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WORK PLAN ADDENDUM TWO PHASE THREE FOR DIOXIN CONTAMINATED DITCH SOIL
EXCAVATION ACTIVITIES WITH TRANSMITTAL SITE 8 NCBC GULFPORT MS

9/1/2002
CH2MHILL



September 12, 2002

CCI NAVY RAC
CH2MHILL Constructors, Inc.
115 Perimeter Center Place, NE
Suite 700
Atlanta, GA
30346-1278
TEL 770.604.9095
FAX 770.604.9282

Mr. Art Conrad
Remedial Project Manager,
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
Charleston, SC 29419-9010

Subject: Work Plan Addendum # 2 for Dioxin Contaminated Ditch Soil Excavation Activities, Naval Construction Battalion Center, Gulfport, MS, CTO 0030, Contract No. N62467-98-D-0995

Dear Mr. Conrad:

Enclosed please find 2 CD ROM copies of the Work Plan Addendum #2 for Dioxin Contaminated Ditch Soil Excavation Activities at NCBC, Gulfport, MS. Work Plan Addendum #2 includes a description of the activities CCI will complete as part of the Action Memorandum implementation at Site 8.

If you have any questions regarding this document, please call.

Sincerely,

CH2M HILL CONSTRUCTORS, Inc.

A handwritten signature in blue ink that reads "Steven N. Tsangaris".

Steven N. Tsangaris, P.E.
Project Manager

xc: Mr. Gordon Crane, NCBC Gulfport (2 copies)
Jon Overholtzer, CH2M HILL

**Work Plan Addendum 02
Phase 3 Dioxin Contaminated Ditch Soil Excavation
Activities**

**Naval Construction Battalion Center
Gulfport, Mississippi**

Revision 01

**Contract No. N62467-98-D-0995
Contract Task Order No. 0030**

Submitted to:

**U.S. Naval Facilities
Engineering Command
Southern Division**

Prepared by:



115 Perimeter Center Place, N.E.
Suite 700
Atlanta, GA 30346

September 2002

Work Plan Addendum 02
Phase 3 Dioxin Contaminated Ditch Soil Excavation Activities

Naval Construction Battalion Center
Gulfport, Mississippi

Revision 01

Contract No. N62467-98-D-0995
Contract Task Order No. 0030

Submitted to:

Department of the Navy, Southern Division
Naval Facilities Engineering Command

Prepared by:



September 2002

Prepared/Approved By:

Steve Tsangaris, Project Manager

Date

Approved By:

Scott Smith, Deputy Program Manager

Date

Client Acceptance:

U.S. Navy Responsible Authority

Date

Contents

1.0	Introduction	1-1
1.1	Site Setting and Background.....	1-2
1.1.1	Regulatory Framework.....	1-5
2.0	Project Execution Plan	2-1
2.1	Scope of Work Activities	2-1
2.1.1	Mobilization and Setup of Temporary Facilities.....	2-1
2.1.2	Site Controls/Utilities Identification	2-1
2.1.3	Backfill.....	2-1
2.1.4	Waste Disposal Cell Construction.....	2-2
2.1.5	Excavation and Disposal of Contaminated Soil from Ditches	2-5
2.1.6	Confirmation Sampling.....	2-8
2.1.7	Installation of Earthen Cover.....	2-8
2.1.8	Site Restoration, Decontamination, and Demobilization.....	2-9
2.1.9	Project Submittals.....	2-9
2.2	Project Schedule.....	2-10
2.3	Communications Plan.....	2-10
2.4	Traffic Control Plan.....	2-11
3.0	Sampling and Analysis Plan	3-1
3.1	Data Quality Objectives for Measurement Data	3-1
3.2	Confirmation Soil Sampling.....	3-3
3.3	Imported Backfill Sampling and Analyses	3-4
3.4	Field Quality Control	3-5
3.4.1	Project Performance Sampling	3-5
3.5	Analytical Methods	3-5
4.0	Waste Management Plan	4-1
4.1	Waste Characterization.....	4-1
4.2	Waste Management.....	4-2
4.2.1	Waste Storage Time Limit	4-2
4.2.2	Labels	4-2
4.2.3	General Requirements	4-3
4.2.4	Drums/Small Containers.....	4-3
4.2.5	Tanks	4-4
4.2.6	Stockpiles.....	4-4
4.2.7	Roll-off Boxes	4-4
4.2.8	Waste/Fuel Storage Area Inspections.....	4-5
4.3	Transportation	4-5
4.3.1	Manifests/Shipping Documentation.....	4-5
4.3.2	Transporter Responsibilities.....	4-6
4.3.3	Transportation and Disposal Log	4-6
4.4	Disposal of Wastestreams	4-7
4.5	Training.....	4-7
4.6	Records/Reporting	4-7

5.0	Environmental Protection Plan.....	5-1
6.0	Quality Control Plan.....	6-1
6.1	Project QC Manager.....	6-1
6.2	Testing Requirements.....	6-1
	6.2.1 Identification and Certification of Testing Laboratories.....	6-1
	6.2.2 Construction.....	6-1
	6.2.3 Environmental.....	6-1
	6.2.4 Testing and Sampling.....	6-4
	6.2.5 Test Control.....	6-4
6.3	CTO Support Organizations.....	6-5
7.0	Works Cited.....	7-1

Tables

2-1	Communication Matrix.....	2-10
2-2	Project Personnel Directory.....	2-11
3-1	Data Quality Objectives.....	3-1
3-2	Sampling and Analysis Summary.....	3-2
6-1	Roles, Responsibilities, and Authorities of Key Project Personnel.....	6-3

Figures

1-1	Site Location Map.....	1-3
1-2	Project Location Map.....	1-4
2-1	Waste Disposal Cell Diagram.....	2-3
2-2	Typical Berm Section after Filling.....	2-4
2-3	Excavation Areas and Site Facilities.....	2-6
2-4	Typical Section of Ditch Excavation.....	2-7
6-1	Project Organization Chart.....	6-2

Appendices

A	Health and Safety Plan
B	Project Schedule
C	Verification of Soil Remediation Guidance, Michigan Department of Environmental Quality
D	Environmental Conditions Report
E	Quality Control Attachments
	– Submittal Register
	– Testing Plan and Log
	– Project QC Manager Letter of Appointment

Acronym List

AALA	American Association for Laboratory Accreditation
AASTHO	American Association of State Highway and Transportation Officials
ACO	Administrative Contracting Officer
AFCEE	Air Force Center for Environmental Excellence
ASTM	American Society for Testing and Materials
BMP	best management practice
C&D	Construction and demolition
CAM	Contract Administration Manager
CCI	CH2M HILL Constructors, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COTR	Contracting Officer's Technical Representative
CS	Contract Specialist
CTO	Contract Task Order
DOT	Department of Transportation
DQO	data quality objective
EISOPQAM	EPA Region IV Environmental Investigative Standard Operating Procedures and Quality Assurance Manual
EPA	U.S. Environmental Protection Agency
FAR	Federal Acquisition Regulations
HSP	Health and Safety Plan
IR CDQM	Installation Restoration Chemical Data Quality Manual
IDW	Investigation derived waste
LDR	land disposal restriction
µg/L	Microgram per Liter
mL	Milliliters
MDEQ	Mississippi Department of Environmental Quality
MS/MSD	matrix spike/matrix spike duplicate
MSDS	Material Safety Data Sheet
NAVFAC	Naval Facilities Engineering Command
NCBC	Naval Construction Battalion Center
NGVD	National Geodetic Vertical Datum
NRC	National Response Center
NVLAP	National Voluntary Laboratory Accreditation Program
PCBs	Polychlorinated biphenyls
ppb	parts per billion

PPE	personal protective equipment
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
QCM	Quality Control Manager
RCRA	Resource Conservation and Recovery Act
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SVOC	semi-volatile organic compound
TAL	Target Analyte List
TAT	Turnaround time
TBD	to be determined
USACE	United States Army Corps of Engineers
VOC	Volatile organic compound

1.0 Introduction

CH2M HILL Constructors, Inc. (CCI) has been contracted by the Department of the Navy, Southern Division, Naval Facilities Engineering Command (NAVFAC), to prepare this site-specific work plan for the removal of dioxin contaminated soil from ditches in Areas 8B and 8C and the construction of a storage cell in Area 8A at the Naval Construction Battalion Center (NCBC) Gulfport, Mississippi. This work is being performed under the Remedial Action Contract No. N62467-98-D-0995, Contract Task Order (CTO) No. 0030.

This Work Plan Addendum serves as a supplement to the Basewide Work Plan prepared by CCI in May 1999 and revised in June 2002 for use as the master document for the work at NCBC Gulfport. CCI will use the procedures outlined in this Work Plan Addendum, in conjunction with the information in the Basewide Work Plan, to complete the work.

Under this scope of work, the following main tasks will be included:

- Mobilization, and demobilization, of CCI and subcontractor resources
- Installation of field project control trailers and support facilities
- Installation and maintenance of erosion control features
- Clearing and grubbing of ditch lines and the waste disposal cell area in Area 8A
- Construction of an unlined, earthen berm, waste disposal cell
- Excavation of dioxin contaminated soils from ditches located in Areas 8A, 8B, and 8C. Black organic surface deposits a few inches to 3 feet thick overlying white sand will be removed, transported, and deposited in the new disposal cell in Area 8A.
- Installation of an earthen cover over the dioxin contaminated soil
- Post-excavation sampling and laboratory analysis to confirm the removal of contaminated soil from the ditches
- Grading and compaction of the newly excavated ditch surface to provide available drainage
- Site restoration of areas impacted by the work

This Work Plan Addendum is organized into seven sections of text and five appendices as follows:

Section 1.0 Introduction describes the organization of the Work Plan Addendum and provides a description of the site setting and regulatory framework for the project.

Section 2.0 Project Execution Plan includes the description of CCI's approach for completing the scope of work activities, project schedule, project communications information, and traffic control plan.

Section 3.0 Sampling and Analysis Plan provides specific information for sampling and analysis during the project. The Basewide Work Plan addresses general sampling and analysis issues related to work at NCBC Gulfport.

Section 4.0 Waste Management Plan provides specific information for the anticipated pilot test wastes. The Basewide Work Plan describes the characterization, disposal, handling, and transportation of wastes generated during the work at NCBC Gulfport.

Section 5.0 Environmental Protection Plan provides processes and methods to be implemented at the site to protect and preserve the environment.

Section 6.0 Quality Control Plan describes the project organization, testing requirements, and CTO support organizations.

Section 7.0 Works Cited lists the references used in developing this Work Plan Addendum.

The following support documents are presented as appendices to this Work Plan Addendum.

Appendix A Health and Safety Plan

Appendix B Project Schedule

Appendix C Verification of Soil Remediation Guidance, Michigan Department of Environmental Quality

Appendix D Environmental Conditions Report

Appendix E Quality Control Attachments

- Submittal Register
- Test Plan and Log
- Project QC Manager Letter of Appointment

1.1 Site Setting and Background

NCBC Gulfport is located in the western part of Gulfport, Mississippi, in Harrison County, in the southeastern corner of the state, approximately 2 miles north of the Gulf of Mexico as shown on Figure 1-1. The base occupies approximately 1,100 acres and has an elevation averaging 30 feet above sea level with the only significant exception being stockpiles of bauxite stored on the surface. The project site where all the remedial activity will be conducted is Site 8, Areas 8A, 8B, and 8C. These sites occupy a combined area of approximately 30 acres of the north-central portion of the base north of 7th Street between Goodier Avenue and Lee Avenue, as shown on Figure 1-2.

From 1968 through 1977, a portion of the base, now known collectively as Site 8, was used as a storage area for 55-gallon drums. Site 8 was divided into three areas (8A, 8B, and 8C), based on the level of storage and handling of herbicide orange; Areas 8B and 8C were periodically used as overflow storage areas, whereas Area 8A was continually in use.

In March 2002, Tetra Tech NUS prepared an Action Memorandum for the Time Critical Removal of Dioxin Contaminated Soil. The ditch excavation activities described in that

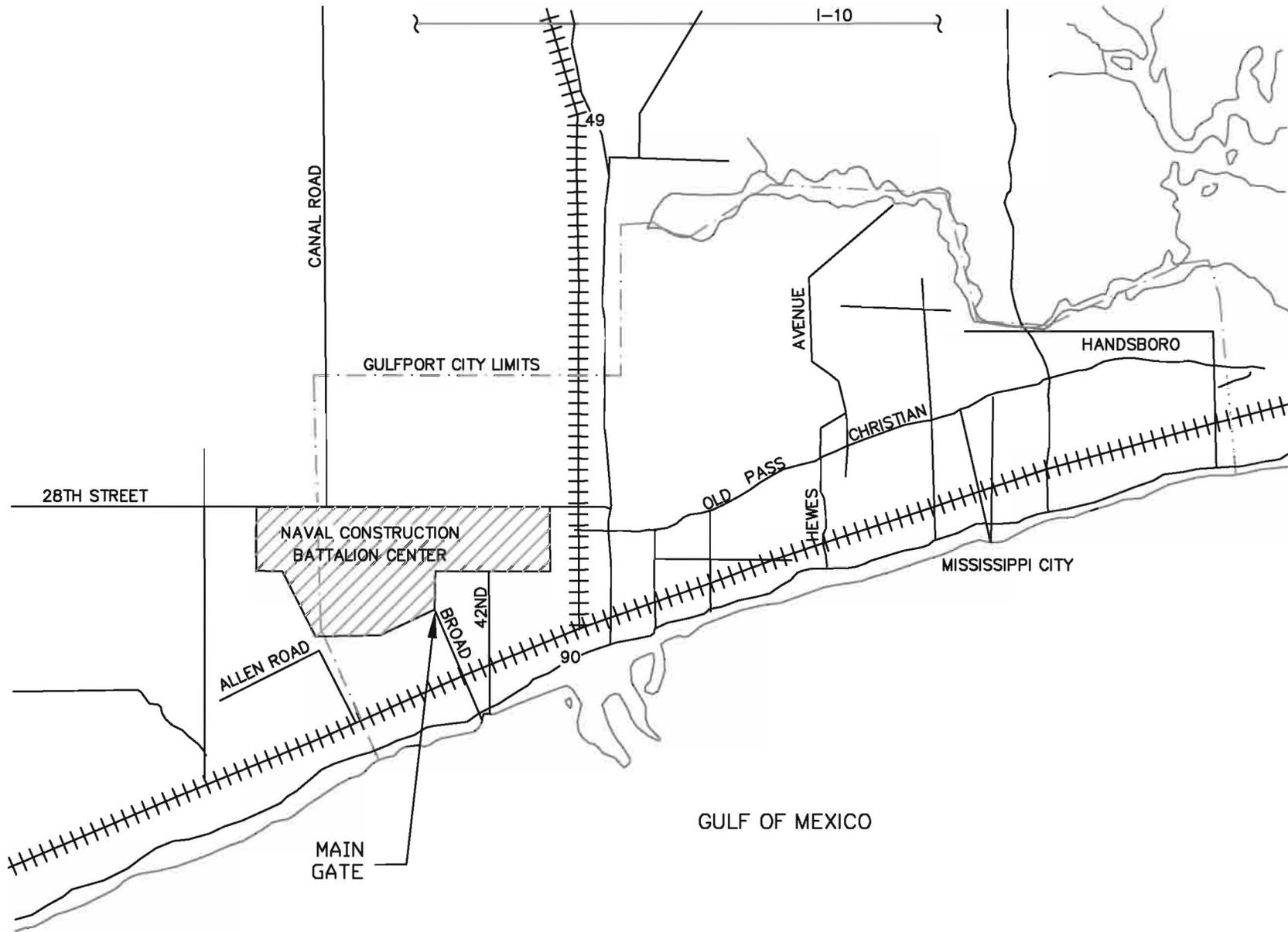


FIGURE 1-1
 SITE LOCATION MAP
 NAVAL CONSTRUCTION BATTALION CENTER
 GULFPORT, MS



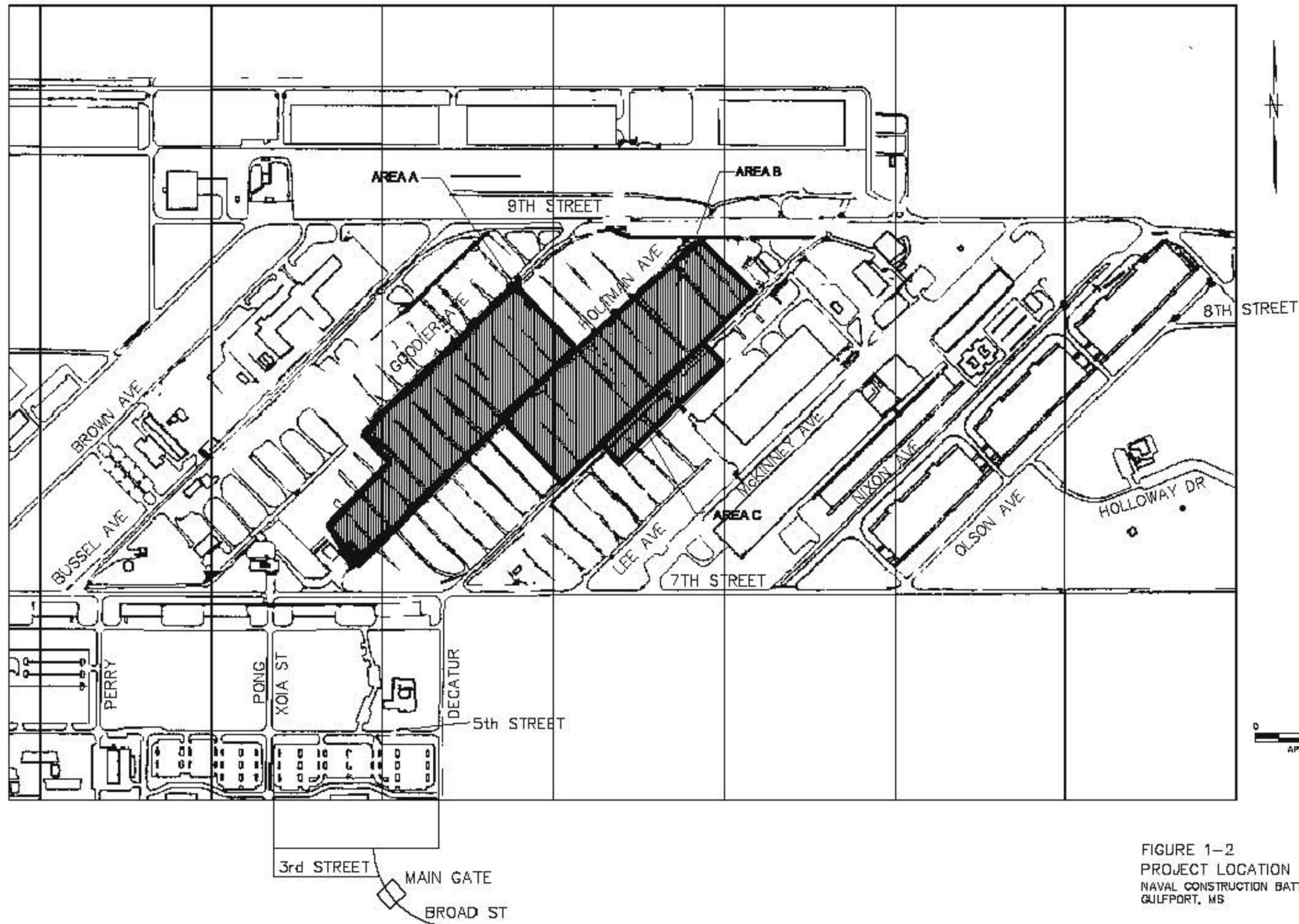


FIGURE 1-2
 PROJECT LOCATION MAP
 NAVAL CONSTRUCTION BATTALION CENTER
 GULFPORT, MS

Action Memorandum form the basis of the activities presented in this Work Plan Addendum.

Areas 8B and 8C are relatively flat with little vegetation. The surface soils consist of fine to medium sand with approximately one-third of these areas stabilized with cement. Areas 8B and 8C are located at the head of local drainage basins; surface water from Area 8B flows north and exits the base, and surface water from Area 8C drains to the southeast, exiting the base at Brickyard Creek. Surface water and sediment from Site 8 passes through a series of sediment traps installed to prevent the migration of dioxin. Tetra Tech NUS issued a Site Assessment P-745 that included a short section of ditch line where dioxins were identified. This ditch, south of Warehouse 200, is also included in this work effort.

1.1.1 Regulatory Framework

The Navy is undertaking this removal action for Site 8, Areas 8B and 8C, on behalf of NCBC Gulfport. While no emergency response action has been requested by the MDEQ, the investigation and long-term remediation of herbicide orange related chemicals has been mandated by MDEQ through administrative actions resulting in the Agreed Order No. 3466-97 (Agreed Order). The Agreed Order will continue to serve as the authority for studies and removal actions. As noted above, the Action Memorandum for the Time Critical Removal of Dioxin Contaminated Soil forms the basis of the project activities described in this Work Plan Addendum.

In addition, the work will be performed in compliance with City and County ordinances for the protection of trees and drainage system modifications. The regulatory permitting and associated best management practices (BMPs) for these items are addressed in Section 5.0, Environmental Protection Plan.

2.0 Project Execution Plan

This section includes a discussion of the scope of work activities, project schedule, communications plan, and traffic control plan.

2.1 Scope of Work Activities

The tasks in the scope of work are described in sequence as the work will progress.

2.1.1 Mobilization and Setup of Temporary Facilities

This task will consist of the mobilization of personnel, equipment, subcontractors, and materials to NCBC Gulfport and the establishment of temporary facilities to conduct the cell construction and removal of the ditch sediment. A kick-off meeting will be conducted on-site the first day of the project and will be attended by all participating parties and Base departments that will be affected by the work (security, fire, etc.) This meeting will be held at the Resident Officer in Charge of Construction's (ROICC's) office at the Base. All CCI field activities will be coordinated from the site and office supplies, field equipment, and personal protective equipment (PPE) will be stored offsite.

2.1.2 Site Controls/Utilities Identification

Prior to the commencement of any excavation, site controls including silt fence, construction barricades, and appropriate signage will be installed in the work area. Roadway closures will be coordinated with the Security Department to ensure that Base personnel are knowledgeable of the work activities and can coordinate railroad access. Prior to any work, utility representatives will be contacted to identify all above- and belowground utilities in the area and mark identified utilities using paint or flagging. A laydown/storage area for project supplies and a decontamination area will be established onsite for exposed personnel and equipment. An exclusion zone will be identified and marked to include all excavation operations. Once site preparations are completed, clearing and grubbing of the work area will commence for the construction of the waste disposal cell and cleaning of the ditch lines. All trees and shrubs that must be removed will be chipped for use as mulch in site restoration.

Once the ditches are cleared and grubbed, the elevations will be determined and marked in the field. This information will be used by the excavation crew during removal of contaminated soil and restoration of the ditches later in the project.

2.1.3 Backfill

To document that offsite soil material is uncontaminated, one representative sample from the soil backfill source will be collected and analyzed (maximum 28-day turnaround time [TAT]), for the presence of the following using U.S. Environmental Protection Agency (EPA) SW-846 procedures and Level III quality assurance/quality control (QA/QC) protocols:

- Volatile organic compounds (VOCs) (Methods 5035/8260B)
- Semi-volatile organic compounds (SVOCs) (Method 8270C)
- Pesticides (Method 8081A)
- Polychlorinated biphenyls (PCBs) (Method 8082)
- Target analyte list (TAL) Total Metals (Methods 7471A and 6010B)
- Dioxins and furans (Method 8290)

CCI will provide the ROICC with analytical results demonstrating that the offsite soil source or sources are free from contamination prior to bringing materials onsite.

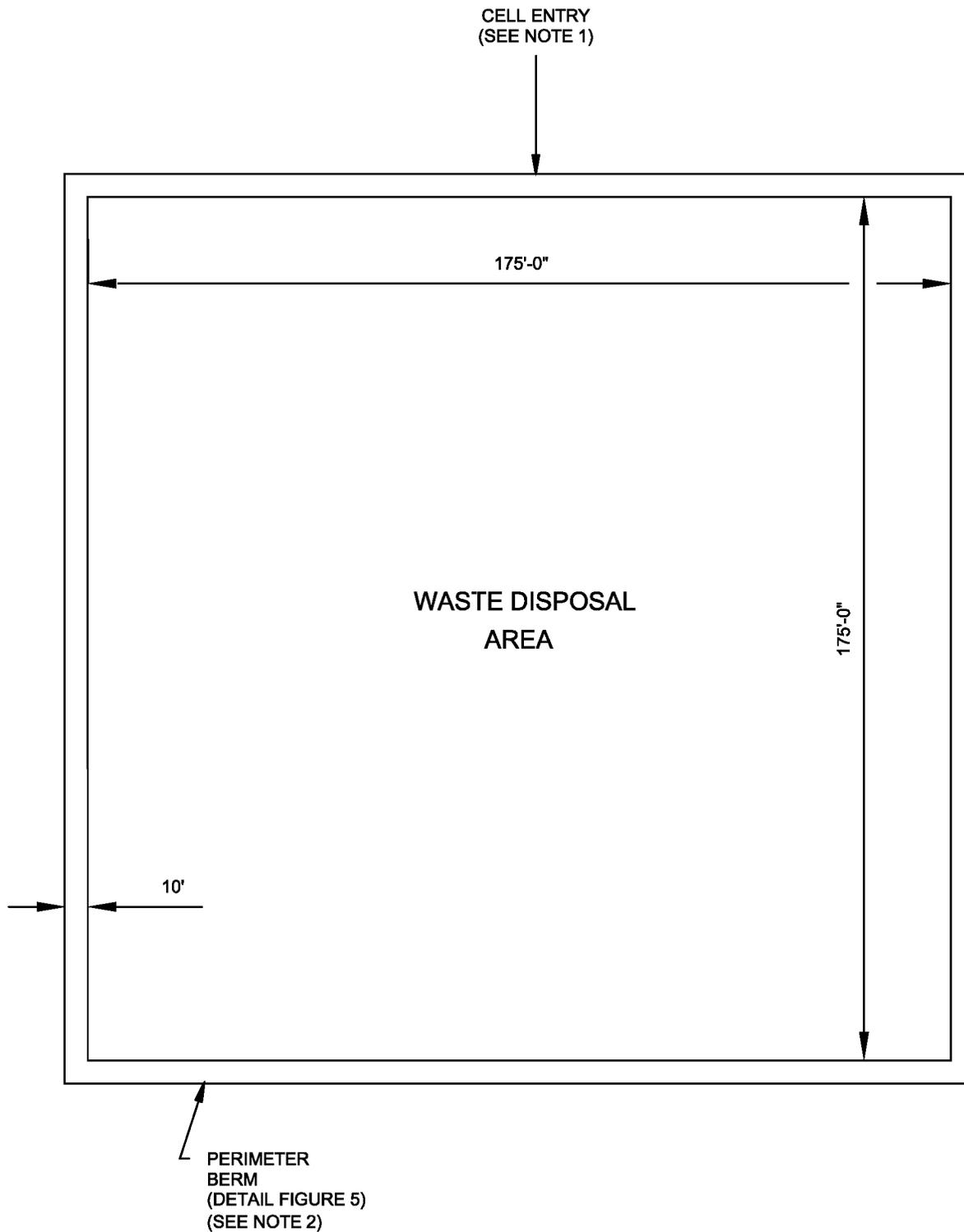
2.1.4 Waste Disposal Cell Construction

CCI will construct a waste disposal cell approximately 175 feet wide by 175 feet long as shown on Figure 2-1. An earthen berm will surround the perimeter and will be approximately 1 foot high and 10 feet wide so that a small bulldozer may form and compact the fill. Figure 2-2 depicts the typical section of the berm. The location in Area 8A identified in the Action Memorandum (Tetra Tech NUS, 2001) will be used for construction of the waste disposal cell. It is located approximately in the center of Area 8A and is one of the few areas not covered with piles of aggregate and construction material. The footprint of the waste disposal cell will be located and marked by CCI personnel prior to construction using site landmarks and a measuring tape. Grade stakes or spray-painted marks will be placed to form a 175-foot by 175-foot square marked on 100-foot centers along the perimeter of the footprint.

The base of the berm and the disposal cell will be cleared with the bulldozer to remove topsoil, grasses, shrubs, debris, and other unwanted material in the footprint. The aggregate piles of material onsite will be formed to create a smooth area large enough to hold the waste disposal cell. This material will be stockpiled and later used for cover materials, where appropriate. Since the area is flat, little material is anticipated to be generated. No synthetic liners will be used in construction of the waste disposal cell and all construction will be performed on the existing ground surface.

The berm will be constructed around the perimeter of the waste disposal cell with clean fill obtained from an offsite source. Initially three sides will be constructed for the loading of the cell, for ease of entry and to allow the exact dimensions for the waste volume. When all the waste is loaded and graded, the final side will be placed at the location needed for the actual waste volume. Approximately 400 cubic yards of clean fill materials are needed to construct the berm. Prior to construction, geotechnical lab testing for Atterberg Limits and Sieve Analyses will be conducted on the proposed fill to ensure that the material has the appropriate cohesive properties, as described in Section 6.2. The fill for the berm will be placed in 9-inch loose lifts and track-rolled a minimum of three times with the bulldozer. The dump trucks will also provide compaction on the fill. Moisture will be added to provide adequate compaction for dike materials to obtain near optimum standard proctor density. No compaction tests will be conducted for the perimeter berms.

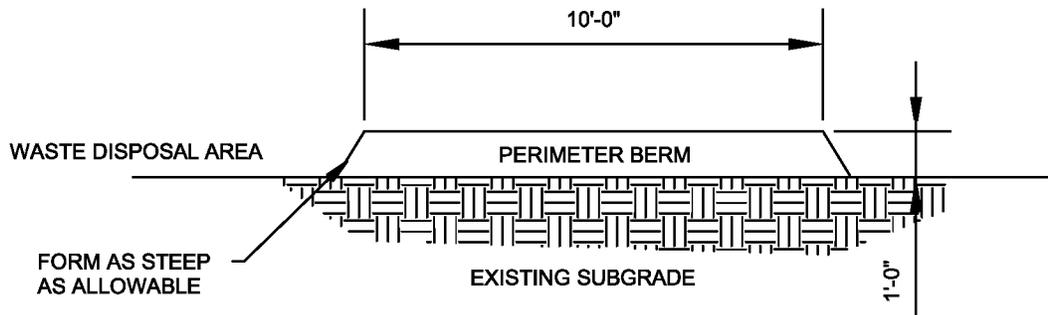
Anticipated equipment for the above task includes dump trucks, a bulldozer, and miscellaneous support equipment. Personnel resources needed for construction include one supervisor, one operator, and one laborer.



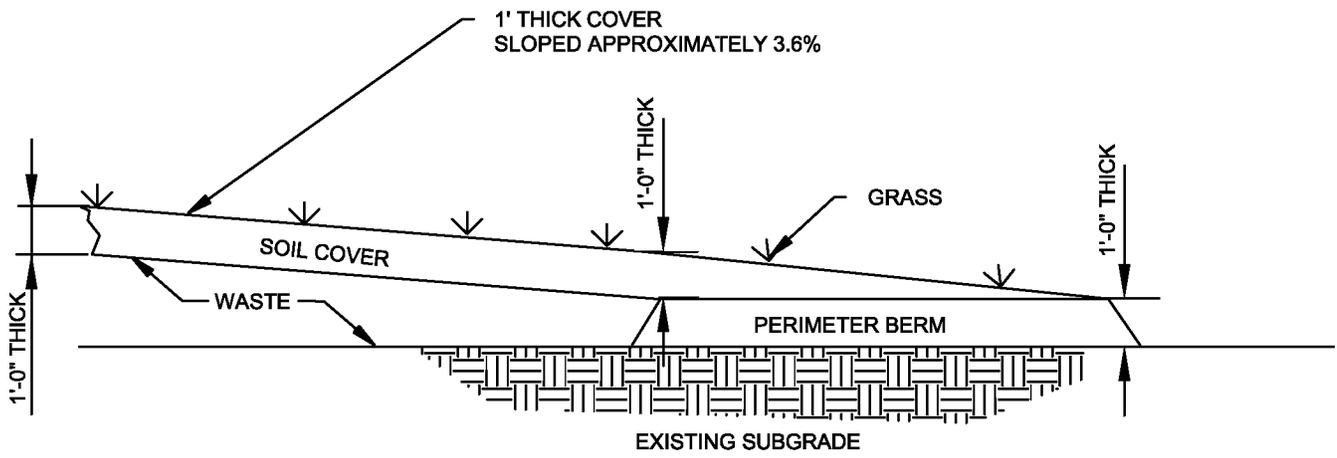
NOTES

1. THIS BERM WILL BE INSTALLED AT COMPLETION OF FILLING.
2. WASTE FILLING WILL START AT THIS END OF CELL.

FIGURE 2-1
 WASTE DISPOSAL CELL
 NAVAL CONSTRUCTION BATTALION CENTER
 GULFPORT, MS



PRIOR TO FILLING



AFTER FILLING

FIGURE 2-2
 TYPICAL BERM SECTIONS AFTER FILLING
 NAVAL CONSTRUCTION BATTALION CENTER
 GULFPORT, MS

2.1.5 Excavation and Disposal of Contaminated Soil from Ditches

Each of the contaminated ditches and the surface soil at the one “hot spot” shown on Figure 2-3 will be excavated. The following estimated quantities of contaminated soil are anticipated to be removed.

- Area 8A 250 cubic yards
- Area 8B 1,700 cubic yards
- Area 8C 200 cubic yards

Approximately 3,000 feet of drainage ditch will be excavated in the drainage flow path for the black surficial organic deposits from a few inches to 3 feet thick, as shown on Figure 2-4. The above volumes of contaminated soil are based on field observations by Tetra Tech NUS during their pilot-scale activities in 2001. CCI will contact Tetra Tech NUS for additional guidance on waste location as needed for the ditches in Areas 8A, 8B and 8C and south of Warehouse 200. The hot spot will be excavated 1 foot below the existing surface across an area of 20 feet by 20 feet. As in the ditches, black organic soil, which has been reported to bind the dioxin (Tetra Tech NUS, 2001), will be removed. A tracked excavator will be used to perform the work. Contaminated soil will be directly loaded into a dump truck as it is being excavated. The dump truck will transfer all the contaminated soil to the waste disposal cell. Since the dump trucks are expected to remain within the work area throughout the entire route, gross contamination monitoring will be performed only to prevent cross-contamination. No washing, cleaning, or brushing of trucks will be performed in the work area.

Culverts and pipes encountered during the project will be removed from the ditches. The culverts and pipes will be stored onsite for future disposal by others. The ditches will be graded in a flat “V” or a trapezoidal section so that they can be crossed easily at any location. New corrugated metal pipes will be installed at the previous culvert locations and will be aligned to allow drainage. These pipes will be covered with aggregate to a depth of 1 foot and the surface will be raised to surrounding grade with general fill. All fill will be compacted in place to at least 95 percent of the maximum dry density of the given soil.

The excavations are expected to be shallow (a few inches to 3 feet deep); some surface water may be encountered. This water will be managed by pumping to other areas. Water will not be contained or removed from the site. It will be pumped into ditches ahead of the operation and sprayed into or mixed into the contaminated waste disposal cell to evaporate. Because of the potential for cross-contamination, the surface water will not be used for dust control operations. The shallow excavations will be graded and sloped as the excavation is conducted. No open excavation areas will be created. The ditch areas will be smoothed and compacted into a flat “V” or trapezoidal shape with the excavator bucket to remove abrupt surfaces and vertical faces, providing safe access to site personnel and confirmation sampling crews.

Dump trucks will transport the contaminated soil to the waste disposal cell, entering the open end of the cell for loading. Activities there will be coordinated with the Security Department when roads are closed to public traffic. The contaminated soil will be dumped directly into the cell and spread with a bulldozer in loose lifts no greater than 12 inches. The

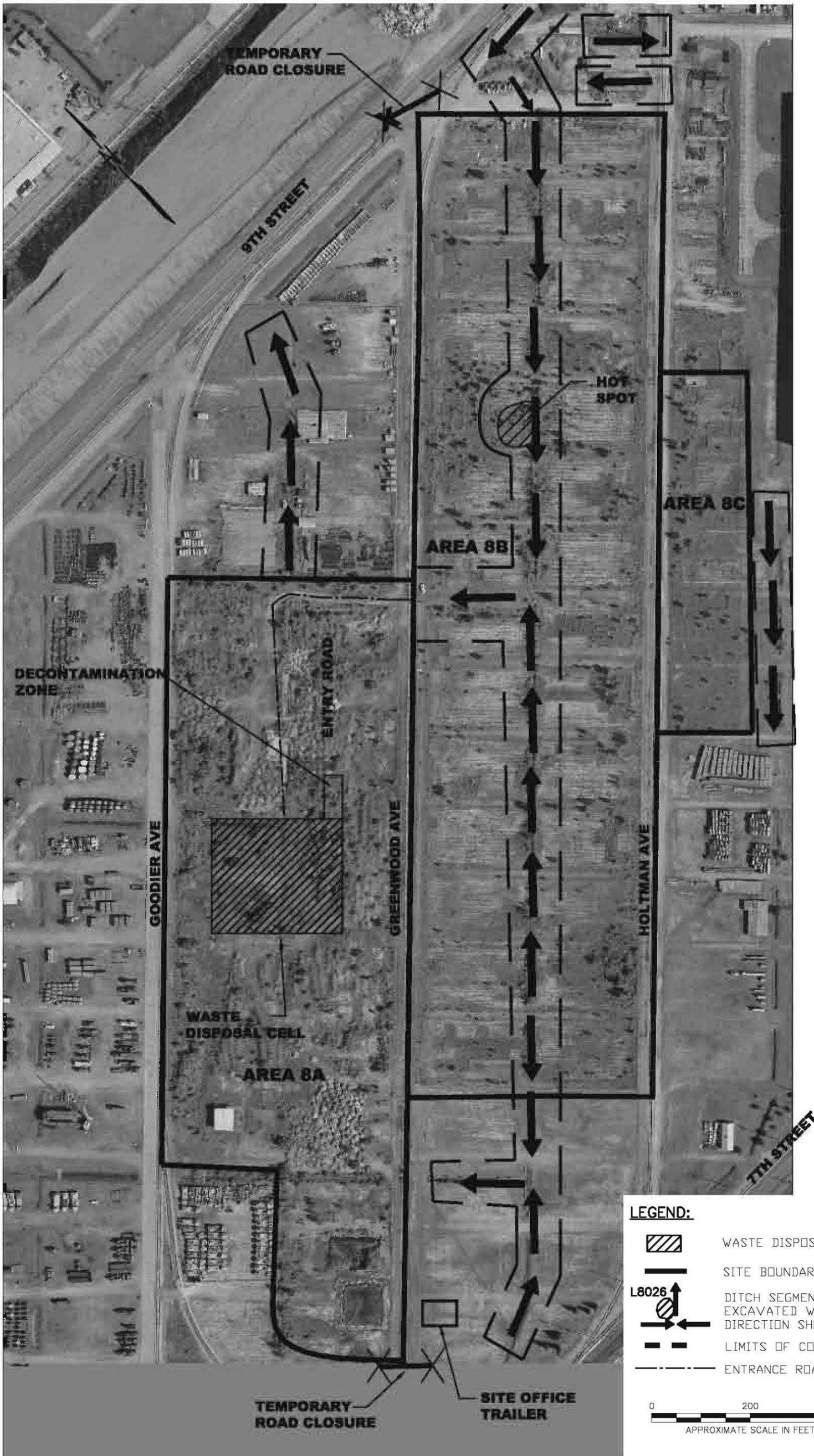


FIGURE 2-3
EXCAVATION AREAS AND SITE FACILITIES
NAVAL CONSTRUCTION BATTALLION CENTER
GULFPORT, MS

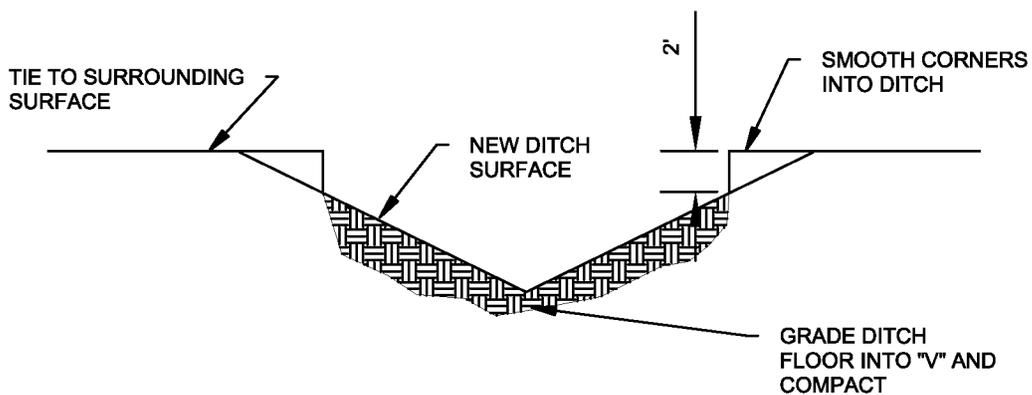
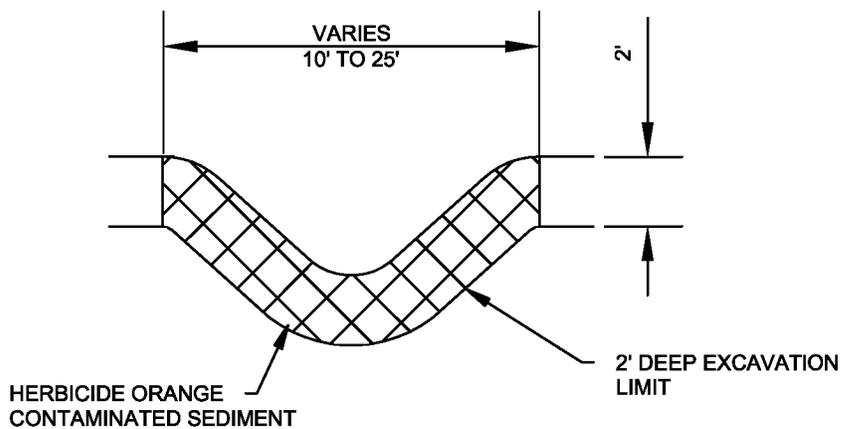


FIGURE 2-4
TYPICAL SECTION OF DITCH EXCAVATION
NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MS

bulldozer will track the soil to compact it. The loading operator will ensure that organic material, debris, and muck are not concentrated into single areas that would allow excessive settlement. If necessary, the operator will remove debris and organic material. The loading operator will also spread wet material to dry or mix wet material with dry material to achieve a moisture content that will allow efficient compaction. This loading process will be conducted to achieve the lines and grades of the final cover shown on Figure 2-2 and discussed in Section 2.1.7.

2.1.6 Confirmation Sampling

Once the initial limit of excavation is reached, CCI will collect confirmation soil samples. No solid waste sampling, except for PPE, will be required. No offsite disposal of solid waste will be conducted during this project. The confirmation samples will be grab samples collected from the excavated surface in accordance with the grid node system proposed in the Action Memorandum (Tetra Tech NUS, 2001). A discussion of the Sampling and Analysis Plan (SAP) is provided in Section 3.0.

The analytical TAT for these confirmation soil samples will be 14 workdays. All other field tasks for this project are expected to be completed prior to the return of the laboratory results. If additional excavation is required, CCI will consult with Southern Division, NAVFAC and Tetra Tech NUS on the type of response and the horizontal and vertical limits of the additional excavation. Because of the period of time required for the analysis near the end of the excavation, heavy equipment may be demobilized from the site. With the Navy's approval, it will be rescheduled for return.

2.1.7 Installation of Earthen Cover

When the contaminated soil has been loaded into the waste disposal cell, a 1-foot-thick soil cover/vegetative layer will be placed across all the waste. The soil cover will tie into the cell berms and provide a continuous and smooth surface for water runoff. Based on the volumes and dimensions, the slope of the cover will be about 3.6 percent. This will be adequate to shed water but not to generate erosive flows of runoff. Figure 2-2 depicts the cross section and plan of the waste disposal cell showing how the cover will tie into the berms. The soil cover will contain clean offsite backfill from the same source used for the berms. The soil will be placed in maximum 9-inch loose lifts and compacted to achieve at least 90 percent compaction of maximum dry density using American Society for Testing and Materials (ASTM) D698 Standard Proctor. The bulldozer and dump trucks will be used to compact the soil in the earthen cover.

When excavation of all known contaminated soil is almost complete and the confirmation sampling laboratory results have been received, the required location of the fourth and final side of the waste disposal cell will be determined and the side will be placed. It will be wrapped around the end of the waste pile and closed in conjunction with the soil cover. The soil cover will be placed across the existing contaminated soil until the final waste is delivered to the cell. If necessary, the end of the cell will remain open to allow loading of waste at a later date.

2.1.8 Site Restoration, Decontamination, and Demobilization

Work areas will be restored after excavation. The ditches, as discussed above, will be graded and smoothed to allow drainage during the excavation process. The excavator bucket will be used to compact and form the new drainage ditches as shown on Figure 2-4. No offsite backfill material is proposed in the ditches. The ditch areas excavated will receive onsite fill to provide drainage and prevent the formation of a pond or hole in the ditch line. This fill will be acquired from onsite by regrading ditches and the surrounding area. Some of the existing aggregate will be placed in the “hot spot” excavation and compacted to achieve the grades of the surrounding material. Grass seed and fertilizer (in the proportions listed below) will be either hand-cast or mechanically applied along the ditch lines based on the size of the area. Finally, the soil cover and berms of the waste disposal cell will be seeded, fertilized, and mulched to minimize erosion. The Mississippi Department of Transportation (DOT), local Soil Conservation Service, or other local organization will be consulted for selection of a grass mix and application protocol that have proven successful in the area. The mixes listed below shall be used for completion of the project from September to December. Any wood chips generated from the clearing and grubbing operation will be spread on the soil cover.

- 20.5 pounds of Bermuda per acre
- 20.5 pounds of Crimson Clover per acre
- 15.2 pounds of Tall Fescue per acre
- 0.45 tons of fertilizer per acre
- 2.9 tons of agricultural limestone per acre
- tons of mulch per acre (no Bahia grass shall be used in mulch or hay mulching)

CCI will perform a final cleanup of all areas impacted by its activities to the satisfaction of the ROICC. Personnel and equipment will be decontaminated prior to leaving the area to prevent the inadvertent spread of contamination. All contaminants and gross decontamination solids and rinses will be placed in the waste disposal cell. Personnel and equipment decontamination will be performed in accordance with the Site Health and Safety Plan (HSP) included in Appendix A and the applicable provisions of Code of Federal Regulations (CFR) 29 1910.120. In the event that special decontamination fluids (i.e., sampling decontamination fluids and rinses) are used, the decontamination waters and solids will be collected, containerized, and spread into the waste cell.

Following approval from Southern Division, NAVFAC, all personnel, equipment, temporary facilities, and utilities will be demobilized from the site. In addition, any remaining debris or other wastes generated during the work will be removed and properly disposed.

2.1.9 Project Submittals

CCI's site supervisor will be responsible for preparing a field activity summary that describes the work performed and estimated quantities of materials removed each day. To this end, CCI will complete the applicable portions of the Contractor Quality Control and the Contractor Production Reports. The originals of these documents will be provided to the ROICC.

This project is a Davis-Bacon Act General Wage project. Consequently, the submittal of certified payroll reports is required and will be provided to the Navy. This requirement is in accordance with Federal Acquisition Regulations (FAR), Subpart 52.222-8, Payrolls and Basic Records.

Within 60 days following completion of the work, CCI will prepare a Construction Completion Report describing the work. This report will be submitted to Southern Division, NAVFAC and will include discussions of the following topics, at a minimum:

- Summary of the Waste Disposal Cell Construction
- Summary of the Excavation and Removal of Contaminated Soil
- Summary of the As-Built Records
- Conclusions and Recommendations

2.2 Project Schedule

The major project activities and estimated duration for each of the tasks to be performed under this CTO are provided in Appendix B. The proposed site hours of operation are 10 hours per day (7:00 a.m. to 5:30 p.m., with a half-hour lunch break) 5 days per week. This anticipated schedule will vary depending on the actual limits of excavation, weather delays, and time needed to determine whether further excavation is required.

2.3 Communications Plan

A communication matrix outlining the lines of communication for the Southern Division, NAVFAC and CCI personnel for this work is presented in Table 2-1. Table 2-2 provides a project personnel directory.

