ARCADIS

Appendix A

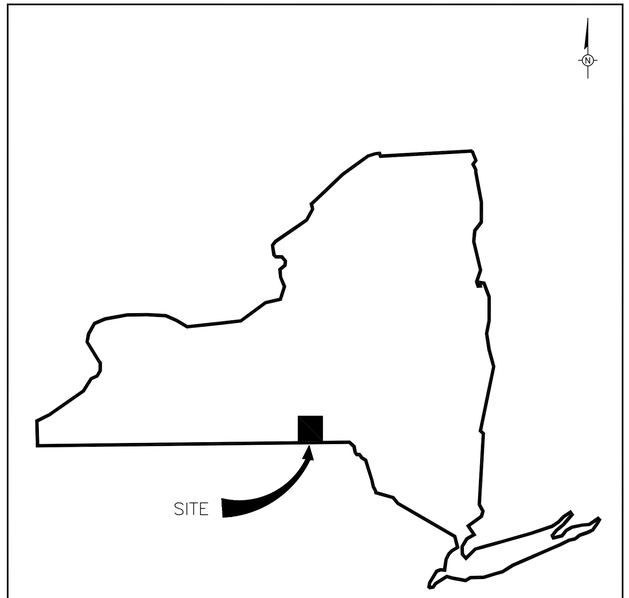
Construction Design Drawings

CONSTRUCTION DRAWINGS FOR FULL SCALE IN-SITU CHEMICAL OXIDATION SYSTEM

DOVER ELECTRONICS SITE, KIRKWOOD, NEW YORK

SITE # 7-04-026

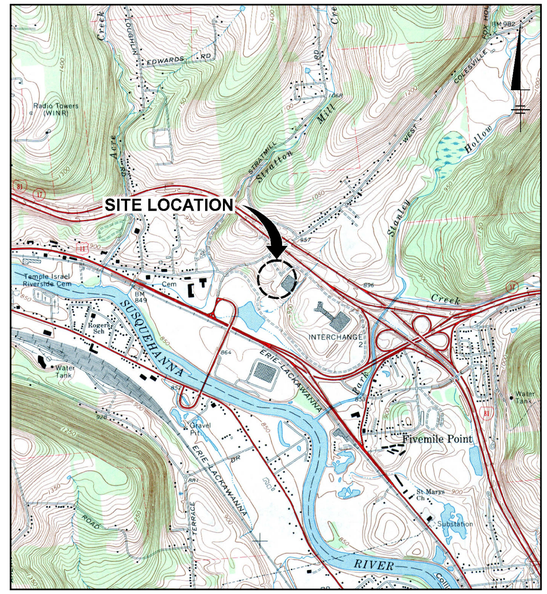
PREPARED BY ARCADIS OF NEW YORK, INC.



SITE VICINITY MAP
NOT TO SCALE

LIST OF DRAWINGS

SHEET No.	TITLE
1	COVER SHEET
2	EXISTING SITE LAYOUT
3	IN-SITU CHEMICAL OXIDATION FULL SCALE SYSTEM LAYOUT PLAN
4	PROCESS AND INSTRUMENTATION DIAGRAM
5A	MISCELLANEOUS DETAILS
5B	MISCELLANEOUS DETAILS
6	DISTRIBUTION BOX DETAILS
7	ELECTRICAL SITE PLAN
8	ELECTRICAL DETAILS



SITE LOCATION MAP
SCALE: 1"=2000'

KEY CONTACTS:

ARCADIS U.S. INC.
105 FIELDCREST AVENUE
SUITE 305
EDISON, NJ 08837
TELEPHONE: 732.225.5061
CONTACT: GREGORY ALBRIGHT/
MOH MOHIUDDIN

CITY: CRANBURY DIV/GROUP: SER1 DB: A.SANCHEZ/T.FATTO LD: PIC: E.CARMAN PM: M.MOHIUDDIN TM: M.MOHIUDDIN LYR:ON=*;OFF=*REF*
G:\ENVCAD\Mahwah\ACTIVE\NJ000616\K010\00001\2011-02\FIG 1-COVER SHEET.dwg LAYOUT: 1SAVED: 3/1/2011 5:48 PM ACADVER: 18.0S (LMS TECH) PAGESETUP: ----PLOTSTYLETABLE: ARCADIS_MELVILLE.CTB PLOTTED: 3/1/2011 5:48 PM BY: GONZALEZ, JAMES
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Fig 1.jpg
South Amboy.tiff

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Professional Engineer's Name
MOH MOHIUDDIN
Professional Engineer's No.
074527

State	Date Signed	Project Mgr.
NY		GA
Designed by	Drawn by	Checked by
SB	JG	KL

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COVER SHEET

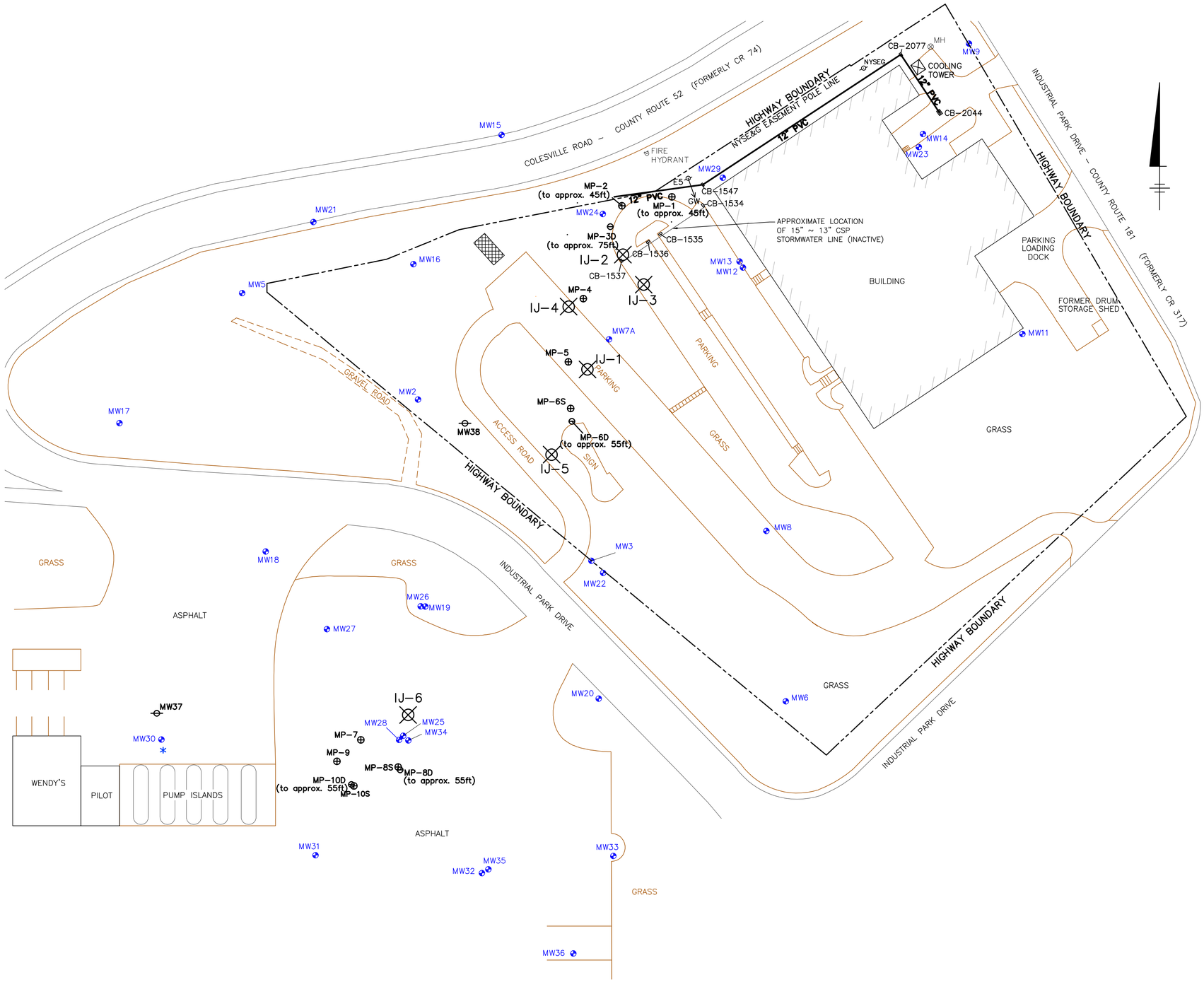
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NJ000616.K010.00001

Date
FEBRUARY 2011

ARCADIS
RARITAN PLAZA III
105 FIELDCREST AVE, SUITE 305
EDISON, NJ 08837
TEL. 732.225.5061

1



LEGEND

- EXISTING MONITORING WELL
- 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH
- EXISTING TREATMENT BUILDING
- EXISTING INJECTION TEST WELL
- FIRE HYDRANT (APPROXIMATE LOCATION)
- POWER POLE (APPROXIMATE LOCATION)
- GW GUIDE WIRE (APPROXIMATE LOCATION)
- MH MANHOLE (APPROXIMATE LOCATION)
- CB CATCH BASINS (APPROXIMATE LOCATION)
- HIGHWAY BOUNDARY (APPROXIMATE LOCATION)
- UNDERGROUND PIPING (APPROXIMATE LOCATION)

SOURCE:

1. BASEMAP FROM FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.
2. UTILITY LOCATION FROM BOUNDARY AND TOPOGRAPHIC SURVEY MAP "UNIVERSAL INSTRUMENTS CORPORATION, 29 INDUSTRIAL PARK DRIVE, TOWN OF KIRKWOOD, BROOME COUNTY, NEW YORK STATE", HAWK ENGINEERING, P.C., OCTOBER 7, 1996.

0 60' 120'

GRAPHIC SCALE

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF* IMAGES: PROJECTNAME: ---- XREFS: 00616X02
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Professional Engineer's Name: MOH MOHIUDDIN
Professional Engineer's No.: 074527
State: NY | Date Signed: | Project Mgr.: GA
Designed by: SB | Drawn by: JG | Checked by: KL

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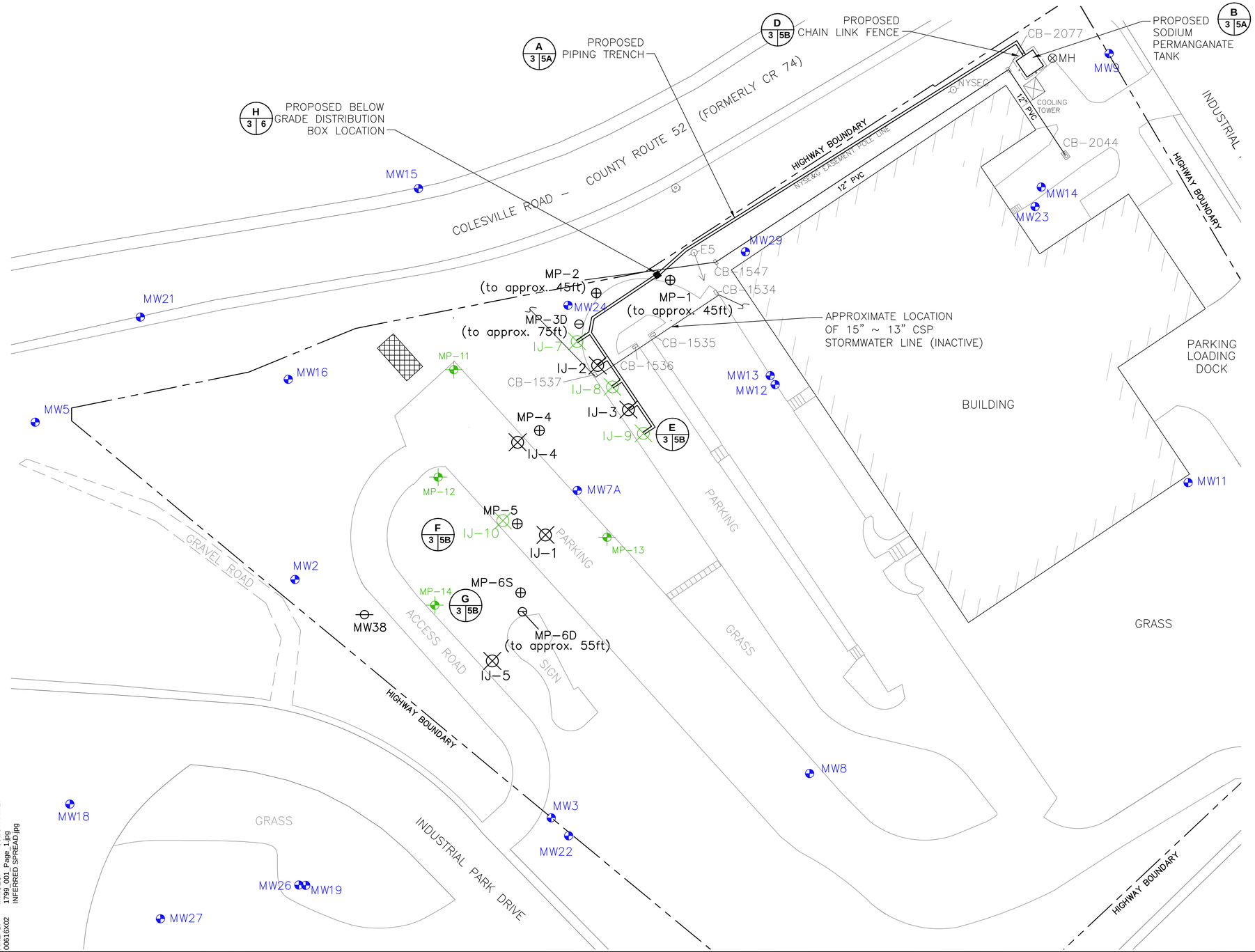
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EXISTING SITE LAYOUT

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EDISON, NJ 08837
TEL. 732.225.5061

2



LEGEND

- PROPOSED INJECTION WELL
- PROPOSED MONITORING POINTS
- PROPOSED CHAIN LINK FENCE
- PROPOSED PIPING TRENCH
- PROPOSED BELOW GRADE DISTRIBUTION BOX
- EXISTING MONITORING WELL
- 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH
- INJECTION TEST WELL
- EXISTING TREATMENT BUILDING
- EXISTING FIRE HYDRANT
- POWER POLE (APPROXIMATE LOCATION)
- GW GUIDE WIRE (APPROXIMATE LOCATION)
- MH MANHOLE (APPROXIMATE LOCATION)
- CB CATCH BASINS (APPROXIMATE LOCATION)
- HIGHWAY BOUNDARY (APPROXIMATE LOCATION)
- UNDERGROUND PIPING (APPROXIMATE LOCATION)

0 40' 80'
GRAPHIC SCALE

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
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INFERRED SPREAD.jpg

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Professional Engineer's Name		
MOH MOHIUDDIN		
Professional Engineer's No.		
074527		
State	Date Signed	Project Mgr.
NY		GA
Designed by	Drawn by	Checked by
SB	JG	KL

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IN-SITU CHEMICAL OXIDATION FULL SCALE SYSTEM LAYOUT PLAN

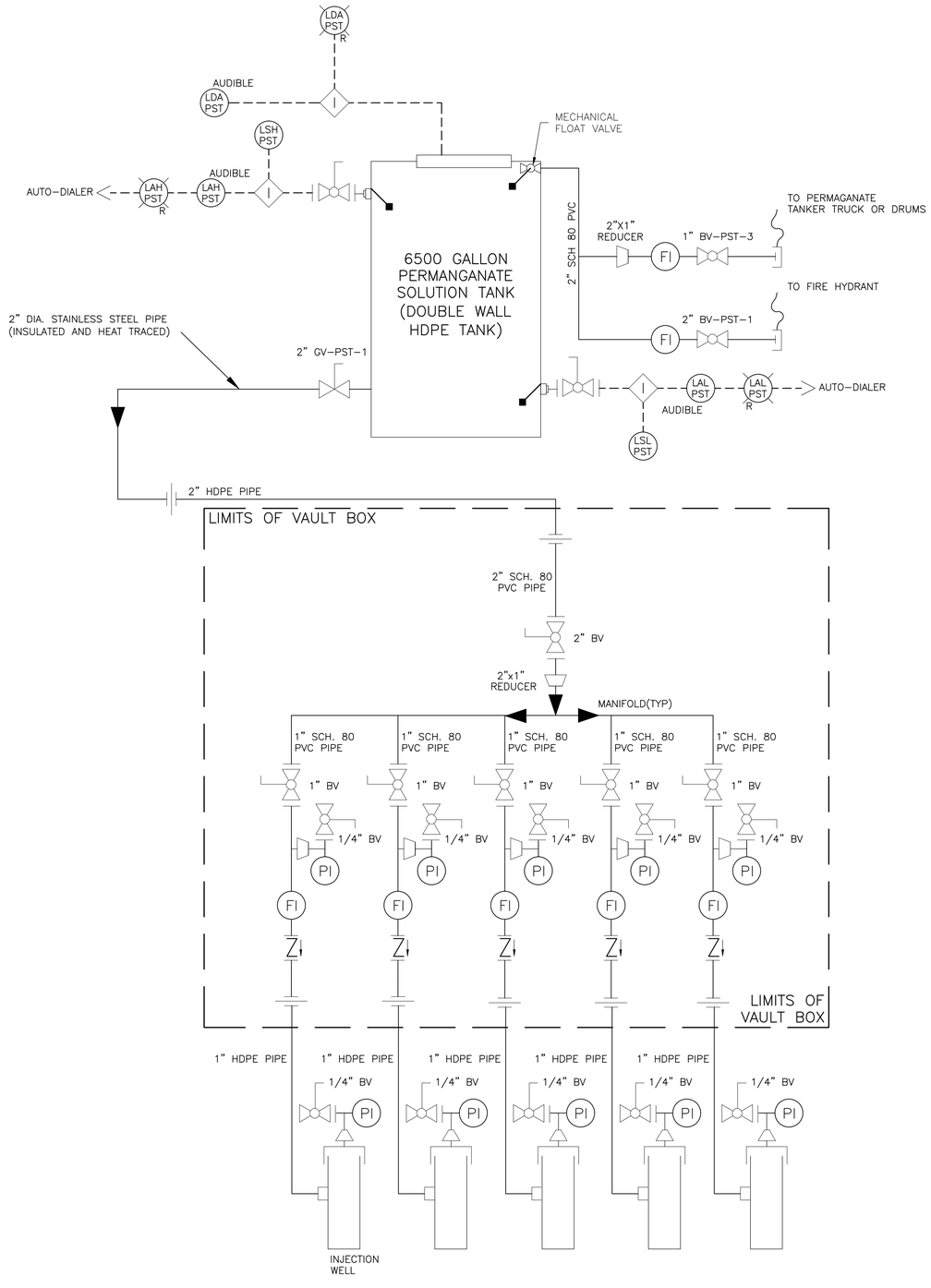
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3



LEVEL SWITCH IS CONNECTED TO A LIGHT AND AN AUDIBLE ALARM. ALARM GOES ON WHEN THE WATER LEVEL RISES TOO HIGH. A LEAK DETECTION SENSOR IS CONNECTED TO A LIGHT AND AN AUDIBLE ALARM. WHEN THE ALARM IS ENGAGED, THE AUTO-DIALER WILL BE ACTIVATED.

LEGEND

	ENCLOSED IN VAULT BOX
I	INTERLOCK
PI	PRESSURE INDICATOR
FI	FLOW INDICATOR/ TOTALIZING FLOW INDICATOR
	GATE VALVE
	BALL VALVE
	CHECK VALVE
	UNION
	CAMLOCK CONNECTION
PST	PERMENGANATE SOLUTION TANK
LSH	LEVEL SWITCH HIGH
LAH	LEVEL ALARM HIGH
LDA	LEAK DETECTION ALARM
LAL	LEVEL ALARM LOW
LSL	LEVEL SWITCH LOW

NOT TO SCALE

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF* G:\ENVCAD\Mahwah\ACTIVE\NJ000616\K010\00001\2011-02\00616D04-CB.dwg LAYOUT: 4SAVED: 2/24/2011 9:49 AM ACADVER: 18.0S (LMS TECH) PAGESETUP: ----PLOTSTYLETABLE: ARCADIS.CTB PLOTTED: 2/24/2011 9:49 AM BY: GONZALEZ, JAMES XREFS: IMAGES: PROJECTNAME: ----

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NY		GA
Designed by: SB	Drawn by: JG	Checked by: KL

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PROCESS AND INSTRUMENTATION DIAGRAM

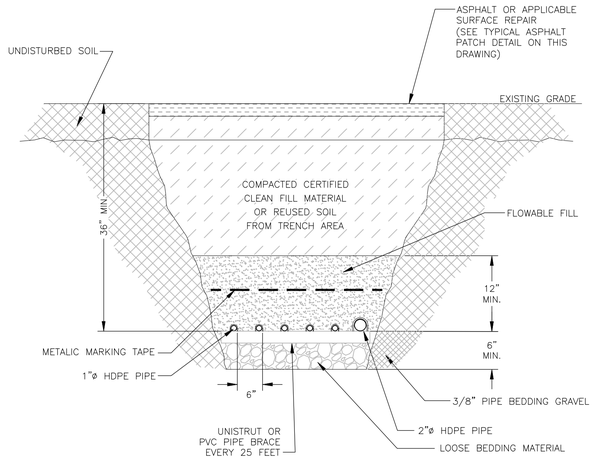
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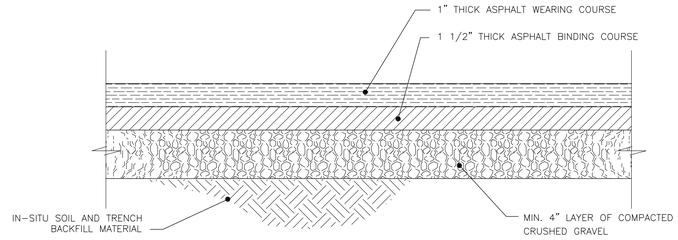


A 3 5A TYPICAL TRENCH DETAIL

SCALE: NONE

NOTES:

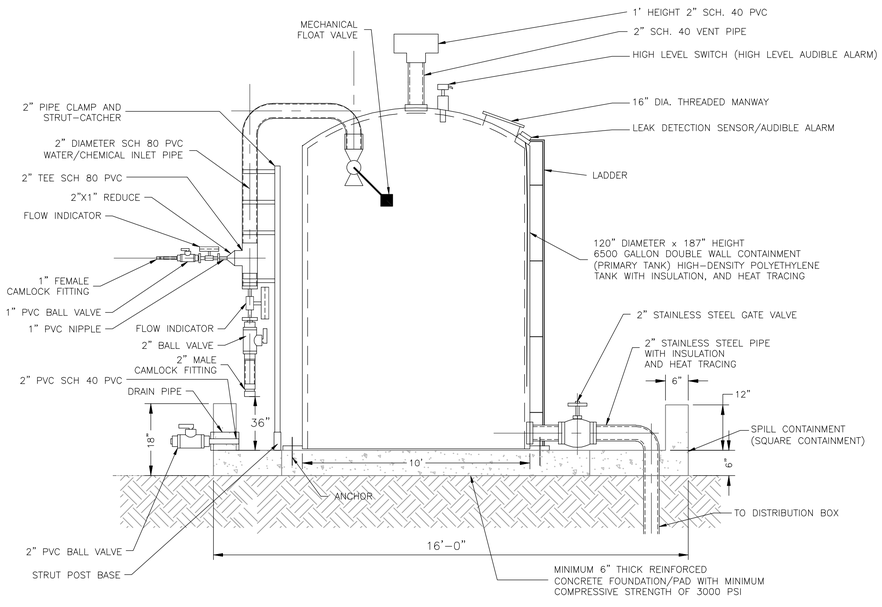
1. BACKFILL TO BE PLACED IN MAXIMUM LOOSE LIFT OF 8 INCHES, RESULTING IN MAXIMUM COMPACTED LIFT OF 6 INCHES (MINIMUM 3 PASSES WITH A WALK–BEHIND PLATE COMPACTOR).
2. BACKFILL TO BE COMPACTED TO A MINIMUM OF 92 PERCENT OF THE MAXIMUM DRY DENSITY BENEATH PAVEMENT AND 85 PERCENT FOR UNPAVED AREAS AS DETERMINED BY ASTM D–1557.
3. FILL SHALL BE COMPACTED WITH A RANGE OF 1 PERCENT BELOW TO 3 PERCENT ABOVE OPTIMUM MOISTURE CONTENT AS DETERMINED BY ASTM D–1557.



C 3 5A TYPICAL ASPHALT PATCH DETAIL

SCALE: NONE

NOTE: ASPHALT PATCHING DETAIL REQUIREMENTS TO BE MODIFIED, PER ENGINEER'S APPROVAL, TO MATCH EXISTING ASPHALT CONDITIONS.



B 3 5A SODIUM PERMANGANATE TANK DETAIL

SCALE: NONE

CONSTRUCTION NOTES:

1. PIPE ROUTING SHOWN FOR CONSTRUCTION LAYOUT PURPOSES ONLY. ACTUAL ROUTING TO BE FIELD DETERMINED AND IS SUBJECT TO ENGINEER'S APPROVAL.
2. REFER TO DRAWING M–2 FOR THE SIZE AND MATERIAL USED FOR PROCESS PIPING.
3. OBSERVATION WELL LOCATIONS ARE SHOWN ON DRAWING 7. CONTRACTOR SHALL EXTEND ALL PROCESS PIPING AND MAKE ALL NECESSARY CONNECTIONS TO WELL VAULTS.
4. ALL PIPING PRESSURE TESTS SHALL BE MADE BY THE CONTRACTOR IN THE PRESENCE OF THE ENGINEER. TESTS SHALL BE PERFORMED PRIOR TO BACKFILL OF TRENCHES.
5. THE CONTRACTOR SHALL PROVIDE ALL PRODUCTS AND PROPERLY CALIBRATED TESTING EQUIPMENT REQUIRED TO PERFORM THE PRESSURE TESTING WORK.
6. ALL INJECTION PIPING SHALL BE PRESSURE TESTED. PIPING JOINTS SHALL BE EXPOSED DURING THE TESTS. UNLESS APPROVED BY ENGINEER TESTS MAY BE PERFORMED ON SEPARATE SECTIONS OF PIPING TO EXPEDITE CONSTRUCTION. THE CONTRACTOR SHALL NOT PERFORM PRESSURE TESTING AGAINST SYSTEM VALVES. INJECTION PIPE SECTIONS SHALL BE HYDROSTATIC ALLY TESTED AT 125 PSI FOR TWO HOURS.
7. AFTER THE INITIAL PRESSURE TEST ON PIPING IS COMPLETED SUCCESSFULLY, THE CONTRACTOR SHALL BACKFILL THE TRENCHES AS SPECIFIED ON HEREIN.
8. TRENCHING WILL BE PERFORMED PER THESE SPECIFICATIONS AND AS SHOWN ON HEREIN.
9. EXCAVATIONS SHALL BE KEPT FREE FROM STANDING WATER.
10. CONTRACTOR SHALL NOTIFY THE ENGINEER AT THE COMPLETION OF EXCAVATIONS AND TRENCHING TO ALLOW FOR INSPECTIONS.
11. CONTRACTOR SHALL PROVIDE APPROPRIATE SAFETY BARRICADES AROUND TRENCHING AND EXCAVATION TO PREVENT ACCIDENTS OR UNAUTHORIZED ENTRY.
12. CONTRACTOR'S FILL SOURCE MUST BE TESTED BY CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO COMMENCING THE WORK AND/OR PLACING THE MATERIAL.
13. EXCAVATIONS WILL BE BACK FILLED AS PROMPTLY AS WORK PERMITS ONCE REQUIRED INSPECTIONS HAVE BEEN COMPLETED.
14. DO NOT PLACE MATERIALS ON SURFACES THAT ARE MUDDY, FROZEN, OR CONTAIN ICE OR FROST.
15. CONTRACTOR SHALL PLACE A SINGLE STRIP OF UTILITY WARNING TAPE IN ALL TRENCHED AREAS. THIS TAPE SHALL CONTAIN A WIRE FOR METAL DETECTION OR HAVE AN ALUMINUM CORE. TAPE SHALL BE PLACED AT A DEPTH OF 6 INCHES IN NON–PAVED AREAS AND BELOW THE SUB–BASE IN PAVED AREAS.
16. REPLACE ASPHALT IN PAVED AREAS FOLLOWING TRENCHING, PIPING INSTALLATION AND BACKFILL. THE CONTRACTOR SHALL PERFORM ALL ASPHALT REPLACEMENT IN THE TRENCHING AREAS IN ACCORDANCE WITH THE DETAILS CONTAINED HEREIN.
17. THE SUB–BASE AND EACH ASPHALT COURSE SHALL BE COMPACTED ACCORDING TO THESE SPECIFICATIONS. EACH LAYER SHALL BE CLEAN AND DRY PRIOR TO THE APPLICATION OF THE NEXT LAYER.
18. ALL RECOVERY PIPELINES SHALL BE FLUSHED WITH POTABLE WATER FOLLOWING FINAL PRESSURE TEST APPROVAL AND PRIOR TO FINAL CONNECTION.

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Professional Engineer's Name: **MOH MOHIUDDIN**
Professional Engineer's No.: 074527

State	Date Signed	Project Mgr.
NY		GA
Designed by	**Drawn by**	**Checked by**
SB	JG	KL

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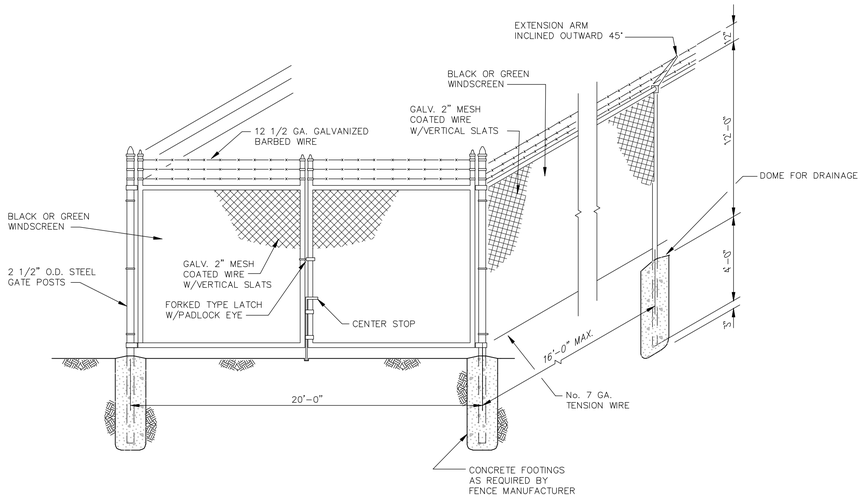
MISCELLANEOUS DETAILS

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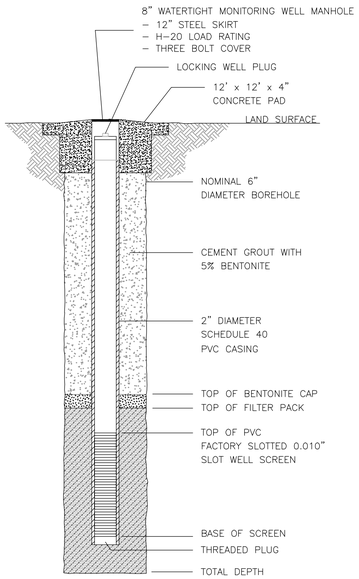
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EDISON, NJ 08837
TEL. 732.225.5061

5A



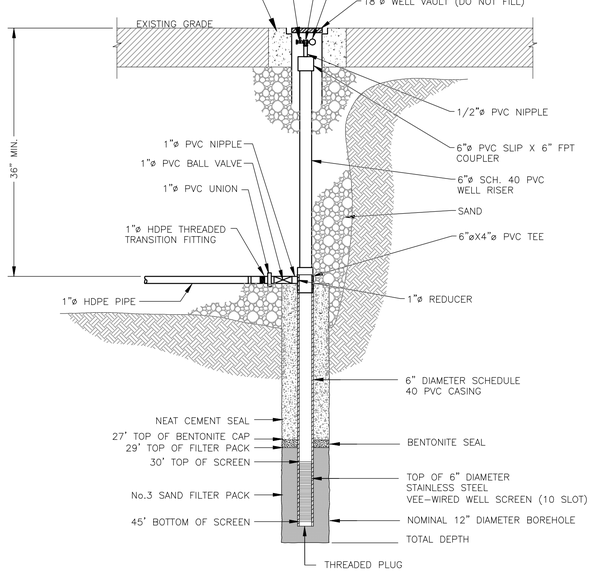
D / 3 5B **CHAIN LINK FENCE DETAIL**

SCALE: NONE



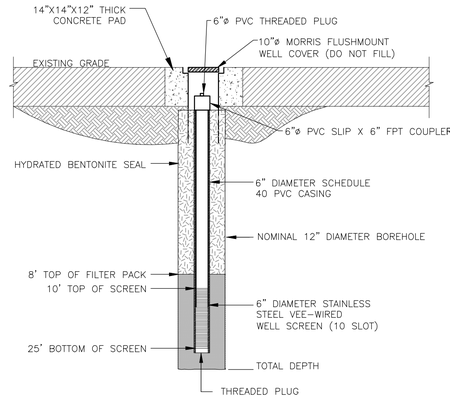
G / 3 5B **MONITORING WELL CONSTRUCTION DETAIL**

SCALE: NONE



E / 3 5B **INJECTION WELL CONSTRUCTION DETAIL FOR INJECTION WELLS IJ-2, IJ-3, IJ-7, IJ-8, AND IJ-9**

SCALE: NONE



F / 3 5B **INJECTION WELL CONSTRUCTION DETAIL FOR INJECTION WELL IJ-10**

SCALE: NONE

NOTES:

1. ALL INJECTION WELL SCREENS ARE STAINLESS STEEL VEE–WIRED.
2. 1"Ø PVC BALL VALVE TO BE SHUT WHILE PRESSURE TESTING THEN OPENED BEFORE BACKFILLING.

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MISCELLANEOUS DETAILS

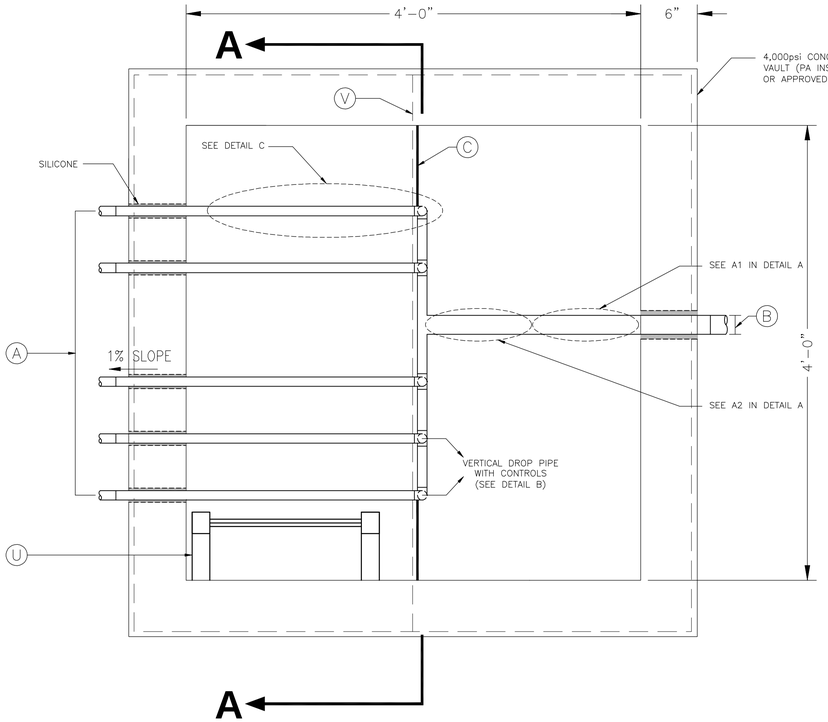
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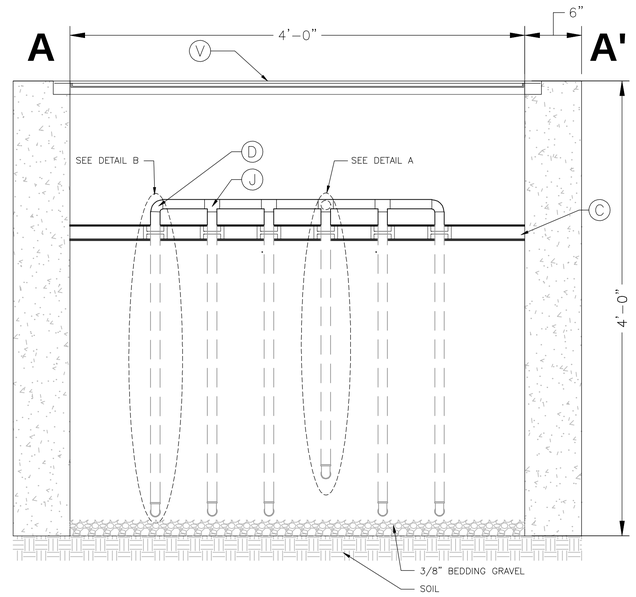
5B



H 3 6

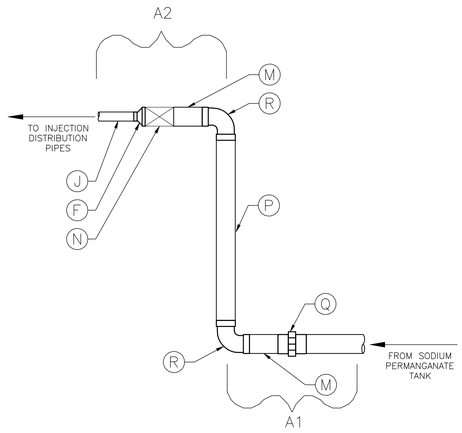
DISTRIBUTION BOX - PLAN VIEW

SCALE: 1 1/2"=1'-0"



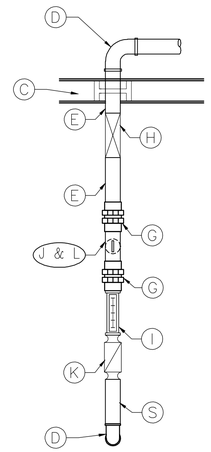
PROFILE VIEW A-A'

SCALE: 1 1/2"=1'-0"



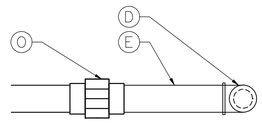
DETAIL A

NOT TO SCALE



DETAIL B

NOT TO SCALE



DETAIL C

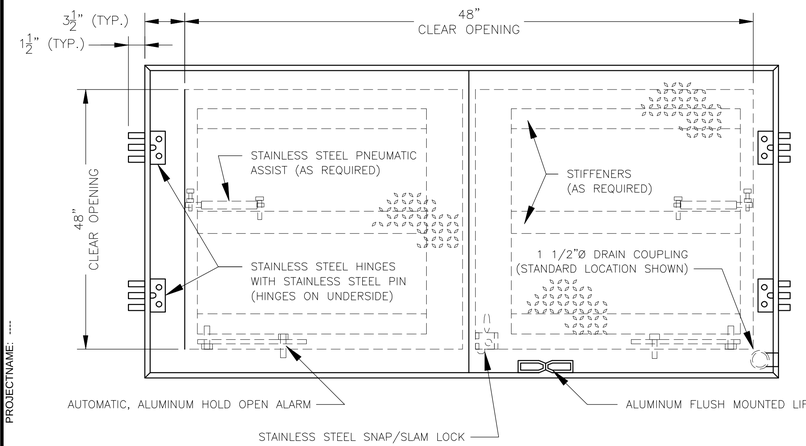
NOT TO SCALE

NOTES:

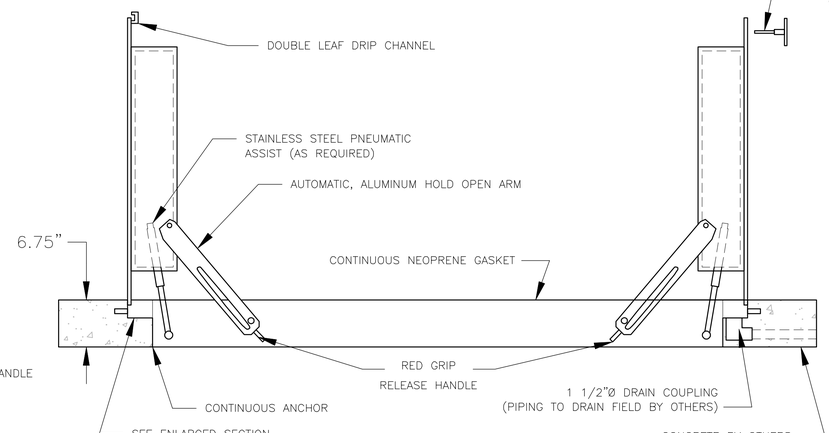
1. 4,000psi PRE-CAST CONCRETE VAULTS MANUFACTURED BY PA. INSERT CORP. OR APPROVED EQUAL.
2. ALUMINUM DOORS AND LADDER MANUFACUTURED BY PA. INSERT CORP. OR APPROVED EQUAL.
3. ALL HDPE PIPING TO BE HEAT WELDED. ALL HDPE PIPE SHALL BE SDR 11 PIPE 160psi. PVC/HDPE JOINT AT WELL SHALL BE PRESSURE TESTED IN FIELD.
4. CONTRACTOR SHALL LABEL ALL INJECTION LINES IN DISTRIBUTION BOXES.
5. ALL PIPES AND VALVES WITHIN THE DISTRIBUTION BOX NEED TO BE INSULATED AND HEAT TRACED.

DISTRIBUTION BOX KEY

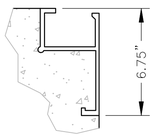
LETTER	DESCRIPTION
A	1"Ø HDPE PIPE – INJECTION WELLS
B	2"Ø HDPE PIPE – SODIUM PERMANGANATE TANK
C	PIPE SUPPORT
D	1"ø PVC 90° ELBOW
E	1"Ø X 3" PVC NIPPLE
F	1"Ø TO 2"Ø PVC BUSHING
G	1"ø PVC UNION
H	1"Ø PVC BALL VALVE
I	TOTALIZER FLOW METER (0.3–3 GPM)
J	1"ø PVC TEE
K	1"Ø PVC SPRING-LOADED PISTON CHECK VALVE
L	1" TO 1/4" PVC BUSHING, 1/4" TEE, PRESSURE GAUGE (0–30 PSI), AND 1/4" PRESSURE RELIEF BALL VALVE
M	2"ø X 3" PVC NIPPLE
N	2"ø PVC BALL VALVE
O	1"Ø HDPE TRANSITION FITTING
P	2"ø X 24" PVC THREADED PIPE
Q	2"ø HDPE TRANSITION FITTING
R	2"ø PVC 90° ELBOW
S	1"ø 12" PVC THREADED PIPE
U	ALUMINUM LADDER
V	HEAVY DUTY, DOUBLE LEAF, ALUMINUM DOOR



PLAN



SECTION



ENLARGED SECTION

DISTRIBUTION DOOR DETAIL

SCALE: NONE

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF* IMAGES: PROJECTNAME: ---- XREFS:
G:\ENVCAD\Mahwah\ACTIVE\NJ000616\K010\000010\2011-02\000616D06-CB.dwg LAYOUT: 6SAVED: 2/24/2011 9:53 AM ACADVER: 18.0S (LMS TECH) PAGESETUP: ----PLOTSTYLETABLE: ARCADIS.CTB PLOTTED: 2/24/2011 9:53 AM BY: GONZALEZ, JAMES

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Professional Engineer's Name: MOH MOHIUDDIN
Professional Engineer's No.: 074527

State	Date Signed	Project Mgr.
NY		GA
Designed by	Drawn by	Checked by
SB	JG	KL

ARCADIS OF NEW YORK, INC.

UNIVERSAL INTRUMENTS CORPORATION • KIRKWOOD, NEW YORK

DISTRIBUTION BOX DETAILS

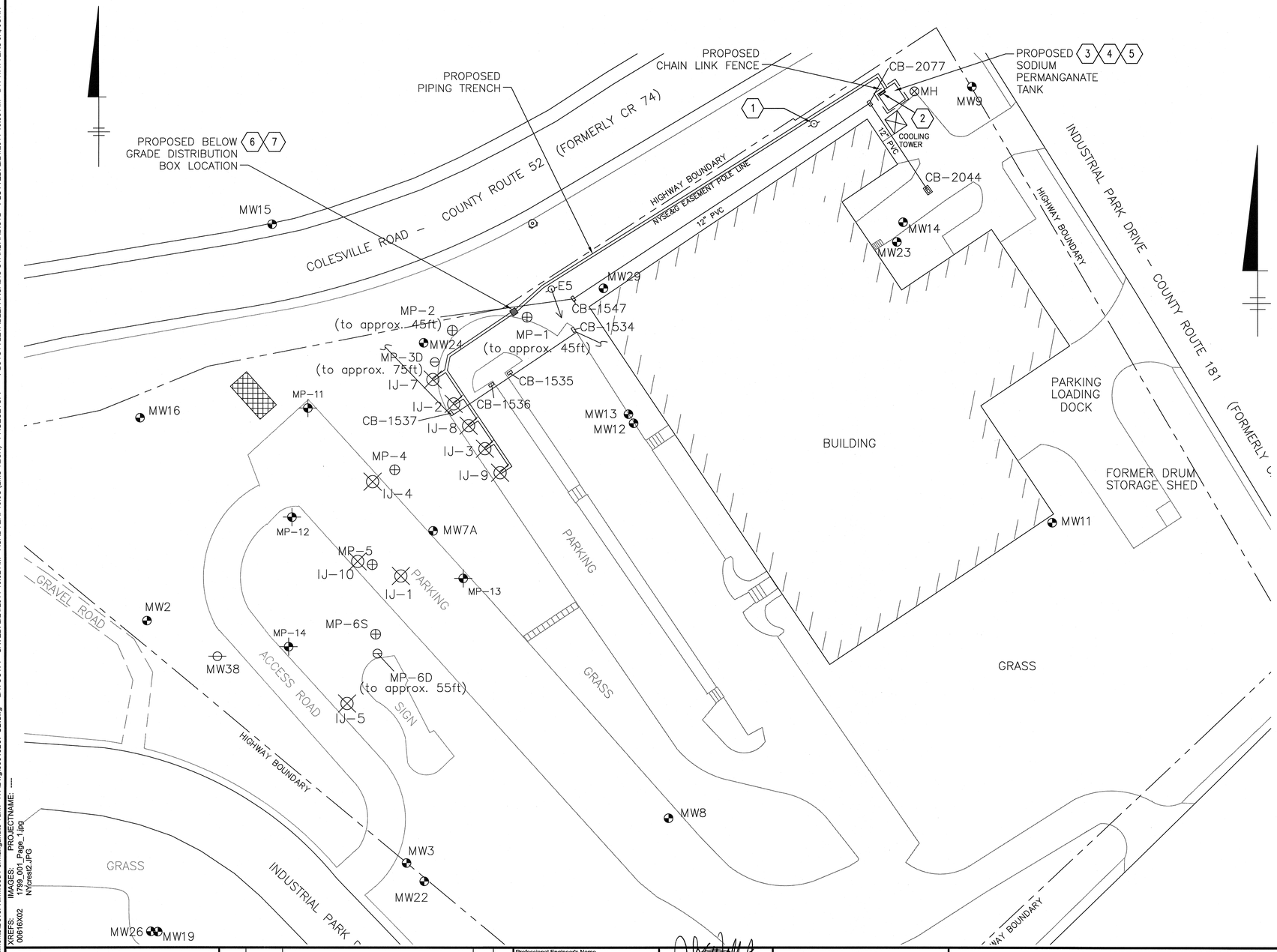
GENERAL

ARCADIS Project No. NJ000616.K010.00001

Date FEBRUARY 2011

ARCADIS
RARITAN PLAZA III
105 FIELDCREST AVE, SUITE 305
EDISON, NJ 08837
TEL. 732.225.5061

6



ELECTRICAL KEYED NOTES (1)

1. EXISTING NYSEG POWER POLE. COORDINATE WITH POWER AND TELEPHONE UTILITIES TO PROVIDE ELECTRICAL SERVICES TO METER AND PANELBOARD P AND AND TELEPHONE SERVICE TO THE DIALER IN THE CONTROL PANEL.
2. PROPOSED LOCATION OF NEW METER AND PANELBOARD P.
3. PROVIDE HEAT TRACE AROUND TANK, ON APPROXIMATELY 7'-0" OF STAINLESS STEEL PIPE AND ONE 2" VALVE IN TANK ENCLOSURE.
4. PROVIDE ALARM PANEL, LEAK DETECTOR WITH READOUT ON ALARM PANEL AND, HIGH AND LOW ALARM LEVEL SWITCHES AT THE PERMANGANATE TANK.
5. PROVIDE A DUPLEX RECEPTACLE AT THE PERMANGANATE TANK.
6. PROVIDE HEAT TRACE IN DISTRIBUTION BOX FOR: 10' OF 1" HDPE PIPE; 4' OF 2" PVC PIPE; ONE 2" VALVE; 10' OF 1" PVC PIPE; FIVE 1" BALL VALVES; FIVE 1" CHECK VALVES; AND FIVE FLOW INDICATORS. CONNECT HEAT TRACE TO A NEMA 4 JUNCTION BOX. FROM THE JUNCTION BOX,
7. PROVIDE A DUPLEX RECEPTACLE AT THE VALVE BOX.

