Wear highly visible clothing such as high visibility reflective traffic vests or clothing. • Stay alert to surroundings and traffic (if possible move vehicle over to work area to reduce take down time and loading, use flashing light and vehicle hazard lights for added safety). • Load all equipment into work vehicle neatly.

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
	Slips, trips, falls. Back strain - Improper lifting technique		• Keep work area clear of caution tape and cords during removal of traffic control. • Utilize proper lifting procedure when loading traffic control equipment back into vehicle. • Be aware of/remove or mark tripping hazards. Be aware of slippery surfaces. Clean/dry if possible. Maintain secure footing.

Equipment to be used (List equipment to be used in the work activity)	**Inspection Requirements** (List inspection requirements for the work activity)	**Training Requirements** (List training requirements including hazard communication)
PPE	Inspect PPE before use.	Training to follow 29 CFR 1910.120. Training on proper use, care and maintenance of PPE .
CGI/PID	Inspect and calibrate daily, or as required by SAP, SOPs	Use training
Fire extinguisher(s)	Inspect before start of work, monthly CH2MHILL inspection documented on card, yearly licensed inspector inspection, documented with new card	Fire extinguisher training
Portable eye wash	Inspect prior to start of job	Use training
First Aid/Bloodborne pathogen/CPR kit	Inspect prior to start of job	First aid training/CPR training for SSC and minimum one other person on site.
Support vehicles	Daily inspection	Appropriate driver’s license

CH2MHILL

ACTIVITY HAZARD ANALYSIS

	PRINT NAME	SIGNATURE	
Supervisor Name:	_____	_____	**Date/Time:**_____
Safety Coordinator Name:	_____	_____	**Date/Time:**_____
Employee Name(s):	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____

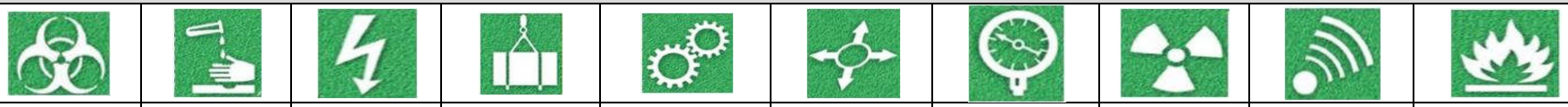
CH2MHILL

ACTIVITY HAZARD ANALYSIS

Date: 6-9-14	Task Risk Assessment Code (RAC): L
Project: Camp Lejeune LTM & VI	L = Low
Site Supervisor: Bridget Berglind	E = Extremely High Risk
Site Safety Coordinator: Bridget Berglind	H = High Risk
HSM Review/Approval:	M = Moderate Risk
Job/Activity: Vapor intrusion sampling **Description of the work**: Sampling indoor sub-slab air. Sample ports already installed.	

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

TYPES OF POTENTIAL ENERGY:



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BIOLOGICAL	CHEMICAL	ELECTRICAL	GRAVITY	MECHANICAL	MOTION	PRESSURE	RADIATION	SOUND	TEMPERATURE

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
Indoor air sampling	Chemical Exposure	Chemical	• Ensure sampling ports allow controlled sample collection. Perform real time air monitoring during sample collection. Minimize time breathing zone is within sample collection area. • All personnel performing this task shall be trained in accordance with 29CFR1910.120 and be enrolled in a medical monitoring program. • Exercise good hygiene practices. Always wash hands before eating, drinking, smoking and leaving site. Only eat, drink, smoke or chew tobacco in designated areas. Adhere to PPE and action monitoring level requirements identified in the site specific HSP.

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
	Hand Tool use Cut/struck	Mechanical	• Select and use the proper tool for the task. • Do not use tools that have been damaged or repaired in a manner which is not consistent with manufacturer's requirements. Do not over torque sample ports and SUMMA canisters when opening / closing.
	High Ambient Temperature/ Low Ambient Temperature	Temperature	• Provide and drink fluids to prevent worker dehydration. • Minimize intake of caffeinated fluids. ▪ Institute a proper work-break regiment in a cool area to avoid heat stress symptoms and overexertion. ▪ Monitor for signs and symptoms of heat stress (maintain use of buddy system, and do physiological monitoring, and document on forms) when the ambient air temperature exceeds 70˚F, the relative humidity is high (>50 percent), or when workers exhibit symptoms of heat stress and especially when wearing disposable or other types of coveralls. 1) Heat Syncope = Sluggishness or fainting while standing erect or immobile in heat. *Treatment = Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.* 2) Heat Rash = Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure. *Treatment = Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.* 3) Heat Cramps = Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours. *Treatment = Remove to cooler area. Rest lying down. Increase fluid intake.* 4) Heat exhaustion = Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low. *Treatment = Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.* 5) Heat Stroke = Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature. *Treatment = Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!*

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
			• Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather. • Frequent intake of non-caffeinated fluids to maintain body core temperature. • Frequent intake of non- caffeinated to prevent dehydration. • Obtain and review weather forecast— be aware of predicted weather systems. • Observe one (buddy system) another for initial signs of cold-related disorders. Frequent observance of Wind Chill Chart (HSP) to assist with work warming regiment determination and frostbite avoidance
	Manual Lifting injury	Gravity	• CH2MHILL or subcontract personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities, especially lifting operation involving repetitive motions. • When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. Use heavy equipment to transfer heavy or awkward loads wherever possible. Have someone assist with the lift— especially for heavy (> 40lbs.) or awkward loads. Do not attempt to manually lift objects that should otherwise be lifted with heavy equipment. • Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear prior to the lift. Avoid carrying heavy objects above shoulder level. Turn with the entire body, rather than at the waist. Prior to lifting heavy loads, evaluate lift with lifting evaluation form attached to H&S plan. Fill out lifting self-assessment checklist periodically as specified in health and safety plan.
	Slips, Trips, Falls	Gravity	• Institute and maintain good housekeeping practices. Clean Work Areas as activities proceed. Clear/removed materials and debris from pathways and commonly traveled areas as soon as possible.

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
	Driving issues	Motion	• Always using a seat belt while driving on military/government facilities. Always observe posted speed limits, traffic signs and signals. Never using a cell phone or two way radio while driving on military/government facilities. Violating these rules may result in loss of military/government facility driving privileges. Follow CH2MHILL cell phone policy. • Buddy System maintained for all phases of work. • Base or Local Emergency medical Service and Fire Dispatch numbers programmed into cellular phones. Have hospital route maps readily available. Report all unsafe conditions and acts, injury/illness or property damage to supervisors immediately

Equipment to be used (List equipment to be used in the work activity)	**Inspection Requirements** (List inspection requirements for the work activity)	**Training Requirements** (List training requirements including hazard communication)
• Fire extinguisher (with fuel and electrical sources) • Eye wash (small portable type) • Miscellaneous hand tools. • First Aid/BbPK/CPR shield	• Visual Inspections of designated work areas identify and address hazardous conditions. • Emergency Response equipment Inspections (Eye wash First Aid/CPR etc.) Fire extinguisher inspected prior to start of job, monthly noted on tag by employee, and yearly licensed inspection. Inspections of hand tools if used.	• Training and medical surveillance per 29CFF1910.120. • SSC needs FA/CPR • Review AHA with all site personnel • Review Health and Safety Plan with site personnel

CH2MHILL

ACTIVITY HAZARD ANALYSIS

	PRINT NAME	SIGNATURE	
Supervisor Name:	_____	_____	**Date/Time:**_____
Safety Coordinator Name:	_____	_____	**Date/Time:**_____
Employee Name(s):	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____

CH2MHILL

CHEMICAL INVENTORY/REGISTER FORM

Refer to Standard of Practice HSE-107 Attachment 1 for instructions on completing this form.

Location: _____

HCC: _____

☐ Office ☐ Warehouse ☐ Laboratory ☐ Project: _____

Project No.: _____

Regulated Product	Location	Container labeled (✓if yes)	MSDS available (✓if yes)

MSDS for the listed products will be maintained at: _____

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Refer to Standard Operating Procedure HSE-107 Attachment 1 for instructions on completing this form.

Location: _____ Project No. (if appropriate): _____

HCC: _____ Trainer: _____

TRAINING PARTICIPANTS:

Name	Signature	Name	Signature

REGULATED PRODUCTS AND/OR TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above:

☐ Physical and health hazards

☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)

☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, and visual appearance or odor of regulated product when being released)

Training participants shall have the opportunity to ask questions concerning these products and upon completion of this training will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

DAILY SITE MONITORING REPORT

Project:	Date:
Task Name:	Subcontractor(s):
Description of Activities:	Description of Potential Contaminant(s) and Source:

Monitoring Instrumentation

Instrumentation Description: Instrument ID Number:	Calibration gas and lot number: Time & Date Calibrated: Calibration Results:

Site Monitoring Results

Time(s)	Monitoring Location (note distance from source, upwind/downwind, etc.)	Sample Type (source, breathing zone, area, etc.)	Instrument Reading (Units)	Comments or list name and company of person if reading is a Breathing Zone sample,*

Review

Sampler:	Signature:	Date:

*If results are breathing zone results, send this completed form to your Health and Safety Manager.

DAILY SITE MONITORING REPORT

Page ___ of ___

Site Monitoring Results

Time(s)	Monitoring Location (note distance from source, upwind/downwind, etc.)	Sample Type (source, breathing zone, area, etc.)	Instrument Reading (Units)	Comments or list name and company of person if reading is a Breathing Zone sample,*

Review

Sampler:	Signature:	Date:

*If results are breathing zone results, send this completed form to your Health and Safety Manager.

HSSE

Lessons Learned

[Date] ESBG LL-11-xx

Subject	**[Insert Descriptive Name of Lessons Learned]**
CH2M HILL Project?	[Yes or No]
Situation	[Describe incident or situation that occurred in general terms. Try to be brief and avoid unnecessary details such as names of people or projects, business groups, divisions, dates, location, etc.]
Lessons Learned (Recommendations and Comments)	• Bullet out any lessons learned, recommendations or other important "take away" information that would benefit others. Tie the recommendations to the incident or event, and avoid including information that is not directly tied to the event.
Submitted By	[Name/Office Location/Phone]
Additional Information Contact	[Name/Office Location/Phone]
Keywords/Categories	[Insert any keywords or incident categories that would aid in a search for this lessons learned]

Send completed Lessons Learned to the HSM and ESBG HSSE Director for posting and distribution. Please include a recommended distribution list.

CH2MHILL

Health and Safety Field Change Request (FCR)

Date of Change:			
FCR No. (assigned by RHSM):			
Applicable Health and Safety Plan Title:			
Project Number:	**Project Name & Location:**		
Subject of Change:			
Recommended Change:			
Reason for Change:			
Submitted by*:*	**Company**: CH2M HILL	**Date:**	
Review & Acceptance:			
Project Manager:	**Date:**		
Health & Safety Mgr:	**Date:**		
Distribution:			
1.	2.	3.	4.
5.	6.	7.	8.

File Copies: Project File

Project Health and Safety Field Change Request Log

INSERT PROJECT NAME

FCR Number	Description of changes	Date of issue
	.	

CH2MHILL

ACTIVITY HAZARD ANALYSIS

Date: 6-6-2014

Project: Camp Lejeune LTM GW and SW monitoring FY 2015

Site Supervisor: Bridget Berglind

Site Safety Coordinator: Bridget Berglind

HSM Review/Approval:

Job/Activity: LTM groundwater sampling, SW sampling

Description of the work: Groundwater sampling LTM monitoring wells, surface water sampling at Camp Lejeune,.

Task Risk Assessment Code (RAC): L

L = Low

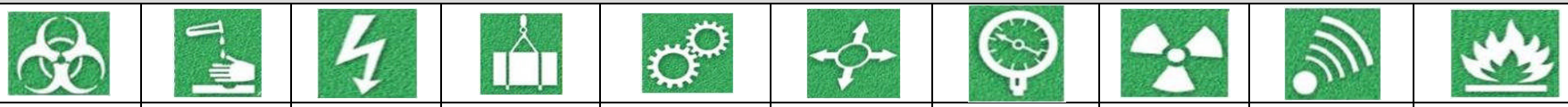
E = Extremely High Risk

H = High Risk

M = Moderate Risk

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

TYPES OF POTENTIAL ENERGY:



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BIOLOGICAL	CHEMICAL	ELECTRICAL	GRAVITY	MECHANICAL	MOTION	PRESSURE	RADIATION	SOUND	TEMPERATURE

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
General site hazards	1. Slips/trips/falls 2. Loading heavy equipment/pinch points back strain 3. Shifting loads/pinch points 4. Fueling vehicles 5. Accidents driving to, from and on site. 6. List accidents/near misses that have happened on this site before. Discuss them with field staff. 7. Lack of understanding of local, site specific hazards.	GRAVITY, MOTION	1. Watch for slippery steps, watch footing. Keep working area clear of trip hazards. Maintain good housekeeping at site. Control cords, tubing, equipment. During cold months maintain site to keep ice off walking areas, steps and ladders. 2. Use partner, and if necessary a dolly or other mechanical lifting/transportation device, lift w/ legs. Evaluate heavy lifts prior to lifting, especially IDW water.

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
	8. Traffic hazards in high traffic areas.		3. Tie down loads securely with rope, load bars. Visualize what load would do in an accident, and prevent injuries from load shifting. 4. Perform vehicle walk-arounds to inspect for safety issues and observe obstacles to backing out of parking spot (preference is pull through parking). 5. Radios and cell phones turned off when fueling. No cell phone use while driving. 6. Get briefing from PM or someone very familiar with the site if possible, and discuss any site specific hazards, and how to mitigate them. Make sure PTSP contains emergency assembly point, emergency procedures and site specific hazards. Daily tailgate meeting required. Daily pre-use inspection of all tools. 7. If working near roadways or in parking lots or areas where there is likelihood of vehicular traffic, wear orange safety vest, follow traffic safety plan in HASP.
Unpacking/prepping botleware/coolers	Cuts from broken bottles, acid/base burns from leaking preservative, lifting hazards	CHEMICAL	Visually evaluate condition of material prior to handling. Use caution when unpacking glass bottleware, wear cut resistant gloves if broken glass is seen or heard. Use acid resistant gloves when unpacking pre-preserved containers. Use appropriate lifting techniques. Follow lifting SOP. Review preservative MSDS and have emergency eyewash in immediate area.
Drive to closest access point for site.	Auto accident. Drivers driving unsafely for the road conditions. Local road conditions Traffic issues Striking equipment, wells Back strain/sprain.	MOTION	Drive very defensively. Obey the speed limit, and drive slowly and defensively along roads. Defensive driving habits are a must. Manage time so as to prevent the need to rush to destinations. No high speed driving to get to FedEx on time. Watch out for other drivers driving erratically. No cell phone use while driving. If you can't safely drive up to the well, drive the nearest safe point, and

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
			carry in equipment in evenly distributed, light loads. Follow heavy lifting self evaluation and check sheet to avoid lifting overly heavy items
Walking in to well sites, carrying in gear	Trip hazards from uneven surfaces. Strains from heavy lifting.	GRAVITY	Watch out for trip hazards, vines and low stumps of previously cut vegetation under current ground cover vegetation. Watch out for ruts, holes and uneven terrain. Wear sturdy, breathable boots with good ankle support and very sturdy soles. Carry light evenly distributed loads to avoid lifting overly heavy loads. Keep work area free of clutter and trip hazards.
	Poisonous and irritating plants.	BIOLOGICAL	Poison Ivy and Poison Oak Be able to recognize the plants and avoid. Use barrier creams and PPE as necessary (if is likely you will come in contact with the plants).
	Heat/cold	TEMPERATURE	Heat: Follow SAHP guidelines for heat stress (pulse monitoring). Drink plenty of fluids. Take breaks as necessary. Watch yourself and your co-worker for signs o heat stress. Make sure to carry sufficient drinking water and sports drinks with you. Keep a cooler in the car with cool water bottles and sports drinks. Wear a hat with a broad brim. Stay out of the sun when possible. Use pop up pavilion or shade tarp where necessary. Cold: Follow SAHP guidelines, dress appropriately, take breaks to warm up in vehicle or trailer.
	Sunburn Inclement weather	RADIATION, ELECTRICAL	Wear a hat and sun screen. Wear long sleeve shirts and long pants. Use sunscreen every morning before the sun gets hot re-apply sunscreen regularly. Stop work in heavy rain or high winds. Stop work in lightning or thunder storms; Seek shelter in a building or rubber tired vehicle. Work will not re-start until 30 minutes after the last lightning strike or thunder clap .
	Tick borne pathogens, Mosquito borne pathogens Bees/Wasps Snakes	BIOLOGICAL	If ticks are possible in the groundwater sampling area in which you are working, read “Tick-Borne Pathogens” in HSP.

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
			The methods for controlling exposure to ticks include, in order of most- to least-preferred: • Avoiding tick habitats and ceasing operations in heavily infested areas • Reducing tick abundance through habitat disruption or application of acracide • Personal protection through use of repellants and protective clothing combined with • Frequent tick inspections and proper hygiene Use insecticide with Deet on clothing to prevent mosquito bites. Wear long sleeved shirts if necessary and long pants. • Check for bees/wasp/spider nests before reaching into/behind any objects. Always wear leather gloves when reaching into areas. • Report all bites stings to your supervisor or SC. Inform supervisor if you are allergic to bees. Wear snake leggings if working in likely snake habitat, or if walking through vegetation over knee high were you can't see the ground/your feet.
Accessing and opening well	1. Over tightened bolts, rusty locks/slipping causing cuts/abrasions to hands. 2. PID readings > 1ppm 3. Contact with potentially contaminated water. 4. Bee/Wasps nests. Spiders/spider nests	MOTION, CHEMICAL, BIOLOGICAL	• Know the limitations of all hand tools. Use socket wrenches and bolt cutters, as necessary, to remove old, rusty locks. Wear work gloves over nitriles when working with tools. • Allow well to vent, if readings continue over 0.5 ppm then recap and advise management. • Wear nitrile gloves • Use caution if bees/wasps in well. • Check for spider and spider nests in well. Do not proceed until bees/wasp/spider nests are addressed or removed.

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
Water level measurement	1. Winding of meter/repetitive motion, probe recoiling too quickly striking personnel, leaning over well	MOTION	1. Share physical aspects of job with partner. Take turns to avoid repetition. 2. Recoil meter slowly as the probe reaches meter 3. If cable begins to rapidly 'free wheel'. Do not try to stop it, let it go.
Sample Collection, surface water or groundwater	1. Pinch points 2. Sampler preservatives/vapors released once water is added or splashing of preservative on skin 3. Shock if sampling with generator powered equipment 4. gas bottle hazards from inert gas drive pumps 5. Lifting hazards from car batteries for battery run equipment. Acid burns from battery 6. Slippery conditions in mud/sediment	CHEMICAL, ELECTRICAL, GRAVITY	1. Watch hands and fingers when attaching sample ports. 2. Hold sample containers away from face and downwind when filling. Wear proper PPE per HSP. 3. Make sure generator is well grounded with ground rod, and equipment on GFCIs. 4. Gas bottles should be chained upright when not in use, and firmly secured when transported. Do not transport bottle with gages attached. Leave bottle secured upright when in use. 5. Use safe lifting techniques when lifting batteries, watch pinch points, check route prior to traveling with the load. Wear nitrile gloves and safety glasses/goggles. Ensure battery is correctly connected when replacing battery 6. Watch footing in mud/sediment.
Fueling generator	Spills Contact with fuel	CHEMICAL	Ensure spill kit is available. Wear proper ppe (gloves, safety glasses/faceshield). Do not leave nozzle during fueling. Portable containers will be metal with spark arrestor and be properly labeled and stored.
Site Breakdown	1. Moving drums of purge water, hazards of heavy lifting and pinch points, muscle strain/sprain	GRAVITY, MOTION	1. Use partner to move pails/carboys from ground to vehicle 2. Safety glasses and nitrile gloves/leather or cut resistant work gloves 3. Do not rush. 4. Limit loads to safe weights

Work Task Sequence (List steps you need to take to complete the activity.)	**Potential Health and Safety Hazards** (How can you be harmed? Cut, struck, exposed…)	**Potential Energy(ies) Associated with Task**	**Hazard Controls** (List the **specific controls** for each potential hazard. Refer to EN&N Market HSSE Handbook for required controls)
			5. Use proper lifting technique Feet shoulder width apart, one leg slightly in front of the other. Bend at the knees, not the back Position objects to be carried close to the body Secure a firm grip Lift with legs Avoid twisting at the waist
Dealing with electrical batteries	Lifting hazard, contact with acids, shock.	GRAVITY, CHEMICAL, ELECTRICAL	Use proper PPE (chemical resistant gloves, goggles) when cleaning/inspecting/charging auto batteries. Charge batteries in open, well ventilated area. Use proper lifting techniques.
Equipment decon	Exposure to decon solutions (methanol, isopropanol, nitric, etc.)	CHEMICAL	1 Safety glasses and nitrile gloves. Wear chemical goggles if there is a splash potential.
Cutting tubing and plastic sheeting	Cuts from knife	MECHANICAL	Use tubing cutter to cut tubing, follow knife policy/Knife use AHA. (knife should be used only if there is no other tool for the job). Wear cut resistant gloves.

Equipment to be used (List equipment to be used in the work activity)	**Inspection Requirements** (List inspection requirements for the work activity)	**Training Requirements** (List training requirements including hazard communication)
First aid kit with ice pack, sting wipes.	Make sure first aid supplies haven't expired, and that chemical ice pack hasn't gone off by itself.	First aid/CPR for SSC OSHA 40, 8-hour refresher Vinyl chloride training Hazcom

Equipment to be used (List equipment to be used in the work activity)	**Inspection Requirements** (List inspection requirements for the work activity)	**Training Requirements** (List training requirements including hazard communication)
PPE, safety glasses, steel toe boots, nitrile gloves	Inspect PPE before use	
Fire extinguisher	Inspect monthly internally, document on tag, and have licensed inspection yearly with replacement tag.	Fire extinguisher training

CH2MHILL

ACTIVITY HAZARD ANALYSIS

	PRINT NAME	SIGNATURE	
Supervisor Name:	_____	_____	**Date/Time:**_____
Safety Coordinator Name:	_____	_____	**Date/Time:**_____
Employee Name(s):	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____

HEAT STRESS PHYSIOLOGICAL MONITORING FORM

Project:

Date:	Company:

1. Take and record measurement of temperature or pulse at the frequency indicated in the safety plan.
2. Follow the Physiological Monitoring Protocol in the safety plan.
3. Never continue work if your body temperature is more than 100.4° F/38° C, or if you are experiencing sudden and severe fatigue, nausea, dizziness, or lightheadedness.

Employee:

Describe action taken below if measurements are exceeded:

Time								
Temp								
Heat Index								
Pulse								

Employee:

Describe action taken below if measurements are exceeded:

Time								
Temp								
Heat Index								
Pulse								

Employee:

Describe action taken below if measurements are exceeded:

Time								
Temp								
Heat Index								
Pulse								

Employee:

Describe action taken below if measurements are exceeded:

Time								
Temp								
Heat Index								
Pulse								

Thermal Stress Monitoring – Permeable or Impermeable Clothing

When permeable work clothes are worn (street clothes or clothing ensembles over street clothes), regularly observe workers for signs and symptoms of heat stress and implement physiological monitoring as indicated below. This should start when the heat index reaches 80° F (27° C) [see Heat Index Table below], or sooner if workers exhibit symptoms of heat stress indicated in the table above. These heat index values were devised for shady, light wind conditions; exposure to full sunshine can increase the values by up to 15°F (8°C). Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

When wearing **impermeable clothing** (e.g., clothing doesn't allow for air or water vapor movement such as Tyvek), physiological monitoring as described below shall be conducted when the ambient temperature reaches 70° F (21° C) or at a lower temperature when workers begin to exhibit signs and symptoms of heat stress.

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	126	130					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Streuous Activity

Caution Extreme Caution Danger Extreme Danger

Heat Index	Possible Heat Disorders	Minimum Frequency of Physiological Monitoring
80°F - 90°F (27°C - 32°C)	Fatigue possible with prolonged exposure and/or physical activity	Conduct initial monitoring as baseline and observe workers for signs of heat stress and implement physiological monitoring if warranted.
90°F - 105°F (32°C - 41°C)	Sunstroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity	Conduct initial monitoring as baseline, then at least every hour, or sooner, if signs of heat stress are observed.
105°F - 130°F (41°C - 54°C)	Sunstroke, heat cramps, or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity.	Conduct initial monitoring as baseline, then every 30 minutes or sooner if signs of heat stress are observed.
130°F or Higher (54°C or Higher)	Heat/Sunstroke highly likely with continued exposure.	Conduct initial monitoring as baseline, then every 15 minutes or sooner if signs of heat stress are observed.
Source: National Weather Service		

MEMORANDUM CH2MHILL

Personal Protection Measures in the Prevention of Biological Incidents

TO: NAVFACLANT CLEAN Members

COPIES: Mark Orman/MKE
Mike Goldman/ATL

FROM: Ray Tyler/VBO, NAVFACLANT Program Manager

DATE: March 4, 2010
1 Attachment

NAVFACLANT CLEAN members, you are to be commended in reducing the number of biological incidents over the past years, particularly those related to tick bites. Our goal is to have zero biological and other safety incidents on the CLEAN program. To achieve Target Zero and to make sure that no one is injured on the job or at home, this memo outlines the procedures in selecting the appropriate clothing, treatment options, and inspection procedures which must be followed on CLEAN projects to prevent biological incidents.

Clothing & Insect Repellant Requirements

The selection of which clothing to utilize will depend on several factors including weather conditions, site vegetation and tasks to be completed. The table below provides the type of protection to be applied for each staff member conducting field work (including site inspections) on Navy CLEAN projects. Any deviations from the below table should be discussed with the PM and the Program H&S Manager, Mark Orman/MKE.

Body Part	Protective Measure
Head	Light colored hat with wide all-around brim (required) Treat neck with DEET (required)
Upper Body	Light colored long sleeve shirt (required) Treat exposed skin with DEET (required) One of the following must be worn: 1) Pre-treated or self-applied Permethrin clothing 2) Tyvek® coverall 3) Bug Suit
Lower Body	Light colored long pants tucked into socks and taped to prevent any entry points (required) One of the following must be followed: 1) Pre-treated or self-applied Permethrin clothing treatment 2) Tyvek® coverall 3) Bug suit

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Feet	White socks (recommended) Taped pant cuffs to boots (required) Pants tucked into socks (required) Permethrin gaiters (optional)

A checklist has been developed for staff to remind us of the procedures that should be followed each day staff are working in an environment where contact with biological is expected (Attachment 1). This checklist should be filled out daily for each team and will become part of the project file and will be asked for if a biological incident occurs.

As with personal clothing as well as suits, it is critical that the user remove the clothing as soon as possible and properly handle the used clothing. Shortening the time the clothing is worn reduces the chances from ticks to make their way from your clothes to your skin.

Self Applied Permethrin Clothing Treatment

Permethrin based repellents (i.e., Permanone) have proven to be highly effective in preventing tick bites. Permethrin is actually an insecticide, rather than a traditional repellant, and works primarily by killing ticks on contact with the clothes (although it also has some repellant properties). Repellants containing Permethrin are for use on clothing only, and **are not intended for skin application**. These products are formulated as aerosol sprays or pumps, and will typically provide up to 2 weeks of protection from a single treatment (lasting through several washings). Typically, these products are applied in a well ventilated area, and allowed to dry for 2-4 hours (more time is required for higher humidity environments). Costs for these repellents generally run from $7 to $20.

While skin reactions are not common, it is recommended to avoid contact with face eyes or skin when treating clothing. If a reaction is noticed, remove the clothing and shower as quickly as is possible. All chemical treatments, either for clothing or for skin, should follow the manufacturer's instructions. Additional information on the application of repellents can be found on the Center for Disease Control (CDC) website:
http://www.cdc.gov/ncidod/dvbid/westnile/repellentupdates.htm

Pretreated Permethrin Clothing

There are some manufacturers which produce clothing that has already been treated with repellents, such as Permethrin. Typically, the fibers are impregnated with the repellant, reportedly making them able to withstand up to 70 wash cycles. While there is likely some variability in how long these clothing remain effective, they could also be retreated to prolong their effectiveness. Purchasing pre-treated clothing is one alternative to applying a Permethrin based repellant to your clothing. However, the costs of these clothes can range from $20 to $50. Staff should discuss the need for such clothing with their PMs.

Bug Suits

Bug Suits (aka Bug-Out-Suits), are garments which are assembled with a mesh foundation woven throughout the pants and jacket, along with a mesh/fabric hood. These provide a physical barrier to small insects. Typically, these garments are not treated with repellants and still are susceptible to infiltration through seams.

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Bug Suits add an additional layer of clothing to the wearer when used properly. Drawbacks to the use of the suits may include an increase of tripping hazards if not properly sized, impaired vision, and an in increase risk of heat related illnesses. The suits should not be used around heavy equipment or moving parts that could catch the material and pull an individual into the equipment. Frequent inspections of the suit is required to ensure that no tears have developed or separations of seams. Additional rest breaks and increased personal monitoring is necessary during their use. Bug Suits should be ordered and charged to the projects they are being used on.

Tyvek®

Tyvek® suits provide a continuous physical barrier for the legs and torso, which makes it very difficult for ticks to infiltrate. The light color also makes it easier to see ticks that have transferred onto the body. The disposable nature of the suits also reduces the hazard associated with ticks which go undetected in clothing at the end of the day. Tyvek® clothing does present an additional heat stress hazard for employees. Additional rest breaks and increased personal monitoring is necessary during their use.

Skin Treatment

The use of skin applied repellants is required when working in areas where the presence of ticks is anticipated. While other repellants may provide some level of protection, DEET (*N*,*N*-Diethyl-*meta*-toluamide) based repellants are required for use on CH2M HILL projects.

These repellants must be reapplied periodically in accordance with manufacturer's recommendations. The effectiveness of DEET on the skin is influenced by the concentration of DEET, absorption through the skin, evaporation, sweating, air temperature, wind and abrasion of the treated surface by rubbing or washing. Studies have shown that 100% DEET may offer up to 12 hours of protection, while lower concentrations of DEET (20%-34%) may provide between 3 to 6 hours of protection. The Centers for Disease Control and Prevention (CDC) recommends repellents with between 20%-30% DEET content. Some non-DEET repellent products also provide some level of protection, but those products have been found to offer a lesser degree of protection than DEET based products. It should be noted that while DEET will repel ticks and decrease the chance of a tick bite, it may not deter a tick from walking across the skin to unexposed and untreated areas.

Tick Checks and Response to Tick Bites

The use of protective clothing and application of repellents is only part of preventing a biological incident. No one should be under the false impression that by using the appropriate clothing and applying adequate repellent that they are immune to tick bites. By conducting routine tick checks, reducing the time which ticks have to find a pathway to your skin, we can further reduce the risk.

Tick Checks

By checking ourselves and others for ticks, we are able to find ticks before they have a chance to attach or transfer diseases. Field staff will conduct personal checks as often as possible, but no less than once at lunch and at the end of the day. The inspection at the end of the day should include an unclothed tick check. Personal checks should be conducted

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using a mirror to look over areas that are not able to be seen by just one person. Clothing should be turned inside-out and thoroughly inspected.

It is also recommended that if facilities are available, that a second set of clothes be brought to change into. The clothing worn during the day should be placed in a plastic trash bag and taped closed. The bag should be transported separate from the passenger area of the vehicle (i.e. in trunk, back of pick-up truck).

Personal Hygiene

In addition to removing clothing as soon as is practical, it is also important to practice good and immediate hygiene following field work. By washing shortly after tasks are complete, not only are you washing away any site dirt, you are also removing the applied repellent. Showering is the recommended method for removing residual repellent and provides an additional opportunity for personal check. If showering is not readily available, the minimum requirement is to wash the hands and face prior to eating or drinking.

Tick Bite and Removal

If bitten by a tick, act promptly. Remove the tick immediately using tweezers pulling gently at the point of attachment (head). Rick removal kits may also be ordered through the equipment warehouse. It is essential to remove the tick as soon as possible (best if found and removed within 24 hours of attachment).

The tick should be placed in a Ziploc bag for testing at a later date, if deemed necessary by the Occ. Nurse. As with any incident, contact the PM, HSM and the WorkCare Occupational Health Nurse at **1-866-893-2514** as soon as possible, and provide as much information as possible regarding the date, time and location of the bite. Follow the nurse's advice regarding monitoring symptoms and follow-up contact.
Complete HITS (incident report) or designate a person to complete the form as soon as possible, but no more than 24-hours after identifying the bite. ***Remember, time is your enemy. The longer you wait to inspect for a tick, the longer it takes for you to communicate a tick bite, the more likely it is that a tick can transfer a blood borne illness.***

Final Words

I am asking all of you to follow the steps described in this memo and really try to modify your behavior and continuously strive for our "Target Zero" goal of no incidents or accidents. This isn't easy, I know. Pleasing the client, meeting deadlines, and staying within budget compete with our time to embrace the H&S culture, but each of us must work harder to push past simply complying with H&S. You need to make an individual commitment to incorporate H&S into every activity you involve yourself with, at work and at home. Thank you all for what you do every day. Be safe.

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OBSERVED HAZARD FORM

NAME/COMPANY OF OBSERVER (*OPTIONAL*):

DATE

TIME

CONTRACTOR/S PERFORMING UNSAFE ACT OR CREATING UNSAFE CONDITION:
1.
_____

UNSAFE ACT OR CONDITION:
_____
_____
_____
_____
_____
_____
_____
_____
_____

NAME OF CH2M HILL REPRESENTATIVE:

CORRECTIVE ACTIONS TAKEN:
DATE: _____
_____
_____

PROJECT SAFETY COMMITTEE EVALUATION:
DATE: _____
_____
_____

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Pre-Task Safety Plan (PTSP) and Safety Meeting Sign-in Sheet

Project:_____ Location: _____ Date:_____

Supervisor: _____ Job Activity:_____

_____

Attendees: Print Name Sign Name

_____

_____

_____

_____

_____

_____

_____

List Tasks and verify that applicable AHAs have been reviewed:

_____

_____

_____

Tools/Equipment Required for Tasks (ladders, scaffolds, fall protection, cranes/rigging, heavy equipment, power tools):

_____

_____

_____

Potential H&S Hazards, including chemical, physical, safety, biological and environmental (check all that apply):

__ Chemical burns/contact	__ Trench, excavations, cave-ins	__ Ergonomics
__ Pressurized lines/equipment	__ Overexertion	__ Chemical splash
__ Thermal burns	__ Pinch points	__ Poisonous plants/insects
__ Electrical	__ Cuts/abrasions	__ Eye hazards/flying projectile
__ Weather conditions	__ Spills	__ Inhalation hazard
__ Heights/fall > 6 feet	__ Overhead Electrical hazards	__ Heat/cold stress
__ Noise	__ Elevated loads	__ Water/drowning hazard
__ Explosion/fire	__ Slips, trip and falls	__ Heavy equipment
__ Radiation	__ Manual lifting	__ Aerial lifts/platforms
__ Confined space entry	__ Welding/cutting	__ Demolition
__Underground Utilities	__ Security	__ Poor communications

Other Potential Hazards (Describe):

_____

_____

_____

Hazard Control Measures (Check All That Apply):			
PPE __ Thermal/lined __ Eye __ Dermal/hand __ Hearing __ Respiratory __ Reflective vests __ Flotation device __ Hard Hat	Protective Systems __ Sloping __ Shoring __ Trench box __ Barricades __ Competent person __ Locate buried utilities __ Daily inspections __ Entry Permits/notification	Fire Protection __ Fire extinguishers __ Fire watch __ Non-spark tools __ Grounding/bonding __ Intrinsically safe equipment	Electrical __ Lockout/tagout __ Grounded __ Panels covered __ GFCI/extension cords __ Power tools/cord inspected __ Overhead line clearance __ Underground utils ID'd
Fall Protection __ Harness/lanyards __ Adequate anchorage __ Guardrail system __ Covered opening __ Fixed barricades __ Warning system	Air Monitoring __ PID/FID __ Detector tubes __ Radiation __ Personnel sampling __ LEL/O2 __ No visible dust __ Other	Proper Equipment __ Aerial lift/ladders/scaffolds __ Forklift/heavy equipment __ Backup alarms __ Hand/power tools __ Crane with current inspection __ Proper rigging __ Operator qualified	Welding & Cutting __ Cylinders secured/capped __ Cylinders separated/upright __ Flash-back arrestors __ No cylinders in CSE __ Flame retardant clothing __ Appropriate goggles
Confined Space Entry __ Isolation __ Air monitoring __ Trained personnel __ Permit completed __ Rescue	Medical/ER __ First-aid kit __ Eye wash __ FA-CPR trained personnel __ Route to hospital	Heat/Cold Stress __ Work/rest regime __ Rest area __ Liquids available __ Monitoring __ Training	Vehicle/Traffic __ Traffic control __ Barricades __ Flags __ Signs
Permits __ Hot work __ Confined space __ Lockout/tagout __ Excavation __ Demolition __ Energized work	Demolition __ Pre-demolition survey __ Structure condition __ Isolate area/utilities __ Competent person __ Hazmat present	Inspections: __ Ladders/aerial lifts __ Lanyards/harness __ Scaffolds __ Heavy equipment __ Drill rigs/geoprobe rigs __ Cranes and rigging __ Utilities marked	Training: __ Hazwaste (current) __ Construction __ Competent person __ Task-specific __ FA/CPR __ Confined Space __ Hazcom
Underground Utilities __Dig alert called __3rd Party locater __As-builts reviewed __Interview site staff __Client review __soft locate necessary?	Incident Communications __Work stops until cleared by TM/CM __Immediate calls to TM/CM __Client notification __24 hour notification setup __Clear communications	AHA' s __reviewed and approved by HSM __on site and current __applicable for this day's work __Communication and incident processes included?	

Field Notes (including observations from prior day, etc.):

_____

_____

_____

Name (Print): _____

Signature:_____ Date:_____

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Safe Behavior Observation Form		
☐ Federal ☐Commercial ☐ International (check one)	☐Construction or ☐Consulting (check one)	
Project Number:	Client/Program:	
Project Name:	Observer:	Date:
Position/Title of worker observed:	Background Information/ comments:	
Task/Observation Observed:		

- Identify and reinforce safe work practices/behaviors
- Identify and improve on at-risk practices/acts
- Identify and improve on practices, conditions, controls, and compliance that eliminate or reduce hazards
- Proactive PM support facilitates eliminating/reducing hazards (do you have what you need?)
- Positive, corrective, cooperative, collaborative feedback/recommendations

Actions & Behaviors	Safe	At-Risk	Observations/Comments
Current & accurate Pre-Task Planning/Briefing (Project safety plan, STAC, AHA, PTSP, tailgate briefing, etc., as needed)			**Positive Observations/Safe Work Practices:**
Properly trained/qualified/experienced			
Tools/equipment available and adequate			
Proper use of tools			**Questionable Activity/Unsafe Condition Observed:**
Barricades/work zone control			
Housekeeping			
Communication			
Work Approach/Habits			
Attitude			
Focus/attentiveness			**Observer's Corrective Actions/Comments:**
Pace			
Uncomfortable/unsafe position			
Inconvenient/unsafe location			
Position/Line of fire			
Apparel (hair, loose clothing, jewelry)			
Repetitive motion			**Observed Worker's Corrective Actions/Comments:**
Other…			

For ES Federal Sector projects please email completed forms to: CH2MHILLESFEDSafeBehaviorObservation@ch2m.com
For ES Commercial Sector projects please email completed forms to: SafeBehaviorObservations@ch2m.com
For CNR ES staff please email completed forms to: cnressafe@ch2m.com
For International ES projects please e-mail completed forms to: ESINTLSafeBehaviorObservation@ch2m.com

Stop Work Order

A work stoppage is issued for nonperformance issue(s) specified below and shall remain in effect until all corrective actions are completed.

Report prepared by:

Name:	Title:	Signature:	Date:

Issue of nonperformance

Description:_____	Date of Nonperformance:
	_____

Subcontractor signature of notification:

Name:	Title:	Signature:	Date:

** Corrective action is to be taken immediately. Note below the action taken, sign and return to CH2M HILL.**

Subcontractor's Corrective Action

Description:_____	Date of Corrective Actions:
	_____

Subcontractor signature of correction:

Name:	Title:	Signature:	Date:

Vinyl Chloride Fact Sheet

Uses and Occurrences

Polyvinyl chloride and its copolymers are used in organic synthesis, adhesives for plastics, and as a precursor in the production of the common plastic polyvinyl chloride (PVC). It is often a degradation product of a number of chlorinated compounds, including tetra-chloroethylene and trichloroethylene at hazardous waste sites in soils and groundwater. It can also be a breakdown product of the combustion of PVC or other chlorinated compounds.

Physical Characteristics

Appearance:	Colorless gas
Odor:	Sweet; odor threshold-3,000 ppm
Flammable:	Class IA Flammable Liquid Gas; NFPA Rating: 4
Flash Point:	-78°C (108°F)
Flammable Range:	3.6% - 33.0% (% by volume in air)
Specific Gravity:	0.91 (water = 1.0)
Stability:	Stable under ordinary conditions of use and storage
Vapor Pressure:	2300 mm Hg (at 20°C)
Incompatibilities:	Atmospheric oxygen and strong oxidizers may react to produce peroxide, which can initiate a violent polymerization reaction.
Melting Point:	-155.7°C (-248°F)
Boiling Point:	-14°C (7°F)

Signs and Symptoms of Exposure

Inhalation: Short Term: Dizziness, light-headedness, nausea, dullness of visual and auditory responses, drowsiness, and unconsciousness. Long term: Thickening of skin, contact and allergic dermatitis, fatigue, coughing and sneezing, abdominal pain, gastrointestinal bleeding, nausea, vomiting, indigestion, diarrhea, jaundice, weight loss, anorexia, and cold and tingling sensations of the hands and feet, carcinogen.

Skin contact: Short Term: Skin contact with liquid can cause frostbite. Long term: Dermatitis

Eye contact: Vapors can cause eye irritation. Contact can produce pain, inflammation and temporal eye damage.

Modes of Exposure

Inhalation: Vapor

Absorption: Liquid causes frostbite

Ingestion: Ingestion of contaminated water

Exposure Limits

Action level (AL) 0.5 ppm

PEL 1 ppm

STEL None

PEL-C 5 ppm

TLV 1 ppm

Exposure Level vs. Regulatory Requirements

EXPOSURE LEVEL (EL)	REGULATORY REQUIREMENTS
EL < AL	Maintain exposure as low as reasonably achievable.
AL > EL, EL < PEL	Implement portions of the OSHA Vinyl Chloride Standard and training.
EL > PEL	Implement all portions of the OSHA Vinyl Chloride Standard, including training, medical surveillance, engineering controls, establishment of work areas, etc.

PPE

Eye: Safety glasses; chemical goggles, face shield.

Skin: Tychem SL or other full-body clothing, depending on the exposure. Nitrile, Viton, or laminated film gloves.

Respiratory: Air purifying respirators and supplied air respirators, depending on the exposure.

First Aid

Inhalation: Move to fresh air; begin rescue breathing if breathing has stopped and CPR if hear action has stopped, transfer promptly to a medical facility.

Skin: Immerse affected part in warm water; seek medical attention promptly.

Eyes: Flush with large amounts of water for 15 minutes; seek medical attention promptly.

Ingestion: Contact a physician.

Working Alone

CALL – IN CONTACT FORM

Date of site work:_____ Expected start time:_____

Name of CH2M HILL employee in the field:_____

Name of CH2M HILL employee responsible to receive contact:

Client Emergency Contact (if any):

CH2M HILL employee's contact numbers:

Radio #_____

Cell Phone #_____

Address and Location of work:_____

Directions/Map:

Planned Activity:_____

Specified Frequency and time for call in:_____

Time	Verified	Location

If lone worker fails to call in at specified frequency/time:

1) Call worker's radio and cell to determine if an emergency exists.
2) If no reply, immediately call Client security/emergency service if there is one at the site.
3) If there is no client security call Emergency Services (911). Inform the dispatcher there is a lone worker that cannot be contacted and there may be an emergency on site. Provide the lone worker's name, their last known location, and your contact information.
4) After Emergency Services have been contacted, call the other emergency contacts, Project Manager, and Health and Safety Manager.

Working Alone Determination Flowchart

Attachment 2: HSE Self-Assessment Checklist - Drilling

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's written safety plan.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to drilling hazards, 2) CH2M HILL staff are providing support function related to drilling activities, and/or 3) CH2M HILL oversight of a drilling subcontractor is required.

Safety Coordinator may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered being imminently dangerous (possibility of serious injury or death) shall be corrected immediately, or all exposed personnel shall be removed from the hazard until corrected.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards (complete Section 1).
☐ Evaluate CH2M HILL support functions related to drilling activities (complete Section 2)
☐ Evaluate a CH2M HILL subcontractor's compliance with drilling safety requirements (complete entire checklist).
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in SOP HSE-204.