TABLE 2-1
Communications Matrix

CCI Position	Navy Direct Report
Scott Newman, Program Manager	Eva Clement, ACO Jimmy Jones, COTR
Scott Smith, Deputy Program Manager	Jimmy Jones, COTR Laurie Newkirk-Paggi, CS
Steve Tsangaris, CTO Project Manager	Art Conrad, RPM Gordon Crane, NCBC Environmental Programs Manager

ACO – Administrative Contracting Officer
 COTR – Contracting Officer's Technical Representative
 RPM – Remedial Project Manager
 CS – Contract Specialist

TABLE 2-2
Project Personnel Directory

Contact	Organization
Scott Newman – Program Manager Scott Smith, Deputy Program Manager Theresa Rojas – QCM Richard Rathnow – HSM Joe Giandorato – CAM Steve Tsangaris – CTO PM	CH2M HILL Constructors, Inc. 115 Perimeter Center Place, N.E. Suite 700 Atlanta, GA 30346-1278 770/604-9182
Eva Clement – ACO Laurie Newkirk-Paggi – CS	Southern Division Naval Facilities Engineering Command P.O. Box 190010 North Charleston, SC 29419-9010
Jimmy Jones – COTR	Southern Division Naval Facilities Engineering Command P.O. Box 190010 North Charleston, SC 29419-9010 843/820-5544
Art Conrad – RPM	Southern Division Naval Facilities Engineering Command P.O. Box 190010 North Charleston, SC 29419-9010 843/820-5517
Gordon Crane – NCBC Environmental Programs Manager	NCBC Gulfport 5200 CBC 2nd Street Gulfport, MS 39501 (601) 871-2485
ACO – Administrative Contracting Officer COTR – Contracting Officer’s Technical Representative RPM – Remedial Project Manager ROICC – Resident Officer in Charge of Construction	CS – Contract Specialist QCM – Quality Control Manager HSM – Health and Safety Manager CAM – Contract Administration Manager

2.4 Traffic Control Plan

Traffic control will be the responsibility of the CCI site supervisor. A minimal amount of traffic will enter the site; however, heavy equipment deliveries are scheduled at the beginning and end of the project and dump trucks will deliver soil for cell construction. The bulk of the daily traffic will be confined to the work area and should not pose a problem to facility operations. CCI will consult with the ROICC to evaluate placement of equipment and traffic flow to minimize the impact of this work to upcoming operations. Further, CCI will review all the pertinent U.S. Navy regulations and SOPs regarding vehicle movement and control inside the property.

3.0 Sampling and Analysis Plan

The SAP provided in this Work Plan Addendum outlines the required sampling activities associated with the removal of the dioxin contaminated soils at Areas 8A, 8B, and 8C at NCBC Gulfport. This SAP outlines the required locations, frequency, and analyses for the soil samples to be collected after remedial activities.

The Basewide Work Plan provides sample collection frequency and sampling methodology for incidental samples collected during the remedial phase of the project completed under this contract; sample QA/QC procedures to be maintained during all sample collection activities; and sample equipment decontamination procedures.

Samples will be collected in accordance with the EPA Region IV Environmental Investigative Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), November 2001. The sampling team will be qualified under the Navy Installation Restoration Chemical Data Quality Manual (IRCDQM) 1999 sampling requirements.

3.1 Data Quality Objectives for Measurement Data

The data quality objectives (DQOs) for each sampling task described above are listed in Table 3-1. The sampling and analytical requirements, along with the required level of quality and data packages, are listed in Table 3-2. The quantitation, precision, accuracy, representativeness, comparability, and completeness by which the data will be evaluated will be provided by the selected laboratory and approved by CCI's QA Chemist.

A Navy, United States Army Corps of Engineers (USACE), or Air Force Center for Environmental Excellence (AFCEE)-approved laboratory will be used for all sample analyses.

TABLE 3-1
Data Quality Objectives

Sampling Activity	Data Quality Objective Category
Confirmation Sampling (offsite laboratory analyses)	Definitive
Imported Backfill Material Sampling (offsite laboratory analyses)	Definitive

TABLE 3-2

Sampling and Analysis Summary

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx No. of Samples	Sampling Method	Sampling Equipment	TAT	DQO Level/ Data Package Reqmnt	Required Analysis	Analytical Methods	Holding Time	Sample Preservation	Containers
Confirmation Sampling													
Confirmation Sampling	Areas 8A, 8B, 8C (62) and area of sample L8026 (2)	Soil	As needed to determine all contamination removed (anticipate once)	62 plus 2 + 7 duplicates + 4 matrix spike/matrix spike duplicates (MS/MSDs)	Surface Grab	SS spoon, SS bowl	14 days	DQO Level III, CCI Level C	Dioxin	8290	30 days Extr; 45 days to Analysis	Cool to 4°C; Dark	(1) 8 oz amber glass
	Equipment Rinsate Blank	Water	1 per 10 samples (10%)	7	Prepared in Field	Analyte-free water, SS funnel	14 days	DQO Level III, CCI Level C	Dioxin	8290	30 days Extr; 45 days to Analysis	0.008% Na ₂ S ₂ O ₃ ; Cool to 4°C; Dark	(1) L amber glass
Imported Backfill Material Sampling													
Characterization of Fill Material	Once per Offsite Source per Material	Soil	1 composite sample of 5 grabs	1	Composite 5 random grabs into 1 sample	SS spoon, SS bowl, syringe; lab prepared vials	7 days	DQO Level III, CCI Level C	TCL Volatiles	5035/826 0B	14 days	Methanol; analyte-free water; Cool to 4°C	(3) 40 mL vials; one with methanol; 2 with analyte-free water
			(1 grab for volatiles)		(1 grab for volatiles)				TCL Semi-Volatiles	8270C	14 day extr; 40 day analysis	Cool to 4°C	(4) 8 oz glass
									TCL Pesticides	8081A	14 day extr; 40 day analysis		
									Herbicides	8151A	14 day extr; 40 day analysis		
									PCBs	8082	14 day extr; 40 day analysis		
									TAL Metals	6010B/74 71A	6 month; Hg 28 days		
	Trip Blank	Water	1 per VOC cooler	As necessary	Prepared by Lab	N/A	7 days	DQO Level III, CCI Level C	TCL Volatiles	8260B	14 days	HCl pH< 2; Cool to 4°C	(2) 40ml vial

The soil remedial goal for dioxin is the risk-based, non-residential, cleanup goal of 38 microgram per kilogram ($\mu\text{g}/\text{kg}$) (parts per billion [ppb]) TEQ. If any of the excavated areas do not meet the remedial goal, CCI will consult with Southern Division, NAVFAC, and Tetra Tech NUS on the response and the horizontal and vertical limits of the additional excavation if necessary.

3.2 Confirmation Soil Sampling

Three areas, Area 8A, 8B, and 8C, will be excavated to limits described in Section 2.0. Once these limits have been reached, confirmation samples will be collected to determine if the dioxin remedial goal of $38 \mu\text{g}/\text{kg}$ has been achieved]. The sampling plan is based upon *Verification of Soil Remediation Guidance* (Michigan Department of Environmental Quality, April 1994) for medium and large sites, which is provided in Appendix C. A medium site is considered to be between 0.25 acre and 3 acres and a large site is considered to be 3 acres and greater (1 acre = 43,560 square feet).

A grid system will be established over the area being remediated. Grid point representation will be proportional to the size of the area. For excavation, both the sidewalls and bottom areas will be included in the determination of the area size. The grid interval will be determined using the following equation:

Medium site: $(A/\pi)^{1/2}/4 = \text{GI}$

Large site: $((A*\pi)/\text{SF})^{1/2} = \text{GI}$

where:

A = area to be included in grid (square feet)

GI = grid interval

SF = Site factor, length of area to be included in grid (unitless)

$\pi = 3.14159$

Once the grid interval is calculated, a scaled grid will be placed over a map of the remediated areas (both the sidewalls and base). A specified point (usually the southwest corner) will be designated as the 0,0 coordinate. The grid will be adjusted to maximize sampling coverage.

Samples will be collected from each grid node (intersection point) by scraping away the top 6 inches of soil using a stainless steel spoon or trowel and placing soil from the exposed area into the sample container. Samples will be analyzed for dioxin by SW-846 Method 8290 (see Table 3-2).

Two additional surface soil samples will be collected to confirm the removal of contamination in the area of sample L8026. Samples will be collected and analyzed as described above.

Navy Level C Quality Control and CCI Level C package will be required along with appropriate QC samples for the required confirmation samples. All analytical data will be submitted in both hard copy and electronic format. All data will be validated by a third party.

3.3 Imported Backfill Sampling and Analyses

Analysis of backfill material must indicate that the material is uncontaminated. If no data are provided by the vendor supplying the backfill material (sand, topsoil, clay, etc.), then one sample will be collected per source and material. The samples will be collected using the procedures described below and delivered to a Navy, USACE, or AFCEE-approved laboratory and analyzed for the parameters listed in Table 3-2. A composite sample will be collected from at least five random points. Volatiles will not be composited but collected from a single point.

Procedures for collection of volatile and non-volatile samples are listed below.

Procedure for Collecting Volatile Soil Samples

1. Using split spoon or similar coring device (auger, etc.), core into the sample point.
2. Open the split spoon or similar device.
3. Using a disposable syringe with the bottom cut off, core into the exposed soil, collecting 5 grams (~ 5 mL).
4. Deposit collected soil into a laboratory pre-preserved vial and cap tightly.
5. Label and place into cooler for shipment.

Soil samples must be collected with a coring device such as a disposable plastic syringe (or other appropriate coring device) and immediately transferred into three VOC vials having a Teflon-lined lid which were prepared and weighed at the laboratory with approximately 5 mL of an appropriate preservative. The appropriate preservative for one of the vials (on which the lab will run its high level analyses to detect VOCs above approximately 200 µg/kg) is methanol and/or polyethylene glycol. The appropriate preservative for two of the vials (on which the laboratory will run a low level analysis if VOCs were not detected on the high level analysis) is organic-free reagent-grade water.

Procedure for Collecting Non-Volatile Samples

1. Using split spoon or similar coring device (auger, etc.), core into each sample point.
2. Deposit soil from each point into a stainless steel bowl.
3. Blend and quarter soil using stainless steel spoon.
4. Fill the appropriate sample jars approximately three-fourths full with the homogenized sample.
5. Close the jar, label, and package the sample for shipment to the lab.

Navy Level C Quality Control and CCI Level C data package will be required along with appropriate QC samples for the required analyses. All analytical data will be submitted in both hard copy and electronic format.

3.4 Field Quality Control

3.4.1 Project Performance Sampling

Field duplicate samples and equipment blank samples will be collected at a minimum frequency of 10 percent of the total number of samples collected for an analysis and rounded to the nearest whole number. One trip blank sample will be provided at a frequency of one per sample cooler containing volatile samples. MS/MSDs will be required at a maximum frequency of one per sample event or a minimum frequency of one per 20 samples. Quantity and frequency are detailed in Table 3-2.

3.5 Analytical Methods

Samples will be collected for analysis by the methods summarized in Table 3-2.

Preliminary analytical results will be faxed to Bonnie Hogue at the fax number shown below per the TAT listed in Table 3-2 from day of sample receipt. The final hardcopy data and electronic files will be delivered to Tatiana Romanova within 14 days of sample receipt.

Bonnie Hogue/Tatiana Romanova
CCI
115 Perimeter Center Place, Suite 700
Atlanta, GA 30346
(770) 604-9182 x263/x562
(678) 579-8106 (fax)
bhogue@ch2m.com
tromanov@ch2m.com

QC and minimum reporting or practical quantitation limit requirements are specified in the approved laboratory's Quality Assurance Project Plan (QAPP). These limits will be reviewed and approved by the CCI QA Chemist.

4.0 Waste Management Plan

The Waste Management Plan describes the requirements and procedures for managing waste that will be generated during the removal of dioxin contaminated soil from ditches in Areas 8B and 8C and the construction of a storage cell in Area 8A at NCBC Gulfport. Wastes generated from this activity will be managed and disposed in accordance with applicable State of Mississippi and Federal solid waste regulations.

As part of the field activities, a certain amount of waste (including contaminated environmental media) will be generated in association with soil excavation, personal protection, sample handling, media sampling, and decontamination. Every effort will be made to minimize the waste generated and to dispose of this waste in the most appropriate, cost-effective manner.

The contaminant of concern is dioxin. It is understood that the dioxin contained in the soil subject to removal has been delisted (in accordance with the Agreed Order). Accordingly, unless otherwise hazardous (i.e., exhibits a hazardous waste characteristic), the soil is not considered a hazardous waste. It is anticipated that other wastes generated during these remediation activities will be uncontaminated or below applicable land disposal limits.

While hazardous wastes are not anticipated, the following procedures include hazardous waste management requirements as a contingency and as a BMP.

4.1 Waste Characterization

The Sampling and Analysis Plan provides detailed information on the waste sampling requirements. However, in some cases, offsite facilities may require additional analyses to evaluate the wastestream prior to acceptance. All wastes will be characterized per 40 CFR 261 to determine if they are hazardous. Typically, uncontaminated wastes and debris will be characterized using process knowledge.

Waste characterization information for wastes will be documented on a waste profile form provided by the offsite treatment or disposal facility as part of the waste acceptance process. An approved copy of the waste profile will be received prior to offsite transportation of the material. If generator certification and/or signature are required, Navy personnel will provide.

The profile typically requires the following information:

- Generator (Navy) information including name, address, contact, and phone number
- Site name including street/ mailing address
- Activity generating waste (soil remediation)
- Source of contamination
- Historical chemical use for area
- Physical state of waste (e.g., soil)

4.2 Waste Management

Clearing and grubbing of the small bushes and trees in the ditches will be conducted during the course of the removal. This organic material will be set to the side for chipping and spreading on the waste disposal cell cover. Contaminated soil will be directly loaded into a dump truck as it is being excavated. The dump truck will transfer all the contaminated soil to the waste disposal cell.

Solid waste generated from excavation activities will be contained in a manner that prevents the spread of contamination. Contaminated or potentially contaminated wastes and debris will be contained in drums or roll-off boxes, and characterized for offsite disposal. Uncontaminated construction and demolition (C&D) debris will be collected daily, segregated, containerized, or placed in stockpiles prior to offsite transportation and disposal. Uncontaminated PPE and other uncontaminated disposable materials may be double-bagged in plastic trash bags and disposed in onsite dumpsters.

Aqueous waste generated during equipment and personnel decontamination procedures will be contained in drums or tanks until sprayed onto the waste cell. Water that accumulates in open excavations and is in contact with contaminated soil will be managed by spraying or mixing with the contaminated waste disposal cell to evaporate. Water that is not in contact with contaminated soil may be pumped into ditches ahead of the operation.

4.2.1 Waste Storage Time Limit

Hazardous wastes will be removed within 90 days from generation and other wastes will be removed from the site as soon as possible. The date of generation is the day that a waste is first placed in a container, tank, or roll-off box.

4.2.2 Labels

Labels will indicate the type of waste, location from which the waste was generated, and accumulation start date. Containers, roll-off boxes, and tanks will be labeled as follows:

- “Analysis Pending” or “Waste Material” – pre-printed labels to be used until analytical results are received and reviewed, and a waste designation determined. This label will include the accumulation start date.
- “Hazardous Waste” - pre-printed hazardous waste labels that include the following information:
 - Accumulation start date
 - Generator Name: U.S. Navy
 - Site EPA ID number
 - Hazardous waste codes

For containers of less than 110 gallons, the manifest number must be on the label before transporting.

“Non-Hazardous Waste” - pre-printed labels with the following information:

- Accumulation start date
- Generator Name: U.S. Navy
- Site EPA ID Number
- Waste-specific information (e.g., contaminated soil)

4.2.3 General Requirements

Security will be provided for waste storage areas according to the risks associated with the wastes' hazard and the proximity or accessibility of the public. In general, a barrier will be provided for hazardous waste accumulation areas and for waste storage areas that are accessible to the general public.

Roll-off boxes, containers, and tanks of hazardous waste will be stored in a temporary accumulation area designated by the Navy. If the Navy has not designated an accumulation area, CCI will temporarily store hazardous wastes in a secure area.

Waste storage areas will contain emergency equipment including fire extinguishers, decontamination equipment, and an alarm system (if radio equipment is not available to all staff working on the site). Spill control equipment (e.g., sorbent pads) will be available in all waste storage areas, and where liquids are transferred from one vessel to another.

4.2.4 Drums/Small Containers

Procedures for managing drums and small containers are as follows:

- Drums and small containers of hazardous waste will be transported to the temporary accumulation areas on wood pallets and will be secured together with non-metallic bonding
- Drums will be inspected and inventoried upon arrival onsite for signs of contamination and/or deterioration.
- Adequate aisle space (e.g., 30 inches) will be provided for containers such as 55-gallon drums to allow the unobstructed movement of personnel and equipment. A row of drums will be no more than 2 drums wide.
- Drums may not be stacked more than two high.
- Each drum will be provided with its own label.
- Drums will remain covered except when waste is being removed from or added to the drum. Covers will be properly secured at the end of each workday.
- Drums will be disposed of with the contents. If the contents are removed from the drums for offsite transportation and treatment or disposal, the drums will be decontaminated prior to re-use or before leaving the site.
- Secondary containment will be provided for drums of liquid hazardous waste and hazardous wastes that are incompatible with other wastes or materials stored nearby.

4.2.5 Tanks

Procedures for managing tanks are as follows:

- Only non-stationary tanks (such as cargo tanks or other wheeled tanks) will be used to accumulate hazardous waste.
- Tanks will be provided with secondary containment.
- Tanks will be inspected upon arrival onsite for signs of deterioration and contamination. Any tank arriving onsite with contents will be rejected.
- Tanks will be provided with covers.
- Each tank will be labeled.

4.2.6 Stockpiles

In the event that the contaminated soil is stockpiled, stockpiles will be managed according to the following:

- Stockpiles will be provided with a liner, cover, and perimeter berm to prevent release and infiltration of liquids.
 - The perimeter berm, typically hay bales placed beneath the liner, will be constructed to allow for collection of any free liquids draining from the stockpiles.
 - Accumulated free liquids will be pumped (or otherwise removed) to a container.
 - Covers will be provided as necessary to prevent wind dispersion or runoff/runoff from precipitation events.
 - Minimum 6-mil polyethylene sheeting will be used for liners and covers.
- Covers and perimeter berms will be secured in-place when not in use and at the end of each workday.
- Construction materials for the stockpiles that contact waste will be disposed of as contaminated debris.

4.2.7 Roll-off Boxes

Procedures for managing roll-off boxes are as follows:

- Roll-off boxes will be inspected upon arrival onsite. Any roll-off containers arriving with contents will be rejected.
- Roll-off boxes for hazardous waste will be provided with covers and disposable liners. Liners will be disposed of as contaminated debris.
- All roll-off boxes will be equipped with securely fastened covers, which will be closed during periods when the boxes are not in use.
- Old labels will be removed.

- Roll-off containers will be inspected by the transporter after removal of the liner and decontaminated if evidence of liner failure is observed.

4.2.8 Waste/Fuel Storage Area Inspections

Areas used for waste accumulation and fuel storage will be inspected for malfunctions, deterioration, discharges, and leaks that could result in a release. The following inspection schedule will be followed:

- At least weekly inspection of containers, tanks, and roll-off boxes (for leaks, signs of corrosion, and signs of general deterioration)
- At least weekly inspection of stockpiles (for liner and berm integrity)
- At least weekly inspection of fuel storage areas (e.g., for eroding containment systems and rusting tanks/ancillary equipment)

If operations will be suspended for more than 7 days, alternate inspection arrangements will be made. Prior to demobilization, all hazardous and other toxic wastes will be removed from the site. Inspections will be recorded and copies of the report will be maintained onsite.

4.3 Transportation

Each transportation vehicle and load of waste will be inspected before leaving the site. The quantities of waste leaving the site will be recorded. A contractor licensed for commercial transportation will transport non-hazardous wastes. For hazardous waste, the transporter will have an EPA Identification number, and will comply with transportation requirements of 49 CFR 171-179 (DOT) and 40 CFR 263.11 and 263.31 (Hazardous Waste Transportation). A copy of the documentation indicating that the selected transporter has appropriate licenses and identification numbers will be received prior to transport of any waste material.

4.3.1 Manifests/Shipping Documentation

Each load of waste material will be manifested prior to leaving the site. At a minimum, the manifest form will include the following information:

- Transporter information, including name, address, contact, and phone number
- Generator information, including name, address, contact, and phone number
- Site name, including street/ mailing address
- Description of waste (e.g., hazardous waste, liquid)
- Type of container
- Quantity of waste (volumetric estimate)

Additionally, each shipment of waste will have a Land Disposal Restriction (LDR) Notification/Certification for hazardous wastes.

If the signed hazardous waste manifest from the designated offsite facility is not received within 35 days, CCI will contact the transporter or the designated facility to determine the status of the waste. If the signed hazardous waste manifest has not been received within

45 days, CCI will prepare an "Exception Report" for the Navy to submit to the State of Mississippi, as required under 40 CFR 262.42.

4.3.2 Transporter Responsibilities

The transporter will be responsible for weighing loads at a certified scale. For each load of material, weight measurements will be obtained for each full and empty container, dump truck, or tanker truck. Disposal quantities will be based on the difference between weight measurements of the full and empty container, dump truck, or tanker truck. Weights will be recorded on the waste manifest. The transporter will provide copies of weight tickets with the final manifest to CCI.

The transporter will observe the following practices when hauling and transporting wastes offsite:

- Minimize impacts to general public traffic.
- Repair road damage caused by construction and/or hauling traffic.
- Clean up material spilled in transit.
- Line and cover trucks/trailers used for hauling contaminated materials to prevent releases and contamination.
- Decontaminate vehicles prior to re-use, other than hauling contaminated material.
- Ensure that all personnel involved in offsite disposal activities follow safety and spill response procedures outlined in the Health and Safety Plan.
- Ensure that no materials from other projects are combined with materials from NCBC Gulfport.
- Seal trucks transporting liquids.

In the event of a spill or release of hazardous wastes, the transporter must immediately notify CCI and local authorities. The transporter must clean up any hazardous waste spill or release that occurs during transportation, or take such action as may be required or approved by Federal, State, or local officials.

The transporter will report any spill or release of hazardous waste, if required by 49 CFR 171.15, to the National Response Center (NRC) at 800-424-8802 or 202-426-2675. The transporter must also report in writing, as required by 49 CFR 171.16, to the Director, Office of Hazardous Materials Regulations, Materials Transportation Bureau, Department of Transportation, Washington, DC 20590.

For any spill of hazardous waste water from a bulk shipment (e.g., tanker), the transporter will immediately notify the NRC (800-424-8802 or 202 - 267-2675), as required in 40 CFR 263.30.

4.3.3 Transportation and Disposal Log

Transportation of wastes will be inventoried the day of transport from the site using the Transportation and Disposal Log. A carbon copy of the initial manifest form for each load

will be retained onsite and attached to the daily Production Report. All required transportation manifests will be prepared by CCI and signed by an NCBC Gulfport representative.

4.4 Disposal of Wastestreams

Offsite treatment or disposal facilities will use the waste profile and supporting documentation (e.g., analytical data) to determine if they will accept a waste. Hazardous wastes will be sent to the appropriate, permitted Resource Conservation and Recovery Act (RCRA) Subtitle C treatment, storage, or disposal facility. Non-hazardous wastes will be disposed at a Subtitle D facility or a municipal landfill, as appropriate. The treatment or disposal facility will be responsible for providing a copy of the final waste manifest and a certificate of treatment or disposal for each load of waste received.

Because these remediation activities are conducted under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), hazardous wastes will be transported to and treated or disposed at an offsite facility determined acceptable by the EPA Regional Offsite Contact, consistent with the CERCLA Offsite Policy (58 FR 49200, September 22, 1993). CCI will obtain a record of the hazardous waste facility's "CERCLA Offsite" approval under this policy.

4.5 Training

Training requirements for onsite personnel, including subcontractors, are presented in the site-specific Health and Safety Plan.

4.6 Records/Reporting

The following records and documents will be maintained:

- Transportation and offsite disposal records, including:
 - Profiles and associated characterization data
 - Manifests, LDR notifications/certifications, bills of lading, and other shipping records
 - Offsite facility waste receipts, certificates of disposal/destruction
- Training records
- Inspection records

CCI will maintain Material Data Safety Sheets (MSDSs) for chemicals and/or hazardous materials brought onsite, including the MSDSs for chemicals brought onsite by subcontractors.

5.0 Environmental Protection Plan

The Environmental Protection Plan in the Basewide Work Plan provides information on the requirements to be met during the work at NCBC Gulfport. An Environmental Conditions Report documenting current conditions at the site is included as Appendix D.

6.0 Quality Control Plan

The Quality Control Plan provided in the Basewide Work Plan details the quality administrators, the project organization for the work to be completed at NCBC Gulfport, and the definable features of work for each project site.

The Submittal Register included in Appendix E of this Work Plan Addendum documents submittals in accordance with Appendix E of CCI's Contract Management Plan (dated July 1998). CCI, the Navy, or others will approve submittals as identified in the Submittal Register. All approved submittals will be distributed by CCI to the appropriate Navy personnel (CO, ROICC [in duplicate], etc.), the project site, and the project file.

The site-specific project organization chart (Figure 6-1) depicts the chain-of-command for this CTO and the individuals responsible for executing the work as indicated. Individual roles and responsibilities of CTO personnel are summarized in Table 6-1.

6.1 Project QC Manager

The Project QC Manager will be Mr. William Knox. The resume and appointment letter of Mr. Knox are included in Appendix E.

6.2 Testing Requirements

This section presents requirements for construction testing and environmental analysis laboratories and their certifications; construction testing and environmental sampling and analysis; and test control. The Testing Plan and Log are provided in Appendix E.

6.2.1 Identification and Certification of Testing Laboratories

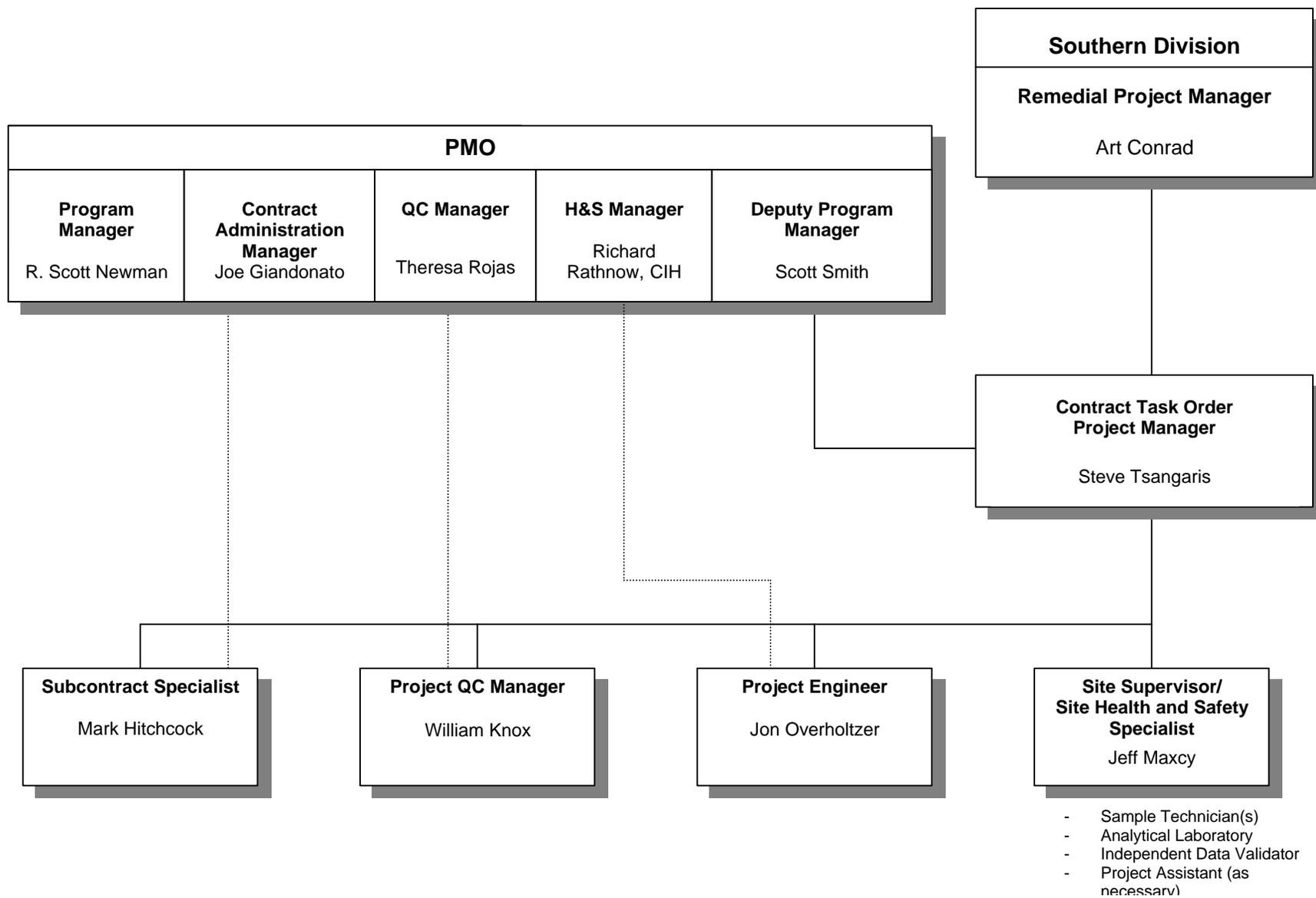
The construction testing and environmental testing laboratories used for this CTO project will function as a subcontractor or a lower tier subcontractor and have not yet been identified.

6.2.2 Construction

Construction testing laboratories will be National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), American Association of State Highway and Transportation Officials (AASHTO), or American Association for Laboratory Accreditation (AALA) certified.

6.2.3 Environmental

Laboratories performing analysis of environmental samples will be Navy-, USACE-, or AFCEE-approved.



- Sample Technician(s)
- Analytical Laboratory
- Independent Data Validator
- Project Assistant (as necessary)

TABLE 6-1
Roles, Responsibilities, and Authorities of Key Project Personnel

Role	Responsibility	Authority
Project Manager	<ul style="list-style-type: none"> • Management and technical direction of work • Communication with Southern Division RPM and NTR • Overview subcontractor performance • Select CTO staff • Develop CTO Work Plan and supporting plans • Meet CTO Performance Objectives • Prepare status reports • Prepare Field Change Requests 	<ul style="list-style-type: none"> • Approve subcontractor selection • Approve invoices to Southern Division • Approve CTO baseline schedule • Stop work at the site for any reason • Approve payment to vendors and suppliers • Approve payment to subcontractors • Review technical qualifications of subcontractors • Respond to Design Change Notices
Site Superintendent	<ul style="list-style-type: none"> • Responsible for all site activities • Provide direction to subcontractors • Act for Project Manager • Provide daily status reports • Prepare CTO Work Plan • Conduct daily safety meetings • Review subcontractor qualifications • Stop work for unsafe conditions or practices 	<ul style="list-style-type: none"> • Stop work for subcontractors • Approve corrective action for site work-arounds • Approve materials and labor costs for site operations • Resolve subcontractor interface issues • Approve daily and weekly status reports
Project QC Manager	<ul style="list-style-type: none"> • Monitor and oversee subcontractor compliance with scope of work • Review requests for changes in scope of work • Recommend improvements in work techniques or metrics • Recommend work-around to Site Superintendent • Monitor and report on subcontractor quality and quantities • Audit subcontractors' offsite fabrication • Maintain Submittal Register • Participate in Incident-Free Operations conference call 	<ul style="list-style-type: none"> • Complete daily compliance report • Monitor and report on subcontractor quality and quantities • Audit subcontractors' offsite fabrication • Maintain Submittal Register • Stop work for non-compliant operations • Maintain Rework Items list
Site Health and Safety Manager	<ul style="list-style-type: none"> • Monitor and report on subcontractor safety and health performance • Record and report safety statistics • Conduct needed site safety and health orientation • Maintain Environmental Log • Stop work for unsafe practices or conditions 	<ul style="list-style-type: none"> • Stop work for unsafe practices or conditions • Approve subcontractor site-specific health and safety plan • Set weekly safety objectives • Approve resumption of work for resolved safety issues
Subcontract Specialist	<ul style="list-style-type: none"> • Prepare bid packages • Purchase disposable materials • Maintain subcontract log • Approve payables for disposable items • Maintain government property records 	<ul style="list-style-type: none"> • Provide project scheduling coordination • Responsible for site cost tracking and reporting • Maintain record of site purchases

6.2.4 Testing and Sampling

Soil, water, and solids will be sampled under the direction of CCI or its subcontractors.

Construction Testing

Soil density testing is not required for this CTO work activity. However, it is critical that construction of the berm walls or dikes, placement of contaminated soil within the disposal cell, and construction of the earthen cover capping the waste disposal cell be compacted to result in firm earthen structures. Compaction will be achieved by placing the fill material in approximately 9-inch loose lifts and traversing each lift using earthmoving equipment. The objective is to create evenly distributed subgrade that does not exhibit evidence of yielding or pumping when traversed.

Environmental Sampling and Analysis

Environmental sampling and analysis, including QC sampling and analysis, is specified in the project Sampling and Analysis Plan, Section 3 of this Work Plan Addendum. Samples will be collected in accordance with EPA methods and industry standards of practice. Additionally, personnel who perform sampling will meet the requirements stated in the Navy IR CDQM- September 1999.

6.2.5 Test Control

Various meetings will be held and inspections performed in accordance with the 3 Phases of Control during the tasks described in this Work Plan Addendum. The definable features of work for this project are: mobilization and site preparation, soil excavation, confirmation sampling, field surveying, backfill and site restoration, and demobilization.

The construction inspections applicable to soil excavation, backfill and site restoration, and site surveying are discussed below.

Soil Excavation

Excavation of Areas 8A, 8B, and 8C will follow the approximate contours of the ditches. Soil and sediments will be removed to a depth of approximately 3 inches to 3 feet at the direction of CCI. In accordance with the Action Memorandum issued by Tetra Tech NUS, excavation will focus on the removal of black organic soil, which has been reported to bind the dioxin (Tetra Tech NUS, 2001). Excavation will continue until white sands exhibiting low or no concentrations of contaminants are encountered. The Tetra Tech NUS onsite representative will provide guidance to the excavation crew for the removal of contaminated soil.

Dimensions of the "hot spot" excavation will be 20 feet by 20 feet by 1 foot in depth below the existing land surface. The horizontal and vertical extents of the excavation will not exceed these boundaries even if the black organic material is encountered.

Confirmation samples will be collected at the completion of the excavation. The black organic material will be placed into the waste disposal cell along with the contaminated soil. Field measurements of the final excavation boundaries will be recorded to the nearest inch.

Backfill and Site Restoration

No backfilling is required for ditches in Areas 8A, 8B, and 8C. The final excavated surface of the ditches will be smoothed and graded to allow drainage. Uncontaminated soil from one or more offsite locations will be used as backfill of the excavated “hot spot” area. Backfill will be evenly placed and compacted to match pre-existing elevations. The Site Superintendent and the Project QC Manager will verify acceptance of the completed work areas.

The seeding will be selected based on recommendations from a local conservation agency or similar organization. The selected seeding will be applied to the earthen cover and the berms of the completed waste disposal cell.

Site Surveying

CCI will collect information to produce “as-built” drawings to illustrate the site work. The drawings will be computer generated, to scale, and will show existing reference locations (roadways, monuments, etc.) within 300 feet of the impacted site areas. The quantities of soil removed will also be documented.

General

The Project QC Manager will verify that:

- The facilities and testing equipment are available and comply with the appropriate testing standards.
- The recording forms, including all of the test and sampling documentation, have been prepared and checked for accuracy and completeness.
- The backfill soil compaction effort is acceptable.
- The excavation tolerances are acceptable.

6.3 CTO Support Organizations

The support organizations are yet to be determined.

7.0 Works Cited

CH2M HILL Constructors, Inc. 1999. Basewide Work Plan, Naval Construction Battalion Center Gulfport, Gulfport Mississippi. Revised June 2002.

Tetra Tech NUS. March 2002. *Action Memorandum for the Time-Critical Removal of Dioxin Contaminated Soil.*

Appendix A

Health and Safety Plan

**Health and Safety Plan
Phase 3 Dioxin Contaminated Ditch Soil
Excavation Activities
Naval Construction Battalion Center
Gulfport, Mississippi**

**Contract No. N62467-98-D-0995
Contract Task Order No. 0030**

Revision 00

Submitted to:

**U.S. Naval Facilities
Engineering Command
Southern Division**

Prepared by:



115 Perimeter Center Place, N.E.
Suite 700
Atlanta, GA 30346

June 2002

Contents

Acronyms.....	v
1.0 Project Information and Description.....	1-1
2.0 Tasks to be Performed Under this Plan.....	2-1
2.1 Hazwoper-Regulated Tasks	2-1
2.2 Non-Hazwoper-Regulated Tasks.....	2-1
3.0 Hazard Control.....	3-1
3.1 Project-Specific Hazards	3-1
3.1.1 Welding/Cutting with Compressed Gas Cylinders	3-1
3.1.2 Working Around Material Handling Equipment	3-2
3.1.3 Excavation Activities	3-2
3.1.4 Operating Heavy Equipment.....	3-3
3.1.5 Lockout/Tagout Activities.....	3-4
3.1.6 Use of Aerial Lifts	3-4
3.1.7 Confined Space Entry	3-5
3.2 General Hazards.....	3-6
3.2.1 General Practices and Housekeeping.....	3-6
3.2.2 Hazard Communication.....	3-6
3.2.3 Shipping and Transportation of Chemical Products.....	3-7
3.2.4 Lifting.....	3-7
3.2.5 Fire Prevention.....	3-7
3.2.6 Electrical.....	3-7
3.2.7 Stairways and Ladders	3-8
3.2.8 Heat Stress	3-9
3.2.9 Cold Stress	3-10
3.2.10 Compressed Gas Cylinders	3-11
3.2.11 Procedures for Locating Buried Utilities.....	3-12
3.3 Biological Hazards and Controls.....	3-12
3.3.1 Snakes	3-12
3.3.2 Poison Ivy and Poison Sumac	3-12
3.3.3 Ticks	3-12
3.3.4 Bees and Other Stinging Insects.....	3-13
3.3.5 Bloodborne Pathogens.....	3-13
3.4 Chemical Hazards	3-13
3.5 Potential Routes of Exposure.....	3-13
4.0 Project Organization and Personnel.....	4-1
4.1 CCI Employee Medical Surveillance and Training.....	4-1
4.2 Field Team Chain of Command and Communication Procedures	4-1
4.2.1 Client.....	4-1
4.2.2 CCI	4-1
4.2.3 CCI Subcontractors	4-4
5.0 Personal Protective Equipment.....	5-1

6.0	Air Monitoring/Sampling	6-1
6.1	Air Monitoring Specifications.....	6-1
6.2	Calibration Specifications	6-1
6.3	Air Sampling.....	6-2
7.0	Decontamination	7-1
7.1	Decontamination Specifications	7-1
7.2	Diagram of Personnel-Decontamination Line.....	7-1
8.0	Spill-Containment Procedures	8-1
9.0	Site Control Plan	9-1
9.1	Site Control Procedures	9-1
9.2	Hazwoper Compliance Plan.....	9-1
10.0	Emergency Response Plan	10-1
10.1	Pre-Emergency Planning	10-1
10.2	Emergency Equipment and Supplies.....	10-2
10.3	Incident Reporting, Investigation and Response	10-2
10.4	Emergency Medical Treatment	10-3
10.5	Evacuation.....	10-3
10.6	Evacuation Signals	10-4
10.7	Incident Notification and Reporting.....	10-4
11.0	Approval	11-1
11.1	Original Plan.....	11-1
11.2	Revisions	11-1

Figures

7-1	Personnel Decontamination Line.....	7-2
-----	-------------------------------------	-----

Tables

3-1	Contaminants of Concern.....	3-18
5-1	PPE Specifications.....	5-1
6-1	Air Monitoring Specifications	6-1
6-2	Air Monitoring Equipment Calibration Specifications	6-1
7-1	Decontamination Specifications.....	7-1
10-1	Emergency Equipment	10-2
10-2	Evacuation Signals	10-4

Attachments

1	Employee Signoff Form
2	Project-Specific Chemical Product Hazard Communication Form
3	Chemical-Specific Training Form
4	Emergency Contacts
5	Activity Hazard Analysis Form
6	Project Activity Self-Assessment Checklists/Permits
7	Incident Reporting Forms
8	Material Safety Data Sheets

Acronyms

°F	degrees Fahrenheit
AHA	Activity Hazard Analysis
ALARA	as low as reasonably achievable
APR	air-purifying respirator
ATL	Atlanta, Georgia
BMP	best management practice
CCI	CH2M HILL Constructors, Inc.
CMP	Contract Management Plan
CNS	central nervous system
CPR	cardiopulmonary resuscitation
CTO	Contract Task Order
dba	decibel A-rated
DOT	Department of Transportation
EPA	U.S. Environmental Protection Agency
FA	first aid
FID	flame ionization detector
GFCI	ground fault circuit interrupter
HAZCOM	hazard communication
HR	heart rate
HSM	Health and Safety Manager
HSP	Health and Safety Plan
IDLH	immediately dangerous to life and health
IDW	investigation-derived waste
lb	pound
LEL	lower explosive limit
mg/m ³	milligrams per cubic meter
MSDS	Material Safety Data Sheet
mW/cm ²	milliwatt per square centimeter
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
NCBC	Naval Construction Battalion Center
NDG	nuclear density gauge
NSC	National Safety Council
OSHA	Occupational Safety and Health Administration
PAPR	powered air-purifying respirator
PCBs	polychlorinated biphenyls
PDF	personal flotation device
PID	photoionization detector
PPE	personal protective equipment
ppm	parts per million
QA/QC	quality assurance/quality control
RMSF	Rocky Mountain Spotted Fever
ROICC	Resident Officer in Charge of Construction
SAR	supplied-air respirator

SCBA	self-contained breathing apparatus
SHSS	Site Health and Safety Specialist
SOP	standard of practice
STEL	short-term exposure limit
SZ	support zone
TAL	target analyte list
TAT	turnaround time
TBD	to be determined
TMCC	truck-mounted crash cushion
TSDF	treatment, storage, and disposal facility

This Health and Safety Plan (HSP) will be kept on the site during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standards of Practice (SOPs) in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual*, as appropriate. In addition, this plan adopts procedures in the project Work Plan. The Site Health and Safety Specialist (SHSS) is to be familiar with these SOPs and the contents of this plan. CH2M HILL Constructors Inc.'s (CCI's) personnel and subcontractors must sign Attachment 1.

1.0 Project Information and Description

Project No: Contract Task Order (CTO) 30

Client: Southern Division, U.S. Navy Facilities Engineering Command (NAVFAC)

Project/Site Name: Naval Construction Battalion Center

Site Address: Naval Construction Battalion Center (NCBC), Gulfport, Mississippi

CCI Project Manager: Jon Overholtzer/Atlanta, Georgia (ATL)

CCI Office: Atlanta, GA

Date Health And Safety Plan Prepared: June 2002

Date(s) of Site Work: June 2002 – June 2003

Site Background and Setting: CH2M HILL Constructors, Inc. (CCI) has been contracted by the Department of the Navy, Southern Division, Naval Facilities Engineering Command (Southern Division, NAVFAC), to prepare a Health and Safety Plan (HSP) for work to be performed by CCI at Naval Construction Battalion Center (NCBC), Gulfport, Mississippi. The work is being performed under Contract No. N62467-98-D-0995 and in accordance with the management approach outlined in the CCI Contract Management Plan (CMP) dated July 1998.

The site has been used by Naval Construction at least since the mid-1960s. Material storage, such as Agent Orange was maintained on the facility.

The Navy is undertaking this removal action for Site 8, Areas B and C of NCBC Gulfport. While no emergency response action has been requested by the Navy, the investigation and long term remediation of herbicide orange related chemicals has been mandated by the Navy through administrative actions resulting in the Agreed Order No. 3466-97 (Agreed Order). The Agreed Order will continue to serve as the authority studies or removal actions. In addition, City and County ordinances for the protection of trees and drainage system modifications. The regulatory permitting and associated best management practices (BMPs) for these items are addressed in Section 3.0, Environmental Protection Plan.

Description of Specific Tasks to be Performed: The following tasks are described in the Work Plan.

- Mobilization and Setup of Temporary Facilities
- Site Controls/Utilities Identification
- Backfill
- Waste Disposal Cell Construction
- Excavation and Disposal of Contaminated Soil from Ditches
- Confirmation Sampling
- Installation of Earthen Cover
- Site Restoration, Decontamination, and Demobilization

2.0 Tasks to be Performed Under this Plan

(Reference Field Project Start-up Form)

Refer to project documents (i.e., Work Plan) for detailed task information. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin. Refer to Section 8.2 for procedures related to “clean” tasks that do not involve hazardous waste operations and emergency response (Hazwoper).

2.1 Hazwoper-Regulated Tasks

- Mobilization
- Site controls/utilities identification
- Backfilling
- Waste Disposal cell destruction
- Excavation and disposal of contaminated soil from ditches
- Confirmation sampling
- Installation of earthen cover
- Site restoration, decontamination, and demobilization
- Oversight of remediation and construction

2.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the Health and Safety Manager (HSM) is required before these tasks are conducted on regulated hazardous waste sites.**

3.0 Hazard Control

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 site or the particular hazard. CCI employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CCI employees and subcontractors who do not understand any of these provisions should contact the SHSS for clarification.

The health and safety hazards posed by field activities and hazard control measures for these activities have been identified for each project activity and are provided in this section.

Activity Hazard Analysis will be prepared before beginning each project activity posing H&S hazards to project personnel using the Activity Hazard Analysis (AHA) form provided in Attachment 5 as a guide. The AHA shall identify the work tasks required to perform each activity, along with potential H&S hazards and recommended control measures for each work task. 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.

In addition to the controls specified in this section, Project-Activity Self-Assessment Checklists are contained in Attachment 6. These checklists are to be used to assess the adequacy of CCI and subcontractor site-specific safety requirements. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. Self-assessment checklists should be completed early in the project, when tasks or conditions change, or when otherwise specified by the HSM. The self-assessment checklists, including documented corrective actions, should be made part of the permanent project records.

Project-activity self-assessments checklist shall be completed weekly by the SHSS during the course of the project, completing the applicable checklist depending on the work performed at the time on the project.

3.1 Project-Specific Hazards

3.1.1 Welding/Cutting with Compressed Gas Cylinders

(Reference CH2M HILL, SOP HS-22, *Welding and Cutting*)

- Complete hot work permit.
- Wear appropriate personal protective equipment.
- Remove or combustible materials in the immediate hot work area.
- Station fire watch with fire extinguisher.
- Valve caps must be in place when cylinders are transported, moved, or stored.

- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured in an upright position at all times.
- Cylinders must be positioned to avoid being struck or knock over; coming in contact with electrical circuits or extreme heat sources; and shielded from welding and cutting operations.
- Cylinders must be secured on a cradle, basket or pallet when hoisted; they may not be hoisted by choker slings.

3.1.2 Working Around Material Handling Equipment

- 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.
- Because heavy equipment may not be equipped with properly functioning reverse signal alarms, 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; 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.

3.1.3 Excavation Activities

(Reference CH2M HILL, SOP HS-32, *Excavation and Trenching*)

- CCI personnel must notify and be granted authorization from the excavation competent person prior to entering any excavation. CCI personnel must follow all excavation requirements established by the competent person.
- The competent person must inspect the trench and/or excavation everyday and after everyday hazard increasing event. Documentation of this inspection must be maintained onsite at all times.
- Excavations must be protected from cave-ins by adequate protective systems unless the excavation is less than 5 feet in depth and a competent person determines there is no indication of cave-in or the excavation is made entirely in stable rock that is not fractured.
- Prior to excavating at a location, buried utilities in the area must be identified; refer to Section 3.2.8 “Procedures for locating buried utilities”.

- CCI personnel must not enter any excavation where protective systems are deficient at any time, for any reason. The competent person must be notified of such conditions.
- Refer to CH2M HILL SOP HS-32 “Excavations and Trenching” for more specific details on excavation requirements.

3.1.4 Operating Heavy Equipment

(Reference CH2M HILL, SOP HS-27, *Earthmoving Equipment*)

- CCI authorizes only those employees qualified by training or previous experience to operate material handling equipment.
- 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.
- 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 powerlines, the closest part of the equipment must be at least 10 feet from the powerlines < 50 kV. Provide an additional 4 feet 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 powerlines 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 Section 3.2.8 “Procedures for locating buried utilities”.
- Operators loading/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.
- When not in operation, the blade/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/buckets landed and shift lever in neutral.

3.1.5 Lockout/Tagout Activities

(Reference CH2M HILL, SOP HS-33, *Lockout and Tagout*)

- Only qualified personnel may work on energized equipment that has not been deenergized by lockout/tagout procedures.
- When CCI controls the work, CCI 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 CCI personnel are affected by the unexpected operation of equipment they must complete the lockout/tagout training course in the Basic Program. Project training may also be required on site specific lockout procedures.
- 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.
- Refer to CH2M HILL SOP HS-33 “Lockout and Tagout” for more specific details on lockout/tagout requirements.

