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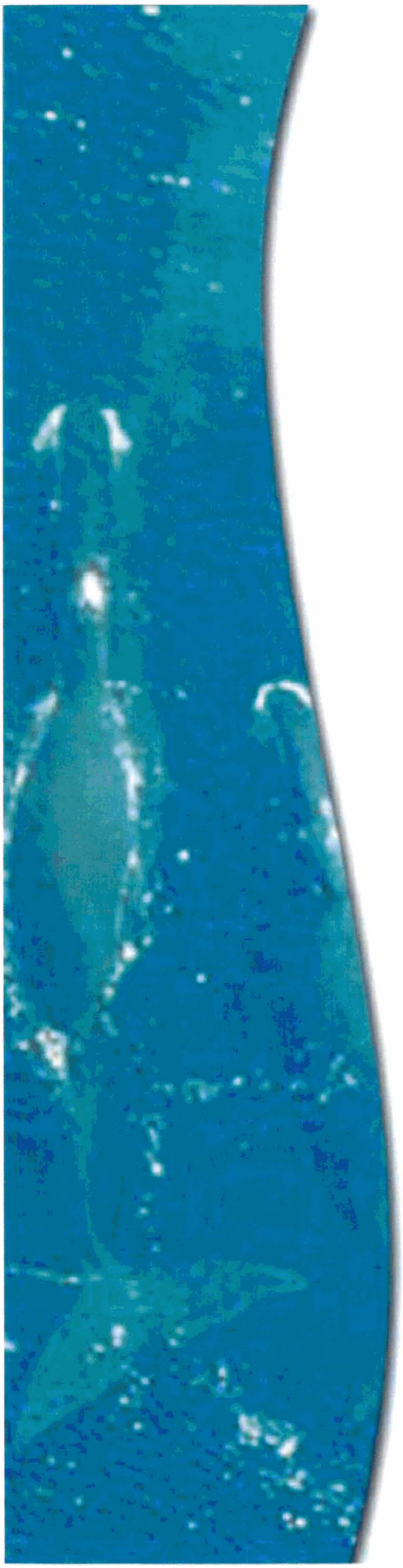

FINAL

Pilot Study Work Plan
Site 73, Operable Unit No. 21

Marine Corps Base
Camp Lejeune, North Carolina

Prepared for

NAVFAC
Naval Facilities Engineering Command

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command
Norfolk, Virginia

Contract No. N62470-03-D-4401
Task Order-0071

November 2006

Prepared by

AGVIQ
ENVIRONMENTAL SERVICES
CH2M HILL
JOINT VENTURE

QC Review Page

Phase 2 Pilot Study Work Plan

OU No. 21, Site 73

MCB Camp Lejeune

Jacksonville, North Carolina

Task Order Number - 0071
Contract Number N62470-03-D-4401
AGVIQ-CH2M HILL JV I Program

Prepared by

AGVIQ-CH2M HILL JV I

November 2006

Approved by: Christopher Bozzini

Date: 11/29/2006

Christopher Bozzini, P.E.
Senior Consultant, CH2M HILL

Approved by: Jessica Skeean

Date: 11/29/2006

Jessica Skeean, P.E.
Project Manager, CH2M HILL

FINAL

Phase 2 Pilot Study Work Plan
Site 73, Operable Unit No. 21

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Prepared for

NAVFAC
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Department of the Navy
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Mid Atlantic Division
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Under
Contract No. N62470-03-D-4401
TO 0071

Prepared by

AGVIQ
AGVIQ ENVIRONMENTAL SERVICES
CH2M HILL
JOINT VENTURE

November 2006

Executive Summary

This work plan describes the objectives and activities for Phase 2 of a pilot study being conducted at Site 73. The study will evaluate the performance and effectiveness of ozone enhanced air sparging using a horizontal well for the purpose of groundwater remediation. Groundwater at Site 73 is impacted by chlorinated volatile organic compounds (cVOCs), primarily trichloroethylene (TCE).

A pilot test was performed at the site from March 18, 2004 to May 26, 2005 by MicroPact Engineering (MicroPact) to evaluate hydrogen gas sparging. The study involved the installation of a horizontal directional drilled (HDD) well and periodic, pulsed injection of pure hydrogen gas into the HDD well, with the objective of enhancing biological reductive dechlorination of CVOCs. It was concluded that not enough hydrogen was used in the study, since hydrogen was not detected in monitoring wells above background levels at any time during the pilot test period and total VOCs decreased only 8%during the test.

Groundwater contamination appears to have migrated horizontally in the direction of groundwater flow, towards Courthouse Bay. Groundwater contamination appears to be concentrated generally in the deep aquifer, with the highest concentrations detected at depths between 70 and 75 feet bgs.

The scope of work for the pilot study will consist of the following:

- Retrofitting the existing horizontal well
- Installation of four soil gas monitoring wells
- Transfer of equipment from Site 86 to Site 73
- System start-up, operation, maintenance, and monitoring

The monitoring plan for the sparging pilot study at Site 73 will address groundwater sampling and ambient air monitoring prior to and after startup. A pilot study report will be prepared after completion of the test to summarize installation, operation, and monitoring results.

The effectiveness of the test will be evaluated according to the following criteria:

1. Contaminant reduction in groundwater, as quantified by pre- and post-startup groundwater samples.
2. Minimization of contaminant mobility, as quantified by comparing groundwater analytical data collected prior to, and during the pilot test.

Table of Contents

Tables

Figures

Appendix

Acronyms and Abbreviations

ASTs	Above ground Storage Tanks
Baker	Baker Environmental, Inc.
bgs	below ground surface
cfm	cubic feet per minute
cis-1,2-DCE	cis-1,2-Dichloroethene
CVOCs	Chlorinated Volatile Organic Compounds
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
DOI	distance of influence
DOT	Department of Transportation
DPT	Direct Push Technology
EPA	Environmental Protection Agency
ft	feet
ft/day	feet per day
FTL	Field Team Leader
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
HSP	Health and Safety Plan
IDW	Investigative-Derived Waste
JVI	AGVIQ/CH2M HILL Joint Venture I
MCB	Marine Corps Base
µg/L	micrograms per liter
NAVFAC	Naval Facilities Engineering Command
NCDENR	North Carolina Department of Environmental and Natural Resources
NCGWQS	North Carolina Groundwater Quality Standards
O&M	Operations and Maintenance
ORP	Oxidation-Reduction Potential
OU	Operational Unit
PHSM	Project Health and Safety Manager
PM	Project Manager

ppm_v	parts per million (by volume)
psi	pounds per square inch
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/ Quality Control
QAPP	Quality Assurance Project Plan
RAC	Remedial Action Contractor
SAP	Sampling and Analysis Plan
SDR	Standard Dimension Ratio
SHSP	Site-Specific Health and Safety Plan
SSC	Site Safety Coordinator
SVE	Soil Vapor Extraction
TCE	Trichloroethylene
USEPA	United States Environmental Protection Agency
UST	Underground storage tank
VC	Vinyl Chloride
VOCs	Volatile Organic Compounds

1. Introduction

This plan describes the objectives and activities for Phase 2 of a pilot study that will be conducted at Operable Unit (OU) 21, Site 73, the Amphibious Vehicle Maintenance Facility, Marine Corp Base (MCB) Camp Lejeune, in Onslow County, North Carolina. The purpose of the study will be to evaluate the effectiveness of air and ozone sparging for removal of trichloroethylene (TCE) and associated chlorinated volatile organic compounds (CVOCs). The test will be performed using an existing horizontal directionally drilled (HDD) well, that was installed by Baker Environmental, Inc. (Baker) in February, 2004.

1.1. Project Overview

Activities associated with this pilot test include baseline sampling, equipment relocation, start-up, and operation and maintenance for a period of one year. The pilot test objectives, implementation, and monitoring activities are discussed in Sections 3.0, 4.0, and 5.0 of this work plan.

1.2. Work Plan Organization

This Work Plan consists of nine sections. Brief descriptions of the sections and appendices are presented as follows:

1.0 – Introduction — Presents an overview of the project and work plan.

2.0 – Site Background – Presents the site background, conditions, and test area information.

3.0 – Pilot Study Design — Presents an overview of ozone sparging technology and a conceptual technical approach for the pilot test.

4.0 – Pilot Study Implementation – Presents how the study will be conducted.

5.0 – Pilot Study Monitoring— Describes the project sample collection locations, the frequency of sampling, and analysis of data.

6.0 – Health and Safety Considerations — Outlines issues to be presented in the Site Health and Safety Plan for the project.

7.0 – Reporting — Describes the reporting that will be completed as part of the project.

8.0 – Schedule and Project Organization —Provides the project schedule.

9.0 – References —Provides the references used in this document

Figures accompanying the main text of this plan are at the end of each section.

The Master Project Plans which include the Master Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), and Master Health and Safety Plan (HSP) will be

followed. A Site-specific Health and Safety Plan (SHSP) will be prepared to address specific health and safety issues related to conducting the pilot study activities at the site.

2. Site Background

Information concerning site characterization, contaminant concentrations, plume distribution, and subsurface geology/hydrogeology is documented in the *Amended Remedial Investigation of Operable Unit 21 (Site 73)* (CH2M HILL, 2006). A summary of this information is provided in the following paragraphs.

2.1 Site Description

Site 73 is located in the Courthouse Bay Area of MCB Camp Lejeune (as shown on **Figure 2-1**) and serves as the Amphibious Vehicle Maintenance Facility, which started operations in 1946 and is still active. Site 73 consists of numerous buildings, aboveground storage tanks (ASTs), underground storage tanks (USTs), vehicle wash racks, and oil/water separators. Most active and former USTs are or were located within the fenced area around Building A47. Non-petroleum type wastes are routinely handled at an active Hazmat Storage Area located near UST A47/3. Other active and former USTs are or were located near Buildings A1, A2, and A10. **Figure 2-2** shows a map of the site.

The primary contaminants of concern at Site 73 are the chlorinated solvent compounds TCE, 1,1-DCE, cis-1,2-dichloroethene (*cis*-1,2-DCE), vinyl chloride (VC), and benzene. Exceedences of comparison criteria, North Carolina Groundwater Quality Standards (NCGWQS, 2L standards), were observed in both the shallow and deep aquifers at Site 73.