SECTION 1 - SAFE WORK PRACTICES - 5.1

	Yes	No	N/A	N/O
1. Personnel cleared during rig start-up, positioning and setup	☐	☐	☐	☐
2. Personnel clear of rotating parts	☐	☐	☐	☐
3. Personnel not positioned under hoisted loads	☐	☐	☐	☐
4. Loose clothing and jewelry removed	☐	☐	☐	☐
5. Smoking is prohibited around drilling operation	☐	☐	☐	☐
6. Personnel wearing appropriate personal protective equipment (PPE), per HSP or FSI	☐	☐	☐	☐
7. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐

SECTION 2 - SUPPORT FUNCTIONS - 5.2

AQUIFER DESIGNATIONS (5.2.1)

8. Aquifer designations determined and BGEM consulted when required.	☐	☐	☐	☐

LOCATION OF UTILITIES (5.2.2)

9. Location of underground and overhead utilities and structures identified	☐	☐	☐	☐
10. Utility company contacted to de-energize/ground power lines due to clearance	☐	☐	☐	☐

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SUPPORRT FUNCTIONS – 5.2 (Continued)

	Yes	No	N/A	N/O
WASTE MANAGEMENT (5.2.3)				
11. Drill cuttings and purge water managed and disposed properly	☐	☐	☐	☐
12. Wastes generated evaluated for proper disposal	☐	☐	☐	☐
13. Appropriate decontamination procedures being followed, per project's written safety plan	☐	☐	☐	☐
DRILLING AT ORDNANCE EXPLOSIVES OR UNEXPLODED ORDNANCE SITES (5.2.4)				
14. MEC plan prepared and approved	☐	☐	☐	☐
15. MEC avoidance provided, routes and boundaries cleared and marked	☐	☐	☐	☐
16. Initial pilot hole established by UXO technician with hand auger	☐	☐	☐	☐
17. Personnel remain inside cleared areas	☐	☐	☐	☐
SECTION 3 - DRILLING SAFETY REQUIREMENTS -5.3				
GENERAL (5.3.1)				
18. Only authorized personnel operating drill rigs	☐	☐	☐	☐
19. Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
20. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
21. Good housekeeping maintained on and around rig	☐	☐	☐	☐
SAFETY EQUIPMENT (5.3.2)				
22. Safety-toed boots, hardhats, safety glasses w/side shields, gloves and hearing protection worn	☐	☐	☐	☐
23. Drill rig equipped with fire extinguisher	☐	☐	☐	☐
24. Air monitoring instruments provided when required	☐	☐	☐	☐
25. Reflective/high visibility vests worn when required	☐	☐	☐	☐
26. PPE for protection from chemical hazards worn if required	☐	☐	☐	☐
BURIED UTILITY AND OVERHEAD CLEARANCE (5.3.3)				
27. Location of underground utilities and structures identified, including third party locate	☐	☐	☐	☐
28. 360^0 visual observation conducted	☐	☐	☐	☐
29. Hand digging, air knifing conducted to expose utilities before drilling	☐	☐	☐	☐
30. Safe clearance distance maintained from overhead power lines	☐	☐	☐	☐
31. Power lines de-energized and grounded when safe distances cannot be maintained	☐	☐	☐	☐
DRILL RIG PLACEMENT (5.3.4)				
32. Drilling pad established, when necessary	☐	☐	☐	☐
33. Drill rig leveled and stabilized	☐	☐	☐	☐
34. Additional precautions taken when drilling in restricted areas	☐	☐	☐	☐
35. In Karst topography use remote sensing or geologist review for sinkholes	☐	☐	☐	☐
DRILL RIG TRAVEL (5.3.5)				
36. Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
37. Tools and equipment secured prior to rig movement	☐	☐	☐	☐
38. Only personnel seated in cab wearing a seat belt are riding on rig during movement	☐	☐	☐	☐
39. Backup alarm or spotter used when backing rig	☐	☐	☐	☐
40. Spotter used when backing rig in tight or restricted areas or when low clearances exist	☐	☐	☐	☐
41. Safe clearance distance maintained while traveling under overhead power lines	☐	☐	☐	☐
EMERGENCY – CONTACT WITH OVERHEAD OR UNDERGROUND ELECTRICAL LINES (5.3.6)				
42. Personnel understand emergency procedures in the event of contact with overhead or underground electrical lines	☐	☐	☐	☐
DRILL RIG OPERATION (5.3.7)				
43. Drill rig operated in accordance with operators' manual	☐	☐	☐	☐
44. Personnel clear while mast is being raised	☐	☐	☐	☐
45. Kill switch clearly identified, operational, and in reach of the operator control station	☐	☐	☐	☐

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SECTION 3 - DRILLING SAFETY REQUIREMENTS - 5.3 (Continued)

46.	All machine guards are in place	☐	☐	☐	☐
47.	Rig ropes never wrapped around any part of the body	☐	☐	☐	☐
48.	Pressurized lines and hoses secured to prevent whipping hazards	☐	☐	☐	☐
49.	Drilling operation stopped during inclement weather	☐	☐	☐	☐
50.	Air monitoring conducted per written safety plan for hazardous atmospheres	☐	☐	☐	☐
51.	Rig gear boxes placed in neutral when operator not at controls	☐	☐	☐	☐
52.	Operator shuts rig engine down prior to leaving the drill rig vicinity	☐	☐	☐	☐
DRILL RIG SITE CLOSURE (5.3.8)					
53.	Ground openings/holes filled or barricaded	☐	☐	☐	☐
54.	Equipment and tools properly stored	☐	☐	☐	☐
55.	All vehicles locked and keys removed	☐	☐	☐	☐
DRILL RIG MAINTENANCE (5.3.9)					
56.	Rig properly maintained per drilling company's maintenance program and records on-site/available for review	☐	☐	☐	☐
57.	Defective components repaired immediately	☐	☐	☐	☐
58.	Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
59.	Cathead in clean, sound condition	☐	☐	☐	☐
60.	Drill rig ropes in clean, sound condition	☐	☐	☐	☐
61.	Fall protection used for fall exposures of 6 feet (U.S.) 1.5 m or greater	☐	☐	☐	☐
62.	Rig in neutral and augers stopped rotating before cleaning	☐	☐	☐	☐
63.	Good housekeeping maintained on and around rig	☐	☐	☐	☐
	FORMS/PERMITS AND CHECKLISTS (7.0)				
64.	Driller license/certification obtained	☐	☐	☐	☐
65.	Well development/abandonment notifications and logs submitted and in project files	☐	☐	☐	☐
66.	Groundwater withdrawal permit obtained where required	☐	☐	☐	☐
67.	Dig permit obtained where required	☐	☐	☐	☐

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SECTION 3

Complete this section for all items checked "No" in previous sections. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

CH2MHILL

HSE Self-Assessment Checklist—HAND AND POWER TOOLS

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: (1) CH2M HILL employees are exposed to hand and power tool hazards and/or (2) CH2M HILL provides oversight of subcontractor personnel who are exposed to hand and power tool hazards.

SC may consult with subcontractors when completing this checklist, but shall not direct the means and methods of hand and power tool use nor direct the details of corrective actions. Subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposure to hand and power tool hazards.
☐ Evaluate a CH2M HILL subcontractor's compliance with hand and power tool requirements.
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HSE-210.

SECTION 1

	Yes	No	N/A	N/O
SAFE WORK PRACTICES (5.1)				
1. All tools operated according to manufacturer's instructions and design limitations.	☐	☐	☐	☐
2. All hand and power tools maintained in a safe condition and inspected and tested before use.	☐	☐	☐	☐
3. Defective tools are tagged and removed from service until repaired.	☐	☐	☐	☐
4. PPE is selected and used according to tool-specific hazards anticipated.	☐	☐	☐	☐
5. Power tools are not carried or lowered by their cord or hose.	☐	☐	☐	☐
6. Tools are disconnected from energy sources when not in use, servicing, cleaning, etc.	☐	☐	☐	☐
7. Safety guards remain installed or are promptly replaced after repair.	☐	☐	☐	☐
8. Tools are stored properly.	☐	☐	☐	☐
9. Cordless tools and recharging units both conform to electrical standards and specifications.	☐	☐	☐	☐
10. Tools used in explosive environments are rated for such use.	☐	☐	☐	☐
11. Knife or blade hand tools are used with the proper precautions.	☐	☐	☐	☐
12. Consider controls to avoid muscular skeletal, repetitive motion, and cumulative trauma stressors.	☐	☐	☐	☐

SECTION 2	Yes	No	N/A	N/O
GENERAL (5.2.2)				
13. PPE is selected and used according to tool-specific hazards anticipated.	☐	☐	☐	☐
14. Tools are tested daily to assure safety devices are operating properly.	☐	☐	☐	☐
15. Damaged tools are removed from service until repaired.	☐	☐	☐	☐
16. Power operated tools designed to accommodate guards have guards installed.	☐	☐	☐	☐
17. Rotating or moving parts on tools are properly guarded.	☐	☐	☐	☐
18. Machines designed for fixed locations are secured or anchored.	☐	☐	☐	☐
19. Floor and bench-mounted grinders are provided with properly positioned work rests.	☐	☐	☐	☐
20. Guards are provided at point of operation, nip points, rotating parts, etc.	☐	☐	☐	☐
21. Fluid used in hydraulic-powered tools is approved fire-resistant fluid.	☐	☐	☐	☐
ELECTRIC-POWERED TOOLS (5.2.3)				
22. Electric tools are approved double insulated or grounded and used according to SOP HSE-206.	☐	☐	☐	☐
23. Electric cords are not used for hoisting or lowering tools.	☐	☐	☐	☐
24. Electric tools are used in damp/ wet locations are approved for such locations or GFCI installed.	☐	☐	☐	☐
25. Hand-held tools are equipped with appropriate on/off controls appropriate for the tool.	☐	☐	☐	☐
26. Portable, power-driven circular saws are equipped with proper guards.	☐	☐	☐	☐
ABRASIVE WHEEL TOOLS (5.2.4)				
27. All employees using abrasive wheel tools are wearing eye protection.	☐	☐	☐	☐
28. All grinding machines are supplied with sufficient power to maintain spindle speed.	☐	☐	☐	☐
29. Abrasive wheels are closely inspected and ring-tested before use.	☐	☐	☐	☐
30. Grinding wheels are properly installed.	☐	☐	☐	☐
31. Cup-type wheels for external grinding are protected by the proper guard or flanges.	☐	☐	☐	☐
32. Portable abrasive wheels used for internal grinding are protected by safety flanges.	☐	☐	☐	☐
33. Safety flanges are used only with wheels designed to fit the flanges.	☐	☐	☐	☐
34. Safety guards on abrasive wheel tools are mounted properly and of sufficient strength.	☐	☐	☐	☐
PNEUMATIC-POWERED TOOLS (5.2.5)				
35. Tools are secured to hoses or whip by positive means to prevent disconnection.	☐	☐	☐	☐
36. Safety clips or retainers are installed to prevent attachments being expelled.	☐	☐	☐	☐
37. Safety devices are installed on automatic fastener feed tools as required.	☐	☐	☐	☐
38. Compressed air is not used for cleaning unless reduced to < 30 psi, with PPE, and guarded.	☐	☐	☐	☐
39. Manufacturer's safe operating pressure for hoses, pipes, valves, etc. are not exceeded.	☐	☐	☐	☐
40. Hoses are not used for hoisting or lowering tools.	☐	☐	☐	☐
41. All hoses >1/2-inch diameter have safety device at source to reduce pressure upon hose failure.	☐	☐	☐	☐
42. Airless spray guns have required safety devices installed.	☐	☐	☐	☐
43. Blast cleaning nozzles are equipped with operating valves, which are held open manually.	☐	☐	☐	☐
44. Supports are provided for mounting nozzles when not in use.	☐	☐	☐	☐
45. Air receiver drains, handholes, and manholes are easily accessible.	☐	☐	☐	☐
46. Air receivers are equipped with drainpipes and valves for removal of accumulated oil and water.	☐	☐	☐	☐
47. Air receivers are completely drained at required intervals.	☐	☐	☐	☐
48. Air receivers are equipped with indicating pressure gauges.	☐	☐	☐	☐
49. Safety, indicating, and controlling devices are installed as required.	☐	☐	☐	☐
50. Safety valves are tested frequently and at regular intervals to assure good operating condition.	☐	☐	☐	☐

SECTION 2 (continued)

	Yes	No	N/A	N/O
LIQUID FUEL-POWERED TOOLS (5.2.6)				
51. Liquid fuel-powered tools are stopped when refueling, servicing, or maintaining.	☐	☐	☐	☐
52. Liquid fuels are stored, handled, and transported in accordance with SOP HSE-403	☐	☐	☐	☐
53. Liquid fuel-powered tools are used in confined spaces in accordance with SOP HSE-203.	☐	☐	☐	☐
54. Safe operating pressures of hoses, valves, pipes, filters, and other fittings are not exceeded.	☐	☐	☐	☐
POWDER-ACTUATED TOOLS (5.2.7)				
55. Only trained employee operates powder-actuated tools.	☐	☐	☐	☐
56. Powder-actuated tools are not loaded until just prior to intended firing time.	☐	☐	☐	☐
57. Tools are not pointed at any employee at any time.	☐	☐	☐	☐
58. Hands are kept clear of open barrel end.	☐	☐	☐	☐
59. Loaded tools are not left unattended.	☐	☐	☐	☐
60. Fasteners are not driven into very hard or brittle materials.	☐	☐	☐	☐
61. Fasteners are not driven into easily penetrated materials unless suitable backing is provided.	☐	☐	☐	☐
62. Fasteners are not driven into spalled areas.	☐	☐	☐	☐
63. Powder-actuated tools are not used in an explosive or flammable atmosphere.	☐	☐	☐	☐
64. All tools are used with correct shields, guards, or attachments recommended by manufacturer.	☐	☐	☐	☐
JACKING TOOLS (5.2.8)				
65. Rated capacities are legibly marked on jacks and not exceeded.	☐	☐	☐	☐
66. Jacks have a positive stop to prevent over-travel.	☐	☐	☐	☐
67. The base of jacks are blocked or cribbed to provide a firm foundation, when required.	☐	☐	☐	☐
68. Wood blocks are place between the cap and load to prevent slippage, when required.	☐	☐	☐	☐
69. After load is raised, it is cribbed, blocked, or otherwise secured immediately.	☐	☐	☐	☐
70. Antifreeze is used when hydraulic jacks are exposed to freezing temperatures.	☐	☐	☐	☐
71. All jacks are properly lubricated.	☐	☐	☐	☐
72. Jacks are inspected as required.	☐	☐	☐	☐
73. Repair or replacement parts are examined for possible defects.	☐	☐	☐	☐
74. Jacks not working properly are removed from service and repaired or replaced.	☐	☐	☐	☐
HAND TOOLS (5.2.9)				
75. Wrenches are not used when jaws are sprung to the point of slippage.	☐	☐	☐	☐
76. Impact tools are kept free of mushroomed heads.	☐	☐	☐	☐
77. Wooden handles of tools are kept free of splinters or cracks and are tightly fitted in tool.	☐	☐	☐	☐
CHAIN SAWS (5.2.10)				
78. Chainsaw equipped with spark arrestor and fully functioning chain brake	☐	☐	☐	☐
79. Chainsaw operator's manual readily available	☐	☐	☐	☐
80. Fully stocked first aid kit and multipurpose fire extinguisher available	☐	☐	☐	☐
81. Appropriate personal protective equipment available and worn	☐	☐	☐	☐
82. Clothing free of loose edges that could become entangled in the saw	☐	☐	☐	☐
83. Chainsaw handles kept dry, clean, and free of oil or fuel mixture	☐	☐	☐	☐
84. Chainsaws held firmly with both hands and used right-handed	☐	☐	☐	☐
85. Operator standing to the left of the saw out of the plane of the chain	☐	☐	☐	☐
86. Saw used between the waist and mid-chest level	☐	☐	☐	☐
87. Full throttle maintained while cutting	☐	☐	☐	☐
88. Operator aware of position of guide bar tip, does not contact tip with anything being cut	☐	☐	☐	☐
89. Bumper spikes maintained as close to the object as possible	☐	☐	☐	☐
90. Operator aware of what is in the saw's downward path after the cut	☐	☐	☐	☐
91. No attempt to made to cut material that is larger than the guide bar of the saw	☐	☐	☐	☐
92. Cuts avoided that will cause chain to jam	☐	☐	☐	☐
93. Non-metallic wedges used to prevent compression cuts from jamming the blade	☐	☐	☐	☐
94. Bystanders and helpers kept at a safe distance from operation	☐	☐	☐	☐
95. Chainsaw not operated when fatigued	☐	☐	☐	☐
96. Fire extinguisher present when operating the chainsaw in forest or brushy areas	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: _____ Project Manager: _____

Attachment 2: Self-Assessment Checklist—Manual Lifting

CH2MHILL

HSE Self-Assessment Checklist—Lifting

This checklist shall be used **only** by CH2M HILL personnel and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: (1) CH2M HILL employees perform manual lifting activities (office or projects), and/or (2) CH2M HILL provides oversight of a subcontractor performing manual lifting activities.
SC or Office Safety Coordinators/Committee members may consult with subcontractors (if applicable) when completing this checklist but shall not direct the means and methods of activities nor direct the details of corrective actions. Subcontractors shall determine how to correct deficiencies, and we must carefully rely on their expertise.
Conditions considered imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazardous area until corrected.
Complete the appropriate project or office information:

Project Information

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

Office Information

Office Location: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee manual lifting activities.

☐ Evaluate a CH2M HILL subcontractor's manual lifting activities.
Subcontractor Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the subcontractor.
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HSE-112.

Planning Activities	**Yes**	**No**	**N/A**	**N/O**
1. Efforts have been made to inquire about receiving equipment or supplies in containers weighting less than 50 pounds (23 kilograms).	o	o	o	o
2. Equipment or supplies are being delivered as close as possible to their use point.	o	o	o	o
3. Heavy equipment or supplies are being stored off the ground and no lower than knee height.	o	o	o	o
4. Adequate space has been provided to access and lift equipment or supplies without reaching or twisting.	o	o	o	o

Safe Work Practices (5.1)	**Yes**	**No**	**N/A**	**N/O**
5. Tasks or activities have been modified to reduce or minimize manual lifting.	o	o	o	o
6. All employees performing manual lifting have received training on how to lift safely.	o	o	o	o

7. Manual lifting control measures are evaluated during assessments.	o	o	o	o
8. Manual lifting incidents are reviewed as part of the HSE Program reviews.	o	o	o	o
9. Manual lifting incidents are reviewed as part of the HSE Program reviews.	o	o	o	o
Office Environments (5.1.1)	**Yes**	**No**	**N/A**	**N/O**
10. Employees have received lifting training.	o	o	o	o
11. Mechanical devices are readily available to employees handling equipment or supplies weighing more than 40 pounds (18 kilograms).	o	o	o	o
Field Projects (5.1.2)	**Yes**	**No**	**N/A**	**N/O**
12. All manual lifting tasks or activities have been addressed in the written site safety plan.	o	o	o	o
13. Employees have received safe lifting training as required by the written site safety plan.	o	o	o	o
Mechanical Lifting (5.2)	**Yes**	**No**	**N/A**	**N/O**
14. Hand trucks and trolleys are visually inspected before use.	o	o	o	o
15. Hand trucks and trolleys do not have any broken or damaged parts.	o	o	o	o
16. Hand truck and trolley paths are free of uneven surfaces, water, oil, or cracks and holes.	o	o	o	o
17. Loads carried by hand trucks are balanced and sturdy.	o	o	o	o
18. Hand trucks or dollies are being pushed when on level ground.	o	o	o	o
19. When going up or down a slope using a hand truck or trolley, the load is downslope of the person.	o	o	o	o
20. Employees using hand trucks or dollies are moving slowly and cautiously.	o	o	o	o
21. Employees using hand trucks or trolleys are able to see over the load.	o	o	o	o
Assisted Lifting (5.3)	**Yes**	**No**	**N/A**	**N/O**
22. Personnel are not performing manual lifting beyond their physical capabilities.	o	o	o	o
23. Loads are evenly distributed when being handled by multiple people.	o	o	o	o
Manual Lifting (5.4)	**Yes**	**No**	**N/A**	**N/O**
24. Before the lift, the load and path was assessed.	o	o	o	o
25. Loads being lifted are free of sharp edges, slivers, or wet or greasy spots.	o	o	o	o
26. Gloves are used for manual lifts of loads with sharp or splintered edges.	o	o	o	o
27. Employees performing manual lifts use the proper lifting techniques.	o	o	o	o
28. Special tools fabricated for lifting grates or manhole covers are used.	o	o	o	o

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: _____ Project Manager: _____

CH2MHILL

HS&E Self-Assessment Checklist -Vinyl Chloride

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI. This checklist is to be used at locations where CH2M HILL employees are exposed to vinyl chloride, or are required to perform oversight of a subcontractor whose personnel are exposed to vinyl chloride.

CH2M HILL staff shall not direct the means and methods of subcontractor vinyl chloride activities nor direct the details of appropriate corrective actions. The subcontractor must determine how to correct deficiencies and CH2M HILL staff must carefully rely on their expertise. Conditions considered to be imminently dangerous (possibility of serious injury or death) must be corrected immediately or all exposed personnel must be removed from the hazard until corrected.

Project Name: _____ Project No.: _____

Location: _____ PM:

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL compliance with its Vinyl Chloride program (SOP HSE-512)

☐ Evaluate a CH2M HILL subcontractor's compliance with its Vinyl Chloride program

Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable
- Check "N/O" if an item is applicable but was not observed during the assessment

SECTION 1

	Yes	No	N/A	N/O
PERSONNEL SAFE WORK PRACTICES (5.1)				
COMPLIANCE PROGRAM (5.1.1)				
1. A written compliance program is established for work above the PEL.	☐	☐	☐	☐
2. The compliance program includes means of maintaining exposures below the PEL	☐	☐	☐	☐
3. The compliance program is based on the most recent air monitoring results.	☐	☐	☐	☐
4. Written compliance program is available to all affected employees.	☐	☐	☐	☐
5. Waste generated must be determined if considered hazardous waste.	☐	☐	☐	☐
EMPLOYEE INFORMATION (5.1.2)				
6. CH2M HILL personnel have completed the Vinyl Chloride Training Module.	☐	☐	☐	☐
7. Training on the Fact Sheet, HSP/FSI and OSHA standard has been met.	☐	☐	☐	☐
8. The selection of the appropriate respirator is based on the airborne vinyl concentration.	☐	☐	☐	☐
9. Written or verbal notification to owners, contractors or other personnel working in the area of vinyl chloride work activities.	☐	☐	☐	☐
10. Storage, waste or shipping containers have been properly labeled	☐	☐	☐	☐

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	Yes	No	N/A	N/O
REGULATED AREAS (5.1.3)				
11. Areas that exceed the PELs (TWA or STEL) have been designated as regulated areas.	☐	☐	☐	☐
12. Personnel do not enter regulated areas unless they meet training, medical and PPE requirements	☐	☐	☐	☐
13. Warning signs have been posted at all entrances to the regulated areas.	☐	☐	☐	☐
Exposure Assessment (5.2)				
14. Initial air monitoring (TWA & STEL) conducted over full shift for each job classification	☐	☐	☐	☐
15. Air monitoring has been repeated when a change in production or controls occurred.	☐	☐	☐	☐
16. Personnel exhibiting signs of exposure have been monitored.	☐	☐	☐	☐
17. EL> AL have been resampled in the last 6 months.	☐	☐	☐	☐
18. EL $\geq$ PEL have been resampled in the 3 months.	☐	☐	☐	☐
19. Air monitoring results above the STEL have been resampled according to frequency established by RHSM.	☐	☐	☐	☐
20. Employees are given opportunities to observe monitoring	☐	☐	☐	☐
21. Relevant employees are notified within 15 days in writing of the results of monitoring.	☐	☐	☐	☐
CONTROL METHODS (5.3)				
ENGINEERING AND WORK PRACTICE CONTROLS (5.3.1)				
22. Engineering controls and work practices are implemented to reduce exposures to below the PEL.	☐	☐	☐	☐
23. Engineering and work practices are implemented to achieve the lowest feasible exposures.	☐	☐	☐	☐
24. Employees are not allowed to eat, drink or smoke in regulated areas.	☐	☐	☐	☐
25. Action plans have been developed to respond to spills.	☐	☐	☐	☐
26. Employees responding to spills have been trained and supplied with PPE	☐	☐	☐	☐
27. Vinyl chloride-contaminated waste is properly handled.	☐	☐	☐	☐
RESPIRATORY PROTECTION (5.3.2)				
28. Respirators are used in areas where EL $\geq$ PEL.	☐	☐	☐	☐
29. A written respiratory protection program is in place where respirators are used.	☐	☐	☐	☐
30. Cartridges changed based on change schedule or at the beginning of each shift.	☐	☐	☐	☐
Personal Protective Equipment (5.3.3)				
31. PPE is provided by the employer at no cost to employees.	☐	☐	☐	☐
32. PPE is selected based on the materials, conditions, and hazards present.	☐	☐	☐	☐
33. PPE is provided clean and dry for each use	☐	☐	☐	☐
34. Personnel who clean or launder protective clothing are informed in writing of the hazards.	☐	☐	☐	☐

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SECTION 3

Complete this section for all items checked "No' in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Environment & Nuclear Business Group

Health, Safety, and Environment Handbook

January 1, 2016

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Employee Sign-Off Form
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1. Introduction

1.1 CH2M HILL Health, Safety, and Environment Policy Commitment and Goals

1.1.1 Health, Safety, and Environment Policy Commitment

Protection of people and the environment is a CH2M HILL core value. It is our vision to create a culture that empowers employees to drive this value into all global operations and achieve excellence in health, safety, and environment (HSE) performance. CH2M HILL deploys an integrated, enterprise-wide behavior based HSE management system to fulfill our mission and the expectations of our clients, staff, and communities based on the following principles:

- We require all management and supervisory personnel to provide the leadership and resources to inspire and empower our employees to take responsibility for their actions and for their fellow employees to prevent injuries, illnesses, and adverse environmental impacts, and create a safe, healthy, and environmentally-responsible workplace.
- We provide value to clients by tailoring HSE processes to customer needs and requiring CH2M HILL employees and subcontractors to deliver projects that identify HSE requirements and commit to compliance with applicable HSE laws and regulations, company standards, and external requirements.
- We are committed to pollution prevention in conjunction with our Sustainability Policy and by offering our clients sustainable solutions.
- We aspire to continually improve our performance and influence others to redefine world-class HSE excellence.
- We evaluate our design engineering and physical work environment to verify safe work conditions and practices are established, followed, and corrected as needed.
- We assess and continually improve our HSE program to achieve and maintain world-class performance by setting and reviewing objectives and targets, reporting performance metrics, and routinely evaluating our program.
- We expect all employees to embrace our Target Zero culture, share our core value for the protection of people and the environment, understand their obligations, actively participate, take responsibility, and "walk the talk" on and off the job.

1.1.2 Project-Specific Health, Safety, and the Environment Goals

All management and employees are to strive to meet the project-specific Health, Safety, and the Environment (HSE) goals outlined below. The team will be successful only if everyone makes a concerted effort to accomplish these goals. The goals allow the project to stay focused on optimizing the health and safety of all project personnel and, therefore, making the project a great success.

The E&NBG has established eleven specific goals and objectives:

- Create an injury-free environment;
- Have zero injuries or incidents;
- Provide management leadership for HSE by communicating performance expectations, reviewing and tracking performance, and leading by example;
- Ensure effective implementation of the project safety plan, environmental plan (or equivalent) through education, delegation, and team work;
- Ensure 100 percent participation in HSE compliance;

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- Continuously improve our safety and environmental performance;
- Maintain free and open lines of communication;
- Make a personal commitment to safety as a value;
- Focus safety improvements on high-risk groups;
- Continue strong employee involvement initiatives; and
- Achieve health, safety, and environmental excellence.

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2. Applicability

This Environment & Nuclear Business Group (E&NBG) Health, Safety, Security, and Environment Handbook (Handbook) applies to:

- All CH2M HILL staff supporting E&NBG projects, including subcontractors and tiered subcontractors of CH2M HILL working on the site; and
- All visitors to the construction or remediation site in the custody of CH2M HILL (including visitors from the Client, the Government, the public, and other staff of any CH2M HILL company).

This Handbook does not apply to the third-party contractors, their workers, their subcontractors, their visitors, or any other persons not under the direct control or custody of CH2M HILL. This document does not apply to LLC companies within the E&NBG.

This Handbook defines the procedures and requirements for the health and safety of CH2M HILL staff and visitors when they are physically on the work site. The work site includes the project area (as defined by the contract documents) and the project offices, trailers, and facilities thereon.

This Handbook will be kept onsite during field activities and will be reviewed as necessary. The Handbook will be amended or revised as project activities or conditions change or when supplemental information becomes available. The Handbook adopts, by reference, the Enterprise-wide Core Standards and Standard Operating Procedures (SOPs), as appropriate. In addition, the Handbook may adopt procedures from the project Work Plan and any governing regulations. If there is a contradiction between this Handbook and any governing regulation, the more stringent and protective requirement shall apply.

This Handbook incorporates the regulatory requirements described in the State of California OSHA agency – Cal/OSHA Title 8 CCR, Section 3203, Injury and Illness Prevention Program (IIPP), and section 1509, Construction Injury and Illness Prevention Program. The current version of CH2M HILL Cal/OSHA IIPP written program can be accessed on the HSE website under Programs.

All CH2M HILL staff and subcontractors must sign the employee sign-off form included at the end of this Handbook to acknowledge review of the document. CH2M HILL employees will send a signed copy of the sign-off form to their SPA. The subcontractor sign-off form will be maintained on site by the project Safety Coordinator (SC).

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3. Roles and Responsibilities

The sections below describe the roles and responsibilities of personnel referred to in the project-specific safety plan.

3.1 CH2M HILL Project Manager

The project manager (PM) is responsible for providing adequate resources (budget and staff) for project-specific implementation of the HSE management process. The PM has overall management responsibility for the tasks listed below. The PM may explicitly delegate specific tasks to other staff, as described in sections that follow, but retains ultimate responsibility for completion of the following in accordance with this document and applicable safety plans:

- Coordinate and lead Subcontractor HSE Chartering meetings prior to the start of field work;
- Ensure CH2M HILL safety plan is current and provide approval alongside the RHSM.
- Ensure CH2M HILL Activity Hazard Analyses (AHAs) are in place and verify RHSM has reviewed and approved;
- Notify HSE staff if changes to scope have an effect on HSE plans, documents, or requirements; review and approve any field change requests (FCRs) to the safety plan.
- Ensure copies of training and medical monitoring records, and site-specific safety procedures are being maintained in the project file accessible to site personnel;
- Provide oversight of subcontractor HSE practices per the site-specific safety plans and procedures;
- Manage the site and interfacing with 3rd parties in a manner consistent with the contract and subcontract agreements and the applicable standard of reasonable care;
- Ensure that the overall, job-specific, HSE goals are fully and continuously implemented;
- Perform a Management Inspection at least once during short-term projects or once a month on long-term projects;
- Provide visible support and motivation for HSE programs, rules, procedures, processes, and training, leading by example and encouraging CH2M HILL employees to take ownership of HSE issues;
- Intervene or stop work when an unsafe condition or behavior is observed, and/or when an environmentally compromising condition is encountered;
- Consistently and even-handedly enforce HSE rules, procedures, and requirements at the office and/or on project work sites;
- Promptly report all work-related HSE incidents or near misses;
- Conduct, cooperate, or assist with HSE incident investigations;
- Wear any required personal protective equipment when visiting project site;
- Consult with the Human Resources Delivery Partner before taking any disciplinary action (other than verbal counseling) associated with CH2M HILL Policy 203 and/or HSE programs rules, procedures, processes and training.

3.2 CH2M HILL Responsible Health and Safety Manager

The Responsible Health and Safety Manager (RHSM) is assigned by the BG HSE Lead or designee to provide ongoing health and safety technical guidance and support to the project, program or facility. The RHSM is responsible for the following:

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- Approve HSP and revisions or amendments as well as AHA(s);
- Review and accept subcontractor training and medical monitoring records prior to start of field operations;
- Review and accept subcontractor site-specific safety procedures for adequacy prior to start of subcontractor's field operations;
- Provide input to the PM on the selection of the SC;
- Support the oversight (or SC's direct oversight) of subcontractor and tiered subcontractor HSE practices;
- Permit upgrades and downgrades in personal protective equipment (PPE), including respiratory protection, in accordance with the site safety plan;
- Conduct audits as determined by project schedule and coordination with PM; and
- Participate in incident investigations, lessons learned, loss and near loss reporting.

3.3 CH2M HILL Project Environmental Manager

The Project EM is responsible for the following:

- Provide environmental program support in areas such as training, auditing, planning, permit tracking, and subcontractor oversight as needed or as specified in the project environmental plan or equivalent plan;
- Assist the PM to identify environmental requirements, including those described in the HSE Management System Manual (ES-S01-01P) , environmental risks, environmental permits and similar documents that CH2M HILL is responsible for complying with (e.g., notices, approvals or other documents that legally bind CH2M HILL);
- Verify that a FPSF has been submitted and that an Environmental Plan or equivalent document is available;
- Assist the PM in preparing or coordinating the preparation of regulatory-required environmental plans (e.g., SPCC, SWPPP) and contract-required environmental plans (e.g., Environmental Protection Plan);
- Review revised scopes of work and changes in project conditions to identify new environmental issues and requirements;
- Review/approve waste characterizations and Client waste profiles, or engage E&NBG Waste Coordinator to review and approve;
- Evaluate any spills, releases, or environmental permit incidents for appropriate follow-up actions, notifications, and recordkeeping requirements; and
- Provide environmental compliance and environmental management expertise, advice, and training to the project team as needed during the course of the project.

3.4 CH2M HILL Safety Coordinator

The SC is responsible for verifying that the project is conducted in a safe manner including the following specific obligations:

- Participate in Subcontractor HSE Chartering meetings prior to the start of field work;
- Verify the project safety plan is current and amended when project activities or conditions change;
- Verify CH2M HILL site personnel and subcontractor personnel read this Handbook, the project safety plan, and applicable AHAs and sign the accompanying sign-off forms for each, prior to commencing field activities;
- Verify CH2M HILL site personnel have completed any required specialty training (for example, fall protection, confined space entry, among others) and medical surveillance as identified in the project safety plan;

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- Verify that project files include copies of accepted subcontractor training and medical monitoring records, and accepted site-specific safety procedures prior to start of subcontractor's field operations;
- Act as the project "Hazard Communication Coordinator" and perform the responsibilities outlined in the project safety plan;
- Act as the project "Emergency Response Coordinator" and perform the responsibilities outlined in the project safety plan;
- Post the Occupational Safety and Health Administration (OSHA) job-site poster; the poster is required at sites where project field offices, trailers, or equipment-storage boxes are established. If you work in a state with an OSHA State Plan, make sure the State Plan poster is posted, if required;
- Hold and/or verify that safety meetings are conducted and documented in the project file initially and as needed throughout the course of the project (as tasks or hazards change);
- Assist in implementing environmental plan requirements at the project as assigned by the PM or project EM.
- Verify that project health and safety forms and permits are being used as outlined in the project safety plan;
- Perform oversight and assessments of subcontractor HSE practices per the site-specific safety plan and verify that project activity self-assessment checklists are being used as outlined in the project safety plan;
- Coordinate with the RHSM regarding CH2M HILL and subcontractor operational performance, and 3rd party interfaces;
- Verify appropriate personal protective equipment (PPE) use, availability, and training;
- Ensure that the overall, job-specific, HSE goals are fully and continuously implemented;
- Calibrate and conduct air monitoring in accordance with the project safety plan; maintain all air monitoring records in project file;
- Maintain HSE records and documentation at the project site;
- Facilitate OSHA or other government agency inspections including accompanying inspector and providing all necessary documentation and follow-up;
- Deliver field HSE training as needed based on project-specific hazards and activities;
- Consistently and even-handedly enforce HSE rules, procedures, and requirements at the office and/or on project work sites;
- Wear any required personal protective equipment;
- Contact the RHSM and PM in the event of an incident;
- Contact the RHSM and Project EM in the event of a spill or release immediately so evaluation of reportable quantity requirements and whether agency reporting is required;
- Conduct, cooperate, or assist with HSE incident investigations;
- Contact the PM and RHSM when standards of conduct or CH2M HILL Policy 203 has been violated by a CH2M HILL employee;
- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, stop affected work until adequate corrective measures are implemented, and notify the PM and RHSM as appropriate; and
- Document all verbal health and safety-related communications in project field logbook, daily reports, or other records.

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3.5 CH2M HILL Employees

All personnel are assigned responsibility for safe and healthy operations. This concept is the foundation for involving all employees in identifying hazards and providing solutions. For any operation, individuals have full authority to stop work and initiate immediate corrective action or control. In addition, each worker has a right and responsibility to report unsafe conditions or practices. This right represents a significant facet of worker empowerment and program ownership. Through shared values and a belief that all incidents are preventable, our employees accept personal responsibility for working safely.

Each employee is responsible for the following performance objectives:

- Understanding and abiding by CH2M HILL and client HSE programs, rules, procedures, processes, and training, including any that are project-specific;
- Completing all required HSE training made available and accessible within established timelines;
- Always wearing any required personal protective equipment;
- Intervening or stopping work for you or other CH2M HILL employees when an unsafe condition or behavior is encountered or observed, and/or when an environmentally compromising condition exists;
- Promptly notifying a supervisor, PM, SC, or RHSM when an unsafe condition or behavior is observed, and/or when an environmentally compromising condition exists;
- Promptly reporting a supervisor, PM, SC, or RHSM all work-related health, safety , and environmental incidents or near misses;
- Attending required project HSE pre-task briefings and meeting prior to performing work; and
- Cooperating or assisting with HSE incident investigations.

3.5.1 Employee Authority

Each employee on the project has the obligation and authority to shut down any perceived unsafe work and during employee orientation, each employee will be informed of their authority to do so.

3.6 CH2M HILL Subcontractors

Subcontractors must comply with the following activities, and are responsible to:

- Participate in Subcontractor HSE Chartering meetings;
- Comply with all local, state, and federal safety standards;
- Comply with project and owner safety requirements;
- Subcontractor shall maintain up to date health and safety training, medical, and competent person qualification records at the project site, readily available for inspection.
- Actively participate in the project safety program and either hold or attend and participate in all required safety meetings;
- Provide a qualified safety representative to interface with CH2M HILL;
- Maintain safety equipment and PPE for their employees;
- Maintain and replace safety protection systems damaged or removed by the subcontractor’s operations;
- Notify the SC of any incidents including, injury, spills or releases, environmental permit issues, near misses or property damage immediately and submit reports to CH2M HILL within 24 hours;

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- Install contractually required general conditions for safety (for example, handrail, fencing, fall protection systems, floor opening covers);
- Conduct and document weekly safety inspections of project-specific tasks and associated work areas;
- Conduct site-specific and job-specific training for all subcontractor employees, including review of the CH2M HILL safety plan, subcontractor safety plans, and subcontractor AHAs and sign appropriate sign-off forms; and
- Determine and implement necessary controls and corrective actions to correct unsafe conditions.

Subcontractors may be required to submit their own site-specific safety plan and other plans such as lead or asbestos abatement compliance plans. Subcontractors are responsible for the health, safety, and environment procedures specific to their work, and are required to submit their plans to CH2M HILL for review and acceptance before the start of field work.

Subcontractors are also required to prepare AHAs before beginning each activity posing hazards to their personnel. The AHA shall identify the principle steps of the activity, potential health and safety hazards for each step and recommended control measures for each identified hazard. In addition, a listing of the equipment to be used to perform the activity, inspection requirements, and training requirements for the safe operation of the equipment listed must be identified.

3.7 Client Contractors

CH2M HILL project safety plans do not cover contractors that are contracted directly to the client or the owner. CH2M HILL is not responsible for the health and safety or means and methods of the contractor's work, and we must never assume such responsibility through our actions (such as advising on health and safety issues). In addition to these instructions, CH2M HILL team members should review contractor safety plans so that we remain aware of appropriate precautions that apply to us. Self-assessment checklists are to be used by the SC and CH2M HILL team members to review the contractor's performance only as it pertains to evaluating CH2M HILL exposure and safety. The RHSM is the only person who is authorized to comment on or approve contractor safety procedures.

Health and safety-related communications with contractors should be conducted as follows:

- Request the contractor to brief CH2M HILL team members on the precautions related to the contractor's work;
- When an apparent contractor non-compliance or unsafe condition or practice poses a risk to CH2M HILL team members:
    - Notify the contractor safety representative;
    - Request that the contractor determine and implement corrective actions;
    - If necessary, stop affected CH2M HILL work until contractor corrects the condition or practice; and
    - Notify the client, PM, and RHSM as appropriate.

If apparent contractor non-compliance or unsafe conditions or practices are observed, inform the contractor safety representative (CH2M HILL's obligation is limited strictly to informing the contractor of the observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions).

If an apparent imminent danger is observed, immediately warn the contractor employee(s) in danger and notify the contractor safety representative (CH2M HILL's obligation is limited strictly to immediately warning the affected individual(s) and informing the contractor of the observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions).

All verbal health and safety-related communications will be documented in project field logbook, daily reports, or other records.

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4. Standards of Conduct

All individuals associated with this project must work injury-free and drug-free and must comply with the following standards of conduct, and the safety requirements of CH2M HILL. Commonly accepted standards of conduct help maintain good relationships between people. They promote responsibility and self-development. Misunderstandings, frictions, and disciplinary action can be avoided by refraining from thoughtless or wrongful acts.

4.1 HSE Accountability

(Reference CH2M HILL Policy 203, *HSE Accountability*)

4.1.1 Prohibited Behaviors and Actions

Managers, supervisors, and employees who openly or recklessly exhibit a disregard, defiance, or disrespect for CH2M HILL's HSE programs, rules, procedures, processes, and training, or who violate established HSE programs, rules, procedures, processes or training endangering themselves or other employees, will be subject to disciplinary actions. Without limitation, behaviors and actions that warrant disciplinary action include the following:

- Requiring, requesting, demanding, asking, or threatening another person in any manner to entice the person to engage in or work around a patently unsafe or environmentally compromising act or condition.
- Condoning or knowingly allowing a person to engage in or work around a patently unsafe or environmentally compromising act or condition.
- Recklessly, knowingly, or purposely failing to wear required personal protective equipment.
- Failing to successfully complete any required HSE training that is scheduled and made available for completion.
- Failing to promptly notify a supervisor, project safety manager, coordinator, lead, or the project manager when an unsafe condition or behavior is observed, and/or when an environmentally compromising condition is encountered.
- Failing to promptly report to a supervisor, project safety manager, coordinator, lead, or the project manager, a work-related HSE incident or near miss.
- If required of the position, failing to maintain as active and in good standing necessary health, safety, and/or environmental licenses or permits needed to support CH2M HILL work and projects.
- Knowingly falsifying any HSE record or investigative document (whether internal to CH2M HILL or external), or providing false testimony, during an HSE or outside agency incident investigation.
- Refusing to cooperate in an HSE incident investigation.
- Knowingly falsifying any inspection or sampling records (whether internal to CH2M HILL or external).
- Performing field work without the required site HSE plan approved by a HSE manager.
- Engaging in any form of workplace violence described in Policy 201 Workplace Violence Awareness and Prevention, including physical encounters, destruction of property, and verbal threats of violence, harm, or mayhem.
- Failing to comply with any HSE procedures contained in any contract, subcontract, site health safety and environment plan, or any federal, state, or local health, safety, or environmental laws and regulations creating actual or potential significant risk for CH2M HILL (whether monetary or otherwise).

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In addition, no individual may have in his or her possession, bring to the project site, or maintain on CH2M HILL property, concealed or otherwise, any weapon, explosive device or substance, firearm, ammunition or instrument that could be used as a weapon. All weapons, explosive devices or substances, firearms, and ammunition are banned from all project sites, properties, vehicles and/or any CH2M HILL activities or events.

4.1.2 Disciplinary Actions

When CH2M HILL employees neglect to fulfill their responsibilities and/or project-specific HSE requirements, CH2M HILL may discipline its employees. All CH2M HILL employees, including management and supervisory employees, are equally subject to disciplinary action for failing to meet the expectations associated with this Policy and/or HSE programs, rules, procedures, processes, and training. CH2M HILL reserves the right in its sole discretion to determine the appropriateness of any discipline imposed, but such disciplinary action may include, without limitation, denial of access to the worksite, verbal and/or written warnings/reprimands, and termination of employment.

4.2 Subcontractor Safety Performance

CH2M HILL should continuously endeavor to observe subcontractors' safety performance and adherence to their plans and AHAs. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

4.2.1 Observed Hazard Form

When apparent non-compliance or unsafe conditions or practices are observed, notify the subcontractor's supervisor or safety representative verbally, and document using the Observed Hazard Form, included as an attachment to the project safety plan, and require corrective action.

If necessary, stop subcontractor's work using the Stop Work Order Form until corrective actions is implemented for observed serious hazards or conditions. Update the Observed Hazard Form to document corrective actions have been taken. The subcontractor is responsible for determining and implementing necessary controls and corrective actions.

4.2.2 Stop Work Order

CH2M HILL has the authority, as specified in the contract, and the responsibility to stop work in the event any CH2M HILL employee observes unsafe conditions or failure of the subcontractor to adhere to its safe-work practices, or observes a condition or practice that may result in a release or violation of an environmental requirement. This authority and action does not in any way relieve the subcontractor of its responsibilities for the means and methods of the work or, therefore, of any corrective actions. Failure to comply with safe work practices can be the basis for restriction or removal of the subcontractor staff from the job site, termination of the subcontract, restriction from future work, or all three.

When an apparent imminent danger is observed, immediately stop work and alert all affected individuals. Remove all affected CH2M HILL employees and subcontractor staff from the danger, notify the subcontractor's supervisor or safety representative, and do not allow work to resume until adequate corrective measures are implemented. Notify the PM, Contract Administrator (KA) and RHSM.

When repeated non-compliance or unsafe conditions are observed, notify the subcontractor's supervisor or safety representative and stop affected work by completing and delivering the Stop Work Order Form (attached to the project safety plan) until adequate corrective measures are implemented. Consult the KA to determine what the contract dictates for actions to pursue in event of subcontractor non-compliance including work stoppage, back charges, progress payments, removal of subcontractor manager, monetary penalties, or termination of subcontractor for cause.

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4.3 Incentive Program

Each project is encouraged to implement a safety incentive program that rewards workers for exhibiting exemplary safety behaviors. Actions that qualify are those that go above and beyond what is expected. Actions that will be rewarded include spotting and correcting a hazard, bringing a hazard to the attention of your foreman, telling your foreman about an incident, coming up with a safer way to get the work done, or stopping a crew member from doing something unsafe. The program will operate throughout the project, covering all workers. The incentive program will be communicated to all employees during the project employee orientation and project safety meetings.

4.4 Reporting Unsafe Conditions/Practices

Responsibility for effective health and safety management extends to all levels of the project and requires good communication between employees, supervisors, and management. Incident prevention requires a pro-active policy on near misses, close calls, unsafe conditions, and unsafe practices. All personnel must report any situation, practice, or condition which might jeopardize the safety of our projects. All unsafe conditions or unsafe practices will be corrected immediately. CH2M HILL has zero tolerance of unsafe conditions or unsafe practices.

No employee or supervisor will be disciplined for reporting unsafe conditions or practices. Individuals involved in reporting the unsafe conditions or practices will remain anonymous.