3.1.6 Use of Aerial Lifts

(Reference CH2M HILL, SOP HS-41, *Aerial Lifts*)

- Only authorized personnel are permitted to operate aerial lifts.
- Personnel shall wear a full body harness and attach their lanyard to the boom or basket; never attach to an adjacent structure. Personnel working in or operating a scissor lift are not required to wear fall protection as long as they are working totally within the confines of the lift, with both feet on the floor of the lift.
- Personnel shall remain in the basket at all times and shall not climb on the lift to gain access to elevated work location.
- Personnel shall always stand on the floor of the basket and not on the guardrails, planks, ladders or other devices to extend reach.
- Aerial lifts shall be positioned on level surfaces when possible and the brakes shall be set. If outriggers are provided, they shall be positioned on solid surfaces or cribbing. Wheel chocks shall be installed before using lifts on inclines.
- Lifts shall be provided with upper and lower controls and these controls shall be tested for proper function before each day’s use. The lower controls shall not be operated unless permission has been obtained from personnel in the lift, except in the case of emergency.

- Boom and basket load limits, as specified by the manufacturer, shall be known and shall not be exceeded.
- Aerial lifts shall be prohibited from moving with workers in the basket, unless specifically designed for this type of operation.
- Personnel shall not work on elevated platforms when winds exceed 20 miles per hour.
- Lifts shall be lowered before moving horizontally.
- An aerial lift shall not be used as a material hoist.

3.1.7 Confined Space Entry

(Reference CH2M HILL SOP HS-17, Confined Space Entry)

The following requirements must be met prior to confined space entry:

- Confined space entrants, attendants, and entry supervisors must complete the CH2M HILL 8-Hour Confined Space Entry training.
- A Confined Space Entry Permit (CSEP), Alternative Procedure Certificate (APC), or Nonpermit Certificate (NPC) must be completed and posted near the space entrance point for review.
- Each confined space entrant and attendant must attend a preentry briefing conducted by the entry supervisor.
- Each confined space entrant and attendant must verify that the entry supervisor has authorized entry and that all permit or certificate requirements have been satisfied.
- Only individuals listed on the Authorization/Accountability Log are permitted to enter the space.
- Each confined space entrant and attendant must verify that atmospheric monitoring has been conducted at the frequency specified on the permit or certificate and that monitoring results are documented and within acceptable safe levels.

The following requirements must be met during confined space entry:

- Communication must be maintained between the attendant and entrants to enable the attendant to monitor entrant status.
- Entrants must use equipment specified on the permit or certificate accordingly.
- All permit or certificate requirements must be followed.
- Entrants must 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 must inform the entry supervisor of any hazards confronted or created in the space or any problems encountered during entry

3.2 General Hazards

3.2.1 General Practices and Housekeeping

(Reference CH2M HILL- SOP HS-20, *General Practices*)

- Site work should be performed during daylight hours whenever possible. Work conducted during hours of darkness require enough illumination intensity to read a newspaper without difficulty.
- 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, and/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.

3.2.2 Hazard Communication

(Reference CH2M HILL-SOP HS-05, *Hazard Communication*)

The SHSS is to perform the following:

- Complete an inventory of chemicals brought on site by CCI using Attachment 2.
- Confirm that an inventory of chemicals brought on site by CCI subcontractors is available.
- Request or confirm locations of Material Safety Data Sheets (MSDSs) from the client, contractors, and subcontractors for chemicals to which CCI employees potentially are exposed.
- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific HAZCOM training using Attachment 3.
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

3.2.3 Shipping and Transportation of Chemical Products

(Reference CH2M HILL's *Procedures for Shipping and Transporting Dangerous Goods*)

Chemicals brought to the site might be defined as hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive CH2M HILL training in shipping dangerous goods. 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. Contact the HSM or the Equipment Coordinator for additional information.

3.2.4 Lifting

(Reference CH2M HILL-SOP HS-29, *Lifting*)

- Proper lifting techniques must be used when lifting any object.
 - Plan storage and staging to minimize lifting or carrying distances.
 - Split heavy loads into smaller loads.
 - Use mechanical lifting aids whenever possible.
 - Have someone assist with the lift -- especially for heavy or awkward loads.
 - Make sure the path of travel is clear prior to the lift.

3.2.5 Fire Prevention

(Reference CH2M HILL- SOP HS-22, *Fire Prevention*)

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet. When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet. Extinguishers must:
 - be maintained in a fully charged and operable condition,
 - be visually inspected each month, and
 - undergo a maintenance check each year.
- 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 from any building.
- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

3.2.6 Electrical

(Reference CH2M HILL-SOP HS-23, *Electrical*)

- Only qualified personnel are permitted to work on unprotected energized electrical systems.

- Only authorized personnel are permitted to enter high-voltage areas.
- 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.
- All temporary wiring, including extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed.
- Extension cords must be:
 - equipped with third-wire grounding.
 - covered, elevated, or protected from damage when passing through work areas.
 - protected from pinching if routed through doorways.
 - not fastened with staples, hung from nails, or suspended with wire.
- Electrical power tools and equipment must be effectively grounded or double-insulated 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 from overhead power lines for voltages of 50 kV or less, and 10 feet plus 0.5 inch 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.
- Protect all electrical equipment, tools, switches, and outlets from environmental elements.

3.2.7 Stairways and Ladders

(Reference CH2M HILL-SOP HS-25, *Stairways and Ladders*)

- Stairway or ladder is generally required when a break in elevation of 19 inches 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.

- Ladders must be used only for the purpose for which they were designed and shall not be loaded beyond their rated capacity.
- 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
- Portable ladders must extend at least 3 feet 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 > 24 feet in height must be provided with fall protection devices.
- Fall protection should be considered when working from extension, straight, or fixed ladders greater than 6 feet 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.

3.2.8 Heat Stress

(Reference CH2M HILL- SOP HS-09, *Heat and Cold Stress*)

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50 °F to 60 °F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. 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 yourself by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- 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 shelter/shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SHSS/DSC to avoid progression of heat-related illness.

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!

Monitoring Heat Stress

These procedures should be considered when the ambient air temperature exceeds 70 °F, the relative humidity is high (>50 percent), or when workers exhibit symptoms of heat stress.

The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 100 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, 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 100 beats/minute at the beginning of the next rest period, the work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 100 beats/minute, or 20 beats/minute above resting pulse.

3.2.9 Cold Stress

(Reference CH2M HILL- SOP HS-09, *Heat and Cold Stress*)

- 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.
- 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 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.
- NSC Guidelines for Work and Warm-Up Schedules can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; workers should be monitored for symptoms of cold-related illnesses. If symptoms are not observed, the work duration can be increased.
- Persons who experience initial signs of immersion foot, frostbite, hypothermia should consult the SHSS 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.

3.2.10 Compressed Gas Cylinders

- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured in an upright position at all times.

- 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 must be secured on a cradle, basket, or pallet when hoisted; they may not be hoisted by choker slings.

3.2.11 Procedures for Locating Buried Utilities

- Where available, obtain utility diagrams for the facility.
- Review locations of sanitary and storm sewers, electrical conduits, water supply lines, natural gas lines, and fuel tanks and lines.
- Review proposed locations of intrusive work with facility personnel knowledgeable of locations of utilities. Check locations against information from utility mark-out service.
- Where necessary (e.g., uncertainty about utility locations), excavation or drilling of the upper depth interval should be performed manually
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon).
- When the client or other onsite party is responsible for determining the presence and locations of buried utilities, the SHSS should confirm that arrangement.

3.3 Biological Hazards and Controls

3.3.1 Snakes

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 a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention 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.

3.3.2 Poison Ivy 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. Become familiar with the identity of these plants. 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.

3.3.3 Ticks

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 in size. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray **only outside** of clothing

with permethrin or permethrin and spray skin with only DEET; and check yourself frequently for ticks.

If bitten by a tick, grasp it at the point of attachment and carefully remove it. After removing the tick, wash your hands and disinfect and press the bite areas. Save the removed tick. Report the bite to human resources. Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash might appear that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, seek medical attention.

3.3.4 Bees and Other Stinging Insects

Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SHSS and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

3.3.5 Bloodborne Pathogens

(Reference CH2M HILL- SOP HS-36, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with landfill waste or waste streams containing potentially infectious material. Exposure controls and personal protective equipment (PPE) are required as specified in CCI SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.

3.4 Chemical Hazards

The following describes the chemical hazards posed by remedial activities at the project. Chemical contaminants of concern (COC), along with their maximum concentration in soil/groundwater, the applicable exposure limit/IDLH and symptoms of exposure are listed in Table 3-1.

3.5 Potential Routes of Exposure

- **Dermal:** Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 5.
- **Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 5 and 6, 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).

TABLE 3-1
 Contaminants of Concern
 (Refer to Project Files for more detailed contaminant information)

Contaminant	Exposure Limit^a	IDLH^b	Symptoms and Effects of Exposure	PIP^c (eV)
Arsenic	0.01 mg/m ³	5 Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyperpigmentation	NA
Benzene	1 ppm	500 Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
2-Butanone (Methyl Ethyl Ketone, MEK)	200 ppm	3,000	Eye, skin, and nose irritation; headache; dizziness; vomiting; dermatitis	9.54
Cadmium	0.005 mg/m ³	9 Ca	Pulmonary edema, coughing, chest tightness/pain, headache, chills, muscle aches, nausea, vomiting, diarrhea, difficulty breathing, loss of sense of smell, emphysema, mild anemia	NA
Carbon Tetrachloride	2 ppm	200 Ca	Central nervous system (CNS) depression, nausea, vomiting, eye and skin irritation, liver and kidney injury, drowsiness, dizziness	11.47
Chlordane	0.5 mg/m ³	100 Ca	Blurred vision, confusion, ataxia, delirium, coughing, abdominal pain, nausea, vomiting, diarrhea, irritability, tremors anuria	UK
Chlorobenzene	10 ppm	1,000	Skin, eye, and nose irritation; drowsiness; uncoordination; CNS depression	9.07
Chloroform	2 ppm	500 Ca	Dizziness, mental dullness, nausea, confusion, disorientation, headache, fatigue, eye and skin irritation, anesthesia, enlarged liver	11.42
Chromium (as Cr(II) & Cr(III))	0.5 mg/m ³	25	Irritated eyes, sensitization dermatitis, histologic fibrosis of lungs	NA
Chromium (hexavalent)	0.01 mg/m ³	15 Ca	Irritated respiratory system, nasal septum perforation, liver and kidney damage, leucytosis, leupen, monocytosis, eosinophilla, eye injury, conjunctivitis, skin ulcer, sensitization dermatitis	NA
Cobalt (Metal, Dusts, and Fumes)	0.05 mg/m ³	20	Coughing, difficulty breathing, wheezing, decreased pulmonary function, diffuse nodule fibrosous, dermatitis, respiratory hypersensitivity, asthma	NA
Cresol (all isomers of 2-, 3-, & 4-methylphenol)	5 ppm	250	Eye, skin, and mucous membrane irritant; CNS effects including confusion, depression, and respiratory failure; difficulty breathing; irregular rapid respiration; weak pulse; eye and skin burns; dermatitis; lung, liver, kidney, and pancreas damage	8.98

TABLE 3-1
 Contaminants of Concern
 (Refer to Project Files for more detailed contaminant information)

Contaminant	Exposure Limit^a	IDLH^b	Symptoms and Effects of Exposure	PIP^c (eV)
DDT	0.5 mg/m ³	500 Ca	Paresthesia of tongue, lips, hand, and face; tremors; dizziness; confusion; headache; fatigue; convulsion; eye and skin irritation; vomiting	UK
Dibutylphthalate (DBP)	5 mg/m ³	4,000	Eye, upper respiratory system, and stomach irritant	UK
o-Dichlorobenzene (1,2-Dichlorobenzene)	25 ppm	200	Nose and eye irritation, liver and kidney damage, skin blisters	9.06
p-Dichlorobenzene (1,4-Dichlorobenzene)	10 ppm	150 Ca	Headache, eye irritation, nausea, vomiting, swelling periorbital, profus rhinitis, jaundice, cirrhosis	8.98
1,1-Dichloroethane	100 ppm	3,000	CNS depression, skin irritation; liver, kidney, and lung damage	11.06
1,2-Dichloroethane (Ethylene Dichloride)	1 ppm	50 Ca	CNS depression, nausea, vomiting, dermatitis, eye irritation, liver, kidney, and CNS damage; corneal opacity	11.05
Bis-(2-ethylhexyl)phthalate (DEHP, DOP)	5 mg/m ³	5,000 Ca	Eye and mucous membrane irritant	UK
Endosulfan	0.1 mg/m ³	NL	Irritated skin, nausea, confusion, agitation, flushing, dry mouth, tremor, convulsion, headache	UK
Ethyl Benzene	100 ppm	800	Eye, skin, and mucous membrane irritation; headache; dermatitis; narcotic; coma	8.76
Lead	0.05 mg/m ³	100	Weakness lassitude, facial pallor, pal eye, weight loss, malnutrition, abdominal pain, constipation, anemia, gingival lead line, tremors, paralysis of wrist and ankles, encephalopathy, kidney disease, irritated eyes, hypertension	NA
Mercury	0.05 mg/m ³	10	Skin and eye irritation, cough, chest pain, difficult breathing, bronchitis, pneumontitis, tremors, insomnia, irritability, indecision, headache, fatigue, weakness, GI disturbance	
Naphthalene	10 ppm	250	Eye irritation, headache, confusion, excitement, nausea, vomiting, abdominal pain, bladder irritation, profuse sweating, dermatitis, corneal damage, optical neuritis	8.12
PCBs (Limits as Aroclor 1254)	0.5 mg/m ³	5 Ca	Eye and skin irritation, acne-form dermatitis, liver damage, reproductive effects	UK
PNAs (Limits as Coal Tar Pitch)	02 mg/m ³	80 Ca	Dermatitis and bronchitis	UK

TABLE 3-1
 Contaminants of Concern
 (Refer to Project Files for more detailed contaminant information)

Contaminant	Exposure Limit^a	IDLH^b	Symptoms and Effects of Exposure	PIP^c (eV)
1,1,2,2-Tetrachloroethane (Tetrachlorethane)	1 ppm	100 Ca	Nausea, vomiting, abdominal pain, finger tremors, jaundice, hepatitis, liver tenderness, monocytosis, kidney damage, dermatitis	11.10
Tetrachloroethylene (PCE)	25 ppm	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
1,1,2-Trichloroethane	10 ppm	100 Ca	Eye and nose irritation, CNS depression, liver damage, dermatitis	11.00
Trichloroethylene (TCE)	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
Toluene	50 ppm	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	100 ppm	900	Irritated eyes, skin, nose, and throat; dizziness; excitement; drowsiness; incoherence; staggering gait; corneal vacuolization; anorexia; nausea; vomiting; abdominal pain; dermatitis	8.56
Vinyl Chloride	1 ppm	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99
Vinylidene Chloride (1,1-dichloroethylene)	1 ppm	NL Ca	Eye, skin, and throat irritation; dizziness; headache; nausea; difficult breathing; liver and kidney dysfunction; pneumonitis	10.0

^a Appropriate value of PEL, REL, or TLV listed

^b 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.

^c PIP = photoionization potential; NA = Not applicable; UK = Unknown.

4.0 Project Organization and Personnel

4.1 CCI Employee Medical Surveillance and Training

(Reference CH2M HILL- SOPs HS-01, *Medical Surveillance*, and HS-02, *Health and Safety Training*)

The employees listed meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated “SHSS” have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SHSS with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated “FA-CPR” are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL SOP HS-04, *Reproduction Protection*, including obtaining a physician’s statement of the employee’s ability to perform hazardous activities before being assigned fieldwork.

Employee Name	Office	Responsibility	SHSS/FA-CPR
Steve Tsangaris	ATL	Project Manager	SC-HW, SHSS-C
Jeff Maxcy	ATL	SHSS/Site Supervisor	SC-HW, SHSS-C
Jon Overholtzer	ATL	Project Engineer	SC-HW, SHSS-C
Rich Rathnow	ORO	HSM	SC-HW, SHSS-C, FA-CPR

4.2 Field Team Chain of Command and Communication Procedures

4.2.1 Client

Contact Name: Eva Clement

4.2.2 CCI

Program Manager: Scott Newman/ATL

Project Manager: Steve Tsangaris/ATL

Health and Safety Manager: Richard Rathnow/ORO

Site Health and Safety Specialist/Site Supervisor: Jeff Maxcy/ATL

Project Engineer: John Overholtzer

The CCI project manager (PM) is responsible for providing adequate resources (budget and staff) for project-specific implementation of the HS&E 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 SOP:

- Include standard terms and conditions, and contract-specific HS&E roles and responsibilities in contract and subcontract agreements (including flow-down requirements to lower-tier subcontractors)
- Select safe and competent subcontractors by:
 - obtaining, reviewing and accepting or rejecting subcontractor pre-qualification questionnaires
 - ensuring that acceptable certificates of insurance, including CCI as named additional insured, are secured as a condition of subcontract award
 - including HS&E submittals checklist in subcontract agreements, and ensuring that appropriate site-specific safety procedures, training and medical monitoring records are reviewed and accepted prior to the start of subcontractor’s field operations
- Maintain copies of subcontracts and subcontractor certificates of insurance (including CCI as named additional insured), bond, contractors license, training and medical monitoring records, and site-specific safety procedures in the project file accessible to site personnel
- Provide oversight of subcontractor HS&E practices per the site-specific safety plan
- Ensure that the overall, job-specific, HS&E goals are fully and continuously implemented

The CCI Navy RAC H&S manager is responsible for:

- Review and accept or reject subcontractor pre-qualification questionnaires that fall outside the performance range delegated to the Contracts Administrator (KA)
- Review and accept or reject subcontractor training records and site-specific safety procedures prior to start of subcontractor’s field operations
- Support the SHSS's oversight of subcontractor (and lower-tier subcontractors) HS&E practices.

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

- Verify these HSP are current and amended when project activities or conditions change
- Verify CCI site personnel and subcontractor personnel read these HSPs and sign Attachment 1 “Employee Signoff Form” prior to commencing field activities

- Verify CCI site personnel and subcontractor personnel have completed any required specialty training (e.g., fall protection, confined space entry) and medical surveillance as identified in Section 2
- Verify compliance with the requirements of these FSI and applicable subcontractor health and safety plan(s)
- Act as the project “Hazard Communication Coordinator” and perform the responsibilities outlined in Section 2.2.2
- Act as the project “Emergency Response Coordinator” and perform the responsibilities outlined in Section 4
- Post OSHA job-site poster; the poster is required at sites where project field offices, trailers, or equipment-storage boxes are established; posters can be obtained by calling 800/548-4776 or 800/999-9111
- Verify that safety meetings are conducted and documented in the project file initially and as needed throughout the course of the project (e.g., as tasks or hazards change)
- Verify that project H&S forms and permits, found in Attachment 7, are being used as outlined in Section 2
- Perform oversight and/or assessments of subcontractor HS&E practices per the site-specific safety plan and verify that project activity self-assessment checklists, found in Attachment 6, are being used as outlined in Section 2
- Verify that project files available to site personnel include copies of executed subcontracts and subcontractor certificates of insurance (including CCI as named additional insured), bond, contractors license, training and medical monitoring records, and site-specific safety procedures prior to start of subcontractor’s field operations
- Coordinate with the HS&E manager regarding CCI and subcontractor operational performance, interfaces
- Ensure that the overall, job-specific, HS&E goals are fully and continuously implemented

The training required for the SHSS is as follows:

- SHSS 10-hour course
- OSHA 10 hour course for Construction
- First Aid and cardio pulmonary resuscitation (CPR)
- Relevant Competent Person Courses (excavation, confined space, scaffold, fall protection, etc.)

The SHSS is responsible for contacting the Site Superintendent and Project Manager. In general, the Project Manager will contact the client. The Health and Safety Manager should be contacted as appropriate.

4.2.3 CCI Subcontractors

(Reference CH2M HILL- SOP HS-55, *Subcontractor, Contractor, and Owner*)

Certain subcontractors (drilling, remedial and construction contractors) are required to be pre-qualified for safety by completing the Subcontractor Safety Performance Questionnaire. The subcontractors listed above are covered by this HSP. However, this plan does not address hazards associated with the tasks and equipment that the subcontractor has expertise in (e.g., drilling, excavation work, electrical). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CCI for review before the start of field work by following the Subcontractor Safety Procedure Criteria specific to their work.

Subcontractors are also required to prepare Activity Hazard Analysis before beginning each activity posing H&S hazards to their personnel using the AHA form provided in Attachment 5 as a guide. The AHA shall identify the principle steps of the activity, potential H&S 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.

Subcontractors must comply with the established health and safety plan(s). The CCI SHSS should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the established plan(s). CCI oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

CCI should continuously endeavor to observe subcontractors' safety performance. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CCI is not responsible for exhaustive observation for hazards and unsafe practices. In addition to this level of observation, the SHSS is responsible for confirming CCI subcontractor performance against both the subcontractor's safety plan and applicable self-assessment checklists. Self-assessment checklists contained in Attachment 6 are to be used by the SHSS to review subcontractor performance.

Health and safety related communications with CCI subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Form included in Attachment 1.
- Request subcontractor(s) to brief project team on the hazards and precautions related to their work.
- When apparent non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action – the subcontractor is responsible for determining and implementing necessary controls and corrective actions.

- When repeat non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected CCI employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the Project Manager and HSM as appropriate.
- Document all oral health and safety related communications in project field logbook, daily reports, or other records.

5.0 Personal Protective Equipment

(Reference CH2M HILL- SOP HS-07, *Personal Protective Equipment*, HS-08, *Respiratory Protection*)

Personal Protective equipment (PPE) specifications are listed in Table 5-1.

TABLE 5-1
PPE Specifications^a

Task	Level	Body	Head	Respirator ^b
General site entry with no dust exposure	D	Work clothes; steel-toe, leather work boots; work glove.	Hardhat ^c Safety glasses Ear protection ^d	None required
Site support without exposure to contaminated soil or dust, mobilization, demobilization	Modified D	Work clothes or cotton coveralls Boots: Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat ^c Safety glasses Ear protection ^d	None required
Intrusive operations, excavation, soil handling and transport, backfilling	C	Coveralls: Polycoated Tyvek® Boots: Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat ^c Splash shield ^c Ear protection ^d Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H cartridges or equivalent ^e .
Tasks requiring upgrade	B	Coveralls: Polycoated Tyvek® Boots: Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat ^c Splash shield ^c Ear protection ^d Spectacle inserts	Positive-pressure demand self-contained breathing apparatus (SCBA); MSA Ultralite, or equivalent.

^a Modifications are as indicated. CCI will provide PPE only to CCI 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 SHSS.

^d Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.

^e Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)--then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.

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 HSM, and an SHSS qualified at that level is present. PPE levels may be upgraded for the following reasons:

- 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 (Section 6) exceeded

PPE levels may be downgraded for the following reasons:

- **New information indicating that situation is less hazardous than originally thought**
- **Change in site conditions that decreases the hazard**
- **Change in work task that will reduce contact with hazardous materials**

6.0 Air Monitoring/Sampling

(Reference CH2M HILL- SOP HS-06, *Air Monitoring*)

6.1 Air Monitoring Specifications

Air monitoring specifications are listed in Table 6-1.

TABLE 6-1
Air Monitoring Specifications

Instrument	Tasks	Contaminant Concentration	Action Levels ^a	Frequency ^b	Calibration
Dust Monitor: Visual Assessment	All Tasks	No Visible Dust Visible Dust	Level D Level C	Initially and periodically during tasks	Zero Daily

^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 SHSS; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.).

6.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Air monitoring equipment calibration specifications are listed in Table 6-2.

TABLE 6-2
Air Monitoring Equipment Specifications

Instrument	Gas	Span	Reading	Method
PID: OVM, 10.6 or 11.8 eV bulb	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg T-tubing
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF = 100	100 ppm	1.5 lpm reg T-tubing
PID: TVA 1000	100 ppm isobutylene	CF = 1.0	100 ppm	1.5 lpm reg T-tubing
FID: OVA	100 ppm methane	3.0 ± 1.5	100 ppm	1.5 lpm reg T-tubing
FID: TVA 1000	100 ppm methane	NA	100 ppm	2.5 lpm reg T-tubing
Dust Monitor: Miniram-PDM3	Dust-free air	Not applicable	0.00 mg/m ³ in "Measure" mode	Dust-free area OR Z-bag with HEPA filter
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL ± 5% LEL	1.5 lpm reg direct tubing

6.3 Air Sampling

Sampling, in addition to real-time monitoring, may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain volatile organic compounds. Contact the HSM immediately if these contaminants are encountered. Results must be sent immediately to the HSM. Regulations may require reporting to monitored personnel.

7.0 Decontamination

(Reference CH2M HILL- SOP HS-13, *Decontamination*)

The SHSS must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SHSS. The SHSS must ensure that procedures are established for disposing of materials generated on the site.

7.1 Decontamination Specifications

Decontamination specifications are listed in Table 7-1.

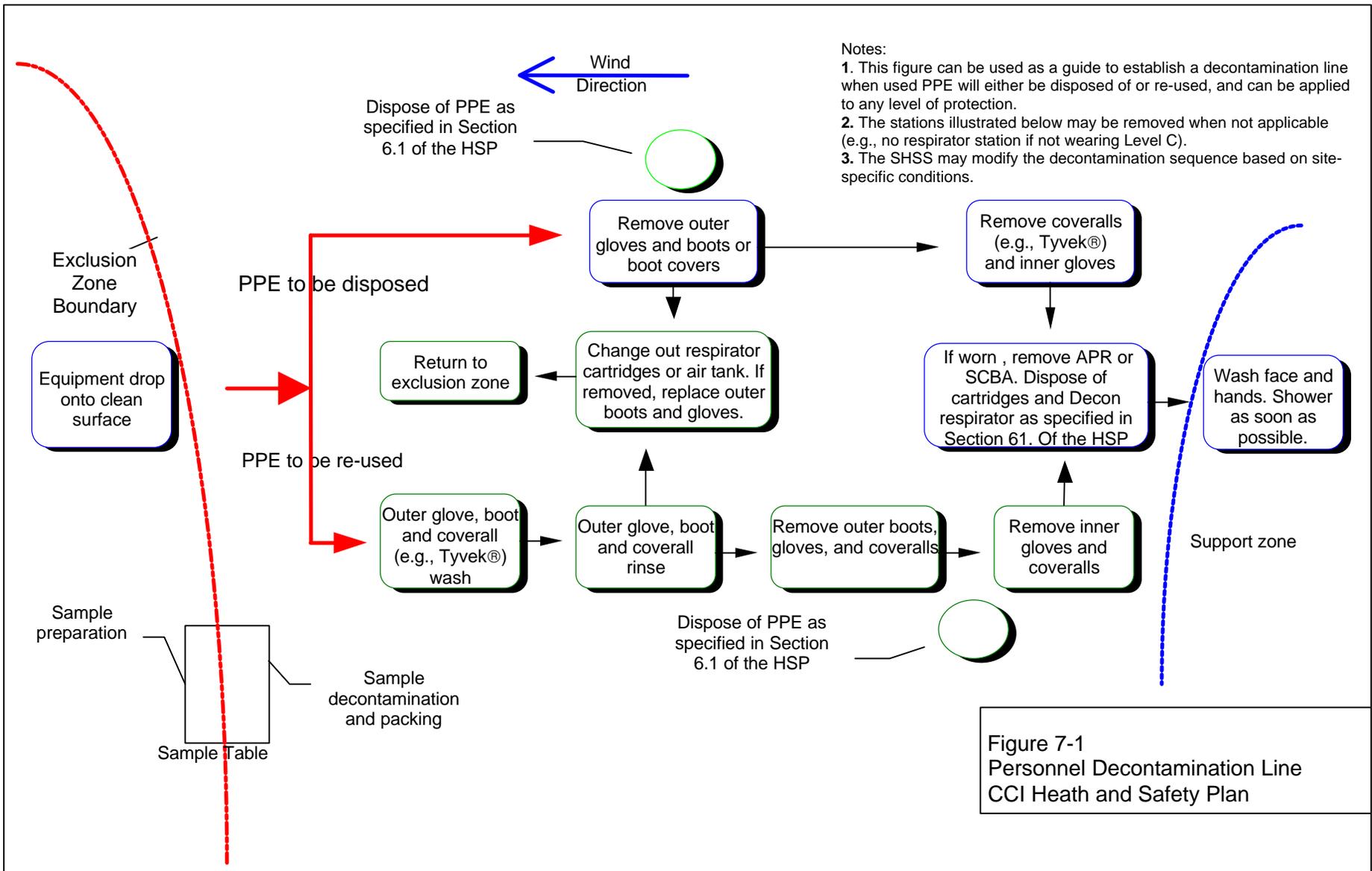
TABLE 7-1
Decontamination Specifications

Personnel	Sample Equipment	Heavy Equipment
<ul style="list-style-type: none"> • Boot wash/rinse • Glove wash/rinse • Outer-glove removal • Body-suit removal • Inner-glove removal • Respirator removal • Hand wash/rinse • Face wash/rinse • Shower ASAP • Dispose of PPE in municipal trash, or contain for disposal • Dispose of personnel rinse water to facility or sanitary sewer, or contain for offsite disposal 	<ul style="list-style-type: none"> • Wash/rinse equipment • Solvent-rinse equipment • Contain solvent waste for offsite disposal 	<ul style="list-style-type: none"> • Power wash • Steam clean • Dispose of equipment rinse water to facility or sanitary sewer, or contain for offsite disposal

7.2 Diagram of Personnel-Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SHSS should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 7-1 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SHSS to accommodate task-specific requirements.



8.0 Spill-Containment Procedures

Sorbent material will be maintained in the support zone. Incidental spills will be contained with sorbent and disposed of properly.

9.0 Site Control Plan

9.1 Site Control Procedures

(Reference CH2M HILL- SOP HS-11, *Site Control*)

- The SHSS will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety: general discussion of Health and Safety Plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SHSS records attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location in accordance with CH2M HILL- SOP HS-71, OSHA Postings.
- Establish support, decontamination, 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
 - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the “buddy system.”
- Initial air monitoring is conducted by the SHSS in appropriate level of protection.
- The SCC is to conduct periodic inspections of work practices to determine the effectiveness of this plan – refer to Sections 2 and 3. Deficiencies are to be noted, reported to the HSM, and corrected.

9.2 Hazwoper Compliance Plan

(Reference CH2M HILL- SOP HS-19, *Site-Specific Written Safety Plans*)

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated Hazwoper tasks (Section 2.1) might occur consecutively or concurrently with respect to non-Hazwoper tasks. This section outlines procedures to be followed when approved activities specified in Section 2.2 do not require 24- or 40-hour training. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site, or while non-Hazwoper-trained staff are working in proximity to Hazwoper activities. Other data (e.g., soil) also must document that there is no potential for exposure. The HSM must approve the interpretation of these data. Refer to subsections 2.5 and 5.3 for contaminant data and air sampling requirements, respectively.
- When non-Hazwoper-trained personnel are at risk of exposure, the SHSS must post the exclusion zone and inform non-Hazwoper-trained personnel of the:
 - nature of the existing contamination and its locations
 - limitations of their access
 - emergency action plan for the site
- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.
- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.
- Remediation treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the Hazwoper standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hours of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must not enter the TSDF area of the site.

10.0 Emergency Response Plan

(Reference CH2M HILL- SOP HS-12, *Emergency Response*)

10.1 Pre-Emergency Planning

The SHSS performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CCI onsite parties, the facility, and local emergency-service providers as appropriate.

- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone).
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- 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.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- 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, including driving route to hospital.
- Brief new workers on the emergency response plan.

The SHSS will evaluate emergency response actions and initiate appropriate follow-up actions.

10.2 Emergency Equipment and Supplies

The SHSS should mark the locations of emergency equipment on the site map and post the map. Emergency equipment is listed in Table 10-1.

TABLE 10-1
Emergency Equipment

Emergency Equipment and Supplies	Location
20 LB (or two 10-lb) fire extinguisher (A, B, and C classes)	Support Zone/Heavy Equipment
First aid kit	Support Zone/Field Vehicle
Eye Wash	Support & Decon Zone/Field Vehicle
Potable water	Support & Decon Zone/Field Vehicle
Bloodborne-pathogen kit	Support Zone/Field Vehicle
Additional equipment (specify):	

10.3 Incident Reporting, Investigation and Response

According to Southern Division, NAVFAC Incident Reporting requirements, all incidents involving personal injury, and property damage greater than \$1,000 incidents involving CCI or subcontractor project personnel must be reported to Southern Division, NAVFAC within 24 hours of incident occurrence. As such, the Site Manager must report the following incident information to the HSM immediately after incident occurrence:

- Date and time of mishap
- Project name and project number
- Name and worker classification
- Extent of known injuries
- Level of medical attention
- Injury cause

According to CCI requirements, all personal injuries, near-misses, or property damage incidents require involving CCI or subcontractor project personnel must be reported immediately to the HSM. An incident investigation shall be performed and submitted to the HSM within 24 hours of incident occurrence by the completing the Incident Report, Near Loss Investigation and Root Cause Analysis provided in Attachment 7.

In fires, explosions, or chemical releases, actions to be taken include the following:

- Shut down CCI operations and evacuate the immediate work area.
- Notify appropriate response personnel.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work-area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

10.4 Emergency Medical Treatment

The procedures listed below may also be applied to non-emergency incidents. CCI employee injuries and illnesses (including overexposure to contaminants) must be reported to their respective Human Resource contacts in Attachment 4. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CCI medical consultant. During non-emergencies, follow these procedures as appropriate.

- Notify appropriate emergency response authorities listed in Section 10.8 (e.g., 911).
- The SCC 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.
- Initiate first aid and CPR where feasible.
- Get medical attention immediately.
- Perform decontamination where feasible; lifesaving and first aid or medical treatment take priority.
- Make certain that the injured person is accompanied to the emergency room.
- When contacting the medical consultant, give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Report incident as outlined in Section 10.7.

10.5 Evacuation

- Evacuation routes and assembly areas (and alternative routes and assembly areas) are specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the SHSS before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The SHSS 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 SHSS will account for all personnel in the onsite assembly area.
- A designated person will account for personnel at alternate assembly area(s).
- The SHSS will write up the incident as soon as possible after it occurs and submit a report to the Corporate Director of Health and Safety.

10.6 Evacuation Signals

Evacuation signals are listed in Table 10-2.

TABLE 10-2
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.

10.7 Incident Notification and Reporting

- Upon any project incident (fire, spill, injury, near miss, death, etc.), immediately notify the PM and HSM. Call emergency beeper number if HSM is unavailable.
- For CCI work-related injuries or illnesses, contact the respective Human Resources contact listed in Attachment 4. For CCI incidents the HR administrator will complete an Incident Report Form (IRF). IRF must be completed within 24 hours of incident.
- For CCI subcontractor incidents, complete the Subcontractor Accident/Illness Report Form (Attachment 7) and submit to the HSM.
- Notify and submit reports to client as required in contract.

11.0 Approval

This site-specific Health and Safety Plan has been written for use by CCI only. CCI 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 site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

11.1 Original Plan

Written By:

Date:

Approved By: Rich Rathnow

Date: 6/06/2002



11.2 Revisions

Revisions Made By:

Date:

Revisions Approved By:

Date:

Attachment 1

Employee Signoff Form

Attachment 2

Project-Specific Chemical Product Hazard Communication Form

Attachment 3

Chemical Specific Training Form

CHEMICAL-SPECIFIC TRAINING FORM

Location:	Project # :
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/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, visual appearance or odor of regulated product when being released, etc.)

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 CCI's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

Attachment 4

Emergency Contacts

Emergency Contacts

24-hour CCI Emergency Beeper – 888/444-1226

Medical Emergency – 911

Facility Medical Response #:
Local Ambulance #:

CH2M HILL- Medical Consultant

Dr. Jerry H. Berke, M.D., M.P.H.
Health Resources
600 West Cummings Park, Suite 3400
Woburn, MA 01801-6350
1-781-938-4653
1-800-350-4511

Fire/Spill Emergency – 911

Facility Fire Response - Gulfport Fire Department
Local Fire Dept #: 911

Local Occupational Physician

Security & Police – 911

Facility Security #: Base Security
Local Police #: 601/871-2631

Navy RAC Program Manager

Name: Scott Newman/ATL
Phone: 770/604/9182

Utilities Emergency

Water: Base Civil Department/Base Security
Gas: Base Civil Department/Base Security
Electric: Base Civil Department/Base Security

CCI Health and Safety Manager (HSM)

Name: Rich Rathnow/ORO
Phone: 865/483-9005 ext. 572 (Office); 865/604-7867(Cell) 865/531-2933(Home)

Designated Site Health and Safety Coordinator (SHSS)

Name: TBD
Phone:

CCI Regional Human Resources Department

Name: Nancy Orr/COR
Phone: 303/771-0900

Navy RAC Project Manager

Name: Jon Overholzer
Phone: 770/604/9182

CH2M HILL Corporate Human Resources Department

Name: John Monark/COR
Phone: 303/771-0900

Federal Express Dangerous Goods Shipping

Phone: 800/238-5355

Emergency Number for Shipping Dangerous Goods

Phone: 800/255-3924

CH2M HILL Worker's Compensation and Auto Claims

Sterling Administration Services
Phone: 800/420-8926 After hours: 800/497-4566

Report fatalities AND report vehicular accidents involving pedestrians, motorcycles, or more than two cars.

Contact the Project Manager. Generally, the Project Manager will contact relevant government agencies.

Facility Alarms:

Evacuation Assembly Area(s):

Facility/Site Evacuation Route(s):

Hospital Name/Address: Columbia Garden Park Hospital
1520 Broad Ave., Gulfport, MS 39501

Hospital Phone #: 228/864-4210

Directions to Hospital

From Main Gate, proceed one block on Broad Avenue. Hospital is on the left

Attachment 5

Activity Hazard Analysis Form

PRINT

SIGNATURE

Supervisor Name:

Date/Time: _____

Safety Officer Name:

Date/Time: _____

Employee Name(s):

Date/Time: _____

Date/Time: _____

Date/Time: _____

Attachment 6

Project Activity Self-Assessment Checklists/Permits

- Welding & Cutting
- Excavations
- Earthmoving Equipment
- Logout/Tagout
- Aerial Lifts
- Confined Space Entry
- Fall Protection
- Respiratory Protection
- Stairways & Ladders
- Scaffolds

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 welding and cutting hazards and/or 2) CH2M HILL provides oversight of subcontractor personnel who are exposed to welding and cutting hazards.

SSC or DSC may consult with subcontractors when completing this checklist, but shall not direct the means and methods of welding and cutting operations 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.

Completed checklists shall be sent to the HS&E Staff for review.

Project Name: _____ Project No.: _____
 Location: _____ PM: _____
 Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

Evaluate CH2M HILL employee exposure to welding and cutting hazards
 Evaluate a CH2M HILL subcontractor’s compliance with welding and cutting 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 HS-63.

SECTION 1

SAFE WORK PRACTICES (3.1)

Yes No N/A N/O

- | | | | | |
|-----------------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. CH2M HILL employees have completed Welding and Cutting training | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Welding and cutting personnel have been properly trained and qualified | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Work area inspected by the authorized person | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Suitable fire extinguishing equipment is available | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Flame-resistant blankets used to control sparks from travelling to lower levels | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Leaking valves of cylinders repaired or tagged and removed from service | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Top of cylinder or manifold kept clear to prevent damage and allow quick closing of valve | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Flow gauges and regulators on cylinders inspected prior to use and removed when not in use | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Hose, leads, and cables covered, elevated, or protected from damage. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Fuel gas and oxygen cylinders in storage separated or protected with fire barrier | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Flash arresters are installed at the torch handle | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. Hot electrode holders not dipped in water to cool | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. Arc welding electrodes not struck against cylinders to strike an arc | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. Arc welding or cutting work shielded with screens to prevent employees from arc | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. Proper ventilation provided to maintain exposure to contaminants below PEL | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. Arc welding equipment exposed to unusual service conditions is task designed | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

SECTION 2

Yes No N/A N/O

COMPRESSED GAS CYLINDERS (3.2.1)

- 17. Cylinders being transported have valve protection caps installed and in vertical position
- 18. Cylinders hoisted by cradle, slingboard or pallet designed to do so and not by valve cap
- 19. Cylinders kept from being knocked over by a chain, truck or steadying device
- 20. Oxygen cylinders are separated from fuel-gas cylinders by 20 feet or a 5 foot fire barrier
- 21. Cylinders stored indoors in a well ventilated location, where they won't be knocked over
- 22. Cylinders in use are kept away from sparks, flames or slag or are shielded
- 23. Valves are "cracked" prior to attaching regulators
- 24. Cylinders are not placed where they can become part of an electrical circuit
- 25. Oxygen or fuel-gas cylinders are outside of confined spaces
- 26. Cylinders, valves, couplings, regulators and valves are free of grease and oil
- 27. Frozen cylinders are thawed with warm water and not boiling water
- 28. Fuel-gas cylinders are opened not more than 1.5 turns for quick closing
- 29. Damaged, defective or leaking cylinders have been removed from service
- 30. Only owner or authorized agent refills cylinders or attempts to mix gasses in cylinder

WELDING AND CUTTING EQUIPMENT (3.2.2)

- 31. Fuel-gas and oxygen manifolds are labeled with one inch letters or sign to identify substance
- 32. Fuel-gas and oxygen manifolds are working properly & located in a well ventilated open area
- 33. Manifold and header hoses capped when not in use
- 34. Flash arresters are used on acetylene cylinders connected together
- 35. Fuel-gas and oxygen hoses are clearly marked, not interchangeable and free of grease and oil
- 36. Parallel sections of hose taped together have no more than 4 inches covered per foot
- 37. Torches and hoses are inspected at the beginning of each shift
- 38. Hoses connections are designed to be disconnected with a rotary motion, not straight pull
- 39. Hoses are stored in a ventilated box
- 40. Torches are lit with friction lighters, not open flames or hot work

ARC WELDING AND CUTTING (3.2.3)

- 41. Only manual electrode holders designed for arc welding are used
- 42. Only cable free of repair/splices < 10 ft. from cable attachment to electrode holder are used
- 43. All parts of the welding and cutting equipment that are gripped are fully insulated
- 44. All welding and cutting cables are fully insulated
- 45. Pipelines containing flammable gases or liquids are not used as a ground return
- 46. All ground connections have been inspected for mechanical strength and current capacity
- 47. Frame of arc welding/cutting machine is grounded.
- 48. When electrode holders are unattended, the electrode is removed
- 49. Hot electrode holder are not be dipped in water to cool
- 50. When welding or cutting is stopped or equipment is moved, power is shut off
- 51. Before starting welding and cutting operations the equipment is inspected
- 52. The frame or case of the welding machine is grounded (except engine driven machines)
- 53. Employees in the vicinity are shielded from the direct rays of the arc, or given filter lenses
- 54. Inert gas welding employees are completely covered to prevent skin burns
- 55. Chlorinated solvents are >200 feet away and surfaces prepared w/ solvents are dry prior

TOXIC FUMES AND GASES (3.2.4)

- 56. Mechanical or local exhaust ventilation is used when welding or cutting in a confined space
- 57. Mechanical ventilation is capable of keeping fumes and smoke below the exposure limits
- 58. Local exhaust ventilation is close to the work to keep employee below the exposure limits
- 59. Contaminated air is exhausted into open air clear of the intake
- 60. Exhausted air is replaced by breathable air, and not oxygen
- 61. Welding/cutting in confined space on toxic metals is done w/ ventilation or supplied air
- 62. Welding/cutting in open air on metals outlined in 3.2.4 done with filter or air line respirator
- 63. Workers exposed to the same atmosphere as welder are protected in the same manner
- 64. In enclosed spaces, all surfaces covered with preservative coating are stripped at least four inches from the area to be heated, or the worker is protected with an air line respirator

Yes	No	N/A	N/O
------------	-----------	------------	------------

FIRE PREVENTION (3.2.5)

- | | | | | |
|-----------------------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 65. Objects to be welded or cut have been moved to a safe location | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 66. Combustibles have been moved at least 35 feet from welding and cutting | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 67. Combustibles that cannot be moved are protected from flame, heat and sparks | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 68. Fire extinguishing equipment is immediately available in the work area | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 69. Additional trained personnel (fire watch) assigned when normal fire fighting is not sufficient | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 70. The atmosphere to be welded or cut in is not explosive as verified by air monitoring, as needed | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 71. Precautions have been taken on the opposite side of walls, floors and ceilings | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 72. Openings in floors and walls are blocked to prevent sparks from passing through | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 73. Gas supply can be shut off at some point outside an enclosed space | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 74. Drums have been filled with water, cleaned or ventilated and tested before welding or cutting | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 75. Drums, containers or structures have an open vent before heat is applied | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 76. Surface coatings have been tested for flammability before welding or cutting | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 77. Flammable coatings have been stripped before welding or cutting | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

PERSONAL PROTECTIVE EQUIPMENT (3.2.6)

- | | | | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 78. When welding or cutting on surfaces with preservative coatings, respirators used | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 79. Workers entering a confined space through a small opening wear a full body harness or other suitable device for quick removal in case of an emergency | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 80. Employees welding or cutting wear the proper eye protective equipment as per Table 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 81. Welders or cutters exposed to other welders arc wear filter goggles under their helmets | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 82. Exposed employees wearing protective clothing to protect against UV damage | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 83. Fall protection is provided when working 6 feet or more above lower levels | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

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 enter excavations (complete Sections 1 and 3), and/or 2) CH2M HILL oversight of an excavation subcontractor is required (complete entire checklist).

SC may consult with excavation subcontractors when completing this checklist, but shall not direct the means and methods of excavation operations nor direct the details of corrective actions. Excavation 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.

Completed checklists shall be sent to the health and safety manager for review.

Project Name: _____	Project No.: _____	
Location: _____	PM: _____	
Auditor: _____	Title: _____	Date: _____
This specific checklist has been completed to:		
<input type="checkbox"/>	Evaluate CH2M HILL employee exposures to excavation hazards	
<input type="checkbox"/>	Evaluate a CH2M HILL subcontractor's compliance with excavation HS&E requirements	
	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 excavation 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 HS-32.

SECTION 1

Yes No N/A N/C

PERSONNEL SAFE WORK PRACTICES (4.1)

1. Competent person has completed daily inspection and has authorized entry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Personnel aware of entry requirements established by competent person	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Protective systems are free from damage and in stable condition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Surface objects/structures secured from falling into excavation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Potential hazardous atmospheres have been tested and found to be at safe levels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Precautions have been taken to prevent cave-in from water accumulation in the excavation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Personnel wearing appropriate PPE, per HSP/FSI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 2

Yes No N/A N/O

GENERAL (4.2.1)

- 8. Daily safety briefing/meeting conducted with personnel Yes No N/A N/O
- 9. Excavation and protective systems adequately inspected by competent person Yes No N/A N/O
- 10. Defective protective systems or other unsafe conditions corrected before entry Yes No N/A N/O
- 11. Guardrails provided on walkways over excavation 6' or deeper Yes No N/A N/O
- 12. Barriers provided at excavations 6' or deeper when not readily visible Yes No N/A N/O
- 13. Barriers or covers provided for wells, pits, shafts, or similar excavation 6' or deeper Yes No N/A N/O
- 14. Excavating equipment operated safely (use earthmoving equipment checklist in HS-27) Yes No N/A N/O

PRIOR TO EXCAVATING (4.2.2)

- 15. Location of underground utilities and installations identified Yes No N/A N/O
- 16. Soils characterized prior to excavation where contamination may be present Yes No N/A N/O
- 17. Excavation area checked for wetlands, endangered species, cultural/historic resources Yes No N/A N/O
- 18. Stockpile construction and management plan Yes No N/A N/O
- 19. ECC consulted and plan established for wastewater disposal from excavation dewatering Yes No N/A N/O
- 20. SWPPP prepared for construction site 1-5 acres (depending on project location) Yes No N/A N/O

EXCAVATING ACTIVITIES (4.2.3)

- 21. Rocks, trees, and other unstable surface objects removed or supported Yes No N/A N/O
- 22. Exposed underground utility lines supported Yes No N/A N/O
- 23. Undermined surface structures supported or determined to be in safe condition Yes No N/A N/O
- 24. Warning system used to remind equipment operators of excavation edge Yes No N/A N/O
- 25. Stockpile, excavation covers, liners, silt fences in place, where required Yes No N/A N/O
- 26. Fugitive dust suppressed Yes No N/A N/O

EXCAVATION ENTRY (4.2.4)

- 27. Trenches > 4' deep provided with safe means of egress within 25' Yes No N/A N/O
- 28. Structure ramps designed and approved by competent person Yes No N/A N/O
- 29. Potential hazardous atmospheres tested prior to entry Yes No N/A N/O
- 30. Rescue equipment provided where potential for hazardous atmospheres exists Yes No N/A N/O
- 31. Ventilation used to control hazardous atmospheres and air tested frequently Yes No N/A N/O
- 32. Appropriate respiratory protection used when ventilation does not control hazards Yes No N/A N/O
- 33. Precautions taken to prevent cave-in from water accumulation in the excavation Yes No N/A N/O
- 34. Precautions taken to prevent surface water from entering excavation Yes No N/A N/O
- 35. Protection provided from falling/rolling material from excavation face Yes No N/A N/O
- 36. Spoil piles, equipment, materials restrained or kept at least 2' from excavation edge Yes No N/A N/O

EXCAVATION PROTECTIVE SYSTEMS (4.2.5)

- 37. Protective systems used for excavations 5' or deeper Yes No N/A N/O
- 38. Protective systems for excavation deeper than 20' designed by registered PE Yes No N/A N/O
- 39. If soil unclassified, maximum allowable slope is 34 degrees Yes No N/A N/O
- 40. Protective systems free from damage Yes No N/A N/O
- 41. Protective system used according to manufacturer recommendations and not subjected to loads exceeding design limits Yes No N/A N/O
- 42. Protective system components securely connected to prevent movement or failure Yes No N/A N/O
- 43. Cave-in protection provided while entering/exiting shielding systems Yes No N/A N/O
- 44. Personnel removed from shielding systems when installed, removed, or vertical movement Yes No N/A N/O

PROTECTIVE SYSTEM REMOVAL (4.2.6)

- 45. Protective system removal starts and progresses from excavation bottom Yes No N/A N/O
- 46. Protective systems removed slowly and cautiously Yes No N/A N/O
- 47. Temporary structure supports used if failure of remaining components observed Yes No N/A N/O
- 48. Backfilling taking place immediately after protective system removal Yes No N/A N/O

SECTION 2

Yes No N/A N/O

EXCAVATING AT HAZARDOUS WASTE SITES (4.2.7)

- 49. Waste disposed of according to HSP and RCRA regulations
- 50. Appropriate decontamination procedures being followed, per HSP

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

BACKFILL (4.2.8)

- 51. Backfill certified clean when required by client or local regulation

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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FORMS/PERMITS (4.3)

- 52. Waste discharge/NPDES permit obtained for excavation de-watering, where required
- 53. Dig permit obtained, where required by client/facility
- 54. USDA soil permit obtained (for south/southeast and coastal states)

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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 potentially exposed to hazards associated with earthmoving equipment operations (complete Sections 1 and 3), and/or 2) CH2M HILL oversight of a earthmoving equipment subcontractor is required (complete entire checklist).