2.2 Geology and Hydrogeology

Site 73 is underlain by the Belgrade Formation, a semi-confining unit that typically separates the surficial and Castle Hayne aquifer; however, based on hydraulic head differentials, it does not appear that this unit is restricting flow from the surficial aquifer to the Castle Hayne aquifer. Geologic cross-section locations are shown on **Figure 2-3** and stratigraphic cross-sections are presented on **Figures 2-4** and **2-5**. During the April 2006 well gauging event, the water table was at a depth ranging from 1.08 feet to 12.18 feet below ground surface (ft bgs) within the vicinity of the Amphibious Vehicle Maintenance Facility. The groundwater contours for the surficial and Castle Hayne aquifers based on April 2006 measurements are depicted on **Figures 2-6** and **2-7**, respectively. In general, groundwater flow direction within the shallow aquifer of Site 73 is to the south/southeast, towards Courthouse Bay. However, mounding effects in the water table create some localized radial flow within the vicinity of Buildings A3 and A11. The average horizontal conductivity of the shallow aquifer is approximately 1.3 feet per day (ft/day). The bottom of the shallow aquifer averages 41 ft bgs. The fine silty and clayey sand of the Belgrade formation is laterally discontinuous at Site 73 and therefore may only provide semi-confining conditions to the deep unit below.

Within the deep (Castle Hayne) unit, groundwater flow was determined to be generally southeast toward Courthouse Bay. The average horizontal conductivity of the upper Castle

Hayne aquifer is approximately 3.6 ft/day, with a horizontal hydraulic gradient of approximately 0.002 ft/ft. Vertical hydraulic potentials calculated between the shallow and deep zones generally indicate a slight downward potential, ranging from 0.005 to 0.054 ft/ft. Variability may be due to lateral discontinuity of the Belgrade formation and heterogeneity of soils underlying Site 73.

2.3 Nature and Extent of Contamination

Based on field investigations associated with the Amended RI, each groundwater contamination plume achieves the highest concentrations beneath the paved area associated with Building A47. Contaminants detected in the shallow aquifer (TCE, vinyl chloride, and benzene) appear to originate in the northeast corner of the concrete pad, in the vicinity of UST A47-3. Contaminants detected in the deep aquifer (TCE, 1,1-DCE, cis-1,2-DCE, vinyl chloride, and benzene) achieve the highest concentrations in either 73-MW44DW or 73-MW49DW, located within the approximate footprint of the former maintenance building and in the suspected vicinity of UST A47-1. **Figures 2-8** and **2-9** summarize the CVOC concentrations in the shallow and deep aquifers, respectively. These results suggest that CVOC contamination in both aquifers is a result of historic liquid disposal activities conducted at Site 73. Additionally, the results indicate that benzene contamination in the shallow and deep aquifers may be associated with USTs A47-3, and A47-1, respectively. The subsurface beneath the concrete pad between Building A47 and Courthouse Bay is the target area.

Groundwater contamination appears to have migrated horizontally in the direction of groundwater flow, towards Courthouse Bay. Groundwater contamination appears to have migrated vertically downward, but NCGWQS exceedances have not been detected beyond 110 ft bgs.

Groundwater contamination appears to be concentrated generally in the deep aquifer, with the highest concentrations detected at depths between 70 and 75 feet bgs.

There is no evidence of dense non-aqueous phase liquid (DNAPL) source areas.

2.4 Phase 1 Pilot Study - Hydrogen Sparging (2004 – 2005)

MicroPact Engineering (MicroPact) performed a pilot test at the site to evaluate hydrogen gas sparging from March 18, 2004 to May 26, 2005. MicroPact installed a HDD well for the study in February 2004. The pilot test involved periodic, pulsed injection of pure hydrogen gas into the HDD well, with the objective of enhancing biological reductive dechlorination of CVOCs. The following overview of the hydrogen sparging pilot study was summarized from the draft Pilot Study Report for Site 73 (MicroPact Engineering, Inc. and Baker Environmental, 2006).

Approximately 40 separate injection events were performed periodically over the 15 month study period, during which hydrogen gas was sparged at flow rates ranging from 15 to 400 cubic feet per minute (cfm) into the Upper Castle Hayne aquifer via the HDD well. Each injection event was completed in less than a half-hour.

Hydrogen was not detected in monitoring wells above background levels at any time during the pilot test period. Helium was injected as a tracer gas during at least two events; however, it was detected in only one well (73-MW63DW), during one of the sampling events. An overall VOC reduction of only 8% was achieved.

The HDD well at Site 73 was designed for injection of gases (preferably air) because of the very low open area (approximately 0.5%). Air sparging will be used to determine if 1) the well is performing adequately (i.e. if flow can be achieved along the entire length of the well, and 2) to determine if performance similar to Site 86 can be duplicated at Site 73, in terms of TCE removal. Air sparging will be performed on a continuous basis. The air sparge distance of influence (DOI) will be verified by dissolved oxygen and oxidation-reduction potential (ORP) measurements in monitoring wells across the treatment area.

Air sparging will be enhanced with ozone to improve performance. The system currently installed at Site 86 will be relocated to Site 73 for this purpose.

\\Ariadne\groups\GIS\USNavFaceNGCom\315007CampLejeune\Projects\Site73_RI\Figure_2_1_Site_Loc_Map.mxd

Duplin
Onslow
Pender
Carteret
Jacksonville
Morehead City
MCB Camp Lejeune
Site 73
Atlantic Ocean
117
258
17
70
241
40
17

WV
VA
NC
SC
Marine Corps Base
Camp Lejeune
Atlantic Ocean

Legend
- Installation Area
- Site 73
- Limited Access Higwhay
- Highway
- Local Roads
- Cities

N

0 4,500 9,000 13,500 18,000
Meters

Figure 2-1
Site Location Map
Site 73 Pilot Study Work Plan
Marine Corps Base, Camp Lejeune
North Carolina

AGVIQ
CH2M HILL

\\Ariadne\proj\USNavFaceNGCom\315007CampLejeune\Projects\Site73_RI\Figure_2_2_Site_73_Site Map.mxd

Legend

- Site 86 Boundary
- Shallow Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Abandoned Monitoring Well - Needs Field Verification
- Damaged Monitoring Well - Needs Field Verification
- Road
- Airfield Surface Area
- Surface Water

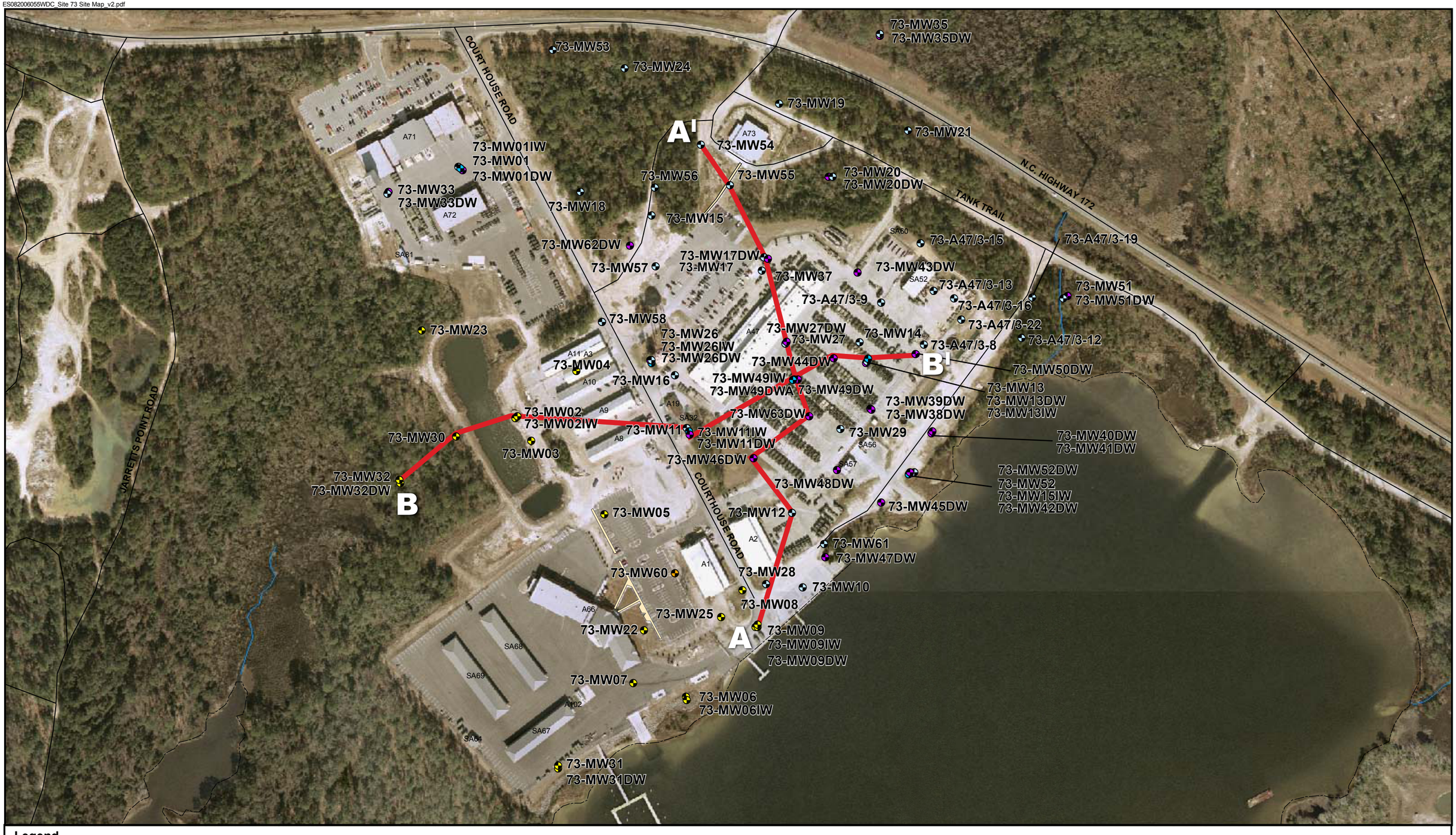
N
W E
S

100 0 100 200
Feet

Figure 2-2
Site Map
Site 73 Pilot Study Work Plan
Marine Corps Base, Camp Lejeune
Camp Lejeune, North Carolina