The following reporting procedures will be followed by all project employees:

- Upon detection of any unsafe condition or practice, the responsible employee will attempt to safely correct the condition;
- The unsafe condition or practice will be brought to the attention of the worker's direct supervisor, unless the unsafe condition or practice involves the employee's direct supervisor. If so, the SC needs to be notified at once by the responsible employee;
- Either the responsible employee or responsible employee's direct supervisor is responsible for immediately reporting the unsafe condition or practice to the SC;
- The SC will act promptly to correct the unsafe condition or practice; and
- Details of the incident or situation will be recorded by the SC in the field logbook or use the Observed Hazard Form if subcontractor was involved.

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5. Safety Planning and Change Management

5.1 Subcontractor HSE Chartering Meeting

A subcontractor HSE chartering meeting shall be held with subcontractors performing field work on the project. The purpose of the meeting is to discuss and agree on key HSE requirements on a project, and to emphasize and reinforce CH2M HILL expectations for subcontractor HSE performance. The target audience includes key CH2M HILL project staff with HSE responsibilities (e.g., PM, RHSM, SC, Field Team Leader (FTL)) and key Subcontractor staff (e.g., project manager, supervisors, designated field HSE contact, drill team leads, foreman). For small scale projects (e.g., small drill crew and limited CH2M HILL staff), all the subcontractor crew members should attend if available. The meeting should be held prior to mobilization with enough time to ensure that HSE issues identified can be addressed prior to the start of work. The meeting can be held over the phone or in person depending on project needs. An example agenda can be found in the E&NBG Program Element Guideline, "Subcontractor HSE Chartering Meeting."

5.2 Daily Safety Meetings and Pre-Task Safety Plans

Daily safety meetings are to be held with all project personnel in attendance to review the hazards posed and required HSE procedures and AHAs that apply for each day's project activities. The Pre-Task Safety Plans (PTSPs) serve to supplement these general assembly safety meetings; the PTSPs are held between the crew supervisor and their work crews to focus on those hazards posed to individual work crews.

At the start of each day's activities, the crew supervisor completes the PTSP, provided as an attachment to the project safety plan, with input from the work crew. The day's tasks, personnel, tools and equipment that will be used to perform these tasks are listed, along with the hazards posed and required HSE procedures, as identified in this Handbook and AHA. The use of PTSPs promotes worker participation in the hazard recognition and control process while reinforcing the task-specific hazard and required HSE procedures with the crew each day. The PTSP can be completed either with the daily safety meeting or, if there are multiple crews, separately with each crew and their supervisor after the general daily safety meeting.

5.3 Change Management

This Handbook and the project safety plan address known activities and associated hazards. As work progresses, if significant changes are identified which could affect health, safety, or environmental conditions at the site, coordinate with the RHSM or EM to determine whether an update to the safety plan and/or environmental plan are necessary. Follow the change management protocol in the safety plan.

The following are examples of changes that may require a revision to the plan:

- Change in CH2M HILL staff;
- New subcontractor to perform work;
- New chemicals brought to site for use;
- Change in scope or addition of new tasks;
- Change in contaminants of concern (COCs) or change in concentrations of COCs; and
- New hazards or hazards not previously identified that are not addressed in this Handbook or the project safety plan.

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5.4 Agency Inspection Guidance

(Reference CH2M HILL SOP HSE-201, *Agency Inspections and Communications*)

Agency inspections (e.g., OSHA, EPA, other regulatory agencies) are on the rise. CH2M HILL implements safety and environmental programs in order to ensure safety to workers, the public, and the environment. Field personnel need to contact the RHSM to update the project safety plan if hazards are encountered that are not addressed.

SOP HSE-201 addresses agency inspections in detail. It is critical to make immediate notification to the RHSM if an inspector arrives (and EM if it is environmental-related); they can help facilitate and make additional notifications.

Review the Target Zero Bulletin attached to the project safety plan. Make it a topic at a safety meeting and keep it readily available in the event of an inspection.

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6. Project Hazard Analysis

A health and safety risk analysis is performed for each task of a given project. In the order listed below, the RHSM considers the various methods for mitigating the hazards. Employees are trained on this hierarchy of controls during their hazardous waste training and reminded of them throughout the execution of projects:

- Elimination of the hazards (use remote sampling methodology to avoid going into a confined space);
- Substitution (reduce exposure to vapors by using of a geoprobe instead of test pitting);
- Engineering controls (ventilate a confined space to improve air quality);
- Warnings (establish exclusion zones to keep untrained people away from hazardous waste work);
- Administrative controls (implement a work-rest schedule to reduce chance of heat stress); or
- Use of PPE (use of respirators when action levels are exceeded).

Employees are trained on the hierarchy of controls during their hazardous waste training and reminded of them throughout the execution of projects.

6.1 Hazard Identification and Control – The 10 Energies

Hazards are created when an object interacts with a type of energy or combination of energies. The first step in incident prevention is recognizing the energy source(s) and the potential for an uncontrolled release of, or contact with, that energy source. Identifying potential energy sources associated with a piece of equipment or a task allows us to mitigate the hazard correctly.

The 10 types of energy to consider are:

- Chemical
- Electrical
- Gravity
- Mechanical
- Motion
- Pressure
- Sound
- Radiation
- Temperature
- Biological

As described in the hierarchy of controls above, there are four basic options available to prevent unwanted exposure of the energy or energies:

- Eliminate the energy,
- Control the energy,
- Provide a protective barrier or,
- Use stop work authority

When possible, plan or do work that does not require exposure to an energy source. Take action to remove or control the energy source, or be sure that barriers are adequate to mitigate the resulting hazard (engineering controls, PPE, etc.). Use safe work observations to look for body position and placement and use of safety equipment with respect to energy sources present and the potential for an uncontrolled release or contact (line of fire incidents!).

Identify the energy source(s) in the safety plan and AHA or during the pre-task safety briefing and **verify** controls are in place for each task or STOP work until they are.

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6.2 Activity Hazard Analysis

An AHA must be developed for each CH2M HILL field activity. The AHA shall define the work tasks required to perform each activity, along with potential HSE hazards and recommended control measures for each hazard, incorporating the hazardous energies described above. In addition, a listing of the equipment to be used to perform the activity, inspection requirements to be performed and training requirements for the safe operation of the equipment listed must be identified. Workers are briefed on the AHA before performing the work and their input is solicited prior, during, and after the performance of work to further identify the hazards posed and control measures required.

6.3 Subcontractor Activity Hazard Analysis

CH2M HILL subcontractors are required to provide AHAs specific to their scope of work on the project for acceptance by CH2M HILL. Each subcontractor shall submit AHAs for their field activities, as defined in their scope of work, along with their project safety plan and procedures. Additions or changes in field activities, equipment, tools, or material used to perform work or hazards not addressed in existing AHAs requires either a new AHA to be prepared or an existing AHA to be revised.

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7. General Hazards and Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. It is a summarized list of requirements. Always consult the appropriate CH2M HILL SOP to ensure all requirements are implemented.

7.1 Bloodborne Pathogens

(Reference CH2M HILL SOP HSE-202, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or cardiopulmonary resuscitation (CPR), or when coming into contact with landfill waste or waste streams containing potentially infectious material (PIM).

Employees trained in first-aid/CPR or those exposed to PIM must complete CH2M HILL's 1-hour bloodborne pathogens computer-based training module annually. When performing first-aid/CPR the following shall apply:

- Observe universal precautions to prevent contact with blood or other PIMs. Where differentiation between body fluid types is difficult or impossible, consider all body fluids to be potentially infectious materials;
- Always wash your hands and face with soap and running water after contacting PIMs. If washing facilities are unavailable, use an antiseptic cleanser with clean paper towels or moist towelettes; and
- If necessary, decontaminate all potentially contaminated equipment and surfaces with chlorine bleach as soon as possible. Use one part chlorine bleach (5.25 percent sodium hypochlorite solution) diluted with 10 parts water for decontaminating equipment or surfaces after initially removing blood or other PIMs. Remove contaminated PPE as soon as possible before leaving a work area.

CH2M HILL will provide exposed employees with a confidential medical examination should an exposure to PIM occur. This examination includes the following procedures:

- Documenting the exposure;
- Testing the exposed employee's and the source individual's blood (with consent); and
- Administering post-exposure prophylaxis.

7.2 Chemical Storage

The following is general guidance for storing chemicals and other hazardous materials:

- Keep acids away from bases;
- Keep oxidizers (nitric acid, nitrates, peroxides, chlorates) and organics away from inorganic reducing agents (metals);
- Keep flammables and corrosives in appropriate storage cabinets;
- Do not store paper or other combustibles near flammables;
- Use secondary containment and lipped shelving that is secured; and
- Have a fire suppression system available.

7.2.1 Storage of Flammable/Combustible Liquids

- Only approved containers and portable tanks shall be used for storage and handling of flammable and combustible liquids.
- Approved safety cans shall be used for the handling and use of flammable liquids in quantities of 5 gallons (19 liters) or less. Do not use plastic gas cans.

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- For quantities of 1 gallon (3.78 liters) or less, the original container may be used for storage and use of flammable liquids.
- Flammable or combustible liquids shall not be stored in areas used for stairways or normally used for the passage of people.

7.2.2 Indoor Storage of Flammable/Combustible Liquids

- No more than 25 gallons (95 liters) of flammable or combustible liquids shall be stored in a room outside of an approved storage cabinet.
- Quantities of flammable and combustible liquids in excess of 25 gallons (95 liters) shall be stored in an acceptable or approved cabinet.
- Cabinets shall be conspicuously lettered: “FLAMMABLE: KEEP FIRE AWAY.”
- Not more than 60 gallons (228 liters) of flammable or 120 gallons (456 liters) of combustible liquids shall be stored in any one storage cabinet. Not more than three such cabinets may be located in a single storage area.

7.2.3 Outside Storage of Flammable/Combustible Liquids

- Storage of containers (not more than 60 gallons [228 liters] each) shall not exceed 1,100 gallons (4,180 liters) in any one area. No area shall be within 20 feet (6.1 meters) of any building.
- Storage areas shall be graded to divert spills away from buildings and surrounded by an earthen dike.
- Storage areas may not be located near a storm drain. Overflow and spills must be diverted away from storm drains or surface waters.
- Storage areas shall be free from weeds, debris, and other combustible materials.
- Outdoor portable tanks shall be provided with emergency vent devices and shall not be closer than 20 feet (6.1 meters) to any building.
- Signs indicating no smoking shall be posted around the storage area.

7.2.4 Storage of Hazardous Waste

- All facilities storing ignitable and combustible liquids and hazardous wastes must be designed, constructed, maintained, and operated to minimize the possibility of a fire, explosion, or any release of hazardous constituents.
- Flammable wastes should be stored more than 50 feet from the property line.

7.2.5 Storage of Chemical Injection Chemicals/Materials

- When chemical injection remediation technologies are being used at a site, the following storage guidelines must be followed:
- Some injection chemicals, such as strong oxidizers, may have stringent storage requirements per local or National Fire Codes. Verify that appropriate storage provisions are in place prior to starting work.
- NOTE: Counties and cities may have requirements specific to storing these chemicals. Also, storage and use of certain chemicals such as potassium permanganate and hydrogen peroxide may be subject to the new Chemical Facility Anti-Terrorism Standards of the Department of Homeland Security – the applicability depends on the chemical, quantity/concentration, and type of facility. Please contact the project Environmental Manager to determine whether chemicals are subject to these standards.
- Injection chemicals must be stored in a designated, secured area with spill prevention capabilities. Review Safety Data Sheet (SDS) or other information to determine potential incompatible materials. Incompatible materials shall not be stored together. Ensure all containers are labeled.

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7.3 Driving Safety

(Reference CH2M HILL HSE Policy 205, Distracted Driving – Wireless Devices, Vehicle Safety Core Standard)

All CH2M HILL employees are prohibited from using wireless devices while operating a motor vehicle when conducting company business regardless of the location or vehicle ownership and whether or not during regular working hours.

All CH2M HILL contractors and subcontractors are prohibited from using wireless devices while operating a CH2M HILL- or CH2M HILL client-owned, leased, or rented motor vehicle, or while operating any other Motor Vehicle on the project site.

Avoid distractions from wireless devices (e.g., mobile phones, smartphones, voice recognition systems, PDAs, notebook, tablets, or laptops) by turning off or silencing the wireless devices before operating a motor vehicle.

- Prohibited use includes the following:
  - Dialing or speed dialing
  - Using a hands-free or voice recognition (blue tooth) device to dial or speed dial
  - Engaging in conversation or listening to a conversation using a wireless device
  - Checking emails or surfing the internet using a wireless device
  - Texting or e-mailing (reading, sending, or screening) with a wireless device
  - Programming or entering coordinates into a global positioning system (GPS) device (following directions by a GPS is permitted)
  - Using a wireless device for voice recording or dictation
  - Employees, contractors, and subcontractors who need to use a wireless device must pull off the road to a safe location, with the vehicle securely stopped and emergency flashers on, or wait until they reach their destination.

Follow the guidance below when operating a vehicle:

- All vehicles have blind spots to the side and the rear. Follow these safe practices for backing up:
  - Walk around your vehicle prior to moving
  - Try to position your vehicle so that you don't have to back up
  - Back into the space if possible when you're parking
  - Back to the left, if possible, so that you can see objects on the driver's side
  - Have a spotter guide your vehicle when you're backing up
  - Apply GOAL (Get Out And Look)
- Obey speed limits; be aware of blind spots or other hazards associated with low visibility. Practice defensive driving techniques, such as leaving plenty of room between your vehicle and the one ahead of you;
- Do no drive while drowsy. Drowsiness can occur at any time, but is most likely after 18 hours or more without sleep;
- Maintain focus on driving. Eating, drinking, smoking, adjusting controls can divert attention from the road. Take the time to park and perform these tasks when parked rather than while driving; and

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- Ensure vehicle drivers are familiar with the safe operation of vehicles of the type and size to be operated. Large vehicles such as full size vans and pick-ups have different vision challenges and handling characteristics than smaller vehicles.

7.4 Electrical Safety

(Reference CH2M HILL SOP HSE-206, *Electrical Safety*)

Below are the hazard controls and safe work practices to follow when using electrical tools, extension cords, and/or other electrical-powered equipment or when exposed to electrical hazards. Ensure the requirements of the referenced SOP are followed:

- Only qualified personnel are permitted to work on unprotected energized electrical systems;
- Only authorized personnel are permitted to enter high-voltage areas;
- CH2M HILL employees who might from time to time work in an environment influenced by the presence of electrical energy must complete Awareness Level Electrical Safety Training located on the CH2M HILL Virtual Office;
- Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until lockout/tagout procedures are implemented;
- Inspect electrical equipment, power tools, and extension cords for damage prior to use. Do not use defective electrical equipment, remove from service;
- CH2M HILL has selected Ground Fault Circuit Interrupters (GFCIs) as the standard method for protecting employees from the hazards associated with electric shock;
  - GFCIs shall be used on all 120-volt, single phase 15 and 20-amphere receptacle outlets which are not part of the permanent wiring of the building or structure.
- An assured equipment grounding conductor program may be required under the following scenarios:
  - GFCIs cannot be utilized;
  - Client requires such a program to be implemented; or
  - Business group decides to implement program in addition to GFCI protection.
- Extension cords must be equipped with third-wire grounding. Cords passing through work areas must be covered, elevated or protected from damage. Cords should not be routed through doorways unless protected from pinching. Cords should not be fastened with staples, hung from nails, or suspended with wire;
- Electrical power tools and equipment must be effectively grounded or double-insulated and Underwriters Laboratory (UL) approved;
- Operate and maintain electric power tools and equipment according to manufacturers' instructions;
- Maintain safe clearance distances between overhead power lines and any electrical conducting material unless the power lines have been de-energized and grounded, or where insulating barriers have been installed to prevent physical contact. Maintain at least 10 feet (3 meters) from overhead power lines for voltages of 50 kV or less, and 10 feet (3 meters) plus 0.4 inches (1.0 cm) for every 1 kV over 50 kV;
- Temporary lights shall not be suspended by their electric cord unless designed for suspension. Lights shall be protected from accidental contact or breakage; and
- Protect all electrical equipment, tools, switches, and outlets from environmental elements.

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7.5 Extended Work Hours and Fatigue Management

A normal work shift is considered to be eight consecutive hours during the day, five days a week, with at least an eight hour rest period. Any shift that incorporates more continuous hours, requires more consecutive days of work, or requires work during the evening should be considered extended or unusual.

Extended or unusual work shifts are typically more stressful for workers physically, mentally, and emotionally, and can lead to increased fatigue, stress, and lack of concentration. These effects can lead to an increased risk of worker error, incidents, and injuries.

If your field project requires extended work hours, including drive time, you must consult with your PM and HSM for approval of the extended hours/days and to be certain that fatigue management practices are included in your safety plan.

Fatigue shall be managed by using a risk management approach which includes:

- Identifying the contributing factors (work hours, type of work to be performed, time of day, travel fatigue/jet lag), collaborating with employees, reviewing incident trends;
- Assessing the risks associated with workplace conditions that contribute to fatigue including time of day, opportunities to recover, how many people are fatigued, skills and experience of those who experience fatigue; and
- Determining and implementing controls to prevent or minimize the risk and reviewing the effectiveness of the controls.

7.6 Field Ergonomics and Manual Lifting

(Reference CH2M HILL SOP HSE-112, *Manual Lifting*)

Some of the most common injuries during field work are the result of performing work in an awkward body position (poor ergonomics) or pushing the body beyond its natural limits. Workers who have to lift, stoop, kneel, twist, grip, stretch, reach overhead, or work in other awkward positions regularly are at risk of developing discomfort or even an injury. Additionally, back injuries are one of the leading causes of work disability and most back injuries are the result of improper lifting techniques or overexertion.

Contact the RHSM to determine hazard control measures if your task involves:

- Repetitive motions;
- Lifting and carrying items over long distances (100 feet) or on uneven, steep, or sloped terrain;
- Heavy lifting;
- Use of vibrating tools or equipment; or
- Being in a static position for extended periods of time;

There are a variety of ergonomically designed tools and work practices that can reduce the potential for discomfort and injury. Following are requirements (“must” or “shall”) and recommendations (“should”) to aid in the prevention of discomfort or injuries while working in the field.

<u>Fitness for Duty</u>

If manual lifting and repetitive activities are not part of your normal work duties, contact your PM and/or RHSM to help determine if you have the physical capability to perform the work. In many cases adding lifting or repetitive tasks to a subcontractor’s scope of work is desirable to prevent injury. If the work task causes any pain or discomfort stop and get assistance.

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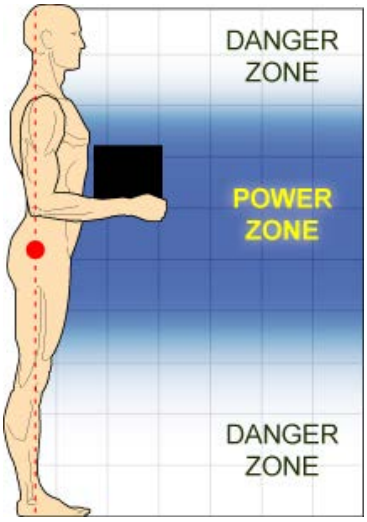
Manual Lifting

- All CH2M HILL workers must have training in proper manual lifting either through New Employee Orientation or through the Manual Lifting module located on the VO;
- When possible, the task should be modified to minimize manual lifting hazards or awkward body positions;
- Lifting occasional loads weighing more than 40 pounds (18 kilograms) should be evaluated by the SC using the Lifting Evaluation Form contained in SOP HSE-112;
- When performing repetitive lifting tasks with loads over 40 pounds, the Lifting Evaluation Form contained in SOP HSE-112 shall be used, and mechanical means used where possible;
- Personnel shall seek assistance when performing manual lifting tasks that appear beyond their physical capabilities;
- Using mechanical lifting devices such as forklifts; cranes, hoists, and rigging; hand trucks; and trolleys; is the preferred means of lifting heavy objects;
- Lift and Work in the Power Zone - The power zone for lifting or working is close to the body, between mid-thigh and mid-chest height. This zone is where arms and back can lift the most with the least amount of effort. This is zone is sometimes refered to as the "strike zone";
- Work near elbow height to avoid excessive bending (avoid working above the shoul knees);



Source: OSHA

- Plan before carrying:
  - Wear appropriate shoes to avoid slips, trips or falls
  - If you wear gloves, wear gloves that fit. Tight-fitting gloves can put pressure on the hands, while loose-fitting gloves reduce grip strength and pose other safety hazards.
  - Avoid carrying large or bulky loads that limit or obstruct your vision
  - Slide, push, or roll instead of carrying when appropriate
  - When there is a choice, push instead of pull
  - Carry only as much as you can safely handle
  - Try to avoid slopes, stairs, or other obstacles that make carrying materials more difficult
  - Beware of and try to avoid slippery floors (e.g., liquids, ice, oil, and fine powders)
  - Use extra caution when moving loads that may be unstable
- In general, the following steps must be practiced when planning and performing manual lifts:
  - Examine the load and the surrounding area
  - Bend knees when lifting a load
  - Look forward to keep back straight
  - Position the load close to the body
  - Maintain a firm grip on the load
  - Test the load for stability and weight prior to lifting
  - Use smooth, controlled movements
  - Keep arms in front of body
  - Turn feet in direction of movement to avoid twisting
- Avoid carrying objects more than 100 feet;

Ergonomic Work Practices

- Avoid repetitive motions, overhead reaching, and kneeling when possible;

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- If prolonged awkward postures are unavoidable, use a “supported” posture to compensate; a supported posture uses part of your body to support the weight of another body segment that is in an awkward position;
- Watch your pace—attempting to do something faster can cause you to lose proper form;
- Use a table or move work to a location where you don’t have to be in a bent-over position to do your work; and
- Where awkward postures or repetitive motions are unavoidable, rotate with another worker, change tasks, stretch, and take short breaks frequently.

7.7 Field Trailer/Office Setup and Maintenance

- Determine trailer placement by considering all potential hazards that could impact “office” work. Trailers usually are placed in the support zone and out of construction zones. Think about what type of PPE will be necessary when exiting the trailer, parking needs, biological hazards or other hazards that could impact location.
- Check utility configuration prior to placement, including electrical, water, and sewer.
- Use spotters when placing trailer.
- Set on flat ground.
- Be sure trailer wheels are chocked.
- When disconnecting trailer from hitch—watch pinch points and wear leather gloves.
- Carefully jack trailer using the appropriately rated jacks and following manufacturer’s recommendations.
- Secure and anchor trailer to protect from wind or other severe weather.
- Place cones in front of hitch.
- Ensure proper stairs and secure stairs next to doors. Ensure stairs are “no slip” and that the platform or landing of the stairs is flush the door threshold.
- Use only qualified electricians to establish electrical service.
- Consider ergonomics when furnishing trailer with desks and chairs.
- Place fire extinguishers near doors, and place signage.
- Put up emergency contacts, evacuation and rally point map, and route to the hospital
- Place right to know posters (OSHA required information).
- Place signage on exit doors.
- Never place porta-johns at HVAC intake (usually HVAC is located at the front of trailer).
- Have capability to properly store food—temporary field offices can quickly develop rodent issues if food is not stored properly or the trailer isn’t cleaned regularly.

7.8 Field Vehicles

- Field vehicles may be personal vehicles, rental vehicles, fleet vehicles, or project vehicles.
- Maintain a first aid kit and bloodborne pathogen kit in the field vehicle.
- Assess whether maintaining a fire extinguisher in the field vehicle is feasible. If fire extinguishers are readily available, for example on heavy equipment, or if the project is short duration, a fire extinguisher would not

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be necessary. Fire extinguishers in field vehicles need to be properly secured and inspected on a monthly basis.

- The following precautions should be implemented if work involves stopping or parking along roadways:
  - Freeways and limited access – no stopping/parking allowed
  - Roads with speed limits 50 mph or higher – flashing beacon required on top of the vehicle.
  - Roads with speed limits 35 mph or higher with no/limited shoulder (not able to get fully off the road at least 12 inches from the fog line or road edge) - flashing beacon required
  - Roads with speed limits 35 mph or higher with full shoulder (are able to get fully off the road at least 12 inches from the fog line or road edge) - flashers required
  - Roads with speed limits under 35 mph - flashers required
- Familiarize yourself with rental vehicle features prior to operating the vehicle:
  - Vision Fields and Blind Spots
  - Vehicle Size
  - Mirror adjustments
  - Seat adjustments
  - Cruise control features, if offered
  - Pre-program radio stations and Global Positioning System (GPS), if equipped
- Always wear seatbelt while operating vehicle.
- Adjust headrest to proper position.
- Tie down loose items if utilizing a van or pick-up truck.
- Close car doors slowly and carefully. Fingers can get pinched in doors.
- Park vehicle in a location where it can be accessed easily in the event of an emergency. If not possible, carry a phone.
- Have a designated place for storing the field vehicle keys when not in use.
- Ensure back-up alarms are functioning, if equipped. Before backing a vehicle, take a walk around the vehicle to identify obstructions or hazards. Use a spotter when necessary to back into or out of an area.
- See the Vehicle Incident Guidance attached to the project safety plan, if a vehicle incident is experienced in a rental or fleet vehicle.

7.9 Fire Prevention

(Reference CH2M HILL SOP HSE-403, *Hazardous Material Handling*)

Follow the fire prevention and control procedures listed below.

7.9.1 Fire Extinguishers and General Fire Prevention Practices

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet (30.5 meters). When 5 gallons (19 liters) or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet (15.2 meters). Extinguishers must:
  - be maintained in a fully charged and operable condition;
  - be visually inspected each month; and
  - undergo a maintenance check each year.

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- The area in front of extinguishers must be kept clear.
- Post “Exit” signs over exiting doors, and post “Fire Extinguisher” signs over extinguisher locations.
- Combustible materials stored outside should be at least 10 feet (3 meters) from any building.
- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Keep areas neat. Housekeeping is important.

7.9.2 Dispensing of Flammable/Combustible Liquids

- Areas in which flammable or combustible liquids are dispensed in quantities greater than 5 gallons (22.7 liters) (shall be separated from other operations by at least 25 feet (7.6 meters).
- Drainage away from storm drains or surface waters or other means of containment shall be provided to control spills.
- Adequate natural or mechanical ventilation shall be provided to maintain the concentration of flammable vapor at or below 10 percent of the lower flammable limit.
- Dispensing of flammable liquids from one container to another shall be done only when containers are electrically interconnected (bonded).
- Dispensing flammable or combustible liquids by means of air pressure on the container or portable tanks is prohibited.
- Dispensing devices and nozzles for flammable liquids shall be of an approved type.

7.10 General Practices and Housekeeping

The following are general requirements applicable to all portions of the work:

- Site work should be performed during daylight hours whenever possible;
- Good housekeeping must be maintained at all times in all project work areas;
- Common paths of travel should be established and kept free from the accumulation of materials;
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions;
- Provide slip-resistant surfaces, ropes, or other devices to be used;
- Specific areas should be designated for the proper storage of materials;
- Tools, equipment, materials, and supplies shall be stored in an orderly manner;
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area;
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals;
- All spills shall be quickly cleaned up; oil and grease shall be cleaned from walking and working surfaces;
- Review the safety requirements of each job you are assigned to with your supervisor. You are not expected to perform a job that may result in injury or illness to yourself or to others;
- Familiarize yourself with, understand, and follow jobsite emergency procedures;
- Do not fight or horseplay while conducting the firm’s business;
- Do not use or possess firearms or other weapons while conducting the firm’s business;
- Report unsafe conditions or unsafe acts to your supervisor immediately;

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- Report emergencies, occupational illnesses, injuries, motor vehicle incidents, and near misses immediately;
- Do not remove or make ineffective safeguards or safety devices attached to any piece of equipment;
- Report unsafe equipment, defective or frayed electrical cords, and unguarded machinery to your supervisor;
- Shut down and lock out machinery and equipment before cleaning, adjustment, or repair. Do not lubricate or repair moving parts of machinery while the parts are in motion;
- Do not run in the workplace;
- When ascending or descending stairways, use the handrail and take one step at a time;
- Do not apply compressed air to any person or clothing;
- Do not wear steel taps or shoes with metal exposed to the sole at any CH2M HILL project location;
- Do not wear finger rings, loose clothing, wristwatches, and other loose accessories when within arm's reach of moving machinery;
- Remove waste and debris from the workplace and dispose of in accordance with federal, state, and local regulations;
- Note the correct way to lift heavy objects (secure footing, firm grip, straight back, lift with legs), and get help if needed. Use mechanical lifting devices whenever possible; and
- Check the work area to determine what problems or hazards may exist.

7.11 Hazard Communication

(Reference CH2M HILL SOPs HSE-107, *Hazard Communication* and HSE-403, *Hazardous Material Handling*)

The hazard communication coordinator is to perform the following:

- Complete an inventory of chemicals brought on site by CH2M HILL using the chemical inventory form included as an attachment to the project safety plan;
- Confirm that an inventory of chemicals brought on site by CH2M HILL subcontractors is available;
- Request or confirm locations of safety data sheets (SDSs) from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed;
- Before or as the chemicals arrive on site, obtain an SDS for each hazardous chemical and include on the chemical inventory sheet (attached to the project safety plan) and add the SDS to the SDS onsite notebook;
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly;
- Give employees required chemical-specific HAZCOM training using the chemical-specific training form included as an attachment to the project safety plan; and
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

7.12 Knife Use

Open-bladed knives (for example, box cutters, utility knives, pocket knives, machetes, and multi-purpose tools with fixed blades such as a Leatherman™) are prohibited at worksites except where the following three conditions are met:

- The open-bladed knife is determined to be the best tool for the job;

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- An approved Activity Hazard Analysis (AHA) or written procedure is in place that covers the necessary safety precautions (work practices, PPE, and training); and
- Knife users have been trained and follow the AHA.

Specific precautions for knife use include:

- Employees are responsible for using cutting tools in the way they are intended, maintaining them in good working order and reporting faulty or unusable items. PPE as specified in the AHA is to be used;
- Those engaging and supervising subcontractors are to ensure that the requirements of this policy are communicated;
- The most appropriate gloves shall be identified within the AHA. In general, cut resistant gloves (e.g., Kevlar) are to be worn when using a knife in an occupational setting. Other types of gloves may be required and will be identified within the AHA. An example may be leather gloves may be worn when using the acetate sleeve cutter;
- All employees that will use a cutting tool must be trained in the proper use;
- Position the item to be cut on a stable surface. Secure it to prevent slippage, wherever possible. Select a work location which does not put your body in the line of fire of a knife slippage or failure;
- When using a knife do not cut towards yourself;
- When cutting, make the force of the cut carry the blade away from any part of your body. If you have a situation where this is not possible, protect yourself with a leather apron, or other material placed between you and the blade. Consider putting the material to be cut in a vise, or other holding device;
- Many tasks using a utility knife require a knife edge but not a sharp point. For these tasks you can add protection against puncture wounds by using a rounded-tip blade;
- In general, a pocket knife if not the preferred tool of choice as there are alternatives (e.g., retracting safety blade).
- If you use a folding knife, it must be a locking blade type.
- Never use a knife that will fold under pressure.
- If you use a fixed blade knife, make sure there is a handle guard to keep your hand from slipping forward. Also, make sure the handle is dry and non- greasy/slippery to assure a better grip. If you carry a fixed blade knife, use a sheath or holder.
- Store utility knives safely, retract the blade or sheath an open blade before storing. Never, leave a knife with the blade exposed on the floor, on a pallet, on a work surface, or in a drawer or cabinet.
- Keep your knife sharp. A dull blade requires you to use more force to cut, and consequently increases the risk of slip or mistake.
- Knives used on the job, but not carried with you, must be properly stored when not in use;
- Never use a defective knife;
- Utility knife blades are brittle and can snap easily. Don’t bend them or apply side loads to them by using them to open cans or pry loose objects. Use the knife only to cut. It was not designed to work as a pry bar, screwdriver, or hole punch.

7.13 Lighting

Lighting shall be evaluated when conducting work inside buildings, confined spaces, or other areas/instances where supplemental light may be needed (e.g., work before sunrise or after sunset). A light meter can be used to evaluate

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the adequacy of lighting. The following are common requirements for lighting and the conditions/type of work being performed:

- While work is in progress outside construction areas shall have at least 33 lux (lx);
- Construction work conducted inside buildings should be provided with at least 55 lux light;
- The means of egress shall be illuminated with emergency and non-emergency lighting to provide a minimum 11 lx measured at the floor. Egress illumination shall be arranged so that the failure of any single lighting unit, including the burning out of an electric bulb will not leave any area in total darkness.

7.14 Personal Hygiene

Good hygiene is essential for personal health and to reduce the potential of cross-contamination when working on a hazardous waste site. Implement the following:

- Keep hands away from nose, mouth, and eyes during work;
- Keep areas of broken skin (chapped, burned, etc.) covered; and
- Wash hands with soap and water prior to eating, smoking, or applying cosmetics.

7.15 Personal Security

Follow the guidelines below for personal security measures. The RHSM and Firm-Wide Security Office can be contacted if additional, specific measures are needed (e.g., such as evaluating the needs for security service).

General Safety and Security Guidelines

CH2M HILL Corporate Security Department recommends the following guidelines for workers in the United States:

- Stay alert and be aware of your surroundings. Avoid pre-occupations with mobile devices, while in an unfamiliar area.
- Whenever possible use the buddy system with another employee or client or subcontractor employee.
- Trust your intuition; if a situation appears strange or wrong, it probably is.
- Be confident in your walk or stride; do not give the appearance you are new in town.
- Avoid carrying and displaying large sums of cash.
- If you sense or see dangerous situations along your route, change your route and depart the area quickly. If you feel that you are being followed, go to the nearest police station or safe location and file a complaint with the police. Provide a description of the person, their vehicle, license plate number and any other useful information.
- Only walk short distances that are safe and secure while visiting an unfamiliar city or location.
- Take host approved transportation for long distances.
- “Fight or Flight?” Leaving the possible or dangerous area is always better than staying to fight.
- Always report suspicious activity to the nearest local law enforcement agency.
- Locate emergency exits in your hotel or where you are staying to ensure you know where to go in case of a fire or a natural or man-made disaster.
- Secure your electronic devices when left in your room or take them with you if you are not able to secure them properly.
- If you feel your life is in danger, call 911. Be sure to speak clearly, concisely and give the dispatcher a good description of where you are physically located.

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Operating or Riding in Vehicles

- When waiting for public transportation or a taxi, remain in a store or restaurant as long as possible before catching your ride and never wait by yourself in an isolated area.
- Approach your vehicle with keys firmly in your hand and ready to unlock the car.
- Quickly check your car before entering it to determine damage or presence of an intruder.
- Vulnerable times can be stopping to find your keys to enter your vehicle or stepping out of your vehicle in an isolated area. Be aware of your surroundings before you perform these activities.
- Always keep your doors locked during transit and when the vehicle is parked.
- Never leave your vehicle unlocked, even when to performing a quick task such as checking in a hotel, getting gas or going picking up food.
- If confronted by an individual inside a vehicle pointing a weapon at you, run the opposite way from where the vehicle is facing and scream as loud as you can. This evasive action will probably cause the individual to drive away.
- If an individual in a passing car points at your tires or engine to indicate a malfunction, only pull over in a well-lit and populated gas or rest stop. Never pull over in an isolated or dimly lit area. You may have a malfunction or the passing motorist may be attempting to rob you.
- Always park your vehicle is a well-lit and secure area. If your vehicle is parked in a dimly lit or isolated area in a parking garage; ask an attendant or friend to accompany you to your vehicle.
- Secure your valuables in the trunk, or place them out of sight or cover them with a blanket or coat if there is no secure storage area in the vehicle. The would-be-perpetrator likes to see what to steal and not knowing what you have concealed will normally prevent a break in.

Riding in a Taxi

- Have your host or a designated travel agent suggest or reserve a reputable taxi service for you during your stay.
- Only use a taxi service that was vetted for safety and reliability.
- If possible, place luggage, laptop and personal belongings inside the taxi.
- When you first enter the taxi, check the driver photo identification card, normally located on the driver's visor with the driver to ensure they match.

Walking

- If you experience automotive trouble, remain inside the locked vehicle and call for assistance.
- If you can't reach assistance via a mobile phone, only walk for help in a safe area facing the traffic.
- If while walking, you are shadowed or followed by a vehicle, run back in the direction of your vehicle and enter the vehicle if possible. File a police report on the incident as soon as practicable.
- Be aware of your surroundings and those around you while walking and do not be distracted by using electronic devices.
- Regularly change your route if you are walking to and from meetings or conferences and choose only well-lit areas to walk in at night.
- If walking long distances, identify a "safe house, shop, store or restaurant" to duck into if confronted by a perpetrator.

Jogging or Running

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- Always jog or run in an area that is safe, secure, and used for exercising.
- Avoid running along busy roads or highways.
- If you chose to venture out on a jog or run, check the route by vehicle prior to beginning to exercise.
- Let the host or a friend know when you leave, when you plan to return, and the route you will take during exercising.
- Take a photo identification and mobile phone with you for emergencies.
- Avoid physically over-extending yourself since reflexes and decision-making ability can be impaired.

Clothing and Jewelry

- Dress to blend in with locals, maintain a low profile and avoid drawing attention to yourself.
- Travel with inexpensive clothing and jewelry.
- Avoid wearing CH2M HILL distinctive clothing or using CH2M HILL logos on luggage or laptops.

Emergency Numbers and Information

- Leave your itinerary and emergency contact numbers where you can be reached with family members and only those that have a need to know.
- Pre-program emergency numbers in the mobile device you are traveling with.
- Carry a list of current medications and specific doses in your purse or wallet.
- Record medical emergency information on a document that can be readily available if you are unable to speak or unconscious.
- Have a photo copy of your driver's license, passport, and credit card information separately in case your wallet or purse is stolen.

7.16 Shipping and Transportation of Hazardous Materials

(Reference CH2M HILL SOP HSE-417, *Hazardous Materials Transportation*)

The U.S. Department of Transportation (DOT) has specific regulations governing shipping of hazardous materials (also called dangerous goods) including calibration gases used in personal exposure monitoring or field instruments. Chemicals brought to the site might be defined as hazardous materials by the U.S DOT. Hazardous wastes that may be shipped offsite are also defined as hazardous materials by U.S. DOT. Other wastes may also be U.S. DOT hazardous materials. To confirm whether a material or a waste is a U.S. DOT hazardous material, check with the E&NBG Waste Coordinator (Lisa Schwan/ATL), the project EM, or the CH2M HILL Dangerous Goods Shipping Coordinators (John Blasco/BAO or Rob Strehlow/MKW).

All staff who affect shipment of hazardous materials, including receiving hazardous materials, preparing profiles or manifests, packaging hazardous wastes, labeling, or transporting hazardous materials by road, are called HazMat employees (note CH2M HILL cannot transport hazardous wastes by public road). HazMat employees must receive CH2M HILL online training in shipping dangerous goods. CH2M HILL's online Dangerous Goods Shipping course can be found on the CH2M HILL HSE website.

All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. If the material is a product that is being shipped (e.g., calibration gas), use the HazMat ShipRight tool on the CH2M HILL virtual office (under Company Resources – Online Shipping). Contact the Dangerous Goods Shipping coordinators, the E&NBG Waste Coordinator or the project EM for additional information.

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49 CFR 172 requires that all hazmat employees be aware of potential transportation security concerns. Hazardous materials security is addressed in CH2M HILL's Hazardous Materials SOP (HSE-403). The following points are provided as an overview of security measures to increase awareness of this important matter:

- It is essential that each employee understand the security risks involved with transporting hazardous materials;
- All transporters of hazardous materials must be prequalified by a Contracts Administrator who evaluate the carrier's safety rating, security measures, and employee screening procedures;
- When shipping hazardous materials, check driver credentials and ask about shipping details;
- When receiving a hazardous materials shipment, inspect packages for signs of tampering or damage to the contents. Verify the drivers and company information on the form with the driver; and
- If there is suspicious or unusual behavior (e.g., driver without credentials, evasive answers) or any discrepancies identified, do not offer or accept the shipment, and immediately notify the project manager or the RHSM.

Employees responsible for shipping hazard materials must also review the CH2M HILL Transportation Security Plan (HSE-417 Appendix A).

7.17 Substance Abuse

(Reference CH2M HILL Policy 810, Drugfree Workplace*)*

Employees who work under the influence of controlled substances, drugs, or alcohol may prove to be dangerous or otherwise harmful to themselves, other employees, clients, the company, the company's assets and interests, or the public. CH2M HILL does not tolerate illegal drug use, or any use of drugs, controlled substances, or alcohol that impairs an employee's work performance or behavior.

Prohibitions onsite include:

- Use or possession of intoxicating beverages while performing CH2M HILL work;
- Abuse of prescription or nonprescription drugs;
- Use or possession of illegal drugs or drugs obtained illegally;
- Sale, purchase, or transfer of legal, illegal or illegally obtained drugs; and
- Arrival at work under the influence of legal or illegal drugs or alcohol.

Drug and/or alcohol testing is applicable under Policy 810. In addition, employees may be required to submit to drug and/or alcohol testing as required by clients. This testing is performed in accordance with Policy 810, Drug-Free Workplace. Contact the Drugfree Workplace administrator, Mary Beth Thomas/DEN (Federal Sector) or Brenda LaBonte/SPB (Commercial Sector), if testing is necessary.

7.18 Unknown or Suspect Objects/Materials

If unknown or suspect objects/materials are encountered (i.e., exposed or partially buried drums, biological waste, cylinders, glass containers, munitions of explosive concern, unexpected stained/discolored soil) are encountered during site operations, ongoing activities shall be immediately suspended. CH2M HILL or subcontractor personnel encountering unknown or suspect objects or materials shall:

- Secure the area and identify the location of the object/material to the extent possible, without causing bodily injury to yourself or others and without disturbing the object.
- Evacuate the work area.
- Immediately notify the project manager/RHSM of the encountered condition.

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- Do not further disturb or otherwise handle the suspect object or material.

The site supervisor or SC shall contact the Project Manager and the RHSM to evaluate potential hazards associated with the specific situation encountered. The project team will then address the need for the use of special procedures, engineering controls, PPE or specialized subcontract personnel to safely mitigate the situation.

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8. Project-Specific Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the work or the particular hazard. Each person onsite is required to abide by the hazard controls. Always consult the appropriate CH2M HILL SOP to ensure all requirements are implemented. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the RHSM for clarification.

8.1 Abrasive Blasting

(Reference CH2M HILL SOP HSE-122, *Abrasive Blasting*)

Abrasive blasting is the cleaning or preparing of a surface by forcibly propelling a stream of abrasive material against the surface using sand, glass bead, aluminum oxide, grit, garnet, steel shot, slag, walnut shells, and others. Below are the hazard controls and safe work practices to follow when overseeing or performing abrasive blasting.

- CH2M HILL employees who work on projects with abrasive blasting operations are required to complete the CH2M HILL 10-Hour Construction Safety Awareness training and waste management training.
- Abrasives and the surface coatings on the materials blasted are shattered and pulverized during blasting operations and the dust formed will contain particles of respirable size. The composition and toxicity of the dust from these sources shall be considered in making an evaluation of the potential health hazards. Air monitoring instruments shall be provided if the potential for a hazardous atmosphere exists.
- Personnel shall remain a safe distance from the abrasive blasting area to reduce exposure to hazardous airborne contaminants.
- Abrasive blasting equipment shall be inspected each day, before use, to ensure safe operational condition.
- Non-silica containing abrasive blasting materials must be used to the extent possible.
- Blast nozzles must be equipped with an operating valve that must be held open manually.
- Eating, drinking, and smoking shall be prohibited in areas where blasting is performed. Employees shall wash their face and hands before eating, drinking or smoking.
- Abrasive blasting debris shall be cleaned up by using dust-free methods. Wet clean-up methods and vacuum cleaners with High Efficiency Particulate Air (HEPA) filters are recommended.
- Fugitive dust must be controlled during abrasive blasting operations by using water sprays or other methods.
- Noise must be monitored and controlled as required by state or local regulations.
- Complete the abrasive blasting self-assessment checklist when performing or when subcontractors perform this operation.

8.2 Aerial Lifts

(Reference CH2M HILL, SOP HSE-301, *Aerial Lifts*)

Below are the hazard controls and safe work practices to follow when working around or operating aerial lifts. Ensure the requirements in the referenced SOP are followed:

- Operate aerial lifts only if you are authorized and trained to do so;
- Inspect aerial lifts and test lift controls prior to use;

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- Wear a full-body harness, with a lanyard attached to the boom or platform (see also SOP HSE-308, *Fall Protection*). When working within a standard guardrail system with scissors lifts, the full-body harness and lanyard are not required;
- Do not attach lanyard to any adjacent structures or equipment while working from an aerial lift;
- Stand firmly on the floor of the platform and do not sit or climb on the railings of the platform, or use planks, ladders, or other devices to increase working height;
- Remain on the platform at all times and do not leave the platform to climb to adjacent structures;
- Position aerial lifts on firm, level surfaces when possible, with the brakes set. Use wheel chocks on inclines. If outriggers are provided, position them on solid surfaces or cribbing;
- Maintain safe clearance distances between overhead power lines and any part of the aerial lift or conducting material, unless the power lines have been de-energized and grounded, or insulating barriers have been installed to prevent physical contact. Maintain at least 10 feet (3 meters) from overhead power lines for voltages of 50 kilovolts (kV) or less, and 10 feet (3 meters) plus 0.4 inches (1.0 cm) for every 1 kV over 50 kV;
- Do not exceed the boom and basket load limits;
- Do not use aerial lifts as cranes, unless specifically designed and approved by the lift manufacturer;
- Do not work or stand below aerial lift operations;
- Do not use aerial lifts when winds exceed 30 miles per hour (48 km per hour) or per manufacturers recommendations; and
- Complete the self-assessment checklist for aerial lifts whenever aerial lifts are being used.

8.3 All-Terrain Vehicles and Utility-Type Vehicle Safety

An all-terrain vehicle (ATV) means any recreational vehicle with three or more tires, has handlebar steering, and a seat designed to be straddled by the operator and are not intended for use on paved roads.

Utility-type vehicle (UTV) means any recreational motor vehicle other than an ATV, motorbike, or snowmobile designed for and capable of travel over designated roads, traveling on four (4) or more tires.

ATVs/UTVs shall not be operated on site unless determined to be the most appropriate vehicle(s) to use and their use is pre-approved by the PM and RHSM.

Operators shall be trained and qualified before operation of the ATV or UTV onsite and will possess a valid driver's license.