SSC/DSC may consult with earthmoving equipment subcontractors when completing this checklist, but shall not direct the means and methods of equipment operations nor direct the details of corrective actions. Earthmoving equipment 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.

Completed checklists shall be sent to the health and safety manager for review.

Project Name: _____	Project No.: _____
Location: _____	PM: _____
Auditor: _____	Title: _____ Date: _____
This specific checklist has been completed to:	
<input type="checkbox"/> Evaluate CH2M HILL employee exposures to earthmoving equipment hazards	
<input type="checkbox"/> Evaluate a CH2M HILL subcontractor's compliance with earthmoving equipment H&S 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 earthmoving equipment 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 HS-27.

SECTION 1

Yes No N/A N/C

PERSONNEL SAFE WORK PRACTICES (3.1)

1. Only authorized personnel operating earthmoving equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Personnel maintaining safe distance from operating equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Personnel and equipment operator in close communication when personnel must be in proximity of operating equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Personnel approach operating equipment safely	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Personnel wearing high-visibility and/or reflective vests when close to operating equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Personnel riding only in seats of equipment cab and using seat belts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Personnel not positioned under hoisted loads	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Personnel not hoisted by equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Personnel instructed not to approach equipment that has become electrically energized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Personnel wearing appropriate PPE, per HSP/FSI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<u>SECTION 2</u>	<u>Yes</u>	<u>No</u>	<u>N/A</u>	<u>N/O</u>
GENERAL (3.2.1)				
11. Daily safety briefing/meeting conducted with crew	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Daily inspection of equipment and equipment accessories conducted before use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. At least one fire extinguisher available at the equipment operating area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EARTHMOVING EQUIPMENT COMPONENTS (3.2.2)				
14. Backup alarm or spotter used when backing equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Operational horn provided on bi-directional equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Seat belts are provided and used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Rollover protective structures (ROPS) provided	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Braking system capable of stopping full payload	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. Headlights and taillights operable when additional light required	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. Brake lights in operable condition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. Cab glass provides no visible distortion to the operator	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. Hauling equipment (dump trucks) provided with cab shield or canopy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. Dump truck beds provided with positive means of support during maintenance or inspection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. Dump truck operating levers provided with latch to prevent accidental dumping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EARTHMOVING EQUIPMENT PLACEMENT (3.2.3)				
25. Location of underground utilities identified	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26. Safe clearance distance maintained while working under overhead powerlines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. Safe distance is maintained while traveling under powerlines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. Unattended equipment visibly marked at night	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29. Parking brake set when equipment parked and equipment chocked when parked on incline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EARTHMOVING EQUIPMENT OPERATION (3.2.4)				
30. Equipment operated on safe roadways and grades	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31. Equipment operated at safe speed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32. Equipment not operated during inclement weather, lightning storms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33. Using equipment to lift loads, other than earth, done according to equipment manufacturer specifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34. Lifting and hauling capacities are not exceeded	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35. Equipment components lowered when not in use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36. All machine guards are in place	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37. Air monitoring conducted per HSP/FSI for hazardous atmospheres	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EARTHMOVING EQUIPMENT MAINTENANCE (3.2.5)				
38. Defective components repaired immediately	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39. Suspended equipment or equipment parts are supported prior to work under or between	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40. Lockout/tagout procedures used prior to maintenance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41. Tires on split rims removed using safety tire rack or cage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42. Good housekeeping maintained on and around equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EXCAVATING AT HAZARDOUS WASTE SITES (3.2.6)				
43. Waste disposed of according to HSP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44. Appropriate decontamination procedures being followed, per HSP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CH2MHILL

H&S Self-Assessment Checklist-Lockout/Tagout

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 the following locations: 1) Where CH2M HILL employees are exposed to equipment requiring lockout/tagout or 2) Where CH2M HILL provides oversight of subcontractor personnel who are exposed to equipment requiring lockout/tagout.

The SSC or DSC may consult with subcontractors when completing this checklist, but shall not direct the means and methods of lockout/tagout operations 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.

Completed checklists shall be sent to the HS&E Staff for review.

Project Name: _____	Project No.: _____
Location: _____	PM: _____
Auditor: _____	Title: _____ Date: _____
This specific checklist has been completed to:	
<input type="checkbox"/> Evaluate CH2M HILL employee exposure to equipment requiring lockout/tagout <input type="checkbox"/> Evaluate a CH2M HILL subcontractor's compliance with lockout/tagout 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 HS-33.

SECTION 1

	<u>Yes</u>	<u>No</u>	<u>N/A</u>	<u>N/C</u>
SAFE WORK PRACTICES (3.1)				
Only authorized personnel are performing lockout/tagout	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Only qualified personnel working on energized equipment via energized electrical work permit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contractor lockout/tagout programs have been verified prior to start of work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
All affected employees notified of lockout/tagout	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Equipment has been shutdown using normal operating controls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
All energy sources have been isolated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Individual locks and tags have been applied to energy isolating device	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stored or residual energy has been relieve or restrained	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Locked/tagged equipment has been tested to verify zero energy state	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. All safe guards have been replaced when lockout/tagout is complete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Controls are positioned in the safe mode prior to lockout/tagout removal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Only individuals who apply locks/tags may remove them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Lockout is selected over tagout as preferred method of hazardous energy control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Master or duplicate keys are prohibited and lock removal is controlled by written procedure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Multiple work group lockout/tagout activities are coordinated on large projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 2

Yes No N/A N/C

GENERAL (3.2.1)

- 16. An energy control program is in place with appropriate procedures Yes No N/A N/C
- 17. Lockout or tagout is performed by trained, authorized employees only Yes No N/A N/C
- 18. Authorized employees are familiar with facility procedures specific to individual energy types Yes No N/A N/C
- 19. Employee do not attempt to start, energize or use equipment that is locked or tagged out Yes No N/A N/C
- 20. Affected employees are notified before and after lockout/tagout controls are applied Yes No N/A N/C
- 21. Locking is the preferred method of energy control Yes No N/A N/C
- 22. Tags are used only where locks cannot be applied Yes No N/A N/C
- 23. Additional safety measures are implemented in conjunction with the tagout system Yes No N/A N/C

LOCKOUT/TAGOUT DEVICES (3.2.2)

- 24. New or modified equipment is designed to accept a lockout device Yes No N/A N/C
- 25. Locks, tags, and other equipment are supplied to employees Yes No N/A N/C
- 26. L/T devices are singularly identified and not used for other purposes Yes No N/A N/C
- 27. L/T devices are capable of withstanding anticipated environmental conditions of use Yes No N/A N/C
- 28. L/T devices are standardized on the project by color, shape, size, print, and format Yes No N/A N/C
- 29. Lockout devices are substantial to prevent removal without the use of excessive force Yes No N/A N/C
- 30. Tagout devices and their means of attachment, are substantial to prevent inadvertent removal Yes No N/A N/C
- 31. L/T devices indicate the identity of the employee applying the device(s) Yes No N/A N/C
- 32. Tagout devices warn against hazardous conditions if equipment is energized Yes No N/A N/C
- 33. Tags are only removed by authorized user and never bypassed, ignored, or defeated Yes No N/A N/C
- 34. Tagout devices are attached at the same location as lockout devices Yes No N/A N/C
- 35. Tags shall be legible and understandable by all employees Yes No N/A N/C

INITIATING CONTROL (3.2.3)

- 36. Orderly shutdown of equipment is conducted that does not increase hazards Yes No N/A N/C
- 37. All devices needed to isolate equipment from energy sources are installed and/or operated Yes No N/A N/C
- 38. Lockout/Tagout devices are affixed to equipment by authorized employees Yes No N/A N/C
- 39. Lockout/Tagout devices are affixed to secure equipment in the "off" position Yes No N/A N/C
- 40. Tags are located as close to or at the energy isolating device Yes No N/A N/C
- 41. All hazardous stored or residual energy is relieved, disconnected or restrained. Yes No N/A N/C
- 42. Isolation of energy sources has been verified (tested) prior to start of work on equipment Yes No N/A N/C

RELEASING CONTROL (3.2.4)

- 43. Work area is inspected prior to removing lockout/tagout devices and re-energization Yes No N/A N/C
- 44. Only authorized employees who installed lockout/tagout devices are removing devices Yes No N/A N/C
- 45. Written procedure is followed for the removal of lockout/tagout devices when authorized employees are not available Yes No N/A N/C
- 46. All affected employees are notified prior to starting equipment previously locked or tagged out Yes No N/A N/C

SPECIAL CONDITIONS (3.2.5)

- 47. Group lockout/tagout procedure is used for a crew or work group Yes No N/A N/C
- 48. Multiple crews or work groups have designated group supervisor to coordinate energy control Yes No N/A N/C
- 49. Designated group supervisors affix a personal lockout/tagout device Yes No N/A N/C
- 50. Designated group supervisor lockout/tagout devices are the last to be removed Yes No N/A N/C
- 51. Procedures are in place to coordinate shift or personnel change to ensure continuity Yes No N/A N/C
- 52. On coming shift or new personnel verify lockout/tagout prior to commencing work Yes No N/A N/C

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 using aerial lifts and/or 2) CH2M HILL provides oversight of subcontractor personnel who are using aerial lifts.

SSC or DSC may consult with subcontractors when completing this checklist, but shall not direct the means and methods of aerial lift 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.

Completed checklists shall be sent to the HS&E Staff for review.

Project Name: _____	Project No.: _____
Location: _____	PM: _____
Auditor: _____	Title: _____ Date: _____
This specific checklist has been completed to:	
<input type="checkbox"/> Evaluate CH2M HILL employee use of aerial lifts <input type="checkbox"/> Evaluate a CH2M HILL subcontractor’s compliance with aerial lift 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 HS-41

SECTION 1

PERSONNEL SAFE WORK PRACTICES (3.1)

	Yes	No	N/A	N/C
1. Only authorized and trained personnel operating aerial lifts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Aerial lifts inspected by the operator prior to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Lift controls tested by the operator each day prior to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Personnel wearing full body harness with lanyard attached to boom or platform	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Lanyards not attached to adjacent structures or equipment while in aerial lift	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Personnel standing firmly on the floor of lift platform	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Personnel remain in the platform at all times and do not climb to adjacent structures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Standard guardrail or equivalent protection provided on lift platform	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Aerial lifts provided with upper and lower controls.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Lower controls operated only with permission of personnel in lift, unless emergency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Lift controls properly marked and legible, and capacity rating posed on lift	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Modifications to aerial lift certified in writing by manufacturer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 2

Yes No N/A N/C

GENERAL (3.2.1)

AERIAL LIFT POSITIONING (3.2.2)

- | | | | | |
|-------------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 13. Aerial lifts positioned on firm, level surface with brakes set | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. Wheel chocks used on inclines | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. Outriggers positioned on solid surfaces or cribbing when used | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. Safe clearance distance maintained while working near overhead powerlines | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. Safe clearance distance maintained while travelling under overhead powerlines | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. Aerial lifts not moved when boom is elevated and personnel are working in platforms | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. Boom is properly cradled and outriggers stowed prior to moving aerial lift for travel | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

AERIAL LIFT OPERATION (3.2.3)

- | | | | | |
|------------------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 20. Safe operating manual should be available for review and use by aerial lift operators | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21. Aerial lift operators know boom and basket load limits and do not exceed them | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 22. Aerial lift platforms are free of slippery conditions | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 23. Personnel not standing or working below aerial lift operations | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 24. Warning signs or barricades provided under aerial lift operations | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 25. Counterweight swing radius barricaded or flagged | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 26. Aerial lifts not being used as cranes | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 27. Platforms free of attachments such as cables, wires, chains, or ropes | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 28. Aerial lifts not operated in winds exceeding 30 miles per hour | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 29. Platform foot switch physically operated and not mechanically blocked or by-passed | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 30. Insulating portion of aerial lift is not altered in any manner | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 31. Aerial lifts used indoors have exhaust properly vented to control carbon monoxide exposure | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

CH2MHILL

H&S Self-Assessment Checklist - FALL PROTECTION

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 fall hazards and/or 2) CH2M HILL provides oversight of subcontractor personnel who are exposed to fall hazards.

SSC or DSC may consult with subcontractors when completing this checklist, but shall not direct the means and methods of fall protection operations 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.

Completed checklists shall be sent to the HS&E Staff for review.

Project Name: _____	Project No.: _____	
Location: _____	PM: _____	
Auditor: _____	Title: _____	Date: _____
This specific checklist has been completed to:		
<input type="checkbox"/> Evaluate CH2M HILL employee exposure to fall hazards		
<input type="checkbox"/> Evaluate a CH2M HILL subcontractor's compliance with fall protection requirements		
Subcontractors Name: _____		

<ul style="list-style-type: none">• 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. <p>Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-31.</p>

SECTION 1

PERSONNEL SAFE WORK PRACTICES (3.1)

Yes No N/A N/C

1. CH2M HILL employees have completed initial fall protection training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Project Fall Protection Evaluation Form completed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. CH2M HILL employees have complete project-specific fall protection training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Fall protection systems used to eliminate construction fall hazards \geq 6'	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Fall protection systems used to eliminate general industry fall hazards \geq 4'	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Personnel aware of and follow requirements established by competent person	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Personal fall arrest systems (PFAS) inspected prior to each use for defects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Personnel remaining within guardrails, when provided	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Fall protection systems constructed and used according to requirements of Section 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CONTROLLED ACCESS ZONE (3.2.7)

- 52. Control lines enclose controlled access zones
- 53. Only personnel engaged in related work permitted in the controlled access zone
- 54. Control lines 30-45" from the walking/working surface
- 55. Control lines flagged at ≤ 6' intervals with high-visibility material
- 56. Overhand bricklaying control lines positioned 10-15' from working edge
- 57. Leading edge control lines positioned 6-25' from leading edge
- 58. Precast concrete control lines positioned 6-60' or half the length of the erected member

SAFETY MONITORING SYSTEM (3.2.8)

- 59. Safety Monitor designated to observe and warn personnel
- 60. Safety monitor not distracted from the monitoring function
- 61. Safety monitor on the same working surface within sight and voice communication
- 62. Only personnel necessary for work in safety monitoring zone
- 63. Personnel adhere to the safety monitors instructions

FALL PROTECTION PLAN (3.2.9)

- 64. Plan prepared by qualified person and specifically for site work being performed
- 65. Plan maintained current with changes approved by a qualified person
- 66. Plan maintained at the job site and implemented by competent person
- 67. Plan documents why fall protection systems are infeasible or would create a greater hazard
- 68. Plan discusses measures taken to reduce or eliminate the fall hazards
- 69. Plan discusses when scaffolds, ladders, or vehicle mounted work platforms shall be used
- 70. Locations cover by plan identified and classified as controlled access zones
- 71. Entry into controlled access zone limited to personnel designated in plan
- 72. Safety monitoring system used when no other alternative measure implemented

COVERS (3.2.10)

- 73. Covers capable of supporting 2x the maximum weight imposed on the cover at any one time
- 74. Covers secured prevent accidental displacement
- 75. Covers color coded or marked "HOLE" or "COVER"

FALLING OBJECT PROTECTION (3.2.11)

- 76. Personnel exposed to falling objects wearing hard hats
- 77. Objects on elevated surfaces position away from surface edge
- 78. Toeboards, screens, guardrails, or canopies used or area barricaded below
- 79. Toeboards, when used, erected along the edge of the overhead walking/working surface
- 80. Toeboards 3 1/2" high, ≤ 1/4" clearance above the surface, and no openings > 1"
- 81. Screening/paneling provided where equipment or materials are piled above toeboards
- 82. Guardrails, when used, no openings small enough to prevent passage of falling objects
- 83. Overhand bricklaying masonry/mortar not stored within 4' of working edge
- 84. Overhand bricklaying excess mortar, masonry units, and other debris kept clear
- 85. Roofing materials not stored within 6' of a roof edge, unless guardrails are provided
- 86. Roofing materials that are positioned near roof edge are stable and self-supporting
- 87. Canopies, when used, strong enough to prevent collapse and penetration by falling objects

This checklist is provided as a method of verifying compliance with the OSHA respiratory protection standard. It shall be used at locations where CH2M HILL personnel are using respiratory protection, or are required to perform oversight of a subcontractor using respiratory protection, or both.

CH2M HILL staff shall not direct the means and methods of subcontractor use of respiratory protection nor direct the details of corrective actions. The subcontractor must determine how to correct deficiencies and CH2M HILL staff must carefully rely on their expertise. Items 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.

Completed checklists must be sent to the appropriate regional health and safety program manager for review.

Project Name: _____	Project No.: _____
Location: _____	PM: _____
Auditor: _____	Title: _____ Date: _____
This specific checklist has been completed to (check only one of the boxes below):	
<input type="checkbox"/> Evaluate CH2M HILL compliance with its respiratory protection program (SOP HS-08)	
<input type="checkbox"/> Evaluate a CH2M HILL subcontractor's compliance with its respiratory protection program Subcontractor's Name: _____	

- Check "Yes" if an assessment item is complete or correct.
 - Check "No" if an item is incomplete or deficient. Section 2 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 HS-08.

	Yes	No	N/A	N/O
SECTION 1				
TRAINING (6.1)				
1. Respirator users have completed appropriate training on the respirator to be used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Training is current within the past 12 months	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Attachment 1 of SOP HS-08 distributed to employees using respirators voluntarily	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MEDICAL EVALUATION (6.2)				
4. Respirator users completed medical evaluation protocol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Respirator use does not exceed any physician's written recommendation limitations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Respirator users know to report any medical signs or symptoms related to respirator use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FIT TESTING (6.3)				
7. Respirator users of tight-fitting facepieces have passed a fit test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Fit test is current within the past 12 months	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Respirator users know to have new fit test performed if any change affects respirator fit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 1 (Continued)

Yes No N/A N/O

RESPIRATOR SELECTION (6.4)

- 10. All feasible engineering controls have been considered in reducing exposure levels
- 11. Appropriate respiratory protection and limitations are specified in HSP/FSI
- 12. Cartridge or canister change-out schedule is specified in HSP/FSI

RESPIRATOR USE (6.5)

- 13. Respirator use is limited to those specified in HSP/FSI
- 14. HSM notified of changes in site conditions that may alter effectiveness of specified respirators
- 15. Respirator users of tight-fitting facepieces are cleanly shaven
- 16. Respirator users of tight-fitting facepieces perform user seal check before each use
- 17. Cartridges or canisters replaced according to change-out schedule in HSP/FSI
- 18. Respirator users informed to report any gas or vapor breakthrough to SSC/DSC
- 19. SSC/DSC knows to report any gas or vapor breakthrough to HSM
- 20. Personnel not entering IDLH areas until standby-person established with appropriate equipment

RESPIRATOR INSPECTION (6.6)

- 21. Respirators in regular use are inspected before each use and during cleaning
- 21. Emergency response respirators are inspected and documented monthly
- 22. Defective respirators are taken out of service or repaired

RESPIRATOR CLEANING AND DISINFECTING (6.7)

- 23. Respirators in regular use are cleaned and disinfected as necessary
- 24. Emergency and transferred respirators are cleaned and disinfected after use

RESPIRATOR STORAGE (6.8)

- 25. Respirators are properly stored to prevent contamination and deformation
- 26. Emergency respirators are accessible and clearly marked as emergency respirators

RESPIRATOR REPAIRS (6.9)

- 27. Respirator repair is limited to routine maintenance
- 28. Respirators beyond routine repair are removed from service

BREATHING AIR SUPPLIED BY CYLINDER (6.10.1)

- 29. Cylinders are marked with NIOSH approval label
- 30. Certificate of analysis meets Grade D specifications
- 31. Certificate of analysis is kept onsite

BREATHING AIR SUPPLIED BY COMPRESSOR (6.10.2)

- 32. Breathing air meets Grade D specifications
- 33. Compressor intake is located away from exhaust gases
- 34. Compressor is provided with sorbent filters
- 35. Sorbent filter change-out documentation is kept on the compressor
- 36. High temperature or carbon monoxide alarm provided on oil-lubricated compressors
- 37. If high temperature alarm is used alone, carbon monoxide levels are monitored
- 38. Practical measures taken to control carbon monoxide levels on non oil-lubricated compressors

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 using stairways and ladders and/or 2) CH2M HILL provides oversight of subcontractor personnel who are using stairways and ladders.

SSC or DSC may consult with subcontractors when completing this checklist, but shall not direct the means and methods of stairway and ladder 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.

Completed checklists shall be sent to the HS&E Staff for review.

Project Name: _____	Project No.: _____
Location: _____	PM: _____
Auditor: _____	Title: _____ Date: _____
This specific checklist has been completed to:	
<input type="checkbox"/> Evaluate CH2M HILL employee use of stairways and ladders <input type="checkbox"/> Evaluate a CH2M HILL subcontractor’s compliance with stairway and ladder 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 HS-25.

SECTION 1

PERSONNEL SAFE WORK PRACTICES (3.1)

	<u>Yes</u>	<u>No</u>	<u>N/A</u>	<u>N/C</u>
1. CH2M HILL employees have completed stairway and ladder training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Carrying objects on stairs with both hands is avoided	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Pan and skeleton metal stairs not used until permanent or temporary treads/landings provided	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Ladders periodically inspected for defects by competent person	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Defective ladders tagged and removed from service until repaired	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Ladders used only for purpose for which they were designed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Ladders not loaded beyond their rated capacity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Only one person simultaneously climbing or working from an individual ladder	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Personnel face ladder when climbing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Personnel climbing ladders maintain 3 points of contact with ladder	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Personnel not carrying tools, materials, or equipment while climbing. Tag lines used.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Ladders not moved, shifted or extended while in use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Stepladders used in open and locked position only	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Stepladders top and top step not used as a step	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Stepladders cross-bracing not used for climbing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Fall protection considered when working from ladders over 6’	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 2

STAIRWAYS AND LADDERS: GENERAL (3.2.1)

Yes No N/A N/C

- 17. Stairways or ladders provided at breaks in elevation \geq 19 inches
- 18. At least one clear access point provided to elevated levels

STAIRWAY: DESIGN AND CONSTRUCTION (3.2.2)

- 19. Stairways maintained free of slippery conditions and dangerous projections
- 20. Stairways installed between 30 - 50 degrees with uniform risers and treads
- 21. Landings (30" deep x 22" wide) provided every 12' of vertical rise.
- 22. Landings extend \geq 20" beyond swing of any doors
- 23. Adequate stair rails installed at each unprotected side or edge
- 24. Handrails installed as handhold for support
- 25. Mid-rails, screens, mesh, or intermediate members installed between top rail and treads
- 26. Adequate guardrails installed at each unprotected side or edge of a landing

LADDERS: GENERAL (3.2.3)

- 27. Ladder components surfaced to prevent injury from puncture, laceration, or snagging clothing
- 28. Ladders maintained free of oil, grease, and other slipping hazards
- 29. The area around the top and bottom of ladders kept free of obstructions

PORTABLE LADDERS: DESIGN AND CONSTRUCTION (3.2.4)

- 30. Only ANSI approved portable ladders used
- 31. Rungs and steps are parallel, level, and uniformly spaced
- 32. Ladders not tied or fastened together to create longer sections unless designed for such use
- 33. Ladders with non-conductive side rails used near energized electrical equipment
- 34. Extension ladders equipped with positive section stops
- 35. Stepladders provided with metal spreader or locking device to hold open when in use
- 36. Wood ladders not coated with opaque covering
- 37. Double-cleated or two ladders provided if $>$ 25 personnel use ladders as only means of access, or when ladder serves simultaneous two-way traffic
- 38. Two or more ladders used to reach elevated work areas offset with platform or landing

PORTABLE LADDER: POSITIONING (3.2.5)

- 39. Ladders used only on stable, level, surfaces unless secured to prevent movement
- 40. Ladders placed in areas where they can be displaced by work activities, secured or barricaded
- 41. Extension ladder section overlap adequate distance
- 42. Extension and straight ladders placed with both side rails supported equally
- 43. Extension and straight ladders positioned at approximately 75 degree angle
- 44. Ladders extend 3' above upper landings or are secured at top

FIXED LADDERS: DESIGN AND CONSTRUCTION (3.2.6)

- 45. Adequate clearances from obstructions maintained behind, in front, and to side of ladder rungs
- 46. Ladder step across distance at access point 7-12"
- 47. Side rails extend 42" above landing platform
- 48. Cages, wells, ladder safety devices, or self-retracting lifelines used for ladders $>$ 24'
- 49. Ladder safety devices operate without the use of hands
- 50. Ladder safety devices activate within 2' after a fall
- 51. Connection between lifeline and harness attachment point \leq 9"

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 work from scaffolds (complete Sections 1 and 3), and/or 2) CH2M HILL oversight of a scaffold subcontractor is required (complete entire checklist).

SSC/DSC may consult with scaffold subcontractors when completing this checklist, but shall not direct the means and methods of scaffold operations nor direct the details of corrective actions. Scaffold 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.

Completed checklists shall be sent to the health and safety manager for review.

Project Name: _____	Project No.: _____
Location: _____	PM: _____
Auditor: _____	Title: _____ Date: _____
This specific checklist has been completed to: <input type="checkbox"/> Evaluate CH2M HILL employee exposures to scaffold hazards <input type="checkbox"/> Evaluate a CH2M HILL subcontractor's compliance with scaffold H&S 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 scaffold 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 HS-73.

<u>SECTION 1</u>	<u>Yes</u>	<u>No</u>	<u>N/A</u>	<u>N/C</u>
PERSONNEL SAFE WORK PRACTICES (3.1)				
1. Competent person has completed work shift inspection and has authorized scaffold access	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Personnel aware of and following access requirements established by competent person	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Scaffold free from damage and in stable condition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Safe means of access provided to scaffold platform	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Personnel remaining within guardrail system when provided	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Personnel using personal fall arrest systems (PFAS) when required	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Personnel working from suspension scaffolds or boatswains' chairs using PFAS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. CH2M HILL personnel have completed CH2M fall protection training when PFAS use required	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Personnel not standing on objects or ladders on top of scaffold platforms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Personnel not using ladders on top of scaffold platforms unless platform covers the entire floor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Personnel not working on scaffolds covered with snow or ice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Personnel not work on scaffolds during storms/high winds unless adequate protection provided	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 2

Yes No N/A N/O

GENERAL (3.2.1)

- 13. Scaffolds inspected by competent person before each work shift Yes No N/A N/O
- 14. Damaged or weakened scaffold components immediately repaired or replaced Yes No N/A N/O
- 15. Scaffolds not loaded in excess of their maximum intended load Yes No N/A N/O
- 16. Debris is not accumulating on scaffolds platforms Yes No N/A N/O

ASSEMBLY/DISASSEMBLY OF SCAFFOLDS (3.2.2)

- 17. Scaffolds designed by qualified person Yes No N/A N/O
- 18. Scaffolds assembled/disassembled by experienced and trained personnel Yes No N/A N/O
- 19. Scaffolds assembled/disassembled under supervision and direction of competent person Yes No N/A N/O
- 20. Adequate planking provided, as determined by competent person Yes No N/A N/O
- 21. Adequate safe means of access provided, as determined by competent person Yes No N/A N/O
- 22. Adequate fall protection provided, as determined by competent person Yes No N/A N/O

SCAFFOLD CONSTRUCTION (3.2.3)

- 23. Scaffolds capable of supporting own weight and 4 times maximum intended load Yes No N/A N/O
- 24. Compatible scaffold components used Yes No N/A N/O
- 25. Scaffolds uprights bear on stable foundations Yes No N/A N/O
- 26. Scaffolds adequately braced to prevent racking/collapse Yes No N/A N/O
- 27. Scaffolds plumb, level, and squared Yes No N/A N/O
- 28. Scaffolds with height to width ratios greater than 4:1 secured from tipping Yes No N/A N/O
- 29. Work platforms fully planked or decked Yes No N/A N/O
- 30. Platform planking extends over supports appropriate amount or restrained Yes No N/A N/O
- 31. Safe means of access is provided to platforms Yes No N/A N/O
- 32. Supported scaffolds > 10 feet provided with guardrails or PFAS Yes No N/A N/O
- 33. When required, adequate guardrail system installed on all platform open sides and ends Yes No N/A N/O
- 34. When required, adequate PFAS provided (may also use fall protection checklist HS31) Yes No N/A N/O
- 35. Falling object protection provided to personnel working on scaffolds/under scaffolds Yes No N/A N/O
- 36. Safe clearance maintained from overhead power lines Yes No N/A N/O

MOBILE SCAFFOLDS (3.2.4)

- 37. Casters/wheels locked while scaffold used in the stationary position Yes No N/A N/O
- 38. Personnel not riding mobile scaffolds unless safe to move Yes No N/A N/O

SUSPENSION SCAFFOLDS (3.2.5)

- 39. Suspension scaffolds and boatswains' chairs > 10 feet provided with personal fall arrest system Yes No N/A N/O
- 40. Supporting devices/counterweights secured to supporting structure Yes No N/A N/O
- 41. Supporting devices inspected by competent person prior to scaffold use Yes No N/A N/O
- 42. Ropes and connecting hardware capable of supporting 6 times the maximum intended load Yes No N/A N/O
- 43. Suspension ropes inspected by competent person before each work shift Yes No N/A N/O
- 44. Damaged or repaired wire rope not used as suspension rope Yes No N/A N/O
- 45. Suspension ropes joined together only by eye splice thimbles connected by shackles Yes No N/A N/O
- 46. Wire rope clips inspected/retightened after initial loading and before each work shift Yes No N/A N/O
- 47. Scaffold ropes protected from welding, heat, and corrosives Yes No N/A N/O
- 48. Scaffolds tied or otherwise secured from swaying Yes No N/A N/O

ADJUSTABLE SUSPENSION SCAFFOLDS (3.2.6)

- 49. Adjustable suspension scaffolds > 10 feet provided with guardrails and PFAS Yes No N/A N/O
- 50. Supporting structures capable of resisting tipping moment Yes No N/A N/O
- 51. Hoist ropes restrained from passing through the hoist Yes No N/A N/O
- 52. Hoists have braking device/locking pawl that engages during scaffold uncontrolled movements Yes No N/A N/O
- 53. Manually operated hoists require positive crank force to lower Yes No N/A N/O
- 54. Scaffold hoist stall load less than 3 times its rated load Yes No N/A N/O
- 55. Gasoline-powered hoists not used Yes No N/A N/O

Attachment 7

Incident Reporting Forms

- Incident Report Form
- Near Loss Investigation Form
- Root Cause Analysis Form

Incident Report Form

Fax completed form to:

425.462.5957

CH2M HILL Seattle Office

Attention: Corporate HS&E Department

Type of Incident (Select at least one)

- | | | |
|-----------------------------------------------------|------------------------------------------|----------------------------------------|
| <input type="checkbox"/> Injury/Illness | <input type="checkbox"/> Property Damage | <input type="checkbox"/> Spill/Release |
| <input type="checkbox"/> Environmental/Permit Issue | <input type="checkbox"/> Near Miss | <input type="checkbox"/> Other |

General Information (Complete for all incident types)

Preparer's Name: _____ Preparer's Employee Number: _____
Date of Report: _____ Date of Incident: _____ Time of Incident: _____ am/pm

Type of Activity (Provide activity being performed that resulted in the incident)

- | | | |
|------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------|
| <input type="checkbox"/> Asbestos Work | <input type="checkbox"/> Excavation Trench-Haz Waste | <input type="checkbox"/> Other (Specify) _____ |
| <input type="checkbox"/> Confined Space Entry | <input type="checkbox"/> Excavation Trench-Non Haz | |
| <input type="checkbox"/> Construction Mgmt- Haz Waste | <input type="checkbox"/> Facility Walk Through | <input type="checkbox"/> Process Safety Management |
| <input type="checkbox"/> Construction Mgmt - Non-Haz Waste | <input type="checkbox"/> General Office Work | <input type="checkbox"/> Tunneling |
| <input type="checkbox"/> Demolition | <input type="checkbox"/> Keyboard Work | <input type="checkbox"/> Welding |
| <input type="checkbox"/> Drilling-Haz Waste | <input type="checkbox"/> Laboratory | <input type="checkbox"/> Wetlands Survey |
| <input type="checkbox"/> Drilling-Non Haz Waste | <input type="checkbox"/> Lead Abatement | <input type="checkbox"/> Working from Heights |
| <input type="checkbox"/> Drum Handling | <input type="checkbox"/> Motor Vehicle Operation | <input type="checkbox"/> Working in Roadways |
| <input type="checkbox"/> Electrical Work | <input type="checkbox"/> Moving Heavy Object | <input type="checkbox"/> WWTP Operation |

Location of Incident (Select one)

- Company Premises (CH2M HILL Office: _____)
- Field (Project #: _____ Project/Site Name: _____ Client: _____)
- In Transit (Traveling from: _____ Traveling to: _____)
- At Home

Geographic Location of Incident (Select region where the incident occurred)

- | | | |
|------------------------------------|------------------------------------|---------------------------------------------|
| <input type="checkbox"/> Northeast | <input type="checkbox"/> Southwest | <input type="checkbox"/> Asia Pacific |
| <input type="checkbox"/> Southeast | <input type="checkbox"/> Corporate | <input type="checkbox"/> Europe Middle East |
| <input type="checkbox"/> Northwest | <input type="checkbox"/> Canadian | <input type="checkbox"/> Latin America |

If a CH2M HILL subcontractor was involved in the incident, provide their company name and phone number: _____

Describe the Incident (Provide a brief description of the incident): _____

Injured Employee Data (Complete for Injury/Illness incidents only)

If CH2M HILL employee injured

Employee Name: _____ Employee Number: _____

If CH2M HILL Subcontractor employee injured

Employee Name: _____ Company: _____

Injury Type

- Allergic Reaction
- Amputation
- Asphyxia
- Bruise/Contusion/Abrasion
- Burn (Chemical)
- Burn/Scald (Heat)
- Cancer
- Carpal Tunnel
- Concussion
- Cut/Laceration
- Dermatitis
- Dislocation

- Electric Shock
- Foreign Body in eye
- Fracture
- Freezing/Frost Bite
- Headache
- Hearing Loss
- Heat Exhaustion
- Hernia
- Infection
- Irritation to eye
- Ligament Damage

- Multiple (Specify) _____
- Muscle Spasms
- Other (Specify) _____
- Poisoning (Systemic)
- Puncture
- Radiation Effects
- Strain/Sprain
- Tendonitis
- Wrist Pain

Part of Body Injured

- Abdomen
- Ankle(s)
- Arms (Multiple)
- Back
- Blood
- Body System
- Buttocks
- Chest/Ribs
- Ear(s)
- Elbow(s)
- Eye(s)
- Face
- Finger(s)
- Foot/Feet

- Hand(s)
- Head
- Hip(s)
- Kidney
- Knee(s)
- Leg(s)
- Liver
- Lower (arms)
- Lower (legs)
- Lung
- Mind

- Neck
- Nervous System
- Nose
- Other (Specify) _____
- Reproductive System
- Shoulder(s)
- Throat
- Toe(s)
- Upper Arm(s)
- Upper Leg(s)
- Wrist(s)

- Multiple (Specify) _____

Nature of Injury

- Absorption
- Bite/Sting/Scratch
- Cardio-Vascular/Respiratory System Failure
- Caught In or Between
- Fall (From Elevation)
- Fall (Same Level)
- Ingestion

- Inhalation
- Lifting
- Mental Stress
- Motor Vehicle Accident
- Multiple (Specify) _____

- Other (Specify) _____

- Overexertion
- Repeated Motion/Pressure
- Rubbed/Abraded
- Shock
- Struck Against
- Struck By
- Work Place Violence

Initial Diagnosis/Treatment Date: _____

Type of Treatment

- Admission to hospital/medical facility
- Application of bandages
- Cold/Heat Compression/Multiple Treatment
- Cold/Heat Compression/One Treatment
- First Degree Burn Treatment
- Heat Therapy/Multiple treatment
- Multiple (Specify) _____

- Heat Therapy/One Treatment
- Non-Prescriptive medicine
- None
- Observation
- Other (Specify) _____

- Prescription- Multiple dose

- Prescription- Single dose
- Removal of foreign bodies
- Skin Removal
- Soaking therapy- Multiple Treatment
- Soaking Therapy- One Treatment
- Stitches/Sutures
- Tetanus
- Treatment for infection
- Treatment of 2nd /3rd degree burns
- Use of Antiseptics – multiple treatment
- Use of Antiseptics – single treatment
- Whirlpool bath therapy/multiple treatment
- Whirlpool therapy/single treatment
- X-rays negative
- X-rays positive/treatment of fracture

Number of days doctor required employee to be off work: _____
Number of days doctor restricted employee's work activity: _____
Equipment Malfunction : Yes No Activity was a Routine Task: Yes No
Describe how you may have prevented this injury: _____

Physician Information

Name: _____
Address: _____
City: _____
Zip Code: _____
Phone: _____

Hospital Information

Name: _____
Address: _____
City: _____
Zip Code: _____
Phone: _____

Property Damage (Complete for Property Damage incidents only)

Property Damaged: _____ Property Owner: _____
Damage Description: _____
Estimated Amount: \$ _____

Spill or Release (Complete for Spill/Release incidents only)

Substance (attach MSDS): _____ Estimated Quantity: _____
Facility Name, Address, Phone No.: _____
Did the spill/release move off the property where work was performed?: _____
Spill/Release From: _____ Spill/Release To: _____

Environmental/Permit Issue (Complete for Environmental/Permit Issue incidents only)

Describe Environmental or Permit Issue: _____
Permit Type: _____
Permitted Level or Criteria (e.g., discharge limit): _____
Permit Name and Number (e.g., NPDES No. ST1234): _____
Substance and Estimated Quantity: _____
Duration of Permit Exceedence: _____

Verbal Notification (Complete for all incident types)(Provide names, dates and times)

CH2M HILL Personnel Notified: _____
Client Notified: _____

Witnesses (Complete for all incident types)

Witness Information (First Witness)

Name: _____
Employee Number (CH2M HILL): _____
Address: _____
City: _____
Zip Code: _____
Phone: _____

Witness Information (Second Witness)

Name: _____
Employee Number (CH2M HILL): _____
Address: _____
City: _____
Zip Code: _____
Phone : _____

Additional Comments:

NEAR LOSS INVESTIGATION FORM

Employer Information

Company Name: _____

Project Name: _____ Project Number: _____

Project Location: _____

CHIL Project? Yes No

Task Location: _____

Job Assignment: _____ Business Group: _____

Preparer's Name: _____ Preparer's Employee Number: _____

Near Loss Incident Specific Information

Date of Incident: _____ Time of Incident: _____ a.m./p.m.

Location of incident:

Company premises Field In Transit Other: _____

Address where the incident occurred: _____

Equipment Malfunction : Yes No Activity was a Routine Task: Yes No

Describe any property damage: _____

Specific activity the employee was engaged in when the incident occurred:

All equipment, materials, or chemicals the employee was using when the incident occurred:

Describe the specific incident and how it occurred:

Describe how this incident may have been prevented:

Contributing Factors (Describe in detail why incident occurred):

Date employer notified of incident: _____ To whom reported: _____

NEAR LOSS INVESTIGATION FORM

Witness Information (First Witness)

Name: _____
Employee Number (for CH2M HILL employees): _____
Address: _____
City: _____
Zip Code : _____
Phone: _____

Witness Information (Second Witness)

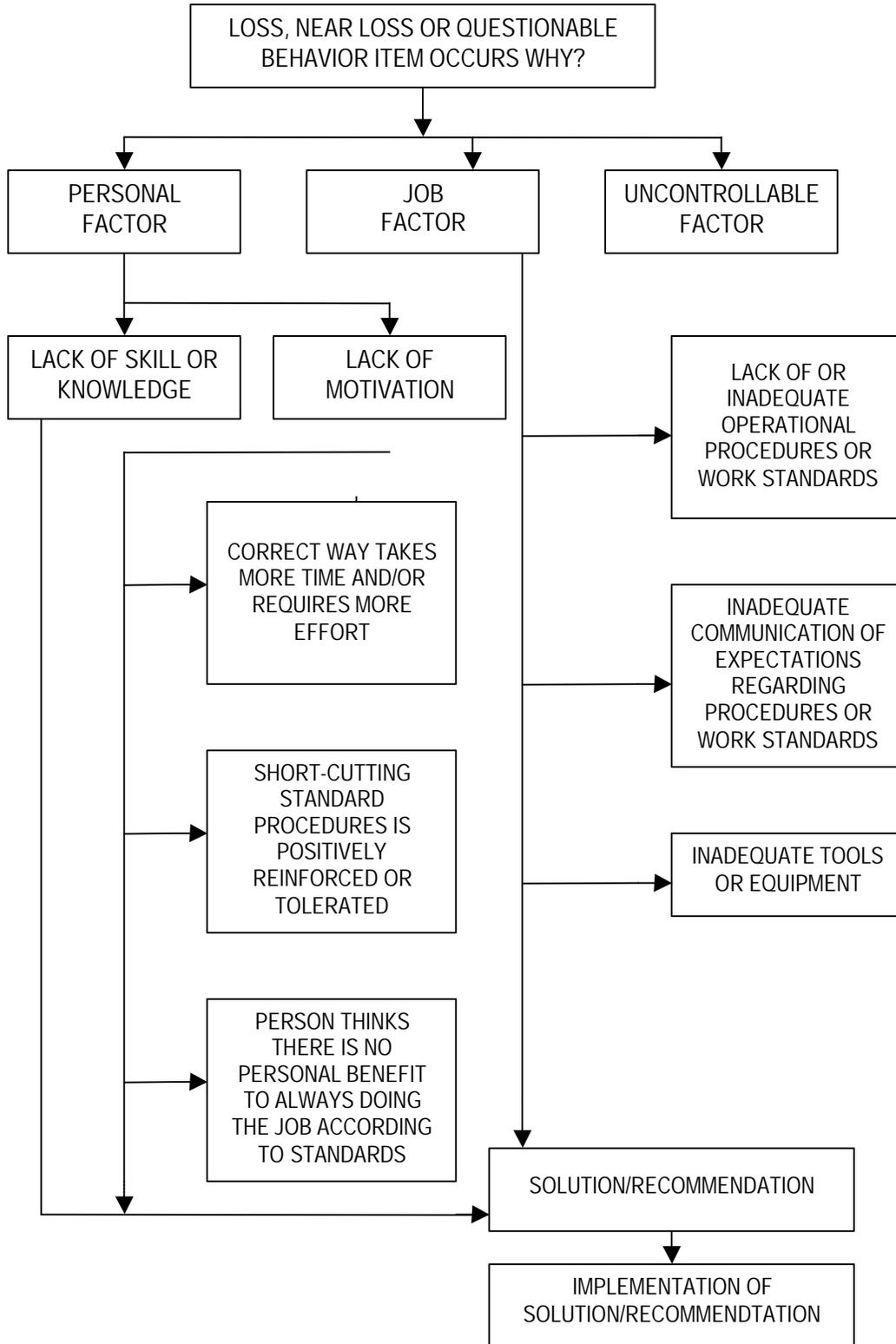
Name: _____
Employee Number (for CH2M HILL employees): _____
Address: _____
City: _____
Zip Code: _____
Phone : _____

Additional information or
comments: _____

Root Cause Analysis Form

Root Cause Analysis (RCA)							
1. Lack of skill or knowledge 2. Lack of or inadequate operational procedures or work standards 3. Inadequate communication of expectations regarding procedures or work standards 4. Inadequate tools or equipment				5. Correct way takes more time and/or requires more effort 6. Short cutting standard procedures is positively reinforced or tolerated 7. Person thinks there is no personal benefit to always doing the job according to standards 8. Uncontrollable			
RCA #	Solution(s): How to Prevent Loss From Occurring	RC ¹	CF ²	Corrective Action Lead	Due Date	Completion Date	Date Verified
¹ RC = Root Cause; ² CF = Contributing Factors (check which applies)							
Investigation Team Members							
Name		Job Title				Date	
Results of Solution Verification and Validation							
Reviewed By							
Name		Job Title				Date	

Root Cause Analysis Flow Chart



Determination of Root Cause(s)

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, to determine the root cause, and to 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 use the Root Cause Analysis Flow Chart 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

- Lack of skill or knowledge
- Correct way takes more time and/or requires more effort
- Short-cutting standard procedures is positively reinforced or tolerated
- Person thinks that there is no personal benefit to always doing the job according to standards

Job Factors

- Lack of or inadequate operational procedures or work standards.
- Inadequate communication of expectations regarding procedures or standards
- 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.

Attachment 8

Material Safety Data Sheets

Alconox®

MATERIAL SAFETY DATA SHEET

Alconox, Inc.
9 East 40th Street, Suite 200
New York, NY 10016

I. IDENTIFICATION

Product Name (as appears on label)	ALCONOX
CAS Registry Number:	Not Applicable
Effective Date:	January 1, 1998
Chemical Family:	Anionic Powdered Detergent

II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

There are no hazardous ingredients in ALCONOX as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

III. PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point (F):	Not Applicable
Vapor Pressure (mm Hg):	Not Applicable
Vapor Density (AIR=1):	Not Applicable
Specific Gravity (Water=1):	Not Applicable
Melting Point:	Not Applicable
Evaporation Rate (Butyl Acetate=1):	Not Applicable
Solubility in Water:	Appreciable-Soluble to 10% at ambient conditions
Appearance:	White powder interspersed with cream colored flakes.

IV. FIRE AND EXPLOSION DATA

Flash Point (Method Used):	None
Flammable Limits:	LEL: No Data UEL: No Data
Extinguishing Media:	Water, dry chemical, CO ₂ , foam
Special Firefighting Procedures:	Self-contained positive pressure breathing apparatus and protective clothing should be worn when fighting fires involving chemicals.
Unusual Fire and Explosion Hazards:	None

V. REACTIVITY DATA

Stability:	Stable
Hazardous Polymerization:	Will not occur
Incompatibility (Materials to Avoid):	None
Hazardous Decomposition or Byproducts:	May release CO ₂ on burning

VI. HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation? Yes Skin? No Ingestion? Yes
Health Hazards (Acute and Chronic):	Inhalation of powder may prove locally irritating to mucous membranes. Ingestion may cause discomfort and/or diarrhea. Eye contact may prove irritating.
Carcinogenicity:	NTP? No IARC Monographs? No OSHA Regulated? No
Signs and Symptoms of Exposure:	Exposure may irritate mucous membranes. May cause sneezing.
Medical Conditions Generally Aggravated by Exposure:	Not established. Unnecessary exposure to this product or any industrial chemical should be avoided. Respiratory conditions may be aggravated by powder.
Emergency and First Aid Procedures:	Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician. Skin: Flush with plenty of water. Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs readminister fluids. See a physician for discomfort.