AGVIQ CH2M HILL

ES082006055WDC_Site 73 Site Map_v2.pdf



Legend

- Site 86 Boundary
- Shallow Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Abandoned Monitoring Well - Needs Field Verification
- Damaged Monitoring Well - Needs Field Verification
- Road
- Airfield Surface Area
- Surface Water

100 0 100 200 Feet

Figure 2-3
Cross Section Location Map
Site 73 Pilot Study Work Plan
MCB Camp Lejeune, North Carolina

AGVIQ CH2M HILL

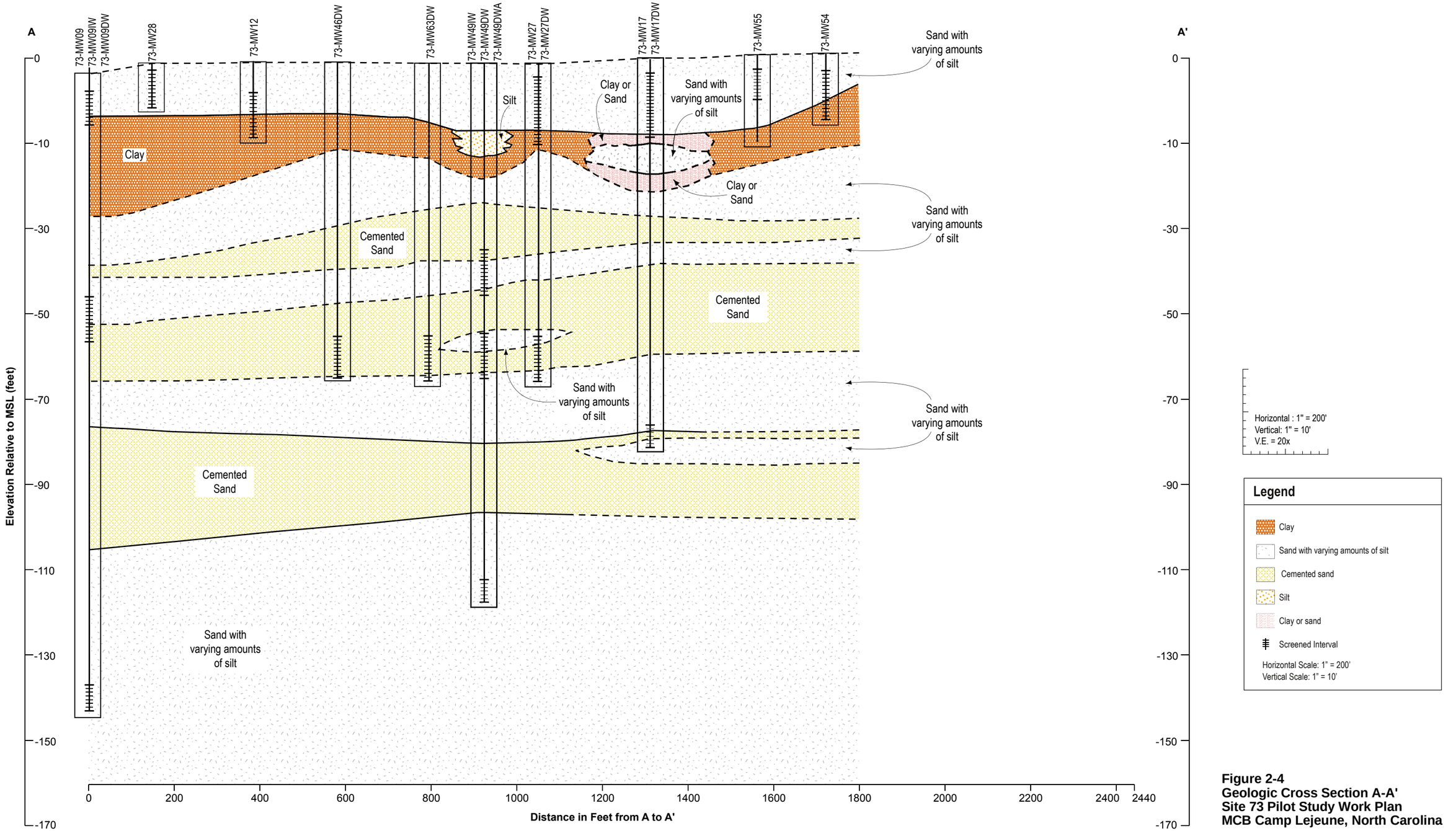


Figure 2-4
Geologic Cross Section A-A'
Site 73 Pilot Study Work Plan
MCB Camp Lejeune, North Carolina

AGVIQ CH2M HILL

ES102006006ATL Figure2-4_AA_v3.ai

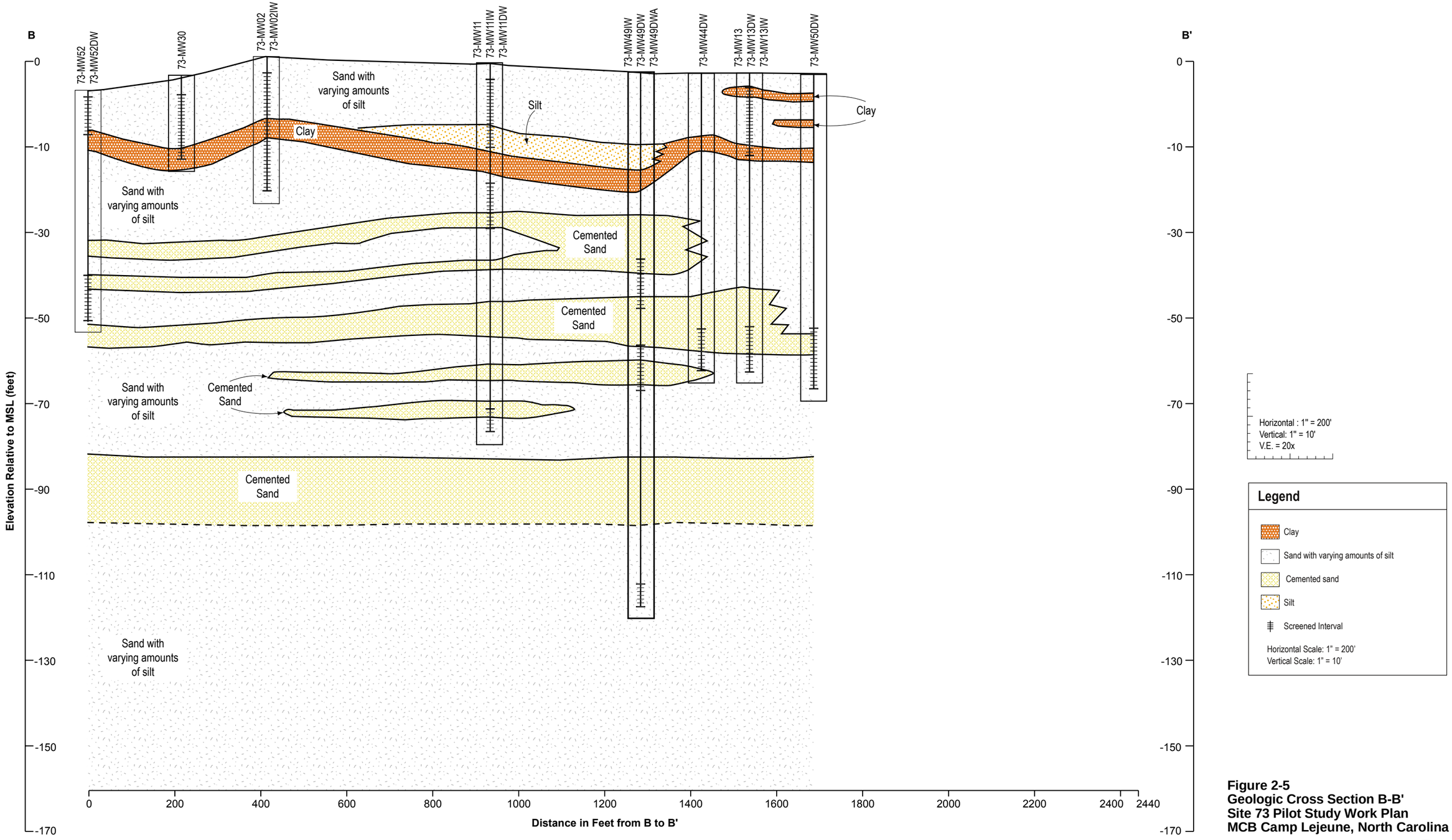


Figure 2-5
Geologic Cross Section B-B'
Site 73 Pilot Study Work Plan
MCB Camp Lejeune, North Carolina

AGVIQ CH2M HILL

ES102006006ATL Figure2-5_BB_v1.ai

\\ariadne\groups\gis\USNavFaceNGCom\Projects\Site73\Figure_2_6_Shallow_GW_Contours.mxd

Legend

- Monitoring Wells
- Base Boundary
- 6 Contours
- 2.12 Water level elevation

Note:
All water level elevations are reported in feet above mean seal level.
Potentiometric surface contours have been interpolated between monitoring well locations. Actual conditions may differ from those shown on this figure.

N

0 200 400

Feet

Figure 2-6
Groundwater Elevation Map, Shallow
Site 73 Pilot Study Work Plan
Marine Corps Base, Camp Lejeune
North Carolina

AGVIO
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CH2M HILL
JOINT VENTURE

\\ariadne\groups\gis\USNavFaceNGCom\Projects\Site73_RI\Figure_2_7_Deep_GW_Contours.mxd

Legend

- Base Boundary
- 6 Contours
- Monitoring Wells
- 2.12 Water level elevation

Note:
All water level elevations are reported in feet above mean seal level.
Potentiometric surface contours have been interpolated between
monitoring well locations. Actual conditions may differ from those shown on this figure.