ATV/UTV operators are prohibited from using any wireless device while operating ATVs/UTVs. Equipment must be stopped before using devices such as two way radios or cell phones. If a wireless device is required for a certain operation, the PM and RHSM must authorize the wireless use on a case by case basis and make sure limitations are addressed in the project safety plan.

Training shall consist of manufacturer's operating manual, hands-on training by a competent person, a demonstration of basic skills, and when required by the state, completion of an ATV safety course. An AHA shall also be developed for the use of ATVs/UTVs and operators shall be trained on the AHA. All individuals are required meet all training aspects before ATV/UTV use and documentation of training shall be maintained at the site.

Some states listed below as requiring an ATV license actually require an ATV or even a motorcycle endorsement on the operator's current driver's license. Be sure to contact the local division of motor vehicles (DMV) office for details. The following are states that require a specialized driver's license: Arizona, Oregon, Georgia, and Illinois. New Hampshire's and Montana's requirements vary by city. Check your state for new local requirements.

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Keep in mind, that states not mentioned above may still:

- Impose age restrictions for operating ATVs;
- Require an ATV safety or education course certification (even if you're older than 18);
- Require ATV insurance.

Daily inspections of vehicles for safety and maintenance are required.

Minimum PPE required for operators and passengers on ATVs include:

- Safety glasses, goggles, or face-shield at all times when moving;
- Leather boots or shoes (if safety-toed boots are not required by the project safety plan); and
- A properly fitted DOT/ANSI/SNELL-approved helmet.

Other safety requirements include:

- ATVs with fewer than four wheels are not allowed on site;
- ATVs and UTVs shall be operated in accordance with the manufacturer's operating manual, any state or client requirements, and task-specific AHA;
- Speed is not to exceed 20 mph. Keep all parts of your body inside any roll over protection;
- Always use the seat belt on UTVs;
- Make sure the engine is turned off before dismounting the vehicle;
- Avoid driving over any extremely large obstacles (i.e., wood/logs, fences, boulders, etc);
- When using trailers, watch your turning radius;
- Shut engine down prior to refueling;
- ATVs/UTVs must have fenders;
- Utilize high visibility flag and wear high visibility vest when operating adjacent to heavy equipment or haul vehicles.

8.4 Arsenic

(Reference CH2M HILL, SOP HSE-501, *Arsenic*)

Arsenic is considered a "Confirmed Human Carcinogen." CH2M HILL is required to control employee exposure to arsenic when exposures are at or above 5.0 micrograms per cubic meter ($\mu g/m^3$), or if there is the possibility of skin or eye irritation from arsenic. The elements of the CH2M HILL arsenic program include the following:

- Exposure monitoring;
- Methods of control, including PPE and respirators;
- Medical surveillance;
- Training on hazards of arsenic and control measures (includes project-specific training and the computer-based training on CH2M HILL's Virtual Office, *Arsenic Exposure);* and
- Recordkeeping requirements.

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If air monitoring indicates there is potential exposure at the action level concentrations, notify the RHSM to ensure the above have been adequately addressed. Full implementation of SOP HSE-501, Arsenic, will be required. Other exposure control measures include:

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met;
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas;
- Avoid skin and eye contact with liquid and particulate arsenic or arsenic trichloride;
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person; and
- Review the fact sheet included as an attachment to the SOP.

8.5 Asbestos

(Reference CH2M HILL SOP HSE-502, *Asbestos*)

Asbestos is a cancer-causing mineral that was included in many building materials. When disturbed harmful asbestos fibers can be released and inhaled and ingested by workers. Materials suspected of containing asbestos shall be treated as asbestos unless documentation and testing results indicate otherwise. Where the presence of asbestos is suspected, if at all possible, design all operations to avoid contact.

When there is a risk of disturbing asbestos and making it friable (able to release fibers when the materials are crushed, abraded or cut) the activity becomes regulated. The asbestos standard for construction regulates asbestos exposure for the following activities:

- Demolishing or salvaging structures where asbestos is present in concentrations greater than 1 percent;
- Removing or encapsulating asbestos-containing materials (1 percent or greater asbestos content);
- Constructing, altering, repairing, maintaining, or renovating asbestos-containing structures or substrates;
- Installing asbestos containing products;
- Cleaning up asbestos spills/emergencies; and
- Transporting, disposing, storing, containing and housekeeping involving asbestos or asbestos containing products on a construction site.

CH2M HILL is required to control employee exposure to asbestos when exposures are at or above 0.1 fibers per cc (f/cc) by implementing a program that meets the requirements of the OSHA Asbestos standard, 29 Code of Federal Regulations (CFR) 1926.1101. The elements of the CH2M HILL asbestos program include the following:

- Exposure monitoring;
- Methods of control, including PPE and respirators;
- Medical Surveillance;
- Training on hazards of asbestos and control measures; and
- Record keeping requirements.

If air monitoring indicates there is potential exposure at the action level concentrations, notify the RHSM to ensure the above have been adequately addressed. Other exposure control measures include:

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met;
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas;

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- Avoid skin and eye contact asbestos;
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person;
- Review the fact sheet included as an attachment to the SOP; and
- Do not disturb waste or other materials labeled “Danger - Asbestos Fibers.”

Subcontractors performing asbestos abatement activities are required to obtain state or special licenses and permits and have a written compliance/abatement plan that has been reviewed and accepted by CH2M HILL before work begins. Subcontractors are required to provide proof that all asbestos workers medically qualified, training and a competent person has been appointed before work begins.

8.6 Benzene

(Reference CH2M HILL SOP HSE-503, *Benzene*)

Benzene is considered a “Confirmed Human Carcinogen.” CH2M HILL is required to control employee workplace exposure to benzene when personal exposures is at or above 0.5 parts per million (ppm) as an 8-hour time-weighted average (TWA) or above 5.0 ppm short term exposure limit (STEL), by implementing a program that meets the requirements of the OSHA Benzene standard, 29 CFR 1910.1028. The elements of the CH2M HILL benzene program include the following:

- Exposure monitoring;
- Methods of control, including personal protective equipment (PPE) and respirators;
- Medical surveillance;
- Training on hazards of benzene and control measures (includes project-specific training and the computer-based training on CH2M HILL’s Virtual Office, *Benzene);* and
- Record keeping requirements.

If air monitoring indicates there is potential exposure at the action level concentrations above, notify the RHSM to ensure the above have been adequately addressed. Other exposure control measures include:

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met;
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas;
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person; and
- Review the fact sheet included as an attachment to the SOP.

8.7 Cadmium

(Reference CH2M HILL SOP HSE-504, *Cadmium*)

Cadmium is considered a “Suspected Human Carcinogen.” CH2M HILL is required to control employee workplace exposure to cadmium when personal exposure is at or above 2.5 micrograms per cubic meter ($\mu g/m^3$) by implementing a program that meets the requirements of the OSHA Cadmium standard, 29 *Code of Federal Regulations* (CFR) 1926.1127. The elements of the CH2M HILL cadmium program include the following:

- Exposure monitoring;
- Methods of control, including PPE and respirators;
- Medical surveillance;

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- Training on hazards of cadmium and control measures (includes project-specific training and the computer-based training on CH2M HILL's Virtual Office, *Cadmium);* and
- Recordkeeping requirements.

If air monitoring indicates there is potential exposure at the action level concentrations above, notify the RHSM to ensure the above have been adequately addressed. Other exposure control measures include:

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met;
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas;
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person; and
- Review the fact sheet included as an attachment to the SOP.

8.8 Chainsaws

(Reference CH2M HILL SOP HSE-210, *Hand and Power Tools*)

Below are the hazard controls and safe work practices to follow when working around or operating chainsaws. Ensure the requirements in the referenced SOP are followed.

8.8.1 Equipment

Only chainsaws equipped with a spark arrestor and fully functioning chain brake or "safety chain" shall be used. The following safety equipment shall be readily available while operating a chainsaw:

- Chainsaw operator's manual;
- Fully stocked first aid kit;
- Multipurpose fire extinguisher;
- Grounded extension cord approved for outdoor use and ground fault circuit interrupter (GFCI) for electrical-powered chainsaws;
- Approved safety gasoline container and funnel or flexible nozzle for refueling gasoline-powered chainsaws; and
- Sledge hammer and non-metallic wedges when necessary to prevent pinching of the chain.

8.8.2 PPE Requirements

The following personal protective equipment shall be worn while operating chainsaws:

- Safety glasses with side shields and face shield to prevent injury from wood chips, sawdust, or other flying objects;
- Hard hat with properly fitted suspension to prevent head injury from falling debris;
- Steel-toed safety shoes or boots to prevent foot injury from falling objects and accidental contact with the moving chain;
- Hearing protection to prevent permanent damage to hearing. Ear muffs or plugs will have a decibel noise reduction rating (NRR) assigned to them. The higher the rating, the greater the protection offered;
- Non-leather, fabric work gloves to prevent hand injury from abrasions, splinters and cuts;
- Clothing that is well-fitted and free of loose edges that could become entangled in the saw; and

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- Protective chaps or leggings that cover the area from the groin to about 2 inches (5.08 cm) above the ankles should be used. These chaps are made from synthetic fabrics that are designed to prevent the running saw chain from coming in contact with your legs.

8.8.3 Safe Operation

The following safe operation guidelines shall be followed regardless of the purpose for using a chainsaw:

- Inspect the chainsaw prior to use;
- Chainsaws shall be held firmly with both hands, with thumbs and fingers encircling both chain saw handles;
- Stand slightly to the left side of the saw, out of the plane of the cutting chain and guide bar to reduce the risk of injury in the event of a kickback;
- Position saw so that it is between the waist and mid-chest level. Overreaching or cutting above the mid-chest height shall be avoided;
- Maintain a full throttle setting while cutting. Chainsaws are designed to be run at full speed;
- Always be aware of what is in the saw's downward path after the cut;
- Do not attempt to cut material that is larger than the guide bar of the saw;
- Avoid cuts that will cause the chainsaw to jam. Always cut into the compression wood first until the cut starts to close; then cut from the other side toward the compression cut;
- Use a non-metallic wedge to prevent the compression cut jamming on the blade;
- Chainsaws are designed to feed themselves into the wood and require only light pressure to cut efficiently. If extra force is required to keep cutting, the chain requires sharpening. Additional signs of a dull chain include a saw that is cutting crooked, results in fine sawdust instead of chips, or the smell of burnt wood. Do not use a dull chain;
- Bystanders and helpers shall be kept at a safe distance from operation;
- Do not operate a chainsaw when fatigued; take frequent breaks;
- Work slowly; don't rush; and
- A fire extinguisher shall be present at all times when operating the chainsaw in forest or brushy areas.

8.8.4 Refueling the Engine

The fuel for gasoline-powered chainsaws shall be mixed in accordance with the manufacturer's recommendations as outlined in the chainsaw operator's manual. Fuel shall be stored and transported in an approved safety container. The following precautions should also be followed:

- The engine shall be shut off and allowed to cool before refueling; never refuel a hot engine;
- A fire extinguisher shall be present during fueling and refueling;
- Smoking around fueling or refueling operations shall be prohibited; and
- A funnel or a flexible nozzle shall be used to avoid spilling fuel on the engine.

8.9 Chemical Injections

When the remedial action objectives for a project include subsurface injection of chemicals, the procedures and handling practices identified below must be implemented.

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Pre-Injection

Review the Safety Data Sheets (SDSs) for the materials which are expected to be utilized in the chemical injection processes for this contract task order and:

- Document training in accordance with the Hazard Communication section of this Handbook.
- Ensure that appropriate spill response materials are present (e.g., absorbent media for oil, neutralizing agents for potassium permanganate, secondary containment for larger chemical tanks).

Evaluate potential for "daylighting" of chemical injection in the work area:

- Evaluation should identify known or potential pathways such as existing monitoring wells screened at the same depth interval as the planned injection, wells that were not properly abandoned, and utility corridors.
- Identify potential surface release areas such as nearby sensitive areas (e.g., wetlands) storm drains, ditches, or streams, and ensure that mitigation measures are in place (e.g., temporarily blocking storm sewer drains).
- Contact the project Environmental Manager for assistance in identifying release scenarios and mitigation measures.

Injection Operations

- Operate and maintain pressure vessels, pumps and hosing in accordance with the manufacturer's recommendations.
- Do not exceed the rated pressure of the vessels and associated piping or hoses of the system.
- The system must be provided with a pressure relief valve/controller that safely reduces the system pressure to within the system rated pressure.
- The pressure relief valve must be rated at no more than 110 percent the rated pressure of the system and must be tested at regular intervals.
- Each vessel must be equipped with a functioning pressure gauge to monitor pressure.
- For PPE and air monitoring requirements, refer to the PPE section and Site Monitoring section of the project safety plan. PPE shall be used to minimize potential exposure to identified site contaminants of concern and injection solutions during site injection operations. In addition, good personal hygiene practices and procedures must be practiced.
- Use face shields in combination with safety glasses or goggles when the potential for exposure to chemical splashes may exist.
- If repairs to injection delivery system components are necessary after the subsurface injection operations have been initiated, the injection lines must be relieved of pressure and drained before conducting repair work. See also the Lockout/Tagout section of this Handbook.
- Drums/containers of injection material shall be moved using a drum "dolly" or other appropriate material handling equipment where the weight of the drum can be properly managed and secured during the movement.
- Empty containers may require special preparation/rinsing prior to disposal. Verify requirements with the project Environmental Manager.
- Only qualified personnel, by prior training or experience, may operate the injection system delivery components/array(s).

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- Appropriate spill response materials for all chemicals must be present at the job site. Only qualified (by training and previous experience) who have proper PPE and equipment available shall provide spill response operations.
- Station a portable eye wash in the immediate work area where chemical injections are occurring, along with wash facilities for hygienic practices and PPE decontamination.
- If PPE becomes saturated and may potentially impact work clothing, dermal surfaces, or mucous membranes, change PPE immediately.
- Verify the competency and integrity of the chemical injection hoses/piping and connection points
- Confirm hose/piping rated for 100 psi.
- Verify the any cam-lock fitting on the injection hose/piping, well head, or direct push technology (DPT) rods are structurally sound and free of defects. Where hoses are used, ensure fittings have been secured to the hose surface via mechanical banding equipment to prevent whipping.
- When injecting under pressure, stand at a sufficient distance (i.e., ~ 20 feet) from the injection well head/point. Keep unessential project personnel away from the injection system, array, and well head(s) during injection operations.
- Remove/stow all unnecessary equipment and material in the area.
- The injection system/array must be monitored/attended at all times during the injection process and when not in use, components must be properly secured, de-energized, or stowed. If the system will operate without an attendant, plans for operating unattended must be in place an approved by the PM an RHSM/EM.
- All pressured lines and fittings should be 'tethered' or otherwise secured to minimize whipping or 'launching' of lines in the event of an equipment failure. Any "quick connect" type fittings (compressed air or fluid) should be secured with appropriate pins, clips to prevent accidental disengagement of the fitting during operation.
- Inspect all equipment, hoses, pressure lines, and fittings daily and prior to pressurizing.

Chemical Storage

- Some injection chemicals, such as strong oxidizers, may have stringent storage requirements per local or National Fire Codes. Verify that appropriate storage provisions are in place prior to starting work.
- NOTE: Counties and cities may have requirements specific to storing these chemicals. Also, storage and use of certain chemicals such as potassium permanganate and hydrogen peroxide may be subject to the new Chemical Facility Anti-Terrorism Standards of the Department of Homeland Security – the applicability depends on the chemical, quantity/concentration, and type of facility. Please contact the project Environmental Manager to determine whether chemicals are subject to these standards.
- Chemicals must be stored in a designated, secured area with spill prevention capabilities. Review SDS or other information to determine potential incompatible materials. Incompatible materials shall not be stored together. Ensure all containers are labeled.

8.10 Compressed Gas Cylinders

(Reference CH2M HILL SOP HSE-403, *Hazardous Materials Handling*)

8.10.1 General

Below are the hazard controls and safe work practices to follow when working around or using compressed gas cylinders. Ensure the requirements in the referenced SOP are followed.

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- Cylinders and pressure-controlling apparatus shall be inspected for defects and leakage prior to use. Damaged or defective items shall not be used. If a cylinder is found to be defective, the gas distributor shall be notified and subsequent instructions followed. If a leak should develop at a fuse plug or other safety device, the cylinder shall be removed from the work area.
- Cylinders shall be labeled with the identity of the contents. Cylinders not labeled shall be sent back to the cylinder distributor. The color of the cylinder shall not be used exclusively to identify cylinder contents.
- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinders must be secured in an upright position at all times.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured on a cradle, basket, or pallet when hoisted; they may not be hoisted by choker slings.
- Eye protection (safety glasses or goggles) shall be worn when using cylinders.
- Cylinders must be shielded from welding and cutting operations and positioned to avoid being struck or knocked over; contacting electrical circuits; or exposed to extreme heat sources.
- Cylinders inside buildings shall be stored in dry, well-ventilated locations at least 20 feet (6.1 meters) from highly combustible materials. Cylinders should be stored in definitely assigned places away from elevators, stairs, or gangways. Assigned storage areas shall be located where cylinders will not be knocked over or damaged.
- Oxygen cylinders in storage shall be separated from fuel gas cylinders or combustible materials by a minimum of 20 feet (6.1 meters) or by a noncombustible barrier at least 5 feet (1.5 meters) high, having a fire resistance rating of at least 0.5 hour.
- Signs indicating no smoking shall be provided for storage areas containing flammable gas cylinders.
- Complete the self-assessment checklist for compressed gas cylinders are being used.

8.10.2 Calibration Gas Cylinder Disposal

Calibration gas for field instruments is usually shipped in non-refillable DOT-39 specification cylinders. They can be identified by a code stamped into the cylinder that begins with “DOT-39, NRC” followed by a series of other numbers and letters. These cylinders cannot be refilled and are intended to be disposed of by the end user once the contents are consumed. Because of the high cost of shipping partially full cylinders to a CH2M HILL warehouse, equipment rental company, or the manufacturer, most calibration gas cylinders should be disposed of locally using this procedure.

Applicability

This procedure applies only to nonrefillable DOT-39 specification cylinders containing calibration gas that is classified by DOT as a Division 2.2 nonflammable gas. The cylinder will display the green nonflammable gas label. Calibration gas usually contains parts per million (ppm)-range concentrations of compounds such as isobutylene, hexane, or methane. This procedure does not apply to Division 2.1 flammable gasses, Division 2.3 poison gasses, corrosive gasses, or oxidizing gasses. It also does not apply to gasses contained in larger refillable DOT-specification cylinders.

Disposal Procedure

1. Review the cylinder labeling and material safety data sheet (MSDS) to verify that the material in question is calibration gas containing ppm-range concentrations of materials such as isobutylene, hexane, or methane, and that the gas is classified as a Division 2.2 nonflammable gas. If the material is a flammable gas (Division 2.1), poison gas (Division 2.3) corrosive gas, oxidizing gas, or contains toxic air contaminants such as trichloroethylene, DO NOT FOLLOW THIS PROCEDURE. Contact a dangerous goods advisor or the project EM for assistance.

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2. Attach the appropriate regulator or valve to the cylinder, open the valve, and allow the gas to vent slowly to the atmosphere in an unconfined, well ventilated area outdoors.
3. If a regulator is not available, depress the valve with a nonsparking tool (e.g., pencil, stick). Be sure that the cylinder is pointed away from you at all times. The valve operates the same way as the valve on a car or bicycle tire.
4. Wear leather work gloves and keep your hands away from the flow of gas.
5. Leave the valve open until all gas is discharged from the cylinder.
6. If the cylinder has a permanently attached valve, leave it open. If a removable regulator or valve was used, remove it from the cylinder.
7. Mark the cylinder as “EMPTY” or “MT.”
8. Recycle the empty cylinder as scrap metal or dispose as solid waste after verifying that the solid waste collection company will accept this material in the trash.
9. If required to puncture the empty cylinder before disposal or recycling, do not attempt to do so using hand tools such as a hammer and nail or punch. Contact a dangerous goods advisor, the project EM, or health and safety manager for assistance.

8.11 Concrete Work and Masonry Construction Activities (Including well pad construction)

(Reference CH2M HILL SOP HSE-302, *Concrete and Masonry*)

Below are the hazard controls and safe work practices to follow when working around or performing concrete and masonry activities. Ensure the requirements in the referenced SOP are followed.

- Wear PPE to avoid contact with concrete including gloves, mud boots, hard hat, safety glasses, long sleeved shirt and long pants.
- Consult the glove supplier or the cement manufacturer’s SDS for help in choosing the proper gloves. Butyl or nitrile gloves (rather than cotton or leather gloves) are frequently recommended for caustic materials such as Portland cement.
- Use only well-fitting gloves. Loose-fitting gloves let cement in. Often the use of gloves and clothing makes exposure worse when cement gets inside or soaks through the garment. Use glove liners for added comfort.
- Wash your hands before putting on gloves. Wash your hands every time that you remove your gloves.
- Dry your hands with a clean cloth or paper towel before putting on gloves.
- Protect your arms and hands by wearing a long sleeve shirt with the sleeves duct-taped to your gloves to prevent wet cement from getting inside the gloves.
- Follow proper procedures for removing gloves, whether reusing or disposing them.
- Clean reusable gloves after use. Before removing gloves, clean the outside by rinsing or wiping off any wet cement. Follow the manufacturer’s instructions for glove cleaning. Place clean and dry gloves in a plastic storage bag and store them in a cool, dry place away from tools.
- Throw out grossly contaminated or worn-out gloves.
- Keep the inside of gloves clean and dry.
- Wear waterproof boots when necessary to prevent wet cement from coming into contact with your skin. It is as important to protect your legs, ankles, and feet from skin contact with wet cement as it is to protect your hands.

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- Boots need to be high enough to prevent wet cement from getting inside. Tuck pants inside and wrap duct tape around the top of the boots to prevent wet cement from entering.
- Change protective boots if they become ineffective or contaminated on the inside with wet cement while in use.
- Change out of any work clothes that become contaminated with wet cement and keep contaminated work clothes separate from your street clothes.
- When kneeling on wet cement use waterproof kneepads or dry kneeboards to prevent the knees from coming into contact with the cement.
- Wear proper eye protection when working with Portland cement.
- Perform hazard communication training for concrete. Read SDSs heed the manufacturers' recommendations for safety precautions.
- Protruding reinforcing steel (rebar), onto which personnel could fall, must be guarded to eliminate the hazard of impalement
- During post-tensioning, only those personnel essential to the operation are permitted behind the tensioning jacks.
- Personnel shall not ride concrete buckets nor position themselves in areas where buckets are lifted overhead.
- Personnel shall maintain a safe distance from formwork and shoring being removed from concrete structures.
- Personnel shall maintain a safe distance from precast and lift-slab concrete being lifted into position until physically secured.
- Personnel shall not enter limited access zones during masonry wall construction.
- When CH2M HILL is in control of concrete and masonry operations, a lift slab competent person will oversee all the concrete and masonry operations.
- Complete the self-assessment checklist for concrete and masonry activities whenever those activities are being performed.

8.12 Concrete Core Drilling

(Reference CH2M HILL SOP HSE-204, *Drilling*)

Below are the hazard controls and safe work practices to follow when working around or performing concrete core drilling.

- Operators must read and understand the Operators Manual(s) for the equipment that will be used.
- Follow all manufacturers' operating instructions and comply with all warning labels on the equipment.
- Inspect equipment to ensure it is in proper operating condition prior to use. Equipment damage or missing parts must be corrected prior to operation.
- Follow all requirements for use of PPE. Minimum PPE includes hearing protection, safety glasses with side shields, safety toed boots. A face shield over safety glasses or liquid splash goggles may be required for wet coring.
- Inspect areas to be cored to ensure there are no obstructions, for example utilities on the opposite side of a wall to be cored through. Follow utility locate procedures for when coring slab on grade.
- Provide dust control (wet coring or local exhaust for dry coring) to avoid potential silica exposure.

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- Make sure that all electrical wiring is grounded.
- The power supply line (electric cord, pneumatic or hydraulic line) must be protected from damage and routed to prevent it becoming a tripping hazard.
- When hydraulic coring equipment is uses, all workers must be aware of hydraulic lines running to the coring equipment. Preparations must be made for containment/clean up in the event of a ruptured hydraulic line.
- All workers must keep their hands and body away from the cutting saw/cable.
- The power supply must be disconnected when changing bits or conducting other maintenance on the equipment.
- Slippery conditions may exist in wet coring operations. Water needs to be controlled during cutting and proper safety toed footwear used to minimize slip potential.
- Use the Drilling Self-Assessment checklist to evaluate coring operations.

8.13 Concrete Saw Cutting

- Ensure operators are trained and familiar with the equipment are operating the saw. Operators must read and understand the Operators Manual(s) for the equipment that will be used.
- Inspect equipment to ensure it is in proper operating condition prior to use. Equipment damage or missing parts must be corrected prior to operation.
- Cutting blades shall be the correct size, installed properly, guarded at all times, and speed should not exceed the manufacturer's suggested operating speed.
- Workers shall use the correct blade for the job and inspect it for defects before each use.
- Saws shall be maintained and kept clean from dust build-up. Workers shall not push against the saw during operation to avoid the blade jumping out of the cutting path and loss of operator control.
- Inspect areas to be sawed to ensure there are no obstructions, for example rocks or other debris. Follow utility locate procedures prior to cutting.
- Personal protective equipment (PPE) saw use shall include hard hats, safety-toed boots, safety glasses and face shields, hearing protection, and leather gloves.
- The dust created by the concrete saw needs to be controlled using the application of water or local exhaust ventilation (i.e., removes dust at the source) to reduce the amount of airborne dust generated. If dust cannot be controlled, suspend work and contact the RHSM to determine if air monitoring/respiratory protection will be necessary.
- If equipped, the power supply line (electric cord, pneumatic or hydraulic line) must be protected from damage and routed to prevent it becoming a tripping hazard. The power supply must be disconnected when changing blades or conducting other maintenance on the equipment.
- Ensure all utilities have been marked and located in accordance with the underground utilities section of this Handbook.
- Slippery conditions may exist in wet cutting operations. Water needs to be controlled during cutting and proper safety toed footwear used to minimize slip potential.

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8.14 Confined Space Entry Activities

(Reference CH2M HILL, SOP HSE-203, *Confined Space Entry*)

A confined space is defined as a space that has all of the following characteristics:

- Large enough to allow personnel to enter the space with their entire body;
- Limited openings for entry and exit; and
- Not designed for continuous human occupancy;

Examples of possible confined spaces include underground vaults, pipelines, ducts, tunnels, storage tanks, sewers, process vessels, and pits. Entry into a confined space is defined as breaking the plane of a confined space with any part of the body.

The following requirements apply when entering a permit-required confined space (PRCS), an Alternate Procedure Confined Space, or a PRCS reclassified as a non-permit confined space (NCS). Ensure the requirements in the referenced SOP are followed.

- Entrants, Attendants, and the Entry Supervisor shall have successfully completed Confined Space Entry training.
- The appropriate confined space entry permit shall be completed as outlined in CH2M HILL SOP HSE-203, *Confined Space Entry*.
- The completed permit or certificate shall be posted for review near the space entrance point.
- The Entry Supervisor shall conduct a pre-entry briefing with all Authorized Entrants and Attendants prior to entry in accordance with SOP HSE-203.
- Entrants and Attendants shall verify that the Entry Supervisor has authorized entry and that all requirements of the permit or certificate have been satisfied prior to each entry.
- Atmospheric monitoring for oxygen, combustible gases, and potential toxic air contaminants shall be conducted at the frequency provided on the permit or certificate. Entry shall not be permitted if an atmospheric hazard is detected above acceptable safe levels. Atmospheric monitoring shall be performed in accordance with the Site Monitoring Section of the project safety plan and SOP HSE-203.
- Entrants shall evacuate the space upon orders of the Attendant or Entry Supervisor, when an alarm is sounded, or when a prohibited condition or dangerous situation is recognized.
- Entrants and Attendants shall inform the Entry Supervisor of any hazards confronted or created in the space, or any problems encountered during entry. The Entry Supervisor shall inform the owner of such issues.
- The Entry Supervisor shall provide a copy of the canceled permit or certificate to the SC for review and maintain it in the project file.
- Complete the self-assessment checklist for confined space entry whenever entries are being performed.

8.15 Cranes

(Reference CH2M HILL SOP HSE-303, *Cranes*)

Below are the hazard controls and safe work practices to follow when working around or operating cranes. Ensure the requirements in the referenced SOP are followed.

- Crane operators are prohibited from using any wireless device while operating a crane. Equipment must be stopped before using devices such as two way radios or cell phones. If a wireless device is required for a

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certain operation, the PM and RHSM must authorize the wireless use on a case by case basis and make sure limitations are addressed in the project safety plan.

- Cranes shall be operated by a certified crane operator. After November 10, 2014, only operators possessing a certificate from a nationally accredited testing organization, an audited employer training program, or U.S. military or state-issuing agency will be authorized to operate cranes.
- The crane's operations manual and load chart specifically designed for the crane shall be in the crane at all times.
- The crane must have a current annual inspection to include load test certification (within the last 12 months) that meets all state and federal safety standards. Documentation of this inspection must be available for review.
- A competent person will inspect the crane daily to ensure it is in safe operating condition. The daily crane inspection log provided within the crane manufacturer's operations manual shall be used. See also the requirements for monthly inspections, among others, in SOP HSE-303.
- All rigging equipment must be inspected by a competent person prior to use for signs of excessive wear; equipment found to be damaged will be tagged and removed from service.
- A qualified and competent Assembly/Disassembly (A/D) Director shall be assigned when cranes must be assembled onsite. The A/D Director is responsible for ensuring the crane is assembled and disassembled according to manufacturer requirements; performing training for the A/D crew; and ensuring sufficient ground conditions exist for crane placement; among other responsibilities (see SOP HSE-303).
- The assembly/disassembly process must comply with requirements in HSE-303, including having an AHA for the task.
- A critical lift plan shall be prepared when the lift is estimated to be greater than 75 percent of the crane capacity or when two cranes will be used to make a lift.
- A pre-lift meeting will be conducted to include all parties involved in that day's crane operation.
- Only one qualified person shall be designated to signal the crane operator. This person shall be thoroughly familiar with the ANSI standard method of hand signals and an illustration of these signals shall be posted at the job site.
- No personnel shall be permitted under the load at any time.
- Tag lines shall be attached to every load being made by the crane.
- The swing radius of the rear rotating superstructure (counterweight) of the crane shall be barricaded and no entrance allowed.
- Suspended loads shall not pass over workers or occupied buildings at any time.
- Complete the self-assessment checklist for crane-suspended personnel platforms whenever they are being used.
- CH2M HILL employees exposed to hazards posed by crane operations, must be trained in hazards awareness and control procedures. See requirements for training in HSE-303.

Power Line Safety

It must be determined whether equipment operations including assembly/disassembly, positioning, and crane operation (including traveling with a load) will occur in proximity to power lines within 20 feet (6.1 meters) for line voltage up to 350 kilo volts (kV), and within 50 feet (15.2 meters) for line voltage between 350 kV to 1000 kV. For power lines over 1000 kV, the distance must be determined by the utility/operator or qualified registered professional engineer in electrical power transmission and distribution.

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If equipment operations are within proximity of aforementioned distances to power lines, one of the following options must be implemented to prevent encroachment and electrocution:

- Option 1: Deenergize and ground the power. Confirm from the utility/operator that the power line has been deenergized and visibly grounded at the worksite
- Option 2: If the voltage is not determined, ensure that no part of the equipment, load line, or load (including rigging and lifting accessories), gets closer than 20 feet (6.1m) by:
  - Conduct a planning meeting with the operator and other workers in the area to review the actions that will be taken to prevent encroachment and electrocution. Training requirements for working around energized power lines are described in Section 6.0, Training.
  - Use non-conductive tag lines.
  - Erect and maintain an elevated warning line, barricade or line of signs in view of the operator, either with flags or other high-visibility markings at 20 feet (1.6m) from the power line. A spotter must be used when the operator does not have clear line of sight to the elevated warning line.
  - To prevent encroachment, the operator can use a proximity alarm, or position a dedicated spotter with visual aids to demarcate the encroachment and constant communication access to the operator.

If the line voltage can be determined, and if any part of the equipment, line load or load (including rigging and lifting accessories) would encroach within that specified distance listed in Table 1, then the requirements listed in Option 2 must be implemented.

TABLE 1
Minimum Clearance Distances

Voltage (nominal, kV, alternating current)	Minimum Clearance – Feet (meters)
Up to 50	10
Over 50 to 200	15
Over 200 to 350	20
Over 350 to 500	25
Over 500 to 750	35
Over 750 to 1000	45
Over 1000	Established by the utility owner/operator or by a qualified registered professional engineer in electrical power transmission and distribution

For equipment traveling within 20 feet (6.1m), under or near power lines without a load, the clearance distances described in Table 2 must be maintained and the following actions implemented.

- A dedicated spotter is assigned during equipment travel, positioned to effectively gauge the clearance distance, and is in continuous communication with the operator.
- During equipment travel, the boom/mast and support system are sufficiently lowered to ensure clearance distances are maintained, along with taking into consideration of the effects of speed and terrain.

TABLE 2
Minimum Clearance Distances While Traveling With No Load

Voltage (nominal, kV, alternating current)	Minimum Clearance – Feet (meters)

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Up to 0.75	4
Over 0.75 to 50	6
Over 50 to 345	10
Over 345 to 750	16
Over 750 to 1000	20
Over 1000	Established by the utility owner/operator or by a qualified registered professional engineer in electrical power transmission and distribution

8.16 Crystalline Silica

(Reference CH2M HILL SOP HSE-511, Crystalline Silica)

CH2M HILL subcontractors shall control employee exposure to crystalline silica when exposures are at or above the ACGIH TLV of 0.025 mg/m^3 by submitting for review and approval a crystalline silica exposure monitoring plan. The elements of an exposure monitoring plan include, but are not limited to the following:

- A bulk sample representative of the material to be demolished must be sent with the air monitoring sample media for analysis;
- Initial monitoring and personal air sampling must be conducted to determine the potential worker exposure to respirable crystalline silica;
- Real-time particulate monitors with a 10 micron respirable size fraction attachment may be used as part of the initial and ongoing monitoring plan to evaluate the potential worker exposure. This must include an action level established by their corporate or site health and safety professional and include actions required (e.g., implement engineering, administrative controls, respiratory protection);

Other exposure control measures include:

- Maintaining surfaces as clean as practicable to minimize accumulation of crystalline silica containing particulate material;
- Clean surfaces with a HEPA-filter vacuum or equivalent method;
- Implement dust suppression during demolition;
- Restricting access to the work area where crystalline silica exposure may exist to only those authorized to perform work or enter the area;
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in these areas;
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person; and

8.17 Demolition

(Reference CH2M HILL SOP HSE-305, *Demolition*)

This section is applicable to all forms of demolition. Demolition is defined as the removal or dismantling of structures or equipment by disassembly.

An engineering survey shall be completed prior to start of demolition operations. The survey shall determine the condition of the structure framing, floors, and walls; the presence of asbestos, polychlorinated biphenyls (PCBs), lead paint, or other regulated hazardous substances; the presence of hazardous materials in tanks, pipes, and equipment; and the possibility of unplanned collapse of any portion of the structure. Any adjacent structure where

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personnel may be exposed shall also be similarly evaluated. The survey shall be conducted by a competent person and a written record of the survey findings shall be maintained at the project site.

The demolition contractor working on this project will provide CH2M HILL with a demolition safety plan prior to the start of work. CH2M HILL will use this plan to verify that the subcontractor is implementing the necessary safety precautions during this activity. In addition, the following safety precautions shall be implemented by CH2M HILL personnel. Below are the hazard controls and safe work practices to follow when working around or performing demolition. Ensure the requirements in the referenced SOP are followed.

- Appropriate warning and instructional safety signs shall be conspicuously posted where necessary.
- Fugitive dust must be controlled during demolition by using water spray or other methods.
- Remain a safe distance from the demolition zone to reduce exposure to fragmentation of glass, steel, masonry, and other debris during demolition operations.
- Do not enter the demolition zone unless completely necessary, and only after the competent person has assessed the condition of the structure and has authorized entry.
- Follow all requirements established by the competent person. The competent person shall inform personnel of the areas that are safe to enter and the areas where entry is prohibited. When possible, the competent person should escort CH2M HILL personnel while in the demolition zone.
- All demolition activities that may affect the integrity of the structure or safety of personnel must cease until personnel have exited the demolition zone.
- During the course of demolition, work areas, passageways, stairs, ladders, and exits shall be kept free of demolition debris.
- Stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel
- Proper control measures shall be in place before welding or cutting on surfaces covered by coatings containing flammable or hazardous materials such as lead, cadmium, zinc, etc. Highly flammable or toxic coatings may require stripping of the coating a sufficient distance from the area to be heated. Welding and cutting shall be performed in accordance with the provisions of OSHA 1926, Subpart J, “Welding and Cutting.” Follow “Welding and Cutting” SOP HSE-314.

The following lead-exposure-control procedures will be implemented during demolition operations involving potential exposure to lead:

- Site personnel will be provided lead-awareness training;
- Site personnel will be provided with hand-washing facilities and will wash their hands daily;
- An excavator equipped with hydraulic shears will be used only to cut painted wooden, concrete, and metal structures;
- Neither hand-held band/chop saws nor torch cutting equipment will be used on painted surfaces without proper PPE and engineering controls in place or removal of paint prior to cutting;
- During all demolition operations to control potential exposures to LBP, wet methods using water mist will be used;
- A direct-reading dust monitor will be used to monitor demolition operations that pose a potential lead-exposure hazard (that is, those with an action level requiring that additional dust control measures be employed and/or that respiratory protection be used.);
- Personal air samples will be collected and analyzed for lead to confirm that no personnel are exposed to levels above the lead action level of 30 micrograms per cubic meter ($\mu g/m^3$); and

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- The selection of respiratory protection and other exposure controls will be based on the most recent exposure monitoring results obtained from the lead-exposure-competent person.
- For more information see CH2M HILL SOP HSE-508, Lead.

8.18 Drilling Safety

(Reference CH2M HILL SOP HSE-204, *Drilling*)

Below are the hazard controls and safe work practices to follow when working around or performing drilling. Ensure the requirements in the referenced SOP are followed.

- When considering drilling at sites with nearby monitoring wells, particularly in cases where drilling methods utilize pressurized fluids (air or water), consider the potential risk of hydraulic communication between the drilling location and the adjacent wells and/or other subsurface conduits.
- The drill rig is not to be operated in inclement weather.
- The driller is to verify that the rig is properly leveled and stabilized before raising the mast.
- Personnel should be cleared from the sides and rear of the rig before the mast is raised.
- The driller is not to drive the rig with the mast in the raised position.
- The driller must check for overhead power lines before raising the mast. Maintain a minimum distance of 10 feet (3 meters) between mast and overhead lines (<50 kV) and an additional 0.4 inches for every 1 kV over 50kV. Verify the voltage of nearby overhead power lines to determine the minimum distance.
- If the project site is suspected of munitions or explosives of concern (MEC) contamination, requirements of the *Explosives Usage and Munitions Response (MR)* SOP HSE-610 shall be followed. MECs include material potentially presenting an explosive hazard (MPPEH), discarded military munitions, materials that present a potential explosive hazard, chemical warfare materials, munitions constituents, and contaminated soil or groundwater. “Down-hole” avoidance support may be required to prevent accidental contact with MPPEH. Safety requirements will be based on the risk assessment identified within the MR (safety) ORE (Opportunity Risk Evaluation).
- Personnel should stand clear before rig startup.
- The driller is to verify that the rig is in neutral when the operator is not at the controls.
- Become familiar with the hazards associated with the drilling method used (cable tool, air rotary, hollow-stem auger, etc.).
- Do not wear loose-fitting clothing, watches, etc., that could get caught in moving parts.
- Do not smoke or permit other spark-producing equipment around the drill rig.
- The drill rig must be equipped with a kill wire or switch, and all personnel are to be informed of its location.
- Be aware and stand clear of heavy objects that are hoisted overhead.
- The driller is to verify that the rig is properly maintained in accordance with the drilling company’s maintenance program.
- The driller is to verify that all machine guards are in place while the rig is in operation.
- The driller is responsible for housekeeping (maintaining a clean work area).
- The drill rig should be equipped with at least one fire extinguisher.

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- If the drill rig comes into contact with electrical wires and becomes electrically energized, do not touch any part of the rig or any person in contact with the rig, and stay as far away as possible. Notify emergency personnel immediately.
- Use the drilling self-assessment checklist to evaluate drilling operations.

8.18.1 Air Rotary Drilling

- When a hydraulic communication hazard may exist, do not perform work at an adjacent structure or conduit when drilling, and be mindful of potential line-of-fire hazards. Evaluate the possibility of:
  - Increasing the distance between the proposed drilling site and the existing structure(s);
  - Abandon the adjacent structure(s)/conduit(s);
  - Consider use of an alternative drilling technology that minimizes propagation of pressures in the borehole to the adjacent formation (e.g., casing methods, continuous override methods, rotosonic); and
  - Ensure that hydraulic communication risks are addressed in your AHA.
- If drilling near a previously installed well, remove or loosen the well cap of that well to relieve pressure that may build during drilling.
- Stay clear of nearby wells that aren't protected by a secured steel casing/monument as a steel casing should provide protection from the inner well in the event of a pressure buildup.
- When opening a well in the vicinity of where air rotary drilling is being performed, or when opening a newly installed well via air rotary methods, remove the cap slowly to relieve pressure, keeping your head away from the line of fire in case the cap does pop off.

8.18.2 Cold Weather Drilling

- When possible, secure a tarp or plastic sheeting on the ground of the drilling work area overnight to reduce buildup of ice/snow.
- Place non-slip pads near work area and clean off regularly.
- Keep the drilling area clear of soil or cuttings at the surface, especially if soil is very wet, to prevent freezing and slipping/tripping hazards.
- Work at a slower pace to avoid slips
- Evaluate alternate methods for extreme conditions with PM/HSM.

8.19 Drum and Portable Tank Handling

Below are the hazard controls and safe work practices to follow when overseeing the movement of drums or when handling drums:

- Ensure that personnel are trained in proper lifting and moving techniques to prevent back injuries;
- Ensure drum or tank bungs and lids are secured and are labeled prior to moving;
- Ensure that drums and tanks remain covered except when removing or adding material or waste. Covers and/or lids will be properly secured at the end of each workday;
- Provide equipment to keep the operator removed from the drums to lessen the likelihood of injury. Such equipment might include: a drum grappler attached to a hydraulic excavator; a small front-end loader, which can be either loaded manually or equipped with a bucket sling; a rough terrain forklift; Roller conveyor equipped with solid rollers; drum carts designed specifically for drum handling;

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- Make sure the vehicle selected has sufficient rated load capacity to handle the anticipated loads, and make sure the vehicle can operate smoothly on the available road surface;
- Ensure there are appropriately designed Plexiglas cab shields on loaders, backhoes, etc., when handling drums containing potentially explosive materials;
- Equipment cabs should be supplied with fire extinguishers, and should be air-conditioned to increase operator efficiency;
- Supply operators with appropriate respiratory protective equipment when needed;
- Ensure that drums are secure and are not in the operator's view of the roadway;
- Prior to handling, all personnel should be warned about hazards of handling;
- Before moving anything, determine the most appropriate sequence in which the various drums, portable tanks, and other containers should be moved (e.g., small containers may have to be removed first to permit heavy equipment to enter and move the drums;
- Overpack drums and an adequate volume of absorbent should be kept near areas where minor spills may occur;
- Use containers or overpacks that are compatible with the waste or materials;
- Drums containing liquids or hazardous waste will be provided with secondary containment and may not be located near a storm water inlet or conveyance;
- Allow enough aisle space between drum pallets and between drums and other equipment that the drums can be easily accessed (at least 2 to 3 feet) by fire control equipment and similar equipment.; and
- Make sure that a spill kit is available in drum or tank storage areas (or where liquids are transferred from one vessel to another).

8.20 Drum Sampling Safety

Personnel are permitted to handle and/or sample drums containing certain types of waste (drilling waste, investigation-derived waste, and waste from known sources) only. Handling or sampling drums with unknown contents requires a plan revision or amendment approved by the RHSM. The following control measures will be taken when sampling drums:

- Minimize transportation of drums;
- Sample only labeled drums or drums from a known waste stream;
- Do not sample bulging or swollen drums. Contact the RHSM;
- If drums contain, or potentially contain, flammable materials, use non-sparking tools to open;
- Use the proper tools to open and seal drums;
- Reseal bung holes or plugs whenever possible;
- Avoid mixing incompatible drum contents;
- Sample drums without leaning over the drum opening;
- Transfer/sample the content of drums using a method that minimizes contact with material;
- Use the PPE and perform air monitoring as specified in the PPE and Site Monitoring sections of the project safety plan;
- Take precautions to prevent contaminated media from contacting the floor or ground, such as having plastic under the sampling area, having a spill kit accessible during sampling activities; and

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- If transferring/sampling drums containing flammable or combustible liquids, drums and liquid transfer equipment should be grounded and bonded to reduce the potential of a static discharge.

8.21 Earthmoving Equipment

(Reference CH2M HILL, SOP HSE-306, *Earthmoving Equipment*)

Below are the hazard controls and safe work practices to follow when working around or operating heavy equipment. Ensure the requirements in the referenced SOP are followed.

- CH2M HILL authorizes only those employees qualified by training or previous experience to operate material handling equipment.
- CH2M HILL employees must be evaluated prior to operating earthmoving equipment by a CH2M HILL earthmoving equipment operator evaluation designated person. This evaluation will be documented according to SOP HSE-306, Earthmoving Equipment.
- Heavy equipment operators are prohibited from using any wireless device while operating equipment. Equipment must be stopped before using devices such as two way radios or cell phones. If a wireless device is required for a certain operation, the PM and RHSM must authorize the wireless use on a case by case basis and make sure limitations are addressed in the project safety plan.
- Equipment must be checked at the beginning of each shift to ensure the equipment is in safe operating condition and free of apparent damage. The check should include: service brakes, parking brakes, emergency brakes, tires, horn, back-up alarm, steering mechanism, coupling devices, seat belts and operating controls. All defects shall be corrected before the equipment is placed in service. Documentation of this inspection must be maintained onsite at all times (use the Earthmoving Equipment Inspection form if operated by CH2M HILL).
- Equipment must be on a stable foundation such as solid ground or cribbing; outriggers are to be fully extended.
- Equipment must not be used to lift personnel; loads must not be lifted over the heads of personnel.
- Equipment, or parts thereof, which are suspended must be substantially blocked or cribbed to prevent shifting before personnel are permitted to work under or between them. All controls shall be in a neutral position, with the motors stopped and brakes set.
- Equipment which is operating in reverse must have a reverse signal alarm distinguishable from the surrounding noise or a signal person when the operators view is obstructed.
- When equipment is used near energized power lines, the closest part of the equipment must be at least 10 feet (3 meters) from the power lines less than 50 kilovolts (kV). Provide an additional 4 feet (1.2 meters) for every 10 kV over 50 kV. A person must be designated to observe clearances and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means. All overhead power lines must be considered to be an energized until the electrical utility authorities indicate that it is not an energized line and it has been visibly grounded.
- Underground utility lines must be located before excavation begins; refer to the Utilities (underground) section.
- Operators loading and unloading from vehicles are responsible for seeing that vehicle drivers are in the vehicle cab or in a safe area.
- The parking brake shall be set whenever equipment is parked; wheels must be chocked when parked on inclines.