SEE SHEET 8 FOR 1-LINE DIAGRAM AND ELECTRICAL DETAILS.

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
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XREFS: 00616X02
IMAGES: 1799_001_Page_1.jpg NYcrest2.JPG
PROJECTNAME: ----

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Professional Engineer's Name: JOHN L. WATTERS, JR.		
Professional Engineer's No.: 087020		
State: NY	Date Signed: 2-24-11	Project Mgr.: GA
Designed by: JW	Drawn by: JW	Checked by: KL

STATE OF NEW YORK JOHN L. WATTERS, JR. 087020 LICENSED PROFESSIONAL ENGINEER

ARCADIS

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ELECTRICAL SITE PLAN

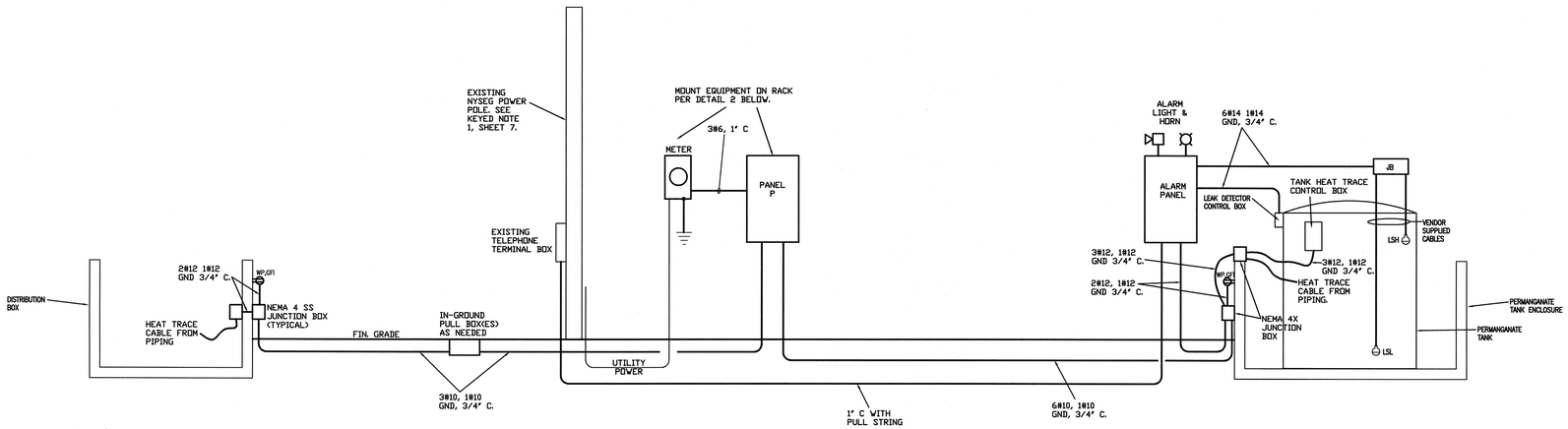
GENERAL

ARCADIS Project No.: NJ000616.K010.00001

Date: FEBRUARY 24, 2011

ARCADIS
RARITAN PLAZA III
105 FIELDCREST AVE, SUITE 305
EDISON, NJ 08837
TEL. 732.225.5061

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1/8 POWER 1-LINE DIAGRAM
NO SCALE

LOAD SERVED	VA PER PHASE A	VA PER PHASE B	CKT BRKR	CKT NO	BUS CONN A B	CKT NO	CKT BRKR	VA PER PHASE A	VA PER PHASE B	LOAD SERVED
HEAT TRACE TANK	500		20	1		2	20	750		RECEPTACLE TANK
HEAT TRACE TANK PIPING		500	20	3		4	20		750	RECEPTACLE DIST. BOX
HEAT TRACE DIST. BOX	500		20	5		6	20			SPARE
CONTROL PANEL, LEAK DETECTOR		1000	20	7		8	20			SPARE
				9		10	20			
				11		12				
				13		14				
				15		16				
				17		18				
				19		20				
VOLTAGE: 240 /120					CONNECTED PHASE KVA			1.8	2.3	

GROUND BAR:	YES	MOUNTING:	NEMA 4X
BOLT-ON CIRCUIT BREAKERS:	YES	CIRCUIT BREAKER TEMP. RATING 75°C	
MAIN CIRCUIT BREAKER:	YES	If Yes ► SIZE:	60 A
SERVICE ENTRANCE RATED:	YES	BUS:	100 A
MINIMUM AIC (K AMPS):	14	LUG:	N/A A
		SN:	100 A

[1] Demand factors per NEC 220, Part III. [2] Largest of NEC Table 220.12 or connected load. [3] NEC Table 220.56. [4] NEC 220.51. [5] NEC 430.24. [6] NEC 220.44. [7] Non-coincident loads, largest of the two loads is counted.

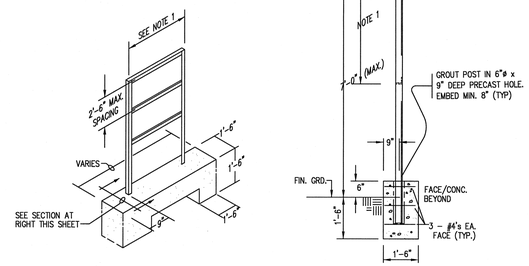
PANEL P

LOCATION: PERMANGANATE TANK

LOAD TYPE		KVA THIS PNL	KVA SUB PNLS	KVA TOTAL	NEC DEMAND FACTOR [1]	KVA DEMAND
GENERAL LIGHTING [2]				0.0	100%	0.0
GENERAL USE				0.0	≤ 10 KVA @ 100%	0.0
RECEPTACLES [6]					> 10 KVA @ 50%	0.0
MOTORS &	LARGEST [5]	1.0		1.0	125%	1.3
EQUIPMENT	ALL OTHERS	3.0		3.0	100%	3.0
KITCHEN EQUIPMENT [3]				0.0	100%	0.0
FIXED ELEC. SPACE HEAT [4]				0.0	100%	0.0
WATER HEATERS				0.0	100%	0.0
TOTAL CONNECTED LOAD =				4.0		
PANEL/FEEDER TOTAL KVA (KVA_T) =						4.3
KVA_T X 1000/V_{L-L} = TOTAL AMPS =						**18**

EQUIPMENT RACK NOTES:

1. COORDINATE W/ SHOP DWGS. OF EQUIPMENT USED. MAXIMUM HORIZONTAL SPAN SHALL BE 5'-0" WITHOUT ADDITIONAL VERTICAL SUPPORTS.
2. FABRICATE FROM 1-5/8" STAINLESS STEEL STRUT.



ISOMETRIC SECTION

2/8 EQUIPMENT RACK DETAIL
NO SCALE

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Professional Engineer's Name: JOHN L. WATTERS, JR.
Professional Engineer's No.: 087020
State: NY | Date Signed: 2-24-11 | Project Mgr.: GA
Designed by: JW | Drawn by: JW | Checked by: KL

JOHN L. WATTERS JR. 087020 LICENSED PROFESSIONAL ENGINEER

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ELECTRICAL DETAILS

GENERAL

ARCADIS Project No.
NJ000616.K010.00001
Date
FEBRUARY 24, 2011
ARCADIS
RARITAN PLAZA III
105 FIELDCREST AVE, SUITE 305
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TEL. 732.225.5061

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ARCADIS

Appendix B

Technical Specifications

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SECTION 01010
SUMMARY OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Contract Description.

B. Definitions.

C. Scope of Work.

D. Principal Features.

E. Responsibilities.

F. Ownership.

G. CONTRACTOR'S Use of Site and Premises.

H. Offsets.

I. Quality Assurance.

J. Materials and Equipment.

K. Warranties.

L. References.

M. Submittals.

N. Project/Site Conditions.

1.02 CONTRACT DESCRIPTION

A. On behalf of Dover Corporation (Dover), ARCADIS of New York, Inc. (ARCADIS) has prepared these Technical Specifications for the design of a proposed groundwater remediation system that will be implemented at the former Dover Electronics site in Kirkwood, Broome County, New York.

1.03 DEFINITIONS

A. For the purpose of these Technical Specifications, Construction Drawings, and other contract documents, the following definitions apply:

1. OWNER/CLIENT: Dover Corporation.

2. CONSULTANT/ENGINEER: ARCADIS of New York, Inc.

3. CONTRACTOR: The individual, firm, partnership, or corporation designated as the CONTRACTOR in these contract documents.

4. VENDOR, SUPPLIER or MANUFACTURER: The individual, firm, partnership, or corporation selected to supply specific system equipment components.

5. SITE: The area as indicated on Construction Drawings No. 1 and 2.

1.04 SCOPE OF WORK

A. The Construction Drawings and these Technical Specifications shall constitute the design and construction requirements for this project. The CONTRACTOR shall provide the necessary supervision, labor, materials, equipment, tools, and appurtenances as required to affect a complete Work, acceptable to the permitting authorities, the CONSULTANT/ENGINEER, and in compliance with the respective codes. Work under this Contract Document includes the following list of items which is meant as a guide and as a general description of the CONTRACTOR'S scope of work.

1. Obtain all required state, county and local permits.

2. Mobilize materials and equipment.

3. Obtain access to and locate all required utilities necessary for completion of the Work, including, but not limited to the following: electric power, telephone, and water.

4. Install four injection wells and four monitoring points as shown on Construction Drawing No. 3 and modify two existing injection wells.

5. Install one distribution box which shall house a manifold and pipes that will be connected to five injection wells and the mixing tank as depicted on Construction Drawings No. 3 and 4 of the design package.

6. Install all necessary pipes within the proposed trench area as shown on Construction Drawing No. 3 to connect the five injection wells and the mixing tank.

7. Install concrete spill containment at the proposed mixing tank area as depicted on Construction Drawing No. 3.

8. Supply and install one mixing tank. Including, installing all associated piping and electrical controls in accordance with the Construction Drawings and these Technical Specifications and MANUFACTURER'S recommendations.

9. Install permanent security fences and gate around the mixing tank area as shown on Construction No. 3.

10. Provide and install all necessary wiring, electrical devices, a panel box and instrumentation. Install and connect electrical devices to a panel box that will be located in the proposed mixing tank area shown on Construction Drawing No. 3.

11. Restore the trench area based on the details shown on Construction Drawing No. 5A and these Technical Specifications.

12. Cleanup and dispose of non-hazardous waste generated during the construction.

1.05 PRINCIPAL FEATURES

This section provides an overview and summary of the different processes associated with the treatment system and the components associated with each portion of the Work to be completed by the CONTRACTOR in accordance with the Construction Drawings and Technical Specifications.

A. Injection System

1. The injection system shall be comprised of two existing injection wells and four proposed injection wells to be installed by a licensed driller, Parratt-Wolff, Inc. Each injection well (except IW-10) shall be equipped with all

necessary piping and appurtenances in accordance with Construction Drawing No. 5B. Therefore, existing monitoring wells shall be modified in order to be equipped with an injection line located at 3-4 feet below ground surface (bgs). All injection wells (except IW-10) will be connected to a distribution box through a piping layout plan, as shown on Construction Drawings. A common manifold located inside the distribution box will service each of the injection wells. Each injection well will be connected to the distribution box by a 1-inch diameter high density polyethylene (HDPE) pipe, with a standard dimension ratio (SDR) of 21. The injection wellheads shall be adapted to accommodate necessary piping and appurtenances in accordance with Drawing No. 5B.

2. The piping from each injection well (except IW-10) shall be directed to a common trench leading up to the proposed mixing tank area as shown on Construction Drawings.

3. Each of the individual injection lines will have the following components located within the distribution box; one ball valve, one totalizing flow meter (0.3-3 gallons per minute [gpm]), schedule 80 PVC unions, one pressure gauge (0-30 psi), one pressure relief ball valve, and one tee to tie the injection line into a common manifold as shown on Drawings No. 4 and 6. Each injection line will be secured to a unistrut pipe rack in the distribution box. In addition, all pipes, valves and flow meters should be insulated and heat traced.

4. The proposed mixing tank area will include a concrete spill containment, one 6,500-gallon HDPE double wall containment tank, and other piping and mechanical components as shown on Drawing No. 5A

B. Piping

1. Piping includes pipe supports and all other associated appurtenances.

C. Electrical System

1. Provide and install all necessary wiring, electrical devices, a panel box, instrumentation to provide for an integrated system operation.

2. The electrical system shall include conduit, wiring, a panel box, devices, instrumentation, and all other items necessary to make the system functional.

D. Monitoring System

The monitoring system shall be comprised of four proposed monitoring points to be installed by a licensed driller, Parratt-Wolff, Inc. Each monitoring well shall be installed in accordance with Construction Drawing No. 5B.

1.06 RESPONSIBILITIES

A. The CONSULTANT/ENGINEER'S responsibilities:

1. Review the CONTRACTOR'S Health and Safety Plan to ensure its consistency with the overall plan for the SITE.

2. Stop work should it not comply with the terms of the Contract.

3. Review shop drawings, product data, and product samples.

4. Render approvals, clarifications, instructions, change orders, etc. (when appropriate).

5. Inspect materials and equipment as required.

6. Observe and verify construction activities.

7. Perform oversight of well drilling and modification.

8. Perform oversight of testing, obtain results of those tests, and evaluate for compliance with specifications.

9. Provide design interpretation and technical support.

10. Dispose of contaminated soils from the trench area, if any and all drill cuttings from the well installation.

11. Approve changes in the Work in writing.

B. The CONTRACTOR'S responsibilities:

1. Adhere to these Technical Specifications and the Construction Drawings.

2. Conduct all work in accordance with applicable local, State, and Federal regulations.

3. Apply for and pay all permit and inspection fees.

4. Supply all utilities required for construction.

5. Provide accurate schedules, adhere to the schedules, and receive approvals from the CONSULTANT/ENGINEER for modifications to the schedules, if necessary.

6. Prepare, submit, and implement a site-specific Health and Safety Plan.

7. Submit product data, components, and equipment to be used to the CONSULTANT/ENGINEER for approval.

8. Perform testing, submit results, and receive approvals from the CONSULTANT/ENGINEER for all materials prior to delivery to the SITE.

9. Arrange for delivery, receive, unload, and install all materials and equipment at the SITE; inspect for completeness or damage. Replace any items damaged after receipt.

10. Store and secure all materials and equipment, as required.

11. Load all excavated soils including the contaminated soils to the roll-off or appropriate containers and dispose of non-contaminated soils and other wastes generated during the construction.

12. Take all necessary precautions to ensure that all work under this contract shall be performed in such a manner that any adverse environmental impacts directly related to performing the Work are reduced to a level that is acceptable to the CONSULTANT/ENGINEER.

13. Provide and install all materials and equipment as specified, and perform testing to document that installation meets contract requirements. Submit test results to CONSULTANT/ENGINEER for review and approval.

14. Submit changes in the Work to the CONSULTANT/ENGINEER for written approval. Obtain written approval from the CONSULTANT/ENGINEER prior to the commencement of such changes in the Work.

15. Accompany the CONSULTANT/ENGINEER for a final inspection upon completion of the Work. The CONSULTANT/ENGINEER will prepare punch list and the CONTRACTOR shall make tradesmen available to make corrections to the system after the inspection.

16. Prepare and submit a complete set of operation and maintenance (O&M) instruction manuals for all equipment furnished by the CONTRACTOR.

17. Maintain a complete set of marked-up contract drawings to reflect all approved field changes and as-built information for the CONSULTANT/ENGINEER to develop record drawings.

1.07 OWNERSHIP

A. The Construction Drawings and Technical Specifications prepared by the CONSULTANT/ENGINEER are the property of the CONSULTANT/ENGINEER. They are not to be used on other projects or extensions to this Project except by agreement in writing from the CONSULTANT/ENGINEER. Submissions or distribution to meet official regulatory requirements, or other purposes in connection with this Project, is not to be construed as publication in derogation of the CONSULTANT/ENGINEER'S and OWNER'S rights.

1.08 CONTRACTOR'S USE OF SITE AND PREMISES

A. In accordance with Section 01012 (Special Conditions), the CONTRACTOR shall be responsible for making sure the locations of all underground and overhead utilities and structures are known. Before doing any work at the SITE, the CONTRACTOR shall notify the CONSULTANT/ENGINEER of the locations of all utilities and structures in the area where construction activities will be taking place.

B. The CONTRACTOR shall take all steps necessary to prevent disruptions or interference to areas adjacent to the SITE.

C. The CONTRACTOR shall limit construction operations to areas noted on Construction Drawings and designated by the CONSULTANT/ENGINEER.

D. The CONTRACTOR shall restore all areas disturbed by construction activities to existing conditions unless otherwise specified by the CONSULTANT/ENGINEER.

E. All work shall be conducted during hours deemed appropriate by the CONSULTANT/ENGINEER, OWNER, and/or local ordinance.

1.09 OFFSETS

A. The Construction Drawings are diagrammatic in nature. Required size and termination of pipes, and suggested routings are shown to conform to the SITE requirements, avoid creating obstructions, and preserve clearances. However, it is not the intention of these documents to indicate all required offsets. It is the specific responsibility of the CONTRACTOR to provide for offsets, horizontal and vertical control points and other surveying requirements in such a manner as to conform to the SITE features, and make all equipment requiring inspection, maintenance, and repair accessible.

1.10 QUALITY ASSURANCE

The CONTRACTOR shall be responsible for quality assurance of the Work as summarized below and in accordance with Section 01400 (Quality Control). The CONTRACTOR shall:

A. Monitor quality control over SUPPLIER'S, MANUFACTURER'S, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with MANUFACTURER'S instructions, including each step in installation, startup, and operating sequence.

C. Should MANUFACTURER instructions conflict with Contract Documents, request clarification from the CONSULTANT/ENGINEER before proceeding.

D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have the Work performed by persons qualified to produce workmanship of specified quality.

1.11 MATERIALS AND EQUIPMENT

The CONTRACTOR shall be responsible for materials and equipment as summarized below and in accordance with Section 01600 (Materials and Equipment):

A. Products

1. Products: means new material, components, fixtures, and systems comprising the Work. Does not include machinery and equipment used for preparation, fabrication, conveying, and erection of the Work.

B. Storage and Protection

1. Equipment, products, backfill material, and all other construction materials shall be stored in an area designated by the CONSULTANT/ENGINEER.

2. Store and protect products in accordance with MANUFACTURER'S instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.

3. The CONTRACTOR will be responsible for providing heating and weather protection for equipment and materials that require that level of care.

C. Substitutions

1. Substitutions after project initiation may be considered when a product becomes unavailable through no fault of the CONTRACTOR.

2. Substitution of components is allowed as follows:

   a. Where specified as "or equal" shall mean that the CONTRACTOR may use a material of equal quality, function, and value.

   b. Where specified as "or approved equal" means that substitution is allowed upon approval by the CONSULTANT/ENGINEER.

   c. Where specified as "no substitutions" means substitutions will not be allowed unless compelling reasons exist to require the substitution, and the CONSULTANT/ENGINEER concurs with the CONTRACTOR and approves substitution.

3. A request for substitution constitutes a representation that the CONTRACTOR:

   a. Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product.

   b. Will provide the same warranty for the substitution as for the specified product.

c. Will coordinate installation and make changes to other Work, which may be required for the Work to be complete, with no additional cost to the CONSULTANT/ENGINEER.

d. Waives claims for additional costs or time extension which may subsequently become apparent.

e. CONSULTANT/ENGINEER'S approval of a request shall place the responsibility under this section on the CONSULTANT/ENGINEER.

1.12 WARRANTIES

The CONTRACTOR shall obtain warranties in accordance with Section 01012 (Special Conditions) and as summarized below.

A. Warranties shall be executed in duplicate by responsible SUBCONTRACTORS, SUPPLIERS, and MANUFACTURERS, at least ten (10) days prior to shipment or completion of the applicable item of Work. Except for items put into use with CONSULTANT/ENGINEER permission, leave date of beginning of time of warranty blank until the Date of Substantial Completion is determined.

1.13 REFERENCES

A. In addition to other applicable local, State, and Federal requirements, the CONTRACTOR shall comply with the specific codes and standards cited in each section.

B. Applicable National Fire Protection Association (NFPA) codes shall also be adhered to.

1.14 SUBMITTALS

The CONTRACTOR shall be responsible for providing submittals in accordance with Section 01300 (Submittals) and as summarized below:

A. Submit as follows:

1. Identify Project, CONSULTANT/ENGINEER, CONTRACTOR, SUBCONTRACTOR, or SUPPLIER, pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.

2. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work.

B. Documents Required:

1. Submit the number of copies which the CONSULTANT/ENGINEER requires.

2. Mark each copy to identify applicable products, models, options, and other data. Supplement MANUFACTURERS' standard data to provide information unique to this Project.

C. Submit product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

D. Mark dimensions and values in units to match those specified.

E. Proposed Products List: Submit information on all products and equipment specified for the Project.

F. Proposed SUPPLIER List: Submit a complete list of SUPPLIERS with product, name, and address.

F. Other submittals shall include (but are not limited to): MANUFACTURER'S instructions; product test results; proposed subcontractor list; site-specific Health and Safety Plan (HASP); construction progress schedules and reports; Operations and Maintenance (O&M) manuals; and record drawings.

1.15 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Construction Drawings, unless prevented by unforeseen conditions.

PART 2 - PRODUCTS

A. Many products are referenced and specified throughout these Specifications by registered trade names. This does not constitute a recommendation of these products to the exclusion of other products. Equivalent products must be approved by the CONSULTANT/ENGINEER before being used (see paragraph 1.11, above). Impact to system layout, cost, and project schedule must be accounted for by the

CONTRACTOR in all requested changes in accordance with Section 01600 (Materials and Equipment).

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01012
SPECIAL CONDITIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Ordinances, Permits, Licenses.

B. Emergency Responsibility.

C. Environmental Protection.

D. Equipment Adjustment and Calibration.

E. System Start-up and Operation.

F. Operation and Maintenance Instruction Manuals.

G. Warranties.

H. CONSULTANT/ENGINEER'S Authority.

1.02 ORDINANCES, PERMITS, AND LICENSES

A. The CONTRACTOR shall at all times follow all applicable local, state, and federal laws. Neither the CONSULTANT/ENGINEER, OWNER, nor any other party shall be liable or held responsible if CONTRACTOR violates any of the above laws.

C. The required state environmental permits shall be in place before start of construction.

1.03 EMERGENCY RESPONSIBILITY

A. In case of emergency which threatens damage of property and/or safety of life, the CONTRACTOR shall act, without previous instructions from the CONSULTANT/ENGINEER or OWNER, as the situation may warrant. The Health and Safety Plan (HASP) required under Section 01300 (Submittals) shall contain all relevant information regarding emergency response and be completed per Part 3 of this section of the Technical Specifications. The CONTRACTOR shall notify the CONSULTANT/ENGINEER of any emergencies immediately thereafter. Any claim for compensation by the CONTRACTOR, together with substantiating documents regarding expenses, shall be submitted to the CONSULTANT/ENGINEER and the amount of compensation shall be determined by agreement between the CONTRACTOR and CONSULTANT/ENGINEER.

1.04 ENVIRONMENTAL PROTECTION

A. General Requirements - The CONTRACTOR shall provide and maintain environmental protection during the life of the Contract. Environmental protection shall be provided to correct conditions that develop during all phases of construction. The CONTRACTOR'S operations shall comply with all federal, state, and local regulations pertaining to water, air, solid waste, and noise pollution.

B. Protection of Natural Resources - It is intended that the natural resources within the SITE and outside the limits of permanent Work performed under this Contract be preserved in their existing condition or be restored to an equivalent or improved condition upon completion of the Work. Construction activities shall be confined to areas defined by the Contract Documents.

1. The CONTRACTOR shall restore damaged areas of the SITE to "Original Conditions" as applicable after performing required work. An inspection by the CONSULTANT/ENGINEER shall determine completion of Work and shall approve the repair and restoration prior to the acceptance of the Work. All restoration operations shall be performed at the CONTRACTOR'S expense.

2. Signs of temporary construction facilities such as haul roads, work areas, stockpiles of excess or waste materials, and other vestiges of construction shall be eliminated in an approved way. Upon completion, all areas shall be clean and natural looking to the maximum extent possible.

3. All Work under this contract shall be performed in such a manner that any adverse environmental impacts are reduced to a level that is acceptable to the CONSULTANT/ENGINEER and the New York State Department of Environmental Conservation (NYSDEC).

4. Special measures shall be taken to prevent oily or hazardous substances from entering the ground, drainage areas, or local bodies of water.

C. Erosion and Sediment Control Measures - Earthwork brought to final grade shall immediately be finished as summarized below and as specified in Section 02225. Side slopes and back slopes shall be protected immediately upon completion of rough grading.

D. Control of Wastes - Wastes shall be picked up and placed in containers which are emptied on a regular schedule. Handling shall be conducted in a way that prevents contamination of the Site and any other areas.

1. All waste shall be transported and disposed of in a manner that complies with federal, state, and local requirements by the CONSULTANT/ENGINEER. The CONSULTANT/ENGINEER shall maintain a copy of any state and/or local permits or licenses that reflect such agency's approval and compliance with applicable solid waste disposal regulations. The permits or licenses and the location of the disposal area shall be provided prior to transporting any waste material.

2. Fueling and lubricating of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spills and evaporation. Lubricants and waste oil shall be disposed of by the CONTRACTOR at his expense, in accordance with approved procedures meeting federal, state, and local regulations.

E. Dust Control - Dust shall be suppressed at all times, including non-working hours, weekends, and holidays. Soil at the Site, haul roads, and other areas disturbed by the construction operations shall be sprinkled with water as necessary to control dust.

F. Noise Control - The maximum use of "low-noise emission products" as certified by the Environmental Protection Agency shall be made when available. When not available, screens and/or barriers shall be used for noise control. No blasting or use of explosives will be permitted.

1.05 EQUIPMENT ADJUSTMENT AND CALIBRATION

A. All mechanical equipment and electrical equipment shall be subjected to preliminary operation and testing before the system is put into operation. Tests shall be made to determine whether the equipment has been properly assembled, aligned, adjusted, wired, or connected.

B. The alarm system shall also be subjected to testing for proper function along with the process instrumentation.

C. The CONTRACTOR shall coordinate and be present during all such tests. The equipment SUPPLIER shall be responsible for testing and demonstrating the equipment supplied in accordance with the relevant equipment specification section.

1.06 SYSTEM STARTUP AND OPERATION

A. All equipment and accessories shall be adjusted and calibrated prior to any startup as specified under these Special Conditions.

1.07 OPERATION AND MAINTENANCE INSTRUCTION MANUALS

A. In accordance with Section 01300, the CONTRACTOR shall prepare and submit a complete set of operation and maintenance instruction manuals for the overall project, covering all equipment furnished. Manuals shall include complete parts lists for all equipment. Manuals shall be prepared specifically for the particular equipment furnished and shall consider the specific operation of this equipment in the particular process system involved. Complete lubrication requirements shall be listed, including recommended lubricant and lubricating intervals or schedule.

1.08 WARRANTIES

A. In accordance with Section 01300 (Submittals) and these Special Conditions, the CONTRACTOR shall obtain and submit in writing warranties, executed in duplicate by responsible SUPPLIERS, and MANUFACTURERS. Except for items put into use with the CONSULTANT/ENGINEER'S permission, the beginning of the time of warranty will be the Date of Substantial Completion.

B. The MANUFACTURER shall guarantee and furnish MANUFACTURER'S warranty against manufacturing and mechanical defects on all equipment provided for a period of two (2) years from date of initial operation.

C. In the event any material, part, or equipment proves defective during this period, the MANUFACTURER shall, at his expense (including labor), furnish and replace the defective item.

D. The MANUFACTURER shall guarantee in writing the structural integrity of all equipment for a period of five (5) years.

E. The MANUFACTURER shall guarantee the performance of the equipment and its components for a period of two (2) years.

F. All warranties shall be provided in writing, signed by an officer of the Manufacturing Company.

1.09 CONSULTANT/ENGINEER'S AUTHORITY

A. When performing the work, the CONTRACTOR shall abide by all orders, directions, and requirements of the CONSULTANT/ENGINEER. The work shall be performed to the satisfaction of the CONSULTANT/ENGINEER at the times and places, the

methods, and in the manner and sequence the CONSULTANT/ENGINEER may require. The CONSULTANT/ENGINEER shall determine the amount, quality, and acceptability of all phases of the work. The CONSULTANT/ENGINEER shall interpret the plans, specifications, contract documents, and any extra work orders. The CONSULTANT/ENGINEER shall decide all other questions in connection with the work. Upon request, the CONSULTANT/ENGINEER shall confirm in writing any oral orders, directions, requirements, or determinations.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

A. The CONTRACTOR shall collect samples and conduct tests in accordance with Section 01400 (Quality Control) and all applicable standards related to the item or system being tested.

3.02 HEALTH AND SAFETY

A. The CONTRACTOR shall be responsible for implementing the site-specific HASP prepared in accordance with Section 01300 (Submittals).

B. The CONTRACTOR shall provide adequate health and safety personal protection equipment (PPE) for his/her employees and others who might be affected by excavation and construction activities.

C. Work procedures shall conform to all applicable OSHA, State of New York, county, local government, and other federal regulations.

3.03 PROJECT SCHEDULE

A. Time is of the essence for construction. The CONTRACTOR is responsible for meeting the system start-up deadline.

B. The CONTRACTOR shall address all punch list items within 1 week of the notice to proceed.

C. The CONTRACTOR shall give the CONSULTANT/ENGINEER two-week notice prior to the date of mobilization.

D. The CONTRACTOR shall develop, implement, and maintain a project schedule that runs 2 weeks from notice to proceed to completion of all punch list items.

E. The CONTRACTOR will be responsible for all fines and extra costs associated with the CONTRACTOR'S failure to meet the deadline specified herein and in the Contract Documents.

END OF SECTION

SECTION 01039
COORDINATION AND MEETINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Site Progress Meetings.

B. Coordination.

1.02 RELATED SECTIONS

A. Section 01010 - Summary of Work.

B. Section 01012 - Special Conditions.

C. Section 01300 - Submittals.

D. Section 01400 - Quality Control.

1.03 SITE PROGRESS MEETINGS

A. The CONSULTANT/ENGINEER shall designate, as necessary, progress meetings that will be conducted to review the progress of the Work, and any unexpected conditions or situations that may have arisen. The CONSULTANT/ENGINEER will ensure conformance with the financial plan. The CONTRACTOR shall be fully responsible for any and all of the subcontractors and shall be responsible for subcontractor attendance and/or input into the meetings.

B. The meetings shall be documented by the CONSULTANT/ENGINEER.

C. Progress meetings shall be held approximately once a week, at which time the weekly progress report will be reviewed.

1.04 COORDINATION

A. CONTRACTOR should provide two-week notice to the CONSULTANT/ENGINEER prior to mobilization.

B. All on-site work shall be coordinated by the CONTRACTOR, with the approval of the CONSULTANT/ENGINEER.

C. SITE and utility access shall be coordinated through the CONSULTANT/ENGINEER and/or the appropriate utility authority.

D. Issues related to design and construction of the specified system shall be handled through the CONSULTANT/ENGINEER in accordance with Sections 01010 (Summary of Work), 01012 (Special Conditions), 01300 (Submittals), and 01400 (Quality Control).

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01090
REFERENCE STANDARDS

PART 1 - GENERAL

1.01 REFERENCE STANDARDS

Where standards of the following organizations or any other standards, codes, or specifications are referred to in the Technical Specifications, the reference is to the particular standard, code, or specification cited, together with all amendments applicable at the date of the opening of Bids; and shall apply except to the extent that said standards and requirements may be in conflict with applicable laws or ordinances.

Acronym	Organization
AASHTO	American Assn. of State Hwy. & Trans. Officials
ACI	American Concrete Institute
AI	The Asphalt Institute
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CRSI	Concrete Reinforcing Steel Institute
IEEE	Institute of Electrical and Electronic Engineers
JIC	Joint Industrial Council
NCMA	National Concrete Masonry Association
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NYDOT	New York Department of Transportation
NYSDEC	New York State Department of Environmental Conservation
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
SSPC	Steel Structures Painting Council
UL	Underwriters Laboratories

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General

B. Submittal Procedures.

C. Shop Drawings.

D. Product Data.

E. MANUFACTURER'S Instructions.

F. Warranties

F. Product Test Results.

G. Proposed SUPPLIER List.

H. Proposed Subcontractor List.

I. Health and Safety Plan (HASP).

J. Construction Progress Schedules.

K. Operation and Maintenance Manuals.

L. Record Drawings.

1.02 GENERAL

A. All submittals shall be complete, neat, and orderly.

B. Submittals shall be provided according to the Contract Schedule.

1.03 SUBMITTAL PROCEDURES

A. Transmit two (2) copies of each submittal to the CONSULTANT/ENGINEER.

B. Sequentially number of transmittal forms. Resubmittals shall have the original numbers with an alphabetic suffix.

C. Identify project, CONTRACTOR name, subcontractor or SUPPLIER name, submission date, pertinent drawing sheet and detail number(s), and specification section number(s) as appropriate.

D. Apply CONTRACTOR'S stamp, signature or initials certifying that review, verification of products, field dimensions, adjacent construction work, and coordination of information, is completed as required.

E. All submittals are to be submitted to and approved by the CONSULTANT/ENGINEER in writing prior to commencing work for the item which requires submittal.

F. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

G. Provide space for CONSULTANT/ENGINEER to place review stamp.

H. Revise and resubmit submittals as required by the CONSULTANT/ENGINEER until approved; identify all changes made since previous submittal.

1.04 SHOP DRAWINGS

A. Shop drawings are not required.

1.05 PRODUCT DATA

A. The CONTRACTOR shall supply to the CONSULTANT/ENGINEER a proposed products list within 7 calendar days after award of contract. This list shall be subject to approval by the CONSULTANT/ENGINEER.

B. The proposed products list shall indicate all products that the CONTRACTOR believes will be incorporated. This list shall be interpreted as agreement by the CONTRACTOR to use the specified products. Omission from this list of any product required by the contract documents shall not relieve the CONTRACTOR of the responsibility for providing that product and completing the associated work as specified.

C. The CONTRACTOR shall submit for the CONSULTANT/ENGINEER'S approval, within 14 calendar days after award of contract, all information and product data related to the products in the proposed products list. The product data shall be submitted with the shop drawings and include data called for under the specifications or requested by the CONSULTANT/ENGINEER, including but not limited to:

1. MANUFACTURER descriptions, technical specifications, and data for each component specified that will not be fabricated on-site.

2. MANUFACTURER warranties in accordance with Section 01012 (Special Conditions).

3. Submittals shall indicate that material or product conforms to or exceeds specified requirements. Submit supporting data or certifications as appropriate.

1.06 MANUFACTURER'S INSTRUCTIONS

A. CONTRACTOR shall submit printed instructions for delivery, storage, assembly, installation, and maintenance of specified components that will not be fabricated on-site to the CONSULTANT/ENGINEER. Instructions shall be provided a minimum of 7 calendar days prior to delivery.

1.07 PRODUCT TEST RESULTS

A. Test results shall be submitted to the CONSULTANT/ENGINEER for review within 5 calendar days of receipt of results, but no later than 30 calendar days after sample is collected for testing.

1.08 PROPOSED SUPPLIER LIST

A. A complete list of SUPPLIERS with product, name, and address shall be submitted to the CONSULTANT/ENGINEER for review within 7 calendar days after award of contract.

1.09 PROPOSED SUBCONTRACTOR LIST

A. A final list of subcontractors with name, address, and experience shall be submitted to the CONSULTANT/ENGINEER for review within 7 calendar days after award of contract.

B. No work on the contract shall commence until all the proposed subcontractors have been approved by the CONSULTANT/ENGINEER in writing.

1.10 HEALTH AND SAFETY PLAN

A. The CONTRACTOR shall prepare a construction health and safety plan (HASP) in accordance with the HASP presently in place at the site. The HASP shall be submitted to the CONSULTANT/ENGINEER for review within 7 calendar days after award of contract.

B. CONTRACTOR shall be responsible for implementing the HASP in accordance with Section 01012 (Special Conditions).

C. No work shall commence at the SITE until a HASP is in place.

1.11 CONSTRUCTION PROGRESS SCHEDULES

The CONTRACTOR shall:

A. Submit initial project schedule within 7 calendar days after award of contract.

B. Submit revised schedules as substantial variations are identified or as required by the CONSULTANT/ENGINEER.

1.12 OPERATION AND MAINTENANCE MANUALS

A. The CONTRACTOR shall provide operation and maintenance instruction manuals and warranty and service information from equipment MANUFACTURERS to the CONSULTANT/ENGINEER within 5 days of (prior to) system startup. The CONTRACTOR shall prepare an operation and maintenance manual that addresses the following items:

1. Operating Procedures: startup, break-in, and routine normal operating instructions and sequences; regulation, control, stopping, shut-down, and emergency instructions; summer, winter, and any special operating instructions.

2. Maintenance Requirements: routine procedures and guide for trouble-shooting, disassembly, repair, and reassembly instructions, and alignment, adjusting, balancing, and checking instructions.

3. MANUFACTURER's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

4. MANUFACTURER'S record drawings and any additional submittal information.

1.13 RECORD DRAWINGS

A. The CONTRACTOR shall furnish drawings with all technical information (including product data, MANUFACTURER'S instructions and certificates) and all field modifications clearly indicated to the CONSULTANT/ENGINEER. All information necessary for the generation of record drawings shall be provided by the CONTRACTOR within 14 calendar days of substantial completion of construction.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01400
QUALITY CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Contractor Quality Control and Assurance of Installation.

B. Workmanship.

C. References.

D. Field Inspection of Contractor's Work.

E. On-Site and Laboratory Testing.

1.02 RELATED SECTIONS

A. Section 01039 - Coordination and Meetings.

B. Section 01090 - Reference Standards.

C. Section 01300 - Submittals.

1.03 CONTRACTOR QUALITY CONTROL AND ASSURANCE OF INSTALLATION

The CONTRACTOR shall:

A. Monitor quality control over SUPPLIERS, MANUFACTURERS, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with MANUFACTURER'S instructions, including each step in installation and startup sequence.

C. If MANUFACTURER'S instructions conflict with Contract Documents, CONTRACTOR shall request clarification from the CONSULTANT/ENGINEER before proceeding.

D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce workmanship of specified quality.

F. Secure products and equipment in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

G. During freezing or inclement weather, or other adverse conditions, no work shall be performed except that which can be performed in a manner that will ensure first-class construction throughout.

1.04 WORKMANSHIP

A. The intent of these Technical Specifications is to describe definitively and fully the character of materials and workmanship required with regard to all ordinary features, and to require first-class work and material in all particulars.

B. For any unexpected features arising during the progress of the Work and not fully covered herein, the specifications shall be interpreted by the CONSULTANT/ENGINEER to require first-class work and materials; and such interpretation shall be accepted by the CONTRACTOR.

C. All labor shall be performed in the best and most workmanlike manner by mechanics skilled in their respective trades. The standards of the Work required throughout shall be of such grade as will bring only first-class results.

D. Materials and methods used in the assemblage of the equipment shall comply with relevant standards, codes, or specifications related to the manufacture and operation of the specified equipment.

1.05 REFERENCES

A. Conform to current reference standards, including those listed in Section 01090 (Reference Standards), by contract documents' date of issue.

B. Obtain copies of standards when required by contract documents.

C. Should specified reference standards conflict with Contract Documents, request clarification from CONSULTANT/ENGINEER before proceeding.

D. The contractual relationship of the parties to the Contract shall not be altered from the contract documents by mention or inference otherwise in any reference document.

E. Where a field sample is specified to be removed in individual sections, clear area after field sample has been accepted by CONSULTANT/ENGINEER.

1.07 FIELD INSPECTION OF CONTRACTOR'S WORK

A. The CONSULTANT/ENGINEER will provide periodic inspection of the CONTRACTOR'S Work which will ensure that the Work is being performed in accordance with the Construction Drawings and these Technical Specifications such that the end product will be in conformance with the Construction Drawings and Technical Specifications.

B. The CONTRACTOR is responsible for complete conformance to the Construction Drawings and Technical Specifications for all Work performed on the project, including all subcontractors.

C. The CONTRACTOR will provide ample opportunity for safe and easy access to the inspectors for proper inspection of the Work.

D. Inform the CONSULTANT/ENGINEER in advance of periods when the CONTRACTOR does not intend to work due to, but not limited to, inability to obtain materials or equipment or expected inclement weather.

E. Upon completion of the Work, the CONTRACTOR shall notify the CONSULTANT/ENGINEER for the final inspection of the system. The CONTRACTOR, or his representative, must accompany the CONSULTANT/ENGINEER on the final inspection. The CONTRACTOR shall have tradesmen available or on call to make changes or corrections to the system after or during the inspection, as determined by the CONSULTANT/ENGINEER.

1.08 ON-SITE TESTING

A. The CONTRACTOR shall be responsible for conducting tests related to the work performed under this contract. Testing shall include, but not be limited to: pipeline and interconnecting piping pressure tests, electrical and control device testing.

B. Unless listed otherwise, all performance tests will be conducted by the CONTRACTOR as detailed in the relevant sections of the Technical Specifications.

C. In addition to the above, the CONTRACTOR shall make his/her own arrangements for the sampling and testing of materials he proposes to incorporate into the Work.

D. Where possible, any work that has been installed but has not been tested as required, shall be tested by other means. Upon CONSULTANT/ENGINEER'S request, uncover any work that has been buried or covered and perform special tests designated by CONSULTANT/ENGINEER. If the work cannot be tested by other means, the CONSULTANT/ENGINEER may declare the work unacceptable. All costs associated with noncompliance and for special testing shall be borne by the CONTRACTOR.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that existing SITE conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Examine and verify specific conditions described in individual specification sections.

C. Verify that utility services are available, of the correct characteristics, and in the correct locations.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substrate.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply MANUFACTURERS required or recommended substrate primer, sealer or conditioner prior to applying any new material or substance in contact or bond.

END OF SECTION

SECTION 01450
PIPE TESTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Testing of piping.

B. Pipe leakage testing shall comply with the limitations established in the attached Schedule.

1.02 RELATED SECTIONS

A. Section 1400 – Quality Control

1.03 DEFINITIONS

A. Leakage– The quantity of water to be supplied into the newly laid pipe, any valved section thereof, or other appurtenance, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

1.04 QUALITY ASSURANCE

The CONTRACTOR shall:

A. Prior to Substantial Completion, pressure pipes shall meet specific leakage requirements. These leakage requirements shall be satisfied by the basic materials alone. Where joint filters and the like have been specified, primarily to protect jointing materials, and secondarily to provide a factor of safety, they shall not be applied until after leakage tests have been completed and have been accepted by CONSULTANT/ENGINEER.

B. Tests will be witnessed by the CONSULTANT/ENGINEER. Tests not witnessed will be considered as not having been performed.

C. Work shall not be closed or covered up until it has been observed for proper and satisfactory construction and installation in compliance with the Contract Documents.

Should incomplete or unacceptable work be covered, the CONTRACTOR shall, at his/her own expense, uncover all work so that it may be properly observed. After such observations, repair and replace the work that was found defective, unsatisfactory, and not in accord with the Contract Documents. After such repair and replacement, bring all work to completeness and status as it was before it was closed and covered, all at the CONTRACTOR'S own expense. The CONTRACTOR shall submit for review and approval means and methods for correcting failed systems.

D. Successful completion of required tests shall be in no way interpreted as relieving the CONTRACTOR of responsibility for defects that become apparent subsequent to the time of testing. It shall be the sole right of the CONSULTANT/ENGINEER to determine whether defects exist. Retest all portions of the Work deemed necessary by the CONSULTANT/ENGINEER prior to Substantial Completion.

1.05 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Complete details and specifications on testing apparatus.

C. At CONSULTANT/ENGINEER'S discretion, additional sections of pipelines may be required to be tested as soon as pipe is laid and prior to backfilling when working conditions or the standard of workmanship have been altered.

PART 2 - PRODUCTS

2.01 TESTING APPARATUS

A. Provide labor, plugs, measuring equipment, and other apparatus, complete, to perform testing.

B. Provide clean water, and other materials as required to accomplish testing.

C. Provide plugs and caps capable of withstanding test pressures.

PART 3 - EXECUTION

3.01 PREPARATION

A. Before tests are conducted, isolate, or remove any regulator, gauge, trap, or other apparatus or equipment which may be damaged by test pressures.

3.02 GENERAL

A. Trapped Air: Trapped air may cause a false indication of the rate of leakage. Points of concern include ends of lines, stubs, and high points in pipelines. No credit will be made for this condition and no adjustment will be made to the allowable leakage. When trapped air is suspected of causing a test failure, do whatever is necessary to evacuate the air and repeat tests until the actual leakage is equal to or less than allowable rate of leakage. All air shall be removed from the test section of the pipe prior to beginning leak testing.

3.03 PRESSURE TESTING PIPES

A. General

1. Test pipes prior to applying insulation and before they are concealed or furred-in.
2. Provide all necessary gauges. Gauges shall be standard pressure type and a pressure range not in excess of 50% of the maximum required test pressure.
3. Where it is necessary for testing, tap pipes and insert approved plugs after testing is completed.
4. Provide test gauges at each end of the line being tested.

B. Hydrostatic Testing

1. All sections of newly installed pipe shall be subject to hydrostatic pressure test.

2. The hydrostatic test will consist of an initial pressure of 50 psi for at least one (1) hour. If leaks are detected at any time during the test, relieve the pressure and take appropriate action to correct the leak. If necessary consult the CONSULTANT/ENGINEER for instruction. The allowable leakage for buried piping having threaded shall be zero gallons.

3.04 RETESTING

A. It is the intent of this Contract to obtain work meeting test requirements on their own and solely through the use of the normal integral sealing components. Joint leaks shall not be stopped using concrete, caulking, mortar, or other patching materials. Leaking pipe joints shall be rejointed or replaced if necessary.

B. Methods other than rejoining, resetting or replacing joint seals shall require the written approval of CONSULTANT/ENGINEER.

END OF SECTION

SECTION 01600
MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Equipment and Products Specified.

B. Storage and Maintenance of Materials.

C. Equipment and Material Installation.

D. Cutting, Patching, and Painting.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 01400 - Quality Assurance

1.03 EQUIPMENT AND PRODUCTS SPECIFIED

A. In the various detailed sections of the Specifications where any item of equipment or product is specified by proprietary name or trade name, with the addition of such expressions as "or approved equal", it is to be understood that equal-quality equipment or products of either a MANUFACTURER named or of a MANUFACTURER not named which meet the detailed requirements of the Specifications, are intended, subject to the approval of the CONSULTANT/ENGINEER as to the equality thereof. The CONTRACTOR must also demonstrate that there will be no adverse impact to the project schedule and no additional cost to the CONSULTANT/ENGINEER.

B. Substitutions after project initiation may also be considered when a product becomes unavailable through no fault of the CONTRACTOR.

C. The CONSULTANT/ENGINEER shall review the technical data for substitutions and shall accept or reject the offered substitution.

D. The CONTRACTOR is responsible for all delays in the project schedule associated with the review of offered substitutions. Such delays shall be incorporated into the CONTRACTOR's projected construction schedule and shall be compensated for such that the overall project schedule is not affected.

E. Substitution of components is allowed as follows:

1. Where specified as "or equal" shall mean that the CONTRACTOR may use material of equal quality, function, and value.

2. Where specified as "or approved equal" means that substitution is allowed upon approval by the CONSULTANT/ENGINEER.

3. "No substitution," or unspecified, means substitutions will not be allowed unless compelling reasons exist to require the substitution, and the CONSULTANT/ENGINEER concurs with the CONTRACTOR and approves the substitution.

F. A request for substitution constitutes a representation that the CONTRACTOR:

1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.

2. Will provide, at a minimum, the same warranty for the Submission as for the specified Product.

3. Will coordinate installation and make changes to other Work, which may be required for the Work to be completed, with no additional cost to CONSULTANT/ENGINEER or delay to the project schedule.

4. Waives claims for additional costs or time extension that may subsequently become apparent.

5. The CONSULTANT/ENGINEER'S approval of a requested change does not place the responsibility under this section on the CONSULTANT/ENGINEER.

1.04 STORAGE AND MAINTENANCE OF MATERIALS

A. All materials provided and Work performed under this Contract shall be protected from damage before and after installation. The CONTRACTOR shall be responsible for Work, equipment, and materials until inspected, tested, and finally accepted in accordance with this Section and these Technical Specifications.

B. All arrangements for delivery, storage, and handling of equipment specified herein shall be the CONTRACTOR'S responsibility.

C. Where materials or products called for under this Contract are installed before the erection of adequate protective structures, the CONTRACTOR without additional compensation therefore, shall provide approved, effective and durable covers for fully protecting such materials or products against damage from the elements or from any other causes.

D. All equipment, piping, and accessories and appurtenances shall be adequately supported and safeguarded against all damage or injury during performance of Work under this Contract.