N

0 200 400

Feet

Figure 2-7
Groundwater Elevation Map, Deep
Site 73 Pilot Study Work Plan
Marine Corps Base, Camp Lejeune
North Carolina

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\\ariadne\groups\gis\USNavFaceNGCom\Projects\Site73_RI\Figure_2_8_VC_Concentrations_Shallow_April_06.mxd

Legend

- Shallow Aquifer April 2006
- Base Boundary
- Plume

0.5	VC Concentration
6.2	VC Concentrations exceeds NC 2L standard
-0.5-	Isoconcentration Contours
-5.0-	Isoconcentration Contours
U	Not detected
J	Estimated value

Note:
All concentrations are reported in µg/L.
Surface contours have been interpolated between monitoring well locations. Actual conditions may differ from those shown on this figure.

N

0 150 300
Feet

Figure 2-8
Vinyl Chloride in Shallow (5-20') Groundwater
Site 73 Pilot Study Work Plan
Marine Corps Base, Camp Lejeune
North Carolina

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\\ariadne\groups\gis\USNavFaceNGCom\Projects\Site73\Figure_2_9_VC_TCE_DCE.mxd

Legend

- Shallow Aquifer April 2006
- Base Boundary
- TCE Contour
- DCE Contour
- VC Contour

Note:
All concentrations are reported in µg/L.
Surface contours have been interpolated between monitoring well locations. Actual conditions may differ from those shown on this figure.

N

0 150 300

Feet

Figure 2-9
TCE, DCE, and Vinyl Chloride in Deep (60-100') Groundwater
Site 73 Pilot Study Work Plan
Marine Corps Base, Camp Lejeune
North Carolina

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CH2M HILL

3. Pilot Study Design

Ozone enhanced air sparging using an existing HDD well, is a potentially effective approach for remediation of TCE and associated dissolved chlorinated solvent contamination at Site 73. This section presents a summary of the conceptual pilot scale design.

3.1 Pilot Study Overview, Objectives and Goals

3.1.1 Pilot Study Overview

HDD technology is well suited to treatment of large plumes. Gas sparging permits a large volume of the aquifer to be contacted efficiently. These types of systems can be operated for several years at less cost than pump and treat or periodic injection systems. Air sparging performance will be enhanced by blending with ozone, a fast acting, powerful oxidant, which dissociates into molecular oxygen. Soil vapor extraction (SVE) is not planned, because of the shallow depth to water and the low permeability/heterogeneous conditions of the thin vadose zone at the site.

The scope of work for the pilot test will consist of the following primary tasks:

1. Retrofitting the existing horizontal well
2. Installation of four soil gas monitoring wells
3. Transfer of equipment from Site 86 to Site 73
4. System start-up, operation, maintenance, and monitoring

The scope of work is presented in detail in Section 4.0.

3.1.2 Study Objectives and Goals

The primary objective of the pilot test is to evaluate the effectiveness of air and ozone sparging for removal of dissolved TCE. The effectiveness of the test will be evaluated according to the following criteria:

1. Contaminant reduction in groundwater, as quantified by pre- and post-start-up groundwater samples.
2. Minimization of contaminant mobility, as quantified by comparing groundwater analytical data collected prior to and during the pilot test. Groundwater samples will be collected and analyzed from monitoring wells positioned at the interior, exterior, and periphery of the plume. Groundwater potentiometric surface measurements will also be recorded in the immediate vicinity of the test area to assist with evaluation of these criteria.

The pilot test is not intended to be the final remedy. A decision to use this technology in other areas of the site will be subject to the approval of the Partnering Team.

3.2 Technology Description

This section comprises a brief technical overview of the technology to be employed at Site 73: horizontal well implementation and air/ozone sparging.

3.2.3 Horizontal Well

The horizontal sparge well was installed by MicroPact in February 2004; the layout is shown in **Figure 3-1**. The well is a "continuous" (double-ended) design, with a depth of approximately 88 feet bgs, consisting of three sections: 420 foot long entry (blank casing) section; 400 foot slotted pipe section; and 350 foot long exit (blank casing) section, resulting in a total borehole length of approximately 1,170 feet. The well is constructed entirely of four-inch diameter standard dimension ration (SDR) 11 high density polyethylene (HDPE). The well is longitudinally slotted, with an open area of approximately 0.5%. The depth and layout of the well was selected to coincide with the 100 µg/L TCE iso-concentration contour.

3.2.4 Compressed Air and Ozone Generation System

The air and ozone sparging system to be transferred to the site from Site 86 consists of two, 8' x 20' steel connex boxes (shipping containers). Container One houses the compressed air equipment: Kaeser BSD 50 rotary screw air compressor, 400 gallon air receiver tank, gas chiller, and condensate management system. Container Two houses the Ozonia CFV-03 ozone generator (capable of producing approximately 60 pounds per day of ozone with dry air feed), Hankinson pressure swing desiccant dryer, booster pump system, and master control panel. The Zarsky cooling water chiller is stored outside, between the two containers. All generator outlet piping is constructed of 304 stainless steel.

Figures 3-2A, 3-2B, and **3-2C** contain the process and instrumentation diagrams (legend, general system, and ozone generator diagrams, respectively). The rated capacity of the air compressor is approximately 200 scfm at 100 pounds per square inch (psi). The required gas pressure required for sparging is expected to range from 40 to 45 psi, based on the hydrogen sparging pilot study and estimations of total head pressure (including friction losses). The actual sparge flow will begin at a much lower flow rate and increased based on monitoring well observations. As shown in Figure 3-2B, a portion of the compressed, cooled gas will be diverted from the main sparge line to an ozone process line, through a series of filters, the desiccant dryer, and into the ozone generator. The generator is capable of producing approximately 2% to 3% (by weight) ozone from cool (40° F), dry (-80 to –100° F dew point), oil-free air. Subsequently, the ozone will be blended into the main line. Based on previous operations at Site 86, the ozone concentrations in the blended gas stream are expected to range from 3,000 to 5,000 parts per million by volume (ppm_v). Ozone production will be increased gradually within three to four weeks after system activation.

3.2.4.1Materials Compatibility

Polyvinyl chloride (PVC) or polypropylene pipe is not recommended for use with ozone, since it eventually becomes brittle and pitted. HDPE is the most cost effective material for the horizontal well screen and riser. Although not 100% resistant to ozone degradation, the SDR11 HDPE used to complete the well at Site 73 is considered sufficiently durable for an extended period of time (5 to 10 years). HDPE has been used for ozone injection at other

sites for over a year with no significant degradation, especially at the low concentrations planned for this test. Stainless steel (304 grade or superior grade) will be used for all ozone generator outlet piping, including the initial 25 feet from the blending tee to the HDD well inlet.

3.2.4.2Safety Issues

Ozone has been used successfully in the wastewater treatment industry for over eighty years. However, because ozone is a powerful oxidizing agent, it should be considered a hazardous material. Ozone is not a known carcinogen.

The odor threshold for ozone is approximately 0.01 ppm_v in air. Symptoms experienced with concentrations at 0.1 to 1 ppm_v are headaches, irritation and burning of the eyes and respiratory irritation. The action level of 0.1 ppm_v is based on exposure to workers on a time-weighted average over an eight-hour period, five days a week.

A monitoring system will be installed inside the trailer to activate an alarm at 0.1 ppm_v and to deactivate the system in the event of a discharge/leak of ozone resulting in an interior concentration in excess of 0.3 ppm_v. There are also personal ozone exposure level badges that employees can wear individually. Ambient ozone will dissipate rapidly.

\\Ariadne\proj\USNavFaceNGCom\315007CampLejeune\Projects\Site73_RI\Figure_3_1_HorizontalSpargeWell_and_ProposedMW.mxd

Legend

- Shallow Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Abandoned Monitoring Well - Needs Field Verification
- Damaged Monitoring Well - Needs Field Verification
- Proposed Pilot Test Soil Gas Well
- 73-MW49DW — Pilot Test Groundwater Monitoring Well
- Horizontal Well
- Slotted Section of Horizontal Well
- TCE Contour

N W E S

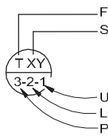
0 250 500 Feet

Figure 3-1
Horizontal Sparge Well and Proposed Monitoring Locations
Site 73 Pilot Study Work
Marine Corps Base, Camp Lejeune
Camp Lejeune, North Carolina

AGVIQ CH2M HILL

INSTRUMENT IDENTIFICATION

EXAMPLE SYMBOLS



ON AND OFF EVENT LIGHTS

ON-OFF HAND SWITCH MAINTAINED CONTACT SWITCH (COMPRESSOR WILL RESTART ON RETURN OF POWER. OZONE GENERATOR REQUIRES MANUAL RE-START)

MOTOR HOURS

STATUS LIGHT-FAIL CONDITION

TEMPERATURE INDICATOR

PRESSSURE INDICATOR

FLOW INDICATOR

FLOW INDICATOR (MASS FLOW)

INSTRUMENTATION, SYSTEMS, AND AUTOMATION SOCIETY

LETTER	FIRST LETTER (S)		SUCCEEDING LETTERS		
	PROCESS OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS (+)		ALARM		
B	BURNER			CLOSE, STOP OR DEC.	
C	CONDUCTIVITY (ELEC)			CONTROL	
D	DENSITY OR SP. GR.	DIFFERENTIAL		OPEN, START OR INC.	
E	VOLTAGE (EMF)		PRIMARY ELEMENT		
F	FLOW RATE	RATIO			FAIL
G	GATE		GLASS		
H	HAND (MANUAL)				HIGH OR OPENED
I	CURRENT (ELEC)		INDICATE		
J	POWER	SCAN			
K	TIME OR TIME SCHEDULE			CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW OR CLOSED
M	MOTOR MOTION				MIDDLE OR INTERMEDIATE
N	USERS CHOICE		USERS CHOICE	USERS CHOICE	ON OR OPERATE
O			ORIFICE (RESTRICTION)		OVERLOAD
P	PRESSURE OR VACUUM		POINT (TEST CONNECTION)		
Q	QUANTITY OR EVENT(+)	INTEGRATE			
R	RADIATION		RECORD OR PRINT		
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE (+)		MULTIFUNCTION (+)	MULTIFUNCTION (+)	MULTIFUNCTION (+)
V	VALVE, DAMPER OR LOUVER			VALVE, DAMPER OR LOUVER	
W	WEIGHT OR FORCE		WELL		
X	UNCLASSIFIED (+)		UNCLASSIFIED (+)	UNCLASSIFIED (+)	UNCLASSIFIED (+)
Y	COMPUTER			RELAY OR COMPUTE	
Z	POSITION			DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT	

(+) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.