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled:	Material foams profusely. Recover as much as possible and flush remainder to sewer. Material is biodegradable.
Waste Disposal Method:	Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.
Precautions to be Taken in Storing and Handling:	Material should be stored in a dry area to prevent caking.
Other Precautions:	No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VIII. CONTROL MEASURES

Respiratory Protection (Specify Type):	Dust mask - Recommended
Ventilation:	Local Exhaust-Normal Special-Not Required Mechanical-Not Required Other-Not Required
Protective Gloves:	Impervious gloves are useful but not required.
Eye Protection:	Goggles are recommended when handling solutions.
Other Protective Clothing or Equipment:	None
Work/Hygienic Practices:	No special practices required

THE INFORMATION HEREIN IS GIVEN IN GOOD FAITH BUT NO WARRANTY IS EXPRESSED OR IMPLIED.

BACHARACH -- CALIBRATION GAS, METHANE 500 PPM IN AIR, 51-1816
MATERIAL SAFETY DATA SHEET
NSN: 663000N048469
Manufacturer's CAGE: 05083
Part No. Indicator: A
Part Number/Trade Name: CALIBRATION GAS, METHANE 500 PPM IN AIR, 51-1816

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General Information

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Company's Name: BACHARACH INC
Company's Street: 625 ALPHA DR
Company's City: PITTSBURGH
Company's State: PA
Company's Country: US
Company's Zip Code: 15238
Company's Emerg Ph #: 800-424-9300 (CHEMTREC)
Company's Info Ph #: 412-963-2223
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 13DEC90
Safety Data Review Date: 17FEB94
MSDS Serial Number: BTYRS
Hazard Characteristic Code: NK

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Ingredients/Identity Information

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Proprietary: NO
Ingredient: METHANE. BP:-260F,-162C. MP:-296F,-182C. FL PT:-306F,-188C.
Ingredient Sequence Number: 01
Percent: 0.05
NIOSH (RTECS) Number: PA1490000
CAS Number: 74-82-8
OSHA PEL: N/K (FP N)
ACGIH TLV: ASPHYXIAN

Proprietary: NO
Ingredient: AIR, REFRIGERATED LIQUID; (AIR)
Ingredient Sequence Number: 02
Percent: 99.95
NIOSH (RTECS) Number: AX5271000
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)

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Physical/Chemical Characteristics

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Appearance And Odor: COLORLESS, ODORLESS, TASTELESS COMPRESSED GAS IN CYLINDERS.
Boiling Point: SEE ING 1
Melting Point: SEE ING 1

Vapor Pressure (MM Hg/70 F): (GAS)
Vapor Density (Air=1): 0.991
Specific Gravity: 0.673
Solubility In Water: NEGLIGIBLE
Percent Volatiles By Volume: 100
pH: N/A

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Fire and Explosion Hazard Data

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Flash Point: SEE ING 1
Flash Point Method: CC
Lower Explosive Limit: 5%
Upper Explosive Limit: 15%
Extinguishing Media: MEDIA SUITABLE FOR SURROUNDING FIRE (FP N). THIS GAS IS NOT FLAMMABLE. COOL EXPOSED CONTAINERS W/WATER.
Special Fire Fighting Proc: USE NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE EQUIPMENT (FP N). USE SHIELDING TO PROTECT FROM CYLINDER EXPLOSION.
Unusual Fire And Expl Hazrds: THIS MIXT IS BELOW LEL OF METHANE & NON-FLAMM. COMPRESSED AIR/METHANE MIXTS AT HIGH PRESS WILL ACCELERATE BURNING OF OTHER MATLS. GAS CYLS EXPOS TO HEAT(SUPDAT)

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Reactivity Data

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Stability: YES
Cond To Avoid (Stability): AVOID HEAT OR FLAMES.
Materials To Avoid: NONE KNOWN.
Hazardous Decomp Products: NONE KNOWN.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT

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Health Hazard Data

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LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry - Inhalation: NO
Route Of Entry - Skin: NO
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: ACUTE:EYE/SKIN:NONE KNOWN OR EXPECTED. INHAL:NONE. METHANE IS NON-TOXIC SIMPLE ASPHYXIANT. CONCENTRATION OF METHANE IN THIS GAS IS TOO LOW TO DEPRESS OXYGEN CONCENTRATION.
INGEST:NOT APPLICABLE. THIS MATERIAL IS A GAS. METHANE IS BIOLOGICALLY INACTIVE & ESSENTIALLY NON TOXIC. CHRONIC:NONE KNOWN OR EXPECTED.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT
Signs/Symptoms Of Overexp: NONE SPECIFIED BY MANUFACTURER.
Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.

Emergency/First Aid Proc: INGEST:CALL MD IMMEDIATELY (FP N). INHAL:
REMOVE
IMMEDIATELY FLUSH W/POTABLE WATER FOR A MINIMUM OF 15 MINUTES, SEEK
ASSISTANCE FROM MD (FP N). SKIN:FLUSH W/COPIOUS AMOUNTS OF WATER. CALL
MD
(FP N). NONE NEEDED (MFR).

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Precautions for Safe Handling and Use
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Steps If Matl Released/Spill: NONE NEEDED. THIS MATERIAL IS NON TOXIC &
NON-FLAMMABLE.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: DISPOSE I/A/W ALL LOCAL, STATE & FEDERAL
REGULATIONS. DO NOT INCINERATE CYLINDER.
Precautions-Handling/Storing: DO NOT STORE CYLS NEAR HEAT/OPEN FLAME.
EXPOS TO TEMPS 130F MAY CAUSE RUPTURE. SECURE CYLS - DO NOT DROP.
CONTENTS
UNDER PRESS.
Other Precautions: DO NOT PUNCTURE. NEVER THROW CNTNR INTO FIRE/INCIN.
KEEP CYLS SECURED. DO NOT DROP/DMG. USE PRESS REGULATOR WHEN CONNECTING
TO
LOWER PRESS PIPING SYS. USE CHECK VALVE TO PVNT BACKFLOW. KEEP CYLS
AWAY
FROM HEAT & FLAMES. FOR ADDNL (SUPDAT)

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Control Measures
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Respiratory Protection: NONE NEEDED. SELECTION OF NIOSH/MSHA APPROVED
RESPIRATORY PROTECTION DEPENDS ON CONTAMINANT TYPE, FORM &
CONCENTRATION.
SELECT I/A/W OSHA 1910.134 & GOOD INDUSTRIAL HYGIENE PRACTICE.
Ventilation: NO SPECIAL VENTILATION REQUIRED.
Protective Gloves: LEATHER GLOVES.
Eye Protection: SAFETY GLASSES.
Other Protective Equipment: NONE NEEDED.
Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER.
Suppl. Safety & Health Data: EXPLO HAZ:OR FLAME MAY VENT
RAPIDLY/EXPLODE.
OTHER PREC:HNDLG RECS ON COMPRESSED GAS CYLS, CONSULT COMPRESSED GAS
ASSOC
PAMPHLET P-1. PROTECT FROM HEAT & PHYSICAL DMG.

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Transportation Data
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Disposal Data
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Label Data

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Label Required: YES
Technical Review Date: 17FEB94
Label Date: 16FEB94
Label Status: G
Common Name: CALIBRATION GAS, METHANE 500 PPM IN AIR, 51-1816
Chronic Hazard: NO
Signal Word: CAUTION!
Acute Health Hazard-None: X
Contact Hazard-None: X
Fire Hazard-Slight: X
Reactivity Hazard-None: X
Special Hazard Precautions: NON-FLAMMABLE, BUT COMPRESSED AIR/METHANE
WILL
ACCELERATE BURNING OF OTHER MATERIALS. CYLINDERS EXPOSED TO HIGH HEAT
MAY
EXPLODE. ACUTE:EYE/SKIN:NONE KNOWN OR EXPECTED. INHAL:NONE. METHANE IS
NON-
TOXIC SIMPLE ASPHYXIANT. CONCENTRATION OF METHANE IN THIS GAS IS TOO
LOW TO
DEPRESS OXYGEN CONCENTRATION. INGEST:NOT APPLICABLE. THIS MATERIAL IS A
GAS. CHRONIC:NONE LISTED BY MANUFACTURER.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: BACHARACH INC
Label Street: 625 ALPHA DR
Label City: PITTSBURGH
Label State: PA
Label Zip Code: 15238
Label Country: US
Label Emergency Number: 800-424-9300 (CHEMTREC)

SCOTT SPECIALTY GASES -- ISOBUTYLENE IN AIR - CALIBRATION GAS CYL
MATERIAL SAFETY DATA SHEET
NSN: 6665012148247
Manufacturer's CAGE: 51847
Part No. Indicator: A
Part Number/Trade Name: ISOBUTYLENE IN AIR

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General Information

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Item Name: CALIBRATION GAS CYL
Company's Name: SCOTT SPECIALTY GASES
Company's Street: ROUTE 611 NORTH
Company's City: PLUMSTEADVILLE
Company's State: PA
Company's Country: US
Company's Zip Code: 18949
Company's Emerg Ph #: 215-766-8861; 908-754-7700
Company's Info Ph #: 215-766-8861
Record No. For Safety Entry: 003
Tot Safety Entries This Stk#: 005
Status: SMJ
Date MSDS Prepared: 23APR92
Safety Data Review Date: 27SEP94
MSDS Serial Number: BVRGC
Hazard Characteristic Code: G3

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Ingredients/Identity Information

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Proprietary: NO
Ingredient: PROPENE, 2-METHYL-; (ISOBUTYLENE)
Ingredient Sequence Number: 01
NIOSH (RTECS) Number: UD0890000
CAS Number: 115-11-7
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)

Proprietary: NO

Ingredient: AIR, REFRIGERATED LIQUID; AIR COMPRESSED (UN1002, DOT); AIR
REFRIGERATED LIQUID (CRYOGENIC LIQUID) (UN1003) (DOT)
Ingredient Sequence Number: 02
NIOSH (RTECS) Number: AX5271000
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)

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Physical/Chemical Characteristics

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Appearance And Odor: COLORLESS GAS W/POSSIBLE SLIGHT OLEFINIC ODOR.
Boiling Point: -318F, -194C
Vapor Pressure (MM Hg/70 F): N/A
Vapor Density (Air=1): 1.2
Specific Gravity: 0.88 (H*20=1)

Evaporation Rate And Ref: NOT APPLICABLE
Solubility In Water: INSOLUBLE
Percent Volatiles By Volume: 100

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Fire and Explosion Hazard Data

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Flash Point: NONFLAMMABLE
Lower Explosive Limit: N/A
Upper Explosive Limit: N/A
Extinguishing Media: USE WHAT IS APPROPRIATE FOR SURROUNDING FIRE.
Special Fire Fighting Proc: USE NIOSH/MSHA APPROVED SCBA & FULL
PROTECTIVE
EQUIPMENT (FP N). USE WATER SPRAY TO KEEP FIRE EXPOSED CYLINDERS COOL.
Unusual Fire And Expl Hazrds: COMPRESSED AIR AT HIGH PRESSURES WILL
ACCELERATE THE BURNING OF FLAMMABLE MATERIALS.

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Reactivity Data

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Stability: YES
Cond To Avoid (Stability): NONE SPECIFIED BY MANUFACTURER.
Materials To Avoid: NONE.
Hazardous Decomp Products: NONE.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT

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Health Hazard Data

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LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: NO
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: ACUTE:CONCENTRATION OF ISOBUTYLENE IS
THIS
MIXTURE SHOULD NOT PRESENT ANY SYMPTOMS OF TOXICITY. CHRONIC:NONE.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT
Signs/Symptoms Of Overexp: NONE SPECIFIED BY MANUFACTURER.
Med Cond Aggravated By Exp: NONE.
IMMEDIATELY FLUSH W/POTABLE WATER FOR A MINIMUM OF 15 MINUTES, SEEK
ASSISTANCE FROM MD (FP N). SKIN:FLUSH W/COPIOUS AMOUNTS OF WATER. CALL
MD
(FP N). INHAL:IMMEDIATELY REMOVE VICTIM TO FRESH AIR. IF BREATHING HAS
STOPPED, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE
OXYGEN.

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Precautions for Safe Handling and Use

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Steps If Matl Released/Spill: EVACUATE & VENTILATE AREA. REMOVE LEAKING CYLINDER TO EXHAUST HOOD OR SAFE OUTDOORS AREA IF THIS CAN BE DONE SAFELY.

Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.

Waste Disposal Method: DISPOSAL MUST BE I/A/W FEDERAL, STATE & LOCAL REGULATIONS (FP N). RETURN CYLS TO SUPPLIER FOR PROPER DISP W/ANY VALVE OUTLET PLUGS/CAPS SECURED & VALVE PROT CAP IN PLACE. ALLOW GAS TO DISCHARGE

AT SLOW RATE TO ATM IN UNCONFINED AREA/EXHST HOOD.

Precautions-Handling/Storing: STORE IN WELL VENTILATED AREAS ONLY. KEEP VALVE PROT CAP ON CYLS WHEN NOT IN USE & SECURE CYL WHEN USING TO PROT FROM FALLING.

Other Precautions: USE SUITABLE HAND TRUCK TO MOVE CYLS. PROT CYLS FROM PHYSICAL DMG. DO NOT DEFACE CYLS/LBLS. MOVE CYL W/ADEQ HAND TRUCK. CYL SHOULD BE REFILLED BY QUALIFIED PRODUCERS OF COMPRESSED GAS. SHIPMENT OF COMPRESSED GAS CYL WHICH HAS NOT (SUPDAT)

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Control Measures
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Respiratory Protection: USE NIOSH/MSHA APPROVED SCBA IN CASE OF EMERGENCY OR NON-ROUTINE USE.

Ventilation: PROVIDE ADEQUATE GENERAL & LOCAL EXHAUST VENTILATION.

Protective Gloves: RUBBER GLOVES.

Eye Protection: ANSI APPROVED CHEM WORKERS GOGGS (FP N).

Other Protective Equipment: WEAR SAFETY SHOES. A SAFETY SHOWER & EYEWASH

STATION SHOULD BE READILY AVAILABLE.

Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER.

Suppl. Safety & Health Data: OTHER PREC:BEEN FILLED BY OWNER OR WITH HIS

WRITTEN CONSENT IS A VIOLATION OF FEDERAL LAW (49 CFR).

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Transportation Data
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Trans Data Review Date: 94269
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Disposal Data
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Label Data
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Label Required: YES

Technical Review Date: 27SEP94

Label Date: 26SEP94

Label Status: G

Common Name: ISOBUTYLENE IN AIR

Chronic Hazard: NO
Signal Word: NONE
Acute Health Hazard-None: X
Contact Hazard-None: X
Fire Hazard-None: X
Reactivity Hazard-None: X
Special Hazard Precautions: ACUTE:CONCENTRATION OF ISOBUTYLENE IS THIS
MIXTURE SHOULD NOT PRESENT ANY SYMPTOMS OF TOXICITY. CHRONIC:NONE
LISTED BY
MANUFACTURER.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: SCOTT SPECIALTY GASES
Label Street: ROUTE 611 NORTH
Label City: PLUMSTEADVILLE
Label State: PA
Label Zip Code: 18949
Label Country: US
Label Emergency Number: 215-766-8861; 908-754-7700

LIQUID AIR -- 0.35% PENTANE AND 19% OXYGEN IN NITROGEN.

MATERIAL SAFETY DATA SHEET

NSN: 683000N055373

Manufacturer's CAGE: 18260

Part No. Indicator: A

Part Number/Trade Name: 0.35% PENTANE AND 19% OXYGEN IN NITROGEN.

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General Information

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Company's Name: LIQUID AIR CORP
Company's Street: CA PLZ 2121 N CALIFORNIA BLVD
Company's City: WALNUT CREEK
Company's State: CA
Company's Country: US
Company's Zip Code: 94596
Company's Emerg Ph #: 800-424-9300 (CHEMTREC)
Company's Info Ph #: 415-977-6500
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 01JAN92
Safety Data Review Date: 13OCT95
MSDS Serial Number: BWBDG
Hazard Characteristic Code: G3

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Ingredients/Identity Information

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Proprietary: NO
Ingredient: PENTANE; BP:97F (36C) VP:@ 100F(37.8C)=15 PSIA (103 KPA)
MP:-
201.5F (-129.7C)
Ingredient Sequence Number: 01
Percent: 0.35
NIOSH (RTECS) Number: RZ9450000
CAS Number: 109-66-0
OSHA PEL: 1000 PPM
ACGIH TLV: 600 PPM

Proprietary: NO

Ingredient: OXYGEN; BP:-297.3F (-182.9C), VP:IS ABOVE THE CRITICAL
TEMPERATURE @ 70F(21.1C), MP:-361.8F (-218.8C).
Ingredient Sequence Number: 02
Percent: 19
NIOSH (RTECS) Number: RS2060000
CAS Number: 7782-44-7
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)

Proprietary: NO

Ingredient: NITROGEN; BP -320.5F (-195.8C), VP:ABOVE THE CRITICAL
TEMPERATURE @ 70F (21.1C), MP: -345.9F (-209.9C).
Ingredient Sequence Number: 03
NIOSH (RTECS) Number: QW9700000

CAS Number: 7727-37-9
OSHA PEL: N/K (FP N)
ACGIH TLV: ASPHYXIAN

Proprietary: NO
Ingredient: SUP DAT:EMER EXISTS. DO NOT ALLOW TEMP WHERE CYLS ARE
STORED
TO EXCEED 125F (52C). FULL & EMPTY CYLS SHOULD BE (ING 5)
Ingredient Sequence Number: 04
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: ING 4:BE SEGREGATED. USE A "FIRST IN-FIRST OUT" INVENTORY
SYS
TO PVNT FULL CYLS BEING STORED FOR EXCESSIVE (ING 6)
Ingredient Sequence Number: 05
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: ING 5:PERIODS OF TIME. THIS MIX IS NONCORR & MAY BE USED
W/ALL
MATLS OF CONSTRUCT. MOISTURE CAUSES METAL OXIDES (ING 7)
Ingredient Sequence Number: 06
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: ING 6:WHICH ARE FORMED W/AIR TO BE HYDRATED SO THAT THEY
INCREASE IN VOLUME & LOSE THEIR PROT ROLE (RUST (ING 8))
Ingredient Sequence Number: 07
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: ING 7:FORMATION). CONCS OF SO*2, CL*2, SALT, ETC. IN THE
MOISTURE ENHANCES THE RUSTING OF METALS IN AIR.
Ingredient Sequence Number: 08
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: OTHER PREC:TITLE III, SECTION 313 NOT REQUIRED.
Ingredient Sequence Number: 09
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

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Physical/Chemical Characteristics

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Appearance And Odor: COLORLESS GAS WITH VERY SLIGHT PARAFFINIC ODOR.
Boiling Point: SEE INGS
Melting Point: SEE INGS
Vapor Pressure (MM Hg/70 F): SEE INGS
Specific Gravity: (SUPP DATA)
Solubility In Water: VERY SLIGHTLY
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Fire and Explosion Hazard Data
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Flash Point: N/A
Lower Explosive Limit: N/A
Upper Explosive Limit: N/A
Extinguishing Media: NONFLAMMABLE GAS MIXTURE.
Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED SCBA & FULL
PROTECTIVE EQUIPMENT (FP N). IF CYLINDERS ARE INVOLVED IN A FIRE,
SAFELY
RELOCATE OR KEEP COOL WITH WATER SPRAY.
Unusual Fire And Expl Hazrds: THIS MIXTURE AT HIGH PRESSURES WILL
ACCELERATE THE BURNING OF MATERIALS TO A GREATER RATE THAN THEY BURN AT
ATMOSPHERIC PRESSURE.
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Reactivity Data
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Stability: YES
Cond To Avoid (Stability): NOT APPLICABLE.
Materials To Avoid: NONE
Hazardous Decomp Products: NONE
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT
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Health Hazard Data
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LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: THIS MIXTURE SHOULD BE CONSIDERED SIMILAR
TO
AIR AND WOULD THEREFORE CAUSE NO SYMPTOMS OF EXPOSURE.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT
Signs/Symptoms Of Overexp: SEE HEALTH HAZARDS.
Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.
Emergency/First Aid Proc: INGEST:CALL MD IMMEDIATELY (FP N). INHAL:
REMOVE
IMMEDIATELY FLUSH W/POTABLE WATER FOR A MINIMUM OF 15 MINUTES, SEEK
ASSISTANCE FROM MD (FP N). SKIN:FLUSH W/COPIOUS AMOUNTS OF WATER. CALL
MD

(FP N) .

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Precautions for Safe Handling and Use

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Steps If Matl Released/Spill: NONE SPECIFIED BY MANUFACTURER.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: DISPOSAL MUST BE I/A/W FEDERAL, STATE & LOCAL REGULATIONS (FP N).
Precautions-Handling/Storing: USE A PRESS REDUCING REGULATOR WHEN CONNECTING CYLINDER TO LOWER PRESS (<500 PSIG) PIPING/SYSTEMS. DO NOT HEAT CYLINDER BY ANY MEANS TO (SUPP DATA)
Other Precautions: DOT 39 CYLS MAY NOT BE REUSED/REFILLED (49CFR). NEVER TRANSPORT THESE CYLS IN TRUNKS OF VEHICLES, ENCLSD VANS, TRUCK CABS/IN PASSENGER COMPARTMENTS. TRANSPORT THEM "CNTND" IN OPEN FLATBED/PICKUP TYPE VEHICLES. RPTDG UNDER SARA, (ING 9)

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Control Measures

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Respiratory Protection: USE NIOSH/MSHA APPROVED RESPIRATOR APPROPRIATE FOR EXPOSURE OF CONCERN (FP N).
Ventilation: NONE
Protective Gloves: IMPERVIOUS GLOVES (FP N).
Eye Protection: ANSI APPROVED CHEM WORKERS GOGGS (FP N).
Other Protective Equipment: SAFETY SHOES.
Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER.
Suppl. Safety & Health Data: SPEC GRAV:(AIR=1 @ 70F (21.1C)=1.00.
HNDLG/
STOR PREC:INCREASE DISCHARGE RATE OF PROD FROM CYL. USE A CHECK VALVE/TRAP IN DISCHARGE LINE TO PVNT HAZ BACK FLOW INTO CYL. CLOSE VALVE AFTER EACH USE & WHEN EMPTY. PROT CYLS FROM PHYSICAL DMG. STORE IN COOL, DRY, WELL VENT AREA AWAY FROM HEAVILY TRAFFICKED AREAS & (ING 4)

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Transportation Data

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Disposal Data

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Label Data

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Label Required: YES

Technical Review Date: 18NOV94
Label Status: G
Common Name: 0.35% PENTANE AND 19% OXYGEN IN NITROGEN.
Chronic Hazard: NO
Signal Word: NONE
Acute Health Hazard-None: X
Contact Hazard-None: X
Fire Hazard-None: X
Reactivity Hazard-None: X
Special Hazard Precautions: THIS MIXTURE SHOULD BE CONSIDERED SIMILAR
TO
AIR AND WOULD THEREFORE CAUSE NO SYMPTOMS OF EXPOSURE.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: LIQUID AIR CORP
Label Street: CA PLZ 2121 N CALIFORNIA BLVD
Label City: WALNUT CREEK
Label State: CA
Label Zip Code: 94596
Label Country: US
Label Emergency Number: 800-424-9300 (CHEMTREC)

ALDRICH CHEMICAL -- HYDROCHLORIC ACID 37% A.C.S REAGENT 32033-1
MATERIAL SAFETY DATA SHEET
NSN: 681000N014447
Manufacturer's CAGE: 60928
Part No. Indicator: A
Part Number/Trade Name: HYDROCHLORIC ACID 37% A.C.S REAGENT 32033-1

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General Information

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Company's Name: ALDRICH CHEMICAL CO
Company's P. O. Box: 355
Company's City: MILWAUKEE
Company's State: WI
Company's Country: US
Company's Zip Code: 53201
Company's Info Ph #: 414-273-3850
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 16MAR90
Safety Data Review Date: 20JUL95
MSDS Serial Number: BKKZK
Hazard Characteristic Code: C1

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Ingredients/Identity Information

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Proprietary: NO
Ingredient: HYDROGEN CHLORIDE (HYDROCHLORIC ACID) (SARA III)
Ingredient Sequence Number: 01
Percent: 37
NIOSH (RTECS) Number: MW4025000
CAS Number: 7647-01-0
OSHA PEL: C 5 PPM
ACGIH TLV: C 5 PPM; 9192

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Physical/Chemical Characteristics

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Appearance And Odor: COLORLESS LIQUID, PUNGENT ODOR.
Boiling Point: 123F,51C
Melting Point: 77.7F,25.4C
Vapor Pressure (MM Hg/70 F): 3.23@21.1C
Vapor Density (Air=1): 1.3
Specific Gravity: 1.2
Solubility In Water: SOLUBLE

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Fire and Explosion Hazard Data

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Flash Point: NONE
Lower Explosive Limit: N/A

Upper Explosive Limit: N/A
Extinguishing Media: NONCOMBUSTIBLE. USE EXTINGUISHING MEDIA
APPROPRIATE
TO SURROUNDING FIRE CONDITIONS.
Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED SCBA AND FULL
PROTECTIVE EQUIPMENT TO PREVENT CONTACT WITH SKIN AND EYES. USE WATER
SPRAY
TO COOL FIRE-EXPOSED CONTAINERS.
Unusual Fire And Expl Hazrds: EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

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Reactivity Data

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Stability: YES
Cond To Avoid (Stability): DO NOT ALLOW WATER TO ENTER CONTAINER
BECAUSE
OF VIOLENT REACTION.
Materials To Avoid: BASES, AMINES, ALKALI METALS, COPPER, COPPER
ALLOYS,
ALUMINUM, CORRODES STEEL.
Hazardous Decomp Products: TOXIC FUMES OF:HYDROGEN CHLORIDE GAS.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT

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Health Hazard Data

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LD50-LC50 Mixture: LD50:(IPR,MUS)1449 MG/KG;(SEE SUPP DATA)
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: NO
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: ACUTE:MAY BE FATAL IF INHALED OR
INGESTED.
CAUSES BURNS. MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF MUCOUS
MEMBRANES & UPPER RESPIRATORY TRACT, EYES AND SKIN. INHALATION MAY BE
FATAL
AS RESULT OF SPASM, INFLAMMATION & EDEMA OF LARYNX & BRONCHI, CHEMICAL
PNEUMONITIS & PULMONARY EDEMA.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT
Signs/Symptoms Of Overexp: BURNING SENSATION, COUGHING, WHEEZING,
LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.
Emergency/First Aid Proc: EYES:IMMEDIATELY FLUSH W/COPIOUS AMTS OF
WATER
FOR AT LEAST 15 MINUTES. ASSURE ADEQ FLUSHING BY SEPARATING LIDS W/
FINGERS. SKIN:IMMEDIATELY FLUSH W/COPIOUS AMTS OF WATER FOR 15 MINUTES
WHILE REMOVING CONTAM CLTHG/SHOES. WASH CONTAM CLTHG BEFORE REUSE.
DISCARD
CONTAM SHOES. INHAL:REMOVE TO FRESH AIR. SUPPORT BRTHG (GIVE O*2/ARTF
RESP)
, CALL MD. INGEST:CALL MD IMMEDIATELY (FP N).

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Precautions for Safe Handling and Use

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Steps If Matl Released/Spill: EVACUATE AREA. WEAR NIOSH/MSHA APPROVED SCBA, RUBBER BOOTS & HEAVY RUBBER GLOVES. COVER W/DRY-LIME, SAND, SODA ASH.

PLACE IN COVERED CNTNRS USING NONSPARKING TOOLS & TRANSPORT OUTDOORS. VENT

AREA & WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

Neutralizing Agent: SEE WASTE DISPOSAL METHOD.

Waste Disposal Method: SMALL QYTS:SLOWLY ADD TO LG STIRRED EXCESS OF WATER. ADJUST PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS/LIQ & PACKAGE

FOR HAZ WASTE DISP. FLUSH AQUEOUS SOLN DOWN DRAIN W/PLENTY OF WATER. HYDROLYSIS/NEUTRALIZATION RXN MAY GENERATE HEAT(SEE SUPP DATA)

Precautions-Handling/Storing: STORE IN COOL, DRY PLACE. OPEN CAREFULLY. KEEP TIGHTLY CLOSED. AVOID PRLNGD/RPTD EXPOSURE. DO NOT GET IN EYES, ON SKIN OR CLTHG. AVOID BREATHING VAPOR.

Other Precautions: POISON. CORROSIVE. REACTS VIOLENTLY WITH WATER. MAY DEVELOP PRESSURE. DO NOT PIPET BY MOUTH.

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Control Measures

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Respiratory Protection: NIOSH/MSHA APPROVED RESPIRATOR IN NONVENTILATED AREAS AND/OR FOR EXPOSURE ABOVE ACGIH TLV.

Ventilation: MECHANICAL EXHAUST REQUIRED.

Protective Gloves: NEOPRENE/PVC GLOVES.

Eye Protection: CHEMICAL WORKERS GOGGLES (FP N).

Other Protective Equipment: SAFETY SHOWER AND EYE BATH. FACESHIELD (8-INCH MINIMUM).

Work Hygienic Practices: WASH HANDS THOROUGHLY AFTER USE AND BEFORE EATING, DRINKING, SMOKING OR USING SANITARY FACILITIES (FP N).

Suppl. Safety & Health Data: LD50-LC50 MIX:LD50:(ORL,RBT)900 MG/KG. WASTE

DISP METH:AND FUMES WHICH CAN BE CONTROLLED BY RATE OF ADDITION.

DISPOSE OF

I/A/W FEDERAL, STATE AND LOCAL REGULATIONS.

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Transportation Data

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Trans Data Review Date: 91221

DOT PSN Code: HJG

DOT Proper Shipping Name: HYDROCHLORIC ACID, SOLUTION

DOT Class: 8

DOT ID Number: UN1789

DOT Pack Group: II

DOT Label: CORROSIVE

IMO PSN Code: IHF

IMO Proper Shipping Name: HYDROGEN CHLORIDE

IMO Regulations Page Number: SEE 8183

IMO UN Number: 1789

IMO UN Class: 8
IMO Subsidiary Risk Label: -
IATA PSN Code: NPG
IATA UN ID Number: 1789
IATA Proper Shipping Name: HYDROCHLORIC ACID
IATA UN Class: 8
IATA Label: CORROSIVE
AFI PSN Code: NPG
AFI Symbols: T
AFI Prop. Shipping Name: HYDROCHLORIC ACID, SOLUTION
AFI Class: 8
AFI ID Number: UN1789
AFI Pack Group: II
AFI Special Prov: A3,A6,N41
AFI Basic Pac Ref: 12-5

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Disposal Data

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Label Data

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Label Required: YES
Technical Review Date: 06JUN91
Label Date: 06JUN91
Label Status: G
Common Name: HYDROCHLORIC ACID
Chronic Hazard: YES
Signal Word: DANGER!
Acute Health Hazard-Slight: X
Contact Hazard-Severe: X
Fire Hazard-None: X
Reactivity Hazard-Moderate: X
Special Hazard Precautions: ACUTE: INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA. EXTREMELY DESTRUCTIVE TO MUCOUS MEMBRANES, EYES, SKIN. CHRONIC: MAY DAMAGE EYES, LUNGS. WARNING! REACTS VIOLENTLY WITH WATER.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: ALDRICH CHEMICAL CO
Label P.O. Box: 355
Label City: MILWAUKEE
Label State: WI
Label Zip Code: 53201
Label Country: US

ALDRICH CHEMICAL -- NITRIC ACID, 90% ACS REAGENT, 25812-1
MATERIAL SAFETY DATA SHEET
NSN: 681000N073464
Manufacturer's CAGE: 60928
Part No. Indicator: A
Part Number/Trade Name: NITRIC ACID, 90% ACS REAGENT, 25812-1

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General Information

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Company's Name: ALDRICH CHEMICAL CO INC
Company's P. O. Box: 355
Company's City: MILWAUKEE
Company's State: WI
Company's Country: US
Company's Zip Code: 53201
Company's Emerg Ph #: 414-273-3850
Company's Info Ph #: 414-273-3850
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 10MAY96
Safety Data Review Date: 01OCT96
MSDS Serial Number: CCMRN

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Ingredients/Identity Information

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Proprietary: NO
Ingredient: NITRIC ACID (SARA 302/313) (CERCLA)
Ingredient Sequence Number: 01
Percent: 90
NIOSH (RTECS) Number: QU5775000
CAS Number: 7697-37-2
OSHA PEL: 2 PPM
ACGIH TLV: 2 PPM/4 STEL

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Physical/Chemical Characteristics

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Appearance And Odor: PALE-YELLOW LIQUID
Vapor Pressure (MM Hg/70 F): 6.6 @ 20C
Vapor Density (Air=1): 1.3
Specific Gravity: 1.490

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Fire and Explosion Hazard Data

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Flash Point: NONE
Extinguishing Media: NON-COMBUSTIBLE. USE EXTINGUISHING MEDIA
APPROPRIATE
TO SURROUNDING FIRE CONDITIONS. DO NOT USE WATER.
Special Fire Fighting Proc: WEAR NIOSH APPROVED SCBA AND FULL

PROTECTIVE
EQUIPMENT (FP N). PREVENT CONTACT WITH SKIN AND EYES. REACTS VIOLENTLY
WITH
WATER.
Unusual Fire And Expl Hazrds: STRONG OXIDIZER. CONTACT WITH OTHER
MATERIAL
MAY CAUSE FIRE. EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

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Reactivity Data
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Stability: YES
Cond To Avoid (Stability): NONE SPECIFIED BY MANUFACTURER.
Materials To Avoid: BASES, REDUCING AGENTS, ALCOHOLS, ALKALI METALS,
BRASS, COPPER, COPPER ALLOYS, GALVANIZED IRON, ALUMINUM. (SUP DAT)
Hazardous Decomp Products: TOXIC FUMES OF NITROGEN OXIDES.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT.

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Health Hazard Data
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LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: ACUTE: MAY BE FATAL IF INHALED,
SWALLOWED,
OR ABSORBED THROUGH SKIN. CAUSES BURNS. MATERIAL IS EXTREMELY
DESTRUCTIVE
TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND
SKIN. INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND
EDEMA
OF THE LARYNX AND BRONCHI, CHEMICAL (EFTS OF OVEREXP)
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT.
Signs/Symptoms Of Overexp: HLTH HAZ: PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING,
LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.
Emergency/First Aid Proc: EYES/SKIN: IMMEDIATELY FLUSH W/COPIOUS AMOUNTS OF
WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAM CLOTHING & SHOES.
REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF
BREATHING IS DIFFICULT, GIVE OXYGEN. INGEST: WASH OUT MOUTH W/WATER
PROVIDED PERSON IS CONSCIOUS. CALL MD IMMEDIATELY. DISCARD CONTAM CLTHG &
SHOES.

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Precautions for Safe Handling and Use
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Steps If Matl Released/Spill: WEAR NIOSH APPROVED SCBA, RUBBER BOOTS
AND

HEAVY RUBBER GLOVES. ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL. VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL

PICKUP IS COMPLETE.

Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.

Waste Disposal Method: FOR SML QTYS: CAUTIOUSLY ADD TO LGE STIRRED EXCESS

OF WATER. ADJUST PH TO NEUT. SEPARATE ANY INSOL SOLIDS/LIQS & PACKAGE THEM

FOR HAZ WASTE DISP. FLUSH AQUEOUS SOLN DOWN DRAIN W/PLENTY OF WATER. THE

HYDROLYSIS & NEUT RXNS MAY GENERATE HEAT (SUP DAT)

Precautions-Handling/Storing: AVOID CONTACT AND INHALATION. AVOID PROLONGED OR REPEATED EXPOSURE. POISON. CORROSIVE. DO NOT ALLOW CONTACT WITH WATER.

Other Precautions: KEEP TIGHTLY CLOSED. DO NOT STORE NEAR, NOR ALLOW CONTACT WITH, CLOTHING AND OTHER COMBUSTIBLE MATERIAL. REFRIGERATE.

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Control Measures

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Respiratory Protection: NIOSH APPROVED RESPIRATOR.

Ventilation: MECHANICAL EXHAUST REQUIRED.

Protective Gloves: WEAR HEAVY RUBBER GLOVES.

Eye Protection: ANSI APPRVD CHEM WORKERS GOGGS (SUP DAT)

Other Protective Equipment: EMERGENCY EYEWASH & DELUGE SHOWER MEETING ANSI

DESIGN CRITERIA (FP N). RUBBER APRON.

Work Hygienic Practices: WASH THOROUGHLY AFTER HANDLING.

Suppl. Safety & Health Data: MATLS TO AVOID: CORRODES STEEL. ORG MATLS, AMINES. MAY DISCOLOR ON EXPOS TO LIGHT. REACTS VIOLENTLY W/WATER. WASTE DISP METH: & FUMES WHICH CAN BE CONTROLLED BY RATE OF ADDN. OBSERVE ALL FED, STATE & LOC ENVIRON REGS. EYE PROT: & FULL LENGTH FACESHIELD (FP N).

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Transportation Data

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Disposal Data

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Label Data

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Label Required: YES

Technical Review Date: 01OCT96

Label Date: 01OCT96

Label Status: G

Common Name: NITRIC ACID, 90% ACS REAGENT, 25812-1

Chronic Hazard: NO

Signal Word: DANGER!

Acute Health Hazard-Severe: X
Contact Hazard-Severe: X
Fire Hazard-Slight: X
Reactivity Hazard-Moderate: X
Special Hazard Precautions: CORROSIVE. ACUTE: MAY BE FATAL IF INHALED,
SWALLOWED, OR ABSORBED THROUGH SKIN. CAUSES BURNS. MATERIAL IS
EXTREMELY
DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY
TRACT,
EYES AND SKIN. INHALATION MAY BE FATAL AS A RESULT OF SPASM,
INFLAMMATION
AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY
EDEMA. SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING,
WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND
VOMITING.
CHRONIC: NONE SPECIFIED BY MANUFACTURER.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: ALDRICH CHEMICAL CO INC
Label P.O. Box: 355
Label City: MILWAUKEE
Label State: WI
Label Zip Code: 53201
Label Country: US
Label Emergency Number: 414-273-3850

ALDRICH CHEMICAL -- 25810-5, SULFURIC ACID, 95-98%, A.C.S. REAG
MATERIAL SAFETY DATA SHEET
NSN: 681000N033846
Manufacturer's CAGE: 60928
Part No. Indicator: A
Part Number/Trade Name: 25810-5, SULFURIC ACID, 95-98%, A.C.S. REAG

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General Information

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Company's Name: ALDRICH CHEMICAL CO
Company's P. O. Box: 355
Company's City: MILWAUKEE
Company's State: WI
Company's Country: US
Company's Zip Code: 53201
Company's Emerg Ph #: 414-273-3850
Company's Info Ph #: 414-273-3850
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 25FEB92
Safety Data Review Date: 11AUG92
MSDS Serial Number: BPQND
Hazard Characteristic Code: NK

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Ingredients/Identity Information

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Proprietary: NO
Ingredient: SULFURIC ACID (SARA III)
Ingredient Sequence Number: 01
Percent: 95-98
NIOSH (RTECS) Number: WS5600000
CAS Number: 7664-93-9
OSHA PEL: 1 MG/M3
ACGIH TLV: 1 MG/M3;3 STEL

Proprietary: NO
Ingredient: WASTE DISP METH: AND FUMES WHICH CAN BE CONTROLLED BY RATE
OF
ADDITION. DISPOSE OF I/A/W FED, ST AND LOCAL REGS (FP N).
Ingredient Sequence Number: 02
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: OTHER PREC: KEEP AWAY FROM COMBUSTIBLE MATERIAL. WEAR
SUITABLE
PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROT. (ING 4)
Ingredient Sequence Number: 03
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: ING 3: DO NOT BREATHE VAPOR. IF YOU FEEL UNWELL, SEEK
MEDICAL
ADVICE (SHOW LABEL WHERE POSSIBLE).
Ingredient Sequence Number: 04
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

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Physical/Chemical Characteristics

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Appearance And Odor: VISCOUS COLORLESS LIQUID.
Vapor Pressure (MM Hg/70 F): 1 @ 145.8C
Vapor Density (Air=1):

ALDRICH CHEMICAL -- SODIUM HYDROXIDE, 50% SOLUTION IN WATER, 41541-3
MATERIAL SAFETY DATA SHEET
NSN: 681000N069964
Manufacturer's CAGE: 60928
Part No. Indicator: A
Part Number/Trade Name: SODIUM HYDROXIDE, 50% SOLUTION IN WATER, 41541-3

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General Information

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Company's Name: ALDRICH CHEMICAL CO INC
Company's P. O. Box: 355
Company's City: MILWAUKEE
Company's State: WI
Company's Country: US
Company's Zip Code: 53201
Company's Emerg Ph #: 414-273-3850
Company's Info Ph #: 414-273-3850
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 11OCT95
Safety Data Review Date: 15MAR96
MSDS Serial Number: BZSML

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Ingredients/Identity Information

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Proprietary: NO
Ingredient: SODIUM HYDROXIDE (CERCLA)
Ingredient Sequence Number: 01
NIOSH (RTECS) Number: WB4900000
CAS Number: 1310-73-2
OSHA PEL: 2 MG/M3
ACGIH TLV: C 2 MG/M3

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Physical/Chemical Characteristics

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Appearance And Odor: NONE SPECIFIED BY MANUFACTURER
Specific Gravity: 1.515

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Fire and Explosion Hazard Data

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Flash Point: NONE
Extinguishing Media: USE DRY CHEMICAL POWDER. DO NOT USE WATER.
Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED SCBA & FULL
PROTECTIVE EQUIPMENT (FP N). REACTS VIOLENTLY WITH WATER.
Unusual Fire And Expl Hazrds: EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

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Reactivity Data

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Stability: YES
Cond To Avoid (Stability): REACTS VIOLENTLY WITH WATER.
Materials To Avoid: ACIDS, ALUMINUM, ZINC, TIN, ORG MATLS, PHOSPHORUS,
CHLORINATED SOLV, SENSITIVE TO AIR, PROTECT FROM LIGHT. (SUP DAT)
Hazardous Decomp Products: NATURE OF DECOMPOSITION PRODUCTS NOT KNOWN.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT.
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Health Hazard Data

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LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: ACUTE: HARMFUL IF SWALLOWED, INHALED/
ABSORBED THRU SKIN. EXTREMELY DESTRUCTIVE TO TISS OF MUC MEMB & UPPER
RESP
TRACT, EYES & SKIN. INHAL MAY BE FATAL AS RSLT OF SPASM, INFLAMM &
EDEMA OF
LARYNX & BRONCHI, CHEM PNEUMIT & PULM EDEMA. SYMPS OF EXPOS MAY INCL
BURNING SENSATION, COUGHING, WHEEZING, (EFTS OF OVEREXPOSURE)
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT.
Signs/Symptoms Of Overexp: HLTH HAZ: LARYNGITIS, SHORTNESS OF BREATH,
HDCH, NAUS & VOMIT. TO THE BEST OF MFR KNOWLEDGE, THE CHEMICAL,
PHYSICAL &
TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THORO INVESTIGATED.
Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.
Emergency/First Aid Proc: EYES/SKIN: IMMED FLUSH W/COPIOUS AMOUNTS OF
WATER FOR AT LEAST 15 MIN WHILE REMOVING CONTAM CLOTHING. ASSURE
ADEQUATE
FLUSHING OF EYES BY SEPARATING EYELIDS W/FINGERS. INHAL: REMOVE TO
FRESH
AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESP. IF BREATHING IS DIFFICULT,
GIVE OXYGEN. INGEST: WASH OUT MOUTH W/WATER PROVIDED PERSON IS
CONSCIOUS.
CALL MD. WASH CONTAM CLTHG BEFORE REUSE. DISCARD CONTAM SHOES.
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Precautions for Safe Handling and Use

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Steps If Matl Released/Spill: EVACUATE AREA. WEAR NIOSH/MSHA APPROVED
SCBA, RUBBER BOOTS AND HEAVY RUBBER GLOVES. ABSORB ON SAND OR
VERMICULITE
AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL. VENTILATE AREA AND WASH
SPILL
SITE AFTER MATERIAL PICKUP IS COMPLETE.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: FOR SML QTYS: CAUTIOUSLY ADD TO LGE STIRRED

EXCESS
OF WATER. ADJUST PH TO NEUT, SEPARATE ANY INSOLUBLE SOLIDS/LIQS &
PACKAGE
THEM FOR HAZ WASTE DISP. FLUSH AQUEOUS SOLN DOWN DRAIN W/PLENTY OF
WATER.

HYDROLYSIS & NEUTRALIZATION RXNS MAY (SUP DAT)

Precautions-Handling/Storing: DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE. CORROSIVE. TOXIC. KEEP TIGHTLY
CLOSED. STORE IN A COOL DRY PLACE.

Other Precautions: DO NOT FREEZE.

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Control Measures

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Respiratory Protection: WEAR APPROPRIATE NIOSH/MSHA APPROVED
RESPIRATOR.

Ventilation: USE ONLY IN A CHEMICAL FUME HOOD.

Protective Gloves: CHEMICAL-RESISTANT GLOVES.

Eye Protection: ANSI APPRVD CHEM WORKERS GOGGS (FP N).

Other Protective Equipment: PROTECTIVE CLOTHING. EMERGENCY EYEWASH &
DELUGE SHOWER MEETING ANSI DESIGN CRITERIA (FP N).

Work Hygienic Practices: WASH THOROUGHLY AFTER HANDLING.

Suppl. Safety & Health Data: MATLS TO AVOID: REACTS VIOLENTLY W/WATER.
ABSORBS CO*2 FROM AIR. WASTE DISP METH: GENERATE HEAT & FUMES WHICH CAN
BE

CONTROLLED BY RATE OF ADDITION. OBSERVE ALL FED, STATE & LOC ENVIRON
REGS.

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Transportation Data

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Disposal Data

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Label Data

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Label Required: YES

Technical Review Date: 15MAR96

Label Date: 15MAR96

Label Status: G

Common Name: SODIUM HYDROXIDE, 50% SOLUTION IN WATER, 41541-3

Chronic Hazard: NO

Signal Word: DANGER!

Acute Health Hazard-Moderate: X

Contact Hazard-Severe: X

Fire Hazard-None: X

Reactivity Hazard-Slight: X

Special Hazard Precautions: REACTS VIOLENTLY WITH WATER. ACUTE: HARMFUL
IF

SWALLOWED, INHALED OR ABSORBED THROUGH THE SKIN. EXTREMELY DESTRUCTIVE

TO

TISSUE OF MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN. INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE

LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA. SYMPTOMS OF

EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING. CHRONIC: NONE SPECIFIED

BY MANUFACTURER.

Protect Eye: Y

Protect Skin: Y

Protect Respiratory: Y

Label Name: ALDRICH CHEMICAL CO INC

Label P.O. Box: 355

Label City: MILWAUKEE

Label State: WI

Label Zip Code: 53201

Label Country: US

Label Emergency Number: 414-273-3850

ALDRICH CHEMICAL SUB OF SIGMA-ALDRICH -- 65550 METHANOL
MATERIAL SAFETY DATA SHEET
NSN: 681000F030311
Manufacturer's CAGE: 60928
Part No. Indicator: A
Part Number/Trade Name: 65550 METHANOL

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General Information

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Company's Name: ALDRICH CHEMICAL CO SUB OF SIGMA-ALDRICH
Company's Street: 1001 W ST PAUL AVE
Company's P. O. Box: 355
Company's City: MILWAUKEE
Company's State: WI
Company's Country: US
Company's Zip Code: 53233
Company's Emerg Ph #: 800-325-5832-S/800-231-8327-A
Company's Info Ph #: 800-325-5832-S/800-231-8327-A
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SE
Date MSDS Prepared: 01APR92
Safety Data Review Date: 30SEP93
Preparer's Company: ALDRICH CHEMICAL CO SUB OF SIGMA-ALDRICH
Preparer's St Or P. O. Box: 1001 W ST PAUL AVE
Preparer's City: MILWAUKEE
Preparer's State: WI
Preparer's Zip Code: 53233
MSDS Serial Number: BRXZV

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Ingredients/Identity Information

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Proprietary: NO
Ingredient: METHANOL (METHYL ALCOHOL), COLUMBIAN SPIRITS
Ingredient Sequence Number: 01
NIOSH (RTECS) Number: PC1400000
CAS Number: 67-56-1
OSHA PEL: S,200PPM/250STEL
ACGIH TLV: S,200PPM/250STEL; 93
Other Recommended Limit: 200 PPM

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Physical/Chemical Characteristics

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Appearance And Odor: COLORLESS LIQUID
Boiling Point: 64.6C
Melting Point: -98C
Vapor Pressure (MM Hg/70 F): 97.68
Vapor Density (Air=1): 1.1
Specific Gravity: 0.791

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Fire and Explosion Hazard Data

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Flash Point: 52F
Lower Explosive Limit: 6%
Upper Explosive Limit: 36%
Extinguishing Media: CO2, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.
Special Fire Fighting Proc: WEAR SELF-CONTAINED BREATHING APPARATUS &
FULL
PROTECTIVE CLOTHING.
Unusual Fire And Expl Hazrds: VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO
725F.
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Reactivity Data

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Stability: YES
Cond To Avoid (Stability): HEAT, SPARKS, OPEN FLAME OR OTHER SOURCES OF
IGNITION.
Materials To Avoid: ACIDS, ACID CHLORIDES, ACID ANHYDRIDES, OXIDIZING/
REDUCING AGENTS, ALKALI METALS.
Hazardous Decomp Products: CO, CO2
Hazardous Poly Occur: NO
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Health Hazard Data

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LD50-LC50 Mixture: ORAL LD50 (RAT): 5628 MG/KG
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: MAY BE FATAL IF SWALLOWED. HARMFUL IF
INHALED OR ABSORBED THROUGH SKIN. VAPOR OR MIST IS IRRITATING TO THEY
EYES,
MUCOUS MEMBRANES, SKIN, & UPPER RESPIRATORY TRACT. CAN CAUSE DAMAGE TO
THE
EYES, LIVER, HEART, KIDNEYS. GASTROINTESTINAL DISTURBANCES &
CONVULSIONS.
MAY CAUSE BLINDNESS IF INGESTED.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NONE
Signs/Symptoms Of Overexp: OPTIC NERVE NEUROPATHY, VISUAL FIELD
CHANGES,
HEADACHE, DYSPNEA, NAUSEA, VOMITING.
Med Cond Aggravated By Exp: CUTS, SCRATCHES
Emergency/First Aid Proc: EYES/SKIN: FLUSH W/PLENTY OF WATER FOR AT
LEAST
15 MINS WHILE REMOVING CONTAMINATED CLOTHING & SHOES. INHALATION:
REMOVE TO
FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING
IS
DIFFICULT, GIVE OXYGEN. INGESTION: WASH OUT MOUTH W/WATER PROVIDED
PERSON

IS CONSCIOUS. DISCARD CONTAMINATED CLOTHING & SHOES. OBTAIN MEDICAL ATTENTION IN ALL CASES.