E. The CONTRACTOR shall store and protect products in accordance with the MANUFACTURER'S recommendations and the requirements specified in these Contract Documents and shall submit the MANUFACTURER'S storage and maintenance instructions prior to delivery.

F. The CONTRACTOR shall make all arrangements and provisions necessary for the storage of materials and equipment. All excavated material, construction equipment, and materials and equipment to be incorporated into the Work shall be placed so as not to injure any part of the Work or existing facilities, and so that free access can be achieved at all times to all parts of the Work, to all unrelated portions of the OWNER'S facility, and to all public utility installations in the vicinity of the Work. Materials and equipment shall be kept neatly and compactly stored in locations that will cause a minimum of inconvenience to other contractors, public travel, adjoining owners, tenants, occupants and the OWNER.

G. Materials and equipment which are to become the property of the OWNER shall be stored to facilitate their inspection and ensure preservation of the quality and fitness of the Work, including proper protection against damage by freezing and moisture.

H. CONTRACTOR shall be fully responsible for loss or damage to stored materials.

I. Any material or equipment which, in the opinion of the CONSULTANT/ENGINEER, has been damaged due to improper storage and/or handling and is unfit for its specified or intended use shall be properly removed from the SITE or Work. The CONTRACTOR shall receive no compensation for the damaged material or its removal or replacement. The CONTRACTOR shall be responsible for replacing any such materials with undamaged material as specified and shall be liable for any damages associated with removal and replacement of damaged materials, as well as damages - direct or consequential - resulting from delays in the project schedule that occur due to the damaged materials.

1.05 EQUIPMENT AND MATERIAL INSTALLATION

A. Install per MANUFACTURER'S instructions and specifications.

B. Maintain plumbness and maintain a pitch all piping toward the injection wells.

C. Locate and install in accordance with plans and specifications.

D. Install in accordance with accepted quality construction practice to assure proper operation and full design life of the system and components.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01700
CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Procedures

B. Clean-up.

C. Substantial Completion.

D. Final Inspection.

E. Project Record Documents.

F. Contractor's Closeout Submittals.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals.

1.03 PROCEDURES

A. Comply with requirements stated in Conditions of the Contract and in Specifications for administrative procedures in closing out the Work.

1.04 CLEAN-UP

A. Remove all waste, debris, rubbish, tools, equipment, machinery and surplus materials to the satisfaction of the CONSULTANT/ENGINEER.

B. Dispose all wastes, debris, and rubbish in accordance with applicable federal, state, and local regulations.

C. Clean all sight-exposed surfaces. Leave work clean and ready for possession by the OWNER.

1.05 SUBSTANTIAL COMPLETION

A. When the CONTRACTOR considers that the work is substantially complete, he/she shall submit to the CONSULTANT/ENGINEER the following:

1. A written notice that the Work or designated portion thereof, is substantially complete.

2. A list of items to be completed or corrected.

B. Within a reasonable time after receipt of such notice, the CONSULTANT/ENGINEER will make an inspection to determine the status of completion.

C. Should the CONSULTANT/ENGINEER determine that the work is not substantially complete, the following shall occur:

1. The CONSULTANT/ENGINEER will promptly notify the CONTRACTOR, in writing, giving the reasons thereof.

2. The CONTRACTOR shall remedy the deficiencies in the work and send a second written notice of substantial completion to the CONSULTANT/ENGINEER.

3. The CONSULTANT/ENGINEER will re-inspect the work.

D. When the CONSULTANT/ENGINEER finds that the work is substantially completed, the CONSULTANT/ENGINEER will:

1. Prepare and deliver to the CLIENT a tentative Certificate of Substantial Completion with a tentative list of items to be completed or corrected before final payment.

2. After consideration of any comments made by the CLIENT as provided in Conditions of the Contract, the CONSULTANT/ENGINEER will execute and deliver to the CONTRACTOR a definite Certificate of Substantial Completion with a revised tentative list of items to be completed or corrected.

1.06 FINAL INSPECTION

A. When the CONTRACTOR considers the work to be complete, the CONTRACTOR shall submit written certification that:

1. The contract documents have been reviewed.
2. Work has been inspected for compliance with Contract Documents.
3. Work has been constructed in accordance with Contract Documents.
4. Equipment and systems have been tested and are operational.
5. Work is completed and ready for final inspection.
6. Certificate of Completion.

B. The CONSULTANT/ENGINEER will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.

C. Should the CONSULTANT/ENGINEER consider that the work is incomplete or defective, the following shall apply:

1. The CONSULTANT/ENGINEER will promptly notify the CONTRACTOR in writing, listing the incomplete or defective work.

2. The CONTRACTOR shall take immediate steps to remedy the stated deficiencies and send a second written certification to the CONSULTANT/ENGINEER.

3. The CONSULTANT/ENGINEER will re-inspect the work.

D. When the CONSULTANT/ENGINEER finds that the work is acceptable under the contract documents, the CONSULTANT/ENGINEER shall request that the CONTRACTOR make closeout submittals.

1.07 PROJECT RECORD DOCUMENTS

A. The CONTRACTOR shall legibly mark on the Construction Drawings actual construction showing field changes of dimension and detail, and changes made by change orders and details not included on the original Construction Drawings.

B. The CONTRACTOR shall deliver record documents (as-builts), consisting of annotated Construction Drawings as indicated to the CONSULTANT/ENGINEER at the completion of the project to be used in preparation of the as-built drawings.

1.08 CONTRACTOR'S CLOSEOUT SUBMITTALS

A. Evidence of payment and release of liens shall be done according to the requirements of the submittal procedures and Special Conditions.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 02225
TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.01 WORK INCLUDED:

A. Trench and backfill for piping.

B. Backfill for utilities.

1.02 RELATED SECTIONS

A. Section 01010 - Summary of Work.

B. Section 01012 - Special Conditions.

C. Section 01400 - Quality Control.

D. Section 01600 - Material and Equipment.

E. Section 02211 - Rough/Final Grading.

F. Section 15000 - Process Piping and Accessories

1.03 BACKFILLING

A. The CONTRACTOR shall be responsible for procuring suitable backfill materials for the performance of the Work.

B. All backfill shall be free from frozen particles, clay lumps, trash, roots, wood, metal, scrap material, other vegetative matter, and refuse. Backfill shall also contain no stones larger than four inches in greatest dimension.

D. Backfill shall be placed in layers not more than 6 inches in loose depth, and each layer shall be compacted as specified hereafter. Backfill around structures shall be placed to the extent practicable, as the work progresses. Backfilling of trenches shall progress as rapidly as the construction permits.

E. Excavations for pipe shall not be backfilled until pipe has been tested by the CONTRACTOR and approved by the CONSULTANT/ENGINEER.

F. After testing has been approved by the CONSULTANT/ENGINEER, fill around and over the pipe shall be compacted unless otherwise noted for the entire depth of the excavation. Backfilling to one foot above the top of the pipes shall proceed uniformly on each side of the pipe to prevent unbalanced loading.

G. Provide 6" minimum of compacted non-frost susceptible base beneath exterior slabs and rigid and flexible pavements.

H. If existing subbase is not well draining to a minimum depth of 3 feet, it shall be removed, replaced with non-frost susceptible material, and compacted as per Section 3.03.

1.04 UNDERGROUND UTILITIES

A. The CONTRACTOR shall locate existing underground utilities before earthwork begins, by hand-digging exploratory pits where earthwork will occur near the utilities, and also at locations where offsets in utility lines are likely to exist. Have representative of respective utility company, and the CONSULTANT/ENGINEER present during this exploratory work.

B. The CONTRACTOR shall comply with utility company rules and directives for excavation work.

C. The CONTRACTOR shall protect exposed utility lines and be responsible for repairing or replacing damage.

PART 2 - PRODUCTS

2.01 BACKFILL MATERIAL

A. Suitable backfill material shall include excavated soils from the trench and distribution box areas, borrow material which is capable of being compacted to the required density at the proper moisture content, and of such type and characteristics approved by the CONSULTANT/ENGINEER. No rock, broken concrete, demolition material, frozen

material, top soil, nor any material designated as unsuitable in Paragraph B shall be used for fill material.

B. Unsuitable material shall include, but not be limited to, all grass, weeds, vegetation of any type, roots, trash, rocks, boulders, debris, demolition materials, or any layer, strata, formation, or deposit of soil determined by the CONSULTANT/ENGINEER to be unsuitable for support of footings, slabs, or any other intended purpose. No material will be classified as unsuitable solely on the basis of excessive moisture content.

C. Borrow material shall be the same as defined for "Suitable Material" above, except that it shall be obtained from approved sources off the site. As specified in Section 01400 (Quality Control), the CONTRACTOR shall provide verification and documentation to the CONSULTANT/ENGINEER that proposed borrow material is certified clean fill.

D. Flowable fill is a mixture of Portland cement, fly ash, fine aggregate, air entraining admixture and water. Flowable fill contains a low cementitious content for reduced strength development. If the CONTRACTOR chooses to use excavatable Flowable Fill for backfill of the trench area, the CONTRACTOR shall submit the location and supplier information for flowable fill. The flowable fill must meet the requirements/specifications of New York State Florida Department of Transportation.

2.02 PIPE BEDDING MATERIAL

A. Material furnished shall be suitable and conform to the following requirements:

1. Gradation - the material shall have the following gradation:

Sieve Size	% Passing by Weight
4-inch	100
No. 40	0 - 70
No. 200	0 - 15

2. Soundness - the material shall be substantially free of shale or other soft, poor durability particles.

PART 3 - EXECUTION

3.01 TRENCHING

A. Sheeting and Shoring - Provide sheeting and shoring, as required, to prevent collapse of excavations and where required by local codes and regulations. Use timbers, cribbing, planking, or sheet piling, as required. All sheeting and shoring shall be approved by the CONSULTANT/ENGINEER prior to being used in the Work.

B. Hand Excavation - Excavation within 3 feet of any existing utility line shall be done by hand and in accordance with the requirements of the utility company involved. Coordinate with the utility company and make necessary arrangements to avoid damage. Be responsible for damage during excavation to existing pipe, conduit or equipment and repair any damage.

C. Trench Depth - Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations.

D. Trench Length - No trench shall be opened more than 100 linear feet in advance of pipe installation without express permission of the CONSULTANT/ENGINEER.

E. Drainage and Dewatering - Keep pipe trenches free from water from any source during excavation, installation and backfilling. Construct berm or grade to prevent surface run-off into excavation.

F. Protection - Protect excavation bottom from freezing when temperature is less than 32^0 F.

3.02 PIPE BEDDING

A. Place a uniform blanket of loose bedding Material under the piping.

B. Where soil at the bottom of trench is unsuitable, remove Material and stabilize the trench bottom with bedding material. Provide depth of stabilization as required to construct a firm subgrade for the bedding Material.

3.03 PLACING BACKFILL

The CONTRACTOR shall:

A. Backfill lifts - Unless otherwise specified, all fill shall be placed in approximately horizontal lifts not exceeding 6 inches in loose thickness. So far as practical, each layer of materials shall extend the entire length and width of the area being filled.

1. Do not place material on surfaces that are muddy, frozen, or which contain frost. No frozen fill shall be placed.

B. Moisture Content - The moisture content of the backfill shall be reduced by aeration or increased by uniform sprinkling of water as necessary, to achieve optimum moisture content to facilitate compaction. The moisture content of the fill shall be within ± 2 percentage points of optimum. Backfill shall not be placed in water.

C. Surface Drainage - The backfill surface shall be sloped to facilitate the removal of run-off from the site and to prevent ponding of surface water.

D. Place the backfill or bedding material in 8-inch lifts that conform to the dimensions as shown on the Construction Drawings.

E. Compact the backfill using suitable compaction equipment such as a walk-behind plate compactor.

F. The compaction technique to be employed shall be to the satisfaction of the CONSULTANT/ENGINEER to obtain a non-yielding surface after completion of compaction.

G. Remove and properly dispose of all surplus backfill materials.

H. Do not place backfill during freezing or excessively wet field conditions.

I. Grade backfill to existing elevations or as shown on the Construction Drawings.

J. Replace any asphalt pavement or concrete that is damaged from the excavation activities, and match the repaved area with the existing elevations.

3.04 COMPACTION

A. Equipment – A walk-behind plate compactor shall be used for compaction of predominantly granular soils.

B. Make a minimum of three (3) passes with the compactor.

C. As compaction of fill in each Work area has been completed, leave the area undisturbed for a reasonable period of time for testing in accordance with Section 01400 (Quality Control). Do not place fill over a layer which has not been accepted by the CONSULTANT/ENGINEER.

D. Maintain moisture content of the exposed lift; desiccation cracking shall result in removal and reinstallation of affected area by the CONTRACTOR at his own expense.

E. Fill and/or backfill in areas to receive pavement and piping, shall be compacted for the full depth of the fill and/or backfill.

END OF SECTION

SECTION 02270
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Work covered by this Section consists of furnishing all materials, equipment, tools and labor to construct temporary erosion and sediment control systems.

B. The Work to be performed includes, but is not limited to, silt fences, straw bales, conveyance channels, and site surface drainage.

1.02 RELATED SECTIONS

A. Section 01300-Submittals.

B. Section 02225-Trenching and Backfilling.

C. Section 02310-Drilling Services.

1.03 SUBMITTALS

A. Product data shall be submitted as indicated in Section 01300.

PART 2 - PRODUCTS

2.01 SURFACE-WATER CONTROL MATERIALS

A. Silt Fence: The CONTRACTOR shall supply silt fence in sufficient quantities to control surface-water runoff and sediment. Acceptable silt fence material shall be as follows:

1. Propex-Silt Stop
2. Mirafi 100X
3. Beltech 755, or
4. An approved equal.

The CONTRACTOR shall submit MANUFACTURERS product data to the CONSULTANT/ENGINEER for approval a minimum of one week prior to installation. Silt fence shall be replaced at a frequency consistent with the MANUFACTURERS directions, or as directed by the CONSULTANT/ENGINEER.

B. Straw Bales: The CONTRACTOR shall supply straw bales in sufficient quantities to be used for sedimentation control as needed. Straw bales shall be replaced at a minimum of every two months, or as directed by the CONSULTANT/ENGINEER.

PART 3 - EXECUTION

3.01 HANDLING

A. Materials shall be handled in such a manner as to prevent damage to the material. Materials shall not be dropped or dragged over the ground. Any materials damaged shall be replaced at no expense to the CONSULTANT/ENGINEER.

3.02 SURFACE-WATER CONTROL STRUCTURES

A. Silt Fence: The CONTRACTOR shall install silt fence in accordance with these Specifications and installation instructions provided by the MANUFACTURER, or as directed by the CONSULTANT/ENGINEER. Presiding authority shall be as follows, in descending order: CONSULTANT/ENGINEER'S direction, Specifications, MANUFACTURER's installation instructions.

B. Straw Bales: The CONTRACTOR shall install straw bales in the locations indicated on the Construction Drawings, or as directed by the CONSULTANT/ENGINEER.

END OF SECTION

SECTION 02310
DRILLING SERVICES

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Work covered by this Section consists of furnishing all labor, materials, transportation, tools, supplies, equipment, and appurtenances necessary for all construction as it pertains to the installation of injection wells and monitoring points, and modification of two existing injection wells.

B. The Work covered also consists of furnishing all equipment, tools, and labor necessary for the development of the all newly installed wells to ensure high well efficiency and relatively sand and silt free water.

C. While the Specifications provided are intended to cover the Work anticipated, they may not include every detail relevant to the Work effort proposed or all activities that may be requested. These Specifications may also be revised by the ENGINEER in response to unanticipated site conditions.

1.02 RELATED SECTIONS

A. Section 01010 SUMMARY OF WORK

B. Section 02225 TRENCHING AND BACKFILLING

1.03 PERMITS, CERTIFICATES, LAWS AND ORDINANCES

A. The CONTRACTOR shall, at its own expense, procure all permits, including but not limited to well construction permits, certificates, and licenses required of the CONTRACTOR by law for the execution of this Work in the State of New York. The CONTRACTOR shall comply with all federal, state or local laws, ordinances, or rules and regulations relating to the performance of the Work.

B. All Work shall be conducted by a drilling subcontractor, Parratt-Wolff, Inc, which is registered and certified in the State of New York. (Contact Person: Sean Pepling , TEL: (800) 782-7260)

1.04 **HEALTH AND SAFETY**

A. The CONTRACTOR shall perform this Work in compliance with OSHA guidelines, 29 CFR 1910. The CONTRACTOR shall use, at a minimum, the standards of the Site Health and Safety. The CONTRACTOR is responsible for development of the approved CHASP, in accordance with Section 01300 – SUBMITTALS.

1.05 **SITE PROTECTION**

A. The CONTRACTOR shall protect all structures, such as roads, wells, pipelines, overhead utilities, trees, and fences during performance of the Work. CONTRACTOR shall store on-site all debris and unused materials for disposal by CONTRACTOR. CONTRACTOR shall, upon completion of the Work, restore the site as nearly as possible to its original condition.

B. The CONTRACTOR shall containerize all drill cuttings produced from the installation of injection and monitoring wells. The ENGINEER shall be responsible for the removal from the site and the disposal of any drill cuttings produced from the well installation.

C. All Work shall be performed under the direct supervision of the ENGINEER.

D. The CONTRACTOR shall containerize all groundwater resulting from the well development. The ENGINEER shall be responsible for the removal of purged groundwater.

PART 2 - PRODUCTS

2.01 **WELL CONSTRUCTION MATERIALS**

A. Well casings for the injection well shall be new, 6-inch diameter, flush joint Schedule 40 threaded PVC and for the groundwater monitoring point shall be new, 2-inch diameter, flush joint Schedule 40 threaded PVC.

B. Well screens for the injection well shall be new, 6-inch diameter, threaded, flush joint, 0.010-inch slotted stainless steel v-wired screen and for the groundwater monitoring point shall be new, 2-inch diameter, threaded, flush joint, 0.010-inch slotted, schedule 40 PVC well screen.

C. The sand pack shall consist of only clean, washed coarse-grained silica sand composed of well-rounded particles. One-half foot of very fine-grained, clean silica sand shall be placed above the sand pack to prevent cement grout from entering the sand pack. The sand pack shall extend to a minimum of 2 feet above the screened interval.

D. A minimum of 2 feet of certified bentonite pellets shall be installed directly over the sand pack in the groundwater monitoring point by the CONTRACTOR.

E. Grout shall consist of a neat cement mixture with a ±5 percent bentonite in accordance with API Class A (Type I Cement). The remaining annulus will be grouted to the surface via the tremie method. The mixture, method of mixing, and consistency of grout shall be approved by the ENGINEER during field execution.

F. A locking cap shall also be provided and installed by the CONTRACTOR for all wells.

PART 3 - EXECUTION

3.01 DRILLING

The CONTRACTOR shall drill boreholes for the installation of the injection wells and groundwater monitoring points, if necessary, using the hollow-stem auger and mud rotary drilling techniques in accordance with the Drawings. The ENGINEER will approve final borehole depths. The proposed borehole depth is summarized below.

Well ID	Borehole/Well Depth (feet below ground surface)	Screen Intervals (feet below ground surface)
IJ-7, IJ-8, IJ-9	46/45	30-45
IJ-10	26/25	10-25
MP-11, MP-12, MP-13, MP-14	26/25	15-25

3.02 INJECTION WELL INSTALLATION

A. Injection well assembles shall be placed in the open borehole. Centralizers shall be utilized during the placement of the well screen and casing to ensure uniform annular space between the well and the borehole wall.

B. The annular space between the well screen and the borehole shall be filled with commercial No. 3 sand or equivalent. The sand shall be poured slowly so that it does not bridge between the well and the borehole wall. The sand-pack shall extend to a minimum of two (2) feet above the top of the screen. The CONTRACTOR shall use a weighted tape to determine the depths of placement for the coarse-grained sand pack and other annular materials.

C. A bentonite seal consisting of 2 feet of bentonite pellets shall be placed on top of the sand pack in injection wells IJ-7 through IJ-9. A 7-feet of bentonite seal shall be placed on top of the sand pack in injection well IJ-10. The CONTRACTOR shall add a sufficient amount of potable water and allow sufficient time for the pellets to hydrate to provide an adequate seal.

D. Injection wells IJ-7 through IJ-9 shall be grouted from the top of the bentonite seal to approximately 3 to 4 feet below ground surface. The grout shall be tremie-placed by pressure grouting into the annular space. Grouting may require more than one application to bring the grout to the required level. No drilling operations or other work within the well will be allowed for a minimum period of 72 hours after grouting. If quick-setting cement is used, this period may be reduced to 24 hours.

E. The injection wells shall be completed with flushmount casing/covers. Covers shall be placed over well and seated into the ground immediately after grouting. CONTRACTOR must assure that grout is no more than 0.5 feet below ground level.

F. At all times during the progress of the Work, the CONTRACTOR shall protect the well in such manner as effectively to prevent either tampering with the well, or the entrance of foreign matter into it.

3.03 GROUNDWATER MONITORING POINTS INSTALLATION

A. Monitoring point assembles shall be placed in the open borehole. Centralizers shall be utilized during the placement of the well screen and casing to ensure uniform annular space between the well and the borehole wall.

B. The annular space between the well screen and the borehole shall be filled with coarse sand. The sand shall be poured slowly so that it does not bridge between the well and the borehole wall. The sand-pack shall extend to a minimum of two (2) feet above the top of the screen. The CONTRACTOR shall use a weighted tape to determine the depths of placement for the coarse-grained sand pack and other annular materials.

C. A bentonite seal consisting of 2 feet of bentonite pellets shall be placed on top of the sand pack in monitoring point. The CONTRACTOR shall add a sufficient amount of potable water and allow sufficient time for the pellets to hydrate to provide an adequate seal.

D. Monitoring point shall be grouted from the top of the bentonite seal to the ground surface. The grout shall be tremie-placed by pressure grouting into the annular space. Grouting may require more than one application to bring the grout to the required level. No drilling operations or other work within the well will be allowed for a minimum period of 72 hours after grouting. If quick-setting cement is used, this period may be reduced to 24 hours.

E. The monitoring points shall be completed with flushmount casing/covers. Covers shall be placed over well and seated into the ground immediately after grouting. CONTRACTOR must assure that grout is no more than 0.5 feet below ground level.

F. At all times during the progress of the Work, the CONTRACTOR shall protect the well in such manner as effectively to prevent either tampering with the well, or the entrance of foreign matter into it.

3.04 WELL DEVELOPMENT

A. The purpose of well development is to assure that each newly constructed well is properly developed so as to provide representative groundwater samples and to be effective for injection. The CONTRACTOR shall furnish all necessary equipment and shall develop the newly installed wells to the satisfaction of the ENGINEER. Equipment needed includes: personal protective equipment; submersible pump and hoses; generator; and, surge block arrangement.

B. Well development shall begin only after the well has been completed and the grout plug has cured for 24-hours. A clean submersible pump with accompanying discharge line and safety rope shall be lowered to a level 2 to 3 feet above the bottom of the well. The pump shall then be turned on and the well pumped dry. If appreciable quantities of fine sediments interfere with the pump performance, the water can be bailed until the water is of sufficient quality to pump. At this time, the pump apparatus shall be removed from the well. Once the well recovers, a surge block shall be placed in the well in the area of the well screen. Water shall be alternately pushed out and then pulled in the formation around the well by raising and lowering the surge block. The surge block apparatus shall then be removed and the submersible pump replaced in the well. During pumping, pH, specific conductance, temperature, clarity and volume of water removed shall be monitored and recorded by the CONTRACTOR. The total volume of sediment and water removed from the well as a result of development shall be recorded by the CONTRACTOR. The process of pumping and surging shall be repeated until the water becomes clear and pH and specific conductance readings have stabilized. After the well has been developed, all materials will be removed and the well shall be secured. Development water removed from the wells shall be collected and pre-treated through the on-site groundwater treatment system, and discharged to the permitted wastewater discharge point.

3.05 WELL MODIFICATION

Existing injection wells IJ-2 and IJ-3 will be modified/retro-fitted to connect to the distribution box. The modification shall be conducted in accordance with the Construction Drawing for new injection wells.

3.06 **DAILY LOG**

A. The CONTRACTOR shall maintain a detailed daily log of operations during all drilling procedures. The log shall give a complete description of all formations encountered, any refusal, footage, size of the hole drilled, depth, sizes of all screens and casings installed, fluid losses, water-level changes and depths at which they occurred, a description of cementing operations, a record of cement quantities, and other such pertinent data as may be requested by ENGINEER. The daily log shall be maintained on the site and available for inspection by ENGINEER at all times.

B. Upon completion of the drilling, the CONTRACTOR shall submit copies of the detailed daily log and of the "Well Completion Report" to the ENGINEER and to the New Jersey Department of Environmental Protection as required.

END OF SECTION

SECTION 02510
ASPHALT PAVING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Work covered by this Section consists of furnishing all equipment, tools, and labor necessary for the installation of asphalt paving including a base course, tack coat, and surface course at the locations shown on the Construction Drawings.

1.02 RELATED SECTIONS

A. Section 01010 - Summary of Work.

B. Section 01300 - Submittals.

C. Section 01400 – Quality Controls.

D. Section 02211 - Rough/Final Grading.

1.03 REFERENCES

A. The Asphalt Institute - Manual MS-4 - The Asphalt Handbook.

B. The Asphalt Institute - Manual MS-13 - Asphalt Surface Treatments and Asphalt Penetration Macadam.

C. ASTM D-1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort.

D. ASTM D-946 - Asphalt Cement for Use in Pavement Construction.

E. New York State Department of Transportation (DOT) Specifications - Section 400: Bituminous Pavements, and Section 407 - Tack Coat.

1.04 SYSTEM PERFORMANCE

A. Paving shall withstand the anticipated short-term daily use by construction equipment, and shall withstand heavy-duty heavy vehicular traffic after the completion of construction activities at the SITE.

1.05 QUALITY ASSURANCE

The CONTRACTOR shall:

A. Perform work in accordance with The Asphalt Institute specifications and the New York State DOT Standard Specifications for Road and Bridge Construction.

B. Obtain materials from the same local, reputable SUPPLIER throughout the project.

1.06 REGULATORY REQUIREMENTS

A. The CONTRACTOR shall conform to applicable local regulations for paving on private property.

1.07 TESTS

A. Testing and analysis of the asphalt paving mix will not be required. However, the CONTRACTOR shall also provide a performance guarantee for a minimum two-year period and repair any damage at no cost to the CONSULTANT/ENGINEER during the guarantee period.

B. The CONTRACTOR shall submit proposed mix designs to the CONSULTANT/ENGINEER for review and approval a minimum of three weeks prior to the commencement of the Work.

1.08 SUBMITTALS

The CONTRACTOR shall submit:

A. All data in accordance with Section 01300.

B. Technical product data to the CONSULTANT/ENGINEER a minimum of two weeks prior to commencement of the Work.

C. Documentation for the asphalt pavement, which includes mix type, sealer, and other technical data to the CONSULTANT/ENGINEER for review and informational purposes a minimum of three weeks prior to the commencement of the Work.

D. MANUFACTURER'S instructions for asphalt repair prior to commencement of the Work.

1.09 ENVIRONMENTAL REQUIREMENTS

A. The CONTRACTOR shall not place asphalt when the base surface temperature is less than 50 °F, unless prior approval is given by the CONSULTANT/ENGINEER.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Base Course: Granular material or crushed stone, which is dry and free of deleterious materials. The base course shall conform to the State of New York DOT Specifications for Base Course "Type 2". The asphalt cement shall be AC-20.

B. Surface Course: Sand type or approved substitute as per Asphalt Institute Manual MS-4. The surface course shall conform to the State of New York DOT Specification for Top Course "Type 7." The surface course asphalt cement shall be 85-100 penetration asphalt cement.

C. The tack coat shall conform to the State of New York DOT Specification Material Designation 702-3401.

D. The CONTRACTOR shall use primer, tackcoat, asphalt cement and aggregates conforming to ASTM D-946 and to those normally used in the geographical locality of the SITE.

E. The asphalt concrete shall consist of a combination of coarse aggregate, fine aggregate and mineral filler uniformly coated and mixed with asphalt cement.

2.02 ASPHALT PAVING MIX

The CONTRACTOR shall use:

A. Dry materials to avoid foaming and for uniform mixing.

B. A base course that has between 4.5 to 6 percent of asphalt cement by weight in mixture.

C. A surface course that has between 5 to 7 percent of asphalt cement by weight in mixture.

2.03 EQUIPMENT

A. Compactors: Shall be sufficient to allow sufficient compaction to prevent settling, and pooling.

PART 3 - EXECUTION

3.01 INSPECTION

The CONTRACTOR shall:

A. Stabilize any subbase to be paved a minimum of 12 inches below the bottom of the base material by compacting and tamping with a heavy smooth-wheeled roller.

B. Verify that the compacted granular material or crushed stone base has been properly prepared and is dry and ready to support paving and imposed loads.

C. Verify gradients and elevations of the base are correct prior to placing the asphalt concrete mix.

D. Accept the granular material or crushed stone base as suitable prior to the installation of asphalt.

3.02 BASE COURSE INSTALLATION

A. After the subbase has been compacted, and approved by the CONSULTANT/ENGINEER, an asphalt base course shall be constructed as herein specified to a compacted thickness as indicated on the Construction Drawings.

B. Base Course Mixing, Transporting and Placing: The mixing, including the plant used in the preparation of the mix; transporting and placing of the mix, shall be in accordance with the New York State DOT Specification for Base Course Type 2 and in accordance with standard practices for quality work.

C. The compaction of the mixture shall be accomplished by the steel wheel roller.

3.03 TACK COAT INSTALLATION

A. Tack coat shall be applied only when the existing surface is dry, and when the atmospheric temperature is above 50 °F. The liquid asphalt shall be applied at a uniform rate by an approved pressure distributor at a spraying temperature and application rate specified hereinafter.

B. Immediately before applying the tack coat, the full width of surface to be treated shall be swept. Care shall be taken to remove all loose dirt, asphalt or other loose objectionable material.

C. The tack coat shall be applied to the surfaces of existing pavement upon which surface course material will be placed. Tack coat shall completely cover the surface to be paved and shall not be applied more than 12 hours before the overlaying course is laid.

D. Following the application, the surface shall be allowed to cure without being disturbed for such period of time as may be necessary to permit drying out and settling of the tack coat.

3.04 WEARING SURFACE INSTALLATION

A. After the tack coat or the stabilized base course has thoroughly cured, an asphalt concrete wearing surface course shall be constructed, as herein specified.

B. Surface Course Mixing, Transporting and Placing: The mixing, including the plant used in the preparation of the mix; transporting and placing of the mix, shall be in accordance with the New York State DOT Specification for Top Course Type "7" and in accordance with standard practices for quality work.

C. The compaction of the mixture shall be accomplished by the steel wheel roller.

D. At all places not accessible to the roller, thorough compaction must be secured by means of hot tampers.

E. Surface Requirements: The course after final compression shall be smooth, of uniform texture and true to the established grade. It shall have a thickness at no point more than one-quarter (1/4) inch from this thickness.

F. Longitudinal and Transverse Joints shall be made in a careful manner. Well-bonded and sealed joints are required. Joints between old and new pavements or between successive days' work shall be carefully made in such a manner as to insure a thorough and continuous bond between the adjoining surfaces.

G. Patching of Deficient Areas: For repairs at joints or other areas behind the paving machine, the mixture shall be hand raked immediately in a fan-shaped pattern and the loose mix left slightly higher than the surrounding mat and immediately rolled.

H. After compaction has been completed, joints shall be painted with RC liquid asphalt.

3.05 FIELD QUALITY CONTROL

A. The CONSULTANT/ENGINEER will perform a field inspection for conformance with these Specifications.

3.06 PROTECTION

A. The CONTRACTOR shall, immediately after placement of the asphalt, protect the pavement from mechanical injury until the pavement has fully hardened and is capable of supporting vehicular traffic without sustaining damage.

3.07 REPAIR

A. The CONTRACTOR shall repair all damage to existing asphalt paving which occurs during execution of the Work.

END OF SECTION

SECTION 02831
CHAIN LINK FENCING AND GATE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish and install, complete in every detail, all new galvanized chain-link fencing to enclose the proposed treatment building as shown on the Construction Drawings.

B. The fence height shall be 12 feet.

C. One gate shall be provided at the location shown on the Construction Drawings.

D. In general this work shall include the furnishing and installation of the following:

1. All new galvanized chain-link fence framework, fabric, and accessories.

2. The construction of concrete footings (4 feet).

3. Manual gate (16-feet wide including gate post). The gate shall be hinged to swing out.

1.02 RELATED SECTIONS

A. Section 01090 - Reference Standards.

B. Section 01300 - Submittals.

C. Section 01400 - Quality Control.

D. Section 01600 - Material and Equipment.

1.03 REFERENCES

A. ANSI/ASTM F567 - Installation of chain-link fence.

B. ASTM A123 - Zinc (Hot Galvanized) coatings of products fabricated from rolled, pressed, and forged steel shapes, plates, bars and strips.

C. ASTM A120 - Pipe, steel, black, and hot-dipped zinc-coated (Galvanized) welded and seamless, for ordinary uses.

D. ASTM C94 - Ready mix concrete.

1.04 QUALITY ASSURANCE

A. MANUFACTURER: Company specializing in commercial quality chain-link fencing with a minimum of two years experience.

B. All equipment and materials furnished under this Contract shall be new, suitable for the conditions of service to which they will be subject and equal to the best of their respective classes. Grade and quality shall meet the applicable cited specifications and standards.

C. Workmanship shall be of the highest quality and shall be carried out by competent and experienced workmen.

1.05 SUBMITTALS

A. CONTRACTOR shall submit product data and installation instructions prior to construction of fence.

B. CONTRACTOR shall include plan layout, grid, spacing of components, accessories, fittings, hardware, anchorages, and schedule of components in accordance with Section 01300 (Submittals).

PART 2 - PRODUCTS

2.01 FENCE MATERIALS

A. All posts and rails shall be hot dipped, zinc-coated steel meeting ASTM specifications A120-83, A128-78 or A153-82, whichever is applicable.

B. The fence fabric shall be No. 9 gauge wire woven meeting ASTM Specification F668.

C. Privacy slats shall be sized (minimum 1.5 inches wide) to fit every link of the fence fabric weave, and forest green color

D. The security wire shall be 12-1/2 gauge galvanized barbed wire.

E. Windscreen or privacy screen shall be sized to fit the fence and gate and forest green color.

2.02 CONCRETE MATERIALS

A. Cement: ASTM C150 - Type I - All cement shall be dry, free from lumps, and its color shall be a uniform bluish-gray.

B. Ready-Mix Concrete: Type I General Purpose.

C. Fine Aggregates: ASTM C 33 - The fine aggregate shall be clean, high-silica sand, having not more than three (3) percent by weight of foreign matter such as loam, clay, dirt, or other impurities and shall be free from injurious amounts of organic impurities. Fine aggregates shall be well graded from coarse to fine.

D. Coarse Aggregates: ASTM C33 - Coarse aggregate, unless otherwise specified, shall be well graded.

E. Water: The water used in mixing concrete shall be clean and accurately measured for each batch. In general, all water for mixing and curing purposes shall be obtained from a local municipality water supply. Water contaminated with sewage or oil, or water containing dirt, clay, filth or vegetable matter, or river or lake water, shall not be used.

2.03 CONCRETE MIX

A. Proportions: Concrete shall be composed of a thorough mixture of cement and fine and coarse aggregates with mixing water. Prior to the beginning of concrete work, a statement of the proportions proposed for the concrete mixture shall be submitted to the CONSULTANT/ENGINEER in quadruplicate, for his information and appropriate action.

2.04 COMPONENTS

A. Line posts shall be 2.5 - inch diameter steel pipe.

B. The fence fabric shall be 2-inch mesh, coated wire, and shall have black or green privacy slats incorporated. Top selvages are to have twisted and barbed ends. Bottom selvages shall be knuckled.

C. Gate frame shall be the same height as the fence and shall be approximately 16-feet wide at the location shown on the Construction Drawings.

D. Post top shall be steel or malleable iron, galvanized; sized to post dimensions with set screw.

E. Fittings shall include: galvanized steel sleeves, bands, clips, rail end, tension bars, fasteners, and fittings.

F. The gate shall be provided with suitable hinges, stops, latching, and locking devices. The gate shall be approximately 16 feet.

2.05 FINISHES

A. Galvanized: ASTM A123; 0.2 oz. / sq. ft. coating.

B. Accessories: Same finish as framing.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install framework, fabric, accessories, and gate in accordance with ANSI/ASTM F567 and FS RR-F-191.

B. Set terminal gate and posts plumb, in concrete footings with top of footing at finished grade.

C. Provide top rail through line post tops and splice with 7 inch long rail sleeves.

D. Brace each gate and corner post back to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail, one bay from end and gate posts.

E. Install center and bottom brace rail on corner and gate leaves.

F. Stretch fabric between terminal posts.

G. Position bottom of fabric 2 inches above finished grade.

H. Fasten fabric to top rail, line posts, braces, and bottom tension wire with wire ties a maximum of 15 inches on center.

I. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

J. Install gate with fabric to match fence. Install hinges, latch, catches, retainer and locking clamp.

K. Install windscreen/privacy screen to the fence and gate.

L. Posts, fabric, and gate assemblies shall be erected in accordance with the MANUFACTURER's standard specifications, the Construction Drawings, and shall be subject to the approval of the CONSULTANT/ENGINEER.

END OF SECTION

SECTION 03110
CONCRETE FORMWORK

PART 1 - GENERAL

1.01 WORK INCLUDED

This section prescribes materials and methods to be used in fabricating, erecting, and removing forms for cast-in-place concrete. The CONTRACTOR shall furnish all form design, forms, shoring, ties, form coating, and materials and all labor, equipment, and other items necessary or convenient to the CONTRACTOR for the fabrication, erection, and removal of formwork.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 03300 - Cast-in-Place Concrete

1.02 GENERAL

A. Forms shall be fabricated, erected, and removed as specified herein and shall be of a type, size, shape, quality and strength to produce hardened concrete having the shape, lines, and dimensions indicated on the Construction Drawings. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes that would deface the finished surfaces.

B. The CONTRACTOR shall be responsible for designing, erecting, supporting, bracing, and maintaining formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. It shall be the responsibility of the CONTRACTOR to correctly assess and analyze the erection stresses induced upon the structure, its elements and supporting foundations during construction. Since the CONSULTANT/ENGINEER does not dictate or determine the CONTRACTOR'S sequence of operations of construction, the CONSULTANT/ENGINEER cannot determine erection stresses and therefore assumes no responsibility or obligation to do so.

C. The CONTRACTOR shall be responsible for adequate formwork design for construction of cast-in-place reinforced concrete.

D. Except as modified herein, form design, fabrication, and erection shall conform to the requirements of the latest editions of ACI 347 and ACI 318 and shall be

acceptable to the CONSULTANT/ENGINEER. Design criteria for plywood shall conform to APA Form V345.

E. Formwork shall comply with the requirements of ANSI A10.9 and OSHA Construction Standards, Part 1926, Subpart Q, "Concrete, Concrete Forms, and Shoring."

1.03 SUBMITTALS

A. Product data for the formwork shall be submitted as indicated in Section 01300 (Submittals).

1.04 STORAGE

All form materials and accessories shall be stored above-ground on framework or blocking and shall be covered with a suitable water-proof covering providing adequate air circulation and ventilation.

PART 2 - PRODUCTS

2.01 FORMS

A. Forms for surfaces which will be exposed to view when construction is completed shall be prefabricated plywood panel forms, job-built plywood forms, or forms that are lined with plywood or fiberboard.

B. Plywood or lined forms will not be required for surfaces which are normally below grade or not ordinarily exposed to view.

C. Forms for cast-in-place concrete shall conform with the following requirements:

§ Prefabricated Steel Forms shall be Simplex "Industrial Steel Frame Forms," Symons "Steel Ply," Universal "Uniform," or equal.

§ Plywood Forms shall be Product Standard PS-1, waterproof, resin- bonded, exterior type douglas fir. For normal finish, face adjacent to concrete Grade B or better. For architectural finish, face adjacent to concrete Grade B or better with plastic overlay.

§ Lumber Forms Straight, dressed all sides, uniform width and thickness, and free from knots, offsets, holes, dents, and other surface defects.

§ Fiberboard Forms Federal Specification LLL-B-810, Type IX, tempered, waterproof, screenback, concrete form hardboard.

§ Chamfer Strips Clear white pine, surface against concrete planed.

D. Reuse of job-built plywood forms shall be permitted only when specifically approved by the CONSULTANT/ENGINEER

E. Where earth is too unstable to serve as a form for sides of footings, the sides against the earth may be formed with 3/4 inch thick No. 2C Yellow Pine with tight butt joints, securely braced to hold a straight line.

2.02 FORM TIES

Form ties shall be approved by the CONSULTANT/ENGINEER and shall be of the snap cone or she-bolt with cone type as manufactured by a recognized MANUFACTURER of concrete forming accessories.

2.03 FORM COATINGS

Where specified herein, forms shall be coated with a nonstaining form release agent prior to concrete placement. Form coatings shall be Industrial Lubricants "Nox-Crete Form Coating," L&M "Debond," Prater "Pro-Cote," Richmond "Rich Cote," or equal.

PART 3 - EXECUTION

3.01 FABRICATION AND ERECTION

A. Forms shall be substantial and sufficiently tight to prevent leakage of concrete. Forms shall be braced or tied to maintain the desired position, shape, and alignment during and after concrete placement.

B. Forms to be reused shall be thoroughly cleaned and repaired. Split, frayed, delaminated, or otherwise damaged forms shall not be used.

C. All form panels shall be placed in a neat, symmetrical pattern with horizontal joints level and continuous.

D. Wherever the top of a wall will be exposed to weathering, the forms on at least one side shall not extend above the top of the wall and shall be brought to true line and grade.

E. Temporary openings shall be provided at the bottom of wall forms and at other points where necessary to facilitate cleaning and inspection prior to concrete placement.

F. Unless shown otherwise or specified by the CONSULTANT/ENGINEER, all salient corners and edges of walls, slabs, and curbs shall be provided with a 3/4- by 3/4-inch chamfer formed by a wood or metal chamfer strip.

G. Forms for exposed surfaces and all steel forms shall be coated with a nonstaining form release agent which shall be applied just prior to placement of steel reinforcement. Wood forms for unexposed surfaces may be thoroughly wetted with water in lieu of coating immediately before concrete placement, except in freezing weather form release coating shall be used.

3.02 FORM REMOVAL

A. Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead and live loads. Shoring beneath slabs shall be left in place and reinforced as necessary to carry any construction equipment or materials placed thereon.

B. Care shall be taken in form removal to avoid surface gouging, corner or edge breakage, or other damage to the concrete. Immediately after form removal, any damaged or imperfect work shall be repaired as specified in "Cast-in-Place Concrete" of these Specifications.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The CONTRACTOR shall furnish all required materials and shall properly place for embedment in the concrete as shown on the Construction Drawings.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 03300 - Cast-in-Place Concrete

1.03 SUBMITTALS

A. The location, size, and configuration of the reinforcing steel shall be specified by the CONSULTANT/ENGINEER and submitted as indicated in Section 01300 (Submittals).

B. Product data shall be submitted as indicated in Section 01300 (Submittals).

1.04 REFERENCES

A. ACI 301- Specification for Structural Concrete for Buildings.

B. ACI 315 - Details and Detailing of Concrete Reinforcement.

C. ACI 318 - Building Code Requirements for Reinforced Concrete.

D. American Welding Society (AWS) D1.4- Structural Welding Code- Reinforcing Steel.

E. ASTM A184 - Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.

F. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

G. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

PART 2 - PRODUCTS

2.01 QUALITY AND GRADE

A. Reinforcing Bars: Reinforcing bars shall be deformed billet-steel bars conforming to ASTM A 615. All bars No. 4 and larger shall be Grade 60. All bars shall be shop-fabricated and bent cold. Bars shall be free from defects and kinks and from bends not indicated on the Drawings or approved bending diagrams.

B. Support Chairs: Reinforcement supports shall conform to Product Standard PS7 and CRSI *Manual of Standard Practice*, Class D or E. Reinforcement support chairs shall be stainless steel or shall be plastic-tipped when used in walls and elevated slabs. Support chairs used in slabs on grade shall be stainless steel or shall be hot-dip galvanized after fabrication or plastic-tipped in such a manner as to provide a minimum 12 inches of protection from the subgrade. Nails shall not be used to support reinforcement.

C. Tie Wire: Tie wire shall conform to Federal Specification QQ-W-461 and shall be of black annealed steel, 16-gauge minimum.

D. All steel used for reinforcement purposes shall be clean, new stock, and free from defects and bends not specified by the CONTRACTOR or the CONSULTANT/ENGINEER. Only corrugated or deformed bars, of an approved type, shall be used in the Work.

E. No reinforcing steel shall be welded unless specifically approved by the CONSULTANT/ENGINEER. Welding of reinforcing bars shall be per AWS D 1.4.

F. All structural steel (sole plates, angle seats, clips) shall be hot dip galvanized when surfaces will be exposed after the concrete is finished.

G. Deformed steel bar mats shall be per ASTM A184.

PART 3 - EXECUTION

3.01 BENDING

A. All reinforcement bars shall be cold bent as specified on the approved Shop Drawings.

B. Bars of a single length shall be used in all cases, except where the CONSULTANT/ENGINEER shall give permission to use shorter lengths or allow lapping.

C. Reinforcement partially embedded in concrete shall not be field bent without the prior permission of the CONSULTANT/ENGINEER.

3.02 STORAGE AND PROTECTION

A. All steel for reinforcement shall be delivered to the SITE without rust, other than that which may have accumulated in normal transit.

B. Reinforcement shall be protected from the weather and stored at least 12 inches above ground on timber mats or other supports acceptable to the CONSULTANT/ENGINEER.

C. All steel shall be kept free from oil, grease, dirt, or other objectionable adhering substances, and it shall be satisfactorily cleaned of scale and heavy or flaky rust before being placed in the Work.

D. If, after having been placed in the Work, installation of the concrete shall be delayed or interrupted for any considerable number of days, the steel shall be well protected.

3.03 SURFACE PREPARATION

A. Before placement, all reinforcement shall be thoroughly cleaned of oil, dirt, mill scale, rust scale, and other coatings that would tend to destroy or reduce bond.

3.04 PLACEMENT

A. Reinforcement shall be accurately positioned and tied at intersections with annealed wire or suitable clips approved by the CONSULTANT/ENGINEER. Reinforcement shall be supported by concrete or metal chairs, stays, spacers, hangers, or other supports acceptable to the CONSULTANT/ENGINEER.

B. Reinforcing bars shall be fastened with wire ties at a minimum of three places per bar. Bars shall be tied at every intersection around the periphery of slabs. Wall steel shall be tied at every fourth intersection as a minimum.

C. Reinforcement supports shall have sufficient strength and stability to maintain the reinforcement in place throughout placement and concreting operations.

D. No bars partially embedded in concrete shall be field-bent unless approved by the

CONSULTANT/ENGINEER.

E. Welding of crossing bars shall not be permitted unless approved by the CONSULTANT/ENGINEER.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Formwork.

B. Cast-in-place concrete foundation, slabs, pipe supports and trench.

C. Concrete curing and finishing.

1.02 RELATED WORK

A. Section 01400 - Quality Control.

B. Section 03200 - Concrete Reinforcement.

1.03 REFERENCES

A. ACI-318 - Building Code Requirements of Reinforced Concrete

B. ACI-MCP-1-74 - Manual of Concrete Practice

C. ASTM C 33 - Concrete Aggregates

D. ASTM C 94 - Ready-Mixed Concrete

E. ASTM C 150 - Portland Cement

F. RP 4-6-1 - Reinforced Concrete Foundation

1.04 QUALITY ASSURANCE

A. Obtain materials from same source throughout the Work.

B. Defective Work: Any concrete found to be defective from any cause whatever, at any time before the final acceptance of the Work, shall be either repaired or removed and replaced at the expense of the CONTRACTOR.

C. Codes and Standards:

1. ACI 301, "Specifications for Structural Concrete for Buildings."

2. ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete."

3. ACI 308, "Standard Practice for Curing Concrete."

4. ACI 318, "Building Code Requirements for Reinforced Concrete."

5. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement: ASTM C150 - Type I - All cement shall be dry, free from lumps, and its color shall be a uniform bluish-gray.

B. Ready-Mix Concrete: Type I General Purpose.

C. Fine Aggregates: ASTM C 33 - The fine aggregate shall be clean, high-silica sand, having not more than three (3) percent by weight of foreign matter such as loam, clay, dirt, or other impurities and shall be free from injurious amounts of organic impurities. Fine aggregates shall be well graded from coarse to fine.

D. Coarse Aggregates: ASTM C33 - Coarse aggregate, unless otherwise specified, shall be well graded.

E. Admixtures: ASTM C260 - Admixtures to the concrete may be used to provide a benefit in water reduction, increased density, improved workability, control of shrinkage, or control of rate of setting, but only with the permission of the CONSULTANT/ENGINEER.