LINE LEGEND

- PROCESS (CLOSED CONDUIT, DASHED LINE INDICATES ALTERNATE FLOW STREAM)
- PROCESS (OPEN CHANNEL)
- A — ANALOG SIGNAL (4 TO 20 mAdc, ETC.)
- DISCRETE SIGNAL (ON/OFF, ETC.)
- P — POWER SIGNAL (120V, 480V, ETC)
- PD — PULSE DURATION SIGNAL
- PF — PULSE FREQUENCY SIGNAL
- R — RESISTANCE SIGNAL
- DCS/PLC SOFTWARE LINK
- PNEUMATIC SIGNAL
- XXX — FILLED SYSTEM SIGNAL
- L L L — HYDRAULIC SYSTEM SIGNAL
- DIGITAL COMMUNICATION SIGNAL
- BUILDING OR FACILITY BOUNDARY
- X(Y) — X=NUMBER OF DEVICES; Y=NUMBER OF SIGNALS PER DEVICE; X MULTIPLIED BY Y=XY= TOTAL NUMBER OF SIGNALS
- 9(2) — EXAMPLE: TOTAL NUMBER OF SIGNALS IS 18, FROM 9 PARALLEL DEVICES, 2 SIGNALS PER DEVICE.
- CONNECTING LINES
- NON-CONNECTING LINES

INTERFACE SYMBOLS

SAD

S = SOURCE DRAWING NO.

A = PROCESS INTERFACE LETTER

D = DESTINATION DRAWING NO.

(N) PROCESS OR SIGNAL LINE CONTINUATION N=1,2,3,ETC — (N)

INTERFACE TO OR FROM PROCESS EXTERNAL TO PROJECT

ABBREVIATIONS & LETTER SYMBOLS

ACK	ACKNOWLEDGE
AFD	ADJUSTABLE FREQUENCY DRIVE
ALT	ALTERNATE
AM	AUTO-MANUAL
AS	ADJUSTABLE SPEED
BW	BACKWASH
CL_2 etc.	CHLORINE (TYP: USE STANDARD CHEMICAL ELEMENT ABBREVIATION)
CP	CONTROL PANEL
CS	CONSTANT SPEED
DC	DIRECT CURRENT
FA	FAIL ALARM
FL	FIBER LINK
FP	FIELD PANEL
FREQ	FREQUENCY
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
I/O	INPUT/OUTPUT
ISR	INTRINSICALLY SAFE RELAY
LAN	LOCAL AREA NETWORK
LCP	LOCAL CONTROL PANEL
LIU	LIGHT INTERFACE UNIT
LOH	LOSS OF HEAD
LR	LOCAL-REMOTE
MA	MANUAL-AUTO
MCC	MOTOR CONTROL CENTER
MFR	MANUFACTURER
MSC	MANUFACTURER SUPPLIED CABLE
MTD	MOTOR TEMPERATURE DETECTOR
MTS	MANUAL TRANSFER SWITCH
NIC	NOT IN CONTRACT
NSH	HIGH TORQUE
NSHH	HIGH HIGH TORQUE
OA	OFF-AUTO
OC	OPEN-CLOSE(D)
OCA	OPEN-CLOSE AUTO
OCK	OPEN-CLOSE COMMAND
OCM	OPTICAL COMMUNICATION MODULE
OCR	OPEN-CLOSE REMOTE
OCS	OPEN-CLOSE STATUS
OOA	ON-OFF-AUTO
OOR	ON-OFF-REMOTE
OSC	OPEN-STOP-CLOSE
OWS	OPERATOR WORKSTATION
PCO	PARTICLE COUNTER
pH	HYDROGEN ION CONCENTRATION
PLC	PROGRAMMABLE LOGIC CONTROLLER
PS	POWER SUPPLY
PWR	POWER
RK	RUN COMMAND
RTU-X	REMOTE TELEMETRY UNIT NO. X
SCD	STREAMING CURRENT DETECTOR
SF	SPEED FEEDBACK
SK	SPEED COMMAND
SLDC	SINGLE LOOP DIGITAL CONTROLLER
SS	SURGE SUPPRESSOR
TURB	TURBIDITY
TYP	TYPICAL
UP	UNDER PLC CONTROL
UPS	UNINTERRUPTIBLE POWER SUPPLY
VIB	VIBRATION
YS	ON STATUS
ZSOC	POSITION STATUS OPEN/CLOSED

VALVE SYMBOLS

- GATE
- GLOBE
- BALL
- PRESSURE RELIEF
- PRESSURE REGULATOR
- BOOSTER PUMP
- INLINE SILENCER
- FLOW TUBE
- M — ELECTRIC MOTOR
- DIAPHRAGM PUMP

TRANSDUCERS

A	ANALOG	I	CURRENT
D	DIGITAL	P	PNEUMATIC
E	VOLTAGE	PF	PULSE FREQUENCY
F	FREQUENCY	PD	PULSE DURATION
H	HYDRAULIC	R	RESISTANCE

SELF CONTAINED VALVE & EQUIPMENT TAG NUMBERS

D-X-Y-Z

D:
- ARV = AIR RELEASE VALVE
- ASV = ANTI-SIPHON VALVE
- AVRV = AIR AND VACUUM RELEASE VALVE
- E = EDUCTOR
- FCV = FLOW CONTROL VALVE
- G = GATE
- LCV = LEVEL CONTROL VALVE
- M = MECHANICAL EQUIPMENT
- P = PUMP
- PCV = PRESSURE CONTROL VALVE
- PRV = PRESSURE REGULATING VALVE
- PSE = RUPTURE DISK
- PSV = PRESSURE RELIEF VALVE
- SS = SAFETY SHOWER
- T = TANK
- TCV = TEMPERATURE CONTROL VALVE

X = PROCESS NUMBER
Y = LOOP NUMBER
Z = UNIT NUMBER

GENERAL NOTES

1. COMPONENTS AND PANELS SHOWN WITH AN ASTERISK (*) ARE PART OF A PACKAGE SYSTEM; SEE EQUIPMENT SPECIFICATIONS.
2. COMPONENTS AND PANELS SHOWN WITH A DIAMOND (◆) ARE TO BE PROVIDED UNDER SECTION INSTRUMENTATION AND CONTROL.
3. THIS IS A STANDARD LEGEND. THEREFORE, NOT ALL OF THIS INFORMATION MAY BE USED ON THIS PROJECT.

DSGN	M. STRONG						VERIFY SCALE
DR	E. GRIGGS						BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"
CHK	M. STRONG						IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.
APVD	B. BOZZINI	NO.	DATE	REVISION	BY	APVD	