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Precautions for Safe Handling and Use

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Steps If Matl Released/Spill: EVACUATE AREA. SHUT OFF ALL IGNITION SOURCES. USE PROTECTIVE EQUIP. COVER W/DRY-LIME, SAND OR SODA ASH. PLACE IN COVERED CONTAIERS USING NON-SPARKING TOOLS & TRANSPORT OUTDOORS. VENTILATE AREA & WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
Neutralizing Agent: DRY LIME, SAND OR SODA ASH
Waste Disposal Method: BURN IN A CHEMICAL INCINERATOR EQUIPPED W/AN AFTERBURNER & SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY FLAMMABLE. OBSERVE ALL FEDERAL, STATE & LOCAL LAWS. UN1230.
Precautions-Handling/Storing: KEEP TIGHTLY CLOSED & AWAY FROM HEAT, SPARKS & OPEN FLAME. PRODUCT IS HYGROSCOPIC. STORE IN A COOL DRY PLACE. NO SMOKING. CANNOT BE MADE NON-POISONOUS
Other Precautions: AVOID CONTACT W/EYES, SKIN, CLOTHING & BREATHING OF VAPORS. DON'T USE IF SKIN IS CUT OR SCRATCHED.

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Control Measures

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Respiratory Protection: WEAR AN APPROPRIATE NIOSH/MSHA APPROVED RESPIRATOR.
Ventilation: MECHANICAL EXHAUST
Protective Gloves: CHEMICAL RESISTANT
Eye Protection: SAFETY GOGGLES
Other Protective Equipment: RUBBER BOOTS, SAFETY SHOWER, EYE BATH
Work Hygienic Practices: WASH THOROUGHLY AFTER HANDLING.

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Transportation Data

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Disposal Data

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Label Data

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Label Required: YES
Technical Review Date: 30SEP93
Label Date: 17SEP93
Label Status: F
Common Name: 65550 METHANOL
Chronic Hazard: YES

Signal Word: DANGER!

Acute Health Hazard-Severe: X

Contact Hazard-Severe: X

Fire Hazard-Severe: X

Reactivity Hazard-Slight: X

Special Hazard Precautions: MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED

OR ABSORBED THROUGH SKIN. VAPOR OR MIST IS IRRITATING TO THE EYES, MUCOUS

MEMBRANES, SKIN, & UPPER RESPIRATORY TRACT. CAN CAUSE DAMAGE TO THE EYES,

LIVER, HEART, KIDNEYS. GASTROINTESTINAL DISTURBANCES & CONVULSIONS. MAY CAUSE BLINDNESS IF INGESTED. TARGET ORGANS: EYES, SKIN, LIVER, HEART, KIDNEYS, RESPIRATORY & DIGESTIVE TRACTS. DIGESTIVE TRACTS, LIVER.

Protect Eye: Y

Protect Skin: Y

Protect Respiratory: Y

Label Name: ALDRICH CHEMICAL CO SUB OF SIGMA-ALDRICH

Label Street: 1001 W ST PAUL AVE

Label P.O. Box: 355

Label City: MILWAUKEE

Label State: WI

Label Zip Code: 53233

Label Country: US

Label Emergency Number: 800-325-5832-S/800-231-8327-A

Year Procured: UNK

ALDRICH CHEMICAL -- HEXANE ACS GRADE - N-HEXANE
MATERIAL SAFETY DATA SHEET
NSN: 681000N040300
Manufacturer's CAGE: 60928
Part No. Indicator: A
Part Number/Trade Name: HEXANE ACS GRADE

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General Information

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Item Name: N-HEXANE
Company's Name: ALDRICH CHEMICAL CO
Company's P. O. Box: 355
Company's City: MILWAUKEE
Company's State: WI
Company's Country: US
Company's Zip Code: 53201
Company's Emerg Ph #: 414-273-3850
Company's Info Ph #: 414-273-3850
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 04AUG92
Safety Data Review Date: 03MAR93
MSDS Serial Number: BRZJT
Hazard Characteristic Code: NK

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Ingredients/Identity Information

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Proprietary: NO
Ingredient: HEXANE
Ingredient Sequence Number: 01
NIOSH (RTECS) Number: MN9275000
CAS Number: 110-54-3
OSHA PEL: 500 PPM
ACGIH TLV: 50 PPM; 9293

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Physical/Chemical Characteristics

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Appearance And Odor: COLORLESS LIQUID
Boiling Point: 154F,68C
Vapor Pressure (MM Hg/70 F): 132@20C
Vapor Density (Air=1): 3
Specific Gravity: 0.661

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Fire and Explosion Hazard Data

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Flash Point: -10F,-23C
Lower Explosive Limit: 1.2%
Upper Explosive Limit: 7.7%

Extinguishing Media: CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.

Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED SCBA AND FULL PROTECTIVE EQUIPMENT (FP N). USE WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.

Unusual Fire And Expl Hazrds: VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK. CONTAINER EXPLOSION MAY OCCUR UNDER FIRE CONDITIONS. EXTREMELY FLAMMABLE.

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Reactivity Data

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Stability: YES

Cond To Avoid (Stability): HEAT, SPARKS AND OPEN FLAME.

Materials To Avoid: OXIDIZING AGENTS. CHLORINE, FLUORINE, MAGNESIUM PERCHLORATGE.

Hazardous Decomp Products: TOXIC FUMES OF: CARBON MONOXIDE, CARBON DIOXIDE.

Hazardous Poly Occur: NO

Conditions To Avoid (Poly): NOT RELEVANT

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Health Hazard Data

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LD50-LC50 Mixture: LD50:(ORAL,RAT)28710 MG/KG

Route Of Entry - Inhalation: YES

Route Of Entry - Skin: YES

Route Of Entry - Ingestion: YES

Health Haz Acute And Chronic: ACUTE: HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THRU SKIN. VAPOR OR MIST IS IRRITATING TO EYES, MUCOUS MEMBRANES

AND UPPER RESPIRATORY TRACT. CAUSES SKIN IRRITATION. MAY CAUSE NERVOUS SYSTEM DISTURBANCES. EXPOSURE CAN CAUSE: COUGHING, CHEST PAINS, DIFFICULTY

IN BREATHING. LUNG IRRIT, CHEST PAIN (EFTS OF OVEREXP)

Carcinogenicity - NTP: NO

Carcinogenicity - IARC: NO

Carcinogenicity - OSHA: NO

Explanation Carcinogenicity: NOT RELEVANT

Signs/Symptoms Of Overexp: HLTH HAZ: & EDEMA WHICH MAY BE FATAL. GI DISTURBANCES, NAUSEA, HEADACHE AND VOMITING.

Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.

Emergency/First Aid Proc: EYES: IMMED FLUSH W/COPIOUS AMTS OF WATER FOR @

LST 15 MIN & SEEK MED ADVICE. SKIN: IMMED FLUSH W/COPIOUS AMTS OF WATER FOR

@ LST 15 MIN WHILE REMOVING CONTAMD CLTHG & SHOES. WASH CONTAMD CLTHG BEFORE REUSE. INHAL: REMOVE TO FRESH AIR. IF NOT BRTHG GIVE ARTF RESP. IF

BREATHING IS DIFFICULT, GIVE OXYGEN. INGEST: WASH OUT MOUTH W/ WATER PROVIDED PERSON IS CONSCIOUS. CALL A PHYSICIAN.

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Precautions for Safe Handling and Use

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Steps If Matl Released/Spill: EVAC AREA. SHUT OFF ALL SOURCES OF IGNIT.
WEAR NIOSH/MSHA APPRVD SCBA, RUBB BOOTS & HEAVY RUBB GLOVES. COVER W/AN
ACTIVATED CARBON ABSORB, TAKE UP & PLACE IN CLSD CONTRS. TRANSPORT
OUTDOORS. VENT AREA & WASH SPILL SITE AFTER MATL PICKUP IS COMPLETE.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN
AFTERBURNER AND SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS
MATERIAL
IS HIGHLY FLAMMABLE. OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL
REGULATIONS.
Precautions-Handling/Storing: KEEP TIGHTLY CLSD. STORE IN A COOL DRY
PLACE. DO NOT BREATHE VAP. AVOID CONT W/EYES/SKIN/CLTHG. IRRITANT.
HARMFUL
VAP. NEUROLOGICAL HAZARD.
Other Precautions: KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.
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Control Measures
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Respiratory Protection: WEAR APPROPRIATE NIOSH/MSHA APPROVED
RESPIRATOR.
Ventilation: USE ONLY IN A CHEMICAL FUME HOOD.
Protective Gloves: CHEMICAL-RESISTANT GLOVES.
Eye Protection: CHEMICAL SAFETY GOGGLES.
Other Protective Equipment: OTHER PROTECTIVE CLOTHING, SAFETY SHOWER
AND
EYE BATH.
Work Hygienic Practices: WASH THOROUGHLY AFTER HANDLING.
Suppl. Safety & Health Data: NONE SPECIFIED BY MANUFACTURER.
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Transportation Data
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Disposal Data
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Label Data
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Label Required: YES
Technical Review Date: 03MAR93
Label Date: 03MAR93
Label Status: G
Common Name: HEXANE ACS GRADE
Chronic Hazard: NO
Signal Word: DANGER!
Acute Health Hazard-Severe: X
Contact Hazard-Slight: X
Fire Hazard-Severe: X

Reactivity Hazard-None: X

Special Hazard Precautions: STORE IN A COOL DRY PLACE. DO NOT BREATHE VAPOR. AVOID CONTACT W/EYES/SKIN/CLTHG. IRRITANT. HARMFUL VAPOR. HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THRU SKIN. VAPOR/MIST IS IRRITATING TO EYES, MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT. CAUSES

COUGHING, CHEST PAINS, DIFFICULTY IN BREATHING, LUNG IRRITATION, CHEST PAIN

& EDEMA WHICH MAY BE FATAL. GI DISTURBANCES, NAUSEA, HEADACHE AND VOMITING.

CHRONIC: NONE LISTED BY MANUFACTURER.

Protect Eye: Y

Protect Skin: Y

Protect Respiratory: Y

Label Name: ALDRICH CHEMICAL CO

Label P.O. Box: 355

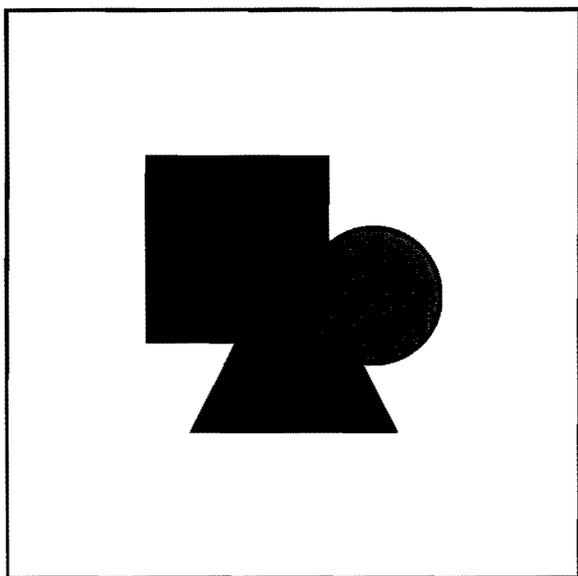
Label City: MILWAUKEE

Label State: WI

Label Zip Code: 53201

Label Country: US

Label Emergency Number: 414-273-3850



Buffer Solution (Biphthalate), pH 4 (Color Coded Red)

MSDS Number: B5641 --- *Effective Date: 09/08/97*

1. Product Identification

Synonyms: None

CAS No.: Not applicable to mixtures.

Molecular Weight: Not applicable to mixtures.

Chemical Formula: Not applicable to mixtures.

Product Codes: 5657

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent
Hazardous		
-----	-----	-----

Water	7732-18-5	97 - 98%
No		
Potassium Acid Phthalate	877-24-7	1 - 2%
Yes		
Propylene Glycol	57-55-6	

3. Hazards Identification

Emergency Overview

CAUTION! MAY CAUSE IRRITATION TO SKIN AND EYES.

J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 0 - None
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Orange (General Storage)

Potential Health Effects

Information on the human health effects from exposure to this substance is limited.

Inhalation:

Not expected to be an inhalation hazard. May cause irritation to respiratory tract because of slight acidity. Symptoms may include coughing and sore throat.

Ingestion:

Large doses may produce nausea, vomiting, and abnormal sensations in hands and feet. Because of slight acidity, causes irritation to the mucous membranes.

Skin Contact:

Contact may cause irritation, with redness and pain.

Eye Contact:

May cause eye irritation.

Chronic Exposure:

No information found.

Aggravation of Pre-existing Conditions:

No information found.

4. First Aid Measures

Inhalation:

Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion:

If large amounts were swallowed, give water to drink and get medical advice.

Skin Contact:

Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention if irritation develops.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention if irritation persists.

5. Fire Fighting Measures

Fire:

Not expected to be a fire hazard.

Explosion:

No information found.

Fire Extinguishing Media:

Use any means suitable for extinguishing surrounding fire.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Contain and recover liquid when possible. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

None established.

Ventilation System:

In general, dilution ventilation is a satisfactory health hazard control for this

substance. However, if conditions of use create discomfort to the worker, a local exhaust system should be considered.

Personal Respirators (NIOSH Approved):

Not expected to require personal respirator usage.

Skin Protection:

Wear protective gloves and clean body-covering clothing.

Eye Protection:

Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Clear, reddish liquid.

Odor:

Odorless.

Solubility:

Completely soluble in water.

Specific Gravity:

No information found.

pH:

4.0

% Volatiles by volume @ 21C (70F):

ca. 98

Boiling Point:

No information found.

Melting Point:

No information found.

Vapor Density (Air=1):

No information found.

Vapor Pressure (mm Hg):

No information found.

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

Carbon dioxide and carbon monoxide may form when heated to decomposition.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

No information found.

Conditions to Avoid:
Heat, incompatibles.

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure.

-----\Cancer Lists\-----

Ingredient Category	---NTP Carcinogen---		IARC
	Known	Anticipated	
Water (7732-18-5) None	No	No	
Potassium Acid Phthalate (877-24-7) None	No	No	
Propylene Glycol (57-55-6) None	No	No	
FD & C Red No. 40 (25956-17-6) None	No	No	

12. Ecological Information

Environmental Fate:
No information found.

Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----

Ingredient	TSCA	EC	Japan
Australia			
Water (7732-18-5)	Yes	Yes	Yes
Potassium Acid Phthalate (877-24-7)	Yes	Yes	Yes
Propylene Glycol (57-55-6)	Yes	Yes	Yes
FD & C Red No. 40 (25956-17-6)	Yes	Yes	No

-----\Chemical Inventory Status - Part 2\-----

Ingredient	Korea	Canada DSL	NDSL
Phil.			
Water (7732-18-5)	Yes	Yes	No
Potassium Acid Phthalate (877-24-7)	Yes	Yes	No
Propylene Glycol (57-55-6)	Yes	Yes	No
FD & C Red No. 40 (25956-17-6)	Yes	Yes	No

-----\Federal, State & International Regulations - Part 1\-----

Ingredient	-SARA 302-	-----SARA	
Chemical Catg.	RQ	TPQ	List
Water (7732-18-5)	No	No	No
Potassium Acid Phthalate (877-24-7)	No	No	No
Propylene Glycol (57-55-6)	No	No	No
FD & C Red No. 40 (25956-17-6)	No	No	No

-----\Federal, State & International Regulations - Part 2\-----

Ingredient	CERCLA	-RCRA-	-
		261.33	8(d)

Water (7732-18-5)	No	No	No
Potassium Acid Phthalate (877-24-7)	No	No	No
Propylene Glycol (57-55-6)	No	No	No
FD & C Red No. 40 (25956-17-6)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
 SARA 311/312: Acute: No Chronic: No Fire: No Pressure: No
 Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: No information found.

Poison Schedule: No information found.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 1 Flammability: 0 Reactivity: 0

Label Hazard Warning:

CAUTION! MAY CAUSE IRRITATION TO SKIN AND EYES.

Label Precautions:

Avoid contact with eyes, skin and clothing.

Keep container closed.

Wash thoroughly after handling.

Label First Aid:

In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Get medical attention if irritation develops or persists.

Product Use:

Laboratory Reagent.

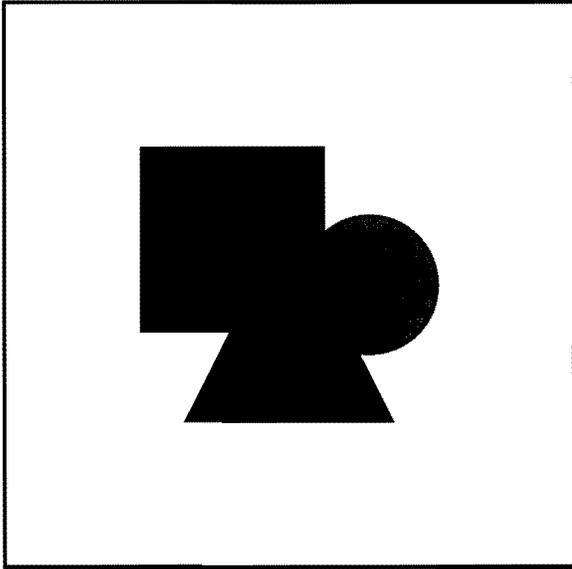
Revision Information:

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RELIANCE UPON THIS INFORMATION.**

Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)



Buffer Solution (Phosphate), pH 7 (Color Coded Yellow)

MSDS Number: B5639 --- *Effective Date: 02/16/98*

1. Product Identification

Synonyms: None

CAS No.: Not applicable to mixtures.

Molecular Weight: Not applicable to mixtures.

Chemical Formula: Not applicable to mixtures.

Product Codes: 5656

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent
Hazardous		
-----	-----	-----

Potassium Phosphate Monobasic	7778-77-0	98%
No		

3. Hazards Identification

Emergency Overview

As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.

J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 0 - None
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Orange (General Storage)

Potential Health Effects

Inhalation:

No adverse health effects via inhalation.

Ingestion:

Not expected to be a health hazard via ingestion. Large oral doses may cause irritation to the gastrointestinal tract.

Skin Contact:

Not expected to be a health hazard from skin exposure. May cause mild irritation and redness.

Eye Contact:

No adverse effects expected. May cause mild irritation, possible reddening.

Chronic Exposure:

No information found.

Aggravation of Pre-existing Conditions:

No information found.

4. First Aid Measures

Inhalation:

Not expected to require first aid measures. Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion:

Not expected to require first aid measures. If large amounts were swallowed, give

water to drink and get medical advice.

Skin Contact:

Not expected to require first aid measures. Wash exposed area with soap and water. Get medical advice if irritation develops.

Eye Contact:

Not expected to require first aid measures. Wash thoroughly with running water. Get medical advice if irritation develops.

5. Fire Fighting Measures

Fire:

Not considered to be a fire hazard.

Explosion:

Not considered to be an explosion hazard.

Fire Extinguishing Media:

Use any means suitable for extinguishing surrounding fire.

Special Information:

Use protective clothing and breathing equipment appropriate for the surrounding fire.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Contain and recover liquid when possible. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

None established.

Ventilation System:

In general, dilution ventilation is a satisfactory health hazard control for this substance. However, if conditions of use create discomfort to the worker, a local exhaust system should be considered.

Personal Respirators (NIOSH Approved):

Not expected to require personal respirator usage.

Skin Protection:

Wear protective gloves and clean body-covering clothing.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible.

Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Yellow liquid.

Odor:

Odorless.

Solubility:

Complete (100%)

Specific Gravity:

No information found.

pH:

7.0

% Volatiles by volume @ 21C (70F):

ca. 98

Boiling Point:

No information found.

Melting Point:

No information found.

Vapor Density (Air=1):

Not applicable.

Vapor Pressure (mm Hg):

Not applicable.

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

Oxides of phosphorus, sodium and carbon may be formed when heated to decomposition.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

No information found.

Conditions to Avoid:

No information found.

11. Toxicological Information

-----\Cancer Lists\-----

Ingredient Category	---NTP Carcinogen---		IARC
	Known	Anticipated	
Potassium Phosphate Monobasic None (7778-77-0)	No	No	
Sodium Phosphate, Dibasic None (7558-79-4)	No	No	
Propylene Glycol (57-55-6) None	No	No	
FD & C Yellow No. 5 (1934-21-0) None	No	No	
Water (7732-18-5) None	No	No	

12. Ecological Information

Environmental Fate:

No information found.

Environmental Toxicity:

No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations.

Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----

Ingredient	TSCA	EC	Japan
Australia			
Potassium Phosphate Monobasic (7778-77-0)	Yes	Yes	Yes
Sodium Phosphate, Dibasic (7558-79-4)	Yes	Yes	Yes
Propylene Glycol (57-55-6)	Yes	Yes	Yes
FD & C Yellow No. 5 (1934-21-0)	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----

Ingredient	Korea	Canada DSL	NDSL
Phil.			
Potassium Phosphate Monobasic (7778-77-0)	Yes	Yes	No
Sodium Phosphate, Dibasic (7558-79-4)	Yes	Yes	No
Propylene Glycol (57-55-6)	Yes	Yes	No
FD & C Yellow No. 5 (1934-21-0)	Yes	Yes	No
Water (7732-18-5)	Yes	Yes	No

-----\Federal, State & International Regulations - Part 1\-----

Ingredient	-SARA 302-	-----SARA	
Chemical Catg.	RQ	TPQ	List
Potassium Phosphate Monobasic (7778-77-0)	No	No	No
Sodium Phosphate, Dibasic (7558-79-4)	No	No	No
Propylene Glycol (57-55-6)	No	No	No
FD & C Yellow No. 5 (1934-21-0)	No	No	No
Water (7732-18-5)	No	No	No

No

-----\Federal, State & International Regulations - Part 2\-----

TSCA-

Ingredient	CERCLA	261.33	8 (d)
Potassium Phosphate Monobasic (7778-77-0)	No	No	No
Sodium Phosphate, Dibasic (7558-79-4)	5000	No	No
Propylene Glycol (57-55-6)	No	No	No
FD & C Yellow No. 5 (1934-21-0)	No	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
 SARA 311/312: Acute: No Chronic: No Fire: No Pressure: No
 Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: None allocated.

Poison Schedule: None allocated.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 0 Flammability: 0 Reactivity: 0

Label Hazard Warning:

As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.

Label Precautions:

None.

Label First Aid:

Not applicable.

Product Use:

Laboratory Reagent.

Revision Information:

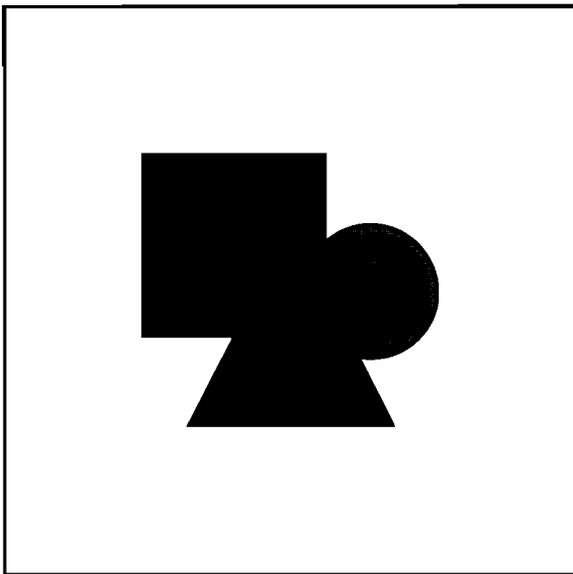
MSDS Section(s) changed since last revision of document include: 3, 4, 5, 6, 7, 10, 16.

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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)



Buffer Solution (Borate), pH 10 (Color Coded Blue)

MSDS Number: B5642 --- *Effective Date: 02/16/98*

1. Product Identification

Synonyms: None

CAS No.: Not applicable to mixtures.

Molecular Weight: Not applicable to mixtures.

Chemical Formula: Not applicable to mixtures.

Product Codes: 5655

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent
Hazardous		

Water	7732-18-5	99%
No		
Boric Acid	10043-35-3	

3. Hazards Identification

Emergency Overview

**DANGER! CORROSIVE. HARMFUL IF SWALLOWED OR INHALED.
CAUSES BURNS TO ANY AREA OF CONTACT.**

J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate

Flammability Rating: 0 - None

Reactivity Rating: 0 - None

Contact Rating: 2 - Moderate

Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER
GLOVES

Storage Color Code: Orange (General Storage)

Potential Health Effects

The health effects from exposure to diluted forms of this chemical are not well documented. They are expected to be less severe than those for concentrated forms which are referenced in the descriptions below.

Inhalation:

Respiratory tract irritant, may cause serious burns on acute contact. Severe injury is usually avoided by the self-limiting coughing and sneezing symptoms.

Ingestion:

Toxic! Corrosive to mucous membranes and may cause perforation of the esophagus and stomach. Abdominal pain, nausea, vomiting, general gastrointestinal upset can be expected.

Skin Contact:

Irritant, possibly corrosive if contact is prolonged. Soreness, redness, destruction of skin may result.

Eye Contact:

Irritant, possibly corrosive to eye tissues. Tearing, redness, pain, impaired vision are symptoms.

Chronic Exposure:

Development of a defatting dermatitis on prolonged contact with potassium hydroxide has been reported. Continued irritation may lead to increased susceptibility to respiratory illness.

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders or eye problems, or impaired kidney or respiratory function may be more susceptible to the effects of the substance.

4. First Aid Measures

First aid procedures given apply to concentrated solutions. Exposures to dilute solutions may not require these extensive first aid procedures.

Inhalation:

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

Ingestion:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:

Not considered to be a fire hazard.

Explosion:

Sealed containers may rupture when heated.

Fire Extinguishing Media:

Use any means suitable for extinguishing surrounding fire.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Contain and recover liquid when possible. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container. Store in a cool, dry, ventilated area. Protect against physical damage. Separate from acids and alkalis. Protect from freezing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

For Potassium Hydroxide [1310-58-3]:

- ACGIH Threshold Limit value (TLV):

2 mg/m³ Ceiling

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, a half-face dust/mist respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece dust/mist respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. **WARNING:** Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

Blue liquid.

Odor:

Odorless.

Solubility:

Complete (100%)

Specific Gravity:

No information found.

pH:

10

% Volatiles by volume @ 21C (70F):

ca. 99 (as water)

Boiling Point:

No information found.

Melting Point:

No information found.

Vapor Density (Air=1):

No information found.

Vapor Pressure (mm Hg):

No information found.

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

Potassium oxide at very high temperatures.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Acids.

Conditions to Avoid:

Incompatibles.

11. Toxicological Information

For potassium hydroxide: Oral rat LD50: 273 mg/kg; Investigated as a mutagen.

Skin Irritation Data (std Draize, 50 mg/24 H): Human, Severe; Rabbit, Severe.

Eye Irritation Data(Rabbit, non-std test,1 mg/24 H, rinse): Moderate.

-----\Cancer Lists\-----

Ingredient Category	---NTP Carcinogen---		IARC
	Known	Anticipated	
Water (7732-18-5)	No	No	

None			
Boric Acid (10043-35-3)	No	No	
None			
Potassium Hydroxide (1310-58-3)	No	No	
None			
C.I. Acid Blue 9 Disodium Salt (3844-45-9)	No	No	3
Citric Acid (77-92-9)	No	No	
None			
Sodium Benzoate (532-32-1)	No	No	
None			
Propylene Glycol (57-55-6)	No	No	
None			
FD & C Red No. 40 (25956-17-6)	No	No	
None			
Propyl Paraben (94-13-3)	No	No	
None			

12. Ecological Information

Environmental Fate:

No information found.

Environmental Toxicity:

Potassium Hydroxide: TLm: 80 ppm/Mosquito fish/ 24 hr./ Fresh water

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements.

Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

-----\Chemical Inventory Status - Part 1\-----			
Ingredient	TSCA	EC	Japan
Australia			

----- Water (7732-18-5) Yes	Yes	Yes	Yes
Boric Acid (10043-35-3) Yes	Yes	Yes	Yes
Potassium Hydroxide (1310-58-3) Yes	Yes	Yes	Yes
C.I. Acid Blue 9 Disodium Salt (3844-45-9) Yes	Yes	Yes	Yes
Citric Acid (77-92-9) Yes	Yes	Yes	Yes
Sodium Benzoate (532-32-1) Yes	Yes	Yes	Yes
Propylene Glycol (57-55-6) Yes	Yes	Yes	Yes
FD & C Red No. 40 (25956-17-6) Yes	Yes	Yes	No
Propyl Paraben (94-13-3) Yes	Yes	Yes	Yes

-----\Chemical Inventory Status - Part 2\-----

Ingredient Phil.	Korea	--Canada--	
		DSL	NDSL
-----	-----	-----	-----
Water (7732-18-5) Yes	Yes	Yes	No
Boric Acid (10043-35-3) Yes	Yes	Yes	No
Potassium Hydroxide (1310-58-3) Yes	Yes	Yes	No
C.I. Acid Blue 9 Disodium Salt (3844-45-9) Yes	Yes	Yes	No
Citric Acid (77-92-9) Yes	Yes	Yes	No
Sodium Benzoate (532-32-1) Yes	Yes	Yes	No
Propylene Glycol (57-55-6) Yes	Yes	Yes	No
FD & C Red No. 40 (25956-17-6) Yes	Yes	Yes	No
Propyl Paraben (94-13-3) Yes	Yes	Yes	No

-----\Federal, State & International Regulations - Part 1\-----

313----- Ingredient Chemical Catg.	-SARA 302-		-----SARA
	RQ	TPQ	List
-----	-----	-----	-----
Water (7732-18-5) No	No	No	No
Boric Acid (10043-35-3)	No	No	No

No	Potassium Hydroxide (1310-58-3)	No	No	No
No	C.I. Acid Blue 9 Disodium Salt (3844-45-9)	No	No	No
No	Citric Acid (77-92-9)	No	No	No
No	Sodium Benzoate (532-32-1)	No	No	No
No	Propylene Glycol (57-55-6)	No	No	No
No	FD & C Red No. 40 (25956-17-6)	No	No	No
No	Propyl Paraben (94-13-3)	No	No	No

-----\Federal, State & International Regulations - Part 2\-----

		-RCRA-	-
TSCA-			
Ingredient	CERCLA	261.33	8(d)
-----	-----	-----	-----
Water (7732-18-5)	No	No	No
Boric Acid (10043-35-3)	No	No	No
Potassium Hydroxide (1310-58-3)	1000	No	No
C.I. Acid Blue 9 Disodium Salt (3844-45-9)	No	No	No
Citric Acid (77-92-9)	No	No	No
Sodium Benzoate (532-32-1)	No	No	No
Propylene Glycol (57-55-6)	No	No	No
FD & C Red No. 40 (25956-17-6)	No	No	No
Propyl Paraben (94-13-3)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
 SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
 Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: None allocated.

Poison Schedule: None allocated.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0

Label Hazard Warning:

DANGER! CORROSIVE. HARMFUL IF SWALLOWED OR INHALED.

CAUSES BURNS TO ANY AREA OF CONTACT.

Label Precautions:

- Do not breathe mist.
- Do not get in eyes, on skin, or on clothing.
- Keep container closed.
- Use only with adequate ventilation.
- Wash thoroughly after handling.

Label First Aid:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 16.

Disclaimer:

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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

GEORGIA STEEL & CHEMICAL -- FK300 SPECIAL RESPIRATOR CLEANER PLUS --
QUATERNARY AMMONIUM GERMICIDAL DETERGENT DISINFECTANT
MATERIAL SAFETY DATA SHEET

NSN: 685000F046838

Manufacturer's CAGE: 3J051

Part No. Indicator: A

Part Number/Trade Name: FK300 SPECIAL RESPIRATOR CLEANER PLUS

=====
=====

General Information

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=====

Item Name: QUATERNARY AMMONIUM GERMICIDAL DETERGENT DISINFECTANT

Company's Name: GEORGIA STEEL & CHEMICAL CO INC

Company's Street: 10810 GUILFORD RD BAY 104

Company's City: ANNAPOLIS JUNCTION

Company's State: MD

Company's Country: US

Company's Zip Code: 20701-5000

Company's Emerg Ph #: 301-317-5502/800-296-0351

Company's Info Ph #: 800-296-0351/301-317-5502

Record No. For Safety Entry: 001

Tot Safety Entries This Stk#: 001

Status: SE

Date MSDS Prepared: 01JAN96

Safety Data Review Date: 31MAY96

Preparer's Company: GEORGIA STEEL & CHEMICAL CO INC

Preparer's St Or P. O. Box: 10810 GUILFORD RD BAY 104

Preparer's City: ANNAPOLIS JUNCTION

Preparer's State: MD

Preparer's Zip Code: 20701-5000

MSDS Serial Number: BYNPW

=====
=====

Ingredients/Identity Information

=====
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Proprietary: NO

Ingredient: QUATERNARY AMMONIUM COMPOUNDS, BENZYL-C12-18-ALKYLDIMETHYL,
CHLORIDES *96-1*

Ingredient Sequence Number: 01

Percent: 5-10

NIOSH (RTECS) Number: 1001813QA

CAS Number: 68391-01-5

Proprietary: NO

Ingredient: OCTYL DECYL DIMETHYL AMMONIUM CHLORIDE; N,N-DIMETHYL-N-
OCTYL-

1-DECANAMINIUM CHLORIDE; AMMONIUM, DECYLDIMETHYLOCTYL

Ingredient Sequence Number: 02

Percent: 1-5

NIOSH (RTECS) Number: HD6520000

CAS Number: 32426-11-2

Proprietary: NO

Ingredient: DIDECYL DIMETHYL AMMONIUM CHLORIDE; DIMETHYLDIDECYLAMMONIUM
CHLORIDE; BTC 1010; BARDAC 22

Ingredient Sequence Number: 03
Percent: 1-5
NIOSH (RTECS) Number: BP6560000
CAS Number: 7173-51-5

Proprietary: NO
Ingredient: DIDECYL DIMETHYL AMMONIUM CHLORIDE
Ingredient Sequence Number: 04
Percent: 1-5
NIOSH (RTECS) Number: RG8250000
CAS Number: 5538-94-3

=====
=====
Physical/Chemical Characteristics
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Appearance And Odor: CLEAR BLUE LIQUID W/A PLEASANT SASSAFRAS ODOR.
Boiling Point: 212F
Vapor Pressure (MM Hg/70 F): AS WATER
Specific Gravity: 1.01
Evaporation Rate And Ref: (WATER =1): 1
Solubility In Water: COMPLETE
=====

=====
Fire and Explosion Hazard Data
=====

=====
Flash Point: NONE TO BOILING
Flash Point Method: TCC
Special Fire Fighting Proc: NONE
Unusual Fire And Expl Hazrds: NONE
=====

=====
Reactivity Data
=====

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Stability: YES
Cond To Avoid (Stability): DON'T MIX W/CLEANING CHEMICALS.
Materials To Avoid: STRONG OXIDIZING/REDUCING AGENTS.
Hazardous Decomp Products: AMMONIA, NITROGEN OXIDES.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NONE
=====

=====
Health Hazard Data
=====

=====
Route Of Entry - Inhalation: NO
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
IRRITATION TO MUCOUS MEMBRANES. INGESTION: SEVERE IRRITATION TO MOUTH,
THROAT, GI TRACT, CIRCULATORY SHOCK & RESPIRATORY DEPRESSION.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NONE
Signs/Symptoms Of Overexp: REDNESS, TEARING, IRRITATION, BURNING IN

MOUTH,
THROAT, ABDOMEN, CIRCULATORY SHOCK, CONVULSIONS.
Med Cond Aggravated By Exp: DERMATITIS.
REMOVE TO FRESH AIR. SKIN: WASH W/MILD SOAP & WATER. OBTAIN MEDICAL
ATTENTION IN ALL CASES. INGESTION: DON'T INDUCE VOMITING. GIVE PROMPTLY
LARGE QUANTITIES OF EGG WHITES/GELATIN SOLUTION. IF UNAVAILABLE, DRINK
LARGE QUANTITIES OF WATER. AVOID ALCOHOL. OBTAIN MEDICAL ATTENTION IN
ALL
CASES. NOTE TO PHYSICIAN: (SEE SUPP)

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=====
Precautions for Safe Handling and Use
=====

=====
Steps If Matl Released/Spill: MOP UP/ABSORB/USE SOLID ABSORBENT &
SHOVEL
INTO CONTAINERS FOR DISPOSAL.
Waste Disposal Method: DISPOSE OF IAW/FEDERAL, STATE & LOCAL
REGULATIONS.
Precautions-Handling/Storing: KEEP CONTAINER CLOSED WHEN NOT IN USE.
DON'T
REUSE EMPTY CONTAINER.
Other Precautions: KEEP AWAY FROM FOOD & WATER SUPPLIES. OPEN DUMPING
IS
PROHIBITED.

=====
=====
Control Measures
=====

=====
Ventilation: MECHANICAL (GENERAL) IS SUFFICIENT
Protective Gloves: RUBBER/NEOPRENE
Eye Protection: GOGGLES
Other Protective Equipment: NONE
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=====
Transportation Data
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Disposal Data
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Label Data
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=====
Label Required: YES
Label Status: G
Common Name: FK300 SPECIAL RESPIRATOR CLEANER
MAY CAUSE IRRITATION OF LUNGS & AIRWAYS. IRRITATION, STOMACH DISTRESS.
Label Name: GEORGIA STEEL & CHEMICAL CO INC
Label Street: 10810 GUILFORD RD BAY 104
Label City: ANNAPOLIS JUNCTION
Label State: MD

Label Zip Code: 20701-5000

Label Country: US

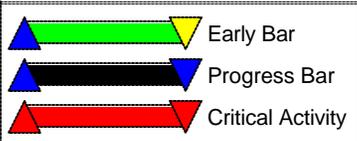
Label Emergency Number: 301-317-5502/800-296-0351

Appendix B

Project Schedule

Activity ID	WBS CHARGE #	% Comp	Activity Description	Orig Dur	Rem Dur	Early Start	Early Finish	Cost to Date	Cost to Complete	Cost at Completion	Budgeted Cost	Cost Variance
CTO #0030 - 154917 - DITCH REMEDIATION												
Subtotal		81		834	71	24AUG99A	11DEC02	71,674.87	343,978.90	415,653.77	410,679.00	-4,974.77
PHASE 1												
Subtotal		100		587	0	24AUG99A	20DEC01A	10,663.59	0.00	10,663.59	18,140.00	7,476.41
PHASE 1B												
Subtotal		100		587	0	24AUG99A	20DEC01A	10,663.59	0.00	10,663.59	18,140.00	7,476.41
FUNDING AUTHORIZATION												
A3 150000	15.01.02.00	100	Project Authorization	0	0	24AUG99A		0.00	0.00	0.00	0.00	0.00
CTO SETUP/SITE VISIT												
A315010290	15.01.02.90	100	CTO SETUP	1	0	24AUG99A	24AUG99A	146.14	0.00	146.14	83.38	-62.76
A315010291	15.01.02.91	100	Site Visit Prep/Tech Review	2	0	25AUG99A	25AUG99A	0.00	0.00	0.00	1,837.61	1,837.61
A315010292	15.01.02.92	100	Site Visit	3	0	25AUG99A	25AUG99A	0.00	0.00	0.00	6,482.37	6,482.37
A315010000		100	Submit Remedial Technology Evaluation	1	0	26AUG99A	26AUG99A	0.00	0.00	0.00	0.00	0.00
A315010293	15.01.02.93	100	TECHNOLOGY MEETINGS	60	0	04MAY00A	20DEC01A	1,560.81	0.00	1,560.81	8,539.00	6,978.19
A315010294	15.01.02.94	100	TECHNOLOGY REVIEW	60	0	04MAY00A	20DEC01A	8,956.64	0.00	8,956.64	1,197.64	-7,759.00
PHASE 2												
Subtotal		99		91	3	26APR02A	04SEP02	11,044.62	0.00	11,044.62	23,650.00	12,605.38
PHASE 2												
Subtotal		99		91	3	26APR02A	04SEP02	11,044.62	0.00	11,044.62	23,650.00	12,605.38
COST PROPOSAL PREPARATION												
A320010326	20.01.03.26	100	DEVELOP COST ESTIMAT	25	0	26APR02A	31MAY02A	1,849.07	0.00	1,849.07	23,650.00	21,800.93
A320010327		100	Submit Cost Proposal to Client	0	0		31MAY02A	0.00	0.00	0.00	0.00	0.00
A3 20187		100	Negotiate CTO with Client	1	0	26JUL02A	26JUL02A	0.00	0.00	0.00	0.00	0.00
A3 20199		100	Submit Final/Negotiated Estimate/Schedule	1	0	26JUL02A	26JUL02A	0.00	0.00	0.00	0.00	0.00
BID PACKAGE PREP/AWARD												
A320010391	20.01.03.91	100	PREPARE BID PACKAGES	10	0	24MAY02A	14JUN02A	655.04	0.00	655.04	0.00	-655.04
A3 20150		100	Issue RFB to Subcontractors	0	0		17JUN02A	0.00	0.00	0.00	0.00	0.00
A320010392	20.01.03.92	100	SUB PRE-BID MEETING	0	0	25JUN02A	25JUN02A	1,332.93	0.00	1,332.93	0.00	-1,332.93
A3 20165		100	Subcontractor Bids Due	0	0		28JUN02A	0.00	0.00	0.00	0.00	0.00
A320010393	20.01.03.93	100	Evaluate Bid Packages	4	0	12AUG02A	15AUG02A	1,011.82	0.00	1,011.82	0.00	-1,011.82
WORK PLANS PREPARATION												
A320010301	20.01.03.01	100	SAMPLING & ANALYSIS	29	0	29APR02A	26JUN02A	433.06	0.00	433.06	0.00	-433.06

Start Date 28AUG99
Finish Date 11DEC02
Data Date 30AUG02
Run Date 11SEP02 08:24



NFAC - C030 Sheet 1 of 3

**Dioxin Contam Ditch Soil, Gulfport
CTO COMPLETION SCHEDULE
NAVY RAC SOUTHERN DIVISION**



Activity ID	WBS CHARGE #	% Comp	Activity Description	Orig Dur	Rem Dur	Early Start	Early Finish	Cost to Date	Cost to Complete	Cost at Completion	Budgeted Cost	Cost Variance
A320010304	20.01.03.04	100	Environmental Protection Plan	29	0	29APR02A	26JUN02A	0.00	0.00	0.00	0.00	0.00
A320010306	20.01.03.06	100	Pollution Control Plan	29	0	29APR02A	26JUN02A	0.00	0.00	0.00	0.00	0.00
A320010308	20.01.03.08	100	SITE SPECIFIC H & S	29	0	29APR02A	26JUN02A	1,121.00	0.00	1,121.00	0.00	-1,121.00
A320010313	20.01.03.13	100	GENERAL SITE WORK	29	0	29APR02A	26JUN02A	4,047.23	0.00	4,047.23	0.00	-4,047.23
A320010314	20.01.03.14	100	QUALITY CONTROL PLAN	29	0	29APR02A	26JUN02A	594.47	0.00	594.47	0.00	-594.47
A320010315	20.01.03.15	100	Transportation & Disposal Plan	29	0	29APR02A	26JUN02A	0.00	0.00	0.00	0.00	0.00
A320010390	20.01.03.90	100	Hazardous Waste Mgmt Plan	29	0	29APR02A	26JUN02A	0.00	0.00	0.00	0.00	0.00
A3 20185		0	Southern Division WP Comment Period	10	1	26JUN02A	30AUG02	0.00	0.00	0.00	0.00	0.00
A3 20290		100	Submit Draft Work Plans	0	0		26JUN02A	0.00	0.00	0.00	0.00	0.00
A3 20190		0	Incorporate WP Comments	4	1	26AUG02A	30AUG02	0.00	0.00	0.00	0.00	0.00
A3 2035		0	Work Plan Approval Received	0	0		04SEP02	0.00	0.00	0.00	0.00	0.00
A3 20191		0	Submit Final WP to Southern Division	0	0		04SEP02	0.00	0.00	0.00	0.00	0.00
PHASE COMPLETE												
A3 20250		0	Phase II Complete	0	0		04SEP02	0.00	0.00	0.00	0.00	0.00
PHASE 3												
Subtotal		72		817	71	17SEP99A	11DEC02	49,966.66	343,978.90	393,945.56	368,889.00	-25,056.56
DIOXIN CONTAMINATED DITCH SOIL EXCAVATION												
Subtotal		72		817	71	17SEP99A	11DEC02	49,966.66	343,978.90	393,945.56	368,889.00	-25,056.56
PROJECT MANAGEMENT												
A399220101	99.22.01.01	90	PROJECT MANAGEMENT	629	65	17SEP99A	03DEC02	48,824.29	9,347.71	58,172.00	34,257.81	-23,914.19
A399220111	99.22.01.11	100	State taxes	1	0	29DEC00A	29DEC00A	0.00	0.00	0.00	0.00	0.00
SUBCONTRACTING												
A331010394	31.01.03.94	100	Submit Subcontractor Plans & Submittals	10	0	15AUG02A	22AUG02A	0.00	2,672.50	2,672.50	2,672.50	0.00
A3 20188		100	Issue Letter of Intent to Award	0	0		15AUG02A	0.00	0.00	0.00	0.00	0.00
A3 20180		100	Subcontractor Plans Due	0	0		22AUG02A	0.00	0.00	0.00	0.00	0.00
A331010395	31.01.03.95	100	Review Subcontractor Plans & Submittals	5	0	23AUG02A	23AUG02A	0.00	1,872.46	1,872.46	1,872.46	0.00
A3 20210		100	Award Subcontracts	0	0		23AUG02A	0.00	0.00	0.00	0.00	0.00
MOBILIZATION & PREPARATORY WORK												
A331221209	31.22.12.09	100	Bond (Subcontractor)	1	0	26AUG02A	26AUG02A	0.00	5,986.40	5,986.40	5,986.40	0.00
A331010292	31.01.02.92	0	Subcontractor Mobilization	2	2	16SEP02	17SEP02	0.00	5,024.30	5,024.30	5,024.30	0.00
A399010291	99.01.02.91	0	CCI Mobilization	2	2	16SEP02*	17SEP02	0.00	3,327.46	3,327.46	3,327.46	0.00
A39901	99.01.02.90	0	CTO Kick-Off Meeting	1	1	16SEP02	16SEP02	0.00	712.81	712.81	712.81	0.00
A399010290	99.01.02.90	0	Pre-Construction Meeting	1	1	16SEP02	16SEP02	441.91	712.81	1,154.72	712.81	-441.91
A399010401	99.01.04.01	0	Initiate Job-Site Presence	1	1	16SEP02	16SEP02	0.00	3,902.99	3,902.99	3,902.99	0.00
CONTAMINATED SOIL EXCAVATION & BACKFILL												
A331031104	31.03.11.04	0	Ditch Rock Dam/Filter	1	1	17SEP02	17SEP02	0.00	19,242.00	19,242.00	19,242.00	0.00
A331080191	31.08.01.91	0	Excavation of Contaminated Soils	14	14	18SEP02	07OCT02	0.00	132,876.70	132,876.70	132,876.70	0.00
A3310801		0	Excavation of Contaminated Soils Complete	0	0		07OCT02	0.00	0.00	0.00	0.00	0.00
SAMPLING & ANALYSIS												
A331020905	31.02.09.05	100	Clean Backfill Analysis	16	0	15AUG02A	06SEP02A	0.00	1,950.93	1,950.93	1,950.93	0.00

Activity ID	WBS CHARGE #	% Comp	Activity Description	Orig Dur	Rem Dur	Early Start	Early Finish	Cost to Date	Cost to Complete	Cost at Completion	Budgeted Cost	Cost Variance
A331020601	31.02.06.01	0	Excavation Sampling	15	15	17SEP02	07OCT02	401.74	11,770.98	12,172.72	11,770.98	-401.74
A331020903	31.02.09.03	0	Confirmation Analysis	41	41	17SEP02	12NOV02	0.00	32,070.00	32,070.00	32,070.00	0.00
A331021490	31.02.14.90	0	Independent Data Validation	4	4	12NOV02	15NOV02	0.00	7,483.00	7,483.00	7,483.00	0.00
A331021491	31.02.14.91	0	Data Evaluation and Management	8	8	12NOV02	21NOV02	298.72	4,588.63	4,887.35	4,588.63	-298.72
TRANSPORTATION AND DISPOSAL												
A331182101	31.18.21.01	0	Transport to Storage Area	15	15	17SEP02	07OCT02	0.00	6,414.00	6,414.00	6,414.00	0.00
SITE RESTORATION												
A331200193	31.20.01.93	0	Backfill with Off/Site Material	4	4	08OCT02	11OCT02	0.00	52,915.50	52,915.50	52,915.50	0.00
A331200591	31.20.05.91	0	Removal of Gravel Dams	1	1	08OCT02	08OCT02	0.00	6,414.00	6,414.00	6,414.00	0.00
A331200402	31.20.04.02	0	Sodding	1	1	14OCT02	14OCT02	0.00	21,430.78	21,430.78	21,430.78	0.00
A331210591	31.21.05.91	0	Subcontractor Demobilization	1	1	21OCT02	21OCT02	0.00	2,084.55	2,084.55	2,084.55	0.00
A399210590	99.21.05.90	0	CCI Demobilization	1	1	21OCT02	21OCT02	0.00	3,038.83	3,038.83	3,038.83	0.00
POST CONSTRUCTION												
A331220410	31.22.04.10	0	Surveying (As-builts)	22	22	16SEP02	15OCT02	0.00	4,276.00	4,276.00	4,276.00	0.00
A331210607	31.21.06.07	0	Prepare Construction Documentation Report	30	30	29OCT02	11DEC02	0.00	3,863.56	3,863.56	3,863.56	0.00
A3312106		0	Submit Construction Documentation Report	0	0		11DEC02	0.00	0.00	0.00	0.00	0.00
CTO COMPLETE												
A3 300		0	Project Complete	0	0		11DEC02	0.00	0.00	0.00	0.00	0.00

Appendix C

Verification of Soil Remediation Guidance Michigan Department of Environmental Quality



WASTE MANAGEMENT DIVISION

GUIDANCE DOCUMENT

VERIFICATION OF SOIL REMEDIATION

ENVIRONMENTAL RESPONSE DIVISION

WASTE MANAGEMENT DIVISION

APRIL 1994, Revision 1

PLEASE NOTE: STATISTICAL TABLES MAY NOT PRINT COMPLETELY WHEN THIS DOCUMENT IS PRINTED AND SHOULD BE USED AS A REFERENCE ONLY. TO ASSURE THAT THE TABLES ARE ACCURATE, PLEASE REQUEST A PAPER COPY OF THIS DOCUMENT. Additionally, this HTML encoded version of the VSR document will only be accurately displayed with browsers that can support tables, superscripted and subscripted characters (i.e. Internet Explorer 3.0 and Netscape 3.0).