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- When not in operation, the blade or bucket must be blocked or grounded; the master clutch must be disengaged when the operator leaves the cab. When equipment is unattended, power must be shut off, brakes set, blades or buckets landed and shift lever in neutral.

8.22 Energized Electrical Work

(Reference CH2M HILL SOP HSE-221, *Energized Electrical*)

Energized electrical work is defined as work performed on or near energized electrical systems or equipment with exposed components operating at 50 volts or greater. Working near energized live parts is any activity inside a Limited Approach Boundary.

All electrical systems shall be considered energized unless lockout/tagout procedures are implemented and verified.

Electrical wiring and equipment shall be de-energized prior to conducting work unless it can be demonstrated that de-energizing introduces additional or increased hazards or is unfeasible due to equipment design or operational limitations. When energized electrical work is the only means that work can be performed, all requirements of SOP HSE-221 must be implemented including the following:

- Only qualified personnel are permitted to work on unprotected energized electrical systems. These personnel shall complete the CH2M HILL energized electrical safety training (refresher training required every 3 years) and must be designated by their supervisor as an Energized Electrical Qualified Person (EEQP). Release of victim, CPR and AED training must be completed by these personnel annually. A skill demonstration must be performed by the EEQP while wearing the necessary PPE and using the required tools and equipment to fulfill the qualification which shall be verified by their supervisor and RHSM.
- An Electrical Hazard Analysis must be performed to identify energized electrical safe work practices before any person approaches exposed live parts within the Limited Approach Boundary (as determined by the shock hazard analysis), by performing both shock hazard analysis and flash hazard analysis, which comprise the electrical analysis.
- The Energized Electrical Work Permit must be completed prior to working on unprotected energized electrical systems.
- CH2M HILL employees designated as qualified persons working on live parts of energized electrical systems 480 volts and above shall implement the buddy system. This means that two EEQPs must be engaged in this work. Working on live parts of energized electrical systems 480 volts and above means actual contact with live parts or working within the Prohibited Approach Boundary, which is one inch (2.54 cm) for 480 volt systems.
- The buddy system requires the presence of an additional EEQP who shall stand by and render assistance, or summon help for the first person, in the event the first person is inadvertently shocked while performing the work. The second person shall not be assigned to additional distracting duties or tasks while the energized electrical work is being performed and shall know the location of the isolation device(s) for the equipment being worked on.
- Workers designated as qualified persons shall wear the required electric shock and arc-flash PPE, as specified by the qualified person responsible for the energized electrical operations.
- Safety signs, safety symbols or incident prevention tags, meeting applicable American National Standards Institute (ANSI) Standards, shall be used where necessary to warn employees about electrical hazards.
- Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas containing live parts. Conductive barricades shall not be used where it may cause an electrical hazard. Barricades shall be placed no closer than the Limited Approach Boundary.

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- If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect unqualified employees. The primary duty and responsibility of an attendant providing manual signaling and alerting shall be to keep unqualified employees outside a work area where the unqualified employee might be exposed to electrical hazards. An attendant shall remain in the area as long as there is a potential for employees to be exposed to the electrical hazards.
- Employees shall not perform tasks near exposed energized parts where lack of illumination or an obstruction precludes observation of the work. Employees shall not reach blindly into areas that may contain energized parts.
- Work shall be performed in accordance with National Fire Protection Association (NFPA) 70E requirements (2012 edition).
- Follow all control measures and procedures identified on the Energized Electrical Work Permit and the AHA.

8.23 Excavation Activities

(Reference CH2M HILL SOP HSE-307, *Excavation and Trenching Safety*)

The requirements in this section shall be followed whenever excavation is being performed. Refer to the Earthmoving Equipment section and SOP for additional requirements applicable to operating/oversight of earthmoving equipment. Below are the hazard controls and safe work practices to follow when working around or performing excavation. Ensure the requirements in the referenced SOP are followed.

- If the project site is suspected of munitions or explosives of concern (MEC) contamination, requirements of the *Explosives Usage and Munitions Response (MR)* SOP HSE-610 shall be followed. MECs include material potentially presenting an explosive hazard (MPPEH), discarded military munitions, materials that present a potential explosive hazard, chemical warfare materials, munitions constituents, and contaminated soil or groundwater. “Down-hole” avoidance support may be required to prevent accidental contact with MPPEH. Safety requirements will be based on the risk assessment identified within the MR (safety) ORE (Opportunity Risk Evaluation).
- Do not enter the excavations unless completely necessary, and only after the excavation competent person has completed their daily inspection and has authorized entry. An inspection shall be conducted by the competent person prior to the start of work, as needed throughout the shift, after every rainstorm, and after any hazard increasing occurrence. Documentation of the inspection must be maintained onsite at all times.
- Follow all excavation entry requirements established by the excavation competent person and any excavation permit being used.
- Sloping, benching, shoring, shielding, or other protective systems are required to protect personnel from cave-ins except when the excavation is made entirely in stable rock or is less than 5 feet deep (1.5 meters) and there is no indication of possible cave-in, as determined by the excavation competent person. Protective systems for excavations deeper than 20 feet (6.1 meters) must be designed or approved by a registered professional engineer.
- Trenches greater than 4 feet (1.2 meters) deep shall be provided with a ladder, stairway, or ramp positioned so that the maximum lateral travel distance is no more than 25 feet (7.6 meters).
- The atmosphere of excavations greater than 4 feet (1.2 meters) deep shall be tested prior to entry when a hazardous atmosphere exists or could reasonably be expected to exist, such as excavating landfills, hazardous waste dumps; or areas containing sewer or gas utility systems, petroleum distillates, or areas where hazardous substances are stored nearby.

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- Spoil piles, material, and equipment must be kept at least 2 feet (61 centimeters) from the edge of the excavation, or a retaining device must be used to prevent the material from falling into the excavation.
- Excavations shall not be entered when:
  - Protective systems are damaged or unstable;
  - Objects or structures above the work location may become unstable and fall into the excavation;
  - The potential for a hazardous atmosphere exists, unless the air has been tested and found to be at safe levels; or
  - Accumulated water exists in the excavation, unless precautions have been taken to prevent excavation cave-in.
- The excavation self-assessment checklist shall be used to evaluate excavations prior to entry.

Excavation Operations

Refer to the Excavation Entry section when entering excavations controlled by other parties. When CH2M HILL performs the excavating, a CH2M HILL excavation competent person will oversee all excavation operations and entry into excavations. The competent person shall:

- Complete the CH2M HILL Excavation Permit to ensure HSE requirements have be satisfied during excavation activities;
- Complete the CH2M HILL Daily Excavation Inspection Checklist to ensure HSE requirements have be satisfied, document that an inspection has been conducted, and to authorize entry into the excavation. A new Checklist shall be completed each day, authorizing excavation entry. Inspections should be continued as needed throughout the work shift, and after any event that could increase the potential for cave-in (e.g., rainfall); and
- Conduct daily safety briefings prior to excavation entry.

8.24 Fall Protection Activities

(Reference CH2M HILL, SOP HSE-308, *Fall Protection*)

Below are the hazard controls and safe work practices to follow when personnel or subcontractors are exposed to unprotected heights. Ensure the requirements in the referenced SOP are followed.

- Fall protection systems must be used to eliminate fall hazards when performing construction activities at a height of 6 feet (1.8 meters) or greater and when performing general industry activities at a height of 4 feet (1.2 meters) or greater.
- CH2M HILL staff exposed to fall hazards must complete initial fall protection training by completing either the CH2M HILL 10-Hour Construction Safety Awareness training course or the Fall Protection computer-based training module. Staff must also and receive project-specific fall protection training using the fall protection evaluation form attached to the project safety plan. Staff shall not use fall protection systems for which they have not been trained.
- The SC or designee must complete the Project Fall Protection Evaluation Form and provide project-specific fall protection training to all CH2M HILL staff exposed to fall hazards.
- The company responsible for the fall protection system shall provide a fall protection competent person to inspect and oversee the use of fall protection system. CH2M HILL staff shall be aware of and follow all requirements established by the fall protection competent person for the use and limitation of the fall protection system.

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- When CH2M HILL designs or installs fall protection systems, staff shall be qualified as fall protection competent persons or work directly under the supervision of a CH2M HILL fall protection competent person.
- When horizontal lifelines are used, the company responsible for the lifeline system shall provide a fall protection qualified person to oversee the design, installation, and use of the horizontal lifeline.
- Inspect personal fall arrest system components prior to each use. Do not use damaged fall protection system components at any time, or for any reason. Fall protection equipment and components shall be used only to protect against falls, not to hoist materials. Personal fall arrest systems that have been subjected to impact loading shall not be used. SC shall periodically inspect CH2M HILL fall protection equipment using the Fall Protection Inspection Log form.
- Personal fall arrest systems shall be configured so that individuals can neither free-fall more than 6 feet (1.8 meters) or contact any lower level.
- Only attach personal fall arrest systems to anchorage points capable of supporting at least 5,000 pounds (2,268 kg). Do not attach personal fall arrest systems to guardrail systems or hoists.
- Remain within the guardrail system when provided. Leaning over or stepping across a guardrail system is not permitted. Do not stand on objects (boxes, buckets, bricks, blocks, etc.) or ladders to increase working height on top of platforms protected by guardrails.
- Only one person shall be simultaneously attached to a vertical lifeline and shall also be attached to a separate independent lifeline.

8.25 Flight Line Safety

Always assume that the airfield is active. An active airfield means there is the possibility, even if an area is “closed”, that aircraft or other vehicles will need access on or through a work area. There is always the potential for an incursion. If in an area of the airfield where radio contact with the control tower is required, the potential for miscommunication exists. Any mistake in communication has the potential to cause a problem with Air Operations. When maneuvering on the airfield, there are fuel trucks, helicopter rotors, jet blast, etc., all of which are potential hazards for workers. Pilots of aircraft do not expect workers to be on the airfield. If equipment is not properly marked, it may go unnoticed by pilots and present the potential for an incursion.

An aircraft always has the right of way. When working in a confined area that is “closed” to traffic, outline the work area with traffic cones or barricades that will provide a warning to other airfield traffic. This will also serve to keep vehicles from running through wet paint. Have one person designated as the point of contact who will be responsible for monitoring the radio and communicating with the control tower. That person shall be properly trained in the use of the radio, and check in daily with Air Operations to confirm work areas. Properly train workers to be aware of airfield operations going on around them, to give way to all moving aircraft, to allow great distances from aircraft, parked or running, when maneuvering on airfield.

It is inherent upon the contractor to be visible to everyone operating on the airfield. Orange and white checkered flags, flashing amber beacons, cones and/or barricades should be in good condition and clearly visible.

Speed limits on airfield area are enforced. Speed limits on an airfield are very low relative to speeds on the roads. Speeding on the airfield can lead to a possible incursion. Restricted areas, particularly on a military installation, must be strictly enforced. They are usually outlined with a red line and often have certain “Entry Control Points” painted along the red line where entry into the area is permitted. Entry into the restricted area without permission may subject the workers to arrest.

There are safety areas around runways on the airfield. All equipment and materials must be stored behind these areas. If a crew working on the runway is instructed to clear the runway, all workers and equipment must be moved beyond the safety area until given clearance by the control tower to return to the runway.

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8.26 Forklift Operations

(Reference CH2M HILL, SOP HSE-309, *Forklifts*)

Below are the hazard controls and safe work practices to follow when working around or operating forklifts. Ensure the requirements in the referenced SOP are followed.

- Forklift operators are prohibited from using any wireless device while operating forklifts. If a wireless device is required for a certain operation, the PM and RHSM must authorize the wireless use on a case by case basis and make sure limitations are addressed in the project safety plan.
- A rated lifting capacity must be posted in a location readily visible to the operator.
- A forklift truck must not be used to elevate employees unless a platform with guardrails, a back guard, and a kill switch is provided on the vehicle. When guardrails are not possible, fall arrest protection is required.
- The subcontractor operating the forklift must post and enforce a set of operating rules for forklift trucks.
- Only certified forklift operators shall operate forklifts.
- Stunt driving and horseplay are prohibited.
- Employees must not ride on the forks.
- Employees must never be permitted under the forks (unless forks are blocked).
- The driver must inspect the forklift once a shift and document this inspection.
- The operator must look in the direction of travel and must not move the vehicle until all persons are clear of the vehicle.
- Forks must be carried as low as possible.
- The operator must lower the forks, shut off the engine, and set the brakes (or block the wheels) before leaving the forklift operator's position unless maintenance or safety inspections require the forklift to be running.
- Trucks must be blocked and have brakes set when forklifts are driven onto their beds.
- Extreme care must be taken when tilting elevated loads.
- Every forklift must have operable brakes capable of safely stopping it when fully loaded.
- Forklifts must have parking brakes and an operable horn.
- When the operator is exposed to possible falling objects, industrial trucks must be equipped with overhead protection (canopy).
- If using certified CH2M HILL forklift operators—forklifts must be inspected and documented daily using the forklift inspection form.

8.27 Groundwater Sampling/Water Level Measurements

Below are the hazard controls and safe work practices to follow when personnel or subcontractors are performing groundwater sampling and/or water level measurements.

- Full coolers are heavy. Plan in advance to have two people available at the end of the sampling effort to load full coolers into vehicles. If two people won't be available use several smaller coolers instead of fewer large ones.
- Wear the appropriate PPE when sampling, including safety glasses, nitrile gloves, and steel toe boots (see PPE section of the project safety plan).

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- Monitor headspace of wells prior to sampling to minimize any vapor inhalation (refer to the “Site Monitoring” section of the project safety plan).
- Use caution when opening well lids. Wells may contain poisonous spiders and hornet or wasp nests.
- Use the appropriate lifting procedures (see CH2M HILL SOP HSE-112) when unloading equipment and sampling at each well.
- Avoid sharp edges on well casings.
- If dermal contact occurs with groundwater or the acid used in sample preservation, immediately wash all affected skin thoroughly with soap and water.
- Avoid eating and drinking on site and during sampling.
- Use ear plugs during sampling if sampling involves a generator.
- Containerize all purge water and transport to the appropriate storage area.
- Use two people to transport full coolers/containers whenever possible. If two people are not available use a dolly to move coolers. If the coolers weigh more than 40 pounds Attachment 1 of the HSE-112, *Manual Lifting,* shall be completed by the SC. If the coolers weigh more than 50 pounds they should never be lifted by one person.

8.28 Hand and Power Tools

(Reference CH2M HILL, SOP HSE-210, *Hand and Power Tools*)

Hands are one of the most complex parts of the body. Every employee uses their hands to help them make a living. There are more on-the-job injuries to hands than any other body part.

Below are the hazard controls and safe work practices to follow when personnel or subcontractors are using hand and power tools. Ensure the requirements in the referenced SOP are followed.

General

- Always select the right tool for the job;
- Keep cutting tools sharp—less force will be needed for the cut. Do not use pocket knives—only safety cutting tools and if using these be sure to comply with the “Knife Use” section of this Handbook;
- Carry and store tools correctly and never put sharp or pointed tools in your pocket or belt;
- Tools shall be inspected prior to use and damaged tools will be tagged and removed from service;
- Store tools properly in a place where they will not be damaged or come in contact with hazardous materials; and
- Tools used in an explosive environment must be rated for work in that environment (that is, intrinsically safe, spark-proof, etc.).

Hand and Power Tools

- Hand and power tools will be used for their intended use and operated in accordance with manufacturer’s instructions and design limitations;
- Screwdrivers are one of the most used and abused tools, never:
  - Hammer with a screwdriver
  - Use as a pry bar
  - Use with a broken handle

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  - Use with worn out tips

- Maintain all hand and power tools in a safe condition;
- When possible, use power tools over hand tools. Powered tools tend to require less exertion and reduce repetitive motion. Be sure that the weight of a powered tool (and cording) does not create additional force issues.
- Whenever possible, select tools that use a full-hand power grip rather than a precision finger grip. The greater the efforts to maintain control of a hand tool, the higher the potential for injury. A compressible gripping surface rather than hard plastic should be used.
- Avoid repetitive trigger-finger actions. Select tools with large switches that can be operated with all four fingers.
- When possible, use tools with extension handles that let you stand up while performing a floor-level task (extension handles must be manufacturer-approved)
- To lessen vibration:
  - Pad tool handles with a soft compressible surface
  - Use vibration damping (gel filled) gloves
  - Select tools (hammers and chippers) with built in damping systems (springs/hydraulics)
- Maintain straight wrists. Avoid bending or rotating the wrists; a variety of bent-handle tools are commercially available.
- Avoid static muscle loading. Reduce both the weight and size of the tool. Do not raise or extend elbows when working with heavy tools.
- Use PPE (such as gloves, safety glasses, earplugs, and face shields) when exposed to a hazard from a tool;
- Do not carry or lower a power tool by its cord or hose;
- Portable power tools will be plugged into GFCI protected outlets;
- Portable power tools will be Underwriters Laboratories (UL) listed and have a three-wire grounded plug or be double insulated;
- Disconnect tools from energy sources when they are not in use, before servicing and cleaning them, and when changing accessories (such as blades, bits, and cutters);
- Safety guards on tools must remain installed while the tool is in use and must be promptly replaced after repair or maintenance has been performed;
- If a cordless tool is connected to its recharge unit, both pieces of equipment must conform strictly with electrical standards and manufacturer's specifications; and

Machine Guarding

- Ensure that all machine guards are in place to prevent contact with drive lines, belts, chains, pinch points or any other sources of mechanical injury;
- Unplugging jammed equipment will only be performed when equipment has been shut down, all sources of energy have been isolated and equipment has been locked/tagged and tested; and
- Maintenance and repair of equipment that results in the removal of guards or would otherwise put anyone at risk requires lockout of that equipment prior to work.

8.29 Haul Trucks

Below are the hazard controls and safe work practices to follow when working around or operating haul trucks:

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- Haul truck operators are prohibited from using any wireless device while operating trucks on site. Trucks must be stopped before using devices such as two way radios or cell phones. If a wireless device is required for a certain operation, the PM and RHSM must authorize the wireless use on a case by case basis and make sure limitations are addressed in the project safety plan.
- Haul truck operators should be familiar with their equipment and inspect all equipment before use;
- Haul truck operators should ensure all persons are clear before operating truck or equipment. Before moving operators should sound horn or alarm, all equipment should be equipped with a working back up alarm;
- Haulage trucks or equipment with restricted visibility should be equipped with devices that eliminate blind spots;
- Employees should stay off haul roads. When approaching a haul area, employees should make eye contact and communicate their intentions directly with the equipment operator;
- If possible minimize steep grades on haul roads;
- Where grades are steep provide signage indicating the actual grade as well as measures for a runaway truck;
- Trucks are to be operated within the manufacturer's recommendations (for example- retarder charts indicate the combination of loads, grades and speeds that should not be exceeded if the truck's retarder is to work properly – to ensure the truck does not descend grade at speeds greater than listed);
- Haul roads should be well lit, sufficiently wide (at least 50 percent of the width of the equipment on both sides of road) and equipped with reflectors to indicate access points;
- Haul roads should have adequate right-of-way signs indicating haul directions;
- Haul trucks will follow designated haul roads; and
- Haul trucks will comply with posted speed limits.

8.30 Hoists

(Reference CH2M HILL SOP HSE-315, *Hoists*)

- Below are the hazard controls and safe work practices to follow when working around or operating hoists. Ensure the requirements in the referenced SOP are followed.
- Manufacturer's specifications and limitations applicable to the operation of material hoists shall be followed. Where manufacturer's specifications are not available, the limitations assigned to the equipment shall be based on the determinations of a professional engineer competent in the field.
- Rated load capacities, recommended operating speeds, and special hazard warnings or instructions shall be posted on hoists.
- Hoisting ropes shall be installed in accordance with the wire rope manufacturer's recommendations.
- The installation of live booms on hoists is prohibited.
- Operating rules shall be established and posted at the operator's station of on hoists.
- No person shall be allowed to ride on material hoists except for the purposes of inspection and maintenance.
- All entrances of the hoistways shall be protected by substantial gates or bars, which guard the full width of the landing entrance.

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- Overhead protective coverings of 2-inch planking, ¾-inch plywood, or other solid material of equivalent strength, shall be provided on the top of every material host cage or platform.
- All hoistway entrance bars and gates shall be painted with diagonal contrasting colors, such as black and yellow.
- A qualified hoist operator will operate, inspect, maintain and oversee all hoist operations. The SC or designee shall verify hoist operator qualifications (e.g., operator to provide for the type of hoist being operated—years of experience, training, background).
- CH2M HILL employees who are required to operate hoists shall read the hoist manufacturer's operations and maintenance manual, be evaluated and approved as qualified hoist operators. The CH2M HILL may require operators to complete separate hoist operations training, provided by commercial training specialists.

8.31 Hydrogen Sulfide

Hydrogen sulfide (H2S) is a colorless, toxic, and flammable gas responsible for the odor of rotten eggs. It often results from the bacterial break down of organic matter in the absence of oxygen, such as in sewers. It also occurs in gases, natural gas and in well waters. H2S may be produced during the biological process when biological substrates are used to expedite the remediation process.

Chemical Properties

Hydrogen sulfide is heavier than air and may travel along the ground. It collects in low-lying and enclosed, poorly-ventilated areas such as basements, manholes, sewer lines, and underground telephone vaults. For work within confined spaces, use appropriate procedures for identifying hazards, monitoring and entering confined spaces (see Confined Space Entry section of this Handbook or the project safety plan). Additionally, H2S is a highly flammable gas and gas/air mixtures can be explosive. It may travel to sources of ignition and flash back. If ignited, the gas burns to produce toxic vapors and gases, such as sulfur dioxide.

Routes of Exposure and Exposure Limit

The primary route of exposure to H2S is inhalation, and the gas is rapidly absorbed by the lungs. Absorption through the skin is minimal. People can smell the "rotten egg" odor of H2S at low concentrations in air. However, with continuous low-level exposure, or at high concentrations, a person loses his/her ability to smell the gas even though it is still present; this is called olfactory fatigue. This can happen very rapidly and at high concentrations, the ability to smell the gas can be lost instantaneously. Therefore, DO NOT rely on your sense of smell to indicate the continuing presence of H2S or to warn of hazardous concentrations.

About half of the population can smell H2S at concentrations as low as 0.5 parts per billion (ppb) in air, and more than 90 percent can smell it at levels of 50 ppb. At higher concentrations H2S rapidly deadens the sense of smell. For most people, this occurs at approximately 150 ppm.

The American Conference of Governmental Industrial Hygienists (ACGIH) 8-hr time-weighted average (TWA) exposure limit for H2S is 1 ppm; the 15-minute short term exposure limit (STEL) is 5 ppm.

The Immediately Dangerous to Life or Health (IDLH) in air is 100 ppm. Exposure to 500 ppm can be fatal in a few breaths. Exposure to 1000 ppm is fatal.

Effects on the Body

Hydrogen sulfide is both an irritant and a chemical asphyxiant with effects on both oxygen utilization and the central nervous system. Its health effects can vary depending on the level and duration of exposure. Low concentrations irritate the eyes, nose, throat and respiratory system (e.g., burning/tearing of eyes, cough, shortness of breath). Asthmatics may experience breathing difficulties. The effects can be delayed for several hours, or sometimes several days, when working in low-level concentrations. Repeated or prolonged exposures may cause eye inflammation, headache, fatigue, irritability, insomnia, digestive disturbances and weight loss.

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Moderate concentrations can cause more severe eye and respiratory irritation (including coughing, difficulty breathing, and accumulation of fluid in the lungs), headache, dizziness, nausea, vomiting, staggering and excitability.

High concentrations can cause shock, convulsions, inability to breathe, extremely rapid unconsciousness, coma and death.

H_2S as a Project Hazard

Elevated levels of H2S have not been reported during normal drilling activities, but experience has shown that high levels of H2S may be present in the well space and in the breathing zone following the injection of emulsified oil, once the biological process has had time to progress. Engineering controls shall be considered to bring the concentrations of H2S down to an acceptable level in the breathing zone, followed by administrative controls, and respiratory protection.

All employees will receive orientation on the emergency contingency plan for the specific actions to follow when there is an H_2S release from equipment, fire involving H_2S, or medical emergency involving exposure to H_2S.

Air Monitoring

Follow the air monitoring action levels in the project safety plan. If elevated levels of H2S are encountered, first implement engineering controls to reduce exposures to allowable levels. If that is not possible, then an upgrade in PPE may be required; refer to the PPE section of the project safety plan.

8.32 Lead

(Reference CH2M HILL SOP HSE-508, *Lead*)

CH2M HILL is required to control employee exposure to lead when exposures are at or above 30 $\mu g/m^3$ by implementing a program that meets the requirements of the OSHA Lead standard, 29 CFR 1910.1025 and 29 CFR 1926.62. The elements of the CH2M HILL lead program include the following:

- Exposure monitoring;
- Methods of control, including personal protective equipment (PPE) and respirators;
- Medical surveillance;
- Training on hazards of lead and control measures (includes project-specific training and the computer-based training on CH2M HILL's Virtual Office, *Lead Exposure Training);* and
- Record keeping requirements.

If air monitoring indicates there is potential exposure at the action level concentrations above, notify the RHSM to ensure the above have been adequately addressed. Other exposure control measures include:

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met;
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas;
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person; and
- Review the fact sheet included as an attachment to the SOP.

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8.33 Lockout/Tagout Activities

(Reference CH2M HILL SOP HSE-310, *Lockout and Tagout*)

Lockout/tagout (LO/TO) shall be performed whenever service or maintenance is necessary on equipment that could cause injury to personnel from the unexpected equipment energizing or start-up or unexpected release of stored energy. Energy sources requiring lockout/tagout may include electrical, pneumatic, kinetic, and potential.

If work on energized electrical systems is necessary—contact the RHSM. Specific training and procedures are required to be followed before any work on energized electrical systems can be performed and are NOT covered in this section. Energized electrical work is defined as work performed **on or near** energized electrical systems or equipment with exposed components operating at 50 volts or greater. Working near energized live parts is any activity inside a Limited Approach Boundary (anywhere from 3.5 feet to 24 feet [1 meter 7.3 meters] depending on voltage). Examples of energized electrical work include using a voltmeter to troubleshoot electrical systems and changing out controllers.

When lockout/tagout is necessary to perform maintenance/repair of a system, all the requirements of SOP HSE-310, Lockout and Tagout, shall be met including the following bulleted items:

- When CH2M HILL controls the work, CH2M HILL must verify that subcontractors affected by the unexpected operation of equipment develop a written lockout/tagout program, provide training on lockout/tagout procedures and coordinate its program with other affected subcontractors. This may include compliance with the owner or facility lockout/tagout program.
- When CH2M HILL personnel are affected by the unexpected operation of equipment they must complete the electrical safety awareness module on the VO. Authorized personnel shall inform the affected personnel of the LO/TO. Affected personnel shall not tamper with LO/TO devices.
- Standard lockout/tagout procedures include the following six steps: 1) notify all personnel in the affected area of the lockout/tagout, 2) shut down the equipment using normal operating controls, 3) isolate all energy sources, 4) apply individual lock and tag to each energy isolating device, 5) relieve or restrain all potentially hazardous stored or residual energy, and 6) verify that isolation and deenergization of the equipment has been accomplished. Once verified that the equipment is at the zero energy state, work may begin.
- All safe guards must be put back in place, all affected personnel notified that lockout has been removed and controls positioned in the safe mode prior to lockout removal. Only the individual who applied the lock and tag may remove them.
- CH2M HILL authorized employees shall complete the LO/TO training module on the VO and either the electrical safety training module on the VO or 10-hour construction training. The authorized employee must also be trained and qualified on the system they are working on (e.g., qualified electrician for working on electrical components of a system).
- When equipment-specific LO/TO procedures are not available or when existing procedures are determined to be insufficient, CH2M HILL authorized employees shall also complete the Equipment-Specific LO/TO Procedure Development Form, provided as an attachment to the SOP, to create an equipment-specific lockout/tagout procedure.

8.34 Avoidance of Munitions and Explosives of Concern (MEC) and/or Materials Potentially Presenting an Explosive Hazard (MPPEH)

(Reference CH2M HILL, SOP HSE-610, Explosives Usage and Munitions Response)

If work will be conducted on a government/military facility or ex-government/military facility; area currently or previously used as a range; or if military munitions, MEC, or material potentially presenting an explosive hazard

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(MPPEH) are associated with the scope of work or location immediately contact the CH2M HILL Central Point of Contact for Explosives Usage and Munitions Response. The following will be required prior to any field work:

- Setting up a conference call with all required personnel to conduct a basic safety risk assessment over the phone.
- Providing written directions detailing job-specific requirements and what actions to take to ensure safety during the work.
- "3R Training" will be required for all affected project personnel. This training teaches personnel to Recognize, Retreat, and Report.

8.35 Marijuana Cultivation Sites

Marijuana grow sites are illegal on public lands, but are becoming more common. These sites may be encountered when working in undeveloped or "back country" areas. These sites pose risks to workers, the public, and the environment and are most often associated with organized crime. The potential for violent confrontations is high.

Grow sites have been discovered in California forest areas including Shasta Trinity National Forest other national forest areas including San Bernardino, Los Padres, and Angeles.

Most marijuana grow sites have someone always watching the site. Even unattended sites pose a significant risk. Recognize the signs of marijuana cultivation sites, and if you think you are near one, be quiet and leave the area immediately.

How to recognize a cultivation site:

- Sometimes marijuana smells like a skunk on hot days.
- Hoses or drip lines (made of black or white PVC piping or rubber hose) located in unusual or unexpected places.
- Discarded containers of herbicides, pesticides or other chemicals. A variety of chemicals for pest and animal control, including chemicals that may be so hazardous they are illegal in the United States are sometimes encountered.
- A well-used trail where there shouldn't be one.
- People standing along roads without vehicles present, or in areas where loitering appears unusual.
- Grow sites are usually found in isolated locations, in rough steep terrain. Look for signs of cultivation, cleared vegetation, soil disturbance.
- Food cached near trailheads or alongside roads.
- Sights or sounds of human activity in remote forest areas.
- Camps containing cooking and sleeping areas with food, fertilizer, weapons, garbage, rat poison, and/or dead animals.
- Small propane bottles, used to avoid the detection of wood smoke.
- Individuals armed with rifles outside of hunting season.
- Paper cups, chicken wire or plastic sheets used for starting and protecting plants.

As soon as you become aware that you have come upon a cultivation site, leave the way you came in immediately and make as little noise as possible. Never engage the growers as these are extremely dangerous people. If you can identify a landmark or it is helpful for authorities, but put your own safety first. The growers may be present and may or may not know that you have found their grow site. Get to a safe place and report as much detail about the location and incident as you can recall to authorities. Ensure you contact the RHSM and Project Manager as soon as possible.

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Other precautions to take include:

- Check with local law enforcement officers to see whether they know of any dangers or concerns in the area where you will be working.
- Establish and follow check-in and checkout procedures every day.
- Make sure your supervisor and the dispatch office know where you will be working.
- If necessary, agree on a phrase that you would use to let your co-workers (SC, RHSM, or PM) know you are in danger and need law enforcement assistance immediately at your last known location.
- Make sure you have a working communication device.
- Use the buddy system. Work in pairs.
- Park your vehicle so it's pointing in the direction of escape.

8.36 Methane (as a Product of Injection Activities)

Methane is a colorless, odorless gas with a wide distribution in nature. Methane is created when organic matter decomposes (rots) without any oxygen present ("anaerobic" decomposition) and is common in landfills, marshes, septic systems and sewers.

Methane may be produced as a by-product of the biological process when biological additives are used in a remediation process (such as when emulsified oil is injected to enhance dechlorination of contaminated groundwater).

Experience has shown that methane may be present in the well space following the injection of emulsified oil, once the biological process has had time to progress. This needs to be considered when returning to collect ground water samples. Although methane degrades Engineering controls shall be considered to bring the concentrations of methane down to an acceptable level in the breathing zone.

Methane is a "simple asphyxiant," which means that it can displace available oxygen. Methane is combustible and mixtures of methane with air are explosive within the range 5-15 percent by volume of methane (the lower and upper explosive limits). At room temperature, methane is lighter than air, so in an outdoor environment, it tends to dissipate.

Methane is not toxic when inhaled, but it can produce suffocation by reducing the concentration of oxygen inhaled. When exposed to concentrations high enough to displace oxygen, you may experience dizziness, deeper breathing, possible nausea and eventual unconsciousness.

The primary danger is from fire and explosion, so ensure that you work in a well-ventilated area, and that there is no source of ignition present. Use spark-proof tools and intrinsically safe equipment, if necessary. If working in a confined space, make sure that appropriate controls are in place and follow an approved permit-required confined space entry plan.

8.37 Methane (as Landfill Gas or Shale Formations)

Landfill gas is normally made up of 50 percent methane and 50percent carbon dioxide

Shale formations can produce methane that has the potential to be released during drilling or groundwater sampling.

Other constituents have been found in the landfill gas. These may include hydrogen sulfide, tetrachloroethene, ethyl benzene, toluene, and xylenes.

- Continuous monitoring is required when performing intrusive activities (e.g., excavation, drilling) in a methane area. This includes refuse and any cover material.
- Monitoring will be conducted with oxygen/combustible gas meters.

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- All instruments will be calibrated according to manufacturer's specifications. Instruments will be calibrated at the frequency specified by the manufacturer.
- Ventilation is the primary control to reduce the fire potential from methane. The action required for ventilation include:
- Natural Ventilation – If the wind speed across the bore hole or sampling apparatus is over 5 mph (8 kph) then natural ventilation is sufficient. Equipment and personnel must be located upwind of the potential methane source to prevent any ignition source from contacting methane in air.
- Forced Ventilation – If the wind speed across the bore hole or sampling apparatus is less than 5 mph (8 kph) then forced ventilation is required. Large air movers are preferable but standard ventilation fans may be used if the air flow is directed to the bore hole or the location in the sampling apparatus where the methane first encounters open air.

8.38 Methylene Chloride

(Reference CH2M HILL SOP HSE-509, *Methylene Chloride*)

Methylene chloride has a faint, sweet odor which is not noticeable at dangerous concentrations. Methylene chloride is shipped as liquefied compressed gas and will cause frostbite on contact.

CH2M HILL is required to control employee workplace exposure to methylene chloride when personal exposures are at or above 12.5 parts per million (ppm) as an 8-hour time-weighted average (TWA) or above 125 ppm short-term exposure limit (STEL) by implementing a program that meets the requirements of the OSHA Methylene Chloride standard, 29 *Code of Federal Regulations* (CFR) 1910.1052. The elements of the CH2M HILL methylene chloride program include the following:

- Exposure monitoring;
- Methods of control, including personal protective equipment (PPE) and respirators;
- Medical surveillance;
- Training on hazards of methylene chloride and control measures (includes project-specific training and the computer-based training on CH2M HILL's Virtual Office, *Methylene Chloride)* and*;*
- Recordkeeping requirements.

If air monitoring indicates there is potential exposure at the action level concentrations above, notify the RHSM to ensure the above have been adequately addressed. Other exposure control measures include:

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met;
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas;
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person;
- Appropriate air-supplied respirators must be used when methylene chloride exposures exceed PEL or STEL;
- Air supplied to respirators must meet Grade D breathing air requirements; and
- Review the fact sheet included as an attachment to the SOP.

8.39 Naturally Occurring Radiation Materials (NORM)

Naturally Occurring Radiation Materials (NORM) is found in the earth's crust, soil, plants and many living organisms. The geologic formations that contain oil and gas deposits also contain NORM, commonly consisting of the elements of uranium, radium, thorium and their associated decay products. If present, these radio nuclides

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dissolve in water and can be bound into the scale deposited in production equipment handling produced water. Radon gas follows the propane/ethane streams of produced (natural) gas and the radon gas byproducts (radon daughters) can be deposited on the inside surfaces of gas handling equipment. Land can be contaminated with NORM from descaling operations, contaminated sludges, and/or residual from produced water.

Equipment that can contain NORM-contaminated scale includes equipment associated with the separators (separate gas from the oil and water) and heater treaters (divide the oil and water phases) such as flowlines, pumps, valves, and piping (especially transition pieces such as elbows and reducer) and filters.

Gas processing equipment can also be contaminated with NORM (radon daughters). This contamination, unlike scales, can be in the form of an invisible film inside gas equipment and can only be detected by internal surveying with appropriate instrumentation.

Natural gas liquid equipment can also be contaminated by radon in the gas. Sludges accumulated in this equipment may contain the heavy metal radon daughters that have attached to dust and other particles that become part of the sludge.

While NORM has generally been associated with exploration and production activities, there is some industry experience to indicate that some refinery process equipment can also be contaminated with NORM, including natural gas stream equipment, crude tank bottoms, desalters, overhead atmospheric pipestill equipment, and exchanger deposits/sludge.

Hazards of NORM

NORM generally does not present an external radiation (Gamma) hazard to employees working around closed process equipment. This is particularly the case with NORM associated with scale inside equipment handling production water due to attenuation by the scale and steel pipe wall. Recent field experience, however, indicates that some in-service gas processing equipment, particularly valves, elbows, or transition piping pieces, may have fairly high external Gamma radiation levels. If gas-processing equipment is out of service for more than 4 hours, external Gamma measurements will not detect internal accumulation of the radon daughters.

Work procedures are recommended when maintaining NORM contaminated equipment such as pipelines, filters, pumps, lines, sludge or wellhead equipment. The exposure risk is highest when grinding, cutting, polishing, or performing other work that may generate dust. These dusts present inhalation hazards that result in internal exposures to radioactive material.

- Radium, radon, and their decay products are radioactive elements of concern in petroleum production and gas processing. Exposure may occur when contaminated dusts and sludge are inhaled or ingested (internal exposure) or when radiation from surrounding equipment strikes the body (external exposure).
- Radium is found in most oil and gas fields in the world in varying concentrations. There is potential to find radium in significant amounts in almost all types of equipment. Radon is found in most natural gas deposits in the world.
- Radon itself does not present a health hazard because it is not easily absorbed into the body and is quickly cleared when absorbed.
- Radon's radioactive breakdown products, called radon "daughters," may be hazardous. Radon naturally breaks down into radioactive metals before becoming non-radioactive lead.
- Radon daughters may be inhaled or ingested when attached to scale or dust generated during equipment inspection and repair. Radon daughter overexposure has been associated with an increased risk of lung cancer.

NORM Hazard Control Measures

- For operations where NORM is a potential hazard, a qualified individual (s) will be assigned for implementing radiological protection of employees, members of the public, and the environment.

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- Surveys and monitoring must be conducted to evaluate the potential radiological hazards. The surveys must include measurements for radiation levels based on the concentrations or quantities of radioactive material, along with any other measurements or evaluations necessary to characterize the potential radiological hazards that could be present.
- Equipment contaminated with NORM must be labeled.
- Gas processing equipment should be opened to allow gas to escape, and allowed to stand idle for at least 4 hours prior to any entry.
- Water washing of any equipment prior to entry is recommended when practical.
- Personal protective equipment (PPE) must be selected based on the hazards (both radiological and non-radiological) work activities to be conducted, and the contamination levels in the work area,
  - Level D PPE must be worn to minimize skin contact with NORM such as gloves and appropriate body protection. Disposable clothing such as TYVEK is preferred since NORM contaminated clothing should be laundered.
  - Level C PPE using full-face air-purifying respirator with high efficiency particulate air (HEPA filters) must be worn if dust exposure is expected.
- Do not sand, grind, cut, or weld on surfaces contaminated with NORM without appropriate cleaning. Equipment should be resurveyed after cleaning prior to these activities.
- NORM-contaminated equipment or material should not be shipped offsite for repair or disposal without first contacting the designated NORM coordinator (may be the RHSM and/or REM)

8.40 PCB/Ballast Handling

Fluorescent lighting used in many older buildings use ballast resistors that contain polychlorinated biphenyl (PCB) oil. PCB is colorless to light-colored, viscous liquid with a mild, hydrocarbon odor.

PCB has been found to cause, irritation eyes; chloracne; liver damage; reproductive effects; and has shown to cause cancer in lab animals.

When work requires the handling or removal of fluorescent ballast resistors, extra care and attention needs to be taken. While ballasts are usually well sealed, it is not uncommon to find a ballast resistor that has leaked. Below are the hazard controls and safe work practices to be followed when PCBs are present.

- A survey must be made to determine whether ballast resistors contain PCB fill.
- Leaking resistors must be identified and handled with appropriated PPE.
- Exposure Routes are inhalation, skin absorption, ingestion, skin and/or eye contact
- Prevent skin contact by using chemical resistant gloves, wear eye protection, and thoroughly wash hands before eating or smoking.
- Ensure eyewash is available.
- In the event of exposure, follow the following First Aid procedures:
  Eyes: Irrigate immediately
  Skin: Soap wash immediately
  Ingestion: Seek medical attention immediately
- Dispose of PCB ballast resistors in accordance with Federal, State and Local environmental regulations.

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8.41 Portable Generator Hazards

(Reference CH2M HILL SOP HSE-206, Electrical Safety)

- Portable generators are useful when temporary or remote electric power is needed, but they also can be hazardous. The primary hazards to avoid when using a generator are carbon monoxide (CO) poisoning from the toxic engine exhaust, electric shock or electrocution, and fire.
- NEVER use a generator indoors or in similar enclosed or partially-enclosed spaces. Generators can produce high levels of carbon monoxide (CO) very quickly. When you use a portable generator, remember that you cannot smell or see CO. Even if you can't smell exhaust fumes, you may still be exposed to CO.
- If you start to feel sick, dizzy, or weak while using a generator, get to fresh air RIGHT AWAY. DO NOT DELAY. The CO from generators can rapidly lead to full incapacitation and death.
- If you experience serious symptoms, get medical attention immediately. Inform project staff that CO poisoning is suspected. If you experienced symptoms while indoors have someone call the fire department to determine when it is safe to re-enter the building.
- Follow the instructions that come with your generator. Locate the unit outdoors and away from doors, windows, and vents that could allow CO to come indoors.
- Generators rated greater than 5 kilowatts that are not vehicle- mounted need to be grounded in accordance with regulatory and manufacturer requirements. Always refer to the manufacturer grounding requirements for any generator used on site.
- Keep the generator dry and do not use in rain or wet conditions. To protect from moisture, operate it on a dry surface under an open, canopy-like structure. Dry your hands if wet before touching the generator.
- Plug appliances directly into the generator. Or, use a heavy duty, outdoor-rated extension cord that is rated (in watts or amps) at least equal to the sum of the connected appliance loads. Check that the entire cord is free of cuts or tears and that the plug has all three prongs, especially a grounding pin.
- Most generators come with Ground Fault Circuit Interrupters (GFCI). Test the GFCIs daily to determine whether they are working
- If the generator is not equipped with GFCI protected circuits plug a portable GFCI into the generator and plug appliances, tools and lights into the portable GFCI.
- Never store fuel near the generator or near any sources of ignition.
- Before refueling the generator, turn it off and let it cool down. Gasoline spilled on hot engine parts could ignite.

8.42 Powder-Actuated Tools

(Reference CH2M HILL SOP HSE-210, *Hand and Power Tools*)

Below are the hazard controls and safe work practices to follow when working around or using powder-actuated tools. Ensure the requirements in the referenced SOP are followed.

- Only trained personnel are permitted to operate powder-actuated tools.
- Inspect and test powder-actuated tools each day before they are loaded per manufacturer's instruction. Remove from service any tool that is not in proper working order.
- Wear appropriate personal protective equipment (eye, face, and hearing protection) when using powder-actuated tools.
- Never point powder-actuated tools at other workers, whether empty or loaded. Tools shall not be loaded until just before use. Never leave loaded tools unattended.

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- Do not drive fasteners into very hard or brittle materials such as, cast iron, glazed tile, surface-hardened steel, glass block, live rock, face brick, or hollow tile.
- Avoid driving fasteners into easily penetrable materials unless backing is provided. Pins or fasteners can otherwise become flying missiles when they pass right through such materials.
- Use powder-actuated tools with the manufacturer's specified guard, shield, or other attachment.
- Do not use powder-actuated tools in explosive or flammable atmospheres.

8.43 Pressure Line/Vessel Systems

- Operate and maintain pressure vessels, pumps and hosing in accordance with the manufacturer's recommendations.
- Do not exceed the rated pressure of the vessels and hosing of the system.
- The system must be provided with a pressure relief valve/controller that safely reduces the system pressure to within the system rated pressure.
- The pressure relief valve must be rated at no more than 110 percent the rated pressure of the system and must be tested at regular intervals.
- Each vessel must be equipped with a functioning pressure gauge to monitor pressure.

8.44 Pressure Washing Operations

Below are the hazard controls and safe work practices to follow when working around or performing pressure washing.

- Only trained, authorized personnel may operate the high-pressure washer.
- Follow manufacturer's safety and operating instructions.
- Inspect pressure washer before use and confirm deadman trigger is fully operational
- The wand must always be pointed at the work area.
- The trigger should never be tied down
- Never point the wand at yourself or another worker.
- The wand must be at least 42 inches (1.1 meter) from the trigger to the tip and utilize greater than 10 degree tips.
- The operator must maintain good footing.
- Non-operators must remain a safe distance from the operator.
- No unauthorized attachment may be made to the unit.
- Do not modify the wand.
- All leaks or malfunctioning equipment must be repaired immediately or the unit taken out-of-service.
- Polycoated Tyvek or equivalent, 16-inch-high steel-toed rubber boots, safety glasses, hard hat with face shield, and inner and outer nitrile gloves will be worn, at a minimum.