CH2MHILL

PILOT STUDY WORK PLAN

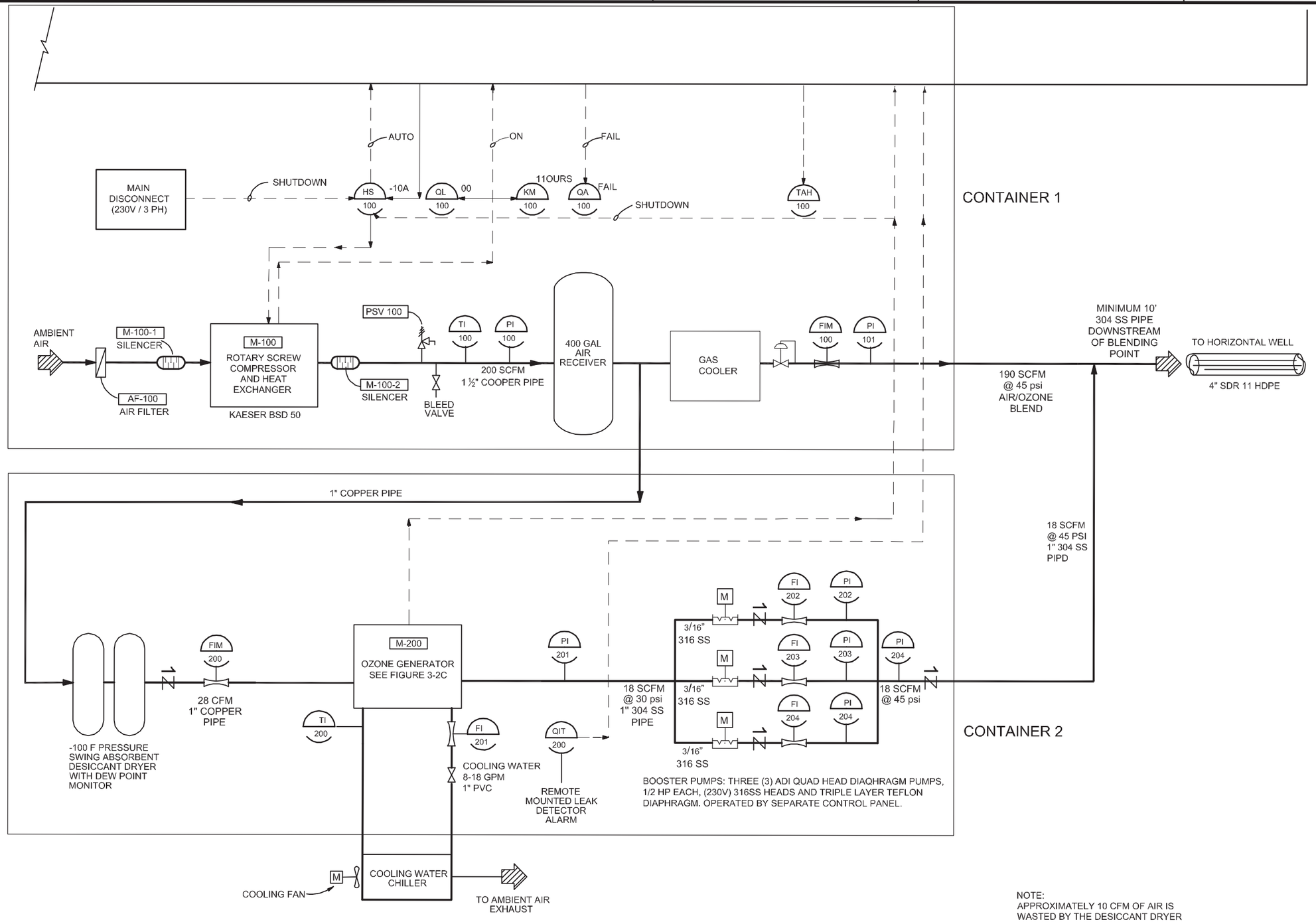
OPERABLE UNIT NO. 21–SITE 73
MARINE CORPS BASE, CAMP LEJEUNE

GENERAL

INSTRUMENTATION AND CONTROL LEGEND

DWG FIGURE 3-2A
DATE OCTOBER 2006
PROJ 346548

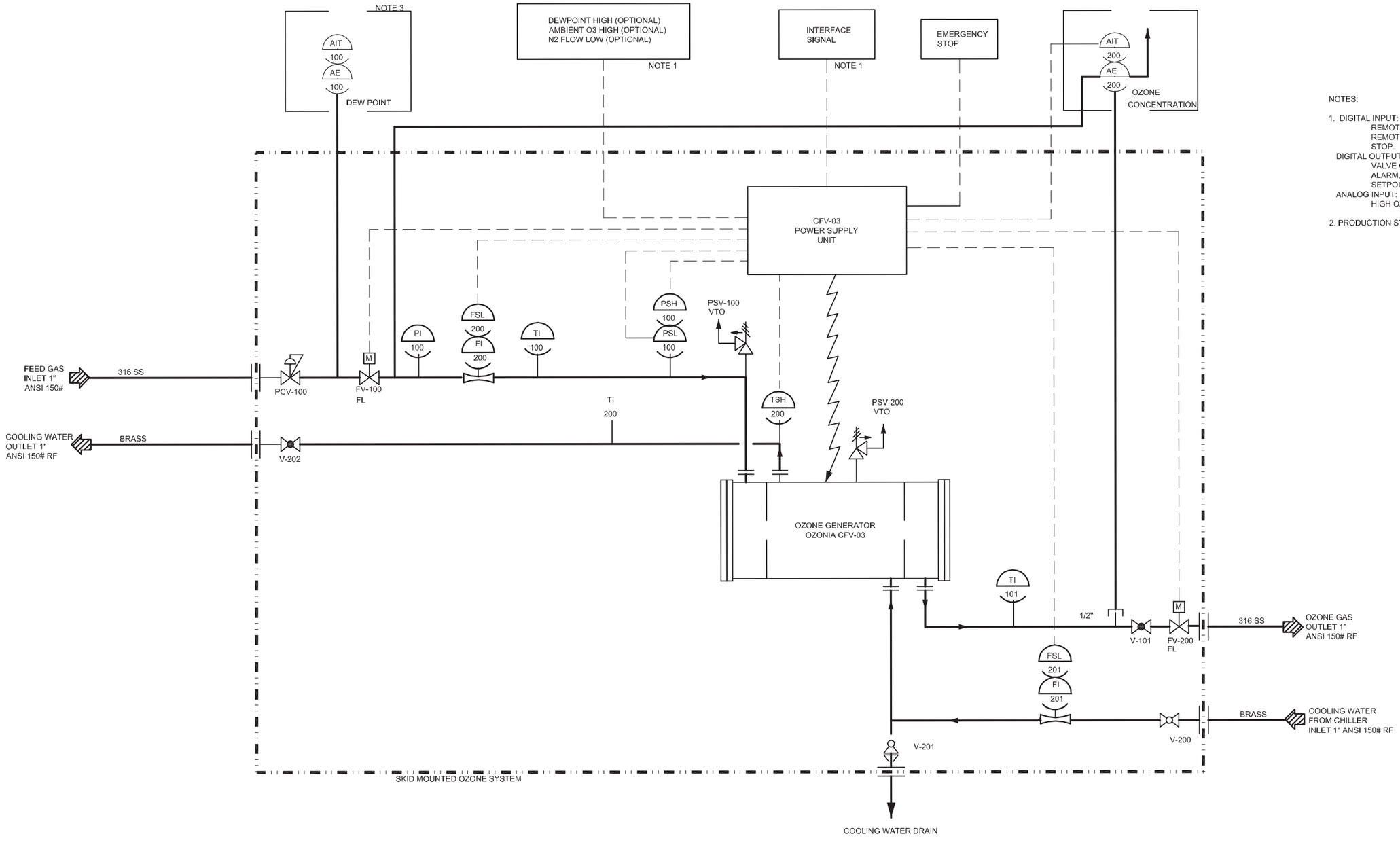
ATL/NAVY CLEAN/346548



NOTE:
APPROXIMATELY 10 CFM OF AIR IS WASTED BY THE DESICCANT DRYER AND OZONE GENERATOR.

DSGN M. STRONG					VERIFY SCALE	CH2MHILL	PILOT STUDY WORK PLAN	INSTRUMENTATION AND CONTROL DIAGRAM	FIGRURE 3-2B
DR 6ml01d_181373.dgn E. GRIGGS					BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.		OPERABLE UNIT NO. 21–SITE 73 MARINE CORPS BASE, CAMP LEJEUNE	AIR AND OZONE SPARGE SYSTEM	DWG
CHK M. STRONG									DATE OCTOBER 2006
APVD C. BOZZINI	NO.	DATE	REVISION	BY	APVD				PROJ 346548

ATL/NAVY CLEAN/346548



NOTES:

1. DIGITAL INPUT: PSU REMOTE ON, RESET, REMOTE OPEN GAS VALVES, REMOTE ENABLE, PRODUCTION STOP.
   DIGITAL OUTPUT: PSU READY, PSU ON, GAS VALVE OPEN, COLLECTIVE ALARM, CONTROL IN REMOTE, SETPOINT REMOTE.
   ANALOG INPUT: REMOTE SET VALUE OR HIGH OZONE CONCENTRATION.

2. PRODUCTION STOP AS EXTERNAL INTERLOCK.

DSGN M. STRONG						VERIFY SCALE	CH2MHILL	PILOT STUDY WORK PLAN OPERABLE UNIT NO. 21–SITE 73 MARINE CORPS BASE, CAMP LEJEUNE	INSTRUMENTATION AND CONTROL DIAGRAM OZONE GENERATOR	FIGURE 3-2C
DR drld to 161373.dgn E. GRIGGS						BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.				DWG
CHK M. STRONG										DATE OCTOBER 2006
APVD C. BOZZINI	NO.	DATE	REVISION	BY	APVD					PROJ 346548

4. Pilot Study Implementation

This section includes a detailed description of the pilot study approach and associated tasks. The scheduled pilot study performance period will be one year from the time of system activation and full-time operation (excluding short-term operating periods associated with start-up).

During construction and operation of the pilot study, site operations will be implemented as presented in this Work Plan and the SHSP. All activities will be conducted in accordance with these site-specific plans.

At the conclusion of the one-year post-startup groundwater sampling event, a Pilot Study Summary Report will be prepared and submitted to the Partnering Team. This report will outline the activities completed during the study period, results obtained, and recommendations with regard to possible HDD and/or air sparging implementation at other areas of Site 73.

Several considerations related to the execution of the fieldwork at Site 73 are listed below. These considerations will include, but are not limited to, the following:

- Site entry and access authorizations
    - Camp Lejeune is an active military base. All personnel working at the test site must check in with Camp Lejeune security and receive a vehicle pass, valid for the duration of the site work.
    - All personnel working at the test site must be U.S. citizens. Personnel should not enter a secured area without the proper training and key card access.
- Equipment, space, and utility requirements
    - Subcontractor shall be solely responsible for their equipment, instrumentation, materials, and supplies.
    - AGVIQ/CH2M HILL Joint Venture I (JVI) will be responsible for obtaining the proper work permits (soil gas wells, etc.).
    - Site access during the project will be limited to authorized personnel only.
- Site security, including securing of equipment
    - During working hours, the JVI will secure the working area (to be determined in the field).
    - During non-working hours, equipment will be secured.

4.1 Pre-Mobilization Activities

JVI will arrange for a electrical power (460 V, 3 ph, 200 A) service to be installed at the site, using readily available transformers existing at Site 73, or relocating the transformers used

during the Site 86 pilot study. Telephone service will be required for telemetry. The telemetry system will allow the remote monitoring of the system.

All proposed drilling and trenching locations will be subject to relocation, based on conditions encountered in the field, including underground utilities, general access and traffic at the work site, overhead obstructions, etc. Typically, the following steps will be taken to avoid underground utilities:

1) JVI will review Base maps of utilities in the proposed (surveyed) drilling and trenching areas. Potential impacts will be marked for discussion with Base personnel.
2) A professional utility locator will be subcontracted to mark locations of all detectable buried utilities, including phone, electrical, water, and sewer, near drilling or trenching locations.

4.2 Site Preparation

The site preparation task will include the following activities:

- Dismantling and removal of the hydrogen sparge manifold system currently in place at the site.
- Installation of a 4-inch diameter SDR11 HDPE "y" pipe at the existing above grade manifold location, for clean-out purposes.
- Excavation of conveyance piping trench from the existing hydrogen sparge manifold location to the new system location, immediately southeast of the retention pond (refer to **Figure 4-1**). The estimated length of trench is 210 feet. The trench will be excavated using a small "ditch witch" type trenching machine; planned trench depth is three feet bgs. Conveyance piping will include a section of stainless steel piping at least 25 feet in length, with the remainder of the pipe section consisting of two or three-inch SDR 11 HDPE.
- Grading of the new system location, as necessary (minimal site disturbance is expected).