F. Water: The water used in mixing concrete shall be clean and accurately measured for each batch. In general, all water for mixing and curing purposes shall be obtained from a local municipality water supply. Water contaminated with sewage or oil, or water containing dirt, clay, filth or vegetable matter, or river or lake water, shall not be used.

2.02 CONCRETE MIX

A. Proportions: Concrete shall be composed of a thorough mixture of cement and fine and coarse aggregates with mixing water. Prior to the beginning of concrete work, a statement of the proportions proposed for the concrete mixture shall be submitted to

the CONSULTANT/ENGINEER in quadruplicate, for his information and appropriate action.

B. Cement: Unless specifically permitted by the CONSULTANT/ENGINEER, the cement content of the concrete shall not be less than the following:

Class A - 6 bags per cubic yard

The weight of a bag of Portland cement will be taken as ninety-four (94) pounds.

C. Aggregates: The relative volume of fine and coarse aggregates shall be subject to adjustments by the CONSULTANT/ENGINEER to obtain the concrete mix best suited to the use intended, but except as otherwise required, the fine aggregate shall constitute not less than thirty (30) percent nor more than fifty (50) percent of the total volume of aggregates.

D. Water: The amount of water used in concrete, inclusive of free water contained in the aggregates but exclusive of water absorbed by the aggregates, shall not exceed five (5) gallons per sack of cement for Class A concrete. So long as the water-cement ratio is kept below this maximum, the water content may be varied by the CONSULTANT/ENGINEER to obtain desired consistencies measured by "slump," not to exceed 4 inches determined by the procedures of "Standard Test Method for Slump of Portland Cement Concrete," A.S.T.M. Designation: C 143-78.

2.03 FORMWORK

A. The forms for exposed surfaces shall be of metal or plywood, adequately supported, or shall be lined with plywood, masonite board or similar lining, and/or with metal. The design of the forms shall be satisfactory to the CONSULTANT/ENGINEER, but need not be submitted for approval unless specifically requested.

B. Metal wall ties shall be of a type that will permit removal to a distance approximately 1½ inches from the face of the wall, free from spilling and allowing for patching immediately after removal of forms.

2.04 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615, Grade 60, deformed.

B. Steel Wire: ASTM A82, plain, cold-drawn steel.

2.05 ACCESSORIES

A. Non-shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 7,000 psi in 28 days.

B. Joint Filler: Ram-Nek Plastic Joint Sealer or approved equal, thickness indicated on Construction Drawings.

C. Epoxy: Mastic Coating.

D. Moisture Barrier: Provide moisture barrier over prepared sub-base material in the concrete slab area. Use only materials which are resistant to decay when tested in accordance with ASTM E154 as follows: polyethylene sheet not less than 6 mils thick.

E. Water Stop: Greenstack Dumbell with Center Bulb water stop or equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Design, erect, support, brace, and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position.

B. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.

C. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, and level in finished structures. Provide for openings, offsets, keyways, anchorages, and inserts, and other features required in Work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

D. Provide and install pipe penetrations as shown on the Construction Drawings or as directed by the CONSULTANT/ENGINEER.

E. All forms shall be thoroughly cleaned and wetted just before placing the concrete, and if necessary to secure a smooth surface, they shall be coated with an approved nonstaining substance. Suitable moldings or bevel strips shall be placed in the forms to

prevent inside or outside sharp edges. No sharp edges will be permitted in the finished Work. All exposed corners and edges of concrete shall have 3/4-inch chamfer unless otherwise shown on the Construction Drawings.

F. Verify anchors, pre-cast sections, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.

G. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with MANUFACTURER's instructions.

H. At locations where new concrete is doweled to existing Work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.

3.02 PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as herein specified.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

D. Place reinforcement at joints as shown on Construction Drawings and as herein specified.

3.03 PLACING CONCRETE

A. Notify CONSULTANT/ENGINEER a minimum of 24 hours prior to commencement of concreting operations. Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.

B. Consolidation: Concrete shall be consolidated by an approved method during placement.

C. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.

3.04 BONDING AND JOINTS

A. Joints, either vertical or horizontal, shall be made only where called for by the Construction Drawings or as permitted by the CONSULTANT/ENGINEER.

B. All joints subject to hydrostatic pressure and all joints which are at or below finished grade shall be provided with plastic water stops.

3.05 FINISHING

A. In general, forms shall not be removed until the concrete has attained sufficient strength to assure structural stability under all dead and construction loads, and until removal can be accomplished without marring concrete surfaces.

B. All form ties shall be carefully snapped back, to a depth of at least one and one-half (1-1/2) inches below the concrete surface. The tie holes shall be patched with the driest 1:2 cement-sand mortar that can be made to stay in place.

C. All horizontal surfaces shall receive the following initial floating operation:

1. The concrete surface shall be accurately struck off and leveled with a long straight edge to the required elevation; suitable guides shall be used, as necessary, to carry the proper grade, pitch or slope; and

2. The surface shall be bull-floated to an even surface.

D. Unless otherwise directed, all edges and corners which will be exposed in the finished Work shall be beveled or rounded by the use of appropriate forms or form inserts, and care shall be taken to prevent chipping or cracking of finished edges.

3.06 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Section 01400 (Quality Control).

B. Maintain records of placed concrete items.

3.07 CONCRETE CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Concrete shall be maintained above 50 degrees Fahrenheit and in a continuously moist condition for at least the first 72 hours after placement. Curing compounds shall not be used. Concrete curing shall be in accordance with ACI 308, "Standard Practice for Curing Concrete."

3.08 WEATHER CONDITIONS

A. When the temperature is below 40 degrees Fahrenheit, or predicted to go below 36 degrees in the next 24 hours, or predicted to go below 32 degrees in the next 72 hours, no concrete shall be poured without express permission of the CONSULTANT/ENGINEER. All concrete placed during cold weather shall conform to AC1 306R.

1. The use of chemicals in the concrete mix to reduce the temperature of freezing will not be permitted.

B. All concrete materials, and all reinforcement, forms, inserts and ground with which the concrete is to come in contact, shall be free from frost.

C. All concrete placed shall have a temperature of between 50 and 90 degrees Fahrenheit.

D. The housing, covering or other protection used in connection with the curing shall remain in place and intact at least 24 hours after artificial heating is discontinued.

E. When concrete is mixed during extremely warm weather, the CONSULTANT/ENGINEER may require the CONTRACTOR to pre-cool aggregates with water sprays and to schedule the placing of successive layers of concrete so as to cause maximum release and dissipation of the heat of setting. All concrete placed during hot weather shall conform to AC1 305R.

3.09 INSERTS AND OPENINGS

A. The CONTRACTOR shall build into the concrete the steel reinforcement, sleeves, anchor bolts, and other inserts as shown on the Construction Drawings or as directed. Great care shall be taken to keep inserts and openings at proper lines and grade, and to thoroughly tamp under and around them so that there will not be a passage for water.

3.10 CONCRETE PAD

A. Where the Construction Drawings or these specifications call for the concrete foundation to support the tank, such base shall be formed as shown on the Construction Drawings.

1. Anchor bolts, where required, shall be positioned by template (furnished under the equipment item) to proper elevation and secured in place. Upper edges shall be chamfered on all sides.

END OF SECTION

SECTION 15000
PROCESS PIPING AND ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Related Sections.

B. Work Description.

C. References.

D. Acceptable MANUFACTURERs.

E. Mixing Tank Piping.

F. Injection Well Piping.

G. Distribution Box

H. Valves.

I. Flowmeters and Totalizer.

J. Pipe Sleeves.

K. Hangers, Supports and Anchoring for Piping.

L. Scheduling of Work.

M. Protection of Work.

N. Pipe Preparation.

O. Pipe Installation.

P. Pipe Sleeve Installation.

Q. Hangers, Supports, and Anchoring Installation.

R. Identification Marker Installation.

S. Marker Tape.

T. Testing.

U. Pipe flush.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals.

B. Section 01400 - Quality Control.

C. Section 01450 – Testing.

1.03 WORK DESCRIPTION

A. The CONTRACTOR is responsible for the installation of all process piping and accessories including, but not limited to, the following items as shown on the Construction Drawings: high density polyethylene pipe, stainless steel pipe and fittings; Sch. 80 PVC pipe and fittings; valves; pipe sleeves; pipe supports and pipe hangers; fasteners and mounting hardware; flow meters and/or totalizers and pressure indicators.

B. Testing of piping.

1.04 REFERENCES

A. ASTM D1784 - Standard Specification for Rigid Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl Chloride (CPVC) Compounds.

B. ASTM D2466 - Standard Specification for Polyvinyl Chloride (PVC) Socket Type Fittings.

C. ASTM D3350 – Standard Specification for Polyethylene Plastic (PE) Pipe and Fittings Materials.

D. ASTM F714 – Standard Specification for Polyethylene Plastic (PE) Pipe (SDR-PR) Based on Outside Diameter.

E. ASTM F402 - Standard Practice for Safe Handling of Solvent Cement and Primer Used for Joining Thermoplastic Pipe and Fittings.

F. BOCA Union Plumbing Code.

G. ANSI B16.5 - Pipe Flanges and Flanged Fittings.

H. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

I. ASTM A105 - Carbon Steel Forgings and Fittings.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Materials and equipment supplied for the Work shall conform to the requirements of these Technical Specifications and Construction Drawings. Suggested SUPPLIERs are indicated in some cases, however the CONTRACTOR may offer substitute material and equipment that is equivalent in all respects to that indicated. The CONTRACTOR shall provide technical data that defines the offered substitute and supports the substitution as an equal to the equipment or materials specified. The ENGINEER will review the technical data submittals from the CONTRACTOR and accept or reject the substitution. If the offered substitution is rejected, the CONTRACTOR shall be responsible for compensating the CONSULTANT/ENGINEER's costs to review the offered substitute. All submittals and substitutions shall be handled in accordance with Section 01300 of these Technical Specifications.

2.02 MIXING TANK PIPING

A. The mixing tank inlet and outlet piping shall be PVC Schedule 80 and stainless steel (unless otherwise noted), respectively and shall be installed as shown on the Construction Drawings and shall conform to applicable standards.

B. The piping that shall be extended from the mixing tank outlet stainless steel pipe to the distribution box shall be HDPE, SDR 11.

2.03 INJECTION WELL PIPING

A. All injection well piping from the distribution box up to the injection wells shall be HDPE, SDR. 11 with a minimum pressure rating of 160 PSI.

B. All piping and fittings located within the injection wells shall be Sch. 80 PVC and shall be installed as shown on the Construction Drawings in accordance with applicable standards.

2.04 DISTRIBUTION BOX

A. All injection wells will be connected to a distribution box through a piping layout plan, as shown on Construction Drawings. A common manifold located inside the distribution box will service each of the injection wells.

B. Each of the individual injection lines will have the following components located within the distribution box; one ball valve, one totalizing flow meter (0.3-3 gallons per minute [gpm]), schedule 80 PVC unions, one pressure gauge (0-30 psi), one pressure relief ball valve, and one tee to tie the injection line into a common manifold as shown on Construction Drawing No 6. Each injection line will be secured to a unistrut pipe rack in the distribution box. All materials shall be compatible with permanganate (a strong oxidant).

2.05 VALVES

A. Valves for the process piping shall be manufactured by an approved SUPPLIER with pressure ratings conforming to those of the piping. The CONTRACTOR shall submit his selection of a MANUFACTURER and technical data to the ENGINEER for approval prior to installation.

1. All similar valves shall be purchased from one MANUFACTURER.

2.06 FLOW METERS AND TOALIZERS

A. All flow meters and totalizers shall be manufactured by Great Plains Industries, Inc. or an approved equivalent as described on the Construction Drawings and the Technical Specifications.

2.07 PIPE SLEEVES

A. All pipes passing through walls and floors of the well vaults shall be provided with sleeves. All pipe penetrations shall be made water tight.

2.08 HANGERS, SUPPORTS AND ANCHORS FOR PIPING

A. All piping shall be supported by means of an approved combination of hangers, supports, and attachments.

PART 3 - EXECUTION

3.01 SCHEDULING OF WORK

A. The CONTRACTOR shall coordinate and schedule mechanical installation with the CONSULTANT/ENGINEER to accommodate the CONSULTANT/ENGINEER'S requirements.

3.02 PROTECTION OF WORK

A. The CONTRACTOR shall protect all piping from entry of dirt, pipe cuttings, lubricants, debris, stormwater and other foreign material. The CONTRACTOR shall remove any foreign materials and clean piping to the satisfaction of the CONSULTANT/ENGINEER.

3.03 PIPE PREPARATION

A. The CONTRACTOR shall:

1. Mark pipe sections with required identification prior to assembly.

2. Inspect for defective or damaged spool pieces prior to assembly.

3. Remove scale, dirt, pipe fittings, and lubricants inside and outside, prior to assembly.

3.04 PIPE INSTALLATION

A. The CONTRACTOR shall cut the pipe to exact measurement and install without forcing or springing.

B. The CONTRACTOR shall install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

C. The CONTRACTOR shall provide adequate clearance, install unions, and orient fittings and appurtenances for access to valves, fittings, and appurtenances.

D. The CONTRACTOR shall install all piping and equipment as indicated on the Construction Drawings. In the event of an installation requirement that is unclear, the CONTRACTOR shall consult with the CONSULTANT/ENGINEER before proceeding with the work in question.

E. The CONTRACTOR shall install all couplings, elbows, tees, and valves as shown on the Construction Drawings. However, the CONTRACTOR may install additional fittings, as necessary to complete the Work. The CONTRACTOR shall consult with CONSULTANT/ENGINEER prior to installation of additional fittings.

3.05 PIPE SLEEVE INSTALLATION

The CONTRACTOR shall:

A. Install pipe sleeves around pipes protruding through walls prior to installing the pipe.

B. Seal all pipe sleeve openings with non-shrink caulking.

C. Rigidly anchor pipe to stable structures where necessary. Provide pipe guides so that movement takes place along the axis of pipe only.

3.06 HANGERS, SUPPORT, AND ANCHORS INSTALLATION

A. Hangers must be absolutely vertical and are to be secured to supplementary steel, using clamps as attachments, wherever possible.

B. Wire, rope, wood, perforated band iron, tape or other makeshift material shall not be used for hangers or attachments. Threaded hangers shall have lock nuts.

C. The CONSULTANT/ENGINEER shall have the option to direct the CONTRACTOR to either support piping from above or below at any time at no additional cost to the CONSULTANT/ENGINEER or OWNER.

D. Fittings with support bases cast with the fitting shall be used to support pipe from floors or walls whenever possible or as directed by the CONSULTANT/ENGINEER.

Piping shall be supported from the floor by means of pipe stanchion saddles and U-bolts. Maximum spacing of hangers shall comply with ASA B31.3. Arrangements and location of all anchors shall be submitted to the CONSULTANT/ENGINEER for approval before installation.

3.07 IDENTIFICATION MARKER INSTALLATION

The CONTRACTOR shall identify:

A. Insulated sections of piping and valves shall be identified on the pipe and on the exterior of the insulation jacketing.

3.08 MARKER TAPE

A. Marker tape installed over all direct burial process piping shall be six (6") inches in width, and shall be Terra Tape "D" detectable as manufactured by Griffolyn, Inc. or approved equal. The tape shall be an inert, bonded layer plastic material with a metallized foil core, so that process piping locations can be determined with a metal detector. The color of the tape shall be blue with the following imprints:

"CAUTION! BURIED PROCESS PIPING LINE BELOW!"

3.09 TESTING

A. Field inspection and testing shall be performed under provisions of Section 01450.

B. Leak tests shall be performed on all piping. If tests indicate work does not meet specified requirements, remove work, replace and re-test at CONTRACTOR'S expense.

C. The tests for piping shall be observed by the CONSULTANT/ENGINEER and written acceptance shall be given to the CONTRACTOR after successful completion of the test.

B. Any damaged or defective pipe, fittings, valves, or joints that are discovered following the pressure tests shall be repaired or replaced at no cost to the OWNER or CONSULTANT/ENGINEER. The test shall be observed by the CONSULTANT/ENGINEER and written acceptance shall be given to the CONTRACTOR after successful test completion.

3.10 PIPE FLUSH

A. Prior to making final connections, CONTRACTOR shall flush the injection piping with potable water to ensure that all sediment/construction debris has been removed from such piping. Pipe flushing shall consist of at least three (3) line volumes.

END OF SECTION

SECTION 15040
MIXING TANK

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section includes requirements for coordinating the delivery, installation and operational testing during initial start-up of the feed solution mixing tank as specified in these Technical Specifications and as shown on the Construction Drawings. The feed solution mixing tank will include: one (1) 6500 gallon vertical mixing tank, high and low switches and alarms, leak detection sensor and alarm, heat tracing and insulation, and all fittings and appurtenances.

1.02 RELATED SECTIONS

A. Section 01090 - Reference Standards.

B. Section 01300 - Submittals.

C. Section 01400 - Quality Control.

D. Section 01600 - Material and Equipment.

E. Section 01700 - Contract Closeout.

F. Section 15000 - Process Piping and Accessories.

1.03 GENERAL

A. Installation shall include, but not be limited to; installation of the mixing tank per VENDOR's requirements, installation of a level switch; installation of all piping and appurtenances; and, integration of all electrical components, the level switch and leak detection system into the subpanel (control panel) for complete system integration.

1.04 REFERENCES

A. ASTM D1998-97 Standard Specification for Polyethylene Upright Storage Tanks.

B. A668/A668M-96e1 Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.

C. A266/A266M-99 Standard Specification for Carbon Steel Forgings for Pressure Vessel Components.

D. ASTM A105 - Carbon Steel Forgings and Fittings.

1.05 SUBMITTALS

The CONTRACTOR shall submit to the CONSULTANT/ENGINEER for review Shop Drawings for the feed solution mixing tank, and all associated appurtenances therewith, in accordance with Section 01300 (Submittals). Shop Drawings shall include proposed MANUFACTURER, materials, proposed level switch location, leak detection system, heat tracing and insulation, ladders, and proposed pipe connection locations.

1.06 PERMITS AND REGULATIONS

A. The CONTRACTOR shall comply with all Local, State, and Federal regulations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The mixing tank shall be a Model IMT6550 double wall tank, or approved equivalent, and shall be manufactured and supplied by Assmann Corporation of America; phone number 260-357-3181, or an approved equivalent.

2.02 INSTRUMENTATION AND CONTROLS

A. General

1. For Instrumentation and process control at the tank, a panel box (control panel), located in the mixing area shall be connected to the tank liquid-levels, which will be connected to the light and audible alarm.

2. For Instrumentation and process control at the tank, a panel box (control panel), located in the mixing area shall be connected to the leak detection sensor, which will be connected to the light and audible alarm.

3. All instrumentation shall be supplied and installed by the CONTRACTOR or electrical subcontractor.

PART 3 - EXECUTION

3.01 INSTALLATION AND INSPECTION

A. The CONTRACTOR is responsible for coordinating the delivery and installing the mixing tank according to the VENDOR's requirements and in accordance with these Technical Specifications and the Construction Drawings. Delivery, storage, and handling of equipment shall conform to the specifications in Section 01600 (Material and Equipment).

B. Installation shall include, but not be limited to; installation of mixing tank, installation of mixing tank mixer; installation of the level switches; installation of all piping and appurtenances, and; installation of all electrical components and level switches into the panel box for complete system integration.

END OF SECTION

SECTION 16111
CONDUIT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions (if included), and Division 1 Specifications Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Steel conduit and tubing.

B. Liquid-tight flexible metal conduit.

C. Conduit sleeves and openings.

D. Wall seals.

E. Mechanical type seals.

F. Pull wires.

G. Installation coatings.

1.3 PROJECT RECORD DOCUMENTS

A. Accurately record actual routing of all conduits installed in floor slab or otherwise concealed.

1.4 PROJECT CONDITIONS

A. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 PRODUCTS

2.1 STEEL CONDUIT AND TUBING

A. Fittings (Couplings, Bushings, etc.):

1. PVC-Coated Rigid Steel and IMC: Cast malleable iron, galvanized or cadmium-plated fittings conforming to Federal Specification WF408.
   a. Manufacturers:
   b. Ocal, Inc.
   c. Robroy Industries.
   d. Or as approved.

B. Conduit Bodies (PVC-Coated Rigid Steel):
   1. Threaded hub, malleable iron body and cover, with captive stainless steel screws, UL Standard 514.
      a. Manufacturers:
         1) Appleton.
         2) Cooper/Crouse-Hinds.
         3) Hubbell/Killark.
         4) Or as approved.
   2. Use mogul units for conduit sizes larger than 2 inches.

C. PVC-Coated Rigid Galvanized Steel Conduit:
   1. Manufacturers:
      a. Ocal, Inc.
      b. Robroy Industries.
      c. Or as approved.
   2. Federal Specification WWC581E, ANSI Specification C80.1 and UL 6. Hot-dip galvanized inside and outside, including the threads. PVC exterior coating 40 mils nominal thickness. Interior urethane coating of 2 mils.
   3. Accessories: All fittings and conduit bodies shall be PVC coated.

2.2 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:
   1. American Brass Company.
   2. American Flexible Conduit Company.
   3. ANAMET, Inc.
   4. Electri-Flex Company.
   5. International Metal Hose Company.
   6. Or as approved.

B. Description: Interlocked flexible galvanized steel construction with liquid-tight PVC jacket, conforming to Federal Specification WF406 and UL 360.

C. Fittings: Malleable iron, cadmium-plated fittings with compression type steel ferrule and neoprene gasket sealing rings with insulated throat, conforming to UL 514B.

2.3 WALL SEALS

A. Manufacturers: O-Z-Gedney, Type WSK Thruwall and Floor Seals, or as approved.

B. Wall Sleeve: High strength PVC pipe, epoxy-coated steel pipe, or high strength polyethylene pipe.

C. Bodies and Pressure Clamps: Hot-dip galvanized malleable iron; provide two bodies and pressure clamps for each wall sleeve.

D. Sealing Grommet: Neoprene; one for each body and pressure clamp assembly.

E. Pressure Rings: PVC-coated steel; two for each sealing grommet.

F. Bolts: Hot-dip galvanized.

2.4 PULL WIRES

A. Zinc-coated steel, polyethylene or nylon line having not less than 200 pound tensile strength.

B. Quantity: Install in each spare conduit with minimum of 10 feet additional wire on each end.

2.5 INSTALLATION COATINGS

A. Outdoor Metallic Conduit Threads (Prior to Assembly):
   1. Manufacturers:
      a. CRC Chemicals, Lectra-Shield.
      b. Emhart Corporation (Bostik Division), Never-Seez.
      c. Ideal Industries, No. 40-640.
      d. Or as approved.
   2. Description: Anti-seize and lubricating compound.

B. Exposed Metallic Conduit Threads (After Assembly):
   1. Manufacturers:
      a. Clearco.
      b. Crown.
      c. Or as approved.
   2. Description: Anti-corrosive cold galvanizing compound. Meet AGA Standard 780-93a for repair of damaged and uncoated areas of hot-dip galvanized coatings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

3.2 INSTALLATION

A. General Conduit Installation:
   1. Install conduit in accordance with NECA "Standard of Installation." Size raceways according to code but not smaller than indicated.
   2. Minimum Size: 3/4 inch trade size unless otherwise specified. Minimum 1 inch trade size for underground conduit.
   3. Ground and bond conduit; see Section 16170.
   4. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
   5. Do not install steel conduit in contact with aluminum where exposed to moisture.
   6. Space conduits installed against concrete surfaces 1/4 inch away from the surface by using clamp backs or conduit hangers.
   7. Unless otherwise specified in Division 1, where necessary to cut holes through existing walls for raceways, make necessary repairs to building structures. Match existing.
   8. Cut conduit square using saw or pipe cutter; de-burr cut ends.
   9. Threaded Joints: Field-cut threads using conduit dies. Clean off all cuttings and oil; coat with a cold galvanizing compound. Recoat exposed threads with cold galvanizing compound after installation.
   10. Where sections of the same conduit are exposed to different temperatures, seal the conduit to prevent condensation and passage of air from one area to the other.
   11. Do not allow moisture traps. Provide junction box with drain fitting at low points in conduit system.
   12. Provide suitable pull wire in each empty conduit; secure at both ends.
   13. Install expansion/deflection couplings on conduit raceways installed in slab where conduits pass through expansion joints.
   14. Provide bonding jumpers across expansion/deflection couplings for metallic raceways.
   15. Exposed conduit on building exteriors is not allowed unless approved by ENGINEER.
   16. Repair damaged coatings of PVC-coated rigid conduit with repair kit and materials manufactured specifically for the purpose.
   17. Coat all conduit threads, which are not scheduled for painting with lubricating compound.
   18. Repair all scratched PVC-Coated surfaces and exposed outdoor conduit threads with manufacturer provided compound.

B. Conduit Use:
   1. Underground Installation: See Section 16118.
   2. Outdoor Locations, Exposed Above Grade:
      a. Use PVC-coated rigid conduit.
   3. Conduit In Cast-In-Place Floor Slab or Wall:
      a. PVC-coated rigid conduit.
      b. Maximum Conduit Outside Diameter: 1/3 slab or wall thickness.
      c. Minimum Concrete Cover on Conduit: 2 inches.
      d. Minimum Clearance Between Conduits and Reinforcement: 1-1/2 inches.
      e. Minimum Center-to-Center Spacing: Three conduit diameters.

C. Protecting Raceways against Corrosion:
      a. Use PVC-coated rigid steel conduit
      b. Use clamp-back spacers for raceways installed along concrete walls.

D. Conduit Routing:
   1. Separate conduits carrying instrumentation wiring from conduits carrying power wiring by at least 6 inches.
   2. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
   3. Route conduits around gratings, passage or walkway areas, and other obstructions to avoid tripping hazards and obstructions to equipment access areas.
   4. Exposed Conduit: Route parallel and perpendicular to walls.
   5. Above Suspended Ceilings: Route parallel and perpendicular to walls.
   6. Concealed Conduit: Route point-to-point.

E. Conduit Bends:
   1. Use factory elbows for 90 degree bends in metal conduit larger than 2 inches.
   2. No bend shall be greater than 90 degrees.
   3. Use conduit bodies to make sharp changes in direction.

F. Openings and Sleeves:
   1. Provide conduit sleeves and/or box frames to provide openings for conduits which pass through interior floors and walls of new structures.
   2. Core conduit openings in existing interior walls and floors to the conduit outside diameter plus a minimum 1 inch additional diameter.

G. Conduit Supporting and Hanging:
   1. General:
      a. Arrange supports to prevent misalignment during wiring installation.
      b. Fasten conduit supports to building structure and surfaces; follow Section 16190.

c. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
d. Do not attach conduit to ceiling support wires.
e. Arrange conduit to maintain headroom and present neat appearance.
f. Support conduits away from walls that are likely to condensate.

2. Individual Conduits:
   a. Support individual conduits directly to structural steel with beam clamps.
   b. Support individual horizontal conduits not larger than 1-1/2 inches in diameter to concrete walls by means of one-hole, malleable iron straps with clamp back spacers.
   c. Support individual horizontal conduits larger than 1-1/2 inches in diameter by individual hangers and forged steel conduit strap for vertical runs.
3. Groups of Conduits:
   a. Construct conduit racks using galvanized steel channel and provide space on each for 25 percent additional conduits.
   b. Attach groups of conduit to structural steel with galvanized steel channel attached with beam clamps. Attach conduit to channel with pipe clamps.
   c. Attach groups of conduit to concrete with cast-in-place galvanized steel channel and anchors. Attach conduit to channel with pipe clamps.
4. Suspended Support:
   a. Attach horizontally suspended, single conduit plumb with a galvanized steel threaded rod not smaller than 3/8 inch diameter. Attach threaded rods to concrete with anchors and to structural steel with beam clamps. Attach conduit to threaded rod with clamps.
   b. Attach horizontally suspended groups of conduit plumb with galvanized steel channel suspended from galvanized steel threaded rods not smaller than 3/8 inch diameter. Attach threaded rods to concrete with anchors and to structural steel with beam clamps. Attach conduit to strut with pipe clamps.
   c. Provide sufficient threading on hanger rods at each end to permit at least 2 inches of adjustment.
5. Vertical Conduit Support:
   a. Space supports not over 10 feet on centers for vertical conduits spanning open areas. Securely anchor conduit at each end, and install so as not to interfere with the installation and operation of equipment at the location.
   b. Install conduit support bushings in vertical raceways at intervals stipulated by NEC.

H. Conduit Terminations:
1. Terminate conduit with insulated bushings.
2. Bring conduit to shoulder of fittings; fasten securely.

3. Use insulated grounding bushings with bonding jumpers for conduit terminations containing conductors No. 8 AWG or larger, to boxes with concentric or eccentric knockouts, and to conduits terminating in or under electrical power distribution cabinets and enclosures.
4. For equipment subject to vibration, make connections using liquid-tight flexible conduit. Do not exceed 4 feet in length unless otherwise approved.

I. Conduit Entrances Below Grade:
1. Use wall seals where conduit penetrates foundation walls.
2. Provide watertight installation.
3. Poured Walls: Set sleeves in formwork at proper elevation prior to concrete pour. Boxing out of forms for later placement is not acceptable.
4. Existing Walls: Use mechanical type seals; core opening, install conduit and seal.
5. Slope underground conduits such that water or moisture collecting in the conduit drains away from building.
6. Install a "T" conduit with drain fitting at the lowest point of each raceway (or drain fitting on pullbox, if used at raceway entrance) with a minimum 1 inch trade size drain to nearest sump for all below grade conduit entrances into buildings or structures.

END OF SECTION

SECTION 16123
BUILDING WIRE AND CABLE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions (if included), and Division 1 Specifications Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Building wire and cable.

B. Service entrance cable.

C. Shielded instrumentation cable.

D. Wiring connectors.

1.3 SUBMITTALS

A. Test Reports: Indicate procedures and values obtained.

1.4 PROJECT CONDITIONS

A. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions. Include wire and cable lengths within 10 feet.

B. Where wire and cable routing is not shown and destination only is indicated, determine exact routing and lengths required.

PART 2 PRODUCTS

2.1 BUILDING WIRE AND CABLE

A. Manufacturers:
   1. BICC/General Cable.
   2. Okonite Company.
   3. Pirelli Cable.

4. Or as approved.

B. Description: Single-conductor insulated wire.

C. Conductor: Stranded copper.

D. Insulation Voltage Rating: 600 volts.

E. Insulation: ANSI/NFPA 70; Type XHHW or THWN insulation for feeders and branch circuits larger than No. 6 AWG; Type THHN/THWN insulation for feeders and branch circuits No. 6 AWG and smaller.

2.2 SERVICE ENTRANCE CABLE

A. Manufacturers:
1. BICC Cable.
2. Okonite Company.
3. Pirelli Cable.
4. Rome Cable Corporation.
5. Or as approved.

B. Description: ANSI/NFPA 70, Type USE.

C. Conductor: Copper.

D. Insulation Voltage Rating: 600 volts.

E. Insulation: Type RHW.

2.3 SHIELDED INSTRUMENTATION CABLE

A. 300 Volt Insulated Analog Signal Cable:
1. Manufacturers: Belden No. 9154, or as approved.
2. Description: NEC Type CMG, two-conductor, stranded tinned copper, No. 20 AWG twisted, shielded cable with No. 22 AWG tinned copper drain wire.
3. Insulation: PVC jacket rated for 300 volts.

B. 600 Volt Insulated Analog Signal Cable:
1. Manufacturers: Alpha No. 5430, or as approved.
2. Description: UL AWM Style 2501, two-conductor, stranded tinned copper, No. 18 AWG shielded cable with tinned copper drain wire.
3. Insulation: PVC jacket rated for 600 volts.

C. RTD Cable:
   1. Manufacturers: Belden, Type 8618, or as approved.
   2. Description: NEC Type CL3, three-conductor, stranded tinned copper, No. 16 AWG, twisted, shielded cable with No. 18 AWG tinned copper drain wire.
   3. Insulation: PVC jacket rated for 600 volts.

2.4 WIRING CONNECTORS

A. Wire Sizes No. 10 AWG and Smaller:
   1. Splices and Taps: 3M Scotchlok Type Y & R insulated spring connectors.
   2. Terminals: Thomas & Betts Stakon Series RA, RB, and RC insulated terminals. Use locking fork type for connection to terminal blocks and ring type for motor terminations.

B. Wire Sizes No. 8 AWG Through 500 MCM:
   1. Splices: Thomas & Betts Series 53500 barrel-type, cast copper, heavy duty, two-way compression connector.
   2. Taps: Thomas & Betts Series 54700 color-keyed, C-type compression connector.
   3. Lugs: Cast copper, heavy duty type:
      a. Motor Terminations and Wire Sizes No. 8 AWG to 1/0 AWG: Thomas & Betts 53100 Series, one-hole type.
      b. Wire Sizes 2/0 and Larger: Thomas & Betts 53200 Series, two-hole type.
   4. Compression type connectors shall be installed using a hydraulic tool with correct die for circumferential or hexagon compressions.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that mechanical work likely to damage wire and cable has been completed.

B. Verify that field measurements are as shown on Drawings.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

B. Determine required separation between cable and other work.

C. Determine cable routing to avoid interference with other work.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Use stranded conductors for feeders and branch circuits No. 12 AWG and smaller to wiring devices.

C. Use stranded conductors for control circuits.

D. Use conductor not smaller than No. 12 AWG for power and lighting circuits.

E. Use conductor not smaller than No. 14 AWG for control circuits and for discrete type instrumentation wiring.

F. Use No. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 100 feet.

G. Pull all conductors into raceway at same time.

H. Use suitable wire pulling lubricant for building wire No. 4 AWG and larger.

I. Provide a properly sized equipment-grounding conductor in all raceways.

J. Neatly train and lace wiring inside boxes, equipment, and panelboards.

K. Clean conductor surfaces before installing lugs and connectors.

L. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

M. After making splice or tap, tape uninsulated conductors and connector with electrical tape (3M 33+) to 150 percent of insulation rating of conductor.

N. Use connector sealing pack for all connections in outdoor or underground boxes or in bases of lighting poles.

O. Do not terminate shielded instrumentation cable shield at field device. Trim shield and sleeve with heat-shrink tubing. Prevent shield from coming in contact with conductive surfaces at field device.

3.4 FIELD QUALITY CONTROL

A. Inspect wire and cable for physical damage and proper connection.

B. Measure tightness of bolted connections and compare torque measurements with manufacturer's stated values.

END OF SECTION

SECTION 16130
BOXES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions (if included), and Division 1 Specifications Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Outlet, pull, and junction boxes.

PART 2 PRODUCTS

2.1 CAST BOXES

A. Manufacturers:
   1. Appleton.
   2. Crouse-Hinds.
   3. O-Z/Gedney.
   4. Or as approved.

B. Type: Corrosion-resistant, Type FD, flat-flanged, cast device box with threaded hubs and external mounting lugs for securing box to surface.

C. Mounting: Surface mount.

D. Rating: Weather-proof and dust-tight.

E. Material: Malleable cast iron.

F. Covers: Malleable cast iron covers; include gasket and stainless steel screws.

2.2 SHEET METAL BOXES

A. Manufacturers:
   1. Appleton.
   2. Raco.

3. Steel City.
4. Or as approved.

B. Type: NEMA OS 4 stainless steel, surface-mounted.

C. Box Depth: 2 inches minimum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Cooperate with other trades to avoid conflict between the locations of conduit, outlets, equipment, ducts, plumbing and other building components.

3.2 INSTALLATION

A. Box Use:
1. Sheet Metal Boxes: Use surface-mounted boxes.

B. General Installation:
1. Install boxes in accordance with NECA "Standard of Installation".
2. Install in locations as required for splices, taps, wire pulling, and equipment connections, and in compliance with regulatory requirements. Electrical boxes shown on Drawings are in approximate locations unless dimensioned.
3. Install boxes so that box covers are accessible at all times.
4. Set wall-mounted boxes at elevations to accommodate mounting heights.
5. Orient boxes to accommodate wiring devices.
6. Maintain headroom and present neat mechanical appearance.
7. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
8. Support boxes independently of conduit.
9. Install knockout and hub closures in unused box openings.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Maintain isolation of separate conduits by installing separate pull boxes or sectionalized pull boxes for each conduit.

B. Support boxes mounted on walls that are likely to generate condensate, away from the wall using Unistrut.

C. Coordinate installation of outlet boxes for equipment connections.

3.4 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 16140
WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions (if included), and Division 1 Specifications Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Receptacles.

B. Cover plates.

PART 2 PRODUCTS

2.1 CONVENIENCE RECEPTACLES

A. Manufacturers:
   1. Duplex Corrosion-Resistant Receptacle:
      a. Arrow Hart Cat. No. 5362CR.
      b. Bryant Cat. No. 5362CR.
      c. Hubbell Cat. No. 53CM62.
      d. Or as approved.
   2. Ground Fault Circuit Interrupter Receptacle:
      a. Arrow Hart Cat. No. GF5362.
      b. Bryant Cat. No. GFR53FT.
      c. Hubbell Cat. No. GF5362.
      d. Or as approved.

B. Description: NEMA WD 1, heavy duty, general-use receptacle with compression terminals for back wiring.

C. Color:
   1. Unfinished Areas: Gray.
   2.

2.2 COVER PLATES

A. In-use, Weather-proof Receptacle Cover: Carlon E9UDVCRN, or equal, non-metallic, non-conductive, corrosion-resistant, paintable, gasketed plastic cover. Cover shall be of the single gang, deep, vertical type rated for in-use protection with bottom entry cord.

B. Mounting Screws: Stainless steel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that outlet boxes are installed at proper heights.

B. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install in accordance with NECA “Standard of Installation”.

B. Install devices plumb and level.

C. All outdoor receptacles to be GFCI type.

D. Connect wiring devices grounding terminal to branch circuit equipment grounding conductor.

E. Install convenience receptacle 48 inches above finished floor in unfinished areas.

F. Install convenience receptacle 6 inches above backsplash of counter.

3.4 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Verify that each receptacle device is energized.

C. Test each receptacle device for proper polarity.

D. Test each GFCI receptacle device for proper operation.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.6 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 16170
GROUNDING AND BONDING

This Section includes basic materials and methods for grounding and bonding electrical systems, building structure and finishes, and piping systems.

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions (if included), and Division 1 Specifications Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Rod electrodes.

B. Exothermic connections.

C. General grounding requirements.

1.3 PERFORMANCE REQUIREMENTS.

A. Grounding System Resistance: 5 ohms.

PART 2 PRODUCTS

2.1 ROD ELECTRODE

A. Manufacturers:
   1. Blackburn/Eritech.
   2. Copperweld Corporation.
   3. Or as approved.

B. Material: Copper-clad steel.

C. Diameter: 3/4 inch.

D. Length: 10 feet.

2.2 EXOTHERMIC CONNECTIONS

A. Manufacturers:
   1. Burndy.
   2. Cadweld.
   3. Or as approved.

2.3 GROUNDING ELECTRODE CONDUCTOR

A. Material: Stranded copper.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

A. Provide grounding and bonding as required to meet NEC 250.

B. Service Entrance.
   1. Install main grounding electrode at nearest point to service entrance disconnect.
   2. Bond grounding electrode conductor to main grounding electrode. Bond grounding electrode conductor to neutral bus bar of main disconnect.
   3. Provide main bonding jumper at main disconnect to meet regulatory requirements.
   4. Provide supplemental grounding as required to meet specified resistance to ground. Supplemental grounding shall connect to main grounding electrode.

C. Underground Work:
   1. Cover all buried copper wire joints and splices with Kearney Aqua Seal.
   2. If rock is encountered while installing ground rods, grounding shall be provided using one of the following methods:
      a. Drive ground rod at no more than a 45 degree angle as required to avoid rock.
      b. Bury ground rod horizontally at a minimum depth of 36 inches below grade.
      c. Bury metal strips of not less than 10 feet in total length, with total surface area (both sides) of not less than 5 feet square. Minimum burial depth shall be 30 inches. Ferrous metal strips shall not be less than 1/4 inch thick and non-ferrous metal electrodes shall not be less than 0.06 inches thick.

D. Grounding Electrode System:
   1. Provide rod electrodes at each service.

2. Coordinate with installation of steel reinforcement systems in floor slabs and foundations to provide a grounding electrode connection to the rebar system near the building service entrance in accordance with NEC 250.52(A)(3).
3. Connect all grounding electrode systems at each building or structure to form a common grounding electrode system.

E. Supplemental Grounding:
1. Provide supplemental grounding as shown on Drawings and as required to meet specified resistance to ground.
2. If testing of the main grounding electrode for a building or structure fails to achieve the specified resistance to ground, install up to two additional rod electrodes to the main grounding electrode until specified resistance is met. Place additional rods at least 10 feet apart. Contact ENGINEER if specified resistance to ground is not met after completing the three-rod cluster.

F. Equipment Grounding Conductor: Provide separate, insulated green conductor within each raceway. Terminate each end on suitable lug, bus, or bushing.

G. Bonding of Equipment:
1. Electrical Equipment: Provide grounding connections for non-current-carrying conductive materials enclosing electrical conductors or equipment as required to establish an effective ground-fault current path and to limit the voltage to ground on these materials.
2. Conductive Materials: Connect electrically conductive materials that have the potential to become accidentally energized together and to the electrical supply source in a manner that establishes an effective ground-fault current path and limits the voltage to ground on these materials. Provide grounding in accordance to NEC 250.110 through 250.116.
3. Piping Systems and Exposed Structural Steel: Provide bonding in accordance with NEC 250.104.
4. Provide grounding and bonding connections using methods which avoid objectionable currents in the grounding system.

3.3 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Ground Resistance Test: See Section 16960.

END OF SECTION

SECTION 16190
SUPPORTING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions (if included), and Division 1 Specifications Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Anchors and fasteners.

B. Channel framing supports.

1.3 PRODUCT REQUIREMENTS

A. Materials and Finishes: Provide corrosion-resistant materials suitable for the application or as noted on the drawings..

B. Provide materials, sizes, and types of anchors, fasteners, and supports to carry the load of equipment and conduit. Consider weight of wire in conduit when selecting products.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. B-Line Systems, Inc.

B. Entrum Industries/Strut Tech.

C. Thomas and Betts/Kindorf.

D. Unistrut Corporation.

E. Or as approved.

2.2 ANCHORS AND FASTENERS

A. Use methods most appropriate for and compatible with substrate. Do not use methods which will cause structural damage.
   1. Steel Structural Elements:
      a. Beam clamps.
      b. Welded fasteners.
   2. Hollow Masonry, Plaster, and Gypsum Board Partitions:
      a. Toggle bolts.
      b. Hollow wall fasteners.
   3. Solid Masonry:
      a. Expansion anchors.
      b. Preset inserts.
   4. Sheet Metal: Sheet metal screws.
   5. Wood Elements: Wood screws or lag bolts.
   6. Fiberglass Elements: Stainless steel bolts.

2.3 CHANNEL FRAMING SUPPORTS

A. Use channel framing for equipment support.
   1. Minimum Size: 1-5/8 inch channel.
   2. Chemically Corrosive Locations:
      a. Use stainless steel channel framing where suitable for weight of supported equipment.
   3. Wet Environments: Use stainless steel channel framing in unheated, below-grade vaults and similar areas exposed to continuous wet conditions.

B. Hardware (channel nuts, spring channel nuts, bolts, washers, etc):
   1. All Areas: Stainless steel hardware.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

C. Rigidly support fixtures and equipment from the building structure.

D. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

E. Do not use spring steel clips and clamps.

F. Obtain permission from ENGINEER before drilling or cutting structural members.

G. Fabricate supports from channel framing. Use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring-lock washers under all nuts.

H. Install surface-mounted cabinets and panelboards with minimum of four anchors.

I. In wet and damp locations, channel framing supports to stand cabinets and panelboards 1 inch off of surface.

J. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

K. Touch up field-cut ends of galvanized steel supports with galvanizing repair paint.

END OF SECTION

SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions (if included), and Division 1 Specifications Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Nameplates.

B. Component markers.

C. Conduit markers.

D. Underground warning tape.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Description: Engraved three-layer laminated plastic, black letters on white background unless otherwise indicated.

B. Locations: Each electrical distribution and control equipment enclosure, telemetry and control panel, motor control center, and control station.

C. Letter Size:
   1. Use 1/8 inch letters for identifying individual equipment and loads unless otherwise indicated.
   2. Use 1/4 inch letters for identifying grouped equipment and loads unless otherwise indicated.

2.2 COMPONENT MARKERS

A. Description: Permanently affixed engraved nameplate uniquely identifying each control device within an enclosure with a number or code corresponding to the circuit diagram.

B. Locate: On or adjacent to each control device and visible from panel front.

2.3 UNDERGROUND WARNING TAPE

A. Manufacturers:
   1. Brady Company.
   2. Seton.
   3. Or as approved.

B. Description: 3 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

A. Install nameplates and labels parallel to equipment lines.

B. Secure nameplate to equipment front using stainless steel screws.

C. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

D. Identify feeders, branch circuits, and service entrance conductors by phase and system voltage using colored electrical tape:
   1. Phase A, 240 Volt System: Black
   2. Phase B, 240 Volt System: Red.
   3. Neutral, 240 Volt System: White.
   4. Ground: Green or bare.

E. Identify underground conduits using underground warning tape. Install one tape per trench at 10 to 12 inches below finished grade.

3.3 FIELD QUALITY CONTROL

A. Verify that every identification marker corresponds with the respective terminal or connection code identification.

B. Except for common connections, do not duplicate numbers, symbols, colors, or prints in the building.

END OF SECTION

SECTION 16470
BRANCH CIRCUIT PANELBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions (if included), and Division 1 Specifications Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Branch circuit panelboards.

1.3 SHOP DRAWINGS

A. Indicate voltage, bus ampacity, ampacity of main lugs or circuit breaker, integrated short circuit ampere rating, and circuit breaker arrangement and sizes.

1.4 MAINTENANCE MATERIALS

A. Panelboard Keys: Two of each.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Cutler-Hammer.

B. General Electric.

C. Siemens.

D. Square D Company.

E. Or as approved.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Type: NEMA PB 1, circuit breaker type; ampacity and number of poles as indicated in Schedule.

B. Panelboard Bus: Copper ratings as indicated in Schedule. Provide copper equipment ground bar and neutral terminal bar (insulated from panel ground) in each panelboard.

C. Minimum Integrated Short Circuit Rating: 14,000 AIC RMS symmetrical.

D. Molded Case Circuit Breakers: NEMA AB 1; bolt-on type, thermal-magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

E. Enclosure: NEMA PB 1, Type 4 stainless steel.

F. Cabinet Box: 6 inches deep; 20 inches wide.

G. Cabinet Front: Surface type with concealed trim clamps, concealed hinge, and flush lock, all keyed alike.

H. Panelboard shall be service entrance rated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards plumb. Provide supports as required for secure installation. Follow Section 16190.

C. Height: Center panelboard on wall at 50 inches above finished grade. Lower as required to keep top of panelboard from exceeding 6 feet above finished grade.

D. Provide filler plates for unused spaces in panelboards.

E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuitry changes required to balance phase loads.

F. Provide engraved plastic nameplates; see Section 16195. Attach plates with corrosion-resistant screws.

3.2 FIELD QUALITY CONTROL

A. Perform the following visual and mechanical inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
3. Check panelboard mounting, area clearances, and alignment and fit of components.
4. Measure steady-state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

SECTION 16885
HEATING CABLE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions (if included), and Division 1 Specifications Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Heating cable and accessories.

B. Ambient temperature controller.

1.3 RELATED SECTIONS

A. Section 13550 – Process Piping Insulation: Insulation for piping heat-traced under this Section 16885.

PART 2 PRODUCTS

2.1 HEATING CABLE

A. Manufacturers:
   1. Thermon
   2. Dekoron Model 2705.
   3. Or as approved.

B. Jacket: Thermo-plastic elastomer.

C. Conductive Core: Self-regulating, 5 watts per foot.

D. Power Requirements: 120 VAC.

E. Accessories:
   1. 2-1/2 inch aluminum tape.
   2. Connection kit.

2.2 AMBIENT TEMPERATURE CONTROLLER

A. Manufacturers:
   1. Dekoron, Model 1660-18911.
   2. Or as approved.

B. Description: Ambient monitoring device to control power to the self-regulating heat tape when ambient temperature drops below an adjustable ambient temperature setting.

C. Housing: NEMA 4X die cast aluminum.

D. Range: 15 to 140 degrees F, adjustable; set at 55 degrees F.

E. Contact Rating: 22 amperes at 120 VAC.

F. Sensor: Type 304 stainless steel sensor stem.

PART 3 EXECUTION

3.1 INSTALLATION

A. Cable Bending Radius: Six times cable diameter, minimum.

B. Avoid pinching and making sharp bends in cable.

C. Do not cross heating cable over itself.

D. Terminate cable ends as instructed by cable manufacturer.

E. Secure heating cable under piping and wrap with aluminum tape prior to pipe being insulated.

F. Provide GFCI rated receptacles for support of heat trace loads.

END OF SECTION

ARCADIS

Appendix C

Site Management Plan

ARCADIS
Infrastructure, environment, buildings

Imagine the result

Site Management Plan

Former Dover Electronics Site
Kirkwood, Broome County, New York
Site Number (7-04-026)

February 2011

ARCADIS

Site Management Plan

Former Dover Electronics Site
Kirkwood, Broome County, New York

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Date:
February 2011

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1. Introduction and Description of Remedial Program

1.1 Introduction

This Site Management Plan (SMP) is required as an element of the remedial program at the former Dover Electronics site in Kirkwood, Broome County, New York under the New York State (NYS) Environmental Restoration Program (ERP) administered by New York State Department of Environmental Conservation (NYSDEC). The site has been remediated in accordance with the Order on Consent (Site Number 7-04-026), which was executed on January 19, 2001 and the Record of Decision (ROD) (March 2000).