8.45 Process Safety Management

(Reference CH2M HILL SOP HSE-213, *Process Safety Management*)

- All CH2M HILL projects require a systematic evaluation of processes to prevent, or minimize the consequences of, catastrophic releases of toxic, reactive, flammable, or explosive chemicals at or above the

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specified threshold quantities listed in Appendix A, List of Highly Hazardous Chemicals, Toxics, and Reactives in OSHA Standard 29 CFR 1910.119, Process Safety Management.

- A Process Hazard Analysis (PHA) is required of all processes covered by PSM.
- Operating procedures shall be developed and implemented that provide clear operating instructions consistent with the process safety information.
- Contractors, whether considered to be CH2M HILL or a subcontractor of CH2M HILL, performing maintenance or repair, turnaround, major renovation, or specialty work on or adjacent to a covered process shall be informed by the client of the known potential fire, explosion, and toxic release hazards related to the contractor work and the provisions of the emergency action plan.
- CH2M HILL projects shall develop and implement the written procedure requirements to maintain the mechanical integrity of pressure vessels, storage tanks, piping systems, relief and vent systems, emergency shutdown systems, and controls and pumps process systems.
- A hot work permit shall be completed for any CH2M HILL work involving welding, cutting, brazing, or similar flame- or spark-producing operations conducted near a covered process.
- Written procedures shall be developed, updated, and implemented to manage changes in chemicals, technology, equipment, and facilities.
- An incident report form (IRF) shall be completed within 24 hours of a PSM-related incident. Incidents involving a release of highly hazardous chemicals shall be reported following the Serious Incident Reporting section of SOP HSE-111.
- An investigation shall be initiated as soon as possible, but no later than 48 hours following an incident that resulted in, or could reasonably have resulted in, a catastrophic release of a highly hazardous chemical.
- An emergency action plan shall be developed and implemented for the entire plant, including procedures for handling small releases.
- A facility or process audit shall be performed every three years to certify compliance with the PSM standard.
- All information regarding compliance with PSM requirements shall be made available to affected personnel without regard to possible trade secret status.
- CH2M HILL employees shall be trained before operating a newly assigned process or when involved in maintaining equipment. Refresher training shall be provided at least every three years and more often if necessary to assure the employee understands and adheres to the current operating procedures of the process.

8.46 Radar Hazards

Airports and all branches of the military use radar of significant power for buildings, towers, aircraft, ships, armor vehicles, and installations in general. Radar devices may emit harmful microwave radiation emissions. Microwave radiation is absorbed by the body and dissipated in the tissue as heat.

The penetration ability of the radiation depends on the wavelength. Microwave wavelengths of 25-200 centimeters have the ability to reach the internal organs with potentially damaging effects. Wavelengths less than 25 centimeters are absorbed and dissipated by the skin and the human body is thought to be transparent to microwave wavelengths greater than 200 centimeters. The health effects of microwave radiation include deep burns and thermal damage to any organ or organ system with low blood flow, most notably the lenses of the eyes. If adequate time has elapsed between exposures, the repair mechanisms of the lens seem to limit damage. Microwave radiation cannot be seen and its effects cannot be felt until serious damage has already occurred.

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The OSHA exposure limit is 10 milliwatts per square centimeter (10 mW/cm^2) averaged over any 6-minute period.

Warning signs must be posted in areas where potentially damaging microwave radiation exists.

The prevention method for microwave radiation exposure is to not be in the path of radar or other microwave emitting devices by either ensuring that the device is not operating or ensuring that there is sufficient shielding between you and the microwave source.

8.47 Rail Road Safety

Careful observation of railroad safety requirements is essential and is governed by the Federal Railroad Administration (FRA). For railroads involving Union Pacific Railroads (UPRR), refer to the "Minimum Safety Requirements for Engineering Department Contractors," of the E&NBG HSE SharePoint site which addresses training, minimum PPE, and safety requirements.

Permission to enter railroad property must be obtained from the local railroad. Working alone is not anticipated for this work. Contact the RHSM if working alone in the vicinity of railroads becomes necessary. Additional hazard controls will be evaluated by the RHSM and incorporated into the project safety plan.

If required by the client or railroad, all employees must participate in and comply with any job briefings conducted by the railroad's employee in charge (EIC). During these briefings, the railroad's EIC will specify safe work procedures, the potential hazards of the job, and emergency response procedures.

The following PPE must be worn when working around trains and rail-yards.

- Reflective/high-visibility safety vests (orange or green-yellow);
- ANSI Z87.1-approved safety glasses shall be worn to protect from flying debris;
- ANSI-approved hard hat;
- Safety-toed boots;
- Hearing protection is required when employees are within 100 feet of locomotive or roadway/work equipment; 15 feet of power operated tools 150 feet of jet blowers or pile drivers 150 feet of retarders in use (when within 10 feet, employees must wear dual ear protection – plugs and muffs); and
- Any other PPE as required by the PPE section of the project safety plan.

Other general safety requirements include:

- Any work conducted within 25 feet of active tracks must first be approved by the client and any EIC requirements addressed (preferably in an AHA). Training (i.e., On-track Railroad Safety Training) is required by the Federal Railroad Administration in these instances. Coordinate this training with the RHSM or Safety Program Assistant (SPA).
- Attend client's safety training courses, as required, and carry or maintain proof of training as required by the client;
- Always pay attention to moving trains – never assume they are looking out for you;
- Work as far from traveled way as possible to avoid creating confusion for trains;
- Use the "buddy system" when work does not face the direction in which trains are coming from.
- The railroad must be promptly notified of any reportable injury;
- The railroad must be promptly notified of any damage to railroad property;
- All waste must be properly disposed of. No fires are permitted;
- All contractor's vehicles stop at all railroad crossings to ascertain the way is clear;

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- Always be on alert for moving equipment in either direction on the tracks. Do not stop or walk on the top of rail, frog, switches, guard rails, or other track components.
- When walking around a standing rail car, stay at least 20 feet behind it. Do not walk between rail cars unless there is a 50 feet clearance between cars. Do not sit on, lie under, or cross between cars.
- No tools or materials are to be left close to the track when trains are passing.

8.48 Rigging

(Reference CH2M HILL SOP HSE-316, *Rigging*)

Below are the hazard controls and safe work practices to follow when personnel are overseeing or performing rigging. Ensure the requirements in the referenced SOP are followed.

8.48.1 General

- All rigging equipment shall be used only for its intended purpose, inspected by a competent person prior to use, and shall not be loaded in excess of its capacity rating. Defective rigging shall be removed from service.
- When CH2M HILL is in control of rigging operations, CH2M HILL shall provide a rigging competent person that will inspect, maintain oversee all rigging operations. The competent person shall use the appropriate rigging inspection log form to inspect wire rope, synthetic slings and/or shackles.
- Tag lines shall be attached to every load being lifted by a crane.
- Rigging equipment shall be protected from flame cutting and electric welding operations, and or contact avoided with solvents and chemicals.
- Rigging equipment, when not in use, shall be stored in an area free from damage caused by environmental elements, hazardous substances, and other factors that may compromise equipment integrity and performance.
- No modification or addition, which that could affect the capacity and or safe operation of the equipment, shall be made without the manufacturer's written approval.
- Rigging equipment shall not be shortened with knots, bolts or other makeshift devices.
- All rigging equipment shall be load tested at least annually by a competent person and documented.
- Special hoisting devices, slings, chokers, hooks, clamps, or other lifting accessories shall be marked to indicate the safe working loads and shall be proof -tested prior to initial use to 125 percent of their rated load. Vendors or suppliers will provide documentation of proof testing documentation.

8.48.2 Equipment

- Protruding end strands of wire rope shall be covered or blunted.
- Wire rope shall not be used, if in any length of eight diameters, the number of total number of visible broken wires exceeds 10 percent of the total number of wires, or if the rope shows other signs of excessive wear, corrosion, or defect.
- When inspecting the end fittings of wire rope slings, if more than one wire in a lay is broken in the fitting, do not use the sling.
- Synthetic web slings shall be immediately removed from service if any of the following conditions are present:
  - acid or caustic burns; melting or charring of any part of the sling
  - surface; snags, punctures, tears or cuts; broken or worn stitches; distortion of fittings;
  - discoloration of or rotting; red warning line showing.

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- Never use makeshift hooks, links or other fasteners. Job or shop hooks and links, or makeshift fasteners, formed from bolts, rods, etc., or other such attachments, shall not be used.
- Alloy steel chains shall have permanently affixed identification stating size, grade, rated capacity and reach.
- Shackles and hooks shall be constructed of forged alloy steel with the identifiable load rating on the shackle or hook.

8.48.3 Rigging Use

- Rigging shall not be pulled from under a load when the load is resting on the rigging.
- Place sling(s) in center bowl of hook.
- When attaching slings to the load hoist hook, corners and sharp edges should be “packed” to prevent cutting or damaging the rope or slings.
- Never use nylon, polyester, or polypropylene web slings, or web slings with aluminum fittings shall not be used where fumes, vapors, sprays, mists or liquids of acids, caustics or phenolics are present.
- Natural and synthetic fiber rope slings, except for wet frozen slings, may be used in a temperature range form from minus 20º F to plus 180º F without decreasing the working load limit. For operations outside this temperature range, and for wet frozen slings, the sling manufacturer’s recommendations shall be followed.
- When used for eye splices, the U-bolt shall be installed so that the “U” section is in contact with the dead end of the rope.

8.49 Scaffolds

(Reference CH2M HILL SOP HSE-311, *Scaffolds*)

Below are the hazard controls and safe work practices to follow when personnel or subcontractor personnel are using scaffolds. Ensure the requirements in the referenced SOP are followed.

8.49.1 Working from Scaffolds

- All scaffolds must be designed by a qualified person and installed under the supervision of a competent person.
- Do not access scaffolds until the competent person has completed the work shift inspection and has authorized access.
- Follow all requirements established by the competent person or as identified on the scaffold tag.
- Do not access scaffolds until authorized by the competent person.
- Do not access scaffolds that are damaged or unstable at any time and for any reason.
- Only access scaffolds by means of a ladder, stair tower, ladder stand, ramp, integral prefabricated scaffold access, or other equivalent safe means of access. Scaffold cross-bracing shall not be used to access scaffold platforms.
- Remain within the scaffold guardrail system when provided. Leaning over or stepping across a guardrail system is not permitted.
- Use personal fall arrest systems when required by the competent person and when working from suspension scaffolds or boatswains’ chairs.
- Do not stand on objects (boxes, buckets, bricks, blocks, etc.) or ladders on top of scaffold platforms to increase working height unless the platform covers the entire floor area of the room.

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- Do not work on scaffolds covered with snow, ice, or other slippery material or work on scaffolds during storms or high winds unless personal fall arrest systems or wind screens are provided and the competent person determines it is safe to remain on the scaffold.
- Do not overload scaffold planks over their rated weight bearing capacity. When feasible, place loads directly over the scaffolds vertical weight bearing structures.

8.49.2 Supported Scaffolds

This section covers the erection, use, and dismantling of supported scaffolds. Supported scaffolds consist of one or more platforms supported by outrigger beams, brackets, poles, legs, uprights, posts, frames, or similar rigid support. Supported scaffolds include frame, fabricated frame, tube and coupler, pole, bricklayer's, and step platform. The common requirements for all supported scaffolds are addressed here; the competent person shall ensure scaffold type specific requirements are included as applicable.

- CH2M HILL staff erecting, dismantling, or working on scaffolds must complete the CH2M HILL 10-Hour Construction Safety Awareness training course. Staff must also and receive project-specific scaffold training from a qualified person. Staff shall not use scaffold systems for which they have not been trained.
- A CH2M HILL scaffold competent person shall be assigned to direct and oversee the erection, dismantling, and use of scaffolds. Additionally, they must inspect scaffolds each day prior to use.
- Scaffolds shall be designed by a qualified person and shall be constructed and loaded in accordance with that design.
- Stationary scaffolds over 125 feet (38.1 meters) in height and rolling scaffolds over 60 feet (18.3 meters) in height must be designed by a professional engineer.
- A tag and permit system shall be used to inform personnel of the construction status of the scaffold. At a minimum, the system used shall inform users when a scaffold is complete and safe to be used and when a scaffold is under construction and is not ready to be used. When additional precautions are required to use the scaffold safely, for example, the use of fall protection systems, the system shall identify the precautions to be taken. The tag or permit shall be placed at each means of access to the scaffold. The competent shall be responsible for the tag and permit system.
- A daily safety briefing shall be conducted with all scaffold personnel to discuss the work planned for the day and the HSE requirements to be followed.
- Scaffolds and scaffold components must be capable of supporting, without failure, their own weight and at least 4 times their maximum intended load.
- The site must be inspected to determine ground conditions, strength of supporting structure, and for proximity of electric power lines, overhead obstructions, wind conditions, the need for overhead protection or weather protection coverings.
- Supported scaffolds must be set on base plates, mudsills, or other adequate firm foundation.
- Frame spacing and mudsill size can only be determined after the total loads to be imposed on the scaffold and the strength of the supporting soil or structure are calculated and considered. This analysis must be done by a qualified person.
- Base plates or screwjacks with base plates must be in firm contact with both the sills and the legs of the scaffolding. Compensate for uneven ground with screwjacks with base plates. DO NOT USE unstable objects such as blocks, loose bricks, etc.
- Scaffolds and scaffold components must be inspected for visible defects before each shift by a competent person, and after each occurrence that could affect a scaffold's integrity (such as being struck by a crane).

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- Maintain scaffolding and materials (e.g., paint roller extensions, building material) at least 10 feet (3 meters) from overhead power lines for voltages of 50 kV or less, and 10 feet (3 meters) plus 0.4 inch (1.0 cm) for every 1 kV over 50 kV.
- All portable electric equipment must be protected by ground-fault circuit interrupters (GFCIs) or an assured equipment grounding conductor program.

8.49.3 Suspended Scaffolding

Suspension scaffolds consist of one or more platforms suspended by ropes or other non-rigid means from an overhead structure(s). The common requirements for suspended scaffolds are addressed here; the competent person shall ensure scaffold type specific requirements are included as applicable.

- CH2M HILL staff erecting, dismantling, or working on scaffolds must complete the CH2M HILL 10-Hour Construction Safety Awareness training course. Staff must also and receive project-specific scaffold training from a qualified person. Staff shall not use scaffold systems for which they have not been trained.
- A CH2M HILL scaffold competent person shall be assigned to direct and oversee the erection, dismantling, and use of scaffolds. Additionally, they must inspect scaffolds each day prior to use.
- Scaffolds shall be designed by a qualified person and shall be constructed and loaded in accordance with that design.
- A tag and permit system shall be used to inform personnel of the construction status of the scaffold. At a minimum, the system used shall inform users when a scaffold is complete and safe to be used and when a scaffold is under construction and is not ready to be used. When additional precautions are required to use the scaffold safely, for example, the use of fall protection systems, the system shall identify the precautions to be taken. The tag or permit shall be placed at each means of access to the scaffold. The competent shall be responsible for the tag and permit system.
- A daily safety briefing shall be conducted with all scaffold personnel to discuss the work planned for the day and the HSE requirements to be followed.
- Scaffolds and scaffold components must be capable of supporting, without failure, their own weight and at least 4 times their maximum intended load.
- The site must be inspected to determine the strength of supporting structure, and for proximity of electric power lines, overhead obstructions, wind conditions, the need for overhead protection or weather protection coverings.
- Scaffolds and scaffold components must be inspected for visible defects before each shift by a competent person, and after each occurrence that could affect a scaffold's integrity (such as being struck by a crane).
- Maintain scaffolding and materials (e.g., paint roller extensions, building material) at least 10 feet (3 meters) from overhead power lines for voltages of 50 kV or less, and 10 feet (3 meters) plus 0.4 inch (1.0 cm) for every 1 kV over 50 kV.
- All portable electric equipment must be protected by ground-fault circuit interrupters (GFCIs) or an assured equipment grounding conductor program.

8.49.4 Fall Protection on Suspended Scaffolds

- Each employee on a multi-point or two-point adjustable suspension scaffold must be protected by both a guardrail system and a personal fall arrest system.
- Personal fall-arrest systems used on scaffolds shall be attached by lanyard to a vertical lifeline, horizontal lifeline, or scaffold structural member.
- Guardrail systems must be installed along all open sides and ends of platforms, and must be in place before the scaffold is released for use by employees other than erection/dismantling crews.

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8.50 Stairways and Ladders

(Reference CH2M HILL SOP HSE-214*, Stairways and Ladders*)

Below are the hazard controls and safe work practices to follow when using stairways and ladders. Ensure the requirements in the referenced SOP are followed.

- Stairway or ladder is generally required when a break in elevation of 19 inches (48.3 cm) or greater exists.
- Personnel should avoid using both hands to carry objects while on stairways; if unavoidable, use extra precautions.
- Personnel must not use pan and skeleton metal stairs until permanent or temporary treads and landings are provided the full width and depth of each step and landing.
- Ladders must be inspected by a competent person for visible defects prior to each day's use. Defective ladders must be tagged and removed from service.
- Always obey and pay attention to warning labels or stickers on the specific ladder being used.
- Ladders must be used only for the purpose for which they were designed and shall not be loaded beyond their rated capacity.
- Ladder safety training on safe use (take the Stairways and Ladders safety training module located on the VO).
- Only one person at a time shall climb on or work from an individual ladder.
- User must face the ladder when climbing; keep belt buckle between side rails.
- Ladders shall not be moved, shifted, or extended while in use.
- User must use both hands to climb; use rope to raise and lower equipment and materials.
- Straight and extension ladders must be tied off to prevent displacement.
- Ladders that may be displaced by work activities or traffic must be secured or barricaded.
- Personnel climbing ladders shall face the ladder and maintain 3 points of contact with the ladder.
- Portable ladders must extend at least 3 feet (91.5 cm) above landing surface.
- Straight and extension ladders must be positioned at such an angle that the ladder base to the wall is one-fourth of the working length of the ladder.
- Stepladders are to be used in the fully opened and locked position.
- Users are not to stand on the top two steps of a stepladder; nor are users to sit on top or straddle a stepladder.
- Fixed ladders $\geq$ 24 feet (7.3 meters) in height must be provided with fall protection devices.
- Fall protection should be considered when working from extension, straight, or fixed ladders greater than six feet (1.8 meters) from lower levels and both hands are needed to perform the work, or when reaching or working outside of the plane of ladder side rails.

8.51 Steel Erection

(Reference CH2M HILL SOP HSE-312*, Steel Erection*)

Below are the hazard controls and safe work practices to follow when working around or performing steel erection activities. Ensure the requirements in the referenced SOP are followed.

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- Protruding reinforcing steel (rebar), onto which personnel could fall, must be guarded to eliminate the hazard of impalement.
- Structural steel loads shall not be released from the hoisting line until the members are secured with at least two bolts, or the equivalent at each connection and drawn up wrench tight.
- Tag lines shall be used for controlling loads.
- Containers shall be provided for storing or carrying rivets, bolts, and drift pins, and secured against accidental displacement when aloft.
- Air line hose sections shall be secured together, except when quick disconnect couplers are used to join sections.
- Impact wrenches used for bolting shall be provided with a locking device for retaining the socket.
- Turnbuckles shall be secured to prevent unwinding while under stress.
- Plumbing-up guys shall be removed only under the supervision of a competent person.
- Metal decking of sufficient strength shall be laid tight and secured to prevent movement.
- Provisions shall be made to secure temporary flooring against displacement. Planks shall overlap the bearing on each end by a minimum of 12 inches (30.5 cm). Wire mesh, exterior plywood, or equivalent, shall be used around columns where planks do not fit tightly.
- All unused openings in floors, temporary or permanent, shall be completely planked over or guarded.

8.52 Slips, Trips and Falls

General

- Institute and maintain good housekeeping practices.
- Designate foot traffic paths in and out of sites, when necessary, to ensure paths are kept free from slip, trip, and fall hazards or to deter personnel from taking “shortcuts” where slip, trip, hazards may be.
- Mitigate icy conditions by keeping foot traffic paths clear of ice and snow.
- Watch footing as you walk to avoid trip hazards, animal holes, or other obstacles, especially in tall grassy areas.

Muddy Conditions

- Muddy conditions present a slipping hazard. Use mats or other similar surface to work from if footing cannot be stabilized.
- Take shortened steps across muddy areas.
- Use a walking staff or other similar means to assist with balance.

Steep Slopes/Uneven Ground/Rock and Vertical Slopes

- Be aware that escarpments can slough. Avoid these areas.
- Exercise caution in relying on rocks and trees/tree stumps to support yourself – many times they are loose.
- Whenever possible, switchback your way up/down steep areas, and maintain a slow pace with firm footing.
- Employees walking in ditches, swales and other drainage structures adjacent to roads or across undeveloped land must use caution to prevent slips and falls which can result in twisted or sprained ankles, knees, and backs.

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- Whenever possible observe the conditions from a flat surface and do not enter a steep ditch or side of a steep road bed.
- If steep terrain must be negotiated coordinate with RHSM to evaluate the need for ladders or ropes to provide stability.

Snow and Ice on Walking/Working Surfaces

Housekeeping and Preparedness

- Evaluate whether the work can be postponed until site conditions improve for both our work and our subcontractors.
- Remove snow from walkways regularly and use ice-melt or sand, when necessary.
- Notify those responsible for clearing walkways and work areas when we observe a potentially hazardous location. At our project sites, be sure someone is responsible for maintaining walkways.
- Don't assume that the walk path is not slippery if it has been plowed and sanded already.
- Mark potential hazards (e.g., holes, rebar, plastic, etc.) prior to snowfall. Designate walkways that avoid such hazards.
- Avoid any ice or snow-covered location where a hazard may exist; use a vehicle rather than walking, when possible.
- If you cannot avoid the area, wear shoes or boots that provide traction on snow and ice or use YakTrax™, ice cleats, or similar product (see links below). *Note* - Additional hazards could be introduced if these types of footwear are worn inside, on stairs, etc. Be sure appropriate donning and doffing areas are established.
- Inspect your footwear before wearing it.
- Ensure that your safety plan or Activity Hazard Analysis is up to date and adequately addresses hazards of winter work environments.

How to Walk in Icy Conditions

- Give yourself sufficient time and plan your route.
- Keep your eyes on where you are stepping and GO S-L-O-W-L-Y!! This will help your reaction time to changes in traction.
- Be aware of hazards you might have missed such as black ice and ice covered by snow.
- Keep both hands free for balance --NOT in your pockets.
- When handrails are available – USE THEM!
- Wear gloves to keep hands warm and readily available to hold snow-covered handrails.
- Take short steps or shuffle for stability, bend slightly, and walk flat-footed. Keep your center of gravity directly over your feet as much as possible. Keep your eyes on where you are going. Remember the "Walk like a penguin" method.
- Don't carry too much or block your line of vision.
- Be prepared to fall!

How to Fall:

Have you ever practiced falling? In the event that you slip and fall while walking in the office, to your car, or on a project site try and remember the following:

- Do not try to break your fall by sticking out your arm, elbow or wrist due to potential for fractures or ligament damage.
- Try instead to create a large surface area by either outstretching your arm and landing on your side or tucking your arm and curling to a ball and landing on your back.

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Getting in and out of Vehicles on icy/snowy surfaces
Use special care when entering and exiting vehicles:

- Use the vehicle for support
- Step out planting foot firmly on the ground
- Have hands free for support

8.53 Stream Crossing

Traversing streams present significant hazards, including drowning, hypothermia, and abrasions. When crossing streams, be sure to implement the bulleted items below.

- When walking in streams, first plan the route. Look ahead for exits should there be any difficulty during the crossing, and "read" the water for spots to avoid such as drop offs, sunken logs, and tricky currents.
- Do seek out the safest route – narrow, low flow, shallow. Evaluate deeper and faster moving sections with caution. Backtracking is often dangerous or impossible once committed.
- If streams to be crossed are deeper than "knee deep", find an alternate crossing location that is less deep.
- Streams should be crossed while facing upstream, stepping side to side, and using a sturdy walking stick. When possible, wade a stream diagonally, moving downstream. Move slowly, keeping the foot on the upstream side in the lead and pointed forward. Your rear, or anchor, foot should point downstream and be at right angles to the lead foot. Move the lead foot forward about half a step, feeling for a solid hold. Next, move the anchor foot forward the same distance – shuffle across so that your anchor foot never passes the lead. This way both feet are always in position to lend support. If you must turn around, do so toward the upstream direction.
- Don't attempt to cross above rocky rapids or a cascade. Step on submersed rocks with great care.
- If you are working in streams, algae covered rocks should be assumed slippery until tested. Always be alert for unstable and extremely slippery rocks.
- Rocks with green moss or attached plants offer better traction or even better, look for gravel and sand pockets among the stream boulders, which are much more stable, and use a wading staff (if not carrying one, find a suitable one nearby) to steady your balance while crossing. Use a solid wading staff instead of the collapsible type.
- Be cautious of areas where there are submerged or partially submerged trees/tree branches – these can create entanglement hazards during a crossing or a "swim".
- If streams are crossed that are deeper than "crotch deep", personnel must use either ropes and/or wear chest waders.
- Choose the right waders (with RHSM/SC involvement).
- Footwear with felt-bottom soles are ideal for rocky bottom streams. The rough texture cuts through algae growing on the rocks and grips well. For very slippery conditions, consider studded felt soles or a slipover, studded sandal. However, felt soles do not provide good traction on muddy, slippery banks. Cleated soles work well for mud or sand bottom streams (a hard molded tread pattern similar to a hiking boot).
- Wear a wading belt with chest waiters to keep your waders from billowing out like a parachute; the currents will carry you and move you in ways you don't want to move.
- Never wade alone.
- If the wader fills with water, don't panic. Waders full of water weigh less in water than on land and the water inside doesn't add any weight as long as you are in the water. Also a common fear is that air trapped

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in the waders will raise the feet higher than the head and force the face underwater is unfounded. Waders do streamline your legs and kicking is useless. Follow these steps if the waders fill with water:

  - Don't try to take them off in the water
  - In calm water, wade or swim to shore
  - In fast-moving water, ride the current:
  - Pull your feet up in front of you, bend your knees
  - Point your feet downstream (so the feet, not the head will bounce off the rocks)
  - Sculling with your hands will help direct to the nearest shallow area
  - When you reach calm water, go ashore and empty your waders
  - Don't waste energy in the vertical position going for the bottom. This position is virtually impossible to maintain and leads quickly to exhaustion (the major cause of drowning).
  - Concentrate on getting out of the water and not saving the equipment.

- The higher the elevation you are at, the steeper the stream gradient is. This means the stream can rise quicker and return to lower flow more quickly.
- Always wait out a swollen stream if at all possible.
- If you do slip into the water and are being swept downstream, don't panic. Cold water will be a shock for 2-3 seconds. Pull your knees up, face your feet downstream and lean back, using your hands as best you can to navigate and get to the bank. Keep your head up; you don't want your head underwater banging into rocks. If you stay calm, you can reach water where you can stand up or swim to the bank.
- When walking along stream banks and not entering streams, wear work boots.

8.54 Traffic Control

(Reference CH2M HILL SOP HSE-216, *Traffic Control*)

The following precautions must be taken when working around traffic, and in or near an area where traffic controls have been established by a sub contractor. Ensure the requirements in the referenced SOP are followed.

- CH2MHILL employees must never perform traffic control activities for 3rd party subcontractors.
- Exercise caution when exiting traveled way or parking along street – avoid sudden stops, use flashers, etc.
- Park in a manner that will allow for safe exit from vehicle, and where practicable, park vehicle so that it can serve as a barrier.
- All staff working adjacent to traveled way or within work area must wear reflective/high-visibility safety vests.
- Eye protection should be worn to protect from flying debris.
- Remain aware of factors that influence traffic related hazards and required controls – sun glare, rain, wind, flash flooding, limited sight-distance, hills, curves, guardrails, width of shoulder (i.e., breakdown lane), etc.
- Always remain aware of an escape route (e.g., behind an established barrier, parked vehicle, guardrail, etc).
- Always pay attention to moving traffic – never assume drivers are looking out for you.
- Work as far from traveled way as possible to avoid creating confusion for drivers.

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- When workers must face away from traffic, a “buddy system” should be used, where one worker is looking towards traffic.
- When working on highway projects, obtain a copy of the contractor’s traffic control plan.
- Work area should be protected by a physical barrier – such as a K-rail or Jersey barrier.
- Review traffic control devices to ensure that they are adequate to protect your work area. Traffic control devices should: 1) convey a clear meaning, 2) command respect of road users, and 3) give adequate time for proper traffic response. The adequacy of these devices are dependent on limited sight distance, proximity to ramps or intersections, restrictive width, duration of job, and traffic volume, speed, and proximity.
- Either a barrier or shadow vehicle should be positioned a considerable distance ahead of the work area. The vehicle should be equipped with a flashing arrow sign and truck-mounted crash cushion (TMCC). All vehicles within 40 feet (12.2 meters) of traffic should have an orange flashing hazard light atop the vehicle.
- Except on highways, flaggers should be used when 1) two-way traffic is reduced to using one common lane, 2) driver visibility is impaired or limited, 3) project vehicles enter or exit traffic in an unexpected manner, or 4) the use of a flagger enhances established traffic warning systems.
- Lookouts should be used when physical barriers are not available or practical. The lookout continually watches approaching traffic for signs of erratic driver behavior and warns workers.
- Vehicles should be parked at least 40 feet (12.2 meters) away from the work zone and traffic. Minimize the amount of time that you will have your back to oncoming traffic.
- Traffic control training module on the VO shall be completed when CH2M HILL workers who work in and around roadways and who exposed to public vehicular traffic.

8.55 Utilities (underground)

An assessment for underground utilities must be conducted where there is a potential to contact underground utilities or similar subsurface obstructions during intrusive activities. Intrusive activities include excavation, trenching, drilling, hand augering, soil sampling, or similar activities.

The assessment must be conducted <u>before any intrusive subsurface activity</u> and must include at least the following elements:

- A background and records assessment of known utilities or other subsurface obstructions.
- Contacting and using the designated local utility locating service.
- Conducting an independent field survey to identify, locate, and mark potential underground utilities or subsurface obstructions. *Note: This is independent of, and in addition to, any utility survey conducted by the designated local utility locating service above.*
- A visual survey of the area to validate the chosen location.

When any of these steps identifies an underground utility within 5 feet (1.5 meters) of intrusive work, then non-aggressive means must be used to physically locate the utility before a drill rig, backhoe, excavator or other aggressive method is used.

Aggressive methods are never allowed within 2 feet of an identified high risk utility (see paragraph below).

Any deviation from these requirements must be approved by the Responsible HS Manager and the Project Manager.

Background and Records Assessment of Known Utilities

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Identify any client- or location-specific permit and/or procedural requirements (e.g., dig permit or intrusive work permit) for subsurface activities. For military installations, contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.

Obtain available utility diagrams and/or as-built drawings for the facility.

Review locations of possible subsurface utilities including sanitary and storm sewers, electrical lines, water supply lines, natural gas lines, fuel tanks and lines, communication lines, lighting protection systems, etc. Note: Use caution in relying on as-built drawings as they are rarely 100 percent accurate.

Request that a facility contact with knowledge of utility locations review and approve proposed locations of intrusive work.

Designated Local Utility Locating Service

Contact your designated local utility locating service (e.g., Dig-Safe, Blue Stake, One Call) to identify and mark the location of utilities. Call 811 in the U.S. or go to www.call811.com to identify the appropriate local service group. Contacting the local utility locating service is a legal requirement in most jurisdictions. Please note that some states (e.g., Washington) require that the entity performing the intrusive work be the responsible for contacting the local service. Where subcontractors are responsible for the intrusive work, CH2M HILL personnel shall verify the subcontractor has contacted the designated local utility locating service.

Independent Field Survey (Utility Locate)

The organization conducting the intrusive work (CH2M HILL or subcontractor) shall arrange for an independent field survey to identify, locate, and mark any potential subsurface utilities in the work area. This survey is in addition to any utility survey conducted by the designated local utility locating service.

The independent field survey provider shall determine the most appropriate instrumentation/technique or combinations of instrumentation/techniques to identify subsurface utilities based on their experience and expertise, types of utilities anticipated to be present, and specific site conditions.

A CH2M HILL or subcontractor representative must be present during the independent field survey to observe the utility locate and verify that the work area and utilities have been properly identified and marked. If there is any question that the survey was not performed adequately or the individual was not qualified, then arrangements must be made to obtain a qualified utility locate service to re-survey the area. Obtain documentation of the survey and clearances in writing and signed by the party conducting the clearance. Maintain all documentation in the project file.

If the site owner (military installation or client) can provide the independent field survey, CH2M HILL or the subcontractor shall ensure that the survey includes:

- Physically walking the area to verify the work location and identify, locate, and mark underground utility locations:
- Having qualified staff available and instrumentation to conduct the locate;
- Agreeing to document the survey and clearances in writing.
- Should any of the above criteria not be met, CH2M HILL or subcontractor must arrange for an alternate independent utility locate service to perform the survey.
- The markings from utility surveys must be protected and preserved until the markings are no longer required. If the utility location markings are destroyed or removed before intrusive work commences or is completed, the PM, SC, or designee must notify the independent utility locate service or the designated local utility locating service to resurvey and remark the area.

Visual Assessment before and during Intrusive Activities

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Perform a “360 degree” assessment. Walk the area and inspect for utility-related items such as valve caps, previous linear cuts, patchwork in pavement, hydrants, manholes, utility vaults, drains, and vent risers in and around the dig area.

The visual survey shall include all surface landmarks, including manholes, previous liner cuts, patchwork in pavement, pad-mounted transformers, utility poles with risers, storm sewer drains, utility vaults, and fire hydrants.

If any unanticipated items are found, conduct further research before initiating intrusive activities and implement any actions needed to avoid striking the utility or obstruction.

Subsurface Activities within 5 feet of an Underground Utility or if there is Uncertainty

When aggressive intrusive activities will be conducted within 5 feet (1.5 meters) of an underground utility or when there is uncertainty about utility locations, locations must be physically verified by non-aggressive means such as air or water knifing, hand digging, or human powered hand augering. Non-conductive tools must be used if electrical hazards may be present. If intrusive activities are within 5 feet (1.5 meters) and parallel to a marked existing utility, the utility location must be exposed and verified by non-aggressive methods every 100 feet (30.5 meters). Check to see if the utility can be isolated during intrusive work.

Intrusive Activities within 2 feet of an Underground Utility

Use non-aggressive methods (hand digging, vacuum excavation, etc.) to perform intrusive activities within 2 feet of a high risk utility (i.e., a utility that cannot be de-energized or would cause significant impacts to repair/replace). Hazardous utilities shall be de-energized whenever possible.

Spotter

A spotter shall be used to monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon, presence of pea gravel or sand in soils, presence of concrete or other debris in soils, refusal of auger or excavating equipment). If any suspicious conditions are encountered stop work immediately and contact the PM or RHSM to evaluate the situation. The spotter must have a method to alert an operator to stop the intrusive activity (e.g., air horn, hand signals).

8.56 Utilities (overhead)

Proximity to Power Lines

It must be determined whether equipment operations including, positioning, and traveling will occur in proximity to power lines within 20 feet (6.1 meters) for line voltage up to 350 kilo volts (kV), and within 50 feet (15.2 meters) for line voltage between 350 kV to 1000 kV. For power lines over 1000 kV, the distance must be determined by the utility/operator or qualified registered professional engineer in electrical power transmission and distribution.

Operations adjacent to overhead power lines are PROHIBITED unless one of the following conditions is satisfied:

- Power has been shut off, positive means (such as lockout) have been taken to prevent the lines from being energized, lines have been tested to confirm the outage, and the utility company has provided a signed certification of the outage.
- The minimum clearance from energized overhead lines is as shown in the table below, or the equipment will be repositioned and blocked to ensure that no part, including cables, can come within the minimum clearances shown in the table.

MINIMUM DISTANCES FROM POWERLINES

Powerlines Nominal System Kv	Minimum Required Distance, Feet (Meters)
0-50	10 (3.0)
50-200	15 (4.6)

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201-350	20 (6.1)
351-500	25 (7.6)
501-750	35 (10.7)
751-1000	45 (13.7)
Over 1000	Established by utility owner/operator or by a professional engineer in electrical power transmission/distribution

(These distances have been determined to eliminate the potential for arcing based on the line voltage.)

- The power line(s) has been isolated through the use of insulating blankets which have been properly placed by the utility. If insulating blankets are used, the utility will determine the minimum safe operating distance; get this determination in writing with the utility representative's signature.
- All inquiries regarding electric utilities must be made in writing and a written confirmation of the outage/isolation must be received by the PM prior to the start of work.

8.57 Vacuum Trucks

When CH2M HILL personnel are exposed to vacuum truck operations, the following safe work practices/hazard controls shall be implemented.

- A pre-operational check should be performed on the vacuum truck before use. Operators must be familiar with the operator's manual.
- Operators of vacuum trucks should be trained and familiar with the equipment. At least one person should be operating the boom and one person signaling and assisting the boom operator.
- Before use the hoses and lines should be checked for fraying and connections checked for leakage. Proper selection of hose diameter and type of hose (smooth bore hose vs. corrugated hose) is vital before the job is performed.
- The amount of force produced by a vacuum truck can kill hose operators. If an eight-inch hose gets stuck to your body at 27 inches Hg, it can be fatal. All trucks should be equipped with an emergency release the hose operator or assistant can initiate if a worker gets sucked into a hose. A remote release, manual release near the truck and an inline "T" should be present on the truck. The inline "T" should be installed between the very last section of hose and the working section of hose. The cord that releases the in-line relief should be tethered to the hose handler's belt or a watch buddy should be nearby holding the cord and ready to relieve in the event of an emergency. Operators should never attempt to vacuum hose with any part of their body to check for suction.
- Tanks on vacuum trucks are a confined space. Before the tank is opened and anyone enters a confined space assessment should be performed.
- The truck should always be grounded before use. The static electricity produced when sucking materials into the system can produce a spark and ignite anything in the tank or hose. Use of a grounding wire will prevent static electric explosions. Vacuum trucks should not be used to pump mixtures with a flash point less than 140 degrees or less - this is an accepted industry standard - refer to the operators manual for more information.
- When positioning truck to work, be extra cautions of personnel and other equipment located next to truck.
- Wet and dry material should not be mixed in the tank.
- When swinging the boom, change directions slowly.

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- Do not load dump body beyond rated capacity. Be aware of possible load surge when turning or braking.

8.58 Vinyl Chloride

(Reference CH2M HILL, SOP HSE-512, *Vinyl Chloride*)

Vinyl Chloride is considered a "Confirmed Human Carcinogen." Vinyl Chloride has a mild, sweet, chloroform-like odor.

CH2M HILL is required to control employee workplace exposure to vinyl chloride when personal exposures are at or above 1.0 ppm as an 8-hour time-weighted average (TWA) or above 5.0 ppm short term exposure limit (STEL), by implementing a program that meets the requirements of the Occupational Safety and Health Administration (OSHA) Vinyl Chloride standard, 29 CFR 1910.1017. The elements of the CH2M HILL vinyl chloride program include the following:

- Exposure monitoring
- Methods of control, including personal protective equipment (PPE) and respirators
- Medical surveillance
- Training on hazards of vinyl chloride and control measures (includes project-specific training and the computer-based training on CH2M HILL's Virtual Office, *Vinyl Chloride)*
- Record keeping requirements

If air monitoring indicates there is potential exposure at the action level concentrations above, notify the RHSM to ensure the above have been adequately addressed. Other exposure control measures include:

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met.
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas.
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person.
- Review the fact sheet included as an attachment to the SOP.

8.59 Welding and Cutting

(Reference CH2M HILL, SOP-314, *Welding and Cutting*)

Below are the hazard controls and safe work practices to follow when working around or performing welding and cutting. Ensure the requirements in the referenced SOP are followed.

- Workers designated to operate welding and cutting equipment shall have been properly instructed and qualified to operate such equipment.
- Before welding or cutting is permitted, the area shall be inspected by the individual responsible for authorizing the welding or cutting operation. The authorization, preferably in the form of a written permit, shall detail precautions to be taken before work is to begin.
- Suitable fire extinguishing equipment shall be immediately available in the work area.
- Flame-resistant blankets shall be used to control sparks produced by welding and cutting operations from traveling to lower levels or adjacent surfaces.
- If the valve on a fuel-gas cylinder is found to leak around the valve stem, the valve shall be closed and the gland nut tightened. If this does not stop the leak, the cylinder is to be tagged and removed from service.

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- Nothing should be placed on top of a cylinder or manifold that will damage it or interfere with the quick closing of the valve.
- Flow gages and regulators shall be inspected prior to use and removed from cylinders when not in use.
- Hoses, leads, and cables shall be not be routed through doorways and walkways unless covered, elevated, or protected from damage. Where hoses, leads, and cables pass through wall openings, adequate protection shall be provided to prevent damage.
- Flash arresters shall be installed at the torch handle.
- Arc welding electrodes shall not be struck against compressed gas cylinders to strike an arc.
- All arc welding or cutting operations shall be shielded by noncombustible or flame resistant screens to protect employees or other persons in the vicinity from the direct rays of the arc.
- Proper ventilation shall be provided so as to maintain the level of contaminants in the breathing zone of welders below applicable permissible exposure limits.
- Minimum personal protective equipment includes the following:
  - Safety-toed shoes or boots, hard hats, and safety glasses
  - Body protection (such as gloves, coveralls, or Tyvek) when chemical hazards exist
  - Hearing protection when working in close proximity to loud equipment and machinery
  - Protective clothing and gloves to prevent burns
  - Suitable eye protective equipment for the type of welding or cutting performed
  - Opaque screens to block arc flash from arc welding and cutting operations
  - Mechanical ventilation systems for welding and cutting operations conducted in enclosed or confined spaces
  - Air monitoring or sampling equipment to evaluate airborne concentrations of welding and cutting contaminants
  - Respiratory protection when airborne concentrations of contaminants exceed regulatory limits

8.59.1 Compressed Gas Cylinders

- Cylinders being transported, moved, or stored shall have valve protection caps installed. When transported by motor vehicle, hoisted, or carried, cylinders shall be in the vertical position.
- Oxygen cylinders in storage shall be separated from fuel-gas cylinders or combustible materials by a minimum of 20 feet (6.1 meters) or by a noncombustible barrier at least 5 feet (1.5 meters) high having a fire resistant rating of at least one half hour.
- Inside of buildings, cylinders shall be stored in well-ventilated, dry locations at least 20 feet (6.1 meters) from highly combustible materials. Cylinders should be stored in definitely assigned places away from elevators, stairs, or gangways. Assigned storage areas shall be located where cylinders will not be knocked over or damaged.
- During use, cylinders shall be kept far enough away from the actual welding and cutting operations to prevent sparks, hot slag, or flames from reaching them. When impractical, fire resistant shields shall be provided.
- Cylinders containing oxygen or fuel-gas shall not be taken into confined spaces.
- If cylinders are frozen, warm (not boiling) water shall be used to thaw them.

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8.59.2 Welding and Cutting Equipment

- Fuel-gas and oxygen hoses shall be easily distinguishable from each other and shall not be interchangeable between fuel-gas and oxygen.
- Hoses shall be inspected at the beginning of each shift. Defective hoses shall be removed from service.
- Hose couplings shall be designed to be disconnected with a rotary motion, not by straight pull.
- Torches shall be inspected at the beginning of each shift for leaking valves, connections, and couplings. Defective torches shall be removed from service.
- Torches shall be ignited with friction lighters, not open flames or hot work.

8.59.3 Arc Welding and Cutting

- Only manual electrode holders that are designed for arc welding or cutting and are capable of safely handling the maximum rated current shall be used.
- Only cable that is free from repair or splices for a minimum distance of 10 feet (3 meters) from the cable's attachment to the electrode holder shall be used.
- Any current-carrying part that arc welders or cutters grip in their hand, as well as the outer surfaces of the jaws of the holder, shall be fully insulated against the maximum voltage encountered to ground.
- The frames of arc welding or cutting machines shall be grounded. Grounding circuits, other than by means of the structure, shall be checked to ensure that the circuit between the ground and the grounded power conductor has resistance low enough to permit sufficient current flow to cause the fuse or circuit breaker to interrupt the current.
- When electrode holders are left unattended, the electrode shall be removed and the holder placed where it cannot harm employees.
- Hot electrode holders shall not be dipped in water to cool them.
- When welding or cutting is stopped for any appreciable length of time, or before the welding or cutting machine is moved, the power shall be shut off.
- Before starting welding or cutting operations, all connections to the machine shall be checked.

8.59.4 Toxic Fumes and Gases

- General mechanical or local exhaust ventilation shall be provided when welding or cutting in a confined space.
- Contaminated air exhausted from the work area shall be discharged into the open air or otherwise clear of the intake air.
- Other employees exposed to the same atmosphere as the welder or cutter shall be protected in the same manner as the welder or cutter.
- In enclosed spaces, all surfaces covered with toxic preservative coatings shall be stripped to a distance of at least four inches from the area to be heated, or the worker shall be protected with an air-line respirator.
- Welding or cutting in an enclosed space shall be performed with local exhaust ventilation or air-line respirators when the following metal bases, fillers, or coatings are involved: lead, cadmium, mercury, zinc, stainless steel, or beryllium.
- Employees welding or cutting in the open air and who are exposed to the metals noted above shall be protected with filter-type respirators; however, when working with beryllium, the employee shall be protected with an air-line respirator.

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8.59.5 Fire Prevention

- When the potential for an explosive atmosphere exists in the immediate area of welding or cutting operations, air monitoring instruments shall be used to verify that no explosive atmosphere is present before or during welding or cutting operations.
- When welding or cutting on walls, floors, or ceilings, the same precautions shall be taken on the opposite side as for the welding or cutting side.
- Whenever openings or cracks in the floor, walls, or doorways cannot be closed, precautions shall be taken to prevent combustible materials in other areas from coming in contact with sparks.
- To prevent fire in enclosed spaces, the gas supply to the torch shall be shut off at some point outside the enclosed space whenever the torch is not in use or is left unattended.
- Drums or hollow structures that have contained toxic or flammable substances shall be filled with water or thoroughly cleaned, ventilated, and tested before welding or cutting on them.
- Before heat is applied to a drum, container, or structure, a vent or opening shall be provided to release built-up pressure during the application of heat.
- Before welding or cutting on any surface covered by a preservative coating whose flammability is unknown, a competent person shall test to determine its flammability.
- Preservative coatings shall be considered highly flammable when scrapings burn rapidly.
- When preservative coatings are determined to be highly flammable, they shall be stripped from the area to be heated.