JVI will coordinate with Base personnel to ensure the proposed location of the equipment is acceptable and unobtrusive to Base activities.

4.3 Installation of Soil Gas Monitoring Wells

Soil vapor sampling will be conducted in the vicinity of the sparge well to determine if air that is being injected as a result of the operation of the sparge system is potentially being released to the vadose zone near the existing, occupied building (Building A47). Four soil gas monitoring wells will be installed to allow for periodic monitoring to determine if VOC concentrations exceed risk-based thresholds and if mitigation steps will need to be undertaken. The proposed locations of the soil gas monitoring wells are shown in **Figure 3-1**.

The wells will be installed to a depth just above the water table, approximately five feet bgs, and will be constructed of schedule 40 PVC with two feet of 0.010 inch slot screen and filter sand, with cement grout to surface. Each well will be completed at grade using flush mount

8.5 inch steel protective covers, set in two foot square concrete aprons. The soil gas monitoring wells will be installed using direct push methods. Characterization and disposal of soil cuttings is discussed in Section 4.7 of this Work Plan. All new well installations will be referenced both horizontally and vertically.

4.4 Transfer of the Air and Ozone Sparge System from Site 86 to Site 73

As stated previously, the air and ozone sparge systems will be transferred from Site 86 to Site 73. The details for the maintenance and decommissioning are contained in Appendix A.

4.5 Pilot Test Operation for One Year

Combined air and ozone sparging will be operated on a continuous basis for a minimum period of twelve months. Groundwater and soil gas samples will be collected at intervals of one, three, six, nine, and 12 months following system activation. All groundwater and soil vapor samples will be submitted for laboratory analysis for volatile organic compounds (VOCs). Groundwater geochemical parameters such as pH, conductivity, oxidation-reduction potential, and dissolved oxygen will be monitored in the field.

JVI will be responsible for operating and maintaining the installed system for the prescribed period of operation. Operational assumptions include:

- Power for system start-up and operations will be provided by Camp Lejeune at no cost to JVI.
- Following the initial start-up period, JVI staff will monitor system operation at least once every two weeks. Maintenance of the ozone generator(s) and air compressor will be performed in accordance with manufacturer recommendations in the Operations and Maintenance (O&M) Manual.

4.6 System Dismantling

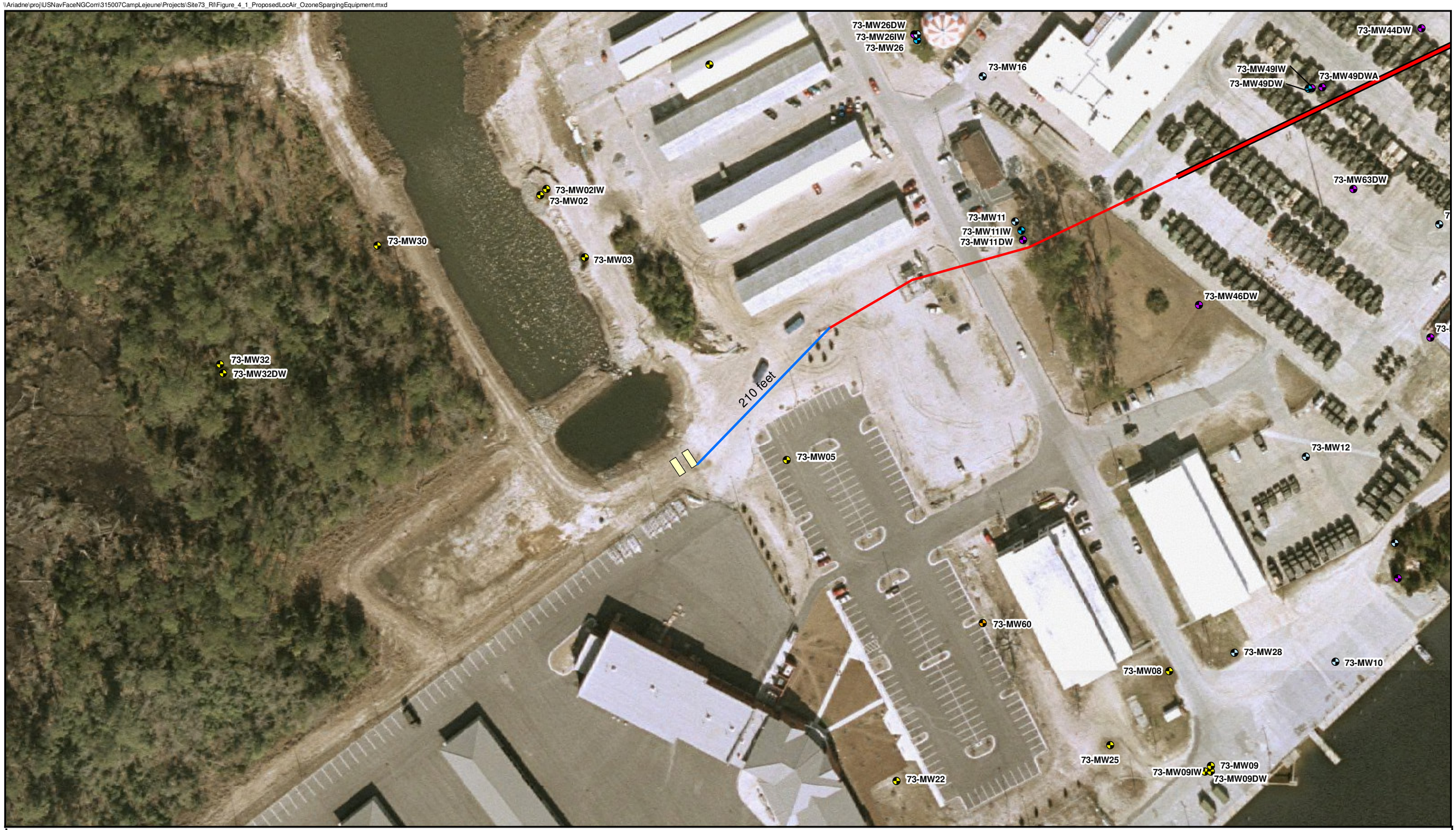
Following completion of the project, the Partnering Team will determine if the system will require dismantling. If dismantling is required, JVI will demobilize all equipment and materials from the site and return the site to its near-original condition. The horizontal well and soil gas wells will be left in place and capped.

4.7 Waste Management

Investigative-derived waste (IDW) will be managed in accordance with Section 4.20 of the Master Project Plans. IDW will consist of health and safety disposables, potentially contaminated soil, decontamination fluids, and groundwater. Health and safety disposables, such as sampling gloves, will be placed in plastic bags and disposed in 55 gallon drums. Soil IDW generated as part of the field activities will be containerized in Department of Transportation (DOT) approved 55- gallon drums. Water IDW will be placed in poly tanks or 55-gallon drums. The drums will be transported to and staged at a

designated 90- day storage area pending final disposition. Large amounts of construction debris, if accumulated, will be segregated and placed in a dumpster. IDW management will be coordinated with the Base Remedial Action Contractor (RAC).

\\Ariadne\proj\USNavFaceNGCom\315007CampLejeune\Projects\Site73_RI\Figure_4_1_ProposedLocAir_OzoneSpargingEquipment.mxd



Legend

- Shallow Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Abandoned Monitoring Well - Needs Field Verification
- Damaged Monitoring Well - Needs Field Verification
- Air and Ozone Sparge Containers
- Air and Ozone Sparge Conveyance Line
- Horizontal Well
- Slotted Section of Horizontal Well

N
W E
S

0 50 100
Feet

Figure 4-1
Proposed Location Of Air and Ozone Sparging Equipment
Site 73 Pilot Study Work
Marine Corps Base, Camp Lejeune
Camp Lejeune, North Carolina

AGVIQ CH2M HILL

5. Pilot Test Monitoring

The monitoring plan for the sparging pilot study at Site 73 will address groundwater and air sampling.

5.1 Groundwater Monitoring

Fifteen existing monitoring wells will be used to monitor the pilot study. Monitoring wells scheduled for sampling as part of this pilot test are summarized in **Table 5-1**. Monitoring wells were selected to permit monitoring of cVOC concentrations within multiple vertical horizons near the axis of the horizontal well. During each sampling event, a groundwater sample will be collected from 15 existing monitoring wells located within the study area, hand delivered or delivered via an overnight carrier to an offsite laboratory, and analyzed for VOCs using Environmental Protection Agency (EPA) method 8260B. All groundwater samples will be analyzed using a standard turn-around time. Geochemical parameters, including dissolved oxygen, pH, conductivity, ORP, and turbidity will be measured in the field.

The frequency of groundwater monitoring will be as follows:

- Prior to start up (Baseline)
- One month after startup
- Three months after startup
- Six months after startup
- Nine months after startup
- Twelve months after startup

5.2 Soil Gas Monitoring

Soil vapor monitoring during the pilot study will include a baseline sampling event, followed by sampling events conducted in conjunction with the groundwater monitoring. Soil gas samples will be collected in a Summa canister by attaching Teflon tubing to the stainless steel vapor probe from the four new soil gas wells and analyzed for VOCs by EPA method TO-15.

The data will be evaluated to determine if mitigation steps will need to be taken to assure indoor air quality.

6. Health and Safety Considerations

Development of a comprehensive SHSP will be the combined responsibility of JVI and Subcontractors. The Master SHSP will address the potential hazards associated with on-site ozone generation, and will be maintained on-site during all field activities.

If additional activities are necessary, addenda to the Master HSP will be prepared by the JVI Project Health and Safety Manager (PHSM) to address specific activities and the hazardous control measures associated with the specific projects. In this manner, the SHSP will be considered a "living document", to be reviewed and updated as necessary.

A monitoring system will be installed in Container Two to deactivate the sparge system in the event of a discharge/leak of ozone resulting in an interior concentration in excess of 0.3 ppm_v. Ambient ozone will dissipate rapidly.