1.1.1 General

Universal Instruments Corporation (former owner of the facility and former subsidiary company of Dover Corporation [Dover]) entered into an Order on Consent with the NYSDEC to remediate a 9.58-acre property located in Kirkwood, Broome County, New York. This Order on Consent required the Dover to investigate and remediate contaminated media at the site. A site location map is shown on **Figure 1**.

This SMP was prepared by ARCADIS of New York, Inc. (ARCADIS), on behalf of Dover, in accordance with the requirements in NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation dated November 2009. This SMP addresses site management requirements for groundwater. Management of soil material that has been addressed in the NYSDEC approved Operations, Maintenance and Monitoring Plan (OM&M) including Soils Management Plan (October 2005) is also summarized in this SMP. Means for implementing the Institutional Controls (ICs) and Engineering Controls (ECs) that are required by the Deed Restriction for the site are also included.

1.1.2 Purpose

The site soils contain contamination left after completion of the soil remedial action in June and July 2003. The site groundwater may contain residual contamination after completion of the in-situ chemical oxidation (ISCO) treatment which was proposed in the Full-Scale ISCO Remedial Design Report, dated March 2010. Engineering Controls have been incorporated into the site remedy to control exposure to remaining contamination during the use of the site to ensure protection of public health and the environment. A Deed Restriction granted to the NYSDEC, and recorded with the

Broome County Clerk, will require compliance with this SMP and all ECs and ICs placed on the site. The ICs place restrictions on site use, and mandate operation, maintenance, monitoring and reporting measures for all ECs and ICs. This SMP specifies the methods necessary ensure compliance with all ECs and ICs required by the Deed Restriction for contamination that remains at the site. This plan will be approved by the NYSDEC, and compliance with this plan is required by the grantor of the Deed Restriction and the grantor's successors and assigns. This SMP may only be revised with the approval of the NYSDEC.

This SMP provides a detailed description of all procedures required to manage remaining contamination at the site after completion of the Remedial Action, including: (1) implementation and management of all Engineering and Institutional Controls; (2) media monitoring; (3) operation and maintenance of all treatment systems; (4) performance of periodic inspections, certification of results, and submittal of Periodic Review Reports (PRRs); and (5) defining criteria for termination of treatment system operations.

To address these needs, this SMP includes three plans:

1. Engineering and Institutional Control Plan: the plan summarizes the implementation and management of EC/ICs which have been approved by the NYSDEC in December 2005.

2. Monitoring Plan: the monitoring plan details the steps necessary to inspect, monitor and report the performance and effectiveness of the remedy.

3. Operations and Maintenance Plan: the operations and maintenance (O&M) plan describes the measures necessary to operate and maintain any mechanical components of the remedy.

This plan also includes a description of PRRs for the periodic submittal of data, information, recommendations, and certifications to NYSDEC.

It is important to note that:

- This SMP details the site-specific implementation procedures that are required by the Deed Restriction. Failure to properly implement the SMP is a violation of the Deed Restriction, which is grounds for revocation of the Certificate of Completion;

- Failure to comply with this SMP is also a violation of Environmental Conservation Law, 6NYCRR Part 375 and the Order on Consent (Site Number 7-04-026) for the site, and there by subject to applicable penalties.

1.1.3 Revisions

Revisions to this plan will be proposed in writing to the NYSDEC's project manager.

1.2 Site Background

1.2.1 Site Location and Description

The former Dover Electronics facility is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York. The facility is located on a site of approximately 9.58 acres in size. A site location map is shown on **Figure 1**.

The property is situated in an industrial setting. Major plants in the area include: Truckstops of America Landfill (0.5 mile southeast), Frito Lay Plant (0.5 mile south), Universal Instruments (147 Industrial Park Drive, 0.5 mile east), Kason Industries (eastern property boundary), Consolidated Freightways (northern property boundary), and the Pilot Truck Stop to the south. Industrial properties surround the property to the north, east, and west.

The property consists of an industrial building with parking areas as shown on **Figure 2** Site Plan. The site had served as one of Universal Instruments' service facilities for product training, research and development, and Odd Form Assembly (OFA), which involves the engineering and assembly of non-standard/specialty circuit boards until 2007. In 2007 the facility was sold to Modern Marketing Concepts, Inc. (MMC). MMC handles outsourced customer service and product ordering for other companies.

1.2.2 Site History

The facility was first constructed in 1973, with subsequent additions built in 1978, 1982, and 1984. It has been occupied by Universal Instruments, Dover Electronics, and, most recently, MMC. In 1993, Dover Electronics was renamed Dovatron, Inc. (Dovatron). In 1995, Dovatron transferred its title to the facility to Universal Instruments. In 1996, Dovatron changed its name to the DII Group. Later, the DII Group sold to Flextronics International, Inc. and Universal Instruments became a wholly-owned subsidiary to Dover Corporation. In 2007, Dover Technologies, Inc. (the parent

company of Universal Instruments) sold the facility to MMC, who now owns and occupies the property.

Circuit board manufacturing processes used tetrachloroethene (PCE) as a cleaning solvent. Originally, the virgin PCE was stored in 55-gallon drums at an outside drum storage area. During the initial facility expansion, a ramp to the east-side overhead door served as the entry point for PCE drums. As production increased and the facility was again expanded, virgin PCE was stored in a 3,000-gallon aboveground storage tank that has since been removed. An aboveground 5,000-gallon waste PCE flux storage tank was also located on the site. In March 1993, the aboveground PCE system was dismantled. Two 480-gallon PCE tanks were reportedly dismantled and removed from the building interior at that time.

1.2.3 Site Geology and Hydrogeology

The site is immediately underlain by surficial soils that consist of various types of silty and gravelly loams that were reworked by cut and fill activities when the site was developed. These surficial soils are derived from the underlying till deposits, a dense soil/sediment type of glacial depositional environment origin.

Below the surficial soils, weathered till is encountered. The weathered till (a slightly decomposed version of the unweathered till) consists of light brown to brown, poorly sorted silts and fine sands that contain varying minor amounts of clay and fine gravel. Cobbles are rarely present. The weathered till is dense and appears to be unstratified. The weathered till unit has a thickness that ranges from 10 to 25 feet. As with the surficial soils above, the weathered till appears to be restricted as a geologic unit to the area of the Universal Instruments property. The weathered till does not extend onto the Pilot Truck Stop property, which occurs at an elevation lower than the Universal Instruments property.

The unweathered till is the next geologic unit encountered beneath the site. The unweathered till consists primarily of brown to olive-gray, poorly sorted silts and fine sands. The unweathered till contains lenses of clay-rich sediment and sand and fine gravel rich lenses. The unweathered till is very dense and has less fracturing. Its thickness ranges from less than 20 feet at the southern part of the site to greater than 80 feet at the northern part of the site. The contact with the overlying weathered till appears to be a gradational boundary rather than a sharp one.

The deepest layer encountered is a well-sorted, medium to coarse-grained sand unit that contains some fine gravel that was found at a depth of 50 feet below ground surface (bgs) at the MW-34 location on the Pilot Truck Stop property. This layer extended to the approximate termination of the boring at a depth of 56 feet.

Bedrock has not been encountered during drilling operations at the site or at the Pilot Truck Stop. Bedrock is believed to start at a depth around 115 feet bgs below the Universal Instruments building or approximately 80 feet bgs below the Pilot Truck Stop (Shield, 2000).

The movement of groundwater at the site is summarized below:

- Two distinct water-bearing zones exist with the first (uppermost) zone having shallow and intermediate parts and the lowermost deep zone constituting the second zone.

- Head differences within the first water-bearing zone vary, both spatially and temporally, with some well-pair locations having upward gradients and others downward gradients.

- There appears to be hydraulic communication between the two halves of the first water-bearing zone, but no hydraulic communication with the deeper water-bearing zone.

Groundwater flow directions are to the southwest within the first water-bearing zone, but vary slightly between the upper and lower halves of this zone.

The groundwater within the upper shallow zone flows toward the southwest with a hydraulic gradient that ranges from 0.046 to 0.196 ft/ft. This gradient range is illustrative of the permeability change in the shallow zone as groundwater moves from the dense, silty and clayey till beneath the Universal Instruments property into the more sandy area found beneath the Pilot Truck Stop. Groundwater within the intermediate zone flows toward the southwest as well, with a hydraulic gradient ranging from 0.019 to 0.063 ft/ft. The September 2009 groundwater elevation contours and flow directions for shallow and intermediate zones are shown on **Figures 3 and 4**, respectively.

1.3 Summary of Remedial Investigation Findings

Several remedial investigations (RI) at the facility have been conducted since the 1990s. The results of the RI are described in detail in the following reports:

- *Environmental Site Investigation for Dover Electronics Company: DEM-East and Kirkwood North Locations* (Hagopian Engineering Associates, 1990)
- *Phase II Environmental Site Investigation for Dover Electronics* (Hagopian Engineering Associates, 1991)
- *Remedial Investigation/Feasibility Study Work Plan* (Shield Environmental Associates, Inc., 1998)
- *Baseline Summary Report* (Shield Environmental Associates, Inc., 1999)
- *Addendum Baseline Summary Report* (Shield Environmental Associates, Inc., 1999)
- *Remedial Investigation Report* (Shield Environmental Associates, Inc., 2000)

The RI indicated that soil, groundwater, surface (storm) water and indoor air have been impacted by volatile organic compounds (VOC) contamination at the site. Below is a summary of site conditions when the RI was performed between 1990 and 2000.

<u>Soil</u>

Many VOC source areas of contamination existed at the site. Source area soil contamination was bounded by glacial till under the building, the area between the rear addition and Catch Basin 2044, and in the northeast parking lot. The largest is under the facility's floor slab. Migration occurred laterally in and around the utility conduits.

Soil samples collected from the site were reported to have PCE detections above the NYSDEC standards. The other VOCs detected include acetone, trichloroethene (TCE), and cis-1,2-dichloroethene (cis-1,2-DCE).

<u>Groundwater</u>

A large part of the groundwater plume originated from the two outfalls: Catch Basin 1537 Outfall and Catch Basin 1547 Outfall. This assumption was supported by analysis of water samples collected from MW-24. The historical analytical results from MW-24 reported a PCE concentration of 2.7 milligrams per liter (mg/L). The lateral and vertical extent of groundwater contamination was defined by site monitoring wells. PCE and its degradation products are the primary compounds found in groundwater at the site.

Off-site, across Industrial Park Drive (in the area of MW-25, MW-28, and MW-34), the groundwater PCE concentrations are in excess of 1 mg/L. PCE concentrations in water from this area were over 5 times higher than the concentrations in samples collected from MW-19 and MW-26. These two wells are between the source area outfalls and MW-25.

The relatively high PCE groundwater concentrations in this area may be the result of several scenarios. They could be the result of a large PCE slug that was released during one or several discharge events from the stormwater system. The PCE slug would have migrated down the steep groundwater gradient and then pooled in the area of lower groundwater gradient. These concentrations could also be from a secondary source area, the result of a PCE-contaminated waste dump. However, during the installation of MW-28, soil samples were fielded screened and a sample from 4 to 6 feet bgs was analyzed. No VOCs were detected in the soil and there were no elevated field screening results. In addition, there could be preferential pathways through the weathered glacial till and other sorted deposits. MW-19 and MW-26 may have missed the most concentrated pathway and only penetrated a secondary pathway with lower concentrations.

Surface Water

Data collected during the RI suggest that three stormwater outfalls (Catch Basin 1547 Outfall, Catch Basin 1537 Outfall, and Catch Basin 1845 Outfall) have been the source of the VOC contamination impacting the surface water. The water that flows from Catch Basin Outfalls 1547 and 1537 originated from roof drains. These roof drains leaded through the floor slab of the facility and were routed through a series of stormwater catch basins. The impacted water that flows from the Catch Basin 1845 Outfall was also from the subsurface piping leading from the building. The subsurface piping associated with the Catch Basin 1845 Outfall was believed to be floor drains. The PCE entered the subsurface piping under the floor slab and eventually discharged from the three outfalls.

The VOC-impacted surface water and sediments were not migrating off the site. Surface water and sediment samples collected from two property line monitoring locations had no VOCs reported above detection limits. Analytical results from the sediment samples were reported to contain estimated PCE concentrations well below the standards.

Indoor Air

Cracks, joints and drains under the building's floor slab in the rear addition are allowing the PCE vapors to migrate into the indoor ambient air. Two locations have been reported as having consistent PCE concentrations above New York State Department of Health (NYSDOH) ambient air guidelines: the electrical area and the A/C air handling area. The electrical area and the A/C air handling area are both located in areas with visible openings in the floor slab. The contamination source associated with the air sample collected in the electrical area may be the subsurface piping line that trends along the rear addition and the original building contact. This subsurface piping line was also believed to be the source of contamination associated with Catch Basins 2044 and 1846. The source for PCE concentrations in the air in the A/C area is believed to be cracks and other openings in the floor which were sealed during an interim remedial measure (IRM) by others.

The extent of the indoor ambient air that was contaminated with VOCs above the NYSDOH standard was limited to the rear extension of the building. Analytical results for all samples collected in this area have exceeded the NYSDOH standard. All background samples collected outside the facility have resulted in no detections. Samples collected from inside the office area, which is where the facility personnel spend most of their time, had low PCE levels that were below the NYSDOH standard.

1.4 Summary of Remedial Actions

1.4.1 Soil

The site soil was remediated in accordance with the NYSDEC-approved Remedial Design (RD) Package prepared by Blasland, Bouck and Lee (BBL) in June 2003. The following is a summary of the Remedial Actions performed at the site.

- Removal of PCE-affected soils from seven isolated areas beneath and adjacent to the facility building during June and July 2003.

- Abandonment and replacement of the roof leader from the roof drain system that handles stormwater runoff from the front part of the roof for the original building section of the facility;

- Extension of the stormwater outfall from the southwest catch basin (CB-1547);

- Construction of a cap system to eliminate the potential for human contact with fill material and remaining contaminated soil, and eliminate the potential for soil erosion and contaminated soil and storm water runoff from the property.

- Installation of an active-slab depressurization (ASD) system that addresses indoor air quality within the facility building.

- Execution and recording of a Deed Restriction for the areas beneath the footprints of the 1978 and 1984 building additions, areas beneath parts of the original building (1973) and the 1982 addition, and for seven additional areas where complete removal of soil to below the NYSDEC criterion for PCE was not achieved. The Deed Restriction also included a restriction on using site groundwater.

- Development and implementation of a Soil Management Plan for long term management of remaining contamination as required by the Deed Restriction.

1.4.2 Groundwater

After the former aboveground 5,000-gallon flux tank that contained PCE was dismantled in March 1993, a groundwater extraction program was implemented as an IRM. Two groundwater recovery wells (RW-1 and RW-2) were installed near the former PCE tanks located at the rear of the facility building in April 1993. The interim groundwater treatment system became operational on August 17, 1994. Historically, groundwater at the two recovery wells (RW-1 and RW-2) was pumped at very low flow rates. The system operated on a limited schedule and it was shut down and abandoned in 1996. This IRM may have removed up to 12,000 gallons of groundwater.

Two more recovery wells were installed (RW-3 and RW-4) in 1997. RW-3 was installed adjacent to MW-7 as part of another IRM groundwater extraction and treatment system. RW-4 was used for a vacuum-enhanced pumping (VEP) pilot treatment well in the source area.

The second IRM groundwater extraction and treatment program was installed next to MW-7 to help control the migration of the dissolved-phase PCE plume. Groundwater treatment was accomplished using granulated activated carbon (GAC). This groundwater extraction and treatment system was installed in November 1997 and this IRM became operational in April 1998 and remained in operation into December 1998. During this time, approximately 41,000 gallons of water were extracted from well RW-3. The groundwater withdrawal rate was estimated to average on continuous basis 0.12 gallon per minute (gpm). This well yield was substantially below the estimated yield for RW-3 of 1.0 gpm.

Previous attempts for groundwater remediation by extraction were unsuccessful because of the tight nature of the subsurface glacial till and the corresponding very low transmissivity in the area of monitoring well MW-7A. For this reason two field pilot tests were conducted as part of the groundwater remediation field study. These field tests consisted of an enhanced bioremediation field study and an ISCO field pilot testing.

In accordance with the *In-Situ Bioremediation Pilot Study Design* (September 2001), an enhanced bioremediation field pilot test was conducted from November 2001 until December 2004 to evaluate enhancement of the PCE reductive dechlorination process by using hydrogen release compound (HRC®) and bio-degradation of vinyl chloride using oxygen release compound (ORC®) in the downgradient area. Enhanced biodegradation of PCE in the source area was found to have limited overall effectiveness.

Because the remediation results from the HRC® study were incomplete and inconsistent, an ISCO field testing using sodium permanganate was proposed in June 2004 Groundwater Remediation Progress Report (GRPR) for the remaining residual chlorinated ethenes within the central part of the groundwater plume. Sodium permanganate is a proven oxidizer of chlorinated ethenes and has very high water solubility allowing high dissolved concentrations of the oxidant to be introduced into the aquifer. The field test objective was to reduce concentrations of PCE within the area defined by the 1,000 micrograms per liter (• g/L) isoconcentration contour line (September 2004 groundwater data).

The first phase of the ISCO field test was approved by NYSDEC on April 28, 2005, and was conducted between May 10 and June 14, 2005. During the field test one single injection well (IJ-1) was installed in the vicinity of MP-5 (the lower parking lot area). Approximately 65 gallons of a 20 weight percent sodium permanganate solution was injected into IJ-1 over two days. The groundwater results indicated that the

permanganate was effective in reducing VOC concentrations within IJ-1, but the effective limit of influence was less than 15 feet in a side-gradient direction. The results of the Phase I ISCO field test were summarized in *In-Situ Chemical Oxidation Field Test Report* submitted to the NYSDEC in January 2006.

The Phase II ISCO field test was conducted between January 16 and May 25, 2006. During the field test, additional injection wells (IJ-2 through IJ-6) were installed at the site. IJ-2, IJ-3, and IJ-4 are located in the upper parking lot area. IJ-5 is located near the site access road and IJ-6 is located at the Pilot Truck Stop. The locations of these injection wells are shown on **Figure 2**.

Oxidant (1,300 gallons of 20 weight percent sodium permanganate solution) was introduced into the upper (IJ-1, IJ-2, IJ-3, IJ-4, IJ-5, and IJ-6) and lower (IJ-6) saturated zones during the Phase II ISCO field test. Following the injection activities, periodic groundwater samples were collected and assessed for visual evidence oxidant arrival and analyzed for changes in VOC concentrations. Results of the Phase II ISCO field test were presented in the March 2007 GRPR.

The apparent lack of horizontal dispersion and diffusion of a 20 percent solution of sodium permanganate observed during the Phase I, Phase II, and early part of Phase III field tests is attributed to the likely combination of low formation hydraulic conductivity and the high density (specific gravity of approximately 1.2) of the 20 percent solution. Therefore, based on the results of the Phase I and II ISCO events and the likelihood of downward density gradient flow outside of the target delivery and treatment zone, field testing was changed to use a more dilute 10 weight percent sodium permanganate solution during Phase III.

The Phase III ISCO field testing was conducted between June 2007 and October 2008. Three ISCO injection events each were conducted in 2007 and 2008.

Two of the events were conducted in June and August 2007, and the third was performed in November 2007 (following the October sampling event). During the June and August 2007 events, approximately 500 gallons of oxidant solution were injected into the existing injection points (IJ locations) and monitoring point MW-24. During the November 2007 event, approximately 380 gallons of oxidant solution were injected.

Three ISCO injection events were conducted in 2008 to continue inject the 10% solution of sodium permanganate into the injection points and MW-24 for VOC treatment. In April 2008, approximately 525 gallons of 10% sodium permanganate was

injected. Results of April 2008 ISCO field test was discussed and submitted in the March 2008 GRPR (ARCADIS, July 2008).

ISCO injection continued and was conducted in July and October 2008. During each event, approximately 510 gallons of 10% sodium permanganate was injected into the injection points (IJ locations) and MW-24. A majority of the oxidant solution (about 230 gallons) was injected in the upper parking lot area (IJ-2 through IJ-4 and MW-24). In the lower parking lot area (IJ-1), about 60 gallons of oxidant solution was injected. Approximate 60 to 75 gallons were injected near the access road area (IJ-5). At the Pilot Truck Stop (IJ-6), about 150 gallons of oxidant solution was injected.

1.4.3 Removal of Contaminated Materials from the Site

In June 2003, remedial action for soils was performed at the site by removing soil from seven separate accessible areas that had been identified during RI as areas of concern (AOCs). One area beneath the facility building was deemed inaccessible. An approximate total of 487 cubic yards was excavated from these seven areas.

1.4.4 Site-Related Treatment Systems

1.4.4.1 Active Sub-slab Depressurization System

ASD is a system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use of a fan-powered vent drawing air from beneath the slab. The ASD system was installed at the site since June 2003 to mitigate/ reduce indoor air concentrations of PCE within the building. The details of the ASD system are provided in Section 2.2.1.2.

1.4.4.2 Proposed Groundwater Remediation System

ISCO was proposed as a full-scale remedy to remediate the remaining residual chlorinated ethenes within the central part of the groundwater plume in the October 2007 draft GRPR. A Full Scale In-Situ Chemical Oxidation Design Report (Design Report) was prepared to provide detailed scope of work and design for full-scale ISCO treatment of the source area and the downgradient area. ISCO as a full-scale groundwater remedy was conceptually approved by NYSDEC in an e-mail dated March 25, 2009 and is scheduled to be implemented by May/June 2011.

The full scale ISCO will consist in the injection of a 5% solution of sodium permanganate to be delivered by a gravity-feed system in the source area and manual injection downgradient of the source area. The volume of oxidant liquid delivered into the subsurface will be approximately 33,500 gallons in total per year in the source area. Delivery will be by pulsed distribution, 5 events per year for gravity feed and 4 events per year for manual injection, through two arrays of injection wells/points. Details of ISCO system design are provided in the ISCO Construction Package (ARCADIS 2011).

1.4.5 Remaining Contamination

June 2003 post-excavation sampling results indicated that some PCE-affected soils that were above NYSDEC TAGM #4046 standards remained onsite after the completion of the excavation. The PCE exceedances were detected in seven post-excavation sampling locations. The PCE soil concentration ranged from 1,600 to 86,000 micrograms per kilogram (µg/kg). Areas with PCE-affected soils were added to the Deed Restriction and are shown on **Figure 5**.

2. Engineering and Institutional Control Plan

2.1 Introduction

Because remaining PCE-contaminated soil and groundwater exist beneath the facility building and seven additional areas of the site, EC/ICs are required to protect human health and the environment. This Engineering and Institutional Control Plan describes the procedures for the implementation and management of all EC/ICs at the site. These procedures have been provided in a Soils Management Plan (Appendix A of OM&M Plan, dated October 2005) for management of subsurface soils and the long-term maintenance of the cover system during any future intrusive work that may breach the cover system (engineering control) at the site. This EC/IC Plan is one component of the SMP and is subject to revision by NYSDEC.

2.1.1 Purpose

This plan provides:

- A description of all EC/ICs on the site;
- The basic implementation and intended role of each EC/IC;
- A description of the key components of the ICs set forth in the Deed Restriction;
- A description of the features to be evaluated during each required inspection and periodic review;
- A description of plans and procedures to be followed for implementation of EC/ICs; and
- Any other provisions necessary to identify or establish methods for implementing the EC/ICs required by the site remedy, as determined by the NYSDEC.

2.2 Engineering Controls

2.2.1 Engineering Controls Systems

Engineering controls at the site consist of two primary types: Surface Cover systems that cap areas of remaining PCE-affected soil and an ASD system that addresses indoor air quality within the facility building. The details of each engineering control are provided in the following sections.

2.2.1.1 Surface Cover System

The purpose of the surface cover system is to eliminate the potential for human contact with fill material and remaining contaminated soil, and eliminate the potential for soil erosion and contaminated soil and storm water runoff from the property. Depending upon location of the area of concern, the cover systems at the site for accessible areas consist of the following two types:

1. Soil and vegetated cover – clean native and/or imported fill stabilized by grass or landscaping (tan bark/peat moss and shrubbery)

2. Soil and asphalt cover – clean native and/or imported fill covered by 4 to 6 inches of asphalt base and a 2-inch thick layer of asphaltic concrete

There are eight areas of the site were PCE-affected soils are capped by a cover system. The PCE-affected soils are capped by asphalt, concrete, and/or a minimum of 3 feet of clean soil. The capped areas and the type of cap are shown on **Figure 5** and listed below.

1. 1978 and 1984 Building Addition Area – 6-inch thick concrete slab

2. Area 1 of **Figure 5**– soil, mulch, and landscaping

3. Area 2 of **Figure 5**– asphalt (driveway)

4. Area 3 of **Figure 5**– soil with grass surface

5. Area 4 of **Figure 5**– soil with grass surface (drainage ditch)

6. Area 5 of **Figure 5**– soil with grass surface (drainage ditch)

7. Area 6 of **Figure 5**– soil with grass surface (drainage ditch)

8. Area 7 of **Figure 5**– asphalt (parking lot)

Procedures for the monitoring, inspection and maintenance of this cover are provided in the Monitoring Plan included in Section 3 of this SMP.

2.2.1.2 Active Sub-slab Depressurization System

ASD is a system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use of a fan-powered vent drawing air from beneath the slab. The ASD system was first installed within the 1978 and 1984 additions during June 2003 to see if it could be helpful in reducing indoor air concentrations of PCE within the building. The ASD system installation was performed as a field fabrication. The ASD system fabrication used typical design criteria, specifications, and technology common to the radon control industry (see ASTM International Standard Practice E 212-01, March 2001). Four extraction points, ASD-1 through ASD-4, were installed at the approximate locations shown on **Figure 6**. Suction pits for each extraction point were prepared by coring a 4.25-inch- diameter hole through the slab and then clearing gravel and soil from beneath the slab to create a hemispherical pit. The suction pits are approximately 12 inches in diameter and have a nominal volume of at least one cubic foot. The extraction point riser pipe was constructed of Schedule 40 PVC with a 4-inch-diameter. The slab penetration for the depressurization points were cleaned, prepared, and sealed in an air-tight manner with a compatible sealant that will not shrink or crack.

One ventilation fan was installed and was used to operate the ASD system (i.e. operated the four sub-slab depressurization points through a manifold setup). The fan was an exterior mount (Radonwaway brand HS series HS5000 fan) and was Underwriter's Laboratory (UL)-approved for outdoor use (UL standard 507) and meets all electrical code requirements.

The performance range of this fan was: electrical usage 180-320 watts, 50 inches of water maximum pressure, 53 standard cubic feet per minute (scfm) at 0.1 inch of water to 24 scfm at 35 inches of water. Fan installation followed the manufacturer's instructions.

All ASD system electrical components are UL listed or of equivalent specifications. All plastic vent pipes and fittings were made of Schedule 40 PVC.

Based on the results of the sub-slab investigations conducted in May and August 2006, an expansion of the existing ASD system was conducted at the end of December 2006. Four additional sub-slab depressurization points (suction pits) and four new fans were installed, and the air discharge piping was re-routed. The system expansion and alteration is shown as a schematic drawing on **Figure 6**.

At sampling point #4, a RadonAway high-suction series fan (HS 5000) was installed on the exterior wall of the building in the same manner as with the pre-existing ASD system. The air discharge piping was re-configured so that the depressurization points in the 1978 addition were all plumbed to the new fan. The original fan operated with only two depressurization points, both in the 1984 addition.

The three new depressurization points located in the cubicle area of the main building (#7) and the hallway (#9) all were installed with individual fans mounted in-line near the top of the building roof, but within the building interior. These fans are RadonAway model GP-501 with a maximum suction of 3.5 inches of water and an air flow rate of 90 cubic feet per minute (cfm) at 1.0 inches of water. The expanded ASD system became operational on December 28, 2006.

Based on indoor air analytical results and recorded system operational data obtained in 2007, modifications were made to the ASD system in January 2008 that included replacement of two fans and installation of a shut-off valve. The HS5000 high-suction series fan servicing suction points #1 through #5 were replaced with HS2000 high-suction series fans to increase air flow rates while maintaining a similar sub-slab vacuum. The valve was installed to shut-off flow from suction point #3 to allow for greater air flow from suction point #5 (MMC computer server room).

Additionally, all suction points, except for #2, were retrofitted with Magnehelic-brand vacuum gauges to facilitate data collection. During system monitoring in January 2008 it was discovered that the gauges had the wrong scale. The gauges were replaced in February 2008 with Radonaway-brand U-tube manometers except at #8 (a closet location) where a correctly scaled Magnehelic gauge was installed to replace the existing gauge. The Radonaway-brand U-tubes were selected to lessen the visibility of monitoring activity and to allow MMC personnel to more easily verify daily positive system operation.

Procedures for operating and maintaining the ASD system are documented in the Operation and Maintenance Plan (Section 4 of this SMP). Procedures for monitoring the system are included in the Monitoring Plan (Section 3 of this SMP).

2.2.2 Criteria for Completion of Remediation/Termination of Remedial Systems

Generally, remedial processes are considered completed when effectiveness monitoring indicates that the remedy has achieved the remedial action objectives identified by the decision document. The framework for determining when remedial processes are complete is provided in Section 6.6 of NYSDEC DER-10.

2.2.2.1 Composite cover system

The composite cover system is a permanent control and the quality and integrity of this system will be inspected at defined, regular intervals in perpetuity.

2.2.2.2 Active sub-slab depressurization system

The ASD system will not be discontinued unless prior written approval is granted by the NYSDEC. In the event that monitoring data indicates that the ASD system is no longer required, a proposal to discontinue the ASD system will be submitted by Dover to the NYSDEC and NYSDOH. After approval by NYSDEC and NYSDOH, the ASD systems will be decommissioned. The vacuum gauges will be removed, the suction points will be sealed, and the suction fans will be disconnected and removed from the site. All decommissioning work will be conducted in accordance with the NYSDEC regulations and local requirements.

2.3 Institutional Controls

A series of Institutional Controls is required by the ROD to: (1) implement, maintain and monitor Engineering Control systems; (2) prevent future exposure to remaining contamination by controlling disturbances of the subsurface contamination; and, (3) limit the use and development of the site to industrial uses only.

The Deed Restriction was filed with the Broome County Clerk's Office to provide an institutional control for inaccessible soils that remain below facility floor slabs. The NYSDEC-approved the Deed Restriction was forwarded by UIC to the site owner on April 26, 2004 for signature and subsequent filing with the Broome County Clerk. The Deed Restriction was filed by the Broome County Redevelopment Authority on October 20, 2005.

The Deed Restriction is for the areas beneath the footprints of the 1978 and 1984 building additions, areas beneath parts of the original building (1973) and the 1982

addition, and for seven additional areas where complete removal of soil to below the NYSDEC criterion for PCE was not achieved. The Deed Restriction is also included a restriction on using site groundwater. The areas that have environmental restrictions on the Deed Restriction are shown on **Figure 5**.
Adherence to these Institutional Controls on the site is required by the Deed Restriction and will be implemented under this Site Management Plan. These Institutional Controls are:

- Compliance with the Deed Restriction and this SMP by the Grantor and the Grantor's successors and assigns.
- All Engineering Controls must be operated and maintained as specified in this SMP.
- All Engineering Controls on the Controlled Property must be inspected at a frequency and in a manner defined in the SMP.
- The building or existing cover over the residual soil contamination shall be maintained as specified in this SMP.
- Excavation and off-site disposal of currently inaccessible soils shall be conducted in accordance with the Excavation Work Plan (EWP) provided in **Appendix A** of this SMP and NYSDEC DER-10.
- Groundwater and indoor air monitoring will be performed as defined in this SMP.
- Data and information pertinent to Site Management of the Controlled Property must be reported at the frequency and in a manner defined in this SMP.

Institutional Controls identified in the Deed Restriction may not be discontinued without an amendment to or extinguishment of the Deed Restriction.

The site has a series of Institutional Controls in the form of site restrictions. Adherence to these Institutional Controls is required by the Deed Restriction. Site restrictions that apply to the Controlled Property are:

- The site is zoned industrial by the Town of Kirkwood and is located in an area known as the Kirkwood Industrial Park. The property is presently owned by the Broome County Redevelopment Authority and leased to UIC, a subsidiary of Dover Corporation. Allowable uses for the site include offices, manufacturing, warehousing, research laboratories, and associated commercial activities.

- The present zoning specifically prohibits residential uses.

- Site soil that is excavated from a restricted area and is intended for removal from the property must be managed, characterized, and properly disposed of in accordance with NYSDEC regulations and directives;

- Prior to any construction activities within the restricted areas, workers are to be notified of the site conditions with clear instructions regarding how the work is to proceed safely. Invasive/intrusive work performed in the restricted areas will be conducted in accordance with applicable local, state, and federal regulations to protect worker health and safety;

- The use of the groundwater underlying the property is prohibited without treatment rendering it safe for intended use;

- The site owner or remedial party will submit to NYSDEC a written statement that certifies, under penalty of perjury, that: (1) controls employed at the Controlled Property are unchanged from the previous certification or that any changes to the controls were approved by the NYSDEC; and, (2) nothing has occurred that impairs the ability of the controls to protect public health and environment or that constitute a violation or failure to comply with the SMP. NYSDEC retains the right to access such Controlled Property at any time in order to evaluate the continued maintenance of any and all controls. This certification shall be submitted annually, or an alternate period of time that NYSDEC may allow and will be made by an expert that the NYSDEC finds acceptable.

2.3.1 Excavation Work Plan

The site has been remediated to TAGM 4046 soil cleanup objectives. Any future intrusive work that will penetrate the soil cover or cap, or encounter or disturb the remaining contamination, including any modifications or repairs to the existing cover

system will be performed in compliance with the EWP that is attached as **Appendix A** to this SMP. Any work conducted pursuant to the EWP must also be conducted in accordance with the procedures defined in a Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP) prepared for the site. Both plans are provided in Full-Scale ISCO Construction Package, dated February 2011. The HASP is in current compliance with DER-10, and 29 CFR 1910, 29 CFR 1926, and all other applicable Federal, State and local regulations. Based on future changes to State and federal health and safety requirements, and specific methods employed by future contractors, the HASP and CAMP will be updated and re-submitted with the notification provided in Section A-1 of the EWP. Any intrusive construction work will be performed in compliance with the EWP, HASP and CAMP, and will be included in the periodic inspection and certification reports submitted under the Site Management Reporting Plan (See Section 5).

The site owner and associated parties preparing the remedial documents submitted to the State, and parties performing this work, are completely responsible for the safe performance of all intrusive work, the structural integrity of excavations, proper disposal of excavation de-water, control of runoff from open excavations into remaining contamination, and for structures that may be affected by excavations (such as building foundations and bridge footings). The site owner will ensure that site development activities will not interfere with, or otherwise impair or compromise, the engineering controls described in this SMP.

2.3.2 Soil Vapor Intrusion Evaluation

Prior to the construction of any enclosed structures located over areas that contain remaining contamination, a soil vapor intrusion (SVI) evaluation will be performed to determine whether any mitigation measures are necessary to eliminate potential exposure to vapors in the proposed structure. Alternatively, a SVI mitigation system may be installed as an element of the building foundation without first conducting an investigation. This mitigation system will include a vapor barrier and passive sub-slab depressurization system that is capable of being converted to an active system.

Prior to conducting a SVI investigation or installing a mitigation system, a work plan will be developed and submitted to the NYSDEC and NYSDOH for approval. This work plan will be developed in accordance with the most recent NYSDOH “Guidance for Evaluating Vapor Intrusion in the State of New York”. Measures to be employed to mitigate potential vapor intrusion will be evaluated, selected, designed, installed,

and maintained based on the SVI evaluation, the NYSDOH guidance, and construction details of the proposed structure.

Preliminary (unvalidated) SVI sampling data will be forwarded to the NYSDEC and NYSDOH for initial review and interpretation. Upon validation, the final data will be transmitted to the agencies, along with a recommendation for follow-up action, such as mitigation. Validated SVI data will be transmitted to the property owner within 30 days of validation. If any indoor air test results exceed NYSDOH guidelines, relevant NYSDOH fact sheets will be provided to all tenants and occupants of the property within 15 days of receipt of validated data.

SVI sampling results, evaluations, and follow-up actions will be summarized in the PRRs.

2.4 Inspections and Notifications

2.4.1 Inspections

Inspections of all remedial components installed at the site will be conducted at the frequency specified in Sections 3 and 4 of this SMP. A comprehensive site-wide inspection will be conducted annually, regardless of the frequency of the PRR. The inspections will determine and document the following:

- Whether Engineering Controls continue to perform as designed;
- If these controls continue to be protective of human health and the environment;
- Compliance with requirements of this SMP and the Deed Restriction;
- Achievement of remedial performance criteria;
- Sampling and analysis of appropriate media during monitoring events;
- If site records are complete and up to date; and
- Changes, or needed changes, to the remedial or monitoring system;

Inspections will be conducted in accordance with the procedures set forth in the Monitoring Plan of this SMP (Section 3). The reporting requirements are outlined in the Periodic Review Reporting section of this plan (Section 5).

If an emergency, such as a natural disaster or an unforeseen failure of any of the ECs occurs, an inspection of the site will be conducted within 5 days of the event to verify the effectiveness of the EC/ICs implemented at the site by a qualified environmental professional as determined by NYSDEC.

2.4.2 Notifications

Notifications will be submitted by the property owner to the NYSDEC as needed for the following reasons:

- 60-day advance notice of any proposed changes in site use that are required under the terms of the Order on Consent, 6NYCRR Part 375, and/or Environmental Conservation Law,

- 7-day advance notice of any proposed ground-intrusive activities within the restricted areas pursuant to the Excavation Work Plan.

- Notice within 48-hours of any damage or defect to the foundations structures that reduces or has the potential to reduce the effectiveness of other Engineering Controls and likewise any action to be taken to mitigate the damage or defect.

- Verbal notice by noon of the following day of any emergency, such as a fire, flood, or earthquake that reduces or has the potential to reduce the effectiveness of Engineering Controls in place at the site, with written confirmation within 7 days that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.

- Follow-up status reports on actions taken to respond to any emergency event requiring ongoing responsive action shall be submitted to the NYSDEC within 45 days and shall describe and document actions taken to restore the effectiveness of the ECs.

Any change in the ownership of the site or the responsibility for implementing this SMP will include the following notifications:

- At least 60 days prior to the change, the NYSDEC will be notified in writing of the proposed change. This will include a certification that the prospective purchaser has been provided with a copy of the Order on Consent, and all approved work plans and reports, including this SMP;

- Within 15 days after the transfer of all or part of the site, the new owner's name, contact representative, and contact information will be confirmed in writing.

3. Monitoring Plan

3.1 Introduction

3.1.1 General

The Monitoring Plan describes the measures for evaluating the performance and effectiveness of the remedy to reduce or mitigate contamination at the site, and all affected site media identified below. Monitoring of other Engineering Controls is described in Section 4. This Monitoring Plan may only be revised with the approval of NYSDEC.

3.1.2 Purpose and Schedule

This Monitoring Plan described the methods to be used for:

- Sampling and analysis of groundwater and indoor air;
- Assessing compliance with applicable NYSDEC standards, criteria and guidance, particularly ambient groundwater standards and TAGM 4046 soil cleanup objectives for soil;
- Assessing achievement of the remedial performance criteria;
- Evaluating site information periodically to confirm that the remedy continues to be effective in protecting public health and the environment; and
- Preparing the necessary reports for the various monitoring activities.

To adequately address these issues, this Monitoring Plan provides information on:

- Sampling locations, protocol, and frequency;
- Information on all designed monitoring systems (e.g., well construction details);
- Analytical sampling program requirements;
- Reporting requirements;

- Quality Assurance/Quality Control (QA/QC) requirements;
- Inspection and maintenance requirements for all components of the remedy (i.e. ISCO remedial system and ASD system);
- ISCO remedial system and ASD system decommissioning procedures; and
- Annual inspection of all components of the remedy and periodic certification.

Periodic monitoring of the performance of the remedy and overall reduction in contamination on-site will be conducted during the first year. The frequency thereafter will be determined by NYSDEC. Trends in contaminant levels in air, and/or groundwater in the affected areas, will be evaluated to determine if the remedy continues to be effective in achieving remedial goals. Monitoring programs are outlined in detail in Sections 3.2 and 3.3 below.

3.2 Soil Cover System Monitoring and Maintenance

The purpose of this section is to provide environmental guidelines for management of subsurface soils and the long-term maintenance of the cover system during any future intrusive work that may breach the cover system.

In accordance with the approved OM&M Plan (BBL, October 2005), the eight capped areas are currently inspected monthly to check that the cap is being maintained in good condition. With respect to asphalt and concrete caps, the area surface is visually checked for subsidence/settlement, excessive wear and/or cracking, and for breaches (such as pot holes). Areas with soil cover are checked for subsidence/settlement, missing vegetative cover and/or excessive erosion. Construction activities (authorized or unauthorized) that have or may interfere with cap integrity will be noted.

If capped surfaces are found to be in unsatisfactory condition during inspections, site management will be notified and cap patches and repairs will be made, as warranted, with suitable material(s) as described in this SMP. The SMP includes the following conditions:

- Sloughing, cracking, visible settling, and erosion of the soil cover system shall be repaired by placing additional cover material to meet, at a minimum, the original soil cover system specifications, or taking other action as appropriate. Unless the current soil cover is replaced with an impervious cover material such

as concrete or asphalt, areas with distressed vegetation or bare spots shall be addressed, as appropriate, to restore vegetation.

- Potential erosion of the surface soil cover shall be mitigated by maintaining a vegetative cover (grass), at a minimum. Additional seeding/watering, as needed, shall be performed to maintain the grass. Control of surface erosion and storm water runoff from the Deed Restriction areas at all times, including during construction activities in these areas.

- Any breach of the cover system, including for the purposes of construction or utility work, must be replaced or repaired using materials such as clean soil with grass seed or sod or impervious asphaltic or cementious concrete (or materials that will perform the same function) to prevent future possible erosion.

- Site soil that is excavated from a restricted area and is intended for removal from the property must be managed, characterized, and properly disposed of in accordance with NYSDEC regulations and directives.

- Prior to any construction activities within the restricted areas, workers are to be notified of the site conditions with clear instructions regarding how the work is to proceed safely. Invasive/intrusive work performed in the restricted areas will be conducted in accordance with applicable local, state, and federal regulations to protect worker health and safety.

- The controlling entity on the site (the responsible party) shall complete and submit the initial PRR to NYSDEC within 18 months when the Certificate of Completion is issued. The subsequent PRRs will be submitted annually after the first PRR. The PRRs shall contain a certification that the institutional controls put in place are still in place; have not been altered and are still effective, that the remedy and protective cover have been maintained; and that the conditions at the site are fully protective of public health and the environment.

- If any (or all) of the cover systems was breached during the year covered by the PRRs, the responsible party shall include a certification that all work, including repair/replacement, was performed in conformance with this SMP.

- Any intrusive construction work will be performed in compliance with the EWP, HASP and CAMP, and will be included in the periodic inspection and

certification reports submitted under the Site Management Reporting Plan (See Section 5).

3.3 Indoor Air Monitoring

In accordance with the approved OM&M Plan (BBL, October 2005), indoor air quality samples are currently collected within the facility building annually (March/April) at seven locations with one background sampling location outside the building. All sampling locations for indoor air quality monitoring are shown on **Figure 6**. The sampling points are labeled according to location. There are 4 sampling points in the main building; two sampling points in the primary cubicle area (Office #1 and Office #2) and two other points (Hallway and Cafeteria [former cafeteria for Universal Instruments Corporation, but now a work area]). There are 3 sampling points in the rear additions; one by the HVAC equipment (A/C Area), one by the electrical switch gear (Electrical Area) and one in the computer server room (Computer Servers). The indoor air quality data will be utilized to evaluate the effectiveness the ASD system.

Indoor air quality is monitored through the collection of 8-hour time-weighted averaged (TWA) samples. The indoor air samples are collected in summa canisters following procedures provided by the analytical laboratory. The indoor air samples shall be analyzed by an NYSDEC and NYSDOH approved analytical laboratory using USEPA method TO-15.

3.3.1 ASD System Decommissioning

Upon completion of the remediation and after approval by NYSDEC and NYSDOH, the ASD systems will be decommissioned. The vacuum gauges will be removed, the suction points will be sealed, and the suction fans will be disconnected and removed from the site. All decommissioning work will be conducted in accordance with the NYSDEC regulations and local requirements.

3.4 Groundwater Monitoring

The purpose of this monitoring plan is to serve as guidance for monitoring changes in ground water quality and chemistry related to the remedial actions taken place at the site. This monitoring plan includes performance monitoring for evaluating the effectiveness of the ISCO remediation at the site. The details of monitoring plan are discussed below.

3.4.1 Ground Water Monitoring Network

3.4.1.1 Performance monitoring

As part of the full-scale ISCO program, performance groundwater monitoring are proposed to collect groundwater samples from a total of 19 monitoring wells and points in both source area and Pilot Truck Stop area to evaluate the effectiveness of the ISCO treatment. The monitoring wells and points for each area are listed below:

- The source area:

  Existing monitoring well and points include MP-4, MP-5, MP-6S, MP-6D, MW-7A, MW-16, IJ-1, IJ-4, and IJ-5. Proposed monitoring points include MP-11, MP-12, MP-13, and MP-14.

- The Pilot Truck Stop area:

  MP-8S, MP-8D, MP-10D, MW-25, MW-28, MW-30

Location of the monitoring well network is shown on **Figure 2**.The well construction details are provided in **Table 1**.

Groundwater levels from 26 monitoring wells and monitoring points will also be collected during the performance monitoring activities. The monitoring well network consist of the following wells and monitoring points: MW-2, MW-7A, MW-12, MW-13, MW-16, MW-24, MW-25, MW-28, MW-30, MW-31, MW-32, MW-34, MW-35, MW-37, MW-38, MP-1, MP-2, MP-3D, MP-4, MP-5, MP-6S, MP-6D, MP-7, MP-8D, MP-8S, and MP-10D). Location of the monitoring well network is shown on **Figure 2**. The well construction details are provided in **Table 1**.

3.4.2 Sampling Schedule

The proposed sampling schedule is summarized below. The sampling frequency may be modified with the approval NYSDEC. The SMP will be modified to reflect changes in sampling plans approved by NYSDEC.

3.4.2.1 Performance monitoring

As stated in the "Full Scale In-Situ Chemical Oxidation Design Report" (ARCADIS, 2010), the proposed performance monitoring schedule is presented in **Table 2** and summarized below.

Baseline Monitoring

Baseline groundwater conditions for benchmarking full-scale ISCO remediation progress has been established by the March 2010 groundwater sampling event.

In addition to the groundwater data collected during the baseline groundwater sampling event conducted on March 2010, baseline field parameter data will be collected from wells that are anticipated to show the arrival of injection solution within the first 90 days. Monitoring wells and points MP-4, MP-5, MP-6S and MP-6D, MW-7A, and injection wells IJ-1, IJ-4, and IJ-9 will be used to establish the site baseline for field parameters pre-full scale remedy implementation. The field measurements will consist of oxidation reduction potential (ORP), specific conductivity, pH and manganese and permanganate using field colorimetric methods. This pre-injection field parameter monitoring will occur approximately 24 hours prior to the start of oxidant injection.

Performance Monitoring at the Source Area:

Field parameter monitoring will be conducted at the specified points daily for the first week, weekly for the two months, monthly for the following four month. Thereafter, the monitoring points will be checked on a bi-monthly basis for field parameters until the injection is suspended. Field parameters including pH, specific conductivity, and redox will be collected using a down-hole water quality instrument; the color due to presence of manganese and permanganate will be measured using a colorimeter.

Groundwater will be sampled for site-specific parameter list (SSPL) VOCs, which include: PCE; TCE; 1,1,1-trichloroethane (1,1,1-TCA); 1,1-dichloroethene (1,1-DCE); cis-1,2-DCE; trans 1,2-DCE; 1,1-dichloroethane (1,1-DCA); and vinyl chloride (VC) at specified monitoring wells and points (**Table 2**) bi-monthly for the first 6 months, quarterly for the next 6 months. Thereafter, the ground water will be sampled semi-annually at all monitoring wells and points.

Performance Monitoring at the Pilot Truck Stop Area:

Field parameters will be monitored at specified monitoring wells and points monthly for the first 6 months, and quarterly for the next 6 months, and quarterly thereafter until the ISCO is suspended.

Groundwater will be sampled for SSPL VOCs quarterly for the first year and semi-annual thereafter at the monitoring wells and points specified in **Table 2**.