8.60 Working Around Material Handling Equipment

When CH2M HILL personnel are exposed to material handling equipment, the following safe work practices/hazard controls shall be implemented:

- Never approach operating equipment from the rear. Always make positive contact with the operator, and confirm that the operator has stopped the motion of the equipment.
- Never approach the side of operating equipment; remain outside of the swing and turning radius.
- Maintain distance from pinch points of operating equipment.
- Never turn your back on any operating equipment.
- Never climb onto operating equipment or operate contractor/subcontractor equipment.
- Never ride contractor/subcontractor equipment unless it is designed to accommodate passengers and equipped with firmly attached passenger seat.
- Never work or walk under a suspended load.
- Never use equipment as a personnel lift; do not ride excavator buckets or crane hooks.
- Always stay alert and maintain a safe distance from operating equipment, especially equipment on cross slopes and unstable terrain.
- Wear a high visibility safety vest or high visibility clothing.

8.61 Working Alone

(Reference CH2M HILL Core Standard, *Working Alone*)

Personnel can only be tasked to work alone by the Project Manager who shall assess potential hazards and appropriate control measures, with assistance from the Responsible Health and Safety Manager (RHSM).

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“Lone workers” with an accountability system in place is permitted, depending on the hazards presented during the execution of the task. Reference the “Lone Worker Protocol” included as an attachment to the project safety plan.

Only limited operations task are permitted to be performed alone. Activities that are not permitted to be performed by a lone worker include the following:

- Working at heights (e.g., on ladders, lifts, scaffolding);
- Energy isolation (e.g., lockout/tagout);
- Any entry into a confined space; and
- Work involving electricity or other hazardous equipment (e.g., chainsaws);
- Work over or near water; and
- Working in an area where there is an increased potential for violence.

An AHA shall be developed that shall include:

- Type or nature of work to be conducted by the lone worker;
- Location of the work
- Length of time the worker will be working alone; and
- Any characteristics of the individual working alone which may increase the risk to the worker (e.g., medical conditions).

The employee working alone shall at all times be equipped with a working voice communication device such as a cellular phone, satellite phone, personal alarms, or two-way radio to check-in to their project contact (s) at pre-determined times. For some work, a satellite-based communication system may be appropriate (i.e., a “SPOT” device).

Call-In System for Lone Worker Accountability

The employee working alone shall at all times be equipped with a working voice communication device such as a cellular phone, satellite phone, personal alarms, or two-way radio to check-in to their project contact (s) at pre-determined times.

Each time before going into the field, a “Call in contact Form” shall be completed by the lone worker and given to the call-in office worker contact prior to going into the field.

During field work, a copy of “The Lone Worker Call-In Contact Form” should be maintained by both the “Office Contact Worker” and the field-worker (“Lone Worker”). Lone Worker and Office Contact Worker must both have cell phones and each others’ phone number, plus one other alternate phone number.

Lone worker shall call the office contact worker when he/she has arrived on-site, before exiting his/her vehicle. On this phone call, a time shall be arranged for a “check-in” call to be made by the field worker, based on duration of task. On each “check-in” call a time should be arranged for the next “check-in” call. Document these times on the form.

Lone Worker shall carry his or her cell-phone throughout the field event and put the ringer on its loudest setting as wind or other noise can muffle the sound. If, for any reason the cell-phone becomes inoperable, the field-worker shall immediately stop work, leave the site and find an alternative method of contacting the Office Contact Worker to verify their safety and to inform them of the issue.

Work shall not proceed in the field until the Lone Worker has a working device that provides communication with the Office Contact Worker.

Upon completion of work activities, Lone Worker should pack up all materials and prepare to leave site. Then, before starting the engine of the vehicle to leave site, the Lone Worker should contact the office-worker and

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inform him or her that work is complete and that he or she is leaving the site. A final call shall be made by the lone work to the office worker to confirm he/she has reached their destination.

If at any time, the Office Contact Worker does not receive a “check-in” call at the scheduled time he/she should attempt to contact Lone Worker. If no contact is made then the Office Contact Worker should contact the facility contact person to check on the Lone Worker.

If no contact is made with the Lone Worker, then the Office Contact Worker shall contact the PM and/or RHSM to let them know they are going to inform emergency services inform that there is a possible emergency and instruct them to go to the field location and assist the Lone Worker. The Office Contact Worker will provide to emergency services the Lone Worker’s name, their last known location, vehicle description and their contact information.

Call in contact Form shall be completed by lone worker and given to call in contact prior to going into the field. Refer to the “Lone Worker Protocol” attached to the project safety plan.

8.62 Working Over Water

If any activities pose a risk to drowning implement the following during the activity:

- Fall protection should be provided to prevent personnel from falling into water. Where fall protection systems are not provided and the danger of drowning exists, U.S. Coast Guard-approved personal flotation devices (PFDs), or a life jacket, shall be worn.
- Provide employees with an approved (USCG for U.S. operations) life jacket or buoyant work vest.
  - Employees should inspect life jackets or work vests daily before use for defects. Do not use defective jackets or vests.
- Post ring buoys with at least 90 feet (27.4 meters) of 3/8-inch solid-braid polypropylene (or equal) line next to the work area. If the work area is large, post extra buoys 200 feet (61 meters) or less from each other.
- Provide at least one life saving skiff, immediately available at locations where employees are working over or adjacent to water.
  - Ensure the skiff is in the water and capable of being launched by one person and is equipped with both motor and oars.
- Designate at least one employee on site to respond to water emergencies and operate the skiff at times when there are employees above water.
  - If the designated skiff operator is not within visual range of the water, provide him or her with a radio or provide some form of communication to inform them of an emergency.
  - Designated employee should be able to reach a victim in the water within three to four minutes.
- Ensure at least one employee trained in CPR and first aid is on site during work activities.

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9. Physical Hazards and Controls

Physical hazards include exposure to temperature extremes, sun, noise, and radiation. If you encounter a physical hazard that has not been identified in this Handbook or the project safety plan, contact the RHSM so hazard controls can be addressed.

9.1 Noise

(Reference CH2M HILL SOP HSE-108, *Hearing Conservation*)

CH2M HILL is required to control employee exposure to occupational noise levels of 85 decibels, A-weighted, (dBA) and above by implementing a hearing conservation program that meets the requirements of the OSHA Occupational Noise Exposure standard, 29 CFR 1910.95. A noise assessment may be conducted by the RHSM or designee based on potential to emit noise above 85 dBA and also considering the frequency and duration of the task.

- Areas or equipment emitting noise at or above 90dBA shall be evaluated to determine feasible engineering controls. When engineering controls are not feasible, administrative controls can be developed and appropriate hearing protection will be provided.
- Areas or equipment emitting noise levels at or above 85 dBA, hearing protection must be worn.
- Employees exposed to 85 dBA or a noise dose of 50 percent must participate in the Hearing Conservation program including initial and annual (as required) audiograms.
- The RHSM will evaluate appropriate controls measures and work practices for employees who have experienced a standard threshold shift (STS) in their hearing.
- Employees who are exposed at or above the action level of 85 dBA are required to complete the online Noise Training Module located on CH2M HILL's virtual office.
- Hearing protection will be maintained in a clean and reliable condition, inspected prior to use and after any occurrence to identify any deterioration or damage, and damaged or deteriorated hearing protection repaired or discarded.
- In work areas where actual or potential high noise levels are present at any time, hearing protection must be worn by employees working or walking through the area.
- Areas where tasks requiring hearing protection are taking place may become hearing protection required areas as long as that specific task is taking place.
- High noise areas requiring hearing protection should be posted or employees must be informed of the requirements in an equivalent manner and a copy of the OSHA standard 29 CFR 1910.95 shall be posted in the workplace.

9.2 Ultraviolet Radiation (sun exposure)

Health effects regarding ultraviolet (UV) radiation are confined to the skin and eyes. Overexposure can result in many skin conditions, including erythema (redness or sunburn), photoallergy (skin rash), phototoxicity (extreme sunburn acquired during short exposures to UV radiation while on certain medications), premature skin aging, and numerous types of skin cancer. Implement the following controls to avoid sunburn.

Limit Exposure Time

- Rotate staff so the same personnel are not exposed all of the time.
- Limit exposure time when UV radiation is at peak levels (approximately 2 hours before and after the sun is at its highest point in the sky).
- Avoid exposure to the sun, or take extra precautions when the UV index rating is high.

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Provide Shade

- Take lunch and breaks in shaded areas.
- Create shade or shelter through the use of umbrellas, tents, and canopies.
- Fabrics such as canvas, sailcloth, awning material and synthetic shade cloth create good UV radiation protection.
- Check the UV protection of the materials before buying them. Seek protection levels of 95 percent or greater, and check the protection levels for different colors.

Clothing

- Reduce UV radiation damage by wearing proper clothing; for example, long sleeved shirts with collars, and long pants. The fabric should be closely woven and should not let light through.
- Head protection should be worn to protect the face, ears, and neck. Wide-brimmed hats with a neck flap or "Foreign Legion" style caps offer added protection.
- Wear UV-protective sunglasses or safety glasses. These should fit closely to the face. Wrap-around style glasses provide the best protection.

Sunscreen

- Apply sunscreen generously to all exposed skin surfaces at least 20 minutes before exposure, allowing time for it to adhere to the skin.
- Re-apply sunscreen at least every 2 hours, and more frequently when sweating or performing activities where sunscreen may be wiped off.
- Choose a sunscreen with a high sun protection factor (SPF). Most dermatologists advocate SPF 30 or higher for significant sun exposure.
- Waterproof sunscreens should be selected for use in or near water, and by those who perspire sufficiently to wash off non-waterproof products.
- Check for expiration dates, because most sunscreens are only good for about 3 years. Store in a cool place out of the sun.
- No sunscreen provides 100 percent protection against UV radiation. Other precautions must be taken to avoid overexposure.

9.3 Temperature Extremes

(Reference CH2M HILL SOP HSE-211, *Heat and Cold Stress*)

Each employee is responsible for the following:

- Recognizing the symptoms of heat or cold stress;
- Taking appropriate precautionary measures to minimize their risk of exposure to temperature extremes (see following sections); and
- Communicating any concerns regarding heat and cold stress to their supervisor or SC.

9.3.1 Heat

California has a specific heat illness prevention regulation that must be implemented. This includes,

- Having enough water onsite so that each worker can consume at a minimum, one quart per hour per shift.
- Frequent reminders and/or water breaks shall be taken so that each person can consume enough water.

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- Access to shade (i.e., blockage from direct sunlight) shall be provided at all times and shall be reasonably close to the work area. Keep in mind that a vehicle or other enclosed are with no air conditioning is NOT considered shade. Must be a well ventilated area or have air conditioning.
- Workers shall be allowed to take a work-free cool-down rest/recovery period in the shade for a minimum of five minutes at any time when they feel the need to do so to protect themselves from overheating, or at the first sign of heat illness-related symptoms. (NOTE: If heat related symptoms are occurring, contact the RHSM).
- Training on risk factors, signs and symptoms of heat illness, importance of hydration and acclimatization, and importance of reporting symptoms and what to do in case of heat illness emergency, and contacting emergency medical services (see sections that follow).

Heat-related illnesses are caused by more than just temperature and humidity factors.

Physical fitness influences a person's ability to perform work under heat loads. At a given level of work, the more fit a person is, the less the physiological strain, the lower the heart rate, the lower the body temperature (indicates less retrained body heat—a rise in internal temperature precipitates heat injury), and the more efficient the sweating mechanism.

Acclimatization is a gradual physiological adaptation that improves an individual's ability to tolerate heat stress. Acclimatization requires physical activity under heat-stress conditions similar to those anticipated for the work. With a recent history of heat-stress exposures of at least two continuous hours per day for 5 of the last 7 days to 10 of the last 14 days, a worker can be considered acclimatized. Its loss begins when the activity under those heat-stress conditions is discontinued, and a noticeable loss occurs after 4 days and may be completely lost in three to four weeks. Because acclimatization is to the level of the heat-stress exposure, a person will not be fully acclimatized to a sudden higher level; such as during a heat wave.

Dehydration reduces body water volume. This reduces the body's sweating capacity and directly affects its ability to dissipate excess heat.

The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). **Heat dissipation** is a function of surface area, while heat production depends on body mass. Therefore, overweight individuals (those with a low ratio) are more susceptible to heat-related illnesses because they produce more heat per unit of surface area than if they were thinner. Monitor these persons carefully if heat stress is likely.

When wearing **impermeable clothing**, the weight of an individual is not as important in determining the ability to dissipate excess heat because the primary heat dissipation mechanism, evaporation of sweat, is ineffective.

SYMPTOMS AND TREATMENT OF HEAT STRESS

	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!

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Precautions

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50°Fahrenheit (10 degrees Celsius [C]) to 60°Fahrenheit (F) (15.6 degrees C) should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons (7.5 liters) per day. Remind employees to drink water throughout their work shift.
- Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate to site work conditions by slowly increasing workloads; for example, do not begin site work with extremely demanding activities. Closely monitor employees during their first 14 days of work in the field.
- Supervisors and SCs must continually observe employees throughout the work shift for signs and symptoms of heat stress or illness. Employees must monitor themselves for heat stress as well as observe their co-workers.
- Effective communication must be maintained with employees throughout the work shift either by voice, observation, or electronic device.
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shade to protect personnel against radiant heat (sun, flames, hot metal).
- Use portable fans for convection cooling or in extreme heat conditions, an air-conditioned rest area when needed.
- In hot weather, rotate shifts of workers.
- Maintain good hygiene standards by frequent changes of clothing and showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should consult medical personnel.
- Brief employees initially before the project work begins and routinely as part of the daily safety briefing, on the signs and symptoms of heat-relatedness illnesses, precautions and emergency procedures to follow as described in the project safety plan.
- Observe one another for signs of heat stress. PREVENTION and communication is key.

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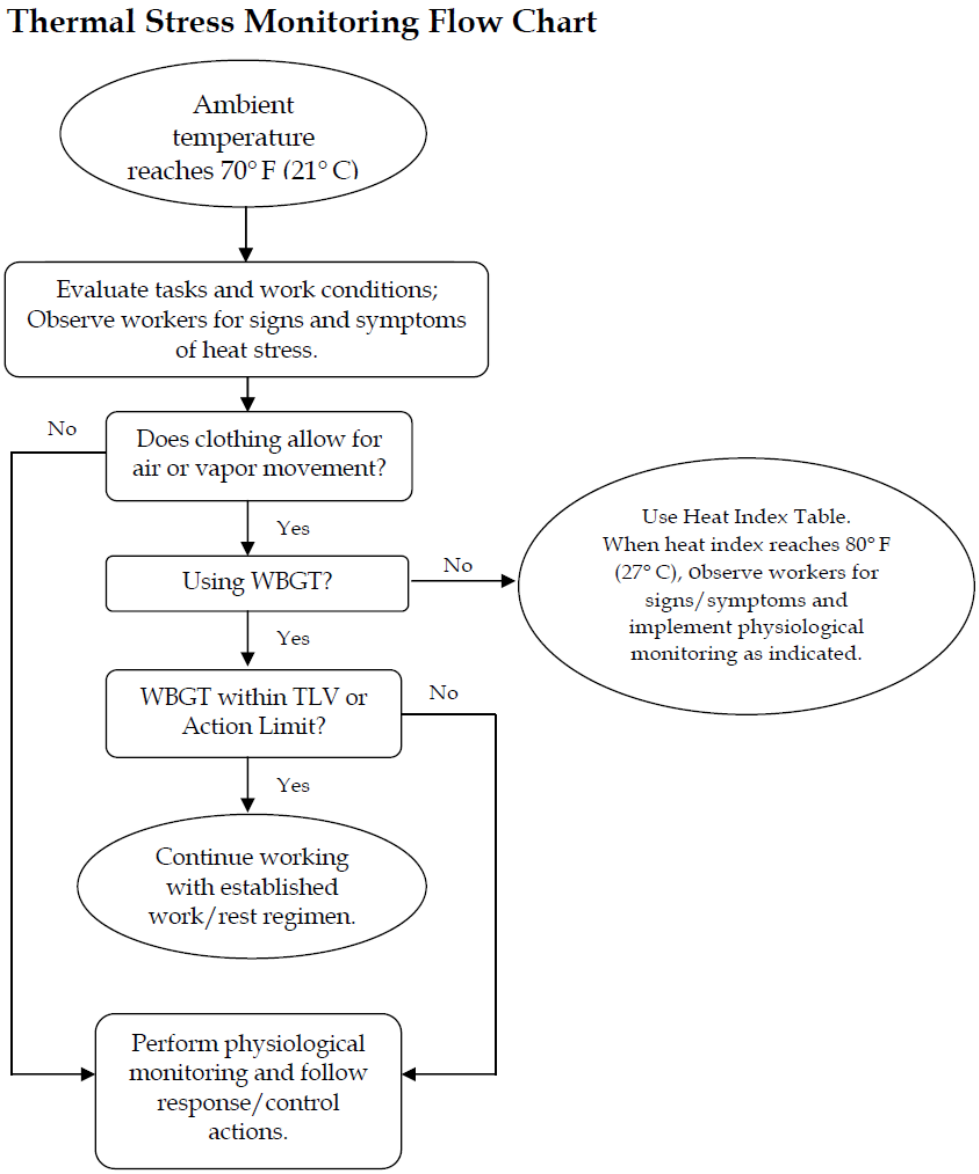
Thermal Stress Monitoring



Permeable Clothing – Monitoring Using WBGT

A Wet Bulb Globe Thermometer (WBGT) is the established and preferred means of measuring the environmental factors associated with heat stress and for providing indication of when physiological monitoring or rest regimens should be incorporated into the work schedule. The WBGT is the composite temperature used to estimate the effect of temperature, humidity, wind speed, and solar radiation on the human body.

When permeable work clothes are worn (street clothes or clothing ensembles over modesty clothes), physiological monitoring may be required based on the outcome of the WBGT measurements, taking into account the clothing adjustment factors. Use of the WBGT should generally begin when the heat index reaches 80° F (27° C) as indicated in the Heat Index Table below, or when workers exhibit symptoms of heat stress as indicated above.

If the WBGT is within the TLV (acclimatized workers) or Action Limit (unacclimatized workers) per the tables below, then work may continue while maintaining the established work/rest regimen. If the WBGT reading meets or exceeds either the TLV or Action Level for a work/rest regimen of 15 minutes work and 45 minutes rest, then physiological monitoring will be implemented.

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Screening Criteria for TLV and Action Limit for Heat Stress Exposure

Allocation of work in a cycle of work and recovery	TLV (WBGT Values in ˚F/C˚) (Acclimatized Workers)				Action Limit (WBGT Values in ˚F/˚C˚) (Unacclimatized Workers)			
	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
75-100%	88/31	82/28	—	—	82/28	77/25	—	—
50-75%	88/31	84/29	82/28	—	83/29	79/26	75/24	—
25-50%	90/32	86/30	84/29	82/28	85/30	81/27	78/26	76/25
0-25%	91/33	89/32	87/31	86/30	86/30	84/29	82/28	81/27

Work Category Descriptions:

Light	Sitting or standing with light manual work using hands or arms; occasional walking.
Moderate	Sustained moderate hand, arm, and leg work; light pushing and pulling; normal walking.
Heavy	Intense arm and trunk work, carrying, shoveling, manually sawing, pushing and pulling heavy loads, walking at a fast pace.
Very Heavy	Very intense activity at fast to maximum pace.

Notes:
WBGT values are expressed to the nearest degree.
"—"Dashes indicate the need for physiological monitoring because screening criteria are not recommended for this type of work.

Clothing Adjustment Factors for Some Clothing Ensembles*

Clothing Type	Addition to WBGT ˚F/˚C˚
Work Clothes (sleeved shirt and pants)	0/0
Cloth (woven material) coveralls	0/0
Double-layer woven clothing	5.4/3
Polypropylene coveralls	0.9/0.5
Limited Use Vapor barrier coveralls	19.8/11

* These values must not be used for completely encapsulating (impermeable) coveralls/suits. Coveralls assume that only modesty clothing is worn beneath.

Thermal Stress Monitoring – Permeable or Impermeable Clothing

When **permeable work clothes** are worn (street clothes or clothing ensembles over street clothes), regularly observe workers for signs and symptoms of heat stress and implement physiological monitoring as indicated below. This should start when the heat index reaches 80° F (27° C) [see Heat Index Table below], or sooner if workers exhibit symptoms of heat stress indicated in the table above. These heat index values were devised for shady, light wind conditions; exposure to full sunshine can increase the values by up to 15°F (8°C). Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

When wearing **impermeable clothing** (e.g., clothing doesn't allow for air or water vapor movement such as Tyvek), physiological monitoring as described below shall be conducted when the ambient temperature reaches 70° F (21° C) or sooner when climatic conditions may present greater risk of heat stress combined with wearing unique variations of impermeable clothing, or workers exhibit symptoms of heat stress

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Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	126	130					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Streuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Heat Index	Possible Heat Disorders	Minimum Frequency of Physiological Monitoring
80°F - 90°F (27°C - 32°C)	Fatigue possible with prolonged exposure and/or physical activity	Conduct initial monitoring as baseline and observe workers for signs of heat stress and implement physiological monitoring if warranted.
90°F - 105°F (32°C - 41°C)	Sunstroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity	Conduct initial monitoring as baseline, then at least every hour, or sooner, if signs of heat stress are observed.
105°F - 130°F (41°C - 54°C)	Sunstroke, heat cramps, or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity.	Conduct initial monitoring as baseline, then every 30 minutes or sooner if signs of heat stress are observed.
130°F or Higher (54°C or Higher)	Heat/Sunstroke highly likely with continued exposure.	Conduct initial monitoring as baseline, then every 15 minutes or sooner if signs of heat stress are observed.

Source: National Weather Service

Physiological Monitoring and Associated Actions

For employees wearing permeable clothing, follow the minimum frequency of physiological monitoring listed in the Heat Index Table.

For employees wearing impermeable clothing, physiological monitoring should begin initially at a 15 minute interval, then if the employee's heart rate or body temperature is within acceptable limits, conduct the subsequent physiological monitoring at 30 minutes, and follow the established regimen protocol below.

When physiological monitoring is required, use either radial pulse or aural temperature and follow actions below:

- The sustained heart rate during the work cycle should remain below 180 beats per minute (bpm) minus the individual's age (e.g., 180 – 35 year old person = 145 bpm). The sustained heart rate can be estimated by measuring the heart rate at the radial pulse for 30 seconds as quickly as possible prior to starting the rest period.

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- The heart rate after one minute rest period should not exceed 120 beats per minute (bpm).
- If the heart rate is higher than 120 bpm after the FIRST minute into the rest period, the next work period should be shortened by 33 percent, while the length of the rest period stays the same.
- If the pulse rate still exceeds 120 bpm at the beginning of the next rest period, the following work cycle should be further shortened by 33 percent.
- Continue this procedure until the rate is maintained below 120 bpm after the FIRST minute into the rest period.

Alternately, the body temperature can be measured, either oral or aural (ear), before the workers have something to drink.

- If the oral or aural temperature exceeds 99.6° F (37.6 ° F) at the beginning of the rest period, the following work cycle should be shortened by 33 percent.
- Continue this procedure until the oral or aural (ear) temperature is maintained below 99.6 ° F (37.6° C). While an accurate indication of heat stress, oral temperature is difficult to measure in the field, however, a digital aural (aural) thermometer is easy to obtain and inexpensive to purchase.

Procedures for when Heat Illness Symptoms are Experienced

- Always contact the RHSM when any heat illness related symptom is experienced so that controls can be evaluated and modified, if needed.
- In the case of cramps, reduce activity, increase fluid intake, move to shade until recovered.
- In the case of all other heat-related symptoms (fainting, heat rash, heat exhaustion), and if the worker is a CH2M HILL worker, contact the occupational physician at 1-866-893-2514 and immediate supervisor.
- In the case of heat stroke symptoms, call 911, have a designee give location and directions to ambulance service if needed, follow emergency medical treatment section of the project safety plan.
- Follow the Incident Notification, Reporting, and Investigation section of this Handbook.

9.3.2 Cold

General

Low ambient temperatures increase the heat lost from the body to the environment by radiation and convection. In cases where the worker is standing on frozen ground, the heat loss is also due to conduction.

Wet skin and clothing, whether because of water or perspiration, may conduct heat away from the body through evaporative heat loss and conduction. Thus, the body cools suddenly when chemical protective clothing is removed if the clothing underneath is perspiration soaked.

Movement of air across the skin reduces the insulating layer of still air just at the skin's surface. Reducing this insulating layer of air increases heat loss by convection.

Non-insulating materials in contact or near-contact with the skin, such as boots constructed with a metal toe or shank, conduct heat rapidly away from the body.

Certain common drugs, such as alcohol, caffeine, or nicotine, may exacerbate the effects of cold, especially on the extremities. These chemicals reduce the blood flow to peripheral parts of the body, which are already high-risk areas because of their large surface area to volume ratios. These substances may also aggravate an already hypothermic condition.

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Precautions

- Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in wet weather.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC).
- Wind-Chill Index (below) is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.
- Persons who experience initial signs of immersion foot, frostbite, and/or hypothermia should report it immediately to their supervisor/PM to avoid progression of cold-related illness.
- Observe one another for initial signs of cold-related disorders.
- Obtain and review weather forecast – be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

SYMPTOMS AND TREATMENT OF COLD STRESS

	Immersion (Trench) Foot	Frostbite	Hypothermia
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm area quickly in warm–but **not** hot–water. Have victim drink warm fluids, but **not** coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but **not** coffee or alcohol. Get medical attention.

Wind Chill Chart

Wind (mph)	Temperature (°F)																	
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

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10. Biological Hazards and Controls

Biological hazards are everywhere and change with the region and season. During project planning stages, ask the site Point of Contact if there are insect or other biological hazards have been noted in any of the work sites.

Biological hazards are everywhere and change with the region and season. If you encounter a biological hazard that has not been identified in the project safety plan or in this Handbook, contact the RHSM so that hazard controls can be addressed. Whether it is contact with a poisonous plant, a poisonous snake, or a bug bite, do not take bites or stings lightly. If there is a chance of an allergic reaction or infection, or to seek medical advice on how to properly care for the injury, contact the occupational nurse at 1-866-893-2514.

10.1 Black Bears

Bears may inhabit wooded areas where there is scarce continuous human presence. Make your presence known-especially when vegetation and terrain make it hard to see. Make noise, sing, or talk loudly. Avoid thick brush. Try to walk with the wind at your back so your scent will warn bears of your presence.

Give bears plenty of room. Every bear has a “personal space” - the distance within which a bear feels threatened – that can be from a few feet to a few hundred feet. If you stray within that zone, a bear may act aggressively. Never approach bears, even if only out of curiosity, and never attempt to feed bears.

If a bear cannot recognize you, he may come closer or stand on his hind legs for a better view. You may try to back away slowly diagonally, but if the bear follows, stop and stand your ground. If the bear moves closer or acts aggressively, stay close together and wave your arms and shout.

Do not climb a tree – black bears are good climbers.

Do not run. Bears have been clocked at speeds of up to 35 mph, and like dogs, will chase fleeing animals. Bears often make bluff charges, sometimes up to 10 feet away without making contact. Continue waving your arms and shouting. Never imitate bears sounds or use high-pitched squeals.

If attacked, do not run. Clasp your hands tightly over the back of your neck or if you are carrying a backpack use it to protect your head and neck and remain still.

For Black bears, if the attack lasts for more than a few seconds, respond aggressively - use sticks, rocks, your fists or noise. Black bears will sometimes back off if they are challenged.

10.2 Bees and Other Stinging Insects

Bees and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic.

Precautions include:

- Watching for and avoiding nests.
- Keep exposed skin to a minimum.
- Carry a kit if you have had allergic reactions in the past, and inform your supervisor and/or a buddy. When working at a remote location, ensure that first-aid kits contain over-the-counter allergy and itch medication (e.g., Benadryl, Claritin, etc) as well as other over-the-counter medications that may not be available to aid in symptom treatment.
- If bees or other stinging insects are known to be present, determine whether additional protective clothing should be donned before entering/working in brushy areas.
- Before entering a heavily vegetated or brushy area, observe the area for several minutes to see if bees or other stinging insects may be present. If nests or individual insects are observed, retreat and inquire whether a specialist or a client service can be contacted to clear the area before work proceeds.

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- Consider if heavy-weight clothing or tyvek, or head netting would provide additional protection in areas where wasps/bees are known or suspected. Be aware of heat stress conditions additional clothing may cause.
- Use insect repellent on clothing. Wear light-colored clothing and remove bright reflective safety-colored clothing if not working near a roadway as these may attract the wasps.
- Wear fragrance-free or lightly-scented sunscreen, and body lotions. Bees are attracted to sweet scents. Avoid using floral scented soaps, shampoos, or conditioners.
- Move slowly and calmly through vegetated areas and try to avoid major disturbance of vegetation as wasps/bees often react to aggressive movement.
- If you encounter a wasp, back away slowly and calmly, do not run or swat at the insect. Wait for it to leave, or gently move or brush it off gently with a piece of paper or other light object. Do not use your hand.

If you are stung, contact the occupational nurse at 1-866-893-2514, no matter how minor it may seem. If a stinger is present, remove it as soon as possible using something with a thin, hard edge (e.g., credit card) to scrape the stinger out. Be sure to sanitize the object first with hand sanitizer, alcohol or soap and water. Wash and disinfect the wound, cover it, and apply ice. Watch for an allergic reaction if you have never been stung before. Call 911 if the reaction is severe.

10.3 Bird Droppings

Large amounts of bird droppings may present a disease risk. The best way to prevent exposure to fungus spores in bird droppings is to avoid disturbing it. A brief inhalation exposure to highly contaminated dust may be all that is needed to cause infection and subsequent development of fungal disease.

If disturbing the droppings or if removal is necessary to perform work, follow these controls:

- Use dust control measures (wetting with water or HEPA vacuuming) for all activities that may generate dust from the accumulated droppings.
- Wear Tyvek with hoods, disposable gloves and booties, and air-purifying respirators with a minimum N95 rating.
- Put droppings into plastic/poly bags and preferably into a 55-gallon drum to prevent bag from ripping.

10.4 Cactus

Cacti are present onsite. Contact with cacti can result in dermatitis as well as causing immunologic and infectious reactions. The spines can scratch the skin or induce wounds and multiple abrasions. Some cacti have glochids (hair-like spines or short prickles, generally barbed). Glochids can induce more troublesome, more persistent, dermatological manifestations such as papules or nodules.

Set up the work area to ensure avoidance of cacti. Wear leather glove if working near cacti. Keep any clothing such as jackets away from cacti as spines can become lodged into the clothing and can be contacted by the skin later. Contact the occupational nurse if cactus contact occurs.

10.5 Cougars/Mountain Lions

Like bears, cougars will often retreat if given the opportunity. Walking in groups and making noise will give the cougar the chance to retreat and reduce the likelihood of a sudden encounter. Be especially cautious during dusk and dawn.

If you see a cougar—do not play dead, do not run. Running may trigger an attack. Face the cougar and retreat slowly maintaining eye contact. If the cougar continues advancing, raise your arms above your head to make yourself look larger than normal. This may help to intimidate the cougar. Sometimes aggressive yelling and rock throwing may scare it off.

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If attacked, fight back with whatever is at hand (without turning your back)—people have utilized rocks, jackets, garden tools, tree branches, and even bare hands to turn away cougars.

10.6 Coyotes

While far from domesticated, coyotes show little fear of humans and have become comfortable living in close proximity to our communities. Although they tend to do most of their hunting after dusk, coyotes can be active at any time. Under normal circumstances, a coyote is not a danger to humans. They are, however, territorial and will respond aggressively if they or their family are threatened.

If you encounter a coyote that behaves aggressively, you have probably gotten too close to its prey or its family. Try to scare the coyote by yelling and waving your arms. Throw rocks, sticks or other objects. Do not turn away and run.

10.7 Feral Dogs

Avoid all dogs – both leashed and stray. Do not disturb a dog while it is sleeping, eating, or caring for puppies. If a dog approaches to sniff you, stay still. An aggressive dog has a tight mouth, flattened ears and a direct stare. If you are threatened by a dog, remain calm, do not scream and avoid eye contact. If you say anything, speak calmly and firmly. Do not turn and run, try to stay still until the dog leaves, or back away slowly until the dog is out of sight or you have reached safety (e.g., vehicle). If attacked, retreat to vehicle or attempt to place something between you and the dog. If you fall or are knocked to the ground, curl into a ball with your hands over your head and neck and protect your face. If bitten, contact the occupational nurse at 1-866-893-2514. Report the incident to the local authorities.

10.8 Feral Pigs

There are 4 million feral swine in over 39 states, with populations in Texas, Florida and throughout the southeastern United States. They have also been noted in California, Oregon, Nebraska, Kansas, Michigan, and Ohio. Although some of the animals have a distinctive “wild boar” appearance, others may look no different than many breeds of domestic hogs.

Feral pigs or hogs have been known to attack human beings. Perhaps the greater risk, though, is that of contracting a disease from an infected hog. People can catch undulant fever from feral hogs infected with swine brucellosis.

Feral hogs have excellent senses of smell and hearing and normally avoid contact with humans, so making noise, and alerting them to your presence most of the time will help you avoid an encounter. There are occasions of hogs chasing hunters up trees, but these are rare, isolated instances. The vast majority of hogs flee from humans. However, should you find yourself nose-to-snout with an angry pig, the best defense is to climb the nearest tree. If the pig charges, sidestep quickly, taking care to avoid the swing of its tusks and promptly find a tree to scamper up.

10.9 Fire Ants

There are several types of fire ants in the United States that can cause painful bites and allergic reactions. Fire ants aggressively defend their nests by stinging several times after climbing on their victims. Large ant mounds are easily visible, but there can be smaller mounds or nests with little “worked” soil that can be stepped on inadvertently. They can also be under rocks, wood or other debris. Implement the following when fire ants are observed:

- Be aware of fire ants and take care not to stand on ant nests;
- Use insect repellents on clothing and footwear to temporarily discourage ants from climbing; and
- Tuck pants into socks.

If stung, get away from the area you are standing on, briskly brush off ants—wash affected area with soap. Call the occupational nurse.

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10.10Hantavirus

Hantavirus pulmonary syndrome (HPS) is a disease caused by a virus which can be transmitted from certain rodents to humans and is prevalent throughout the United States. Avoid disturbing rodent nests. Contact is most likely to occur when there is a current rodent infestation in things like control boxes, storage sheds, wellheads, remediation equipment, or trailers. Once excreted into the environment by the rodent, hantaviruses can survive in the environment and remain infectious for a period of 2-3 days. Ultraviolet rays in sunlight inactivate hantaviruses.

Nesting material and droppings must be removed if work is necessary in a rodent-infested area. PPE for removal shall include:

- Tyvek coveralls;
- Rubber boots or disposable shoe covers;
- Rubber, latex, or vinyl gloves;
- Respiratory protection such as a full face or half-mask air-purifying respirator with a high-efficiency particulate air (HEPA) filter; and
- Protective goggles if wearing a half-mask respirator.

Spray any urine, droppings, and nesting materials with either a bleach and water solution (1 parts bleach to 9 parts water) or a household disinfectant prepared according to the label instructions for dilution and disinfection time. Soak well and let stand for 15 minutes. Use a paper towel or rag to pick up the materials and dispose of them.

Mop floors after spraying them using bleach and water solution or a disinfectant. Dirt floors can be sprayed with either bleach and water solution or a disinfectant.

Personal protective gear shall be decontaminated upon removal at the end of the day. All potentially infective waste material (including respirator filters) from clean-up operations shall be double-bagged in plastic bags.

Symptoms of HPS

Symptoms develop between 14 and 31 days after exposure to infected rodents and include fatigue, fever, and muscle aches, especially the large muscle groups—thighs, hips, back and sometimes shoulders. About half of all HPS patients also experience headaches, dizziness, chills and/or abdominal pain. Four to 10 days after the initial phase of the illness, late symptoms of HPS may appear. These include coughing and shortness of breath. If you develop symptoms suggestive of HPS, call the occupational nurse at 1-866-893-2514.

10.11Hazards during Hunting Seasons

Various times of the year can be particularly hazardous for personnel working in the field. The danger is highest for our teams doing cross-country surveys of pipelines and transmission lines, but everyone doing field work should be aware of the hunting seasons that are active where you are working.

Big game hunting can be very dangerous, but also be aware of water fowl seasons and hunting seasons for less common game in your area. Work in wetlands can bring us in close proximity to these types of hunters.

If possible consider postponing field surveys so they do not coincide with hunting seasons but if you must be in the field be as visible as possible at all times.

This site gives all the different hunting seasons by state:

www.huntinfo.org/

Implement the following if hunting may be a hazard:

- Do not wear kaki, brown or tan clothing, wear high visibility colors including hats and vests;
- Avoid wearing white or light colored scarves, gloves, handkerchiefs (a woman wearing white mittens hanging laundry was shot and killed as bad hunter shot at flash of white);

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- When carrying white plans, field data sheets etc keep them in binder or backpack;
- Wear your safety vest at all times including standing by car/truck;
- Wear a safety hat/cap or put florescent markers on hard hats;
- Be alert particularly in early mornings and at end of day when most hunters are present;
- Avoid being in field altogether at dawn or dusk - start a little later in the morning and make sure you get out of the field earlier;
- Stop at local hardware or convenience market and pick up hunter safety gloves, caps, rolls of tape etc. All the stores carry them and they are cheap visual protection.
- Make your presence known, such as slamming car doors, honk horn, talk loudly when getting out to a field site; and
- Stop and survey your surroundings. Many hunters are up in tree stands.

10.12Leeches

Leeches are bloodsucking aquatic or terrestrial worms. They can crawl through or over your socks or brush onto you from shrubbery. They carry no disease and there is low risk of significant blood loss. Leech bites do not hurt since they release an anesthetic, but they can bleed profusely due to an anticoagulant they release to facilitate the flow of blood.

Possible Complications

- Some people suffer allergic reaction from leech bites and require urgent medical care. Symptoms include an ulcer infection, itchy rash, red blotches or an itchy rash over the body, swelling around the lips or eyes, feeling faint or dizzy, and difficulty breathing. If you experience any of these symptoms, seek medical attention immediately.

Prevention options

- The best protection against leeches is covering up and using tropical strength insect repellent on socks and clothing.
- Use anti leech socks and fit over outer garments which served as a barrier.
- Various reports suggest applying salt, dettol spray, bath soap, eucalyptus oil or lemon juice to your skin.
- Inspect your body after leaving leech-infested waters or area, removing them promptly.

First Aid

- Locate the head with a sucker attached to the wound. It will be the narrow end of leech's body.
- Use your fingernail or other flat, blunt object to break the seal of the oral sucker at which point the leech's jaws will detach. Repeat with the posterior end.
- Quickly flick the leech away before it bites you again and reattaches.
- Treat the wound with soap and water and antiseptic wipes; then bandage to stop bleeding.
- Do not just pull off the leech as this may cause a severe wound and the jaws may stay imbedded in the skin
- If the leech has attached to an orifice such ear, nose or mouth use salt or strong (drinkable) alcohol to cause it to release before it expands.
- Apply pressure to the area and a cold pack to reduce pain or swelling.
- The wound normally itches as it heals, but should not be scratched, as this may complicate healing and introduce other infections. Apply an antihistamine if necessary to reduce itching.

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- If assisting a bitten person, use the usual protective universal precautions to protect against blood borne pathogens
- Call the occupational nurse.

10.13Mosquito Bites

Due to the recent detection of the West Nile Virus in the southwestern United States it is recommended that preventative measures be taken to reduce the probability of being bitten by mosquitoes whenever possible. Mosquitoes are believed to be the primary source for exposure to the West Nile Virus as well as several other types of encephalitis. The following guidelines should be followed to reduce the risk of these concerns for working in areas where mosquitoes are prevalent:

- Stay indoors at dawn, dusk, and in the early evening;
- Wear long-sleeved shirts and long pants whenever you are outdoors;
- Spray clothing with repellents containing permethrin or N,N-diethyl-meta-toluamide (DEET) since mosquitoes may bite through thin clothing;
- Apply insect repellent sparingly to exposed skin. An effective repellent will contain 35 percent DEET. Repellents may irritate the eyes and mouth, so avoid applying repellent to the hands; and
- Whenever you use an insecticide or insect repellent, be sure to read and follow the manufacturer's DIRECTIONS FOR USE, as printed on the product.

Vitamin B and "ultrasonic" devices are NOT effective in preventing mosquito bites.

Symptoms of Exposure to the West Nile Virus

Most infections are mild, and symptoms include fever, headache, and body aches, occasionally with skin rash and swollen lymph glands. More severe infection may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and, rarely, death.

The West Nile Virus incubation period is from 3 to 15 days.

Contact the project RHSM with questions, and immediately report any suspicious symptoms to your supervisor, PM, and contact the occupational nurse at 1-866-893-2514.

10.14Poison Ivy, Poison Oak, and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Shrubs are usually 12 to 30 inches high, or can also be a tree-climbing vine, with triple leaflets and short, smooth hair underneath. Plants are red and dark green in spring and summer, with yellowing leaves anytime especially in dry areas. Leaves may achieve bright reds in fall, but plants lose its (yellowed, then brown) leaves in winter, leaving toxic stems. All parts of the plant remain toxic throughout the seasons. These plants contain urushiol a colorless or pale yellow oil that oozes from any cut or crushed part of the plant, including the roots, stems and leaves and causes allergic skin reactions when contacted. The oil is active year round.

Become familiar with the identity of these plants (see below). Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

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Poison Ivy

Poison Sumac

Poison Oak

Contamination with poison ivy, sumac or oak can happen through several pathways, including:

- Direct skin contact with any part of the plant (even roots once above ground foliage has been removed).
- Contact with clothing that has been contaminated with the oil.
- Contact from removing shoes that have been contaminated (shoes are coated with urishol oil).
- Sitting in a vehicle that has become contaminated.
- Contact with any objects or tools that have become contaminated.
- Inhalation of particles generated by weed whacking, chipping, vegetation clearing.

If you must work on a site with poison ivy, sumac or oak the following precautions are necessary:

- Do not drive vehicles onto the site where it will come into contact with poison ivy, sumac or oak. Vehicles which need to work in the area, such as drill rigs or heavy equipment must be washed as soon as possible after leaving the site.
- All tools used in the poison ivy, sumac or oak area, including those used to cut back poison oak, surveying instruments used in the area, air monitoring equipment or other test apparatus must be decontaminated before they are placed back into the site vehicle. If on-site decontamination is not possible, use plastic to wrap any tools or equipment until they can be decontaminated.
- Personal protective equipment, including Tyvek coveralls, gloves, and boot covers must be worn. PPE must be placed into plastic bags and sealed if they are not disposed immediately into a trash receptacle.
- As soon as possible following the work, shower to remove any potential contamination. Any body part with suspected or actual exposure should be washed with Zanfel, Tecnu or other product designed for removing urishiol. If you do not have Zanfel or Tecnu wash with cold water. Do not take a bath, as the oils can form and invisible film on top of the water and contaminate your entire body upon exiting the bath.
- Tecnu may also be used to decontaminate equipment.
- Use IvyBlock or similar products to prevent poison oak, ivy and sumac contamination. Check with the closest CH2M HILL warehouse to see if these products are available. Follow all directions for application.
- If you do come into contact with one of these poisonous plants and a reaction develops, contact your supervisor and the occupational nurse 1-866-893-2514. Be aware that in some instances, there can be a delay between contact with poisonous plants and the symptoms. If you are working near poison ivy or other poisonous plants and feel a mild skin irritation, apply Zanfel/Technu immediately and contact the occupational nurse.

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10.15Scorpions

Scorpions usually hide during the day and are active at night. They may be hiding under rocks, wood, or anything else lying on the ground. Some species may also burrow into the ground. Most scorpions live in dry, desert areas; however, some species can be found in grasslands, forests, and inside caves.

When entering an area that has the potential to contain scorpions, the following PPE is recommended: long pants, long sleeved shirts with collars, leather work gloves and leather work boots. Reaching into enclosures or recesses without prior visual inspection is not recommended. Thoroughly inspect each area before accessing. Shake out clothing, jackets, shoes or boots prior to putting them on.

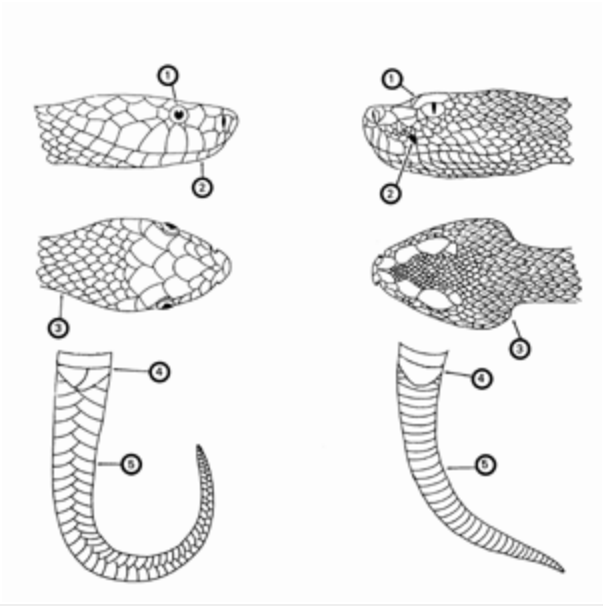
If you are stung by a scorpion, call the occupational nurse 1-866-893-2514 and try to note the description of the scorpion. Cleanse the sting area and apply ice.

10.16Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Call the occupational nurse at 1-866-893-2514 immediately. Do not apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings. Below is a guide to identifying poisonous snakes from non-poisonous snakes.

Identification of Poisonous Snakes

Major Identification Features Non-venomous Snake	Major Identification Features Venomous Snake
1. Round pupils 2. No sensing pit 3. Head slightly wider than neck 4. Divided anal plate 5. Double row of scales on the underside of the tail	1. Elliptical pupils 2. Sensing pit between eye and nostril 3. Head much wider than neck 4. Single anal plate 5. Single scales on the underside of the tail



10.17Spiders - Brown Recluse and Widow

The Brown Recluse spider can be found most anywhere in the United States. It varies in size in shape, but the distinguishing mark is the violin shape on its body. They are typically non-aggressive. Keep an eye out for irregular,

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pattern-less webs that sometimes appear almost tubular built in a protected area such as in a crevice or between two rocks. The spider will retreat to this area of the web when threatened.