Housekeeping and maintaining the cleanliness of the site will be a priority during construction activities to minimize the potential of foreign object debris dangers to personnel and equipment during inclement weather conditions.

The hurricane season in the immediate area surrounding Camp Lejeune begins on June 1 and continues through November 30. Storms of non-tropical origins such as frontal passages, local thunderstorms, and tornadoes are much more frequent and can occur year-round. The Contractor will review all Navy notification procedures and local readiness plans concerning inclement weather once they are made available.

7. Pilot Study Report

Upon conclusion of the one year pilot study period, a summary report will be prepared that will include the following information:

- Summary of all analytical data and geochemical data, including graphical summary of data trends over time;
- Overview and analysis of pilot test effectiveness in terms of reducing cVOC concentrations;
- Site photographs; and
- Discussion and conclusions from the study.

A draft report will be issued to allow for a comment period. Any comments received will be addressed in the final version.

8. Schedule and Project Organization

8.1 Schedule

The proposed schedule for implementing the pilot study at Site 73 is presented in **Figure 8-1**. The tasks presented in the pilot study schedule correspond to the tasks identified in this work plan.

8.2 Project Organization

The Partnering team includes representatives from CH2M HILL, Naval Facilities Engineering Command (NAVFAC), MCB Camp Lejeune, North Carolina Department of Environment and Natural Resources (NC DENR), EPA Region IV, and Shaw Group.

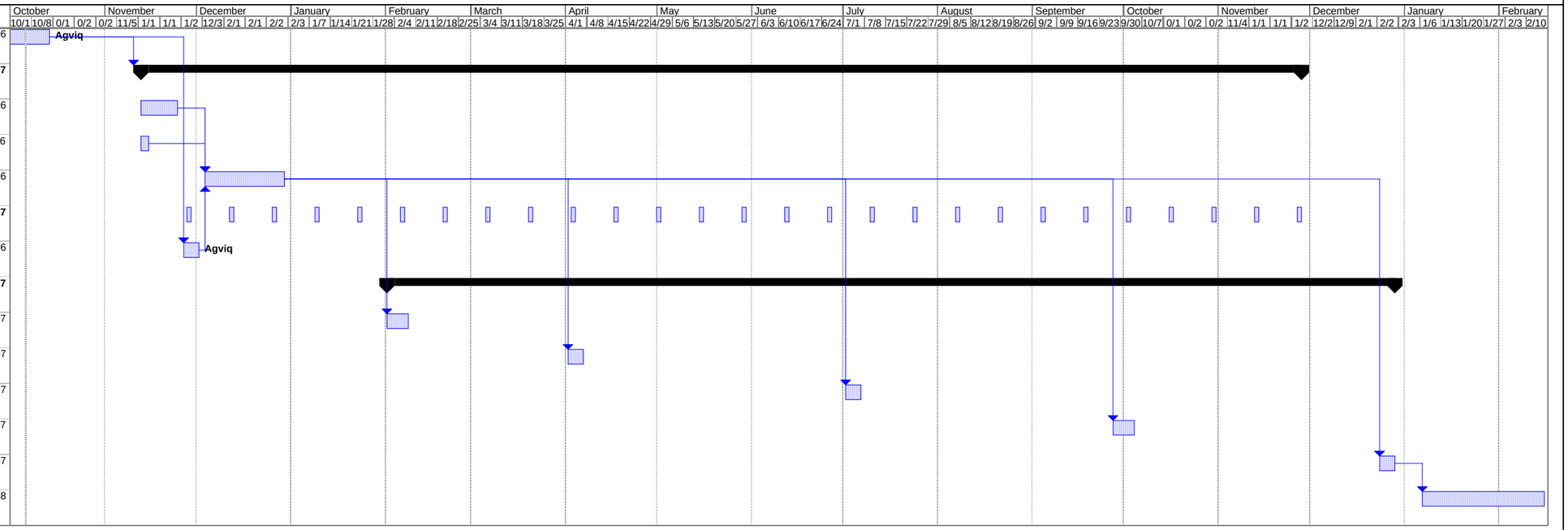
Jessica Skeean, P.E. with CH2M HILL will serve as the Project Manager (PM) for the pilot study and as the primary JV1 contact. The PM is responsible for overall project management and the overall quality assurance and quality control (QA/QC) of project deliverables.

The Senior Consultant will be Christopher Bozzini, P.E of CH2M HILL. The Senior Consultant will review the technical aspects of the work from project scoping to project completion.

The project team will include: the Project Engineer, Field Team Leader (FTL), and Site Safety Coordinator (SSC). All field and subcontractor activity will be under the direction of the Field Team Leader.

Figure 8-1
Project Schedule
Site 73 Pilot Study Work Plan
MCB Camp Lejeune, North Carolina

ID	Task Name	Start	Finish
1	Site 73 Work Plan	Tue 7/18/06	Fri 10/13/06
2	**Site 73 Pilot Test**	**Mon 11/13/06**	**Wed 11/28/07**
3	Site 86 demob/fencing	Mon 11/13/06	Fri 11/24/06
4	Site 73 soil gas well installation	Mon 11/13/06	Wed 11/15/06
5	Site 73 installation	Mon 12/4/06	Fri 12/29/06
6	**Site 73 O&M visits**	**Tue 11/28/06**	**Wed 11/28/07**
34	Site 73 Monitoring - Baseline	Mon 11/27/06	Fri 12/1/06
35	**Site 73 Monitoring**	**Thu 2/1/07**	**Fri 12/28/07**
36	Site 73 Monitoring - 1 month	Thu 2/1/07	Thu 2/8/07
37	Site 73 Monitoring - 3 months	Mon 4/2/07	Fri 4/6/07
38	Site 73 Monitoring - 6 months	Mon 7/2/07	Fri 7/6/07
39	Site 73 Monitoring - 9 months	Thu 9/27/07	Thu 10/4/07
40	Site 73 Monitoring - 12 months	Mon 12/24/07	Fri 12/28/07
41	Site 73 Report	Mon 1/7/08	Fri 2/15/08



Project: Site 73 Pilot Study
Date: Fri 10/6/06

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

9. References

CH2M HILL. October 2006. *Draft Amended Remedial Investigation of Operable Unit 21 (Site 73).*

MicroPact Engineering, Inc. and Baker Environmental, Inc. May 2006. *Pilot Study Report* for Site 73 (Operable Unit 21).

Appendix A

Detailed Sparge System Maintenance and Decommissioning Tasks

The following is a list of maintenance- and decommissioning-related tasks to be completed prior to, or immediately after, transfer of the air and ozone equipment from Site 86 to Site 73:

Site 86 Container 1 (Air Compressor) Maintenance and Decommissioning

1. Drain oil and check belts and replace all filters.
2. Replace oil with new oil and run unit for about 10 minutes to allow oil to circulate.
3. Shut off power and close discharge hand valve.
4. Manually drain air receiver tank of water. After all water has been drained, drain all air from tank.
5. Replace carbon filter bag for "Aquamat" condensate management system.
6. Shut off all inlet and outlet valves for receiver.
7. De-energize refrigerated dryer.
8. Shut off all inlet and outlet valves for refrigerated dryer.
9. Service air dryer, as required by manufacturer.
10. Lock-out, tag-out main disconnect for system.

Site 86 Container 2 (Ozone Generator) Maintenance and Decommissioning

1. Replace chiller power transformer with new fused unit (completed September 7, 2006).
2. Replace faulty flow switch and pressure sensor on ozone generator (both switches are currently jumpered to allow temporary operation).
3. Replace inlet air filters on the desiccant dryer, re-start and allow to function for 24 hrs; shut off power to the unit while under pressure. Thoroughly purge ozone generator with dry air. After purging with –100 deg dew point air for approximately 24 hours, lower the pressure of the inlet regulator (~5 psig) and shut off the discharge valve to the unit. Shut inlet and outlet valves to desiccant dryer system.
4. De-energize the ozone generator and deactivate the chiller, cooling water inlet, and outlet to the ozone generator.
5. Drain the cooling liquid and recover coolant in buckets.
6. Close hand valves for chiller water, cut off PVC piping outside ozone container.
7. Clean all cooling air filters on the power supply cabinet.
8. Remove ambient ozone sensor from bottom of unit, place in secure sealed container and place in refrigerator.
9. Replace inlet air filters on the desiccant dryer filters, restart and allow to function for 24 hrs; shut off power to the unit while under pressure.
10. Shut off the inlet and outlet hand valve.
11. Lock-out, tag-out main disconnect for ozone generator.

Site 86 General Decommissioning Activities:

1. Contact electrical subcontractor to de-energize the system from the pole, remove wiring from the pole to the weatherhead (Container 1) and remove the buried conduit between the two containers.
2. Dismantle exterior threaded copper and stainless steel piping and temporarily store inside one of the Containers.
3. Contact fencing subcontractor to re-locate perimeter fencing.
4. Load containers onto flatbed trailer using industrial forklift with at least eight to ten foot long forks.
5. Grade and re-seed area.
6. Cap horizontal well at both ends.

Site 73 Container 1 and 2 Commissioning

1. Place Containers at Site 73 using industrial forklift with minimum eight foot long forks. Containers should be placed no more than eight feet apart.
2. Contract electrical subcontractor to perform final connections from power pole to weatherhead (Container 1), bury electrical conduit between Containers, and make final connections, including new fused sub-panel for the ozone booster pump (Container 2), and new emergency disconnect at base of power pole. Electrical contractor should also energize system, and turn on main breaker panels.
3. Re-calibrate Hach dissolved oxygen/oxidation reduction potential (DO/ORP) meter.
4. Schedule baseline groundwater sampling at Site 73. (see Section 5)
5. Contract pipe fitter to re-assemble exterior manifold piping, assemble new booster pump manifold piping inside Container 2 (one-inch threaded 304 stainless steel), install buried conveyance piping (approximately 210 feet of SDR 11 HDPE and 25 feet of 304 stainless steel), and check for leaks.
6. Perform three to five days of start-up testing to evaluate optimum sparge flow rate and ozone boost pressure.