EXECUTIVE SUMMARY

The document provides guidance for sampling soils to verify that soil contamination has been remediated to Type A or Type B criteria in accordance with Act 307 P.A. 1982, as amended. This document is not designed to either guide investigations to determine whether a release has occurred or the nature and extent of an identified release, nor to guide due diligence by a potential property owner. Issuance of this guidance document does not invalidate remedial action plans (RAPS) or clean-ups previously conducted and approved by the DNR.

Soil sampling and analyses to verify that site remediation is complete can result in two basic errors.

- Declaring a site clean when it is contaminated
- Declaring a site contaminated when it is clean

A soil sampling plan submitted to the DNR must minimize these errors. The guidance document

presents acceptable methods for verifying soil remediation. It contains guidance on soil sampling protocols and documentation necessary to characterize and verify cleanup of contaminated soils. The document provides recommended procedures for establishing soil background concentrations, sampling grids, chemical constituent evaluations, statistical comparisons, verifying excavation and in-situ and ex-situ remedies, evaluating treated soils, and soil characterization. The recommended procedures are **not absolutes**. Other methods are available to verify soil remediation. The Department of Natural Resources will evaluate other sampling and statistical strategies on a case-by-case basis.

The guidance document is divided into two parts:

- **Part 1** contains guidance for small site cleanup verification (less than 10,890 square feet--<0.25 acre). It is a "biased" sampling strategy recommending soil sampling from areas most likely to contain contamination.
- **Part 2** contains guidance for soil characterization and cleanup verification of medium and large sites (greater than 10,890 square feet-->0.25 acre). It is a statistical random sampling strategy that minimizes biases in sampling.

Both sampling strategies require discrete soil samples. Compositing samples for cleanup verification is not accepted without prior DNR approval.

The guidance document contains verification checklists and reporting sections. The reporting sections should be carefully followed in reporting sampling rationale.

Reader's Note: Questions regarding this guidance document should be directed to Department staff you are currently working with for your project or site.

APRIL 94, Revision 1

TABLE OF CONTENTS--DNR GUIDANCE DOCUMENT

VERIFICATION OF SOIL REMEDIATION

PART 1--Small Site Soil Cleanup Verification, Introduction 1

Verifying Excavation Remedies 2-4

Sample Locations 2

Number of Samples 3-4

Number of Excavation Floor Samples 3

Number of Excavation Sidewall Samples 3-4

Verifying In-Situ and Ex-Situ Soil Remedies 4

Sample Analysis 4

Background Soil Samples 5-8

Establishing Soil Background 5

Statistical Analysis for Establishing Background Concentrations 6-8

1. *Mean Plus 3 Standard Deviation Approach* 6-7

2. *Other Statistical Procedures for Establishing Background* 8

Procedures for Non-Detect Values 8

Report for Small Site Verification 9

TABLE OF CONTENTS--DNR GUIDANCE DOCUMENT

VERIFICATION OF SOIL REMEDIATION

PART 2--Medium and Large Site Soil Cleanup Verification, Introduction 10

Establishing Grid Interval 11-14

1. *Basic Strategies* 11-12

2. *Setting the Grid* 12

3. *Variations on Basic Strategy* 13-14

Sampling of Grid 14

Establishing Soil Background 14-15

Statistical Analysis for Establishing Background Concentrations 15-18

1. *Mean Plus 3 Standard Deviation Approach* 15-17

2. *Tolerance Limit* 17

3. *t-tests* 18

4. *Other Statistical Procedures for Establishing Background* 18

Procedures for Non-Detect Values 18

Statistical Evaluation of Data 18

Grid Approach to Additional Remediation 19

Two-Dimensional Node Sampling Excavation Grid 19

Two-Dimensional Subcell Sampling Excavation Grid 19

Three-Dimensional Cleanup Verification 19

Batch Sampling for Ex-Situ Treatment Processes 19

Disposal Options 20

Report for Medium & Large Site Verification 20

RCRA Clean Closure Certification Checklist 20

Cited References 42

ATTACHMENTS--DNR GUIDANCE DOCUMENT

VERIFICATION OF SOIL REMEDIATION

attachment attachment page #
#

1 Guide to Sample Bias 21-22

2 Sampling Protocol for Characterizing

Waste/Treatment Levels 23-38

Strategies for Evaluating Treated

Soils and Waste Materials 23

Statistical Sampling Strategies 24

Random Numbers Table 25-27

Sampling Grids 28

Statistical Evaluation of Waste/Treatment Characterization Samplings ...29-31

Example: Calculation of Confidence Limits & Lamda Calculation 32-34

Table: Cumulative t Distribution 35

Table: Number of Observations for t test of Mean 36

Sampling Process Streams 37

Random Time Waste Sampling Example 38

3 Tolerance Factors (K): [NTIS Document PB89151047, Table 5] 39

4 Waste Management Division's Clean Closure Certification Checklist 40-41

DNR--GUIDANCE DOCUMENT, PART 1

SMALL SITE SOIL CLEANUP VERIFICATION (LESS THAN 10,890 SQUARE FEET)

Part 1 of this document is a guide for a biased sampling strategy to verify that soil contamination has been remediated at sites no greater than 0.25 acres (small sites). Soil sampling and analyses to verify that a site remediation is complete can result in two basic errors.

- Declaring a site clean when it is contaminated
- Declaring a site contaminated when it is clean

A soil sampling plan submitted to the DNR must minimize these errors. Part 1 presents a biased sampling method of verifying soil remediation at small sites. The biased sampling approach specified in this guidance recommends soil sampling from areas most likely to still exceed cleanup criteria. The location of the soil sample points relies on a site specific analysis of the released or contaminant distribution and the soil types encountered. The remediation is verified using a point by point comparison of sample values with the appropriate cleanup criteria. If the cleanup criteria are exceeded at any sampled point, the biased sampling methodology may require additional remediation at that point until the criteria are met. Verification of cleanup utilizing the biased approach should generally require fewer samples to demonstrate attainment than by using the unbiased approach. DNR will evaluate other sampling and statistical strategies on a case-by-case basis.

Any biased sampling plan, whether presented in the guidance document or some other geostatistical approach, requires professional judgment. Therefore, documentation and the rationale used to select sample locations are extremely important. The report section (page 9) of this guidance document should be carefully followed.

Compositing samples for verifying soil remediation is not acceptable without prior DNR approval. When verifying a soil remediation is complete, contaminant concentrations will be low. Compositing may result in the contaminant concentrations not being representative of what remains in the soil. If concentrations are low, compositing may dilute the concentrations of a contaminant to below its threshold detection limit. Additionally, if contamination is indicated in a composited sample, the location of the contamination remains unknown.

Part 1 is divided into five main sections: Verifying Excavation Remedies, Verifying In-Situ and Ex-Situ Soil Remedies, Sample Analysis, Background Soil Samples, and Reports. The excavation and in-situ remediations require different strategies for verification. Guidance is presented for statistically determining background concentrations of compounds/contaminants. Guidance for reporting all appropriate information is presented to facilitate remediation approval.

-1-

VERIFYING EXCAVATION REMEDIES

Verifying that contaminated soil is remediated by means of excavation requires samples from the excavation bottom and sidewalls. Tables and formulas presented provide the minimum number of samples necessary to verify cleanup for various size excavations. The biased approach specified in this guidance recommends soil sampling from areas most likely to still exceed cleanup criteria. The location of the sample collection points relies on site specific analysis of the release or contaminant distribution and the soil types encountered in the excavation. The minimum number of excavation floor and sidewall samples required to demonstrate verification using a point by point comparison with the cleanup criteria are specified. If the cleanup criteria are exceeded at any point, this verification methodology may require additional excavation at that point until the criteria are attained.

Sampling and analyzing the locations most likely to have contaminants can minimize the number of samples needed to verify remediation is complete. Since professional judgment and site specific knowledge are required for selecting sampling locations, the rationale used to select these locations must be documented in the verification report.

SAMPLE LOCATIONS

Using a biased sampling approach, samples must be collected where they will most likely encounter contamination which could exceed the cleanup criteria. This will minimize the number of samples needed to verify a site is remediated. A sampling strategy that uses bias to choose sample locations is recommended. While it is inappropriate for this guidance document to dictate exact locations for sample collection in this strategy, site specific information (e.g., the location of leaks in an underground storage tank or its piping) from the remedial investigation concerning the release and soil conditions should be used along with professional judgment and the general guidance provided here to select appropriate soil sampling locations.

EXAMPLE: It would be incorrect to sample the north side of an excavation pit as extensively as the south side when the leak was confirmed on the south side of the tank.

Because a site must be remediated to a certain degree before approval can be considered, an analysis of data generated by a prior investigation should yield information for the verification analysis. The field personnel present during remediation should be sufficiently familiar with the conditions on-site to implement an appropriate verification strategy. A soil verification strategy should incorporate all pertinent biases of a site which may include, but are not limited to, those listed below.

- preferential pathways of contaminant migration
- source areas
- stained soils

- other site specific "clues" (e.g., fractures in clays)
- changes in soil characteristics (e.g., sand/clay interfaces)
- soil types and characteristics

-2-

NUMBER OF SAMPLES

The following tables are used to determine the minimum number of samples necessary from the floor and sidewalls of an excavation no greater than 0.25 acres using a biased sampling approach. If the area of the excavation floor exceeds 10,890 square feet, use Part 2 of this guidance document. A site may have an appropriate number of samples collected for verification, but, if the samples are not collected from the appropriate locations (discussed previously) and adequately reported, remediation may not be considered adequate. All sample locations must be accurately located, described, and reported. It should be noted that "excavation" as used here refers only to that area excavated for remediation purposes and being verified to meet Type A/Type B cleanup criteria.

Number of Excavation Floor Samples

Determine the minimum number of excavation floor samples from the table below.

TABLE 1	
EXCAVATION FLOOR SAMPLES	
<i>Area of Floor (sq ft)</i>	<i>Number of Samples</i>
< 500	2
500 < 1,000	3
1,000 < 1,500	4
1,500 < 2,500	5
2,500 < 4,000	6
4,000 < 6,000	7
6,000 < 8,500	8
8,500 < 10,890	9

Number of Excavation Sidewall Samples

Sidewall samples are required to verify that the horizontal extent of contamination has been remediated. Use Table 2 to determine the minimum number of required sidewall samples. In no case is less than one sample on each sidewall (i.e., four) acceptable. In the case of irregularly shaped excavations, where four walls are not readily discernible, divide the total wall area into four segments of approximately equal size. Sidewall samples should be located in accordance with "biases" outlined earlier in Part 1.

-3-

TABLE 2

EXCAVATION SIDEWALL SAMPLES	
<i>Total Area of Sidewalls (sq ft)</i>	<i>Number of Samples</i>
< 500	4
500 < 1,000	5
1,000 < 1,500	6
1,500 < 2,000	7
2,000 < 3,000	8
3,000 < 4,000	9
> 4,000	1 sample per 45 lineal feet of sidewall

VERIFYING IN-SITU AND EX-SITU SOIL REMEDIES

The effectiveness of in-situ soil remedies must be verified by three-dimensional random soil sampling. Refer to Attachment 2 for approved statistical sampling strategies. Certain ex-situ remedies, such as bio-piles or above-ground vapor extraction, may be amenable to statistical sampling strategies or batch sampling. Any proposed sampling strategy for in-situ or ex-situ remedies should be pre-approved by the DNR.

SAMPLE ANALYSIS

All test methods and associated target detection levels for cleanup verification must be consistent with those specified in MERA Operational Memorandum #6. Also, MERA Operational Memorandum #13 may be reviewed to evaluate appropriate QA/QC procedures. Generally, constituents in soil will be measured on a total, dry weight basis.

BACKGROUND SOIL SAMPLES

ESTABLISHING SOIL BACKGROUND

Establishing soil background, as required by Act 307 PA 1982, as amended, Michigan Environmental Response Act (MERA), can be accomplished by utilizing Operational Memorandum #15 or using the following guidance.

Background should be established as appropriate for site specific waste constituents, specific chemicals used in various processes, facility operations, or remedial investigation results. Sample analyses may include metals, organic constituents, or other site specific waste constituents. Analyses should be in accordance with MERA Operational Memorandum #6

Many factors can play a part in the background concentrations of a chemical in soil.

EXAMPLE: The geologic origin (e.g., the parent rock) of glacial drift may have been high in copper, lead, or other metals that may be potential contaminants. Additionally, the hydrogeologic situation can

alter the quantity of these elements. Groundwater recharge areas (e.g., highlands) are frequently leached of metals while groundwater discharge areas (e.g., swamps, floodplain) are the recipients of leached metals. Thus, sites in low areas will usually have higher background concentrations than upland areas. Other conditions, such as precipitation and atmospheric fallout from widely dispersed human and natural activities, also affect soil concentrations.

A minimum of four samples must be used to establish "background" in soils. This will help account for natural constituent occurrences and inherent variability within each distinctive soil horizon. Background samples must be collected in an area which has not been impacted by environmental contamination from the site and representative of natural background conditions. Based on waste type, contaminant mobility, operation practices, and soil type (sand, silty sand, clay), an estimate of contamination depth should be made and background samples taken at comparable depths for the particular soil type. Multiple soil horizons should have "background" established separately (e.g., minimum of four samples per each soil unit).

EXAMPLE:

Ground Surface		
Brown medium-coarse SAND		4 samples
Lt. brown silty fine SAND		4 samples
Gray silty CLAY w/trace of fine-med sand		4 samples

STATISTICAL ANALYSIS FOR ESTABLISHING BACKGROUND CONCENTRATIONS

The recommended statistical method for establishing background concentrations at small sites is (1) establishing the upper limit of background concentration of a constituent at the mean plus 3 standard deviations or (2) other statistical methods submitted to DNR for approval.

1. Mean Plus 3 Standard Deviation Approach

Calculate the "upper limit" of background concentration by using the following 5 step process.

A. Calculate the background mean (X_b) by dividing the sum of the total background readings by the total number of background readings:

$$\bar{X}_b = (X_1 + X_2 + \dots + X_n) / n$$

B. Calculate the background variance (S_b^2) by taking the sum of the squares of each reading minus the mean and dividing by the degrees of freedom (the total number of background samples minus one):

$$S_b^2 = ((X_1 - \bar{X}_b)^2 + (X_2 - \bar{X}_b)^2 + \dots + (X_n - \bar{X}_b)^2) / n - 1$$

NOTE: Any sample populations less than ($n < 30$ samples) must use $n - 1$ for degrees of freedom

C. Calculate the background standard deviation (S_b) by taking the square root of the variance:

$$S_b = (S_b^2)^{1/2}$$

D. The Coefficient of Variation Test (CV) where

$$CV = S_b / \bar{X}_b$$

is used to evaluate data distribution. The background data should generally have a CV of less than 0.5 for granular soils, less than 0.75 for cohesive soils, or an explanation accounting for higher CV values. The maximum recommended CV is 1. If the data distribution exceeds a CV of 1.0, then a thorough evaluation will need to be made to account for this variability (e.g., lab QA/QC, typographical errors, soil classification, sample location, data not normally distributed, etc.). If the CV exceeds 1.0 and there is sufficient evidence to suggest a data point does not accurately represent background conditions or if QA/QC problems exist which invalidate that data point, the outlier data may be dropped or additional samples collected and analyzed to ensure a sufficient representative data population (n) is achieved. A high concentration in and of itself is not sufficient justification to exclude the data point.

E. Use the $\bar{X}_b + 3 * S_b$ of "background" data as the maximum allowable limit or upper limit.

Where $3 * S_b$ equals three times the standard deviation and \bar{X}_b equals the background mean (this statistical method only requires one sample per station). Compare each sample point to the calculated maximum allowable limit or upper limit analyzed from background data.

EXAMPLE: Four sand samples from a site were analyzed for background concentrations for lead. Concentrations of lead from the sample analyses returned from the lab were 56, 25, 18, and 35 ppb. Now, the investigator wants to examine the data set to discover whether the 56 ppb sample is an outlier:

$$\bar{X}_b \text{ (mean)} = (56 + 25 + 18 + 35) / 4 = 33.5$$

$$s_b^2 = ([56 - 33.5]^2 + [25 - 33.5]^2 + [18 - 33.5]^2 + [35 - 33.5]^2) / 3 =$$

$$s_b = (\text{standard deviation}) = (s_b^2)^{1/2} = 16.5$$

$$CV = 16.5/33.5 = 0.49$$

Because 0.49 is less than 0.5, no further evaluation of the background data set is necessary.

Therefore, the background upper limit value for this site is:

$$X_b + 3*S_b = 33.5 + (3 * 16.5) = 83.0 \text{ ppb}$$

If a value is found to be an outlier which is not representative of background conditions, it may be replaced by another sample that is not an outlier to maintain at least four samples for background determination.

-7-

2. *Other statistical procedures for establishing background.* Refer to a statistical reference book or US EPA's Interim Final Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (April 1989) and Addendum (July 1992).

PROCEDURES FOR NON-DETECT VALUES

The following provides some guidelines in incorporating non-detectable sample results into the procedure to calculate background concentrations.

1. If less than 50% of the background data is below the detection limit (DL), use ½ of the detection limit as the value.
2. If more than 50% of the background data is below the detection limit, use one of the following procedures.
 - Alternate "0" and the detection limit (DL) resulting in a net value of of the detection limit with a variance.

EXAMPLE :	Actual Value	Substitute Value
	<DL	DL
	<DL	0
	<DL	DL
	<DL	0

- The Continuity Correction procedure with the t-test, Cohen's method, or other approved methods.

-8-

REPORT FOR SMALL SITE VERIFICATION

Soil cleanup verification reports for small sites must identify the number and location of samples and justify the sample location selected (why and how). The verification report must include the following.

1. MAP(s) and CROSS SECTIONS

Provide a scaled map of the floor and walls of an excavation (the vertical and horizontal area treated for in-situ remediations) with sample locations identified. The cross section should depict the stratigraphy, fractures, soil types, discolorations, unusual characteristics, odor, etc.

2. SAMPLE LOCATION RATIONALE

- A. Background sample locations
- B. Verification sample locations
- C. Sample depths
- D. Sample collection procedures
- E. Describe biases and rationale used for collecting each sample (e.g., clay fractures, discolored soil, location of leak in tank)

3. DATA ANALYSES

- A. Analytical parameters
- B. Analytical methods used
- C. Method detection limits
- D. Laboratory Quality Assurance/Quality Control

4. STATISTICAL ANALYSES

- A. Calculation of background concentrations
- B. Coefficient of variance calculations
- C. Lab results
- D. Narrative explanation of background concentrations

-9-

DNR--GUIDANCE DOCUMENT, PART 2

MEDIUM AND LARGE SITE SOIL CLEANUP VERIFICATION

(GREATER THAN 10,890 SQUARE FEET)

Part 2 describes statistical random sampling strategies to verify the remediation of medium and large sites greater than 0.25 acres in size. The strategies employ the use of gridding to facilitate the unbiased selection of sampling points and accepted statistical tools for evaluating the resultant data. The strategies

provide a 95% confidence level of determining any hot spot concentrations on a site. It contains guidance on sampling protocol and necessary documentation for clean closures. Part 2 also discusses how to establish grid intervals, set grids, sample grids, statistically evaluate the data, use grids to guide additional remedial activities, disposal options, reporting, and a certification checklist. It also provides guidance on the sampling of ex-situ remedial processes (e.g., thermal desorption).

The term 'clean closure' means that the site has been restored to either Type A or Type B levels. Type A is defined in Act 307 P.A. 1982, as amended, which references nondetect or background levels. Type B is defined in Act 307 P.A. 1982, as amended, which references riskbased or background levels. Waste, soil, other environmental media, and/or debris removed should be classified as hazardous or non-hazardous to determine disposal options and handling requirements (i.e., solid waste under Act 641 P.A. 1978, as amended; hazardous waste under Act 64 P.A. 1979, as amended; land ban restrictions under 40 CFR Part 268).

All cleanup verification evaluations must consider the spatial arrangements of sample values (patterned vs totally random) and the impacts on the present and future uses of the site. Because Type B cleanups are based on residual risk, the distribution of that risk, now and in the future, must be determined. These procedures are **not absolutes**. Other sampling approaches may be developed and submitted for DNR approval.

Three of the statistical sampling strategies most commonly used for evaluating remedial sites and wastes are described in Attachment 2. For further discussion on sampling strategies and sample collection methods, see "Test Methods for Evaluating Solid Waste," SW-846 Volume II: Field Methods, November 1986, Third Edition, US EPA.

Compositing samples for verifying soil remediation is not acceptable without prior DNR approval. When verifying a soil remediation is complete, contaminant concentrations will be low. Compositing may result in the contaminant concentrations not being representative of what remains in the soil. If concentrations are low, compositing may dilute the concentrations of a contaminant to below its threshold detection limit. Additionally, if contamination is indicated in a composited sample, the location of the contamination remains unknown.

-10-

ESTABLISHING GRID INTERVALS

When obtaining samples to verify that soil or wastes have been adequately remediated, it is important to insure that the analytical results obtained will provide an accurate representation of the entire area or volume under consideration. The location and number of samples to be taken at a particular remediation site depends on many factors: the level of confidence desired, the spatial and temporal variability of the media to be sampled, and the costs involved. An important objective in any sampling program is to obtain the most accurate data possible while minimizing the associated costs. One method to accomplish this goal is to use statistically valid sampling strategies. The appropriate sample number can be estimated and the sampling locations can be chosen without bias.

Such strategies employ the use of gridding to facilitate the unbiased selection of sampling points and accepted statistical tools for evaluating the resultant data. Statistical theory allows for the sampling of a subset of the grid points to achieve a reliable characterization of the entire remedial area or waste. Subsections describe ways to use sampling grids and statistical tools to evaluate areas of remediation.

The following equations and tables provide a simple basis to establish a grid system to facilitate unbiased selection of sampling points and sample coverage proportional to the area being verified.

1. *Basic Strategies.* A grid system should be established over the area being remediated. Grid point representation should be proportional to the size of the area. For excavation, both the sidewalls and bottom areas would be included in the determination of the area size. It is recommended that one of the following equations be used to determine grid intervals for stationing:

small site: see Part 1

$$\text{medium site: } (A/\pi)^{1/2} / 4 = \text{GI}$$

$$\text{large site: } ((A*\pi) / \text{SF})^{1/2} = \text{GI}$$

WHERE: **A** = area to be grid (square feet)
 GI = grid interval
 SF = Site Factor, length of area to be grid (unitless)
 pi = 3.14159

-11-

It appears that there are logical size ranges of sites to which the grid equations apply:

- A) small: up to 0.25 acre
- B) medium: 0.25 3.0 acres
- C) large: 3.0 acres and greater

To simplify this application, use the following chart based on an average size range of sites (1 acre = 43,560 square feet). The approximate grid ranges are provided as a quick check on numbers generated for specific sites using the above formulas.

<i>Site Acreage*</i>	<i>Square Feet*</i>	<i>~Grid Interval Ranges</i>
up to 0.25 (small)	up to 10,890	See Part 1
0.25-3.00 (medium)	10,890-130,680	15-50 feet
3.0 and over (large)	130,680 +	30 feet plus

* Site acreage, square footage, is total area of sidewalls and base of excavation.

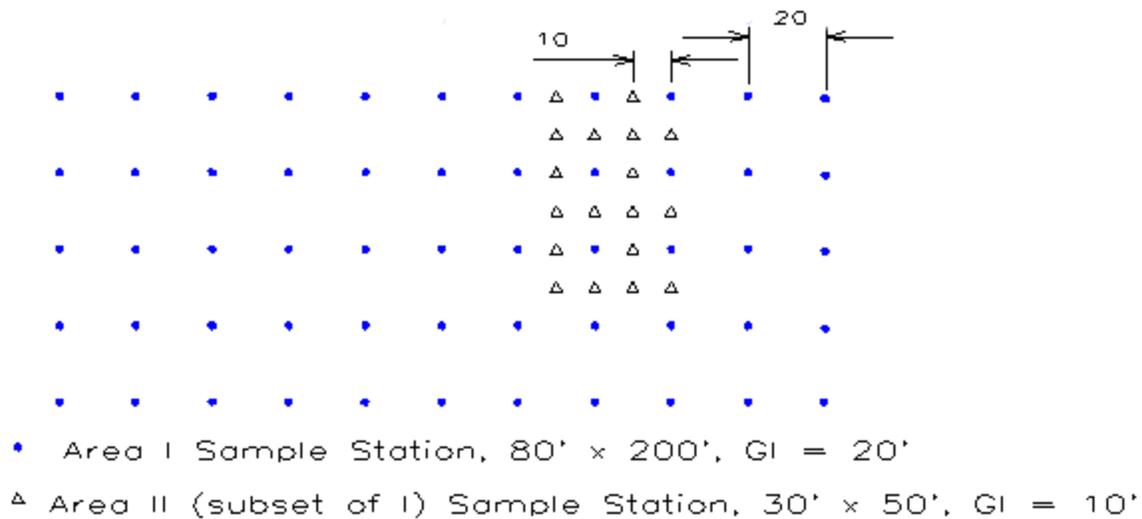
2. *Setting the Grid.* After the grid interval is calculated, it is recommended that a scaled grid overlay be

made to superimpose on a map of the remediated area (this area includes both sidewalls and base). Some specified point (usually the southwest corner) should be designated as the 0,0 coordinate. The grid can then be adjusted to maximize sampling coverage. Some grid adjustment may be necessary for unusually shaped areas. Grid adjustment may also be needed to accommodate a minimum of at least one sample from each sidewall. Proposals for different grid strategies may be submitted for DNR review and approval on a case-by-case basis.

-12-

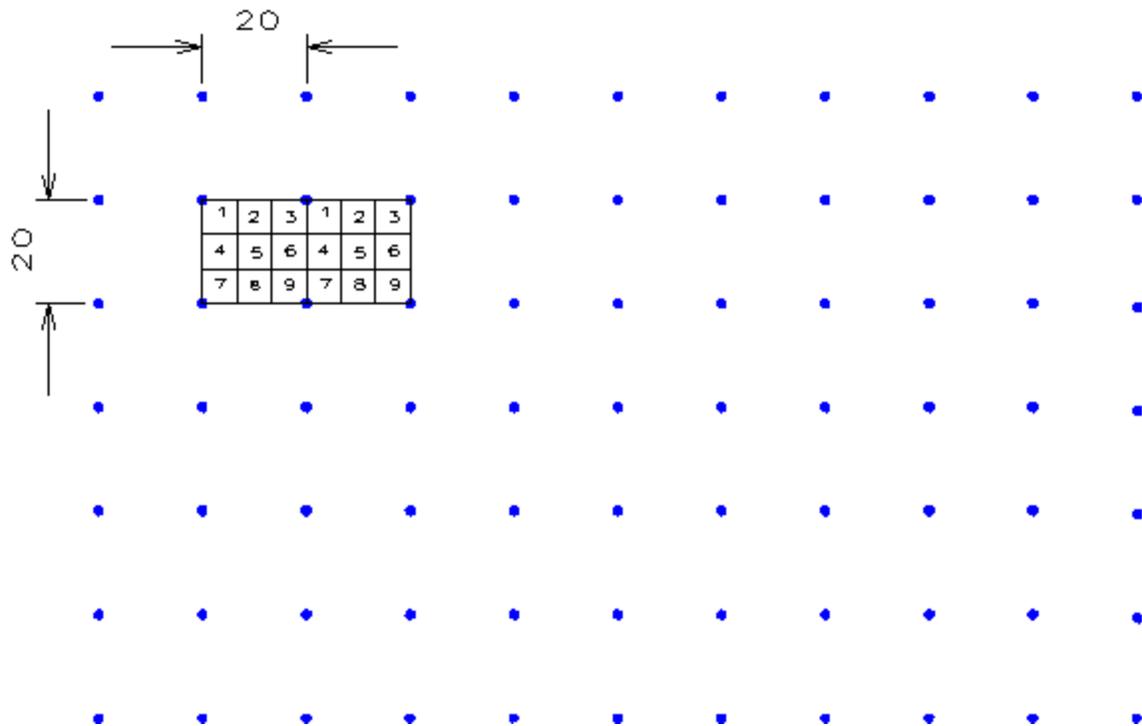
3. Variations on Basic Strategy.

A. Subgridding. It may be warranted to apply grids with different intervals within the remediated area so that a proportional sampling can be focused on suspect areas (such as sumps, tank leak areas, etc.).



B. Further Randomization. Sites that may have a patterned distribution of waste or contamination due to time sequence of filling, production sequences, or physical site conditions (i.e., furrows) may require a further randomization of sampling. In such cases, the following grid cell sampling format may be selected instead of at grid point stations. Each grid cell to be sampled must be divided into nine equal sized "subcells." Next, a random number table is used to select in which of the subcells the sample will be taken. The random number table is used again to select which subcell for the next cell and so on.

EXAMPLE :



Area = 120' x 200', GI = 20'

In the example above, a sampling grid has been set up with grid point stations 20 feet apart using the appropriate formula. Two cells which have been selected at random have been divided into nine subcells each. Subcell #4 was chosen randomly in one cell and subcell #2 in the other cell. This process is continued for all of the cells selected at random for sampling. Samples are then taken in each randomly chosen subcell.

C. Three dimensional gridding: In-Situ and Ex-Situ Remediations.

In-situ and ex-situ remediations involving soils and/or wastes with a significant vertical component should be evaluated in three dimensions (volume evaluation). Examples of such remediations would be in-situ soil vapor extraction or ex-situ bioremediation involving several cubic feet of soil and/or waste. A grid is superimposed on the remediation area as described in the previous sections and a vertical component is added at each node. The vertical sampling increments would be site specific and require prior approval from the DNR. Refer to Attachment 1 "Guide to Sample Bias" for additional guidance on vertical sampling increments.

SAMPLING OF GRID

Sampling of grids may include all of the grid stations or a phased subset of the total stations. The subset of grid stations is created by assigning coordinates to all the nodes and randomly selecting nodes using a random number generator or a random number table (refer to Attachment 2). A minimum of 12 samples or 25%, whichever is larger, of the total grid stations should be sampled and analyzed initially to allow a large enough data pool for statistical analysis. It is advisable that extra samples also be taken and kept

under proper chain of custody and storage procedures at the time of initial sampling. If the statistical analysis indicates that more samples are needed, an additional sample trip to the field may have been avoided. A method for calculating the sample size requirements is presented in Attachment 2 (Lamda relationship).

ESTABLISHING SOIL BACKGROUND

Establishing soil background, as required by Act 307 PA 1982, as amended, Michigan Environmental Response Act (MERA), can be accomplished by utilizing Operational Memorandum #15 or using the following guidance.

Background should be established for site specific waste constituents, specific chemicals used in various processes, facility operations, or remedial investigation results. Sample analyses may include metals, organic constituents, or other site specific waste constituents. Analyses should be in accordance with Act 307 P.A. 1982, as amended.

Many factors can play a part in the background concentrations of a chemical in soil.

EXAMPLE: The geologic origin (e.g., the parent rock) of glacial drift may have been high in copper, lead, or other metals that may be potential contaminants. Additionally, the hydrogeologic situation can alter the quantity of these elements. Groundwater recharge areas (e.g., highlands) are frequently leached of metals while groundwater discharge areas (e.g., swamps, floodplain) are the recipients of leached metals. Thus, sites in low areas will usually have higher background concentrations than upland areas. Other conditions, such as precipitation and atmospheric fallout from widely dispersed human and natural activities, also affect soil concentrations.

A minimum of four samples must be used to establish "background" in soils. This will help account for natural constituent occurrences and inherent variability within each distinctive soil horizon. Background samples must be collected in an area which has not been impacted by environmental contamination from the site and representative of natural background conditions. Based on waste type, contaminant mobility, operation practices, and soil type (sand, silty sand, clay), an estimate of contamination depth should be made and background samples taken at comparable depths for the particular soil type. Multiple soil horizons should have "background" established separately (e.g., minimum of four samples per each soil unit).

EXAMPLE:

Ground Surface		
Brown medium-coarse SAND		4 samples
Lt. brown silty fine SAND		4 samples

Gray silty CLAY w/trace of fine-med sand		4 samples
------------------------------------------	-----------------------------------------------------------------------------------	-----------

STATISTICAL ANALYSIS FOR ESTABLISHING BACKGROUND CONCENTRATIONS

The recommended statistical method(s) for establishing background concentrations at medium and large sites are (1) establishing the upper limit of background concentration of a constituent at the mean plus 3 standard deviations, (2) tolerance limit, (3) t-tests, and (4) other statistical methods submitted to the DNR for approval.

1. Mean Plus 3 Standard Deviation Approach

Calculate the "upper limit" of background concentration by using the following 5 step process.

A. Calculate the background mean (X_b) by dividing the sum of the total background readings by the total number of background readings:

$$X_b = (X_1 + X_2 + \dots + X_n) / n$$

B. Calculate the background variance (S_b^2) by taking the sum of the squares of each reading minus the mean and dividing by the degrees of freedom (the total number of background samples minus one):

-15-

$$S_b^2 = ((X_1 - X_b)^2 + (X_2 - X_b)^2 + \dots + (X_n - X_b)^2) / n - 1$$

NOTE: Any sample populations less than ($n < 30$ samples) must use $n - 1$ for degrees of freedom

C. Calculate the background standard deviation (S_b) by taking the square root of the variance:

$$S_b = (S_b^2)^{1/2}$$

D. The Coefficient of Variation Test (CV) where

$$CV = S_b / X_b$$

is used to evaluate data distribution. The background data should generally have a CV of less than 0.5 for granular soils, less than 0.75 for cohesive soils, or an explanation accounting for higher CV values. The maximum recommended CV is 1. If the data distribution exceeds a CV of 1.0, then a thorough evaluation will need to be made to account for this variability (e.g., lab QA/QC, topographical errors,

soil classification, sample location, data not normally distributed, etc.). If the CV exceeds 1.0 and there is sufficient evidence to suggest a data point does not accurately represent background conditions or if QA/QC problems exist which invalidate that data point, the outlier data may be dropped or additional samples collected and analyzed to ensure a sufficient representative data population (n) is achieved. A high concentration in and of itself is not sufficient justification to exclude the data point.

-16-

E. Use the $\bar{X}_b + 3*S_b$ of "background" data as the maximum allowable limit or upper limit.

Where $3*S_b$ equals three times the standard deviation and \bar{X}_b equals the background mean (this statistical method only requires one sample per station). Compare each sample point to the calculated maximum allowable limit or upper limit analyzed from background data.

EXAMPLE: Four sand samples from a site were analyzed for background concentrations for lead. Concentrations of lead from the sample analyses returned from the lab were 56, 25, 18, and 35 ppb. Now, the investigator wants to examine the data set to discover whether the 56 ppb sample is an outlier:

$$\bar{X}_b \text{ (mean)} = (56 + 25 + 18 + 35) / 4 = 33.5$$

$$s_b^2 = ([56-33.5]^2 + [25-33.5]^2 + [18-33.5]^2 + [35-33.5]^2) / 3 =$$

$$s_b = (\text{standard deviation}) = (s_b^2)^{1/2} = 16.5$$

$$CV = 16.5/33.5 = 0.49$$

Because 0.49 is less than 0.5, no further evaluation of the background data set is necessary. Therefore, the background upper limit value for this site is:

$$\bar{X}_b + 3*S_b = 33.5 + (3 * 16.5) = 83.0 \text{ ppb}$$

If a value is found to be an outlier which is not representative of background conditions, it may be replaced by another sample that is not an outlier to maintain at least four samples for background determination.

2. *Tolerance Limit.* This statistical procedure is a fairly sensitive program for environmental purposes. It minimizes false positive and is simple to perform. **A minimum background data base of n=8** (optimum n=16) is needed for this method. Other suggested criteria follow:

A. The Coefficient of Variation Test (CV) to evaluate data distribution. See this Guidance Document, Part 2, Statistical Analysis for Establishing Background Concentrations, #1.D. (the Coefficient of Variation Test...).

B. Using the mean (\bar{X}_b) and standard deviation (S_b), construct the onesided upper tolerance limit (TL) by taking the mean plus a tolerance coefficient (K) at the 95% probability level for a 95% coverage (for

K values, see Attachment 3) times the standard deviation as follows:

$$TL = X_b + KS_b$$

-17-

3. *ttests*. Any ttest should be "approved" by DNR prior to use since there are a number of variations. The Gosset Student ttest (1908) or Cochran's Approximation to the Behren'sFisher Student's ttest as referenced in the 40 CFR Part 264, Appendix IV, are recommended. **Note** that these statistical comparison methods require that two or more discrete samples be taken at each sampling station.

4. *Other statistical procedures for establishing background*. Refer to a statistical reference book or US EPA's Interim Final Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (April 1989) and Addendum (July 1992).

PROCEDURES FOR NON-DETECT VALUES

The following provides some guidelines in incorporating non-detectable sample results into the procedure to calculate background concentrations.

1. If less than 50% of the background data is below the detection limit (DL), use ½ of the detection limit as the value.
2. If more than 50% of the background data is below the detection limit, use one of the following procedures.
 - Alternate "0" and the detection limit (DL) resulting in a net value of of the detection limit, with a variance

EXAMPLE:	Actual Value	Substitute Value
	<DL	DL
	<DL	0
	<DL	DL
	<DL	0

- The Continuity Correction procedure with the t-test, Cohen's method, or other approved methods.

STATISTICAL EVALUATION OF DATA

A detailed description of an acceptable approach for evaluating the data generated by statistically based random sampling strategies such as those described in the foregoing sections is provided in Attachment 2 (page 29). The 95% upper confidence limit (UCL) of the mean is calculated for each constituent of concern and compared to the regulatory threshold (RT) (i.e., cleanup criterion; e.g., Type A or B). If the

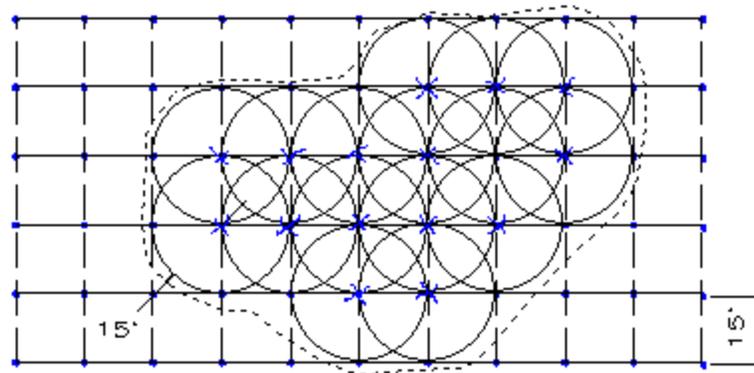
UCL is less than the RT and an adequate number of samples have been collected and spatially evaluated, the remediation is deemed complete. Attachment 2 also provides a step wise procedure for determining whether an adequate number of samples have been collected, based on the analytical data derived from the initial and subsequent rounds of samples. **All evaluations must consider the spatial correlation of sample values** (e.g., highest concentrations in the same area), **present and future uses of the site, residual risk, and distribution of that risk now and in the future.** Other acceptable methods for UCL and sample size calculations can be found in US EPA SW-846, Third Edition, Section 9.1.1.3.

-18-

GRID APPROACH TO ADDITIONAL REMEDIATION

1. *TwoDimensional Node Sampling Excavation Grid.* Verification sampling as described above will at times indicate that remediation is incomplete. Excavation of contaminated areas should be based on the established grid system interval (as recommended in this Guidance Document, Part 2). Where a subset of grid points has indicated that the entire area exceeds the cleanup, the nodes adjacent to the sampled nodes that are causing the exceedance should be sampled, and this process repeated until the "Hot spots" requiring removal have been defined. The radius of excavation around the contaminated sample point(s) is equal to the grid interval ($GI=r$). Excavation depth is to the deepest point of contamination or to the depth where acceptable levels are anticipated. After excavation, the impacted point(s) must be resampled at their new elevations to verify that the area meets the selected cleanup criteria. If continued contamination is detected, the excavation format is repeated until a satisfactory result is obtained.

EXAMPLE:



GL = 150
 A = 11,250
 GI = 14.9

• Sample Station
 x Contaminated Station
 r = GI = 15 feet

Remediation of contaminated soil by excavation will be in accordance with Act 307 P.A. 1982, as amended. The proposed remedial action plan must be approved by the DNR.

2. *Two-Dimensional Subcell Sampling Excavation Grid*. Use this Guidance Document, Part 2. The radius of excavation around a contaminated point may need to be adjusted to greater than the GI distance. This adjustment is due to the variable distances between sampling points.

3. *ThreeDimensional Cleanup Verification*. If sampling and statistical analysis using this Guidance Document indicate that Act 307 cleanup criteria have not been met, additional remediation will be required. The sampling protocol and strategies described in Attachment 2 and in SW-846, Third Edition, Volume II, Part III, Chapter 9, are acceptable. All sampling strategies, detection levels, and sampling pathways must be in accordance with Act 307 P.A. 1982, as amended. If any portion of the soil mass in question appears to be causing the material to fail, it may be identified through hot spot sampling and selectively removed. Subsequent sampling must be done to confirm that the remaining material meets Act 307 P.A. 1982, as amended.

4. *Batch Sampling for exsitu treatment processes*. If exsitu treatment processes of contaminated soil or waste is used in the remediation, a sampling program for the process stream needs to be developed. The basis of this program is to get representative samples over time versus a spatial approach (Attachment 2, Sampling Process Streams).

-19-

DISPOSAL OPTIONS

Soils remediated to Act 307 P.A. 1982, as amended, standards (Type A and/or Type B) are no longer considered a waste per Act 64 P.A. of 1979, as amended, and RCRA regulations. Disposal of excavated waste, soil, other environmental media, and/or debris must be in accordance with all applicable Federal, State, and local regulations.

REPORT FOR MEDIUM AND LARGE SITES VERIFICATION

Soil cleanup verification reports for medium and large sites must identify the number and location of samples and justify the sample location selected (why and how). The verification report must include the following.

1. MAP(S) AND CROSS SECTIONS

Provide a scaled map of the floor and walls of the excavation (the vertical and horizontal area treated for in-situ remediations) with sample grid and sample locations identified. Appropriate cross section should depict the stratigraphy, fractures, soil types, and final depth and elevations of the excavation.

2. SAMPLE LOCATION RATIONALE

- a. Properly labeled and easily identified sampling grid stations (map) including background stations
- b. Sample Depths

- c. Sample Collection Procedures
- d. Results of all tests to determine clean closure (charts, tables, lab sheets, field notes, well logs, boring logs)

3. DATA ANALYSES

- a. Analytical parameters
- b. Analytical methods used
- c. Method detection limits
- d. Laboratory Quality Assurance/Quality Control

4. STATISTICAL ANALYSES

- a. Explanation and calculation of background concentrations
- b. Statistical comparisons on sampling results compared to background (this should include full computations on background and statistical analysis)
- c. Lab results

5. Additional information to support closure (e.g., residual risks, spatial correlation of sample values, present and future land uses).

RCRA CLEAN CLOSURE CERTIFICATION CHECKLIST

Attachment 4 is a guide that indicates the information that a facility should provide to certify that their activities meet the conditions for a clean closure under the Act 64/RCRA regulations.

-20-

A T T A C H M E N T 1

GUIDE TO SAMPLE BIAS

Many factors can play a part in the concentrations of contaminants. The following contains some of the factors impacting chemical concentrations and locations.

CHEMICAL TRANSFORMATIONS

Many organic chemicals may undergo aerobic and anaerobic degradation. A description of these processes is beyond the scope of this document. The subject is approached here, however, to be sure that samplers are aware that the chemical(s) spilled may not be the only chemical(s) in the soil after a transformation has occurred. These occurrences should be documented in the remedial investigation. The full scan of chemicals from the remedial investigation requiring cleanup should be analyzed when doing a closure. Analyses should be done for all chemicals that have been identified as breakdown products of the chemicals found on-site.

The professional literature contains many articles on this subject (Cline and Brown, 1989; Borden and Bedient, 1987; Wilson and Wilson, 1985). The interested reader is directed to these articles.

Organic Carbon Content of Soil

The organic carbon content of soils is a key factor in the ability of any soil to adsorb contaminants. For a variety of reasons (Lindsay, 1979), an increase in organic carbon content leads to an increase in the adsorption of several classes of chemicals.

Where to sample: Areas of the excavation that appear to have excess organic carbon (e.g. peat, muck, darker soils) should be preferentially sampled.

Medium Sand or Larger Grains

Medium to larger grain size sand has from 20 to 40 percent porosity. Most sands in Michigan are composed of quartz, limestone, and small amounts of metamorphic rock fragments. These soils have a low capacity for adsorbing metals or hydrophilic (soluble) organic chemicals. Hydrophobic (insoluble) organic chemicals with low molecular weight will adsorb to this soil in small amounts. Hydrophobic chemicals with high molecular weight will adsorb in moderate amounts (Cline & Brown, 1989). These soils have a low capacity to hold contaminants in the grain interstices due to low capillary action. Contaminants that are held in these soils adhere to the grains themselves in dry soils and are forced into the smaller pore spaces in wet soils (Schwille, 1988).