3.4.2.2 Post-Injection Monitoring

As stated in the "Full Scale In-Situ Chemical Oxidation Design Report" (ARCADIS, 2010), it is proposed that oxidant injections will be continued actively treat the groundwater until the following criterion is met:

- Low-level asymptotic concentrations are observed in monitoring wells in the source area and downgradient of the source area.

Once the asymptotic concentrations are observed (after a minimum of 8 groundwater sampling events to determine asymptotic conditions), the ISCO operation will be temporarily suspended, and the ground water sampling will be continued on a semi-annual basis to evaluate the overall effectiveness of the ISCO program, to estimate the mass of any remaining residual PCE, and to determine if the SSPL VOCs concentrations in the ground water rebound. If the average total SSPL VOC remain below low-level asymptotic concentrations within the source-area for two consecutive sampling events (one year timeframe post- oxidant injection) and SCGs are attained at the property line, an active oxidation termination request letter will be submitted to the NYSDEC for approval to permanently suspend the ISCO program. If SCGs are not attained while asymptotic groundwater concentrations still occur or a rebound of total SSPL VOC concentrations are observed in the source area or elevated COC concentrations are observed in the groundwater at the property line, another ground water monitoring program will be proposed according to the suggested monitored natural attenuation (MNA) or enhanced reductive dechlorination (ERD) or other remedial alternatives.

3.4.3 Sampling and Analysis Protocol

All monitoring well sampling activities will be recorded in a field book and a groundwater-sampling log presented in **Appendix B**. Other observations (e.g., well integrity, etc.) will be noted on the sampling log. The sampling log will serve as the inspection form for the groundwater monitoring well network.

During each monitoring event, water levels at each monitoring well and point will be measured with a Solinst water level meter equipped with a stainless steel probe and measuring tape graduated in engineering units to 0.01 foot prior to sample collection. Groundwater elevations collected during the semiannual sampling will be used to generate groundwater contour maps.

Groundwater samples will be collected using low flow purging and sampling technique and equipment decontamination following the requirements described in the Quality Assurance Project Plan (QAPP) and Field Sampling Plan, which are included in Full Scale ISCO Construction Package, dated February 2011. All groundwater samples will be submitted to Columbia Analytical Services (CAS), Rochester, New York, for SSPL VOCs. The analytical method used to test the groundwater samples for VOCs was United States Environmental Agency (USEPA) Method 8260B following Contract Laboratory Protocol (CLP) Statement of Work (SOW), document OLM04.2, as modified by the NYSDEC Analytical Services Protocol (ASP) dated June 2000.

Monitoring well and points which contain visibly purple colored water due to the presence of permanganate will be sampled and preserved with the sodium thiosulfate instead of hydrochloric acid. Sodium thiosulfate will neutralize the residual permanganate in the water samples. Then the samples can be analyzed at the laboratory to obtain contaminant concentrations without damaging the laboratory instrument.

The details of sampling protocol are presented in Field Sampling Plan in Appendix E of Full Scale ISCO Construction Package (ARCADIS 2011).

3.4.4 Monitoring Point Installation

Four proposed monitoring points: MP-11, MP-12, MP-13, MP-14 will be installed at the source area to supplement the existing monitoring well and point network for ISCO program. Proposed locations of the wells are shown on **Figure 7** and the construction details are shown in **Table 3**. These monitoring points will be installed using a hollow-stem auger drill rig. The wells will be constructed of 2-inch-diameter polyvinyl chloride (PVC) casing and a 10-foot-long 0.010-inch slotted PVC screen. These wells will be installed to a maximum depth of approximately 20 feet bgs. Soil samples will be collected and described continuously during drilling. These soil descriptions will be recorded on location-specific boring logs. No soil samples will be submitted for laboratory analysis.

3.4.5 Monitoring Well Repairs, Replacement, and Decommissioning

Monitoring wells at the site will be inspected semiannually during the monitoring events and repaired as needed. If biofouling or silt accumulation occurs in the on-site and/or off-site monitoring wells, the wells will be physically agitated/surged and redeveloped. Repairs and/or replacement of wells in the monitoring well network will be performed based on assessments of structural integrity and overall performance. Additionally, monitoring wells not included in the groundwater monitoring program that are found to be inoperative conditions will be properly decommissioned.

The NYSDEC will be notified prior to any repair or decommissioning of injection or monitoring wells for the purpose of replacement, and the repair or decommissioning and replacement process will be documented in the subsequent periodic report. Well decommissioning without replacement will be done only with the prior approval of NYSDEC. Well abandonment will be performed in accordance with NYSDEC's "Groundwater Monitoring Well Decommissioning Procedures." Monitoring wells that are decommissioned because they have been rendered unusable will be reinstalled in the nearest available location, unless otherwise approved by the NYSDEC.

Upon completion of the remediation and after approval by NYSDEC, the ISCO systems will be decommissioned. In addition to the injection and monitoring wells discussed above, the piping associated with the ISCO systems will be plugged and the aboveground tank will be cleaned and removed from the site.

3.5 Site-Wide Inspection

Site-wide inspections will be performed during the performance monitoring events. Site-wide inspections will also be performed after all severe weather conditions that may affect Engineering Controls or monitoring devices. During these inspections, inspection forms will be completed (**Appendix B**) and site condition and field observations will be recorded in the field book. The inspections will gather enough information to assess the following:

- Compliance with all ICs, including site usage;
- An evaluation of the condition and continued effectiveness of ECs;
- General site conditions at the time of the inspection;

- The site management activities being conducted including, where appropriate, confirmation sampling and a health and safety inspection;
- Compliance with permits and schedules included in the Operation and Maintenance Plan; and
- Confirm that site records are up to date.

3.6 Monitoring Quality Assurance/Quality Control

All sampling and analyses will be performed in accordance with the requirements of the QAPP prepared for the site (see Appendix D of Full Scale ISCO Construction Package). Main components of the QAPP include:

- QA/QC Objectives for Data Measurement;
- Sampling Program:
    - Sample containers will be properly washed, decontaminated, and appropriate preservative will be added (if applicable) prior to their use by the analytical laboratory. Containers with preservative will be tagged as such.
    - Sample holding times will be in accordance with the NYSDEC ASP requirements.
    - Field QC samples (e.g., trip blanks, coded field duplicates, and matrix spike/matrix spike duplicates) will be collected as necessary.
- Sample Tracking and Custody;
- Calibration Procedures:
    - All field analytical equipment will be calibrated immediately prior to each day's use. Calibration procedures will conform to manufacturer's standard instructions.

- The laboratory will follow all calibration procedures and schedules as specified in USEPA SW-846 and subsequent updates that apply to the instruments used for the analytical methods.

- Analytical Procedures;
- Preparation of a Data Validation Report (DVR), which will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and chain of custody procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method.
- Internal QC and Checks;
- QA Performance and System Audits;
- Preventative Maintenance Procedures and Schedules;
- Corrective Action Measures.

3.7 Monitoring Reporting Requirements

Forms and any other information generated during regular monitoring events and inspections will be kept on file on-site. All forms, and other relevant reporting formats used during the monitoring/inspection events, will be (1) subject to approval by NYSDEC and (2) submitted at the time of the PRR, as specified in the Reporting Plan of this SMP.

All monitoring results will be summarized and submitted to NYSDEC in a letter/letter report after each sampling event. The report will include data tables, graphs and a groundwater contour map. The report will also include a review of the analytical results and recommendation for future monitoring. The monitoring results will also be provided in the annual PRR.

PRRs will be submitted annually to NYSDEC to describe the site management activities performed during the reporting period with respect to both soil and groundwater operable units and the results of the coincident air or groundwater sampling events. The report will include, at a minimum:

- Date of event;
- Personnel conducting sampling;
- Description of the activities performed;
- Type of samples collected (e.g., indoor air, groundwater, etc);
- Copies of all field forms completed (e.g., groundwater sampling logs, chain-of-custody documentation, etc.);
- Sampling results in comparison to appropriate standards/criteria;
- A figure illustrating sample type and sampling locations;
- Copies of all laboratory data sheets and the required laboratory data deliverables required for all points sampled (o be submitted electronically in the NYSDEC-identified format);
- Any observations, conclusions, or recommendations; and
- A determination as to whether groundwater conditions have changed since the last reporting event.

In addition, the report will state the operation and monitoring activities conducted, observations made, and report operational data recorded. The report will also describe proposed system modifications or modifications made. The inspection check lists, system operational logs and a summary of technician field notes will also be included in the report.

A summary of the monitoring program deliverables are summarized in the table below.

Task	**Reporting Frequency**
Periodic Review Reports (PRRs)	Annual
Groundwater Sampling Result Table/Letter	After each event

4. Operation and Maintenance Plan

This Operation and Maintenance Plan describes the measures necessary to operate, monitor and maintain the mechanical components of the remedy selected for the site. This Operation and Maintenance Plan:

- Includes the steps necessary to allow individuals unfamiliar with the site to operate and maintain the ASD and Full Scale ISCO systems;
- Includes an operation and maintenance contingency plan; and,
- Information on non-mechanical Engineering Controls (i.e. soil cover system) is provided in Section 3 - Engineering and Institutional Control Plan. A copy of this Operation and Maintenance Plan, along with the complete SMP, will be kept at the site. This Operation and Maintenance Plan is not to be used as a stand-alone document, but as a component document of the SMP.

4.1 Engineering Control System Operation and Maintenance

4.1.1 Active Sub-Slab Depressurization System

4.1.1.1 Scope

ASD is a system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use of a fan-powered vent drawing air from beneath the slab. The ASD system was installed to see if it could be helpful in reducing indoor air concentrations of PCE within the building. The purpose of the operation and maintenance is to provide for proper procedures that will ensure that the ASD system is operating, functioning properly, and is maintained in good condition. Moreover, system performance will be monitored to assess whether modifications are warranted for system equipment and/or other system operations and infrastructure.

4.1.1.2 System Operation: Routine Operation Procedures

The ASD system is essentially self-operating and does not require adjustments. The ASD system essentially operates as either on or off. The ASD system includes mechanisms to monitor system performance and warn of system failure (shut off). The electrical monitor is installed on non-switched circuits and is designed to reset automatically after a power supply interruption.

Manometer-type pressure gauges are clearly marked to indicate the pressure readings that existed prior to system start. The circuit breakers controlling the circuits on which the vent fan and electrical system monitor operate are “ASD System.”

4.1.1.3 System Operation: Equipment Maintenance

The ASD system includes five suction fans/blowers as discussed in Section 2.2.1.2. The fans do not require maintenance and has an expected operational life of 7 to 8 years. Other systems components, such as piping, gauges, and wiring could be inadvertently damaged or broken by other site activities. During inspections these features will be checked for damage. Broken or damaged parts of the system will be repaired or replaced.

The ASD system is a basic design based on radon mitigation type technology. Essentially the system consists of extraction points (suction pits) within the floor slab, plastic piping, and fans. This system can be easily modified should future conditions warrant such changes. Additional extraction points can be added and plumbed to the existing system. Should additional points be added, an additional fan may be needed.

4.1.2 Full Scale ISCO System

4.1.2.1 Scope

The full scale ISCO will consist in the injection of a 5% solution of sodium permanganate to be delivered by a gravity-feed system in the source area and manual injection downgradient of the source area. The purpose and objective of the operation and maintenance is to provide for proper procedures that will ensure that the groundwater remediation system is operating, functioning properly, and is maintained in good condition. Moreover, system performance will be monitored to assess whether modifications are warranted for system equipment, the number and location of injection points, frequency of injections, and/or other system operations and infrastructure.

The sodium permanganate solution will be prepared onsite in a 6,500 gallon capacity feed tank with secondary containment located behind the facility building by adding potable water (sourced from a nearby fire hydrant) to more concentrated sodium permanganate solution delivered by Carus Chemical.

The discharge line from the sodium permanganate tank will contain a flow totalizer and a control valve. The tank discharge line will be manifolded into multiple discharge lines

(one to each of the source area injection points) each containing a flow totalizer and flow control valve. This configuration will allow for injection into each injection point to be controlled so that valve adjustments can be made to evenly distribute flow to each well. **Figure 8** shows a conceptual piping and instrumentation diagram and **Figures 9A and 9B** shows miscellaneous conceptual details for the ISCO system.

4.1.2.2 System Start-up and Testing

Startup Procedures

The following provides a short checklist of required manual operator inspections and activities prior to initiating an injection event.

1. Feed tank, flow totalizer, pressure guage, valves and spill containment should be inspected prior to solution preparation.

2. Verify that all valves are closed.

3. An initial water flush is performed prior to the first injection event to facilitate the sodium permanganate injections.

    a. Pump approximately 500 gallons of hydrant water to the feed tank.

    b. Open gate valve at the outlet of the feed tank as well as the ball valves inside the distribution box (including the main ball valve for feed line and five ball valves for individual injection wells), allowing for a water rinse of the piping from the feed tank, the manifold header to the injection well casing.

    c. Check the water levels at each injection well.

    d. Check manifold line pressure and wellhead pressure.

    e. Close the valves once the initial water flush is completed.

    f. Record the volumes from the flow totalizer/flow indicator.

Permanganate Solution Preparation (Mixing)

The 40% sodium permanganate solution from Carus Chemical delivers to the site by a tanker truck or stored in drums. The concentrated sodium permanganate solution transfers/pumps from the tanker truck or drums to the 6,500-gallon feed tank and dilutes to 5% via mixing with hydrant water. The 5% sodium permanganate solution (by weight) will be prepared by adding a ratio of 7 gallons of potable water from a nearby fire hydrant to every gallon of 40% sodium permanganate solution. The 5% solution will contain approximately 50 grams per liter (g/L) of sodium permanganate.

The concentrated sodium permanganate solution and the hydrant water will be transferred to the feed tank simultaneously (i.e. in-line mixing). After completion of transferring concentrated sodium permanganate solution, the hydrant water will be pumped continuously to the feed tank until the high-level alarm is activated. The feed tank is equipped with a level switch that connects to a light and an audible alarm. It generates an alarm when the oxidant solution level within the tank rises too high.

During mixing operations, the total volumes of 40% sodium permanganate solution and water should be recorded on a chemical mixing log (see **Appendix B**) to track the batches of injection solution. Preparation of the permanganate solution should be done using appropriate personal protection equipment (PPE) and following safety procedures described in the HASP. The Material Safety Data Sheet (MSDS) for sodium permanganate is provided in **Appendix C**.

Injection

The injection sequence proceeds as described.

1. Total volume of sodium permanganate solution prepared in the feed tank should be recorded on the Operations and Maintenance Log (**Appendix B**).

2. Open gate valve at the outlet of the feed tank as well as the ball valves inside the distribution box (including the main ball valve for feed line and five ball valves for individual injection wells), allowing permanganate solution flows to the five injection wells. The expected flow rate is 0.25 gpm (maximum rate).

3. Adjust the gate valve at the outlet of the feed tank to control the flow of permanganate solution to distribution box.

4. Remove residual moisture/air in the injection lines by opening air release valves inside the distribution box and at the wellhead. Removal of moisture from the injection lines is performed to prevent freezing of the lines during the winter months. Air release valves shall be closed throughout the injection period.

5. Injection solution flow rate, accumulative injected volume, and wellhead pressure will be monitored at each injection well every 30-60 minutes during the first four hour of injection and daily up to five working days. Above information will be recorded on the example injection log provided in **Appendix B**.

6. System injection shall be suspended if any leaks or significant pressure rises are observed.

Shutdown Procedures

The following provides a short checklist of required manual operator inspections and activities after the completion of each injection event.

1. Close valves at the outlet of the feed tank and inside the distribution box.

2. Record the accumulative injected volume for each injection well based on the reading from the flow totalizer/indicator.

3. Repair any minor leaks, equipment externals, and address other equipment issues, as necessary.

4.1.2.3 System Operation: Routine Operation Procedures

Once the aboveground feed tank is filled, it will take about 12 to 24 days to drain into the injection wells. Followed by a post-injection period (total of approximately 70 days), the feed tank will be re-filled w/ oxidant and the sequence repeated. The volume of oxidant liquid delivered into the subsurface will be approximately 33,500 gallons in total per year in the source area. Delivery will be 5 events per year for gravity feed through an array of injection wells/points.

The procedures of start-up, solution preparation, injection and system shutdown provided in Section 4.1.2.2 will be followed during each injection event. The flow rate to the each source area injection point will be controlled by the individual ball valve and be monitored by the individual flow meter/totalizer located in the valve box. During the operation, monthly system inspection will be conducted to check if the injection point is still accepting the ISCO product. The injection flow rate, wellhead pressure, head in the injection well, injected volume should be monitored weekly during the first two week of 1st injection, and at minimum once per month thereafter throughout the course of the injection. All field parameters should be recorded on the attached injection log (**Appendix B**).

The following are descriptions of potential problems that may be encountered during normal operation of the full-scale ISCO system along with the probable cause. This section describes the probable solution(s) required to alleviate the problem once detected by operating personnel.

Problem Identification	Probable Cause	Probable Solution
Elevated Injection Line Pressure	Injection well is fouled	1. Well redevelopment required.
	Injection line is fouled	1. Perform water rinse. 2. Verify proper operation of feed tank, as needed.
Low Injection Line Pressure	System Leak	1. Determine and isolate source of leak. Repair as needed.
Poor Injection Rate	Air Locking of Formation (Cavitation)	1. Verify operation of relief valve installed on wellhead. 2. Repair/Replace relief valve, as necessary.
	Plugging of the casing slots	1. Well redevelopment required.

4.1.2.4 System Operation: Equipment Maintenance

Although the ISCO system will be essentially self-operating because it is a gravity feed system, the following equipments will be checked/monitored periodically (minimum on a monthly basis) in accordance with the manufacturer's O&M information:

- High level switch/high level audible alarm
- Leak detection sensor and audible alarm
- Valves, aboveground piping, and injection lines
- Heat trace, flow totalizer/indicator, pressure gauges, and tank condition
- Injection well and piping manifold vaults
- Spill containment
- Security fencing

Repair or replacement has to be implemented as soon as possible if any of above equipment does not work properly or is damaged.

4.2 Engineering Control System Performance Monitoring

4.2.1 Active Sub-Slab Depressurization System

The ASD system has been operated at the site since 2003. The ASD system was installed to see if it could be helpful in reducing indoor air concentrations of PCE within the building. System performance monitoring and inspection are discussed below.

4.2.1.1 Inspection

In accordance with the approved OM&M Work Plan (BBL, October 2005), ASD system operation is checked on a monthly basis to verify that it is operating. Vacuum readings on the system shall be recorded during each inspection. The Monthly Inspection Sheets are presented in **Appendix B**.

Inspection frequency is subject to change with the approval of the NYSDEC. Unscheduled inspections and/or sampling may take place when a suspected failure of the ASD system has been reported or an emergency occurs that is deemed likely to affect the operation of the system. Monitoring deliverables for the ASD system are specified later in this Plan.

4.2.1.2 Performance Monitoring

Indoor air sampling has been conducted by ARCADIS to monitor the effectiveness of the ASD system. The indoor air sampling is conducted in accordance with the approved OM&M Plan (BBL 2005) and Remedial Design Package (BBL 2003).

Indoor air samples are collected at 7 points within the facility building at locations where facility employees regularly work or where SSPL VOC vapors were detected in sub-slab samples. An outdoor background sampling point is located by the buildings HVAC air intakes. Details of the indoor air monitoring are discussed in Section 3.3 Indoor Air Monitoring.

4.3 Maintenance and Performance Monitoring Reporting Requirements

Maintenance reports and any other information generated during regular operations at the site will be kept on-file on-site. All reports, forms, and other relevant information generated will be available upon request to the NYSDEC and submitted as part of the PRRs, as specified in the Section 5 of this SMP.

4.3.1 Routine Maintenance Reports

Checklists or forms (**Appendix B**) will be completed during each routine maintenance event. Checklists/forms will include, but not be limited to the following information:

- Date;
- Name, company, and position of person(s) conducting maintenance activities;
- Maintenance activities conducted;
- Any modifications to the system;

- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents noted (included either on the checklist/form or on an attached sheet); and,

- Other documentation such as copies of invoices for maintenance work, receipts for replacement equipment, etc., (attached to the checklist/form).

4.3.2 Non-Routine Maintenance Reports

During each non-routine maintenance event, a form will be completed which will include, but not be limited to, the following information:

- Date;

- Name, company, and position of person(s) conducting non-routine maintenance/repair activities;

- Presence of leaks;

- Date of leak repair;

- Other repairs or adjustments made to the system;

- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents (included either on the form or on an attached sheet); and,

- Other documentation such as copies of invoices for repair work, receipts for replacement equipment, etc.

5. Inspections, Reporting and Certifications

5.1 Site Inspections

5.1.1 Inspection Frequency

All inspections will be conducted at the frequency specified in the schedules provided in Section 3 Monitoring Plan and Section 4 Operation and Maintenance Plan of this SMP. Inspections of remedial components will also be conducted when a breakdown of any treatment system component has occurred or whenever a severe condition has taken place, such as an erosion or flooding event that may affect the ECs.

5.1.2 Inspection Forms, Sampling Data, and Maintenance Reports

All inspections and monitoring events will be recorded on the appropriate forms for their respective system which are contained in **Appendix B**. Additionally, a general site-wide inspection form will be completed during the site-wide inspection (see **Appendix B**). These forms are subject to NYSDEC revision.

All applicable inspection forms and other records, including all media sampling data and system maintenance reports, generated for the site during the reporting period will be provided in electronic format in the PRRs.

5.1.3 Evaluation of Records and Reporting

The results of the inspection and site monitoring data will be evaluated as part of the EC/IC certification to confirm that the:

- EC/ICs are in place, are performing properly, and remain effective;
- The Monitoring Plan is being implemented;
- Operation and maintenance activities are being conducted properly; and, based on the above items;
- The site remedy continues to be protective of public health and the environment and is performing as designed in the remedial design reports.

5.2 Certification of Engineering and Institutional Controls

The necessary EC/IC certification will be provided to NYSDEC on a periodic basis and will also be included in the annual PRR. The certification will state that the approved institutional and engineering controls are in place and functioning as intended.

After the last inspection of the reporting period, a qualified environmental professional or Professional Engineer licensed to practice in New York will prepare the following certification:

For each institutional or engineering control identified for the site, I certify that all of the following statements are true:

- The inspection of the site to confirm the effectiveness of the institutional and engineering controls required by the remedial program was performed under my direction;
- The institutional control and/or engineering control employed at this site is unchanged from the date the control was put in place, or last approved by the Department;
- Nothing has occurred that would impair the ability of the control to protect the public health and environment;
- Nothing has occurred that would constitute a violation or failure to comply with any site management plan for this control;
- Access to the site will continue to be provided to the Department to evaluate the remedy, including access to evaluate the continued maintenance of this control;
- If a financial assurance mechanism is required under the oversight document for the site, the mechanism remains valid and sufficient for the intended purpose under the document;
- Use of the site is compliant with the Deed Restriction;
- The engineering control systems are performing as designed and are effective;

- To the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the site remedial program.

- The information presented in this report is accurate and complete.

- I certify that all information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law. I, [name], of [business address], am certifying as [Owner or Owner's Designated Site Representative] (and if the site consists of multiple properties): [I have been authorized and designated by all site owners to sign this certification] for the site.

The signed certification will be included in the PRRs described below.

5.3 Periodic Review Reports

PRRs will be submitted annually to NYSDEC to describe the site operation and monitoring activities performed during the reporting period with respect to the groundwater operable unit and the results of the coincident groundwater sampling event. The report will be prepared in accordance with NYSDEC DER-10.

The PRRs will be certified by a New York State licensed professional engineer. The report will state the operation and monitoring activities conducted, observations made, and report operational data recorded. The report will also describe proposed system modifications or modifications made. The inspection check lists, system operational logs and a summary of technician field notes will also be included in the report.

In addition, the inspection and monitoring activities for the soil operable unit (OU-1) will be included in the annual PRR to NYSDEC. The report will describe the operation of the ASD system, the indoor air sampling results and inspection of the engineering controls associated with the Deed Restriction. The report will also describe any modifications that are made to the ASD system.

5.4 Corrective Measures Plan

If any component of the remedy is found to have failed, or if the periodic certification cannot be provided due to the failure of an institutional or engineering control, a corrective measures plan will be submitted to the NYSDEC for approval. This plan will

explain the failure and provide the details and schedule for performing work necessary to correct the failure. Unless an emergency condition exists, no work will be performed pursuant to the corrective measures plan until it is approved by the NYSDEC.

6. References

ARCADIS of New York, Inc. March 2010. Full Scale In-Situ Chemical Oxidation Design Report.

ARCADIS of New York, Inc. February 2011. Final In-Situ Chemical Oxidation Construction Package.

Blasland, Bouck and Lee, Inc. (ARCADIS). January 2006. In Situ Chemical Oxidation Field Test Report.

Blasland, Bouck and Lee, Inc. (ARCADIS). February 2002. Groundwater Contingency Plan.

Blasland, Bouck and Lee, Inc. (ARCADIS). July 2004. Remedial Action Report.

Blasland, Bouck and Lee, Inc. (ARCADIS). October 2005. Operation, Maintenance and Monitoring Plan.

New York State Department of Environmental Conservation (NYSDEC). March 2000. Record of Decision: Dover Electronics Site, Kirkwood (T), Broome County, Site Number 7-04-026.

New York State Department of Environmental Conservation (NYSDEC). January 2001. Order on Consent: Index #B7-0515-97-05.

Shield Environmental Associates, Inc. July 2000. Remedial Investigation Report.

ARCADIS

Table 1 Well Construction Specifications, Former Dover Electronics Site, Kirkwood, New York

Monitoring Well	Top of Casing (ft.)	Total Depth (ft)	Screened Interval (ft)	Water Bearing Unit
MW-2	863.28	16.37	5-15	Shallow
MW-3	859.16	14.20	5-15	Shallow
MW-5	864.68	21.70	5-20	Shallow
MW-6	863.67	34.57	15-35	Intermediate
MW-7A	882.74	16.09	7-17	Shallow
MW-8*	899.21	59.11	30-60	Intermediate
MW-9	923.94	60.65	30-60	Shallow
MW-11	918.87	62.45	52-62	Intermediate
MW-12	912.31	73.60	63-73	Intermediate
MW-13	912.14	48.31	39-49	Shallow
MW-14	915.40	73.10	62-72	Intermediate
MW-15	899.38	45.76	36-46	Shallow
MW-16	878.87	30.40	18-28	Shallow
MW-17	859.29	20.05	8-18	Shallow
MW-18*	857.34	16.50	8-18	Shallow
MW-19	859.59	19.00	8-18	Shallow
MW-20	858.94	23.45	14-24	Shallow
MW-21	883.22	40.18	31-41	Intermediate
MW-22	861.62	21.34	17-22	Intermediate
MW-23	916.62	51.08	40.5-50.5	Shallow
MW-24	907.66	44.08	35-45	Shallow
MW-25	857.52	39.79	34-39	Intermediate
MW-26	859.04	28.00	22.5-27.5	Intermediate
MW-27	860.01	26.72	16.5-26.5	Shallow
MW-28	859.09	25.84	15-25	Shallow
MW-29*	917.36	48.85	39-49	Shallow
MW-30*	857.66	20.75	15-25	Shallow
MW-31*	856.90	21.74	13-23	Shallow
MW-32	861.18	23.22	15.1-25.1	Shallow
MW-33	863.64	22.47	15-25	Shallow
MW-34*	857.03	57.80	53-58	Deep
MW-35*	856.89	36.73	32-37	Intermediate
MW-36	857.19	22.10	14-24	Shallow
MW-37*	857.71	36.35	31-36	Intermediate
MW-38	862.20	23.67	20-25	Intermediate
MP-1	912.63	39.87	31-41	Shallow
MP-2	911.00	44.83	34-44	Shallow
MP-3D	910.59	74.50	46-56	Intermediate
MP-4	883.65	24.26	17-27	Shallow
MP-5*	881.66	24.20	14-24	Shallow
MP-6S	875.67	24.52	14-24	Shallow
MP-6D	873.83	49.95	39-49	Intermediate
MP-7*	856.48	18.07	8-18	Shallow
MP-8S*	857.40	21.01	13-23	Shallow
MP-8D*	857.20	53.98	44-54	Intermediate
MP-9*	856.93	17.39	7-17	Shallow
MP-10S*	857.25	20.58	10-20	Shallow
MP-10D*	857.31	56.15	46-56	Intermediate
IJ-1	-	25.00	15-25	Shallow
IJ-2	-	43.90	30-45	Intermediate
IJ-3	-	44.38	30-45	Intermediate
IJ-4	-	24.63	10-25	Shallow
IJ-5	-	24.80	10-25	Shallow
IJ-6	-	39.94	10-20, 30-40	Shallow-Intermediate

-: Not Applicable

* Well was repaired. Well casing was re-surveyed by Thew Associates, October 9, 2009

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Table 2 Groundwater Monitoring Matrix - Full-Scale ISCO Remediation, Former Dover Electronics Site, Kirkwood, New York

Injection Well ID No.	Monitoring Points		Monitoring Schedule	
	Shallow Zone	Intermediate Zone	VOC Analysis	Field Parameters
IJ-1	MP-5, MP-6S, IJ-5	MP-6D	Bi-monthly for the first 6 months, quarterly for the next 6 months, and semi-annual thereafter at all monitoring points	Daily for the first week, weekly for the next two months, monthly for the following 4 months, and bi-monthly thereafter at all monitoring points
IJ-2	MP-4, MP-12, IJ-4	--		
IJ-3	MP-4, MW-7A, IJ-1, IJ-4	MP-6D		
IJ-4	MP-5, MP-12	--		
IJ-5	Offline for the first year			
IJ-7	MP-4, MP-11, IJ-1, IJ-4	--		
IJ-8	MP-4, MP-5, IJ-1, IJ-4	--		
IJ-9	MP-4, MP-13, MW-7A, IJ-1	MP-6D		
IJ-10	MP-5, MP-6S, MP-14, IJ-5	--		
MW-24	MP-11, MW-16	--		
IJ-6	MW-28, MW-30, MP-8S	MP-8D, MP-10D, MW-25	Quarterly for the first year and semi-annual thereafter	Monthly for the first 6 months and quarterly for the next 6 months

Notes:

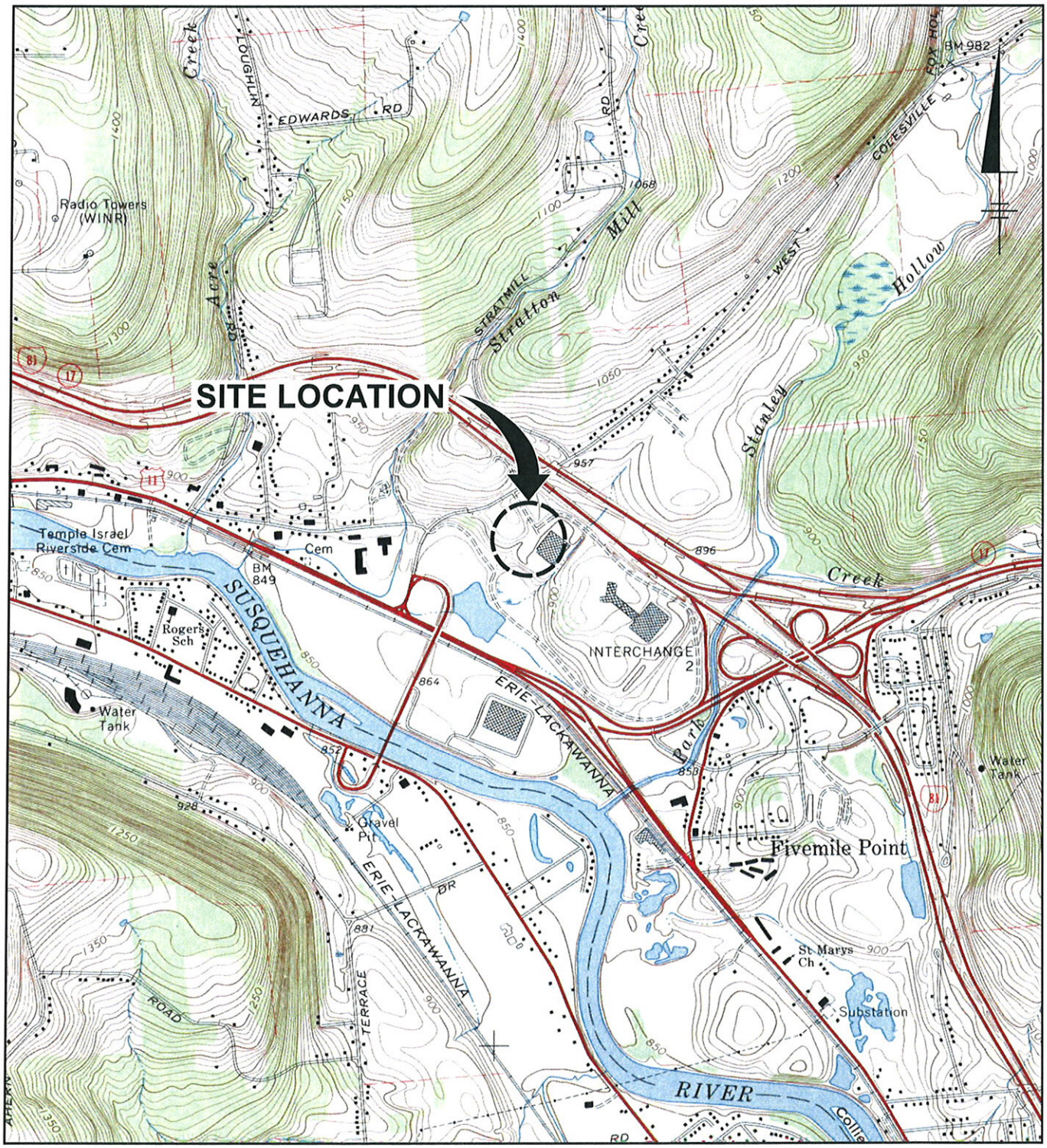
1. All monitoring points listed in the table will be sampled for VOCs (Site-Specific Parameter List [SSPL]) and/or field parameters based on the proposed monitoring schedule.
2. Field parameters including pH, specific conductivity, and redox will be collected using a down-hole water quality instrument and manganese and permanganate using a colorimeter.
3. IJ-1, IJ-4, and IJ-10 will be used as monitoring points for the 1st Quarter of operations.

ARCADIS

Table 3 Injection Well Construction Specifications, Former Dover Electronics Site, Kirkwood, New York

Well ID No.	Total Depth (feet)	Slotted Casing Interval Depth (feet)	Slot Size (inches)	Filter Pack Type	Well Head Completion
IJ-1	25	10-25	0.010	#3 sand	Flush Mount
IJ-2	45	30-45	0.010	#3 sand	Flush Mount
IJ-3	45	30-45	0.010	#3 sand	Flush Mount
IJ-4	25	10-25	0.010	#3 sand	Flush Mount
IJ-5	25	10-25	0.010	#3 sand	Flush Mount
IJ-6	40	10-20; 30-40	0.010	#3 sand	Flush Mount
IJ-7*	45	30-45	0.010	#3 sand	Flush Mount
IJ-8*	45	30-45	0.010	#3 sand	Flush Mount
IJ-9*	45	30-45	0.010	#3 sand	Flush Mount
IJ-10*	25	10-25	0.010	#3 sand	Flush Mount
MW-24	45	35-45	NA	NA	Flush Mount

Notes:
All IJ wells to be constructed of 6" diameter, threaded, Schedule 40 PVC casing with machine slotting where applicable.
* Denotes proposed injection wells as specified in the "Full-Scale ISCO Design Report"
NA - Not available



REFERENCE: Base Map Source USGS 7.5 Minute Quad. Series Binghamton East, New York, 1968, Photorevised 1976.

2000' 0 2000'

Approximate Scale: 1" = 2000'



AREA LOCATION

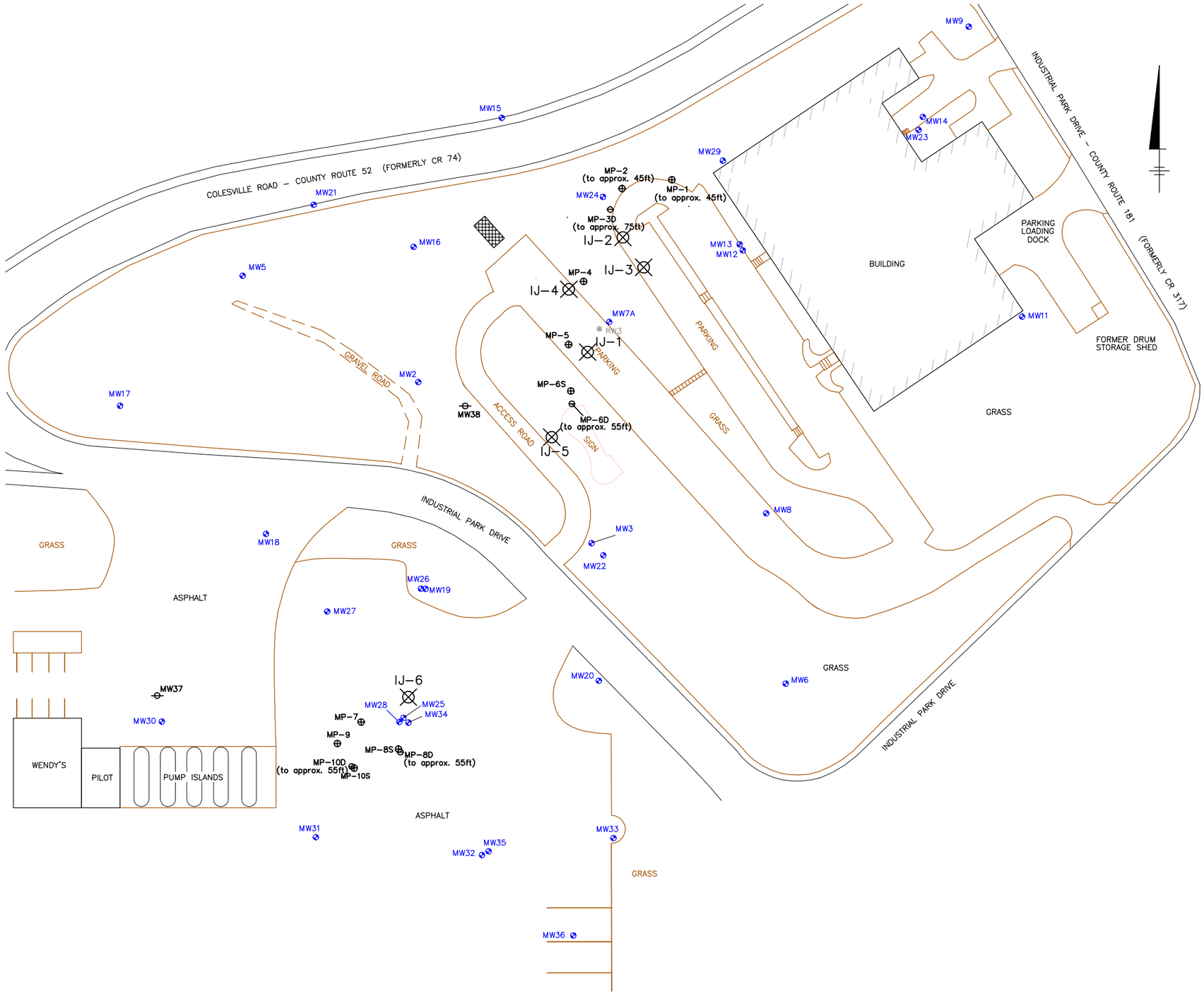
FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK

SITE LOCATION MAP

ARCADIS

FIGURE
1

7/11/08 CRA-85-TLF
00616/0001/00002/00616N01.CDR



LEGEND

- FORMER RECOVERY WELL
- EXISTING MONITORING WELL
- 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH
- TREATMENT BUILDING
- INJECTION TEST WELL

SOURCE:
BASEMAP FROM FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

0 120' 240'
GRAPHIC SCALE

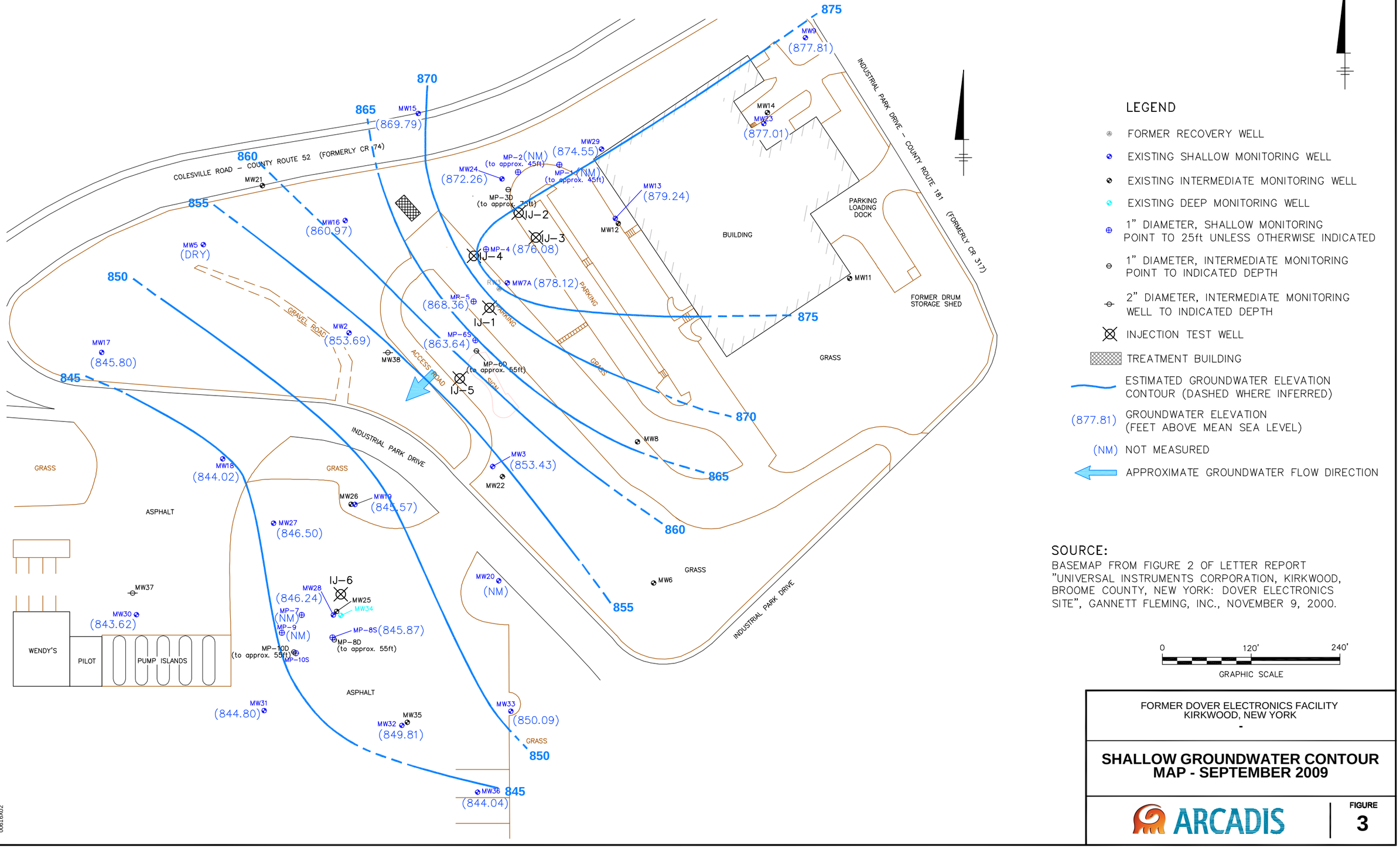
UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
-

SITE MAP

ARCADIS

FIGURE 2

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IMAGES:
00616X02



LEGEND

- FORMER RECOVERY WELL
- EXISTING SHALLOW MONITORING WELL
- EXISTING INTERMEDIATE MONITORING WELL
- EXISTING DEEP MONITORING WELL
- 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- 1" DIAMETER, INTERMEDIATE MONITORING POINT TO INDICATED DEPTH
- 2" DIAMETER, INTERMEDIATE MONITORING WELL TO INDICATED DEPTH
- INJECTION TEST WELL
- TREATMENT BUILDING
- ESTIMATED GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- (877.81) GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- (NM) NOT MEASURED
- APPROXIMATE GROUNDWATER FLOW DIRECTION

SOURCE:

BASEMAP FROM FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

0 120' 240'

GRAPHIC SCALE

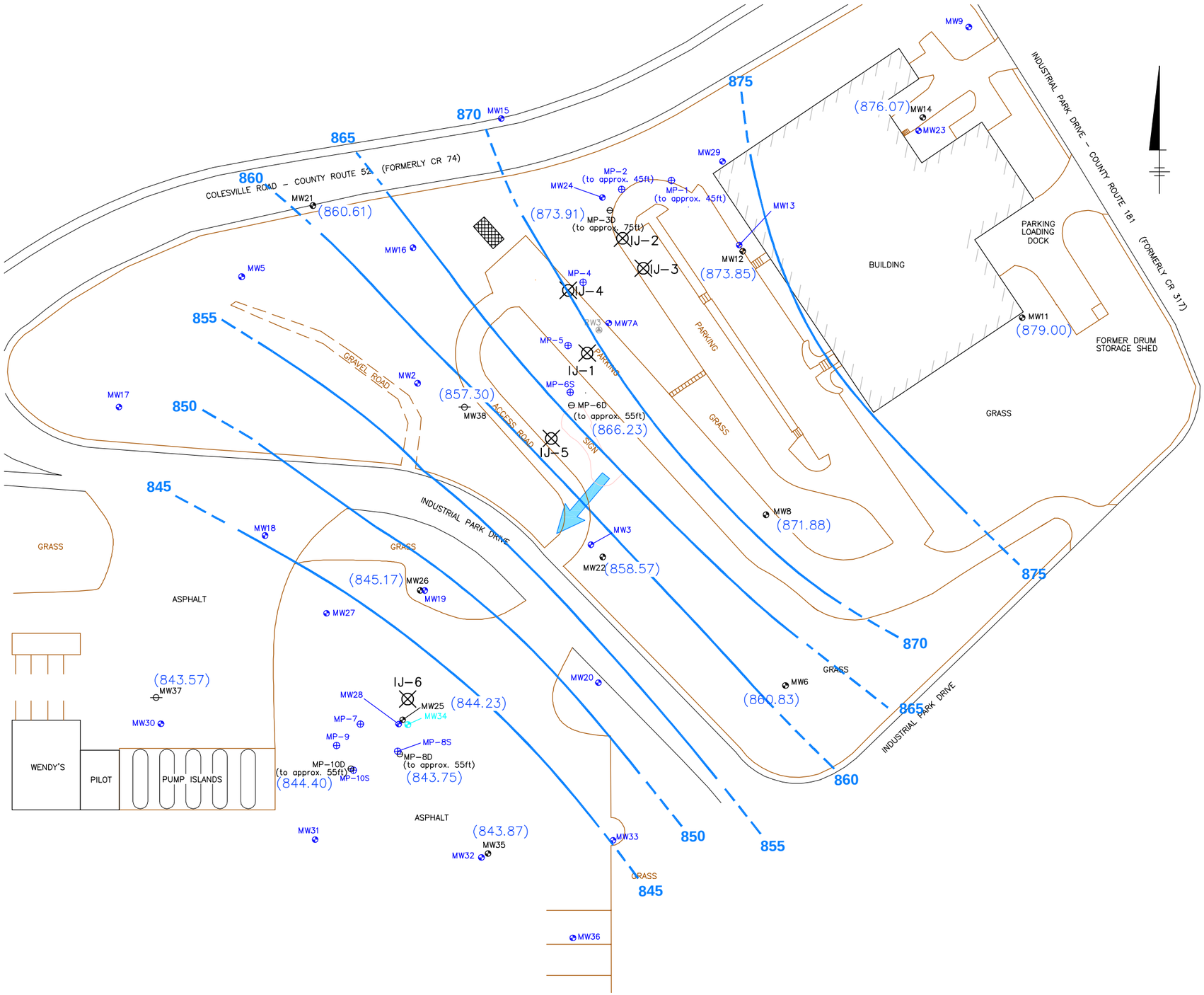
FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK
-

SHALLOW GROUNDWATER CONTOUR MAP - SEPTEMBER 2009

ARCADIS

FIGURE 3

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000616X02



LEGEND

- FORMER RECOVERY WELL
- EXISTING SHALLOW MONITORING WELL
- EXISTING INTERMEDIATE MONITORING WELL
- EXISTING DEEP MONITORING WELL
- 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- 1" DIAMETER, INTERMEDIATE MONITORING POINT TO INDICATED DEPTH
- 2" DIAMETER, INTERMEDIATE MONITORING WELL TO INDICATED DEPTH
- INJECTION TEST WELL
- TREATMENT BUILDING
- ESTIMATED GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
- (876.07) GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- APPROXIMATE GROUNDWATER FLOW DIRECTION