The Black Widow, Red Widow and the Brown Widow are all poisonous. Most have globose, shiny abdomens that are predominantly black with red markings (although some may be pale or have lateral stripes), with moderately long, slender legs. These spiders are nocturnal and build a three-dimensional tangled web, often with a conical tent of dense silk in a corner where the spider hides during the day.

Hazard Controls

- Inspect or shake out any clothing, shoes, towels, or equipment before use.
- Wear protective clothing such as a long-sleeved shirt and long pants, hat, gloves, and boots when handling stacked or undisturbed piles of materials.
- Minimize the empty spaces between stacked materials.
- Remove and reduce debris and rubble from around the outdoor work areas.
- Trim or eliminate tall grasses from around outdoor work areas.
- Store apparel and outdoor equipment in tightly closed plastic bags.
- Keep your tetanus boosters up-to-date (every 10 years). Spider bites can become infected with tetanus spores.

If you think you have been bit by a poisonous spider, immediately call the occupational nurse at 1-866-893-2514 and follow the guidance below:

- Remain calm. Too much excitement or movement will increase the flow of venom into the blood;
- Apply a cool, wet cloth to the bite or cover the bite with a cloth and apply an ice bag to the bite;
- Elevate the bitten area, if possible;
- Do not apply a tourniquet, do not try to remove venom; and
- Try to positively identify the spider to confirm its type. If the spider has been killed, collect it in a plastic bag or jar for identification purposes. Do not try to capture a live spider—especially if you think it is a poisonous spider.

Black Widow

Brown Recluse

10.18Ticks

Every year employees are exposed to tick bites at work and at home putting them at risk of illness. Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch (6.4 mm) in size.

In some geographic areas exposure is not easily avoided. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray only outside of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks.

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Where site conditions (vegetation above knee height, tick endemic area) or when tasks (having to sit or kneel in vegetation) diminish the effectiveness of the other controls mentioned above, bug-out suits (check with your local or regional warehouse) or Tyvek shall be used. Bug-out suits are more breathable than Tyvek.

Take precautions to avoid exposure by including pre-planning measures for biological hazards prior to starting field work. Avoid habitats where possible, reduce the abundance through habitat disruption or application of acracide. If these controls aren't feasible, contact your local or regional warehouse for preventative equipment such as repellants, protective clothing and tick removal kits. Use the buddy system and perform tick inspections prior to entering the field vehicle. If ticks were not planned to be encountered and are observed, do not continue field work until these controls can be implemented.

See Tick Fact Sheet attached to project safety plan for further precautions and controls to implement when ticks are present. If bitten by a tick, follow the removal procedures found in the tick fact sheet, and call the occupational nurse at 1-866-893-2514.

Be aware of the symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme disease is a rash that might appear that looks like a bull's eye with a small welt in the center. RMSF is a rash of red spots under the skin 3 to 10 days after the tick bite. In both RMSF and Lyme disease, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, again contact the occupational nurse at 1-866-893-2514.

Be sure to complete an Incident Report (either use the Hours and Incident Tracking System [HITS] system on the VO) if you do come in contact with a tick.

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11. Personal Protective Equipment

(Reference CH2M HILL- SOP HSE-117, *Personal Protective Equipment*)

11.1 Required Personal Protective Equipment

PPE must be worn by employees when actual or potential hazards exist and engineering controls or administrative practices cannot adequately control those hazards.

A PPE assessment has been conducted by the RHSM based on project tasks (see PPE specifications below). Verification and certification of assigned PPE by task is completed by the RHSM in each project safety plan. Below are items that need to be followed when using any form of PPE:

- Employees must be trained to properly wear and maintain the PPE; if you are unsure of how to use or maintain your PPE, ask your RHSM for guidance.
- Employees must be trained in the limitations of the PPE; if you are unsure, ask your RHSM for guidance.
- In work areas where actual or potential hazards are present at any time, PPE must be worn by employees working or walking through the area;
- Areas requiring PPE should be posted or employees must be informed of the requirements in an equivalent manner;
- PPE must be inspected prior to use and after any occurrence to identify any deterioration or damage;
- PPE must be maintained in a clean and reliable condition;
- Damaged PPE shall not be used and must either be repaired or discarded; and
- PPE shall not be modified, tampered with, or repaired beyond routine maintenance.

Each project safety plan will outlines PPE to be used according to task based on project-specific hazard assessment.

11.2 Respiratory Protection

(Reference CH2M HILL SOP HSE-121, *Respiratory Protection*)

Implement the following when using respiratory protection:

- Respirator users must have completed appropriate respirator training within the past 12 months. Level C training is required for air-purifying respirators (APR) use and Level B training is required for supplied-air respirators (SAR) and self-contained breathing apparatus (SCBA) use. Specific training is required for the use of powered air-purifying respirators (PAPR);
- Respirator users must complete the respirator medical monitoring protocol and been approved for the specific type of respirator to be used;
- Tight-fitting facepiece respirator (negative or positive pressure) users must have passed an appropriate fit test within past 12 months;
- Respirator use shall be limited to those activities identified in the safety plan. If site conditions change that alters the effectiveness of the specified respiratory protection, the RHSM shall be notified to amend the written plan;
- Tight-fitting facepiece respirator users shall be clean-shaven and shall perform a user seal check before each use;
- Canisters/cartridges shall be replaced according to the change-out schedule specified in the safety plan. Respirator users shall notify the SC or RHSM of any detection of vapor or gas breakthrough. The SC shall report any breakthrough events to the RHSM for schedule upgrade;

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- Respirators in regular use shall be inspected before each use and during cleaning;
- Respirators in regular use shall be cleaned and disinfected as often as necessary to ensure they are maintained in a clean and sanitary condition;
- Respirators shall be properly stored to protect against contamination and deformation;
- Field repair of respirators shall be limited to routine maintenance. Defective respirators shall be removed from service;
- When breathing air is supplied by cylinder or compressor, the SC or RHSM shall verify the air meets Grade D air specifications; and
- The SC or designee shall complete the Self-Assessment Checklist – Respiratory Protection included in the SOP and/or in the safety plan to verify compliance with CH2M HILL's respiratory protection program.

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12. Worker Training and Qualification

12.1 CH2M HILL Worker Training

(Reference CH2M HILL SOP HSE-110, *Training*)

12.1.1 Hazardous Waste Operations Training

All employees engaging in hazardous waste operations or emergency response shall receive appropriate training as required by 29 CFR 1910.120 and 29 CFR 1926.65. At a minimum, the training shall have consisted of instruction in the topics outlined in 29 CFR 1910.120 and 29 CFR 1926.65. Personnel who have not met these training requirements shall not be allowed to engage in hazardous waste operations or emergency response activities.

12.1.1.1 Initial Training

General site workers engaged in hazardous waste operations shall, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations, unless otherwise noted in the above-referenced standards.

Employees who may be exposed to health hazards or hazardous substances at treatment, storage, and disposal (TSD) operations shall receive a minimum of 24 hours of initial training to enable the employee to perform their assigned duties and functions in a safe and healthful manner.

Employees engaged in emergency response operations shall be trained to the level of required competence in accordance with 29 CFR 1910.120.

12.1.1.2 Three-Day Actual Field Experience

General site workers for hazardous waste operations shall have received three days of actual experience (on-the-job training) under the direct supervision of a trained, qualified supervisor and shall be documented. If the field experience has not already been received and documented at a similar site, this supervised experience shall be accomplished and documented at the beginning of the assignment of the project.

12.1.1.3 Refresher Training

General site workers and TSD workers shall receive 8-hours of refresher training annually (within the previous 12-month period) to maintain qualifications for fieldwork. Employees engaged in emergency response operations shall receive annual refresher training of sufficient content and duration to maintain their competencies or shall demonstrate competency in those areas at least annually.

12.1.1.4 Eight-Hour Supervisory Training

On site management or supervisors who will be directly responsible for, or supervise employees engaged in hazardous waste site operations, will have received at least 8 hours of additional specialized training on managing such operations. Employees designated as Safety Coordinator – Hazardous Waste are considered 8-hour HAZWOPER Site Safety Supervisor trained.

12.1.2 Competent Person

The term "Competent Person" is used in many OSHA and International standards and documents. OSHA defines a "competent person" as one who, by way of training and/or experience, is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. Some standards add additional specific requirements which must be met by the competent person.

CH2M HILL's practice is that the employer responsible for directing the means and methods of an activity (typically the employer responsible for actually performing the work) is responsible for designating the qualified competent person for that activity. This is typically a subcontractor or a third party contractor, unless CH2M HILL is actually self-performing the work.

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Should CH2M HILL self-perform work and an employee needs to be designated as a competent person, the CH2M HILL site or project manager shall coordinate with the BG HSE Lead or RHSM to verify that the employee has the requisite training and experience to be identified as the competent person.

12.1.3 First Aid/Cardiopulmonary Resuscitation

First aid and CPR training consistent with the requirements of a nationally recognized organization such as the American Red Cross Association or National Safety Council shall be administered by a certified trainer. A minimum of two personnel per active field operation will have first aid and CPR training. Bloodborne pathogen training located on CH2M HILL's Virtual Office is also required for those designated as first aid/CPR trained.

12.1.4 Safety Coordinator Training

SCs are trained to implement the HSE program on CH2M HILL field projects. A qualified SC is required to be identified in the project safety plan for CH2M HILL field projects. SCs must also meet the requirements of the worker category appropriate to the type of field project (construction or hazardous waste). In addition, the SCs shall have completed additional safety training required by the specific work activity on the project that qualifies them to implement the HSE program (for example, fall protection, excavation).

12.1.5 Site-Specific Training

Site-specific training will be addressed in the project safety plan. Prior to commencement of field activities, all field personnel assigned to a project will have completed site-specific training that will address the contents of applicable project safety plans, including the activities, procedures, monitoring, and equipment used in the site operations. Site-specific training will also include site and facility layout, potential hazards, risks associated with identified emergency response actions, and available emergency services. This training allows field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and work operations for their particular activity.

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13. Medical Surveillance and Qualification

(Reference CH2M HILL SOP HSE-113, *Medical Surveillance)*

All site workers participating in hazardous waste operations or emergency response (HAZWOPER) will maintain an adequate medical surveillance program in accordance with 29 CFR 1910.120 or 29 CFR 1926.65 and other applicable OSHA standards. Documentation of employee medical qualification (e.g., physician's written opinion) will be maintained in the project files and made available for inspection.

13.1 Hazardous Waste Operations and Emergency Response

CH2M HILL personnel expected to participate in on site HAZWOPER tasks are required to have a current medical qualification for performing this work. Medical qualification shall consist of a qualified physician's written opinion regarding fitness for duty at a hazardous waste site, including any recommended limitations on the employee's assigned work. The physician's written opinion shall state whether the employee has any detected medical conditions that would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response, or from respirator use.

13.2 Respirator User Qualification

Personnel required to wear respirators must have a current medical qualification to wear respirators. Medical qualification shall consist of a qualified physician's written opinion regarding the employee's ability to safely wear a respirator in accordance with 29 CFR 1910.134.

13.3 Hearing Conservation

Personnel working in hazardous waste operations or operations that fall under 29 CFR 1910.95 and exposed to noise levels in excess of the 85dBA time-weighted average shall be included in a hearing conservation program that includes annual audiometric testing.

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14. Site-Control Plan

14.1 Site-Control Procedures

(Reference CH2M HILL SOP HSE-218, *Hazardous Waste Operations)*

Site control is established to prevent the spread of contamination throughout the site and to ensure that only authorized individuals are permitted into potentially hazardous areas.

The SC will implement site control procedures including the following bulleted items.

- Establish support, contamination reduction, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals;
  - Air horn; and
  - Two-way radio or cellular telephone if available.
- Establish offsite communication.
- Establish and maintain the "buddy system."

14.2 Remediation Work Area Zones

(Reference CH2M HILL SOP HSE-218 Hazardous Waste Operations)

A three-zone approach will be used to control areas where site contaminants exist. Access will be allowed only after verification of appropriate training and medical qualification. The three-zone approach shall include an EZ, Contamination Reduction Zone (CRZ) and a Support Zone (SZ). The three-zone approach is not required for construction work performed outside contaminated areas where control of site contamination is not a concern.

Specific work control zones shall be established as necessary during task planning. Site work zones should be modified in the field as necessary, based on such factors as equipment used, air monitoring results, environmental conditions, or alteration of work plans. The following guidelines shall be used for establishing and revising these preliminary zone designations.

14.2.1 Support Zone

The SZ is an uncontaminated area (trailers, offices, field vehicles, etc.) that will serve as the field support area for most operations. The SZ provides field team communications and staging for emergency response. Appropriate sanitary facilities and safety and emergency response equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone. The only exception will be appropriately packaged and decontaminated materials, or personnel with medical emergencies that cannot be decontaminated.

14.2.2 Contamination Reduction Zone

The CRZ is established between the EZ and the SZ, upwind of the contaminated area where possible. The CRZ provides an area for decontamination of personnel, portable handheld equipment and tools, and heavy equipment. In addition, the CRZ serves as access for heavy equipment and emergency support services.

14.2.3 Exclusion Zone

The EZ is where activities take place that may involve exposure to site contaminants and/or hazardous materials or conditions. This zone shall be demarcated to prevent unauthorized entry. More than one EZ may be established if there are different levels of protection to be employed or different hazards that exist in the same work area. The EZ

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shall be large enough to allow adequate space for the activity to be completed, including field personnel and equipment, as well as necessary emergency equipment.

The EZ shall be demarcated with some form of physical barrier or signage. The physical barrier or signage shall be placed so that they are visible to personnel approaching or working in the area. Barriers and boundary markers shall be removed when no longer needed.

14.2.4 Other Controlled Areas

Other work areas may need to be controlled due to the presence of an uncontrolled hazard, to warn workers of requirements, or to prevent unauthorized entry. Examples include general construction work areas, open excavations, high noise areas, vehicle access areas, and similar activities or limited access locations. These areas shall be clearly demarcated with physical barriers (fencing, cones, reinforced caution tape or rope) as necessary and posted with appropriate signage.

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15. Decontamination

(Reference CH2M HILL SOP HSE-218, *Hazardous Waste Operations*)

Decontamination areas will be established for work in potentially contaminated areas to prevent the spread of contamination. Decontamination areas should be located upwind of the exclusion zone where possible and should consider any adjacent or nearby projects and personnel. The SC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SC. The SC must ensure that procedures are established for disposing of materials generated on the site.

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SC should establish areas for eating, drinking, and smoking.

15.1 Contamination Prevention

Preventing or avoiding contamination of personnel, tools, and equipment will be considered in planning work activities at all field locations. Good contamination prevention and avoidance practices will assist in preventing worker exposure and result in a more efficient decontamination process. Procedures for contamination prevention and avoidance include the following:

- Do not walk through areas of obvious or known contamination;
- Do not directly handle or touch contaminated materials;
- Make sure there are no cuts or tears in PPE;
- Fasten all closures in suits and cover them with duct tape, if appropriate;
- Take particular care to protect any skin injuries;
- Stay upwind of airborne contamination, where possible;
- Do not eat or drink in contaminated work areas;
- Do not carry food, beverages, tobacco, or flame-producing equipment into contaminated work areas;
- Minimize the number of personnel and amount of equipment in contaminated areas to that necessary for accomplishing the work;
- Choose tools and equipment with nonporous exterior surfaces that can be easily cleaned and decontaminated;
- Cover monitoring and sampling equipment with clear plastic, leaving openings for the sampling ports, as necessary; and
- Minimize the amount of tools and equipment necessary in contaminated areas.

15.2 Personnel and Equipment Decontamination

Personnel exiting an EZ must ensure that they are not spreading potential contamination into clean areas or increasing their potential for ingesting or inhaling potential contaminants. Personal decontamination may range from removing outer gloves as exiting the EZ, to proceeding through an outer layer doffing station including a boot and glove wash and rinse, washing equipment, etc. Equipment that has come into contact with contaminated media must also be cleaned/decontaminated when it is brought out of the EZ.

15.3 Decontamination During Medical Emergencies

Standard personnel decontamination practices will be followed whenever possible. For emergency life saving first aid and/or medical treatment, normal decontamination procedures may need to be abbreviated or omitted. In this

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situation, site personnel shall accompany contaminated victims to advise emergency response personnel on potential contamination present and proper decontamination procedures.

Outer garments may be removed if they do not cause delays, interfere with treatment, or aggravate the problem. Protective clothing can be cut away. If the outer garments cannot be safely removed, a plastic barrier between the individual and clean surfaces should be used to help prevent contaminating the inside of ambulances or medical personnel. Outer garments can then be removed at the medical facility.

15.4 Waste Collection and Disposal

All contaminated material generated through the personnel and equipment decontamination processes (e.g., contaminated disposable items, gross debris, liquids, sludges) will be properly containerized and labeled, stored at a secure location, and disposed in accordance with the project plans.

15.5 Diagram of Personnel-Decontamination Line

The following figure illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SC to accommodate task-specific requirements.

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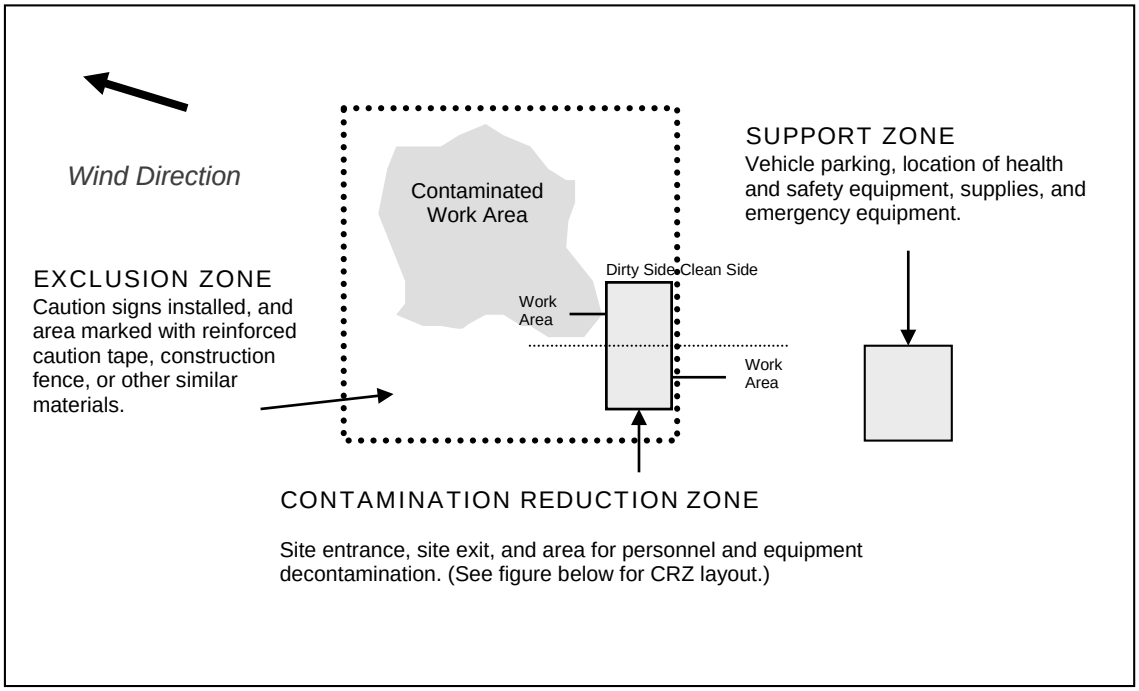
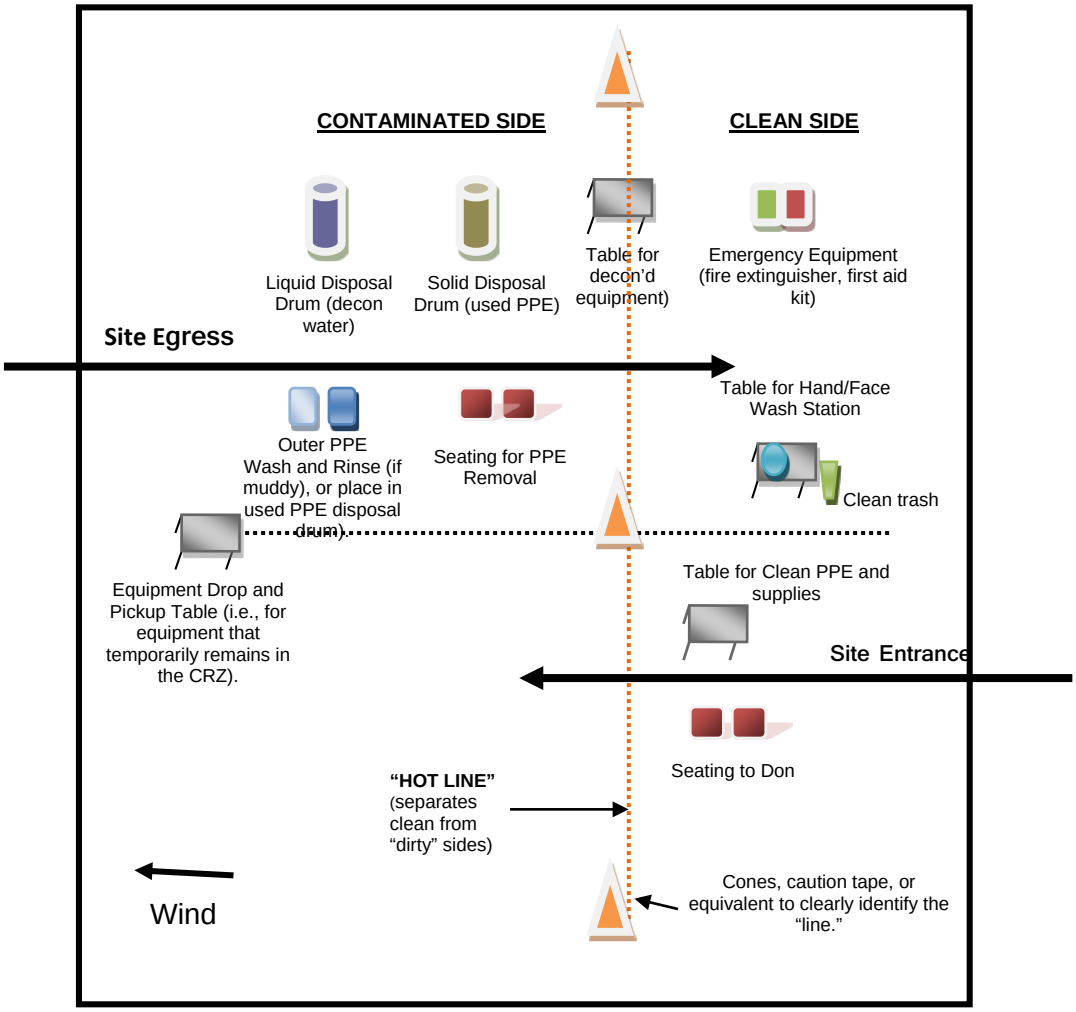
Work Area - Set up appropriately based on wind direction



Typical Contamination Reduction Zone



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16. Emergency Preparedness

(Reference CH2M HILL SOP HSE-106, *Emergency Planning*)

16.1 Pre-Emergency Planning

The Emergency Response Coordinator (ERC), typically the SC or designee, performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate. Pre-Emergency Planning activities performed by the ERC include:

- Review the facility emergency and contingency plans where applicable;
- Determine what onsite communication equipment is available (two-way radio, air horn);
- Determine what offsite communication equipment is needed (nearest telephone, cell phone);
- Confirm and post the "Emergency Contacts" page and route to the hospital located in this section in project trailer(s) and keep a copy in field vehicles along with evacuation routes and assembly areas. Communicate the information to onsite personnel and keep it updated;
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear;
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures;
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies;
- Inventory and check site emergency equipment, supplies, and potable water;
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases;
- Rehearse the emergency response plan before site activities begin. This may include a "tabletop" exercise or an actual drill depending on the nature and complexity of the project. Drills should take place periodically but no less than once a year;
- Brief new workers on the emergency response plan; and
- The ERC will evaluate emergency response actions and initiate appropriate follow-up actions.

16.2 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

- Notify appropriate response personnel;
- Shut down CH2M HILL operations and evacuate the immediate work area;
- Account for personnel at the designated assembly area(s);
- Assess the need for site evacuation, and evacuate the site as warranted;
- Implement HSE-111, Incident Notification, Reporting and Investigation; and
- Notify and submit reports to clients as required in contract.

Small fires or spills posing minimal safety or health hazards may be controlled with onsite spill kits or fire extinguishers without evacuating the site. When in doubt evacuate. Follow the incident reporting procedures in the "Incident Notification, Reporting, and Investigation" section of this Handbook.

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16.3 Emergency Medical Treatment

Emergency medical treatment is needed when there is a life-threatening injury (such as severe bleeding, loss of consciousness, breathing or heart has stopped). When in doubt if an injury is life-threatening or not, treat it as needing emergency medical treatment.

- Notify 911 or other appropriate emergency response authorities as listed in the "Emergency Contacts" page located in this section.
- The ERC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury, perform decontamination (if applicable) where feasible; lifesaving and first aid or medical treatment takes priority.
- Initiate first aid and CPR where feasible.
- Notify supervisor and if the injured person is a CH2M HILL employee, the supervisor will call the occupational nurse at 1-866-893-2514 and make other notifications as required by HSE SOP-111, *Incident Notification, Reporting and Investigation*.
- Make certain that the injured person is accompanied to the emergency room.
- Follow the Serious Incident Reporting process in HSE SOP-111, Incident Notification, Reporting and Investigation, and complete incident report using the HITS system on the VO or if not feasible, use the hard copy forms provided as an attachment to the project safety plan.
- Notify and submit reports to client as required in contract.

16.4 Evacuation

- Evacuation routes, assembly areas, and severe weather shelters (and alternative routes and assembly areas) are to be specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the ERC or designee before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The ERC and a "buddy" will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.
- The ERC will account for all personnel in the onsite assembly area.
- A designated person will account for personnel at alternate assembly area(s).
- The ERC will follow the incident reporting procedures in the "Incident Notification, Reporting and Investigation" section of this Handbook.

16.5 Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

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16.6 Inclement Weather

Sudden inclement weather can rapidly encroach upon field personnel. Preparedness and caution are the best defenses. Field crew members performing work outdoors should carry clothing appropriate for inclement weather. Personnel are to take heed of the weather forecast for the day and pay attention for signs of changing weather that indicate an impending storm. Signs include towering thunderheads, darkening skies, or a sudden increase in wind. If stormy weather ensues, field personnel should discontinue work and seek shelter until the storm has passed.

Protective measures during a lightning storm include seeking shelter; avoiding projecting above the surrounding landscape (don't stand on a hilltop—seek low areas); staying away from open water, metal equipment, railroad tracks, wire fences, and metal pipes; and positioning people several yards apart. Some other general precautions include:

- Know where to go and how long it will take to get there. If possible, take refuge in a large building or vehicle. Do not go into a shed in an open area;
- The inclination to see trees as enormous umbrellas is the most frequent and most deadly mistake. Do not go under a large tree that is standing alone. Likewise, avoid poles, antennae, and towers;
- If the area is wide open, go to a valley or ravine, but be aware of flash flooding;
- If you are caught in a level open area during an electrical storm and you feel your hair stand on end, drop to your knees, bend forward and put your hands on your knees or crouch. The idea is to make yourself less vulnerable by being as low to the ground as possible and taking up as little ground space as possible. Lying down is dangerous, since the wet earth can conduct electricity. Do not touch the ground with your hands; and
- Do not use telephones during electrical storms, except in the case of emergency.

Remember that lightning may strike several miles from the parent cloud, so work should be stopped and restarted accordingly. The lightning safety recommendation is 30-30: Seek refuge when thunder sounds within 30 seconds after a lightning flash; and do not resume activity until 30 minutes after the last thunder clap.

High winds can cause unsafe conditions, and activities should be halted until wind dies down. High winds can also knock over trees, so walking through forested areas during high-wind situations should be avoided. If winds increase, seek shelter or evacuate the area. Proper body protection should be worn in case the winds hit suddenly, because body temperature can decrease rapidly.

16.6.1 Tornado Safety

Recognizing imminent tornado signs include seeing an unusually dark sky, possibly with some green or yellow clouds. You may hear a roaring or rumbling sound like a train, or a whistling sound like a jet. Large hail may also be falling. You may be able to see funnels, or they may be hidden by rain or hail.

Listen to your radio for tornado warnings during bad thunderstorms. If a tornado warning is issued, don't panic. Instead, listen and look. Quickly but calmly follow directions for getting to shelter.

Take cover. Indoors you should go down into the basement and crouch down under the stairs, away from windows. Do not take an elevator. If you can't get to a basement, go into a closet or bathroom and pull a mattress over you or sit underneath a sturdy piece of furniture on the ground floor near the center of the building. Pull your knees up under you and protect your head with your hands.

A bad place to be in a tornado is in a building with a large freestanding roof such as a gymnasium, arena, auditorium, church or shopping mall. If you are caught in such a building, take cover under something sturdy.

More than half of tornado deaths occur in mobile homes. If a tornado threatens, get out and go to a building with a good foundation, or lay down in a ditch away from vehicles and other objects.

If you are driving, get to a shelter, lie down in a ditch or seek cover up under the girders of an overpass or bridge. Stay as close to the ground as you can. Protect your head and duck flying debris.

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Stay away from metal and electrical equipment because lightning accompanies tornadoes.

If you have time before the tornado strikes, secure objects such as garbage cans and lawn furniture which can injure people. While most tornado damage is a result of the violent winds, most injuries and deaths actually result from flying debris.

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17. Inspections

17.1 Management Health, Safety, Security, and Environment Inspections

The Management Inspection Checklist is intended to facilitate PM leadership, provide an opportunity for PM's to mentor field staff on HSE and identify any big picture actions that need to be addressed. Observations that would improve global HSE program should also be included on the form. This Checklist does NOT take the place of a formal HSE audit. The PM shall:

- Complete one checklist per month during field work when visiting the site. The PM may delegate completion to the task lead, field team leader, or construction manager if the project is short duration and a visit is not planned for.
- Complete applicable sections of the checklist (can by typed or hand-written). Address issues with the field team, taking the opportunity to mentor staff by identifying the "root cause" of observation (e.g., why are SBOs not being completed, had this hazard been noted by any other team members?).
- E-mail the completed form to the address listed at the bottom of the form, and courtesy copy the Project Delivery Manager, Sector HSE Lead, and RHSM for tracking and review. Original should be kept in the project files.

17.2 Project Activity Self-Assessment Checklists

In addition to the hazard controls specified in this document, Project Activity Self-Assessment Checklists are contained as an attachment to the project safety plan. The Project-Activity Self–Assessment Checklists are based upon minimum regulatory compliance and some site-specific requirements may be more stringent. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. The self-assessment checklists, including documented corrective actions, shall be made part of the permanent project records and maintained by the SC.

The self-assessment checklists will also be used by the SC in evaluating the subcontractors and any client contractors' compliance on site.

17.3 Safe Behavior Observations

Safe Behavior Observations (SBOs) are a tool to be used by supervisors to provide positive reinforcement for work practices performed correctly, while also identifying and eliminating deviations from safe work procedures that could result in a loss.

The SC or designee shall perform at least one SBO each week for any field work performed by subcontractors or when there are at least two CH2M HILL personnel performing field work.

The SC or designee shall complete the SBO form (attached to the project safety plan) for the task/operation being observed and submit them weekly.

E-mail the completed form to the appropriate e-mail address at the bottom of the SBO Form.

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18. Incident Notification, Reporting, and Investigation

(Reference CH2M HILL SOP HSE-111, *Incident Notification, Reporting and Investigation*)

18.1 General Information

This section applies to the following:

- All injuries involving employees, third parties, or members of the public;
- Damage to property or equipment;
- Interruptions to work or public service (hitting a utility);
- Incidents which attract negative media coverage;
- Near misses;
- Spills, leaks, or regulatory violations; and
- Motor vehicle incidents.

Documentation, including incident reports, investigation, analysis and corrective measure taken, shall be kept by the SC and maintained onsite for the duration of the project.

18.2 Section Definitions

Incident: An incident is an event that causes or could have caused undesired consequences. An incident may be caused by natural forces, employees, subcontractors, or third parties in any location associated with CH2M HILL operations, including offices, warehouses, project sites, private property, or public spaces. Incidents include:

- Injury or illness to a CH2M HILL employee or subcontractor employee, or member of the public;
- Property damage;
- Spill or release;
- Environmental requirement or permit violation;
- A “near-miss”; or
- Other (e.g., fire, explosion, bomb threat, workplace violence, threats)

Near Miss: A near-miss occurs when an intervening factor prevented an injury or illness, property damage, spill or release, permit violation or other event from occurring. Examples of near-miss situations include: a hard hat or other personal protective equipment (PPE) prevented an injury; secondary containment or emergency shutoff prevented a spill; or an alert co-worker prevented an incident.

Serious Incident

A Serious Incident must be immediately reported to senior management includes:

- Work related death, or life threatening injury or illness of a CH2M HILL employee;
- subcontractor, or member of the public;
- Kidnap/missing person;
- Acts or threats of terrorism;

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- Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 in damage; or
- Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community or the environment.

18.3 Reporting Requirements

All employees and subcontractors' employees shall immediately report any incident in which they are involved or witness verbally to the SC or HS Manager and Field Team Leader or Site Supervisor (including "near misses").

Incident notification is made through both the HSE and the Operations chain of command. Upon notification of an incident, the SC or HS Manager initiates the HSE notification chain, and the Field Team Leader or Supervisor initiates the Operations notification chain.

If the incident was an environmental permit issue (potential permit non-compliance, other situation that result in a notice of violation) or a spill or release, contact the Project EM immediately so evaluation of reportable quantity requirements and whether agency reporting is required.

All recordable incidents and regulatory agency actions are reported up to the E&NBG President and the HSE Director. Other incident notification is made up the chains to the indicated group depending on the severity, and any project, geographic, or client specific notification and reporting requirements.

The CH2M HILL team shall comply with all applicable statutory incident reporting requirements such as those to OSHA, the police, or state or Federal environmental agency.

Be aware that many OSHA-designated states require reporting to the area OSHA office if one person is admitted to the hospital (e.g., California and Washington); whereas Federal OSHA requires it if three or more are admitted.

18.4 Drug and Alcohol Testing for CH2M HILL Employees

As required by CH2M HILL Policy 810, U.S. Employees are subject to post-incident and reasonable suspicion drug and alcohol testing. The Employee must submit to drug and alcohol testing if the supervisor has a reasonable suspicion, and when any of the following occur:

- Work-related injury in which the Company reasonably believes (under the Reasonable Suspicion provisions in the Policy) that drug and/or alcohol use is a contributing factor;
- Incident resulting in property damage over USD$500 as determined by the Company;
- Injury on or in Company Property/Workplace (to Employee or third parties) involving the Employee's use of heavy machinery as determined by the Company;
- Incident considered to be a serious near-miss injury that occurs in the field or in the office as determined by the Company and where the Company reasonably believes (under the Reasonable Suspicion provisions in the Policy) that drug and/or alcohol use is a contributing factor to the serious near miss injury;
- Other circumstances as dictated by Employee Relations; or
- An Employee contributes to any of the above.

Except in emergencies, the employee must remain available for testing. Failure to remain available will be considered as a refusal to submit to the testing, which will result in disciplinary action. Following the test, if there is no reasonable suspicion, the Employee returns to work. The employee will not be allowed to operate any company vehicle or company equipment, or work in any designated areas, pending the result of the drug and/or alcohol test.

Employees who are required to submit to reasonable suspicion testing are prohibited from transporting themselves to or from the collection site. The supervisor will arrange for transportation; the employee will be transported by a CH2M HILL staff member. The employee must remain under the direct observation of the supervisor until turned over to the transporter. The employee will not be allowed to eat or drink unless instructed by the collector as this

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may hinder or decrease the company's ability to obtain a valid sample once the drug and/or alcohol test is administered.

After returning from the collection site, the employee must make arrangements to be transported home or to his/her residence. Supervisors must contact local authorities if an employee insists on driving a vehicle. Pending receipt of the drug and alcohol test results, the employee may not return to work.

18.5 Drug and Alcohol Testing for Subcontractors

The drug and alcohol testing requirements stated above apply to subcontractors when required by the subcontract.

18.6 HITS System and Incident Report Form

CH2M HILL maintains a HITS entry and/or Incident Report Form (IRF) for all work-related injuries and illnesses sustained by its employees in accordance with recordkeeping and insurance requirements. A HITS entry and/or IRF will also be maintained for other incidents (property damage, fire or explosion, spill, release, potential violation, and near misses) as part of our loss prevention and risk reduction initiative.

The SC shall complete an entry into the Hours and Incident Tracking System (HITS) database system located on CH2M HILL's Virtual Office (or if VO not available, use the hard copy Incident Report Form and Root Cause Analysis Form and forward it to the RHSM) within 24 hours and finalize those forms within 3 calendar days.

18.7 Injury Management/Return-to-Work (for U.S./Canada/Puerto Rico based CH2M HILL Staff Only)

(Reference CH2M HILL, SOP HSE-124, Injury Management/Return-to-Work)

18.7.1 Background

The Injury Management Program has been established to provide orderly, effective and timely medical treatment and return-to-work transition for an employee who sustains a work-related injury or illness. It also provides guidance and assistance with obtaining appropriate treatment to aid recovery, keep supervisors informed of employee status, and to quickly report and investigate work-related injury/illnesses to prevent recurrence.

To implement the Injury Management/Return-to-Work Program successfully, supervisors and/or SC should:

- Ensure employees are informed of the Injury Management/Return-to-Work Program;
- Become familiar with the Notification Process (detailed below); and
- Post the Injury Management/Return-to-Work Notification Poster.

18.7.2 The Injury Management/Return-to-Work Notification Process:

- Employee informs their supervisor.
- Employee calls the Injury Management Program toll free number 1-866-893-2514 immediately and speaks with the Occupational Injury Nurse. This number is operable 24 hours per day, 7 days a week. **Employees are encouraged to enter this phone number into their cell phones prior to starting field work.**
- Supervisor ensures employee immediately calls the Injury Management Program number. Supervisor makes the call with the injured worker or for the injured worker, if needed.
- Nurse assists employee with obtaining appropriate medical treatment, as necessary schedules clinic visit for employee (calls ahead, and assists with any necessary follow up treatment). The supervisor or SC accompanies the employee if a clinic visit is necessary to ensure that employees receive appropriate and timely care.
- Supervisor or SC completes the HITS entry or Incident Report Form immediately (within 24 hours) and forwards it to the Project Manager and RHSM.

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- Nurse notifies appropriate CH2M HILL staff by e-mail (supervisor, Health & Safety, Human Resources, Workers' Compensation).
- Nurse communicates and coordinates with and for employee on treatment through recovery.
- Supervisor ensures suitable duties are identified and available for injured or ill workers who are determined to be medically fit to return to work on transitional duty (temporary and progressive).
- Supervisor ensures medical limitations prescribed (if any) by physician are followed until the worker is released to full duty.

18.8 Serious Incident Reporting Requirements

(Reference CH2M HILL SOP HSE-111, *Incident Reporting, Notification and Investigation*)

The serious incident reporting requirements ensures timely notification and allows for positive control over flow of information so that the incident is handled effectively, efficiently, and in conjunction with appropriate corporate entities. This standard notification process integrates Health, Safety, Security and Environment and Firm Wide Security Operations requirements for the consistent reporting of and managing of serious events throughout our operations.

18.8.1 Serious Incident Determination

The following are general criteria for determining whether an incident on CH2M HILL owned or managed facilities or program sites is considered serious and must be immediately reported up to Group President level through the reporting/notification process:

- Work related death, or life threatening injury or illness of a CH2M HILL employee, subcontractor, or member of the public;
- Kidnap or missing person;
- Acts or threats of terrorism;
- Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 in damage; or
- Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community or the environment.

18.8.2 Serious Incident Reporting

If an incident meets the "Serious Incident" criteria, the Project Manager is to immediately contact the Crisis Manager at 720-286-4911, then follow the standard incident reporting procedure.

For all serious incidents this standard reporting process is implemented immediately so as to ultimately achieve notification to the Business Group President within 2 hours of incident onset or discovery, and notification to appropriate corporate Crisis Management Support Team.

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18.9 Incident Root Cause Analysis

The incident analysis is essential if all causes of the incident are to be identified for the correct remedial actions to be taken to prevent the same and similar type of incident from recurring. Root Cause Analysis (RCA) shall be completed for all recordable injuries, property damage incidents in excess of $5,000.00 (U.S.), environmental permit violations, spills and releases which are required to be reported to regulatory agencies, and any other incident, including near misses where they RHSM or PM determines an RCA is appropriate. The RHSM/REM is responsible for ensuring it is completed and results entered in the incident report form in HITS. RCA's must be completed using a Team that includes, at least the RHSM or designee, the involved party(ies), a responsible operations representative (e.g., PM, construction manager, crew supervisor, etc.) and an independent management representative not associated with the incident.

The Root Cause Analysis Form must be completed for all Loss Incidents and Near Loss Incidents. This form must be submitted to the investigation team for review.

For minor losses or near losses, the information may be gathered by the supervisor or other personnel immediately following the loss. Based on the complexity of the situation, this information may be all that is necessary to enable the investigation team to analyze the loss, determine the root cause, and develop recommendations. More complex situations may require the investigation team to revisit the loss site or re-interview key witnesses to obtain answers to questions that may arise during the investigation process.

Photographs or videotapes of the scene and damaged equipment should be taken from all sides and from various distances. This point is especially important when the investigation team will not be able to review the loss scene.

The investigation team must follow the Root Cause Analysis Flow Chart (see Attachment 4 of the SOP) to assist in identifying the root cause(s) of a loss. Any loss may have one or more root causes and contributing factors. The root cause is the primary or immediate cause of the incident, while a contributing factor is a condition or event that contributes to the incident happening, but is not the primary cause of the incident. Root causes and contributing factors that relate to the person involved in the loss, his or her peers, or the supervisor should be referred to as "personal factors." Causes that pertain to the system within which the loss or injury occurred should be referred to as "job factors."

Personal factors include:

- Lack of skill or knowledge;
- Correct way takes more time and/or requires more effort;
- Short-cutting standard procedures is positively reinforced or tolerated; or
- Person thinks there is no personal benefit to always doing the job according to standards.

Job Factors include:

- Lack of or inadequate operational procedures or work standards;
- Inadequate communication of expectations regarding procedures or standards; or
- Inadequate tools or equipment.

The root cause(s) could be any one or a combination of these seven possibilities or some other uncontrollable factor. In the vast majority of losses, the root cause is very much related to one or more of these seven factors. Uncontrollable factors should be used rarely and only after a thorough review eliminates all seven other factors.

18.9.1 Corrective Actions

Include all corrective actions taken or those that should be taken to prevent recurrence of the incident. Include the specific actions to be taken, the employer and personnel responsible for implementing the actions, and a timeframe for completion. Be sure the corrective actions address the causes.

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Once the investigation report has been completed, the PM shall hold a review meeting to discuss the incident and provide recommendations. The responsible supervisors shall be assigned to carry out the recommendations, and shall inform the SC upon successful implementation of all recommended actions.

- Evaluation and follow-up of the IRF will be completed by the type of incident by the RHSM, EM, or FWSO.
- Incident investigations must be initiated and completed as soon as possible but no later than 72 hours after the incident.

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19. Records and Reports

An organized project filing system is essential for good documentation and recordkeeping. There are many benefits to an organized filing system:

- Other CH2M HILL employees can easily and quickly find documents;
- Records are readily available for review;
- Records may be needed during OSHA investigations, audits, or other legal matters;
- Records may be needed on short notice in case of an injury, illness or other emergency; and
- Systematic recordkeeping aids in overall project organization.

The project filing system shall be established at the beginning of the project and maintained throughout all phases of construction and archived in accordance with CH2M HILL's Records Retention Policy. The information contained in the filing system shall be updated regularly and/or as specified in this document. The PM and SC are responsible for collecting documentation, including subcontractor documentation, and maintaining a complete and organized filing system.

Below are examples of records that must be maintained as the project progresses:

- Exposure records includes air monitoring data (including calibration records), SDSs, exposure modeling results;
- Physical hazard exposure records include noise, ionizing radiation, non-ionizing radiation, vibration, and lasers exposure assessments and measurements;
- Respiratory fit test records;
- Training records;
- Incident reports, investigations and associated back-up information such as agency notifications, calculations, and corrective actions taken;
- Federal or state agency inspection records;
- Waste analytical data;
- Waste profiles;
- Manifests;
- Permit inspection records;
- Agency submittals and reports;
- Certifications [such as Notice(s) of Intent, state-required erosion and sediment control inspector certifications, Stormwater Pollution Prevention Plan (if permit requires certification), and discharge, wastewater, and monitoring data];
- Other Records:
  - Ergonomic evaluations;
  - HSE audits and assessments;
  - Project-specific HSE plans;
  - Confined space entry permits;
  - Equipment inspections;

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  - Equipment maintenance;
  - Emergency equipment inspection records;
  - SBOs;
  - Self-assessment checklists

- The RHSM shall coordinate with the PM or designee to ensure that final project-specific HSE records described in this section, including negative exposure determinations, are maintained with the project files in accordance with the CH2M HILL records retention schedule, or forwarded to the Medical Surveillance Program Administrator, as appropriate. Records retention requirements are detailed in the Recordkeeping and Access to Records SOP, HSE-119.

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CH2M HILL Employee Sign-Off

I hereby acknowledge that I have received, read, understand, and will comply with this Handbook.

Name (printed):_____

Signature: _____

Employee Number (GEN):_____

Date:_____

Make a photo copy or scan and send this completed sign-off page to your CH2M HILL Safety Program Assistant (SPA).

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Subcontractor Sign-Off

E&NBG HSE HANDBOOK

The CH2M HILL subcontractors listed below have been provided with this Handbook, have read and understand it, and agree to abide by its provisions.

This sign-off sheet shall be maintained with the project safety plan.

Project Name: **Project Number:**

EMPLOYEE NAME (Please print)	**EMPLOYEE SIGNATURE**	**COMPANY**	**DATE**

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