Where to sample: Samples should be placed at regular intervals along the base and sidewalls of the excavation being sure that samples are located where the source was removed. In these soils, the capillary force is low enough to ignore its effects in transporting contaminants lateral to gravity. Therefore, sidewall samples should be located near the excavation floor. This is especially true for low surface tension products such as gasoline.

The limestone sand grains can act as a buffer to contaminants that cause pH changes (e.g., steel mill pickling acids). For these types of contaminants, the sampler should be on the lookout for intra-granular precipitates. These can appear as grain surface staining or make the soil appear clumpy or aggregated. Soils containing precipitates should be sampled.

- 21 -

Fine Sand and Silt

These soils have strong capillary action due to the small inter-granular distances. A determination of the fluid surface tension of the spilled product is helpful. High surface tension aids in the ability of a substance to overcome gravity by capillary action. As before, higher molecular weight products can be expected to adsorb to the grains to a greater degree. This allows a product to move lateral to gravity and, to a degree, upward from the leak location. Low surface tension products, such as TCE (trichloroethene), are more likely to go straight down than oils in these kinds of soils. However, the hydraulic head (i.e., the amount of product in the original spill) must be substantial to force a dense non-aqueous phase liquid through a media with a hydraulic conductivity less than 1×10^{-3} cm/sec (Schwille, 1988).

Where to sample: Interfaces between fine sand layers with larger grains above should be sampled. When high surface tension contaminants are suspected, silt layers should be sampled.

Clays

Clay soils are very different from the sands and silts. Clays possess a net negative charge. This causes heavy metal cations (e.g., Cr^{+6} , Cd^{+2} , Pb^{+2}) to adsorb to the clay surface. In fact, this is true for any positive ionizable substance. Clays also have a much greater secondary porosity than primary (primary porosity is the space between the soil particles; secondary porosity is the space between fractures, bedding planes, and soil structures). As a result, spills in clay soils tend to follow preferred pathways. Clays will often show signs of shrinkage cracks or fractures that will allow contaminants to migrate in what would otherwise be considered a "tight" soil in a lab analysis of permeability. Signs of fracturing include "patterned" mottling. This is where the Fe (and also Mn) will be oxidized to a red, yellow, or reddish brown color along the crack while the matrix remains the reduced blue/gray color (Lindsay, 1979).

Where to sample: It is very important to take clay soil samples from fractures. The fractures are the avenue of travel for contaminants in clay soils. Clay soils may also have sand lenses which should always be sampled. Sand lenses in clays tend to collect fluids. As such, they may harbor contaminants.

Bedrock

Excavations in bedrock present difficult problems. Unlike clay, some bedrock formations have substantial primary porosity as well as secondary porosity. In Michigan, these are sandstones, conglomerates, and brecciated/coarse grained limestones. Examples of bedrock in Michigan with low primary porosity are fine grained limestones, shale, and crystalline metamorphic rocks (e.g., gneiss). If the sampler is unaware of the type of bedrock that is in an excavation, a geologist must be consulted.

Where to sample: Excavations in areas of bedrock with significant primary porosity must be sampled in both the fractures and the matrix. Bedrock without primary porosity should have sampling predominantly in the fractures as in the clay situation. Weathered zones in bedrock will hold contaminants better than unweathered zones. This is due to the increased number of adsorption sites available in weathered rock.

- 22 -

ATTACHMENT 2

SAMPLING PROTOCOL FOR CHARACTERIZING WASTE/TREATMENT LEVELS:

STRATEGIES FOR EVALUATING TREATED SOILS AND WASTE MATERIALS

When obtaining samples to characterize a treated soil or waste material, it is important to insure that the analytical results obtained will provide an accurate estimation of the nature of the entire area/volume under consideration. The location and number of samples to be taken at a particular site depend on many factors: the degree of accuracy desired, the spatial and temporal variability of the media to be sampled, and the costs involved. An important objective in any sampling program is to obtain the most accurate data possible while minimizing the associated costs. One method to accomplish this goal is to use statistically valid sampling strategies. The appropriate sample number can be estimated and the sampling locations can be chosen without bias.

Attachment 2 provides information on the methods used to obtain accurate data while minimizing the costs. The attachments include a discussion of three statistical sampling strategies and methods to determine the appropriate grid size for the area under investigation. If several areas on a site are under investigation, it may be advisable to grid them separately. This is especially true if information does not exist to indicate that the areas contain similar constituents or that they were placed at the same time period.

Information is also supplied on the statistical evaluation of the resultant analytical data. A minimum of 12 samples or 25%, whichever is greater, of the total grid stations should be sampled and analyzed initially to allow a large enough data pool for the statistical analysis. Extra samples should be taken and kept under proper chain of custody and handling procedures at the time of initial sampling. If the statistical analysis indicates that two or three more samples are needed, an additional trip to the field may not be necessary. This may also avoid the need to reestablish the grid pattern at a later date.

For further discussion on sampling strategies and sample collection methods, see "Test Methods for Evaluating Solid Waste," SW846 Volume II: Field Methods, November 1986, Third Edition, US EPA.

- 23 -

STATISTICAL SAMPLING STRATEGIES

Statistical sampling strategies can often produce increased data accuracy while eliminating sampler bias. Random sampling is based on the theory of random chance probabilities in order to choose the most representative sample. Knowledge of the waste distribution is not necessary. The error in data accuracy of a random sampling scheme can be objectively measured since the probability of choosing each sampling point is known. A random numbers table (attached) or a random numbers generator should be used to select the sampling locations eliminating bias by the sample collector.

Several statistical sampling strategies are available to produce an unbiased, representative sampling program. The principles behind three of these and the situations for which they are best suited are provided below. To achieve true random sampling, composite sampling is not acceptable.

1. **Simple Random** is a method that requires little or no prior knowledge of material distribution. It relies on random chance probability theory--where each sampling location has an equal and known probability of being selected. In this way, sampling error can be accurately estimated. Usually, the area of interest is sectioned into a two or three dimensional grid pattern and random coordinates are chosen for sampling.
2. **Systematic random** is an extension of simple random sampling that may produce a more efficient sampling survey. It can be more efficient by reducing the sampling error while maintaining the sample number, or by reducing the number of samples needed to achieve a specified sampling error, or by reducing the cost of collection. This method also requires little or no knowledge about the waste distribution, but bias and imprecision can be introduced if unseen trends or cycles exist. Two methods used to select sample locations

under this method follow.

- A) randomly selecting a transect or transects and sampling at preselected intervals
- B) preselecting both the transect or transects and the sampling interval and starting from a randomly selected point.

3. **Stratified random sampling** requires some knowledge about the waste distribution. When stratification is known or suspected, sampling efficiency can be improved by dividing the material into strata that are more homogeneous than the total area. Simple random sampling techniques can then be used to sample each stratum independently. Each stratum is divided into a grid pattern and the sampling points are selected randomly. If the area is vertically stratified, the sampling points in each stratum are selected randomly and then selected depths are sampled. If the area is horizontally stratified, the sampling points within each stratum are selected randomly, but the total depth is sampled. An analysis of variance (ANOVA) should be done on the analytical results to determine if the strata differ significantly. This is done to assure that the use of stratified random sampling was statistically valid. When the volume of the strata differ or the number of samples within each strata differs, the results must be weighed appropriately to avoid bias.

- 24 -

RANDOM NUMBERS TABLE

HOW TO USE THE RANDOM NUMBERS TABLE

1. Determine the number of samples you need to take. Identify the number of digits necessary to cover the sample population (e.g., for a sample population of 55, two digits are necessary to cover the selected grid stations 01 through 55).
2. Using the random numbers table, choose any number as a starting point.
3. From this starting point number, go in any direction and continue in the same direction and pattern sequence until you have selected the predetermined number of samples with no repetitions. Numbers larger than the population size are ineligible (e.g., numbers greater than 55 in the example are ineligible).

Line/Col.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	10480	15011	01536	02011	81647	91646	69179	14194	62590	36207
2	22368	46573	25595	85393	30995	89198	27982	53402	93965	34095
3	24130	48360	22527	97265	76393	64809	15179	24830	49340	32081
4	42167	93093	06243	61680	07856	16376	39440	53537	71341	57004
5	37570	39975	81837	16656	06121	91782	60468	81305	49684	60672
6	77921	06907	11008	42751	27756	53498	18602	70659	90655	15053

7	99562	72905	56420	69994	98872	31016	71194	18738	44013	48840
8	96301	91977	05463	07972	18876	20922	94595	56869	69014	60045
9	89579	14342	63661	10281	17453	18103	57740	84378	25331	12566
10	85475	36857	43342	53988	53060	59533	38867	62300	08158	17983
11	28918	69578	88231	33276	70997	79936	56865	05859	90106	31595
12	63553	40961	48235	03427	49626	69445	18663	72695	52180	20847
13	09429	93969	52636	92737	88974	33488	36320	17617	30015	08272
14	10365	61129	87529	85689	48237	52267	67689	93394	01511	26358
15	07119	97336	71048	08178	77233	13916	47564	81056	97735	85977
16	51085	12765	51821	51259	77452	16308	60756	92144	49442	53900
17	02368	21382	52404	60268	89368	19885	55322	44819	01188	65255
18	01011	54092	33362	94904	31273	04146	18594	29852	71585	85030
19	52162	53916	46369	58586	23216	14513	83149	98736	23495	64350
20	07056	97628	33787	09998	42698	06691	76988	13602	51851	46104
21	48663	91245	85828	14346	09172	30168	90229	04734	59193	22178
22	54164	58492	22421	74103	47070	25306	76468	26384	58151	06646
23	32639	32363	05597	24200	13363	38005	94342	28728	35806	06912
24	29334	27001	87637	87308	58731	00256	45834	15398	46557	41135
25	02488	33062	28834	07351	19731	92420	60952	61280	50001	67658
Line/Col.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
26	81525	72295	04839	96423	24878	82651	66566	14778	76797	14780
27	29676	20591	68086	26432	46901	20849	89768	81536	86645	12659
28	00742	57392	39064	66432	84673	40027	32832	61362	98947	96067
29	05366	04213	25669	26422	44407	44048	37937	63904	45766	66134
30	91921	26418	64117	94305	26766	25940	39972	22209	71500	64568
31	00582	04711	87917	77341	42206	35126	74087	99547	81817	42607
32	00725	69884	62797	56170	86324	88072	76222	36086	84637	93161
33	69011	65797	95876	55293	18988	27354	26575	08625	40801	59920
34	25976	57948	29888	88604	67917	48708	18912	82271	65424	69774
35	09763	83473	73577	12908	30883	18317	28290	35797	05998	41688
36	91567	42595	27958	30134	04024	86385	29880	99730	55536	84855
37	17955	56349	90999	49127	20044	59931	06115	20542	18059	02008
38	46503	18584	18845	49618	02304	51038	20655	58727	28168	15475
39	92157	89634	94824	78171	84610	82834	09922	25417	44137	48413
40	14577	62765	35605	81263	39667	47358	56873	56307	61607	49518
41	98427	07523	33362	64270	01638	92477	66969	98420	04880	45585
42	34914	63976	88720	82765	34476	17032	87589	40836	32427	70002
43	70060	28277	39475	46473	23219	53416	94970	25832	69975	94884
44	53976	54914	06990	67245	68350	82948	11398	42878	80287	88267
45	76072	29515	40980	07391	58745	25774	22987	80059	39911	96189
46	90725	52210	83974	29992	65831	38857	50490	83765	55657	14361
47	64364	67412	33339	31926	14883	24413	59744	92351	97473	89286
48	08962	00358	31662	25388	61642	34072	81249	35648	56891	69352
49	95012	68379	93526	70765	10593	04542	76463	54328	02349	17247
50	15664	10493	20492	38391	91132	21999	59516	81652	27195	48223
51	16408	81899	04153	53381	79401	21438	83035	92350	36693	31238
52	18629	81953	05520	91962	04739	13092	97662	24822	94730	06496
53	73115	35101	47498	87637	99016	71060	88824	71013	18735	20286
54	57491	16703	23167	49323	45021	33132	12544	41035	80780	45393
55	30405	83946	23792	14422	15059	45799	22716	19792	09983	74353
56	16631	35006	85900	98275	32388	52390	16815	69298	82732	38480
57	96773	20206	42559	78985	05300	22164	24369	54224	35083	19687
58	38935	64202	14349	82674	66523	44133	00697	35552	35970	19124
59	31624	76384	17403	53363	44167	64486	64758	75366	76554	31601

60	78919	19474	23632	27889	47914	02584	37680	20801	72152	39339
61	03931	33309	57047	74211	63445	17361	62825	39908	05607	91284
62	74426	33278	43972	10119	89917	15665	52872	73823	73144	88662
63	09066	00903	20795	95452	92648	45454	09552	88815	16553	51125
64	42238	12426	87025	14267	20979	04508	64535	31355	86064	29472
65	16153	08002	26504	41744	81959	65642	74240	56302	00033	67107
66	21457	40742	29820	96783	29400	21840	15035	34537	33310	06116
67	21581	57802	02050	89728	17937	37621	47075	42080	97403	48626
68	55612	78095	83197	33732	05810	24813	86902	60397	16489	03264
69	44657	66999	99324	51281	84463	60563	79312	93454	68876	25471
70	91340	84979	46949	81973	37949	61023	43997	15263	80644	43942
71	91227	21199	31935	27022	84067	05462	35216	14486	29891	68607
72	50001	38140	66321	19924	72163	09538	12151	06878	91903	18749
73	65390	05224	72958	28609	81406	39147	25549	48542	42627	45233
74	27504	96131	83944	41575	10573	08619	64482	73923	36152	05184
75	37169	94851	39117	89632	00959	16487	65536	49071	39782	17095
Line/Col.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
76	11508	70225	51111	38351	19444	66499	71945	05422	13442	78675
77	37449	30362	06694	54690	04052	53115	62757	95348	78662	11163
78	46515	70331	85922	38329	57015	15765	97161	17869	45349	61796
79	30986	81223	42416	58353	21532	30502	32305	86482	05174	07901
80	63798	64995	46583	09765	44160	78128	83991	42865	92520	83531
81	82486	84846	99254	67632	43218	50076	21361	64816	51202	88124
82	21885	32906	92431	09060	64297	51674	64126	62570	26123	05155
83	60336	98782	07408	53458	13564	59089	26445	29789	85205	41001
84	43937	46891	24010	25560	86355	33941	25786	54990	71899	15475
85	97656	63175	89303	16275	07100	92063	21942	18611	47348	20203
86	03299	01221	05418	38982	55758	92237	26759	86367	21216	98442
87	79626	06486	03574	17668	07785	76020	79924	25651	83325	88428
88	85636	68335	47539	03129	65651	11977	02510	26113	99447	68645
89	18039	14367	61337	06177	12143	46609	32989	74014	64708	00533
90	08362	15656	60627	36478	65648	16764	53412	09013	07832	41574
91	79556	29068	04142	16268	15387	12856	66227	38358	22478	73373
92	92608	82674	27072	32534	17075	27698	98204	63863	11951	34648
93	23982	25835	40055	67006	12293	02753	14827	22235	35071	99704
94	09915	96306	05908	97901	28395	14186	00821	80703	70426	75647
95	50937	33300	26695	62247	69927	76123	50842	43834	86654	70959
96	42488	78077	69882	61657	34136	79180	97526	43092	04098	73571
97	46764	86273	63003	93017	31204	36692	40202	35275	57306	55543
98	03237	45430	55417	63282	90816	17349	88298	90183	36600	78406
99	86591	81482	52667	61583	14972	90053	89534	76036	49199	43716
100	38534	01715	94964	87288	65680	43772	39560	12918	86537	62738
101	13284	16834	74151	92027	24670	36665	00770	22878	02179	51602
102	21224	00370	30420	03883	96648	89428	41583	17564	27395	63904
103	99052	47887	81085	64933	66279	80432	65793	83287	34142	13241
104	00199	50993	98603	38452	87890	94624	69721	57484	67501	77638
105	60578	06483	28733	37867	07936	98710	98539	27186	31237	80612
106	91240	18312	17441	01929	18163	69201	31211	54288	39296	37318
107	97458	14229	12063	59611	32249	90466	33216	19358	02591	54263
108	35249	38646	34475	72417	60514	69257	12489	51924	86871	92446
109	38980	46600	11759	11900	46743	27860	77940	39298	97838	95145
110	10750	52745	38749	87365	58959	53731	89295	59062	39404	13198
111	36247	27850	73958	20673	37800	63835	71051	84724	52492	22342
112	70994	66986	99744	72438	01174	42159	11392	20724	54322	36923

113	99638	94702	11463	18148	81386	80431	90628	52506	02016	85151
114	72055	15774	43857	99805	10419	76939	25993	03544	21560	83471
115	24038	65541	85788	55835	38835	59399	13790	35112	01324	39520
116	74976	14631	35908	28221	39470	91548	12854	30166	09073	75887
117	35553	71628	70189	26436	63407	91178	90348	55359	80392	41012
118	35676	12797	51434	82976	42010	26344	92920	92155	58807	54644
119	74815	67523	72985	23183	02446	63594	98924	20633	58842	85961
120	45246	88048	65173	50989	91060	89894	36063	32819	68559	99221
121	76509	47069	86378	41797	11910	49672	88575	97966	32466	10083
122	19689	90332	04315	21358	97248	11188	39062	63312	52496	07349
123	42751	35318	97513	61537	54955	08159	00337	80778	27507	95478
124	11946	22681	45045	13964	57517	59419	58045	44067	58716	58840
125	96518	48688	20996	11090	48396	57177	83867	86464	14342	21545

- 27 -

SAMPLING GRIDS

1. A grid system should be established over the specified area (sidewalls and base). Grid point representation should be proportioned to the size of the area. It is recommended that one of the following equations be used to determine grid intervals for stationing.

$$\textit{small site: } (A/\pi)^{1/2} / 2 = GI$$

$$\textit{medium site: } (A/\pi)^{1/2} / 4 = GI$$

$$\textit{large site: } ((A*\pi) / SF)^{1/2} = GI$$

WHERE: **A** = area to be grid (square feet)
GI = grid interval
SF = Site Factor, length of area to be gridded (unitless)
pi = 3.14159

It appears that there are logical size ranges of sites to which the grid equations apply:

- A) small: up to 0.25 acre
- B) medium: 0.25 3.0 acres
- C) large: 3.0 acres and greater

To simplify this application, use the following chart based on an average size range of sites (1 acre = 43,560 square feet). The approximate grid ranges are provided as a quick check on numbers generated for specific sites using the above formulas.

<i>Site Acreage*</i>	<i>Square Feet*</i>	<i>~Grid Interval Ranges</i>
up to 0.25 (small)	up to 10,890	See Part 1
0.25-3.00 (medium)	10,890-130,680	15-50 feet
3.0 and over (large)	130,680 +	30 feet plus

* Site acreage, square footage, is total area of sidewalls and base of excavati

2. After the grid interval is calculated, it is recommended that a scaled grid overlay be made to superimpose on the area under consideration. Some specified point (usually the southwest corner) should be designated as the 0,0 coordinate. The grid can then be adjusted to maximize sampling coverage. Some grid adjustment may be necessary for unusually shaped areas.

- 28 -

STATISTICAL EVALUATION WASTE/TREATMENT CHARACTERIZATION SAMPLINGS

Following is a step by step description of the approach used to calculate confidence limits based on the analytical data derived from the preliminary samples.

1. Calculate a preliminary estimate of the mean, \bar{X}

$$\bar{X} = (X_1 + X_2 + X_3 + \dots + X_n) / n$$

where:

n = number of measurements
 X = variable concentration
 Xi = individual measurements

2. Calculate a preliminary estimate of the variance (S^2) and the standard deviation (S). Standard deviation is a function of both sampling variability and measurement variability.

$$S^2 = [(X_1 - \bar{X})^2 + (X_2 - \bar{X})^2 + \dots + (X_n - \bar{X})^2] / n - 1$$

$$S = (S^2)^{1/2}$$

3. Calculate the standard error of the mean (S_x). Standard error is inversely proportional to the square root of the number of samples (increasing n from 4 to 16 reduces S_x by 50%).

$$Sx = S / (n)^{1/2}$$

4. Since the concern is only whether the upper limit of a confidence interval is below or above the regulatory threshold, the lower confidence limit (LCL) need not be considered. The upper confidence limit (UCL) can be calculated using the onetailed (onesided) t values with n-1 degrees of freedom derived from a table of the Student's t distribution. Where only small sized statistical samples are involved (n<30), the normal or Gaussian distribution is not accurate, and the t distribution must be used.

-29 -

5. The 95% UCL is calculated by using the following formula and substituting the values determined above plus the appropriate t value obtained from the t table.

$$UCL = X + [t_{0.95,(n-1)}] * Sx$$

The term in brackets indicates a one-tailed t-test at n-1 degrees of freedom. See the t-distribution table in Attachment 2.

The UCL number resulting from this formula will indicate with a 95% probability that it is either above or below the regulatory threshold (RT) developed for the constituent being subjected to the test. If a compound does not have a specified RT, then the UCL is compared to whatever concentration is of concern (i.e., a clean up level, action level, etc). Other confidence levels can be used, based on the specific sampling situation.

If the preliminary data indicate that more samples are needed to make a hazard determination, the Lambda relationship should be used. A step by step approach to calculating the appropriate sample size follows:

1. The appropriate number of samples to be collected can be estimated by use of the Lambda relationship and then consulting a table of values and their corresponding sample size number.

$$Lambda = (RT - X) / S$$

The lower the calculated value, the more samples are required to maintain a certain level of confidence. Also, as approaches RT, Lambda becomes smaller, and therefore a greater sample size is indicated for a certain level of confidence.

2. To obtain the appropriate sample size from the table of values, use the single sided value for to test at the desired significance level (for 5%, = 0.05).

3. Randomly collect any additional samples that may be needed using the same grid and random numbers sequence as the first sampling. All field and laboratory procedures should be kept as consistent as possible to lower the amount of variability in the data.

4. Use all data values to calculate new X, S, and Sx.

- 30 -

5. If the new $X \geq RT$, then the contaminant is present at an unacceptable concentration and the study would be complete.

6. If $X < RT$ and $X > S^2$, calculate C (the criterion for determining if contamination is present at hazardous concentration). If $X = S^2$ or $X < S^2$, the data must be transformed prior to calculating C. Using the new data, C is calculated by the formula:

$$C = (RT - X) / Sx$$

7. Compare the calculated C value to the two-tailed t value for the level of significance desired. The two-tailed t-value is used because both the possibility that C is $> t$ or that C is $< t$ must be checked.

Use $t_{0,95}$ and df (degrees of freedom) = n-1.

8. If $C > t$ value, the contaminant is present at unacceptable concentrations and the study would be over. If $C < t$ value, reestimate the total number of additional samples to be collected by deriving a new Lambda. Use the newly calculated values of X and S.

9. If this new number of samples is not more than 20% greater than the last set collected, there is little chance that additional samples would decrease Sx and result in the material being considered unacceptable. Therefore, the study would be complete.

- 31 -

EXAMPLE

CALCULATION OF CONFIDENCE LIMITS AND LAMDA CALCULATION

Problem 1: STATISTICAL SAMPLING

A metal plating factory has been discharging process wastewaters into a large nearby swampy area for several years. This swampy area drains into a small river. The discharged wastewaters are known to be contaminated with very low levels of cadmium and chromium (i.e., the levels in the wastewater are below the facilities NPDES permit limitations). However, it has been suspected that the sediments in this swampy area may contain high levels of cadmium and chromium. Three preliminary sediment samples were taken with a Ponar dredge and analyzed to determine whether or not these sediments were contaminated with hazardous levels of these two metals. In 40 CFR 261.24, it states that a waste is hazardous under the characteristic of EP toxicity if it contains cadmium at a level ≥ 1.0 mg/l or chromium at a level ≥ 5.0 mg/l. The analysis of the three preliminary samples indicated a mean cadmium concentration of 0.37 mg/l (3 samples at 0.25, 0.51, and 0.35 mg/l) and a mean chromium concentration of 4.66 mg/l (3 samples at 4.93, 4.21, and 4.84 mg/l). Based on this analytical data, the cadmium level is well below the regulatory threshold (RT), but

the chromium level closely approaches its RT. Because large legal or monetary losses may be incurred if the sediments are declared hazardous, the analytical data must be sound and a high degree of confidence is necessary in any decision made.

QUESTIONS: Given the above scenario, answer the following questions and calculate the appropriate answers.

1. Based on the chromium data supplied

Calculate S^2 , S, S_x

Calculate the 95% UCL

With what degree of confidence can it be stated that the chromium concentration does not exceed the RT?

2. If more samples are deemed necessary, determine how many

Calculate the Lambda value

Calculate the appropriate number of additional samples using $\alpha=0.05$ and $\beta=0.05$

-32-

PROBLEM 1 ANSWER SHEET

Given three samples with chromium concentrations of 4.93, 4.21, and 4.84 mg/l and

$$\bar{X} = 4.66 \text{ mg/l}$$

(1a) Calculate S^2

$$\begin{aligned} S^2 &= [(X_1 - \bar{X})^2 + (X_2 - \bar{X})^2 + \dots + (X_n - \bar{X})^2] / n - 1 \\ &= [(4.93 - 4.66)^2 + (4.21 - 4.66)^2 + (4.84 - 4.66)^2] / 2 \\ &= 0.15 \end{aligned}$$

Calculate S

$$S = (S^2)^{1/2} = (0.15)^{1/2} = 0.39$$

Calculate S_x

$$S_x = S/(n)^{1/2} = 0.39/(3)^{1/2} = 0.23$$

(1b) Calculate the 95% UCL

$$\begin{aligned} 95\% \text{ UCL} &= X + [t_{0.95,(n-1)}] * Sx \\ &= 4.66 + (2.920) * (0.23) \\ &= 5.33 \end{aligned}$$

(1c)

$$\begin{aligned} 90\% \text{ UCL} &= X + [t_{0.90,(n-1)}] * Sx \\ &= 4.66 + (1.886) * (0.23) \\ &= 5.09 \end{aligned}$$

$$\begin{aligned} 80\% \text{ UCL} &= X + [t_{0.80,(n-1)}] * Sx \\ &= 4.66 + (1.061) * (0.23) \\ &= 4.90 \end{aligned}$$

- 33 -

The preceding two calculations indicate that it can be stated with somewhere between 80% and 90% confidence that the chromium concentration does not exceed the RT. This degree of confidence may not be sufficient to meet the needs of the sampling plan. Therefore, more samples may need to be taken.

2a. Calculate the Lambda value

$$\begin{aligned} \text{Lambda} &= (RT - X) / S \\ &= (5.0 - 4.66) / 0.39 = 0.87 \end{aligned}$$

2b. Calculate the number of additional samples

Using Attachment 2, Number of Observations for t Test of Mean, page 36 of this Guidance Document, using a single-sided test with $\alpha=0.05$ and $\beta=0.05$, approximately 15 to 17 total samples need to be collected. Therefore, based on the three preliminary samples that were collected, an additional 13 samples need to be taken.

Cumulative t Distribution

	0.550	0.750	0.080	0.900	0.950	0.975	0.990
one-tailed	0.100	0.500	0.600	0.800	0.900	0.950	0.980
two-tailed							
1	0.158	1.000	1.376	3.078	6.314	12.706	31.82
2	0.142	0.816	1.061	1.886	2.920	4.303	6.925
3	0.137	0.765	0.978	1.638	2.353	3.182	4.541
4	0.134	0.741	0.941	1.533	2.132	2.776	3.747
5	0.132	0.727	0.920	1.476	2.015	2.571	3.365
6	0.131	0.718	0.906	1.440	1.943	2.447	3.143
7	0.130	0.711	0.896	1.415	1.895	2.365	2.998
8	0.130	0.706	0.889	1.397	1.860	2.306	2.896
9	0.129	0.703	0.883	1.383	1.833	2.262	2.821
10	0.129	0.700	0.879	1.372	1.812	2.228	2.764
11	0.129	0.697	0.876	1.363	1.796	2.201	2.718
12	0.128	0.695	0.873	1.356	1.782	2.179	2.681
13	0.128	0.694	0.870	1.350	1.771	2.160	2.650
14	0.128	0.692	0.868	1.345	1.761	2.145	2.624
15	0.128	0.691	0.866	1.341	1.753	2.131	2.602
16	0.128	0.690	0.865	1.337	1.746	2.120	2.583
17	0.128	0.689	0.863	1.333	1.740	2.110	2.567
18	0.127	0.688	0.862	1.330	1.734	2.101	2.552
19	0.127	0.688	0.861	1.328	1.729	2.093	2.539
20	0.127	0.687	0.860	1.325	1.725	2.086	2.528
21	0.127	0.686	0.859	1.323	1.721	2.080	2.518
22	0.127	0.686	0.858	1.321	1.717	2.074	2.508
23	0.127	0.685	0.858	1.319	1.714	2.069	2.500
24	0.127	0.685	0.857	1.318	1.711	2.064	2.492
25	0.127	0.684	0.856	1.316	1.708	2.060	2.485
26	0.127	0.684	0.856	1.315	1.706	2.056	2.479
27	0.127	0.684	0.855	1.314	1.703	2.052	2.473
28	0.127	0.683	0.855	1.313	1.701	2.048	2.467
29	0.127	0.683	0.854	1.311	1.699	2.045	2.462
30	0.127	0.683	0.854	1.310	1.697	2.042	2.457
40	0.126	0.681	0.851	1.303	1.684	2.021	2.423
60	0.126	0.679	0.848	1.296	1.671	2.000	2.390
120	0.126	0.677	0.845	1.289	1.658	1.980	2.358
	0.126	0.674	0.842	1.282	1.645	1.960	2.326

NOTE: For one-tailed distributions $a/2 = 1-p$
 For two-tailed distributions $a = 1-p$

NUMBER OF OBSERVATIONS FOR t TEST OF MEAN
Level for t Test

	A=0.005					A=0.01					A=0.025			
	A=0.01					A=0.02					A=0.05			
B=0.01	0.05	0.1	0.2	0.5	0.01	0.05	0.1	0.2	0.5	0.01	0.05	0.1	0.2	

LAMBDA															
0.15															
0.20										139					
0.25					110					90				128	
0.30				134	78					115	63		119	90	
0.35			125	99	58			109	85	47		109	88	67	
0.40		115	97	77	45			101	85	66	37	117	84	68	51
0.45		92	77	62	37	110		81	68	53	30	93	67	54	41
0.50	100	75	63	51	30	90		66	55	43	25	76	54	44	34
0.55	83	63	53	42	26	75		55	46	36	21	63	45	37	28
0.60	71	53	45	36	22	63		47	39	31	18	53	38	32	24
0.65	61	46	39	31	20	55		41	34	27	16	46	33	27	21
0.70	53	40	34	28	17	47		35	30	24	14	40	29	24	19
0.75	47	36	30	25	16	42		31	27	21	13	35	26	21	16
0.80	41	32	27	22	14	37		28	24	19	12	31	22	19	15
0.85	37	29	24	20	13	33		25	21	17	11	28	21	17	13
0.90	34	26	22	18	12	29		23	19	16	10	25	19	16	12
0.95	31	24	20	17	11	27		21	18	14	9	23	17	14	11
1.00	28	22	19	16	10	25		19	16	13	9	21	16	13	10
1.1	24	19	16	14	9	21		16	14	12	8	18	13	11	9
1.2	21	16	14	12	8	18		14	12	10	7	15	12	10	8
1.3	18	15	13	11	8	16		13	11	9	6	14	10	9	7
1.4	16	13	12	10	8	14		11	10	9	6	12	9	8	7
1.5	15	12	11	9	7	13		10	9	8	6	11	8	7	6
1.6	13	11	10	8	6	12		10	9	7	5	10	8	7	6
1.7	12	10	9	8	6	11		9	8	7		9	7	6	5
1.8	12	10	9	8	6	10		8	7	7		8	7	6	
1.9	11	9	8	7	6	10		8	7	6		8	6	6	
2.0	10	8	8	7	5	9		7	7	6		7	6	5	
2.1	10	8	7	7		8		7	6	6		7	6		
2.2	9	8	7	6		8		7	6	5		7	6		
2.3	9	7	7	6		8		6	6			6	5		
2.4	8	7	7	6		7		6	6			6			
2.5	8	7	6	6		7		6	6			6			
3.0	7	6	6	5		6		5	5			5			
3.5	6	5	5			5									
4.0	6														

99% confidence

SAMPLING PROCESS STREAMS

Although sampling is generally thought to occur on a pile of material or over an area of treated soil, other schemes are possible. The most common instance is when the material is to be sampled at the point of generation. This is the preferred method, since it is most representative of the material under study. The lack of exposure to elements that might cause chemical degradation and/or leaching will result in material most indicative of actual conditions.

A sampling point along the material conveyor that can be fairly easily and safely reached should be chosen. It should be in an area where the entire belt can be accessed for sampling.

Under this scenario, a temporal, rather than a spatial, approach needs to be used.

Time stratum should be established over the course of the process day. Ideally, the entire active time of the line should be included in the sampling scheme. Once time strata are chosen, the random numbers table can be used to establish sampling times. For a four hour period, a point somewhere on the table would be chosen and every number greater than 0 but less than 240 would be selected until the number of samples for that strata were obtained. The number would relate to time in minutes. This would be added to the starting time for that strata to determine the time of sampling.

If the time strata chosen are of unequal lengths, the number of samples chosen from any one strata should reflect the percentage contribution that strata makes to the time frame as a whole. For example, if for a 24 hour operating time, strata 1 is 4 hours and strata 2 is 8 hours, strata 2 should have twice as many samples as strata 1.

When the appropriate sampling time arrives, the material from the conveyor belt point that had been identified would be removed. This material should be well mixed and a subsample taken for inclusion in the jar for lab analysis. An example of the use of this protocol is attached.

- 37 -

RANDOM TIME WASTE SAMPLING EXAMPLE

	Sampling Point	Random Minute	Time
Stratum #1			
6:00 to 8:00 hours	1	28	6:28
	2	62	7:02
	3	99	7:39
	4	112	7:52
Stratum #2			
8:00 to 20:00 hours	1	11	8:11
	2	107	9:47
	3	156	10:36
	4	173	10:53
	5	296	12:56
	6	313	13:13
	7	398	14:38
	8	497	16:17
	9	555	17:15
	10	600	18:00
	11	637	18:37
	12	706	19:46
Stratum #3			
20:00 to 22:00 hours	1	13	20:13
	2	52	20:52
	3	88	21:28
	4	108	21:48
Stratum #4			

8:00 to 20:00 hours	1	48	22:48
	2	113	23:53
	3	153	24:33
	4	189	1:09
	5	227	1:47
	6	290	2:49
	7	314	3:14
	8	474	5:44

- 38 -

ATTACHMENT 3

TOLERANCE FACTORS (K)

TOLERANCE FACTORS (K) FOR ONE-SIDED NORMAL TOLERANCE INTERVALS WITH PROBABILITY
Y = 0.95 AND COVERAGE P = 95%

n	K	n	K
3	7.655	75	1.972
4	5.145	100	1.924
5	4.202	125	1.891
6	3.707	150	1.868
7	3.399	175	1.850
8	3.188	200	1.836
9	3.031	225	1.824
10	2.911	250	1.814
11	2.815	275	1.806
12	2.736	300	1.799
13	2.670	325	1.792
14	2.614	350	1.787
15	2.566	375	1.782
16	2.523	400	1.777
17	2.486	425	1.773
18	2.453	450	1.769
19	2.423	475	1.766
20	2.396	500	1.763
21	2.371	525	1.760
22	2.350	550	1.757
23	2.329	575	1.754
24	2.309	600	1.752
25	2.292	625	1.750
30	2.220	650	1.748
35	2.166	675	1.746
40	2.126	700	1.744
45	2.092	725	1.742
50	2.065	750	1.740
55	2.036	775	1.739
60	2.017	800	1.737
65	2.000	825	0.736
70	1.986	850	1.734
		875	1.733
		900	1.732
		925	1.731
		950	1.729
		975	1.728

1,000

1.727

SOURCE: FOR SAMPLE SIZES < 50: Lieberman, Gerald F. 1958. "Tables for One-sided Statistical Tolerance Limits." Industrial Quality Control. Vol. XIV, No. 10.

FOR SAMPLE SIZES > 50: K values were calculated from large sample approximation.

NTIS Document PB-89-151-047

- 39 -

ATTACHMENT 4

WASTE MANAGEMENT DIVISION'S

CLEAN CLOSURE CERTIFICATION CHECKLIST

This checklist was developed to review RCRA clean closures. Due to direct reference to 40 CFR, Part 264, Subpart G, by Act 64, Rule 613; Act 64 closures should also be evaluated by this checklist.

Documentation supporting the owners/operators and the independent registered professional engineer's certification can be requested under 40 CFR, 264.115 and 265.115 (as of October 29, 1986). The owner/operator must submit at least four copies of certification documentation.

The checklist identifies items recommended to properly evaluate a closure certification. These items are not "absolutes." Other information or substitutions may be provided which technically justify and certify a "clean closure."

This checklist can be used for land disposal, storage, and treatment facilities. Several of the items would not be required for storage and/or treatment facilities where testing was minimal. Items 1 through 5 would be required for all closures. Items 6 through 11 would be optional for storage and/or treatment facilities, dependent on extent of testing required. Land disposal facilities would require all items listed.

1. Manifests (or some type of manifest/waste removal summary) of where and how much waste was shipped.
2. Certification statement is needed by the owner/operator AND an independent registered engineer. All independent registered professional engineer certificates must have an original stamp on at least one copy.
3. Summary of decontamination procedures (pressure wash, Steam clean, etc.) and how the resultant waste water was disposed.
4. Summary analysis (include conditions of haul roads, time table, soil and groundwater

results, weather conditions, runoff controls, equipment decontamination, etc.).

5. Results of all tests used to determine clean closure (charts, tables, lab sheets).
6. Statistical comparisons on sampling results compared to cleanup criteria (this should include full computations on background and statistical analysis).
7. Sampling and analysis procedures (specify references).
8. Final depth and elevations of excavations of wastes and soils.

- 40 -

9. Properly labeled and easily identified sampling locations and grid stations (map) including background stations.
10. Groundwater data (and statistical evaluation) used to determine if groundwater degradation has occurred (usually four sets of replicate analysis compared to sampling event after closure activities). Monitor well construction details and sampling and analysis procedures may be required if documentation is not in the file.
11. Summary of final restoration of excavated area... information on fill material used and/or future land use outline. If clean closure cannot be achieved (e.g., contaminated soils to water table and groundwater results show contamination). This summary item should be used to address the need for any post closure program and/or corrective action.
12. A copy of all field notes pertaining to these closure activities.
13. A copy of the approved closure plan and letter of closure plan approval.

- 41 -

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Return to  home page
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Questions or Comments; Send e-mail to: DEQ-WMD-WEB@michigan.gov

Revised November 15, 2001

<http://www.deq.state.mi.us/wmd/docs/vsr.html>

Appendix D

Environmental Conditions Report

Environmental Conditions Report

Naval Construction Battalion Center Gulfport, Mississippi

Phase 3 Dioxin Contaminated Ditch Soil Excavation Activities

Revision 00

Contract No. N62467-98-D-0995
Contract Task Order No. 0030

Submitted to:

**U.S. Naval Facilities
Engineering Command
Southern Division**

Prepared by:



115 Perimeter Center Place, N.E.
Suite 700
Atlanta, GA 30346

June 2002

Contents

1.0 Introduction	1
1.1 Purpose.....	1
1.2 Scope.....	1
2.0 Environmental Conditions.....	1
2.1 Excavation of Dioxin Contaminated soils from ditches located in Areas 8A, B and 8 C.....	1
2.2 Existing Environmental Conditions.....	1
3.0 References	3

Appendices

- A Pre-Construction Activity Photographs

Acronym List

CCI	CH2M HILL Constructors, Inc.
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-term Environmental Action Navy
COTR	Contracting Officer's Technical Representative
CS	Contract Specialist
CSO	Caretaker Site Office
CTO	Contract Task Order
EPA	U.S. Environmental Protection Agency
FAR	Federal Acquisition Regulations
NAVFAC	Naval Facilities Engineering Command
NGVD	National Geodetic Vertical Datum
NIST	National Institute of Standards and Technology
NOR	Notice of Registration
NRC	National Response Center
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Project Manager
TBD	to be determined

Introduction

CH2M HILL Constructors, Inc. (CCI) has been contracted by the Department of the Navy, Southern Division Naval Facilities Engineering Command (Southern Division, NAVFAC), to prepare this site-specific Work Plan Addendum for the removal of dioxin contaminated soil from ditches in Areas 8A, 8B and 8C and the construction of a storage cell in Area 8A at the Naval Construction Battalion Center (NCBC) Gulfport, Mississippi. This work is being performed under the Remedial Action Contract No. N62467-98-D-0995, Contract Task Order (CTO) No. 0030.

In accordance with the *Basewide Work Plan*, CCI is to conduct an environmental conditions survey for each project site prior to the start of construction. Construction activities associated with remediation involve removal of dioxin contaminated soil from ditches in Areas 8A, 8B and 8C and the construction of a storage cell in Area 8A.

1.1 Purpose

The purpose of this Environmental Conditions Report is to document, by narrative and photographs, the existing conditions at the project site prior to remediation activities.

1.2 Scope

Each project site is surveyed to record the pre-construction conditions of the site. The condition of grassy areas, trees, shrubs, paving, gutters, curbs, buildings/structures, and any disturbed areas (e.g., stressed vegetation, staining, or evidence of previous construction activity) are photographed in the survey. Additionally, photographs of haul roads, decontamination pad areas, storage areas, and staging areas are also included in this survey.

Environmental Conditions

A discussion of the planned remediation activities and a description of pre-construction environmental conditions for Areas 8A, 8B and 8C are presented in this section of the report.

2.1 Excavation of Dioxin-contaminated soils from ditches located in Areas 8A, 8B , 8C and construction of a waste disposal cell in Area 8A.

- CCI will perform clearing and grubbing of ditch lines and the waste disposal cell area in Area 8A, and construct a waste disposal cell approximately 175 feet wide by 175 feet long surrounded by an earthen berm approximately 1 foot high and 10 feet wide. CCI will also complete excavation of dioxin-contaminated soils from ditches located in Areas 8A, 8B, and 8C. The first 2 feet of soil from the ditches will be removed, transported, and deposited in the new disposal cell in Area 8A. CCI will install an earthen cover over the dioxin -contaminated soil. CCI will also provide grading and compaction of the newly excavated ditch surface to provide available drainage. CCI will also conduct site restoration of areas impacted by the work prior to site demobilization.

The environmental conditions survey for this work was conducted by CCI during May 2002. Photographs taken to document the existing environmental conditions of the site are included in Appendix A of this report.

2.2 Existing Environmental Conditions

The area now known as Site 8 at the Naval Construction Battalion Center, Gulfport, Mississippi was used as an equipment storage and staging area prior to 1968. Between 1968 and 1977, the area was used by the U.S. Air Force as a storage and handling area for Herbicide Orange (HO) in support of the defoliation program in Vietnam known as Operation Ranchland. Spills and leaks of HO occurred at all three areas of Site 8 contaminating the surface soil and sediment with the mixture components, 2,4,5-T and 2,4-D; as well as the byproduct contaminants (dioxins and furans)-primarily (TCDD). The HO drums were removed from Site 8 in 1977 and placed on an incinerator ship for destruction. The confirmation that dioxins were released during storage activities was established in 1977; and the site was fenced and left inactive until 1985.

Between 1985 and 1987 Site 8 was remediated to the standards that existed at that time (1 ppb- part per billion). The excavated soil and sediment above that level was incinerated and placed on Site 8, Area A. Between 1987 and January 2002, access has been restricted and no base operations have been conducted within site boundaries. Since January 2001, a new rail-loading ramp has been constructed on the south side of Area 8A. There are no current actions taking place on Areas B and C.

The Navy is undertaking this removal action for Site 8, Areas A, B and C, on behalf of NCBC Gulfport. While no emergency response action has been requested by MDEQ, the investigation and long term remediation of herbicide orange related chemicals has been mandated by MDEQ through administrative actions resulting in the Agreed Order No. 3466-97 (Agreed Order). The Agreed Order will continue to serve as the authority studies removal actions. In addition, City and County ordinances for the protection of trees and drainage system modifications will be adhered

The area surrounding Area 8 is relatively flat with a sandy soil covering. Area 8 is bordered by two existing streets that define the north and west perimeter of the area and one street that separates area 8B from area 8C

Area 8B primarily consists of stressed grasses, low lying scrubs and young pine trees ranging from 4 to 10 feet in height. Along the northwest side of Area 8B, the majority of the vegetation seems to be stressed grasses and fledgling pine trees. The southwest section of the landscape consists of mid-sized shrubs and bushes, stressed vegetation, grasses and, low-lying trees.

Area 8 C contains a concrete along the ditch line that will be removed during site clearance. The trees will be cut and chipped for mulch. A ditch containing sediment and concrete will be removed during site clearance located along Area 8C. The landscape is similar to Area 8B in that mid-sized shrubs and bushes stressed vegetation, grasses and, low-lying trees cover it. A container storage area borders the southwest perimeter of Area 8C.

References

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CH2M HILL Constructors, Inc. May 2002. *Work Plan Addendum Number 00, Phase 3 Dioxin Contaminated Ditch Soil Excavation Activities*, Naval Construction Battalion Center (NCBC) Gulfport, Mississippi. Submitted to U.S. Naval Facilities, Engineering Command, Southern Division.

Appendix A

Pre-Construction Activity Photographs



Area 8A, Southwest View



Area 8B, Northwest View



Area 8B Ditch, Southwest View



Area 8B, North View

Appendix E

Quality Control Attachments

- Submittal Register
- Testing Plan and Log
- Project QC Manager Letter of Appointment



CH2M HILL
115 Perimeter Center Place, N.E.
Suite 700
Atlanta, GA
30346-1278
Tel 770.604.9095
Fax 770.604.9282

September 9, 2002

William Knox
CH2M HILL
115 Perimeter Center Place, N.E.
Suite 700
Atlanta, GA 30346

RE: Contract No. N62467-98-D-0995
Contract Task Order No. 0030
Naval Construction Battalion Center (NCBC) Gulfport, Mississippi
Project Quality Control Manager Letter of Appointment

Dear Mr. Knox:

Herein describes the responsibilities and authority delegated to you in your capacity as the Project QC Manager on the NCBC Gulfport, Mississippi site, Contract Task Order (CTO) 0030 under the Navy RAC Contract # N62467-98-D-0995.

In this position, you assist and represent the Program QC Manager in continued implementation and enforcement of the Project QC Plans. Your primary role is to ensure all requirements of the contract are met. Consistent with this responsibility, you will: (i) implement the QC program as described in the Navy RAC contract; (ii) manage the site-specific QC requirements in accordance with the Project QC Plans; (iii) attend the coordination and mutual understanding meeting; (iv) conduct QC meetings; (v) oversee implementation of the three phases of control; (vi) perform submittal review and approval; (vii) ensure testing is performed; (viii) prepare QC certifications and documentation required in the Navy RAC Contract; and, (ix) furnish a Completion Certificate to the Contracting Officer or designated representative, upon completion of work under a contract task order, attesting that "the work has been completed, inspected, and tested, and is in compliance with the contract."

Your responsibilities further include identifying and reporting quality problems, rejecting nonconforming materials, initiating corrective actions, and recommending solutions for nonconforming activities.

You have the authority to control or stop further processing, delivery, or installation activities until satisfactory disposition and implementation of corrective actions are achieved. You have the authority to direct the correction of non-conforming work. All work requiring corrective action will be documented on daily reports, and, in the event non-conforming work is not immediately corrected you are required to submit a non-conformance report to the PM and copy the Program QC Manager. A status log will be kept of all non-conforming work. You shall immediately notify the Program QC Manager in the event of any stop work order.

It is imperative that you comply with all terms of the basic contract. In particular, Section C, Paragraph 6.5.2, which states:

“No work or testing may be performed unless the QC Program Manager or Project QC Manager is on the work site.”

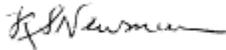
In the event that you are not able to be at the work site when work or testing is to be performed, it is your responsibility to inform the Program QC Manager and Project Manager, in advance, so that other arrangements can be made.

Further, if you are requested to perform the duties of the Site Supervisor, it is your responsibility to inform the Program QC Manager so that approval can be obtained in advance from the Contracting Officer or designated representative, in accordance with Section C Paragraph.6.2.1 of the contract.

You are a key member of the Project Manager’s team. You ensure that work meets the specific requirements and intent of the work plan, the Navy’s scope of work and the basic contract. Should you have any questions regarding this role, you should immediately contact the Program QC Manager, Theresa Rojas. Your day-to-day activities on the site should be coordinated with all site personnel and the Project Manager. In event of any deficient items, the Superintendent and Project Manager should be advised immediately so they have opportunity to remedy the situation.

Sincerely,

CH2M HILL Constructors, Inc.



R. Scott Newman
Program Manager

cc: Steve Tsangaris/TPA
Theresa Rojas/ATL
CCI Project File No. 154917