SOURCE:
BASEMAP FROM FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

0 120' 240'
GRAPHIC SCALE

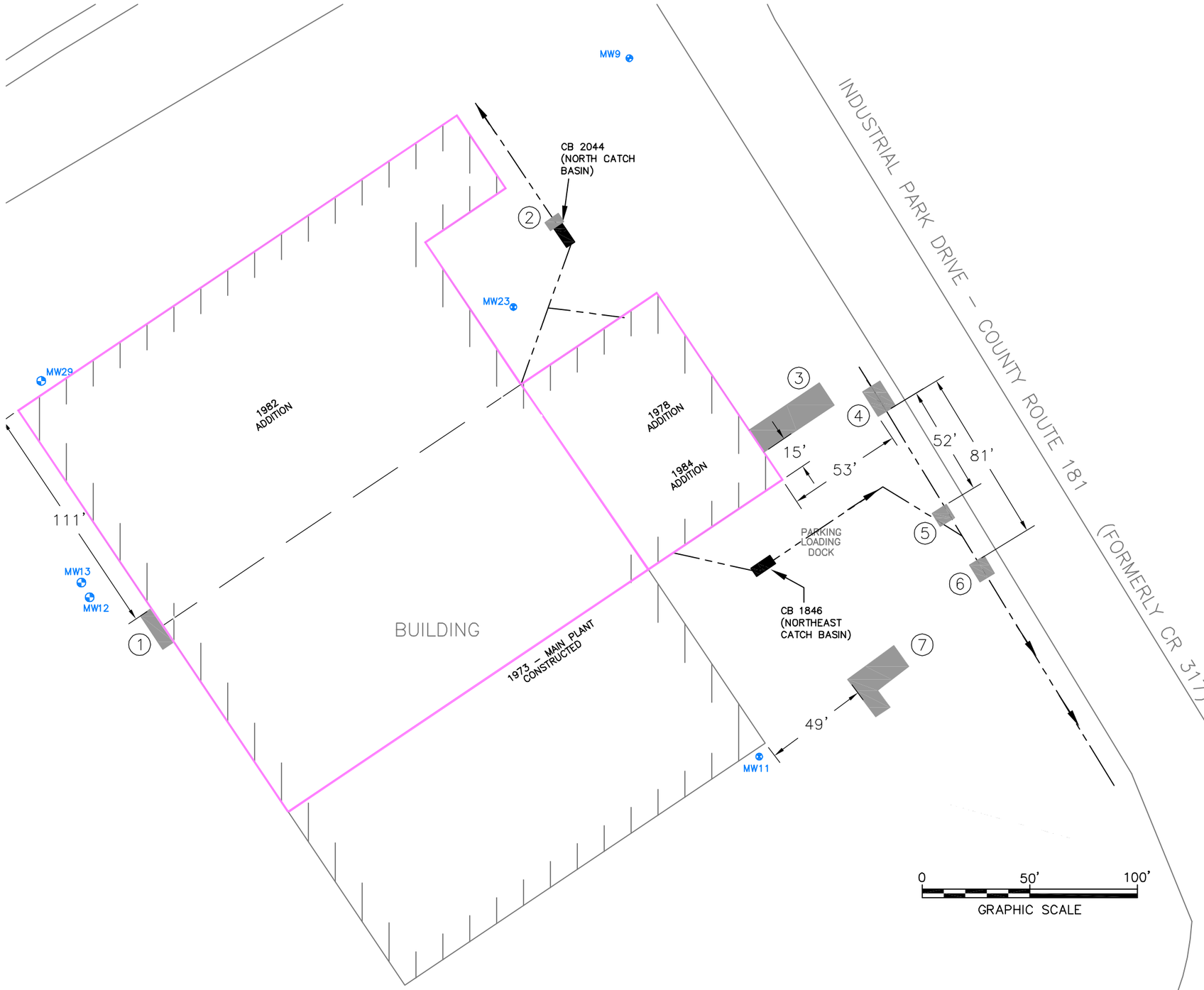
FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK
-

INTERMEDIATE GROUNDWATER CONTOUR MAP - SEPTEMBER 2009

ARCADIS

FIGURE 4

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XREFS: 00616X02 IMAGES: PROJECTNAME: ----



LEGEND

- EXISTING MONITORING WELL
- BUILDING DEED NOTICE AREAS
- EXTERIOR DEED NOTICE AREAS

DEPTH TO PCE–AFFECTED SOIL

1. 4 FEET
2. 6 FEET
3. 8 FEET
4. 8 FEET
5. 5 FEET
6. 7 FEET
7. 3 FEET

SOURCE:
FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

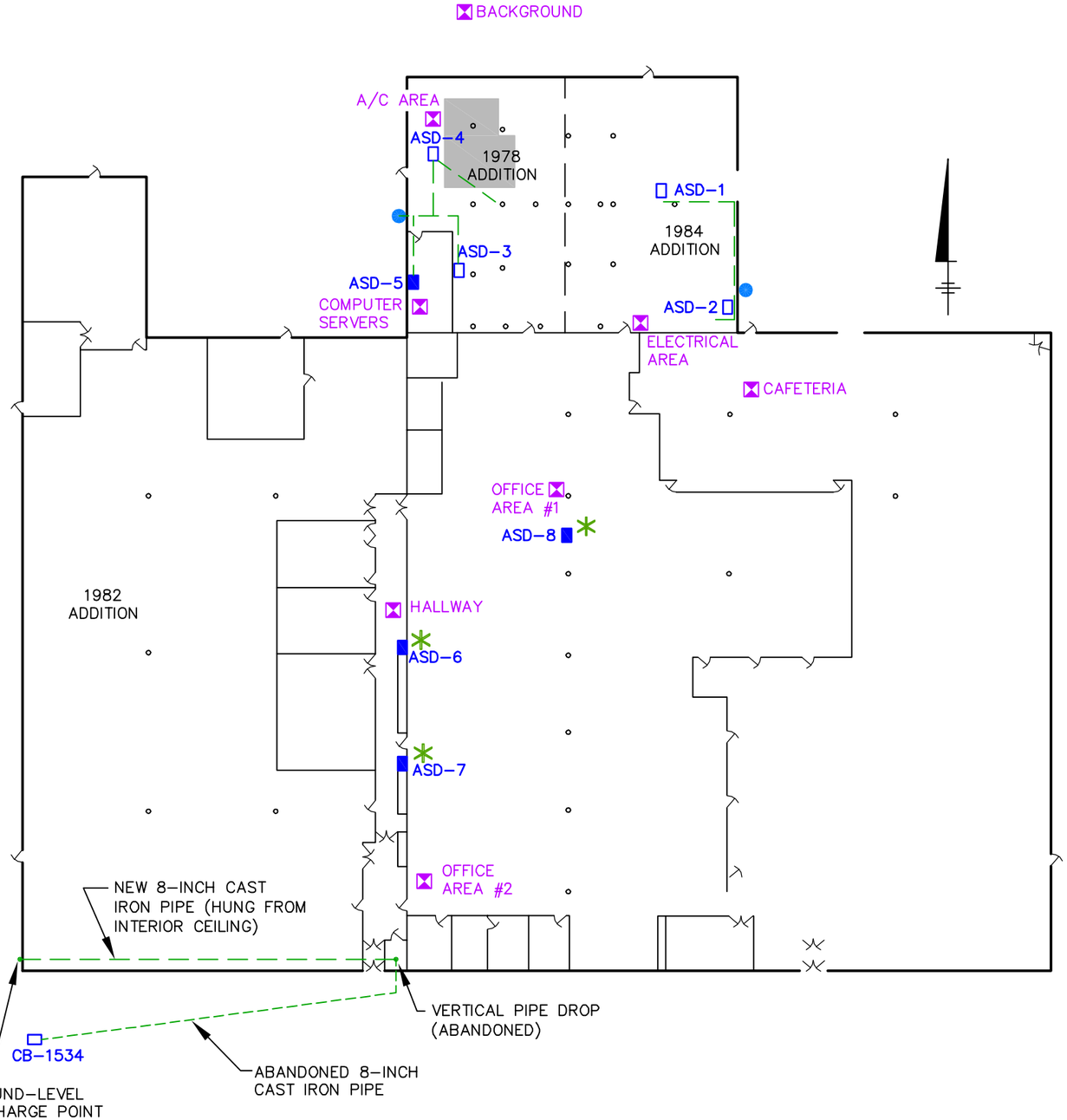
UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW JERSEY
SITE MANAGEMENT PLAN

DEED NOTICE AREAS

ARCADIS

FIGURE
5

CITY:CRANBURY-NJ DIV/GROUP:ENVCAD DB:TFATTO LD: PIC: PM:GALBRIGHT TM:KJIAO LYR:ON=*;OFF=*REF*
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00616X04



LEGEND:

- ACTIVE SUB-SLAB DEPRESSURIZATION POINT LOCATION
- NEW ACTIVE SUB-SLAB DEPRESSURIZATION POINT LOCATION
- PIPING RUN
- VERTICAL BUILDING POST
- EXTERIOR FAN AND EXHAUST LOCATION
- INACCESSIBLE AREA
- INDOOR AIR SAMPLING LOCATION
- DEDICATED FAN LOCATED ON RISER PIPE

SOURCE:

BUILDING LAYOUT DIGITIZED FROM PHOTOCOPY OF DRAWING FAXED FROM UNIVERSAL INSTRUMENTS CORPORATION FACILITIES DEPARTMENT. NO FILE NAME OR SCALE PROVIDED.

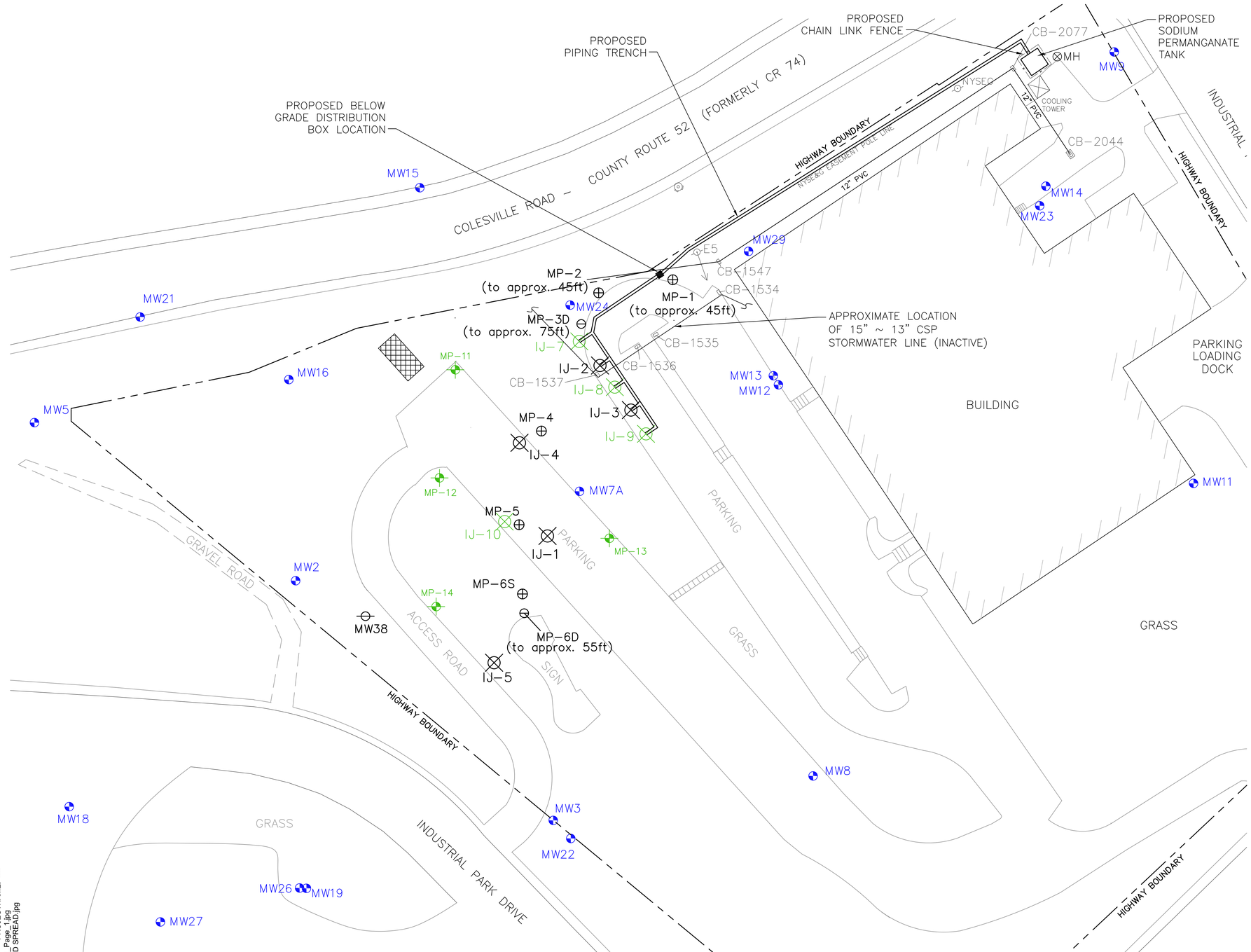
UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
SITE MANAGEMENT PLAN

ASD SYSTEM AND INDOOR AIR SAMPLING LOCATIONS

ARCADIS

FIGURE
6

CITY:GRANBURY-NJ DIV/GROUP:ENVCAD DB:TFATTO LD: PIC: PMG&ALBRIGHT TM:KLIAO LYR:ON=*;OFF=*REF* G:\ENVCAD\GRANBURY\ACTIVE\J000616\K010000015\MP\000616G01.dwg LAYOUT: 6 SAVED: 7/28/2010 11:48 AM ACADVER: 17.0S (LMS TECH) PAGESETUP: CRA-LB-PDF PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 7/28/2010 11:48 AM BY: FATTO, TRACEY
XREFS: IMAGES: PROJECTNAME: --



LEGEND

- PROPOSED INJECTION WELL
- PROPOSED MONITORING POINTS
- PROPOSED CHAIN LINK FENCE
- PROPOSED PIPING TRENCH
- PROPOSED BELOW GRADE DISTRIBUTION BOX
- EXISTING MONITORING WELL
- 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH
- INJECTION TEST WELL
- EXISTING TREATMENT BUILDING
- EXISTING FIRE HYDRANT
- POWER POLE (APPROXIMATE LOCATION)
- GW GUIDE WIRE (APPROXIMATE LOCATION)
- MH MANHOLE (APPROXIMATE LOCATION)
- CB CATCH BASINS (APPROXIMATE LOCATION)
- HIGHWAY BOUNDARY (APPROXIMATE LOCATION)
- UNDERGROUND PIPING (APPROXIMATE LOCATION)

0 40' 80'
GRAPHIC SCALE

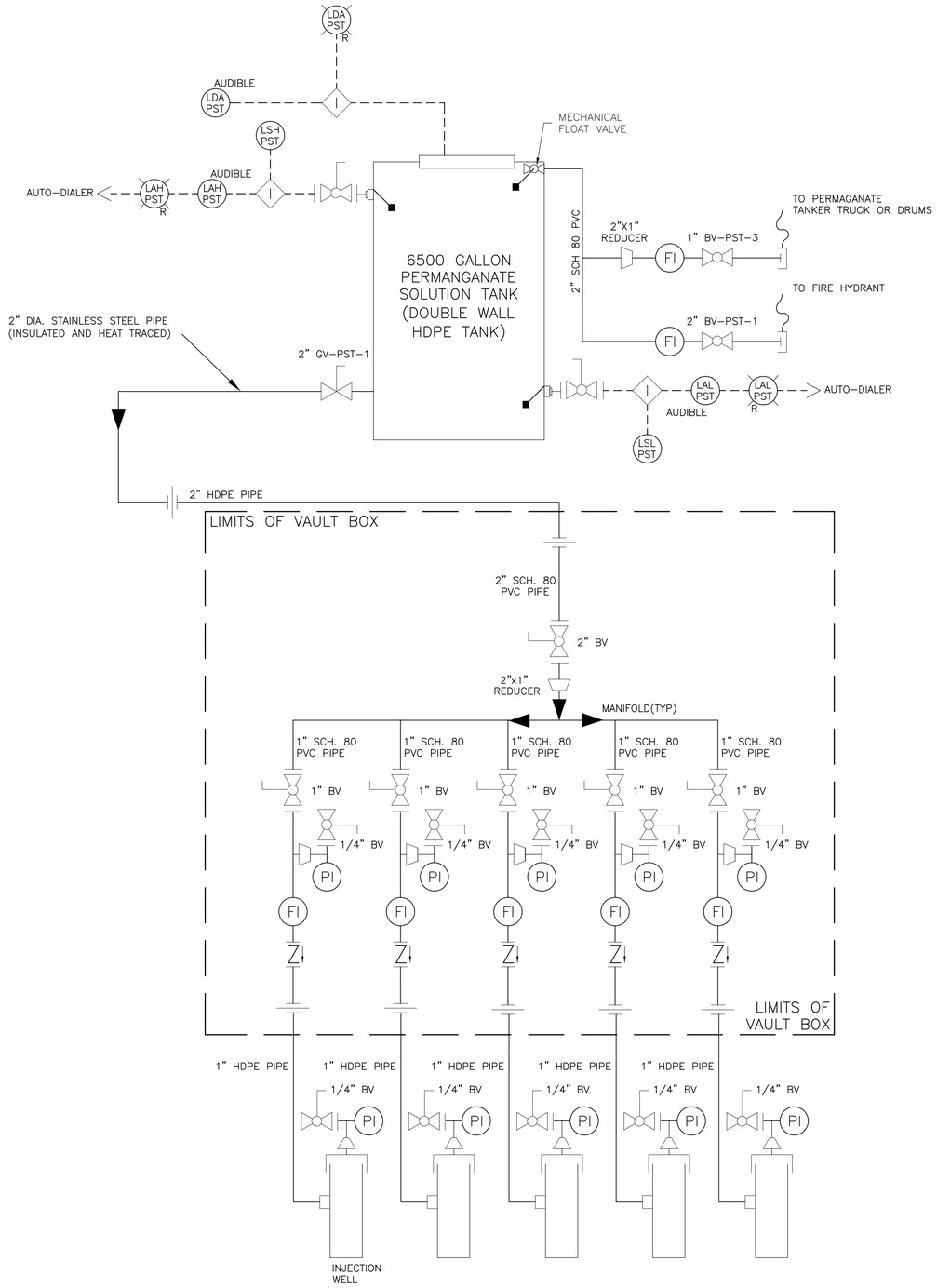
UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
SITE MANAGEMENT PLAN

IN-SITU CHEMICAL OXIDATION FULL SCALE SYSTEM LAYOUT PLAN

ARCADIS

FIGURE 7

CITY:MAHWAH DIV/GROUP:ENVCAD DB:JG LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\Mahwah\ACTIVE\00061610\000061610\2010_SMP\FIG 7.dwg LAYOUT: 7 SAVED: 7/28/2010 1:36 PM ACADVER: 17.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ARCADIS.CTB PLOTTED: 7/28/2010 1:36 PM BY: GONZALEZ, JAMES
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LEVEL SWITCH IS CONNECTED TO A LIGHT AND AN AUDIBLE ALARM. ALARM GOES ON WHEN THE WATER LEVEL RISES TOO HIGH. A LEAK DETECTION SENSOR IS CONNECTED TO A LIGHT AND AN AUDIBLE ALARM. WHEN THE ALARM IS ENGAGED, THE AUTO-DIALER WILL BE ACTIVATED.

LEGEND

	ENCLOSED IN VAULT BOX
I	INTERLOCK
PI	PRESSURE INDICATOR
FI	FLOW INDICATOR/ TOTALIZING FLOW INDICATOR
	GATE VALVE
	BALL VALVE
	CHECK VALVE
	UNION
	CAMLOCK CONNECTION
PST	PERMENGANATE SOLUTION TANK
LSH	LEVEL SWITCH HIGH
LAH	LEVEL ALARM HIGH
LDA	LEAK DETECTION ALARM
LAL	LEVEL ALARM LOW
LSL	LEVEL SWITCH LOW

NOT TO SCALE

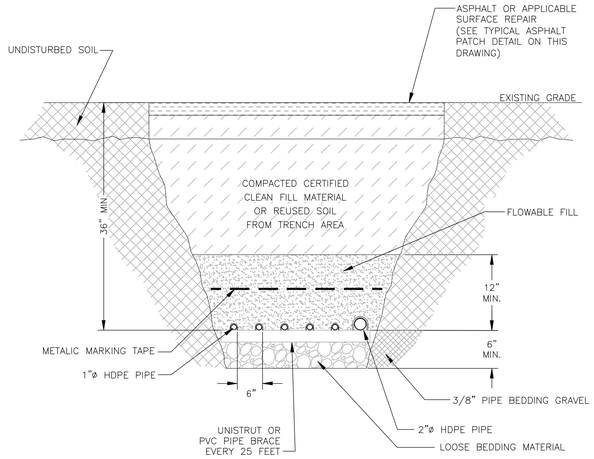
UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
SITE MANAGEMENT PLAN

PROCESS AND INSTRUMENTATION DIAGRAM

ARCADIS

FIGURE
8

CITY:MAHWAH DIV/GROUP:ENVCAD DB:JG LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\Mahwah\ACTNJ0006616K01010000012010_SMP\FIG 8.dwg LAYOUT: 8 SAVED: 8/11/2010 4:05 PM ACADVER: 17.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ARCADIS.CTB PLOTTED: 8/11/2010 4:05 PM BY: GONZALEZ, JAMES
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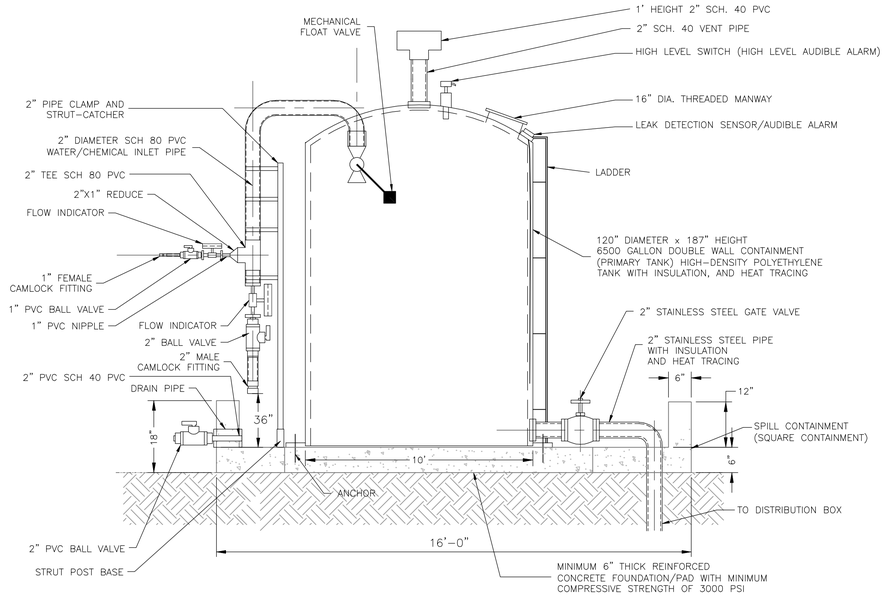


TYPICAL TRENCH DETAIL

SCALE: NONE

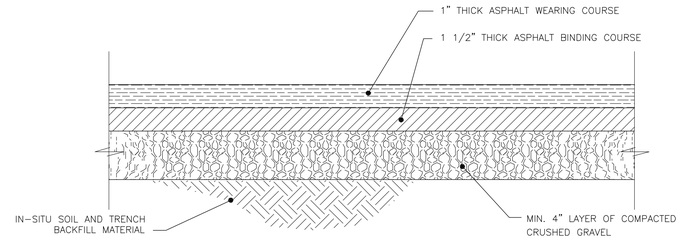
NOTES:

1. BACKFILL TO BE PLACED IN MAXIMUM LOOSE LIFT OF 8 INCHES, RESULTING IN MAXIMUM COMPACTED LIFT OF 6 INCHES (MINIMUM 3 PASSES WITH A WALK–BEHIND PLATE COMPACTOR).
2. BACKFILL TO BE COMPACTED TO A MINIMUM OF 92 PERCENT OF THE MAXIMUM DRY DENSITY BENEATH PAVEMENT AND 85 PERCENT FOR UNPAVED AREAS AS DETERMINED BY ASTM D–1557.
3. FILL SHALL BE COMPACTED WITH A RANGE OF 1 PERCENT BELOW TO 3 PERCENT ABOVE OPTIMUM MOISTURE CONTENT AS DETERMINED BY ASTM D–1557.



SODIUM PERMANGANATE TANK DETAIL

SCALE: NONE



TYPICAL ASPHALT PATCH DETAIL

SCALE: NONE

NOTE: ASPHALT PATCHING DETAIL REQUIREMENTS TO BE MODIFIED, PER ENGINEER'S APPROVAL, TO MATCH EXISTING ASPHALT CONDITIONS.

CONSTRUCTION NOTES:

1. PIPE ROUTING SHOWN FOR CONSTRUCTION LAYOUT PURPOSES ONLY. ACTUAL ROUTING TO BE FIELD DETERMINED AND IS SUBJECT TO ENGINEER'S APPROVAL.
2. REFER TO DRAWING M–2 FOR THE SIZE AND MATERIAL USED FOR PROCESS PIPING.
3. OBSERVATION WELL LOCATIONS ARE SHOWN ON DRAWING 7. CONTRACTOR SHALL EXTEND ALL PROCESS PIPING AND MAKE ALL NECESSARY CONNECTIONS TO WELL VAULTS.
4. ALL PIPING PRESSURE TESTS SHALL BE MADE BY THE CONTRACTOR IN THE PRESENCE OF THE ENGINEER. TESTS SHALL BE PERFORMED PRIOR TO BACKFILL OF TRENCHES.
5. THE CONTRACTOR SHALL PROVIDE ALL PRODUCTS AND PROPERLY CALIBRATED TESTING EQUIPMENT REQUIRED TO PERFORM THE PRESSURE TESTING WORK.
6. ALL INJECTION PIPING SHALL BE PRESSURE TESTED. PIPING JOINTS SHALL BE EXPOSED DURING THE TESTS. UNLESS APPROVED BY ENGINEER TESTS MAY BE PERFORMED ON SEPARATE SECTIONS OF PIPING TO EXPEDITE CONSTRUCTION. THE CONTRACTOR SHALL NOT PERFORM PRESSURE TESTING AGAINST SYSTEM VALVES. INJECTION PIPE SECTIONS SHALL BE HYDROSTATIC ALLY TESTED AT 125 PSI FOR TWO HOURS.
7. AFTER THE INITIAL PRESSURE TEST ON PIPING IS COMPLETED SUCCESSFULLY, THE CONTRACTOR SHALL BACKFILL THE TRENCHES AS SPECIFIED ON HEREIN.
8. TRENCHING WILL BE PERFORMED PER THESE SPECIFICATIONS AND AS SHOWN ON HEREIN.
9. EXCAVATIONS SHALL BE KEPT FREE FROM STANDING WATER.
10. CONTRACTOR SHALL NOTIFY THE ENGINEER AT THE COMPLETION OF EXCAVATIONS AND TRENCHING TO ALLOW FOR INSPECTIONS.
11. CONTRACTOR SHALL PROVIDE APPROPRIATE SAFETY BARRICADES AROUND TRENCHING AND EXCAVATION TO PREVENT ACCIDENTS OR UNAUTHORIZED ENTRY.
12. CONTRACTOR'S FILL SOURCE MUST BE TESTED BY CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO COMMENCING THE WORK AND/OR PLACING THE MATERIAL.
13. EXCAVATIONS WILL BE BACK FILLED AS PROMPTLY AS WORK PERMITS ONCE REQUIRED INSPECTIONS HAVE BEEN COMPLETED.
14. DO NOT PLACE MATERIALS ON SURFACES THAT ARE MUDDY, FROZEN, OR CONTAIN ICE OR FROST.
15. CONTRACTOR SHALL PLACE A SINGLE STRIP OF UTILITY WARNING TAPE IN ALL TRENCHED AREAS. THIS TAPE SHALL CONTAIN A WIRE FOR METAL DETECTION OR HAVE AN ALUMINUM CORE. TAPE SHALL BE PLACED AT A DEPTH OF 6 INCHES IN NON–PAVED AREAS AND BELOW THE SUB–BASE IN PAVED AREAS.
16. REPLACE ASPHALT IN PAVED AREAS FOLLOWING TRENCHING, PIPING INSTALLATION AND BACKFILL. THE CONTRACTOR SHALL PERFORM ALL ASPHALT REPLACEMENT IN THE TRENCHING AREAS IN ACCORDANCE WITH THE DETAILS CONTAINED HEREIN.
17. THE SUB–BASE AND EACH ASPHALT COURSE SHALL BE COMPACTED ACCORDING TO THESE SPECIFICATIONS. EACH LAYER SHALL BE CLEAN AND DRY PRIOR TO THE APPLICATION OF THE NEXT LAYER.
18. ALL RECOVERY PIPELINES SHALL BE FLUSHED WITH POTABLE WATER FOLLOWING FINAL PRESSURE TEST APPROVAL AND PRIOR TO FINAL CONNECTION.

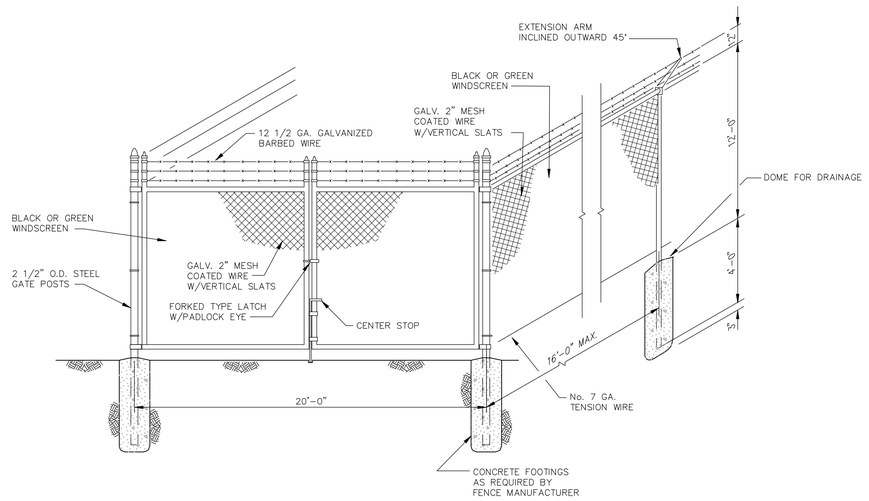
UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
SITE MANAGEMENT PLAN

MISCELLANEOUS DETAILS

ARCADIS

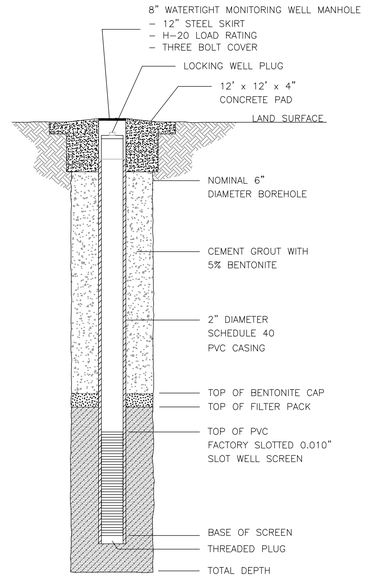
FIGURE
9A

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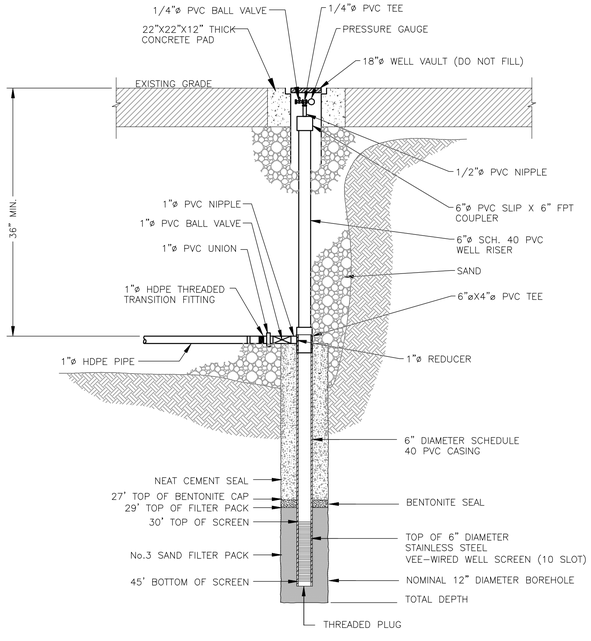
CHAIN LINK FENCE DETAIL

SCALE: NONE



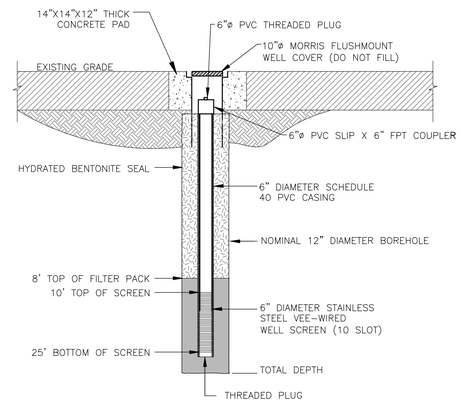
MONITORING WELL CONSTRUCTION DETAIL

SCALE: NONE



INJECTION WELL CONSTRUCTION DETAIL FOR INJECTION WELLS IJ-2, IJ-3, IJ-7, IJ-8, AND IJ-9

SCALE: NONE



INJECTION WELL CONSTRUCTION DETAIL FOR INJECTION WELL IJ-10

SCALE: NONE

NOTES:

1. ALL INJECTION WELL SCREENS ARE STAINLESS STEEL VEE–WIRED.
2. 1"Ø PVC BALL VALVE TO BE SHUT WHILE PRESSURE TESTING THEN OPENED BEFORE BACKFILLING.

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
SITE MANAGEMENT PLAN

MISCELLANEOUS DETAILS

ARCADIS

FIGURE
9B

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ARCADIS

Appendix A

Excavation Work Plan

EXCAVATION WORK PLAN

1.0 NOTIFICATION

At least 15 days prior to the start of any activity that is anticipated to encounter remaining contamination, the site owner or their representative will notify the Department. Currently, this notification will be made to:

Ed Hampston
625 Broadway-12th Floor
Albany, NY 12233-7017
(518) 402-9812
EMail: exhampston@gw.dec.state.ny.us

This notification will include:

- A detailed description of the work to be performed, including the location and areal extent, plans for site re-grading, intrusive elements or utilities to be installed below the soil cover, estimated volumes of contaminated soil to be excavated and any work that may impact an engineering control,
- A summary of environmental conditions anticipated in the work areas, including the nature and concentration levels of contaminants of concern, potential presence of grossly contaminated media, and plans for any pre-construction sampling;
- A schedule for the work, detailing the start and completion of all intrusive work,
- A summary of the applicable components of this excavation work plan (EWP),
- A statement that the work will be performed in compliance with this EWP and 29 CFR 1910.120,
- A copy of the contractor's health and safety plan, in electronic format,
- Identification of disposal facilities for potential waste streams,
- Identification of sources of any anticipated backfill, along with all required chemical testing results.

2.0 SOIL SCREENING METHODS

Visual and instrument-based soil screening will be performed by during all remedial and development excavations into known or potentially contaminated material (remaining contamination). Soil screening will be performed regardless of when the invasive work is done and will include all excavation and invasive

work performed during development, such as excavations for foundations and utility work, after issuance of the certification of completion.

Soils will be segregated based on previous environmental data and screening results into material that requires off-site disposal, material that requires testing, material that can be returned to the subsurface, and material that can be used as cover soil.

3.0 STOCKPILE METHODS

Separate stockpiles of excavated soils will be maintained for the clean soils and the chemical of concern (COC)-affected soils, if any. Both soil-types will be stockpiled within designated areas. These areas will be diked and lined with two layers of 6-mil polyethylene sheeting. Hay bales will be used as needed near catch basins, surface waters and other discharge points.

Stockpiled soils will be covered at all times with plastic to mitigate volatile organic compound (VOC) vapor emissions and wind erosion. Stockpiles will be routinely inspected and damaged covers will be promptly replaced.

Stockpiles will be inspected at a minimum once each week and after every storm event. The stockpiled soil will be disposed of as soon as possible. Results of inspections will be recorded in a logbook and maintained at the site and available for inspection by New York State of Department of Environmental Conservation (NYSDEC).

4.0 MATERIALS EXCAVATION AND LOAD OUT

All soil will be removed by means and methods proposed by the contractor. Hand digging may be required to avoid damaging underground utilities. All excavated material will be handled as potentially contaminated material. All excavated material will be staged onto a 40-mil thick liner and be covered by two layers of 6-mil thick plastic. The plastic cover will be maintained to prevent rainfall infiltration of the stockpiled soil and contaminated runoff from the staging area. If the excavation will be conducted the proximity of the building, the excavated area will not extent more than 25 feet along the building wall at any one time. During construction, site security will be implemented to prevent unauthorized entries. A temporary construction fence will be installed around the construction area to restrict access to the excavation area.

ARCADIS or the qualified environmental professional will oversee all invasive work and the excavation and load-out of all excavated material. The responsible party and its contractors are solely responsible for safe execution of all invasive and other work performed under this Plan.

The presence of utilities and easements on the site will be investigated by the qualified utility locators. It will be determined whether a risk or impediment to the planned work under this Site Management Plan (SMP) is posed by utilities or easements on the site.

Loaded vehicles leaving the site will be appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and New York State Department of Transportation (NYSDOT) requirements (and all other applicable transportation requirements).

A truck wash will be operated on-site. The qualified environmental professional will be responsible for ensuring that all outbound trucks will be washed at the truck wash before leaving the site until the activities performed under this section are complete.

Locations where vehicles enter or exit the site shall be inspected daily for evidence of off-site soil tracking.

The qualified environmental professional will be responsible for ensuring that all egress points for truck and equipment transport from the site are clean of dirt and other materials derived from the site during intrusive excavation activities. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to site-derived materials.

The proposed protocols for the loading and transport of hazardous and non-hazardous soil generated during the construction are described in the following sections.

Vehicle Loading

The dump trailer, truck bed, or roll off box will be equipped with a watertight liner (6 mil minimum thickness polyethylene sheeting) prior to placing the excavated soils onto the transport vehicle. The plastic liner will cover the bottom and sidewalls of the dump trailer, truck bed, or roll off box such that the edges of the liner can be folded over the soil after the vehicle has been loaded. All transport vehicles will be equipped with watertight tarps or covers. Soils that temporarily accumulate in roll off boxes or staging areas prior to off-site transportation and disposal will be covered by a tarp, synthetic liner, or other appropriate cover.

All loading will be done in a manner to avoid incidental spillage of soil during movement outside the work area. In the case of any incidental spillage, the spilled soil will be recovered, and any contaminated soil removed. The soil should not mound above the side rails of the dump trailer or bed, and should be distributed evenly throughout the transport vehicle to avoid load shifting during transport.

Soil loading into trucks will occur on an asphalt-paved surface covered with a 40-mil thick liner so that any soil dropped or spilled during loading will not come in contact with a clean native ground surface. Soil spilled on the plastic will be removed with mechanical buckets, shovels, and/or brooms, as appropriate, and be placed back in the soil stockpile from which it was taken.

All soil transportation vehicles will be decontaminated prior to exiting the project site. This procedure will consist of pressure washing or steam cleaning the transport vehicles at a vehicle decontamination station. Decontamination will focus on the tires, undercarriages, and side rails of the transport vehicle. All vehicle decontamination rinsates will be removed from the vehicle decontamination station as needed to prevent overflow of the removal sump. Vehicle decontamination rinsates will be managed as contaminated liquids, including drumming, labeling, and staging.

The vehicle/equipment/personnel decontamination areas will be located within the site parking lots where the excavated soils are to be stockpiled and where vehicle loading will be performed. Within this decontamination area, separate zones will be set up for decontamination of vehicles, equipment, and personnel so that workers not directly involved with vehicle loading and decontamination are not mixed

with vehicles that are being decontaminated. The decontamination area will consist of a bermed area lined with at least a 100-mil thick synthetic liner with ingress/egress points for vehicles (rounded berms to allow for vehicle traffic).

Vehicle Departure

After the loading is complete, the load will be covered and the vehicle inspected. The vehicle inspection will include:

- Freeboard (i.e., soil not mounded above the side rails of the sump trailer or bed);
- Proper closure and locking of the tailgate;
- Cleanliness of the transport vehicle, with particular emphasis on the tires, undercarriage, and side rails of the vehicle;
- Security of the tarp over the dump trailer or bed; and
- Appropriate federal and state labeling and placarding.

The inspection will be documented in an inspection checklist, which will provide space for a signature and comments or notations.

5.0 MATERIALS TRANSPORT OFF-SITE

All transport of materials will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded.

Material transported by trucks exiting the site will be secured with tight-fitting covers. Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used.

All trucks will be washed prior to leaving the site. Truck wash waters will be collected and disposed of off-site in an appropriate manner.

Truck transport routes will be identified and submitted to the NYSDEC prior to mobilization. All trucks loaded with site materials will exit the vicinity of the site using only these approved truck routes. This is the most appropriate route and takes into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of city mapped truck routes; (c) prohibiting off-site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport; [(g) community input [where necessary]]

Trucks will be prohibited from stopping and idling in the neighborhood outside the project site.

Egress points for truck and equipment transport from the site will be kept clean of dirt and other materials during site remediation and development.

Queuing of trucks will be performed on-site in order to minimize off-site disturbance. Off-site queuing will be prohibited.

6.0 MATERIALS DISPOSAL OFF-SITE

All soil/fill/solid waste excavated and removed from the site will be treated as contaminated and regulated material and will be transported and disposed in accordance with all local, State (including 6NYCRR Part 360) and Federal regulations. If disposal of soil/fill from this site is proposed for unregulated off-site disposal (i.e. clean soil removed for development purposes), a formal request with an associated plan will be made to the NYSDEC. Unregulated off-site management of materials from this site will not occur without formal NYSDEC approval.

Off-site disposal locations for excavated soils will be identified in the pre-excavation notification. This will include estimated quantities and a breakdown by class of disposal facility if appropriate, i.e. hazardous waste disposal facility, solid waste landfill, petroleum treatment facility, C/D recycling facility, etc. Actual disposal quantities and associated documentation will be reported to the NYSDEC in the Periodic Review Report. This documentation will include: waste profiles, test results, facility acceptance letters, manifests, bills of lading and facility receipts.

Non-hazardous historic fill and contaminated soils taken off-site will be handled, at minimum, as a Municipal Solid Waste per 6NYCRR Part 360-1.2. Material that does not meet Track 1 unrestricted SCOs is prohibited from being taken to a New York State recycling facility (6NYCRR Part 360-16 Registration Facility).

7.0 MATERIALS REUSE ON-SITE

If materials reuse is proposed for the proposed excavation activity, a plan will be prepared and provided all details regarding materials reuse on-site. 'Reuse on-site' means reuse on-site of material that originates at the site and which does not leave the site during the excavation. The following will be discussed:

- Procedure for determining if reuse is appropriate:
    - Sampling (methods and analytical)
    - Chemical limits for on-site reuse
    - Stockpile segregation scheme for on-site reuse

Chemical criteria for on-site reuse of material which have been approved by NYSDEC will be listed in a table. The qualified environmental professional will ensure that procedures defined for materials reuse in this SMP are followed and that unacceptable material does not remain on-site. Contaminated on-site material, including historic fill and contaminated soil, that is acceptable for re-use on-site will be placed below the demarcation layer or impervious surface, and will not be reused within a cover soil layer, within landscaping berms, or as backfill for subsurface utility lines.

Any demolition material proposed for reuse on-site will be sampled for asbestos and the results will be reported to the NYSDEC for acceptance. Concrete crushing or processing on-site will not be performed without prior NYSDEC approval. Organic matter (wood, roots, stumps, etc.) or other solid waste derived from clearing and grubbing of the site will not be reused on-site.

8.0 FLUIDS MANAGEMENT

All liquids to be removed from the site, including excavation dewatering and groundwater monitoring well purge and development waters, will be handled, transported and disposed in accordance with applicable local, State, and Federal regulations. Dewatering, purge and development fluids will not be recharged back to the land surface or subsurface of the site, but will be managed off-site.

Discharge of water generated during large-scale construction activities to surface waters (i.e. a local pond, stream or river) will be performed under a State Pollution Discharge Elimination System (SPDES) permit.

9.0 COVER SYSTEM RESTORATION

After the completion of soil removal and any other invasive activities the cover system will be restored in a manner that complies with the Record of Decision (ROD). The demarcation layer, consisting of orange snow fencing material or equivalent material will be replaced to provide a visual reference to the top of the 'Remaining Contamination Zone', the zone that requires adherence to special conditions for disturbance of remaining contaminated soils defined in this SMP. If the type of cover system changes from that which exists prior to the excavation (i.e., a soil cover is replaced by asphalt), this will constitute a modification of the cover element of the remedy and the upper surface of the 'Remaining Contamination. A figure showing the modified surface will be included in the subsequent Periodic Review Report (PRP) and in any updates to the SMP.

10.0 BACKFILL FROM OFF-SITE SOURCES

Detailed of import, handling and placement of backfill material from off-site will be provided to the NYSDEC once the excavation area is fully defined. The following topics will be discussed:

- Source area approval process
    - Sources of backfill material
        - Past use of site
        - Source area background check
        - DOT Certification
    - Chemical sampling
        - Analytes
        - Frequency
    - Imported Soil Chemical Quality (SCOs) Standards
        - Applicability of protection of groundwater SCOs
        - Applicability of protection of ecological resources SCOs
- Procedure for determining if reuse is appropriate
    - Sampling (methods and analytical)

- Stockpile procedures for imported backfill material
    - Size of stockpiles, cover, etc.

In general, all materials proposed for import onto the site will be approved by the qualified environmental professional and will be in compliance with provisions in this SMP prior to receipt at the site.

Material from industrial sites, spill sites, or other environmental remediation sites or potentially contaminated sites will not be imported to the site.

All imported soils will meet the backfill and cover soil quality standards established in 6NYCRR 375-6.7(d). Soils that meet 'exempt' fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this site, will not be imported onto the site without prior approval by NYSDEC. Solid waste will not be imported onto the site.

Trucks entering the site with imported soils will be securely covered with tight fitting covers. Imported soils will be stockpiled separately from excavated materials and covered to prevent dust releases.

11.0 STORMWATER POLLUTION PREVENTION

A summary of the Stormwater Pollution Prevention Plan that conforms to the requirements of NYSDEC Division of Water guidelines and NYS regulations should be prepared and submitted to the NYSDEC once the excavation area is defined. For larger excavations (especially areas larger than 1 acre), procedures for stormwater pollution prevention will be specified.

In general, barriers and hay bale checks will be installed and inspected once a week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the site and available for inspection by NYSDEC. All necessary repairs shall be made immediately.

Accumulated sediments will be removed as required to keep the barrier and hay bale check functional.

All undercutting or erosion of the silt fence toe anchor shall be repaired immediately with appropriate backfill materials.

Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.

Erosion and sediment control measures identified in the SMP shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters

Silt fencing or hay bales will be installed around the entire perimeter of the construction area.

12.0 CONTINGENCY PLAN

If other previously unidentified contaminant sources are found during post-remedial subsurface excavations or development related construction, excavation activities will be suspended until sufficient equipment is mobilized to address the condition.

Sampling will be performed on product, sediment and surrounding soils, etc. as necessary to determine the nature of the material and proper disposal method. Chemical analysis will be performed for full a full list of analytes (TAL metals; TCL volatiles and semi-volatiles, TCL pesticides and polychlorinated biphenyl [PCBs]), unless the site history and previous sampling results provide a sufficient justification to limit the list of analytes. In this case, a reduced list of analytes will be proposed to the NYSDEC for approval prior to sampling.

Identification of unknown or unexpected contaminated media identified by screening during invasive site work will be promptly communicated by phone to NYSDEC's Project Manager. Reportable quantities of petroleum product will also be reported to the NYSDEC spills hotline. These findings will be also included in the periodic reports prepared pursuant to Section 5 of the SMP.

13.0 COMMUNITY AIR MONITORING PLAN

Once the proposed excavation area has been identified, a Community Air Monitoring Plan (CAMP) will be prepared and submitted to the NYSDEC in accordance with the guidance provided in Appendix 1A of DER-10, Generic Community Air Monitoring Plan. At a minimum, this section must include:

- Details of the perimeter air monitoring program;
- Action levels to be used;
- Methods for air monitoring ;
- Analytes measured and instrumentation to be used;
- A figure of the location(s) of all air monitoring instrumentation. A figure showing specific locations of air sampling stations based on generally prevailing wind conditions. These locations will be adjusted on a daily or more frequent basis based on actual wind directions to provide an upwind and at least two downwind monitoring stations.

Exceedances of action levels listed in the CAMP will be reported to NYSDEC and New York State of Department of Health (NYSDOH) Project Managers.

14.0 ODOR CONTROL PLAN

This odor control plan is capable of controlling emissions of nuisance odors off-site. Specific odor control methods to be used on a routine basis will include applying polyethylene sheets or covers and using water soluble, non-toxic, non-reactive, and non-volatile odor suppression agents. Work will not resume until all nuisance odors have been abated. NYSDEC and NYSDOH will be notified of all odor events and

of any other complaints about the project. Implementation of all odor controls, including the halt of work, is the responsibility of the property owner's Remediation Engineer, and any measures that are implemented will be discussed in the PRP.

All necessary means will be employed to prevent on- and off-site nuisances. At a minimum, these measures will include: (a) limiting the area of open excavations and size of soil stockpiles; (b) shrouding open excavations with tarps and other covers; and (c) using foams to cover exposed odorous soils. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: (d) direct load-out of soils to trucks for off-site disposal; (e) use of chemical odorants in spray or misting systems; and, (f) use of staff to monitor odors in surrounding neighborhoods.

If nuisance odors develop during intrusive work that cannot be corrected, or where the control of nuisance odors cannot otherwise be achieved due to on-site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering the excavation and handling areas in a temporary containment structure equipped with appropriate air venting/filtering systems.

15.0 DUST CONTROL PLAN

A dust suppression plan that addresses dust management during invasive on-site work will include, at a minimum, the items listed below:

- Dust suppression will be achieved through the use of a dedicated on-site water truck for road wetting. The truck will be equipped with a water cannon capable of spraying water directly onto off-road areas including excavations and stockpiles.

- Clearing and grubbing of larger sites will be done in stages to limit the area of exposed, unvegetated soils vulnerable to dust production.

- Gravel will be used on roadways to provide a clean and dust-free road surface.

- On-site roads will be limited in total area to minimize the area required for water truck sprinkling.

Any dust suppression plan will be consistent with the guidance included in DER-10, Appendix 1A.

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Appendix B

Field Forms

ARCADIS
Groundwater Sampling Form

Project Number: _____ Task: _____ Well ID: _____
Date: _____ Sampled By: _____
Sampling Time: _____ Recorded By: _____
Weather: _____ Coded Replicate No.: _____

INSTRUMENT IDENTIFICATION

	PID	Water-Level Meter	Water Quality Meter(s)
Serial #:			

PURGING INFORMATION

Casing Material: _____ Purge Method: _____
Casing Diameter: _____ Volumes to be Purged: _____
Total Depth: _____ Total Volume Purged: _____
Depth to Water: _____ Pump on: _____ Off: _____
Water Column: _____
Gallons/Foot: _____
Gallons in Well: _____

LOW FLOW PURGE FIELD PARAMETERS

Time	Minutes Elapsed	Rate (mL/min)	Gallons Purged	Turbidity (NTUs)	REDOX (mV)	pH (SI Units)	Conductivity (mS/cm)	Temp (ºC)	Depth to Water	Dissolved O2 (ppm)	Comments

OBSERVATIONS DURING SAMPLING

Well Condition: _____ Purge Water Disposal: _____
Color: _____ Odor: _____

O_2: _____ PID: _____
CO: _____
H_2S: _____
LEL: _____
VOC: _____

Monthly Cap Inspection Checklist
Universal Instruments Site
Kirkwood, New York

Date: Representative:

Item No.	Description	Yes	No	Actions	Comments
1	1978 Building Addition floor slab in good condition?				
2	1984 Building Addition floor slab in good condition?				
3	Area 1 (front employee entrance) landscape cover intact?				
4	Area 2 (driveway at north catch basin CB-2044) asphalt surface in good condition?				
5	Area 3 (transformer pad location) vegetative cover intact?				
6	Area 4 (drainage ditch along CR 181) in good condition?				
7	Area 5 (drainage ditch along CR 181) in good condition?				
8	Area 6 (drainage ditch along CR 181) in good condition?				
9	Area 7 (parking lot at southeast loading dock) asphalt surface in good condition?				
10	ASD system operational?				
11	ASD system vacuum readings normal?				
12	ASD system components in good condition?				

Active Sub-Slab Depressurization (ASD) Operational Data, Former Dover Electronics Site, Kirkwood, New York

Date	Time	System On? (Y/N)	Vaccum Reading (inches water)								Comments
			ASD-1	ASD-2	ASD-3	ASD-4	ASD-5	ASD-6	ASD-7	ASD-8	

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PERMANGANATE SOLUTION MIXING LOG

Former Dover Electronics Site, Kirkwood, New York

Date: _____ Monitoring Zone: _____

Weather _____ Personnel: _____

INJECTION SOLUTION CHARACTERISTICS

	Mixing Tank					
	Time	**Color**	**Act Cond.**	**Sp Cond.**	**$NaMnO_4$ (gal)**	**Total Volume**
Batch 1						
Batch 2						
Batch 3						
Batch 4						
Batch 5						
Batch 6						
Batch 7						
Batch 8						
Batch 9						
Batch 10						
Batch 11						
Batch 12						
Batch 13						
Batch 14						
Batch 15						

ARCADIS

PERMANGANATE INJECTION LOG

Former Dover Electronics Site, Kirkwood, New York

Date: _____ Monitoring Zone: _____

Weather _____ Personnel: _____

INJECTION SOLUTION CHARACTERISTICS

	Batch 1	Batch 2	Batch 3	Batch 4	Batch 5	Batch 6	Batch 7
Volume of Water:							
/olume of $NaMnO_4$:							
Sp. Cond. ( ):							

INJECTION LINE READINGS

Time	Wellhead Pressure (psi)	Water Level (ft bgs)	Injected Volume (gal)	Flowrate (gal/min)	NOTES:

VERTICAL PROFILING - PERMANGANATE MONITORING LOG

Former Dover Electronics Site, Kirkwood, New York

Date: _____ Well Total Depth (ft): _____

Weather _____ Personnel: _____

Well ID _____

Time	Volume gals	Water Level ft TOC	Screen Intervals															NOTES:
			1			2			3			4			5			
			color	Actual	Specific	color	Actual	Specific	color	Actual	Specific	color	Actual	Specific	color	Actual	Specific	

ARCADIS

PERMANGANATE SAMPLING LOG

Former Dover Electronics Site, Kirkwood, New York

Sample Date	Sample Time	Well ID	Initial Concentration (without dilution)		Dilution		Concentration of diluted sample		Actual Concentration (after dilution)		Notes
			$KMnO_4$	$NaMnO_4$	Initial sample volume	Final sample volume	$KMnO_4$	$NaMnO_4$	$KMnO_4$	$NaMnO_4$	

Note:
1. Using the following equation to convert for sodium permanganate
mg/L KMnO4 X 0.898 = mg/L NaMnO4

In-Situ Chemical Oxidation Injection System Inspection, Former Dover Electronics Site, Kirkwood, New York

Date	Time	Condition					Comments
		ISCO Fence	ISCO Distribution Box	ISCO Feed Tank	ISCO Trench Area	Asphalt and Concrete Pavement (around the wells)	

ARCADIS

Appendix C

Material Safety Data Sheet

RemOx® L
ISCO Reagent

EC- SAFETY DATA SHEET according to Regulation (EC) № 1907/2006 of the European Parliament and of the Council, of 18 December 2006 concerning REACH

Material Safety Data Sheet

Section 1 Chemical Product and Company Identification

PRODUCT NAME: RemOx® L ISCO Reagent **TRADE NAME:** RemOx® L ISCO Reagent	**Revision Date: January 2010**

USES OF SUBSTANCE: RemOx® L ISCO Reagent is a liquid oxidant recommended for in-situ and ex-situ remediation of sites that require a strong oxidant.

COMPANY NAME (Europe): CARUS EUROPE	**COMPANY ADDRESS:** C/SECUNDINO ROCES, 3-Planta 1ª-Oficina 14 33428 Cayes – Llanera, Asturias - Spain **INFORMATION:** (34) 985-785-513 (34) 985-785-513 **EMERGENCY TELEPHONE:** (34) 985-785-513
COMPANY NAME (US): CARUS CORPORATION	**COMPANY ADDRESS:** 315 Fifth Street Peru, IL 61354, USA **INFORMATION:** (815)-223-1500 www.caruscorporation.com (Web) salesmkt@caruscorporation.com (Email) **EMERGENCY TELEPHONE:** (800) 435 –6856 (USA) (800) 424-9300 (CHEMTREC, USA) (815-223-1500 (Other countries)

Section 2 Hazards Identification

1. Eye Contact
   RemOx® L ISCO Reagent is damaging to eye tissue on contact. It may cause burns that result in damage to the eye.
2. Skin Contact
   Momentary contact of solution at room temperature may be irritating to the skin, leaving brown stains. Prolonged contact is damaging to the skin.
3. Inhalation
   Acute inhalation toxicity data are not available. However, airborne concentrations of RemOx® L ISCO Reagent in the form of mist may cause irritation to the respiratory tract.
4. Ingestion
   RemOx® L ISCO Reagent if swallowed, may cause burns to mucous membranes of the mouth, throat, esophagus, and stomach.

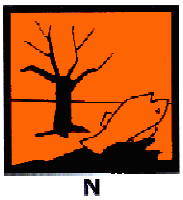
Section 3 Hazardous Ingredients

Material or Component	CAS No.	%	Hazard Data
Sodium Permanganate	10101-50-5	40	**PEL/C** 5 mg Mn per cubic meter of air **TLV-TWA** 0.2 mg Mn per cubic meter of air

HAZARD SYMBOLS:


O


Xn


N

RISK PHRASES:

8 Contact with combustibles may case fire.
22 Harmful if swallowed.
50/53 Very toxic to aquatic organisms, may cause long-term effects in the aquatic environment.

SAFETY PHRASES:

17 Keep away from combustible materials.
24/25 Avoid contact with skin and eyes.
26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice

Section 4 First Aid Measures

1. Eyes
   Immediately flush eyes with large amounts of water for at least 15 minutes holding lids apart to ensure flushing of the entire surface. Do not attempt to neutralize chemically. Seek medical attention immediately. Note to physician: Decomposition products are alkaline.
2. Skin
   Immediately wash contaminated areas with water. Remove contaminated clothing and footwear. (Caution: Solution may ignite certain textiles). Wash clothing and decontaminate footwear before reuse. Seek medical attention immediately if irritation is severe and persistent.
3. Inhalation
   Remove person from contaminated area to fresh air. If breathing has stopped, resuscitate and administer oxygen if readily available. Seek medical attention immediately.
4. Ingestion
   Never give anything by mouth to an unconscious or convulsing person. If person is conscious, give large quantities of water or milk. Seek medical attention immediately.

Section 5 Fire Fighting Measures

NFPA* HAZARD SIGNS:

Health Hazard	1	=	Materials which under fire conditions would give off irritating combustion products. (less than 1 hour exposure) Materials which on the skin could cause irritation.
Flammability Hazard	0	=	Materials that will not burn.
Reactivity Hazard	0	=	Materials which in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water.
Special Hazard	OX	=	Oxidizer

***National Fire Protection Association 704**

FIRST RESPONDERS:
Wear protective gloves, boots, goggles, and respirator. In case of fire, wear positive pressure breathing apparatus. Approach incident with caution. Use 2004 Emergency Response Guidebook (U.S. DOT RSPA, TC and STC). Guide No. 140. (http://hazmat.dot.gov/pubs/erg2004/erg2004.pdf).

FLASHPOINT	None
FLAMMABLE OR EXPLOSIVE LIMITS	Lower: Nonflammable Upper: Nonflammable
EXTINGUISHING MEDIA	Use large quantities of water. Water will turn pink to purple if in contact with RemOx® L ISCO Reagent. Dike to contain. Do not use dry chemicals, CO_2Halon® or foams.
SPECIAL FIREFIGHTING PROCEDURES	If material is involved in fire, flood with water. Cool all affected containers with large quantities of water. Apply water from as far as a distance as possible. Wear self-contained breathing apparatus and full protective clothing.
UNUSUAL FIRE AND EXPLOSION	Powerful oxidizing material. May decompose spontaneously if exposed to heat (135°C/275°F). May be explosive in contact with certain other chemicals (Section 10). May react violently with finely divided and readily oxidizable substances. Increases burning rate of combustible material. May ignite wood and cloth.

Section 6 Accidental Release Measures

PERSONAL PRECAUTIONS

Personnel should wear protective clothing suitable for the task. Remove all ignition sources and incompatible materials before attempting clean up.

ENVIRONMENTAL PRECAUTIONS:

Do not flush into sanitary sewer system or surface water. If accidental release into the environment occurs, inform the responsible authorities. Keep the product away from drains, sewers, surface and ground water and soil.

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

Contain spill by collecting the liquid in a pit or holding behind a dam (sand or soil). Dilute to approximately 6% with water, and then reduce with sodium thiosulfate, a bisulfite or ferrous salt solution. The bisulfite or ferrous salt may require some dilute sulfuric acid (10% w/w) to promote reduction. Neutralize with sodium carbonate to neutral pH, if acid was used. Decant or filter and deposit sludge in approved landfill. Where permitted, the sludge may be drained into sewer with large quantities of water. To clean contaminated floors, flush with abundant quantities of water into sewer, if permitted by federal, state, and local regulations. If not, collect water and treat as above.

Section 7 Handling and Storage

WORK/HYGIENIC PRACTICES
Wash hands thoroughly with soap and water after handling RemOx® L ISCO Reagent. Do not eat, drink or smoke when working with RemOx® L ISCO Reagent . Wear proper protective equipment. Remove clothing, if it becomes contaminated.

VENTILATION REQUIREMETNS
Provide sufficient mechanical and/or local exhaust to maintain exposure below the TLV/TWA.

CONDITIONS FOR SAFE STORAGE
Store in accordance with NFPA 430 requirements for Class II oxidizers. Protect containers from physical damage. Store in a cool, dry area in closed containers. Segregate from acids, peroxides, formaldehyde, and all combustible, organic, or easily oxidizable materials including antifreeze and hydraulic fluid.

Section 8 Exposure Controls and Personal Protection

RESPIRATORY PROTECTION
In cases where overexposure to mist may occur, the use of an approved NIOSH-MSHA mist respirator or an air supplied respirator is advised. Engineering or administrative controls should be implemented to control mist.

EYE
Faceshield, goggles, or safety glasses with side shields should be worn. Provide eyewash in working area.

GLOVES
Rubber or plastic gloves should be worn.

OTHER PROTECTIVE EQUIPMENT
Normal work clothing covering arms and legs, and rubber, or plastic apron should be worn. Caution: If clothing becomes contaminated, wash off immediately. Spontaneous ignition may occur with cloth or paper.

Section 9 Physical and Chemical Properties

APPEARANCE AND ODOR	Dark purple solution, odorless
BOILING POINT, 760 mm Hg	105 °C
VAPOR PRESSURE (mm Hg)	760 mm at 105ºC
SOLUBILITY IN WATER % BY SOLUTION	Miscible in all proportions

PERCENT VOLATILE BY VOLUME	61% (as water)
EVAPORATION RATE	Same as water
FREEZING POINT	-15.0 °C
SPECIFIC GRAVITY	1.36-1.39
pH	5-9
OXIDIZING PROPERTIES	Strong oxidizer. May ignite wood and cloth.
EXPLOSIVE PROPERTIES	Explosive in contact with sulfuric acid or peroxides, or readily oxidizable substances.

Section 10 Stability and Reactivity

STABILITY	Under normal conditions, the material is stable.
CONDITIONS TO AVOID could	Contact with incompatible materials or heat (135°C / 275ºF) result in violent exothermic chemical reaction.
INCOMPATIBLE MATERIALS	Acids, peroxides, formaldehyde, antifreeze, hydraulic fluids, and all combustible organic or readily oxidizable materials, including metal powders. With hydrochloric acid, toxic chlorine gas is liberated.
HAZARDOUS DECOMPOSITION PRODUCTS	When involved in a fire, liquid permanganate may form corrosive fumes.
CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION	Material is not known to polymerize.

Section 11 Toxicological Information

SODIUM PERMANGANATE: Acute oral LD_{50} not known.

1. Acute toxicity

Irritating to body tissue with which it comes into contact. No acute toxicity data is available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate. The toxicity data for potassium permanganate is given below:

Ingestion:
LD 50 oral rat: 780 mg/kg male (14 days); 525 mg/kg female (14 days).
Harmful if swallowed. ALD: 10g. Ingestion may cause nausea, vomiting, sore throat, stomach-ache and eventually lead to a perforation of the intestine. Liver and kidney injuries may occur.

Skin contact:
LD 50 dermal no data available.

The product may be absorbed into the body through the skin. Major effects of exposure: severe irritation, brown staining of skin.

Inhalation:
LC 50 inhal. no data available.
The product may be absorbed into the body by inhalation. Major effects of exposure: respiratory disorder, cough.

2. Chronic toxicity
No known cases of chronic poisoning due to permanganates have been reported. Prolonged exposure, usually over many years, to heavy concentrations of manganese oxides in the form of dust and fumes may lead to chronic manganese poisoning, chiefly involving the central nervous system.

3. Carcinogenicity
Sodium permanganate has not been classified as a carcinogen by ACGIH, NIOSH, OSHA, NTP, or IARC.

4. Medical Conditions Generally Aggravated by Exposure
Sodium permanganate solution will cause further irritation of tissue, open wounds, burns or mucous membranes.

Section 12 Ecological Information

Entry to the Environment
Permanganate has a low estimated lifetime in the environment, being readily converted by oxidizable materials to insoluble MnO_2.

Bioconcentration Potential
In non-reducing and non-acidic environments MnO_2 is insoluble and has a very low bioaccumulative potential.

Aquatic Toxicity
No data.

Section 13 Disposal Considerations

Waste Disposal

RemOx® L ISCO Reagent, once it becomes a waste, is considered a D001 hazardous (ignitable) waste. For disposal of RemOx® L ISCO Reagent solutions, follow procedures in Section 6 and deactivate the permanganate to insoluble manganese dioxide. Dispose of it in a permitted landfill. Contact Carus Chemical Company for additional recommendations.

Section 14 Transport Information

USA (land, D.O.T.)	**Proper Shipping Name:**	49 CFR172.101 Permanganates, inorganic, aqueous solution, n.o.s .(contains sodium permanganate
	Hazard Class:	49 CFR172.101….Oxidizer
	ID Number:	49 CFR172.101….UN 3214
	Packing Group:	49 CFR172.101….II
	Division:	49 CFR172.101….5.1

European Labeling in accordance Road/Rail Transport (ADR/RID)	**ID Number:**	UN 3214
	ADR/RID Class	5.1
	Description of Goods:	Permanganates, inorganic, aqueous solution, n.o.s (contains sodium permanganate)
	Hazard Identification No.	50
European Labeling in accordance with EC directive (Water, I.M.O.)	**Proper Shipping Name:**	Permanganates, inorganic, aqueous solution, n.o.s (contains sodium permanganate)
	Hazard Class:	Oxidizer
	ID Number:	UN 3214
	Packing Group:	II
	Division:	5.1
	Marine Pollutant:	No
European Labeling in accordance with EC directive (Air, I.C.A.O.)	**Proper Shipping Name:**	Permanganates, inorganic, aqueous solution, n.o.s (contains sodium permanganate)
	Hazard Class:	Oxidizer
	ID Number:	UN 3214
	Packing Group:	II
	Division:	5.1

Section 15 Regulatory Information (Sodium Permanganate)

TSCA	Listed in the Toxic Substances Control Act (TSCA) Chemical Substance Inventory.
CERCLA	Not listed.
RCRA	Oxidizers such as RemOx® L ISCO Reagent solution meet the criteria of ignitable waste. 40 CFR 261.21.
SARA TITLE III Information	
Section 302/303	Extremely hazardous substance: Not listed
Section 311/312	Hazard categories: Fire, acute and chronic toxicity.
Section 313	RemOx® L ISCO Reagent contains 40% manganese compounds as part of the chemical and is subject to the reporting requirements of Section 313 of Title III, Superfund Amendments and Reauthorization Act of 1986 and 40 CFR 372.
FOREIGN LIST	Canadian Non-Domestic Substance List , EINECS

Section 16 Other Information

NIOSH	National Institute for Occupational Safety and Health
MSHA	Mine Safety and Health Administration
OSHA	Occupational Safety and Health Administration
NTP	National Toxicology Program

IARC	International Agency for Research on Cancer
PEL	Permissible Exposure Limit
C	Ceiling Exposure Limit
TLV-TWA	Threshold Limit Value-Time Weighted Average
CAS	Chemical Abstract Service
EINECS	Inventory of Existing Chemical Substances (European)

Chithambarathanu Pillai (S.O.F.)
January 2010

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Responsible Care®
Good Chemistry at Work

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Sodium Thiosulfate
SOD8600

Section 1 - Chemical Product and Company Identification 61

Material Name: Sodium Thiosulfate **CAS Number:** 7772-98-7
Chemical Formula: $Na_2O_3S_2$
EINECS Number: 231-867-5
ACX Number: X1000149-3
Synonyms: AMETOX; ANTICHLOR; CHLORINE CONTROL; CHLORINE CURE; DECLOR-IT; DISODIUM SALT; DISODIUM THIOSULFATE; S-HYDRIL; HYPO; SODIUM HYPOSULFITE; SODIUM OXIDE SULFIDE; SODIUM THIOSULFATE; SODIUM THIOSULFATE ANHYDROUS; SODIUM THIOSULPHATE; SODOTHIOL; SULFOTHIORINE; THIOSULFURIC ACID,DISODIUM SALT
General Use: Used widely as bleaching agent, an ingredient in photographic fixer solutions, for extraction of silver from ores, as a mordant in dyeing and printing textiles, reducers in chrome dyeing, in leather manufacture and a reagent in analytical and organic chemistry.
Antidote for cyanide poisoning.

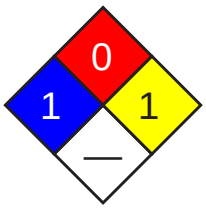
Section 2 - Composition / Information on Ingredients

Name	CAS	%
sodium thiosulfate	7772-98-7	>98

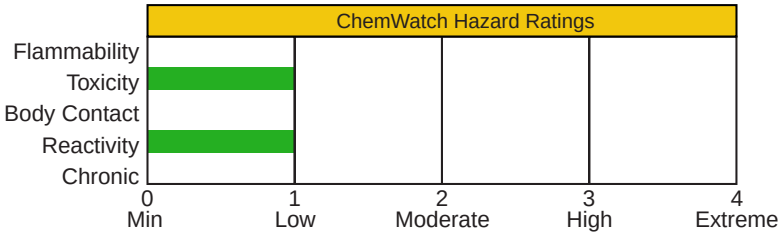
OSHA PEL **NIOSH REL**

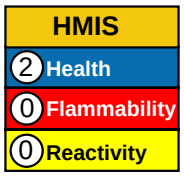
ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White powder or crystals; almost odorless. Mildly irritating to eyes/skin/respiratory tract. Also causes: nausea, abdominal cramping, diarrhea, GI irritation, allergic contact dermatitis. Chronic effects: chronic dermatitis.

Potential Health Effects

Target Organs: skin, eyes, mucous membranes, upper respiratory system, gastrointestinal (GI) tract
Primary Entry Routes: inhalation, ingestion
Acute Effects

Inhalation: The dust may be discomforting to the upper respiratory tract.
Persons with impaired respiratory function, airway diseases, and conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.

Eye: The material is moderately discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

Skin: The material is moderately discomforting to the skin.
Solution of material in moisture on the skin or in perspiration may increase irritant effects.
Open cuts, abraded or irritated skin should not be exposed to this material.

Ingestion: The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed in large quantity.

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Ingestion can cause irritation of the gastrointestinal tract and purging.
Diarrhea may occur from ingestion of large quantities. In treatment of cyanide poisoning, 12.5 gm. has been injected intravenously without ill-effect.
Thiosulfate salts are poorly absorbed from the alimentary tract and as a consequence act as an osmotic cathartic.
Absorbed thiosulfates are remarkably inert and are distributed in extracellular fluids where they may cause osmotic disturbances.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: No human exposure data available. For this reason, health effects described are based on experience with chemically-related materials.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water. Consider drinking water to remove dust from throat.
Seek medical attention if irritation or discomfort persist.

Eye Contact: Immediately hold the eyes open and flush with fresh running water.
Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.
Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water.
Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

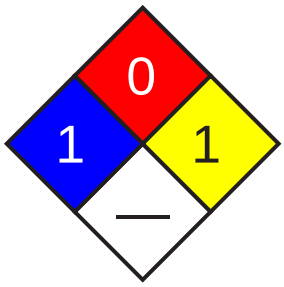
Autoignition Temperature: Not applicable

LEL: Not applicable

UEL: Not applicable

Extinguishing Media: There is no restriction on the type of extinguisher which may be used.

General Fire Hazards/Hazardous Combustion Products: The material is not readily combustible under normal conditions. However, it will breakdown under fire conditions and the organic component may burn.
Not considered to be a significant fire risk.
Heating may cause expansion and violent bursting - rupture of containers.
May emit acrid smoke.
Decomposition will occur at high temperatures and may produce fumes of Flammable hydrogen sulfide (H_2S).



Fire Diamond

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear impervious gloves and safety glasses.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up.
Place spilled material in clean, dry, sealable, labeled container.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or

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waterways.
Stop leak if safe to do so.
Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Neutralize/decontaminate residue.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing dust. Limit all unnecessary personal contact.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. When handling DO NOT eat, drink or smoke.
Always wash hands with soap and water after handling.
Avoid physical damage to containers. Use good occupational work practices.
Observe manufacturer's storing and handling recommendations.

Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Glass container or Plastic container or Plastic drum or Polylined drum.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved dust respirator.
Correct fit is essential to obtain adequate protection.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Neoprene rubber gloves or rubber gloves or PVC gloves.
Protective footwear.

Other: Overalls. Barrier cream.
Ensure that there is ready access to eye wash unit.

Glove Selection Index:

NATURAL RUBBER..... Best selection
NEOPRENE..... Best selection
NITRILE..... Best selection
NITRILE+PVC..... Best selection
PVC..... Best selection

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear to white crystals or granules with no odor. Insoluble in alcohol. Slowly decomposes in aqueous solution.

Physical State: Divided solid
Vapor Pressure (kPa): Not applicable
Vapor Density (Air=1): Not applicable
Formula Weight: 158.10
Specific Gravity (H_2O=1, at 4 °C): 1.7
Evaporation Rate: Not applicable
pH: Not applicable
pH (1% Solution): 6.5-8.0 (5% sol)
Boiling Point: 100 °C (212 °F)
Freezing/Melting Point: 48 °C (118.4 °F)
Volatile Component (% Vol): Negligible
Decomposition Temperature (°C): >100 C
Water Solubility: Practically insoluble in water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Contact with acids produces toxic fumes, i.e. sulfur dioxide (SO_2).
Avoid storage with acids, metal nitrites, sodium nitrite, halogens and oxidizing agents.

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Section 11 - Toxicological Information

Toxicity
Oral (human) TD_{Lo}: 300 mg/kg/7d

Irritation
Nil reported

See *RTECS* XN 6476000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.
Small quantities may be discharged to sewer with a large excess of water.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: None

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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ARCADIS

Appendix D

Quality Assurance Project Plan

ARCADIS
Infrastructure, environment, buildings

Imagine the result

Dover Corporation

Quality Assurance Project Plan

Kirkwood, Broome County, New York
Site Number (7-04-026)

February 2011

ARCADIS

Quality Assurance Project Plan

Former Dover Electronics Site

Kaiti Liao
Project Engineer

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Date:
February 2011

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Preface

This Quality Assurance Project Plan (QAPP) has been prepared by ARCADIS of New York, Inc. (ARCADIS), on behalf of Dover Corporation (Dover), for the former Dover Electronics site in Kirkwood, Broome County, New York (Site Number 7-04-026). This QAPP presents the sampling and analytical methods and procedures that will be used during the full scale in-situ chemical oxidation (ISCO) performance monitoring at the site. This QAPP (which is presented as Appendix D to the ISCO Construction Package) was prepared in a manner consistent with the following reference and guidance documents:

- United States Environmental Protection Agency's (USEPA's) Test Methods for Evaluating Solid Waste, SW-846 (USEPA, 1996);
- The USEPA's guidance document entitled EPA Requirements for Quality Assurance Project Plans for Environmental Operations, EPA-QA/R-5 (USEPA, 2001), which replaces QAMS-005/80 Interim Guidance and Specifications for Preparing Quality Assurance Project Plans (USEPA, 1980); and
- The National Enforcement Investigations Center (NEIC) Policies and Procedures Manual (USEPA, 1991).

Information contained in this QAPP has been organized into the following sections:

Section	Content
Project Management	
1	Project Organization and Responsibilities
2	Project Background
3	Quality Objectives and Criteria for Measurement Data
4	Special Training Requirements/Certification
5	Documentation and Records
Measurement/Data Acquisition	
6	Sampling Process Design
7	Sampling Method Requirements
8	Sample Handling and Custody Requirements
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14	Data Management
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15	Assessment and Response Actions
16	Reports to Management
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17	Data Review, Validation, and Verification
18	Validation and Verification Methods
19	Reconciliation with User Requirements
20	References

Details are provided in the subsequent sections. This document also contains pertinent information related to the measurements and evaluation of the analytical data.

Acronyms

ASP	Analytical Services Protocol
CLP	Contract Laboratory Program
DO	Dissolved Oxygen
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
FID	Flame Ionization Detector
FSP	Field Sampling Plan
HASP	Health and Safety Plan
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NYSDEC	New York State Department of Environmental Conservation
ORP	Oxidation/Reduction Potential
PRRs	Periodic Review Reports
OSHA	Occupational Safety and Health Administration
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
RPD	Relative Percent Difference
SMP	Site Management Plan
SDG	Sample Delivery Group

USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1. Project Organization and Responsibilities

1.1 Project Organization

The site will require integration of personnel from the organizations identified below collectively referred to as the "project team". A detailed description of the responsibilities of each member of the project team is presented in Section 1.2.

1.1.1 Overall Project Management

ARCADIS of New York, Inc. (ARCADIS), on behalf of Dover Corporation (Dover), has overall technical responsibility for the monitoring activities. ARCADIS personnel will perform related sampling activities, evaluate data, and prepare the deliverables as specified in the Full Scale In-Situ Chemical Oxidation (ISCO) Design Report (ARCADIS 2010) and Site Management Plan (SMP). Project direction will be provided by Dover, with oversight by the New York State Department of Environmental Conservation (NYSDEC). A listing of project management personnel and their responsibilities is provided below.

Company / Organization	Title	Name	Phone Number
NYSDEC	Project Manager	Ed Hampston	518.402.9812
Dover Corporation	Associate Counsel	Chelley Talbert Robert Gan	630.743.5029
ARCADIS	Project Manager in Charge	TBD	
	Project Manager	Gregory R. Albright	609.860.0590
	Task Manager	Kaiti Liao	267.685.1822
	Quality Assurance Manager	Dennis Capria	315.671.9299
Lab – Columbia Analytical Services, Rochester	Project Manager	Janice M. Jaeger	585.288.5380
	Quality Assurance Officer	Lisa Reyes	585.288.5380

1.2 Team Member Responsibilities

The responsibilities and duties of the various team members are summarized below by organization.

1.2.1 NYSDEC

<u>Project Manager</u>

Responsibilities and duties include:

- Provide NYSDEC review and approval of the ISCO Construction Package, SMP, QAPP, supporting documents, and future deliverables;
- Review of the quality assurance/quality control (QA/QC) portion of any submitted report;
- Monitor progress of site activities;
- Ensure that all activities are performed in compliance with applicable federal, state, and regional requirements; and
- Perform field and laboratory audits, if necessary.

1.2.2 Dover Corporation

Project Manager

Responsibilities and duties include:

- Provide overall direction of site actions;
- Provide ARCADIS approval for major project deliverables;
- Review of ARCADIS work products and all other documents transmitted to the NYSDEC

1.2.3 ARCADIS

Principal in Charge

Responsibilities and duties include:

- Oversee ARCADIS work products; and
- Provide ARCADIS approval for major project deliverables.

Project Manager

Responsibilities and duties include:

- Management and coordination of all aspects of the project as defined in the Full Scale ISCO Design Report and SMP with an emphasis on adhering to the project objectives.
- Review reports and all documents prepared by ARCADIS.
- Confirms that corrective actions are taken for deficiencies cited during audits of the field activities.

Task Manager

Responsibilities and duties include:

- Manage relevant day-to-day activities
- Develop, establish, and maintain files on relevant site activities;
- Review data reductions from the site activities;
- Perform final data review of field data reductions and reports on relevant site activities;
- Ensure that corrective actions are taken for deficiencies cited during audits of relevant site activities;
- Perform overall QA/QC of the relevant portions of the site activities;
- Review relevant field records and logs;
- Instruct personnel working on relevant site activities;
- Coordinate field and laboratory schedules pertaining to relevant site activities;
- Oversight of field activities;
- Request sample bottles from laboratory;
- Review field instrumentation, maintenance, and calibration to meet quality objectives;

- Prepare reports (e.g. Periodic Review Reports [PRRs])and other key documents pertaining to relevant site activities;
- Maintain field and laboratory files of logbooks/logs, data reductions, and calculations and transmit originals to the Project Manager; and
- Instruction of field staff.

Field Personnel

Responsibilities and duties include:

- Perform field procedures associated with the tasks presented in Section 2
- Perform field analyses and collect QA samples
- Calibrate, operate, and maintain field equipment
- Reduce field data
- Maintain sample custody
- Prepare field records and logs.

Quality Assurance Manager

Responsibilities and duties include:

- Review laboratory data packages
- Oversee and interface with the analytical laboratories
- Coordinate field quality assurance/quality control (QA/QC) activities with task manager, including audits of field activities, concentrating on field analytical measurements and practices to meet data quality objectives (DQOs)
- Review field reports
- Review audit reports

- Prepare a QA/QC report that includes an evaluation of field and laboratory data and data validation reports.

1.2.4 Laboratory Subcontractor

General responsibilities and duties include:

- Perform sample analyses
- Supply sample containers and shipping cartons
- Maintain laboratory custody of samples
- Strictly adhere to laboratory protocols

Laboratory Project Manager

- Serve as primary communication link between ARCADIS and laboratory staff
- Monitor workloads and confirm availability of resources
- Oversee preparation of analytical reports
- Supervise in-house chain of custody.

Quality Assurance Officer

- Supervise technical staff in QA/QC procedures.
- Conduct audits of all laboratory activities.

2. Project Background

2.1 Site Location and Description

The former Dover Electronics facility is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York. The facility is located on a site of approximately 9.58 acres in size. The property is situated in an industrial setting. Major plants in the area include: Truckstops of America Landfill (0.5 mile southeast), Frito Lay Plant (0.5 mile south), Universal Instruments (147 Industrial Park Drive, 0.5 mile east), Kason Industries (eastern property boundary), Consolidated Freightways (northern property boundary), and the Pilot Truck Stop to the south. Industrial properties surround the property to the north, east, and west.

The property consists of an industrial building with parking areas. The site had served as one of Universal Instruments' service facilities for product training, research and development, and Odd Form Assembly (OFA), which involves the engineering and assembly of non-standard/specialty circuit boards until 2007. In 2007 the facility was sold to Modern Marketing Concepts, Inc. (MMC). MMC handles outsourced customer service and product ordering for other companies.

2.2 Site History

The facility was first constructed in 1973, with subsequent additions built in 1978, 1982, and 1984. It has been occupied by Universal Instruments, Dover Electronics, and, most recently, MMC. In 1993, Dover Electronics was renamed Dovatron, Inc. (Dovatron). In 1995, Dovatron transferred its title to the facility to Universal Instruments. In 1996, Dovatron changed its name to the DII Group. Later, the DII Group sold to Flextronics International, Inc. and Universal Instruments became a wholly-owned subsidiary to Dover Corporation. In 2007, Dover Technologies, Inc. (the parent company of Universal Instruments) sold the facility to MMC, who now owns and occupies the property.

Circuit board manufacturing processes used PCE as a cleaning solvent. Originally, the virgin PCE was stored in 55-gallon drums at an outside drum storage area. During the initial facility expansion, a ramp to the east-side overhead door served as the entry point for PCE drums. As production increased and the facility was again expanded, virgin PCE was stored in a 3,000-gallon aboveground storage tank that has since been removed. An aboveground 5,000-gallon waste PCE flux storage tank was also located on the site. In March 1993, the aboveground PCE system was dismantled. Two 480-

gallon PCE tanks were reportedly dismantled and removed from the building interior at that time.

2.3 Project Description

This section presents a description of the activities to be conducted at the site. Sampling protocols to be followed during the monitoring activities are detailed in the Field Sampling Plan (FSP) (included in Appendix E of the ISCO Construction Package). The monitoring activities to be conducted include:

- Full-Scale ISCO Performance Monitoring – The performance monitoring program will include collecting and analyzing groundwater samples from select groundwater monitoring wells and points at the two areas subjected to ISCO injections (upper parking lot area and Pilot Truck Stop area). Monitoring will be performed in accordance with the approved monitoring schedule as stated in the Full-Scale ISCO Design Report or attached **Table 1** to assess the dispersion of the sodium permanganate into the target areas and reduction in the concentrations of target compounds. Groundwater samples will be analyzed for site-specific parameter list (SSPL) volatile organic compounds (VOCs), which include: PCE; trichloroethene (TCE); 1,1,1-trichloroethane (1,1,1-TCA); 1,1-dichloroethene (1,1-DCE); cis-1,2-dichloroethene (1,2-DCE); trans-1,2-DCE; 1,1-dichloroethane (1,1-DCA); and vinyl chloride. The analytical method to be used for VOCs is United States Environmental Agency (USEPA) Method 8260B following Contract Laboratory Protocol (CLP) Statement of Work (SOW), document OLM04.2, as modified by the NYSDEC Analytical Services Protocol (ASP) dated June 2000. **Table 1** presents the detailed schedule for full-scale ISCO performance monitoring program.

- Indoor Air Monitoring – As part of site operation maintenance and monitoring (OM&M), indoor air quality samples will be collected within the facility building semi-annually (March/April and September) at seven locations with one background sampling location outside the building. Indoor air quality is monitored through the collection of 8-hour time-weighted averaged (TWA) samples. The indoor air samples will be analyzed using USEPA method TO-15.

3. Quality Objectives and Criteria for Measurement Data

The data quality objective (DQO) process, as described in the USEPA QA/G-4 QAPP instructions document, is intended to provide a “logical framework” for planning field activities. The following addresses, in turn, each of the seven sequential steps in the USEPA QA/G-4 QAPP DQO process.

Step 1: State the Problem

The PCE impacted groundwater has been identified above the NYSDEC regulatory criteria at the site. Groundwater sampling will be conducted as part as the full-scale ISCO performance monitoring plan to assess the groundwater quality at the site.

The PCE-affected soils are capped by concrete within 1978 and 1984 Building Addition Area where complete removal of soil to below the NYSDEC criterion for PCE was not achieved.

Step 2: Identify the Goal of the Study

The purposes of the monitoring activities are to (1) assess the dispersion of the sodium permanganate into the target areas; (2) check assumptions and assigned parameter values incorporated into the basis for ISCO design; (3) evaluate if the ISCO technology can reduce the dissolved groundwater impacts of PCE in the source area to conditions acceptable to NYSDEC for monitored natural attenuation; (4) provide data to support performance evaluation of the active soil depressurization (ASD) system (engineering control), which is being operated to reduce the potential for exposure to PCE vapors in excess of acceptable concentrations.

Step 3: Identify Information Inputs

Information inputs will consist of visual characterization of groundwater and analytical results for groundwater and air samples. The data will be evaluated for completeness, general conformance with requirements of this QAPP, and consistency among data sets and with historical data, as appropriate.

Step 4: Define the Boundaries of the Study

The upper parking lot area (i.e. the site) is bordered by the main building to the north, by the Industrial Park Drive to the south and east, and the Colesville Road (County Route 22) to the west. The Pilot Truck Stop area is located southwest of the site/Industrial Park Drive.

Step 5: Developing the Analytical Approach

The decision on whether groundwater data can be used will be based on the validation results. Following validation, the groundwater data will be flagged, as appropriate, and any use restrictions noted. The sampling plan has been devised so that the loss of any

single data point will not hinder description of the distribution of constituents of concern. Given this, a reasonable decision rule would be that 90% of the data points not be rejected and deemed unusable.

Step 6: Specify Performance or Acceptance Criteria

Specifications for this step call for: 1) giving forethought to corrective actions to improve data usability; and 2) understanding the representative nature of the sampling design. This QAPP has been designed to meet both specifications for this step. The sampling and analysis program has been developed based on a review of previous site data and knowledge of present site conditions. Corrective actions are described elsewhere in the document and in the appended documents. The representative nature of the sampling design has been assured by discussions among professionals familiar with the site and the appropriate government agencies.

Step 7: Develop the Plan for Obtaining Data

The overall quality assurance objective is to develop and implement procedures for field sampling; Chain of custody (COC), laboratory analysis, and reporting that will provide results to support the evaluation of the site data consistent with National Contingency Plan (NCP) requirements. Specific procedures for sampling, COC, laboratory instrument calibration, laboratory analysis, data reporting, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP.

A DQO summary for the sampling efforts is presented in the subsequent section. The summary consists of stated DQOs relative to data uses, data types, data quantity, sampling and analytical methods, and data measurement performance criteria.

3.1 Data Categories

Three data categories have been defined to address various analytical data uses and the associated QA/QC effort and methods required to achieve the desired levels of quality. These categories are:

Screening Data: Screening data affords a quick assessment of site characteristics or conditions. This objective for data quality is applicable to data collection activities that involve rapid, non-rigorous methods of analysis and QA. This objective is generally applied to physical and/or chemical properties of samples, degree of contamination relative to concentration differences, and preliminary health and safety assessment.

Screening Data with Definitive Confirmation: Screening data allows rapid identification and quantitation, although the quantitation can be relatively imprecise. This objective for data quality is available for data collection activities that require qualitative and/or quantitative verification of a select portion of sample findings (10 percent or more). This objective can also be used to verify less rigorous laboratory-based methods.

Definitive Data: Definitive data are generated using analytical methods, such as approved USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files.

It is anticipated that both the screening and definitive data categories will be used during the groundwater monitoring activities. Field parameters (e.g., dissolved oxygen [DO], turbidity, conductivity, temperature, oxidation reduction potential [ORP], and pH) which will be obtained during groundwater sampling for use in qualitatively interpreting other site data will be determined using screening techniques. All remaining parameters will be determined using definitive techniques.

During the indoor air monitoring activities, screening data with definitive confirmation category will be use.

For this project, three levels of data reporting have been defined. They are as follows:

Level 1 – Minimal Reporting: Minimal or "results only" reporting is used for analyses that, either due to their nature (i.e., field monitoring) or the intended data use (i.e., preliminary screening), do not generate or require extensive supporting documentation.

Level 2 – Modified Reporting: Modified reporting is used for analyses that are performed following standard USEPA-approved methods and QA/QC protocols and that, based on the intended data use, require some supporting documentation but not, however, full "Contract Laboratory Program-type" (CLP-type) reporting.

Level 3 – Full Reporting: Full "CLP-type" reporting is used for those analyses that, based on intended data use, require full documentation. This reporting level would include ASP Superfund and Category B reporting.

The analytical methods to be used during the monitoring activities will be USEPA SW-846 methods with NYSDEC ASP Revision 2005, QA/QC requirements, and Category B reporting deliverables. The groundwater analytical data will require a level 3 data

deliverable. Level 2 reporting will be used for sampling activities associated with indoor air quality (ASD monitoring).

3.2 Field Activities

As presented in the Full-Scale ISCO Design Report and SMP, groundwater samples will be collected to support the DQOs during the full scale ISCO performance monitoring program. In addition, as part of site OM&M, indoor air quality samples will be collected at the selected locations at the site.

Details of the field activities are described in the Full Scale ISCO Design Report and SMP. **Table 1** presents the parameters to be analyzed under the proposed groundwater monitoring program. **Table 2** presents the laboratory quantitation limits for each groundwater parameter to be analyzed under USEPA Method 8260.

4. Special Training Requirements/Certification

Compliant with the Occupational Safety and Health Administration's (OSHA's) final rule, *Hazardous Waste Operations and Emergency Response*, 29 Code of Federal Regulations Part 1910.120(e), all personnel performing monitoring activities at the site will have completed the requirements for OSHA 40-hour Hazardous Waste Operations and Emergency Response training. Persons in field supervisory positions will have also completed the additional OSHA 8-hour Supervisory Training. In addition, all field personnel will have completed Loss Prevention Training. Training certificates for ARCADIS personnel working on-site are maintained on file at ARCADIS local offices.

5. Documentation and Records

5.1 General

Groundwater samples will be collected, as described in the Full Scale ISCO Design Report and SMP. Detailed descriptions of the documentation and reporting requirements are presented below.

5.2 Sample Designation System

Samples will be identified with a unique designation system that will facilitate sample tracking. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events and conditions. An alpha-numeric system is considered appropriate and will be used by field personnel to assign each sample with a unique sample identification number. Field samples will be linked to geographic location via location codes. All field samples will be labeled as follows:

- Water sample IDs will end with the date in "(mmddyy)" format (e.g. MW-7(100510)).
- Blind duplicate samples will be labeled “DUP” and the date “(mmddyy)” (e.g. DUP(100510).
- Field blank samples will be labeled “FB” and the date shipped “(mmddyy)” (e.g. FB(100510).
- Trip blank samples will be labeled “TB” and the date shipped “(mmddyy)” (e.g. TB(100510).

The location type codes are listed below:

MW = monitoring well
MP = monitoring point
IJ = Injection point
WC = Waste classification

In addition to the above classifications, the chain-of-custody will be completed to include both the Sample Type and Sample Matrix using the codes defined below. The sample matrix will be identified using the following codes:

AR = air sample;
IDW = aqueous investigation derived waste;
SO = soil sample; and,
GW = groundwater.

Indoor air samples will be designated by the location of the sample collection point. There are six locations for indoor air sample collection. The designation for each location shall be as follows:

Ambient Air Sample = BACKGROUND

Air Conditioning Area = A/C AREA

Switch Gear Area = ELECTRICAL ROOM

Office Space North = OFFICE AREA #1

Office Space South = OFFICE AREA #2

Cafeteria = CAFETERIA

Computer Server Room = COMPUTER ROOM

Between Office Spaces = HALLWAY

Should additional samples be collected from the same location during the same indoor air monitoring and sampling event, they may be labeled as “-1”, “-2” or “A”, “B”.

Additional sample volumes collected for matrix spike (MS) and matrix spike duplicate (MSD) analysis will be noted on the COC forms, and the associated additional sample containers will be labeled with the appropriate suffix (MS or MSD). Chain-of-custody records will be completed and shipped with the samples to the laboratories. A copy of the chain-of-custody will be retained with the field records. If samples are shipped by commercial carrier, the shipping records will be maintained in the project files with the field records.

5.3 Field Documentation

Field personnel will provide comprehensive documentation covering all aspects of field sampling, field analysis, and sample chain of custody. This documentation constitutes

a record that allows reconstruction of all field events to aid in the data review and interpretation process. All documents, records, and information relating to the performance of the field work will be retained in the project file.

The various forms of documentation to be maintained throughout the action include:

- *Daily Production Documentation* – A field notebook consisting of a waterproof, bound notebook that will contain a record of all activities performed at the site.

- *Sampling Information* – Detailed notes will be made as to the exact site of sampling, physical observations, and weather conditions (as appropriate).

- *Sample Chain of Custody* – Chain of custody forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. Chain of custody forms will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by ARCADIS field personnel designated to be responsible for sample custody. In the event that the samples are relinquished by the designated sampling person to other sampling or field personnel, the chain of custody form will be signed and dated by the appropriate personnel to document the sample transfer. The original chain of custody form will accompany the samples to the laboratory, and copies will be forwarded to the project files. A sample chain of custody form is included in **Appendix A**.

  Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

- *Field Equipment, Calibration, and Maintenance Logs* – To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory calibrated.

5.4 Laboratory Documentation

5.4.1 Laboratory Project Files

The laboratory will establish a file for all pertinent data. The file will include all correspondence, faxed information, phone logs, and chain of custody forms. The laboratory will retain all project files and data packages for a period of 5 years.

5.4.2 Laboratory Logbooks

Workbooks, bench sheets, instrument logbooks, and instrument printouts will be used to trace the history of samples through the analytical process and document and relate important aspects of the work, including the associated QCs. As such, all logbooks, bench sheets, instrument logs, and instrument printouts will be part of the permanent record of the laboratory.

Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in entry will be crossed out in indelible ink with a single stroke, corrected without the use of whiteout or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Pages of logbooks that are not used will be completed by lining out unused portions.

Information regarding the sample, analytical procedures performed, and the results of the testing will be recorded on laboratory forms or personal notebook pages by the analyst. These notes will be dated and will also identify the analyst, the instrument used, and the instrument conditions.

Laboratory notebooks will be periodically reviewed by the laboratory group leaders for accuracy, completeness, and compliance to this QAPP. All entries and calculations will be verified by the laboratory group leader. If all entries on the pages are correct, then the laboratory group leader will initial and date the pages. Corrective action will be taken for incorrect entries before the laboratory group leader signs.

5.4.3 Computer Tape and Hard Copy Storage

All electronic files and deliverables will be retained by the laboratory for not less than 5 years; hard copy data packages (or electronic copies) will also be retained for not less than 5 years.

5.5 Data Reporting Requirements

5.5.1 Field Data Reporting

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks or data sheets and/or on field forms. Such data will be reviewed by the appropriate Task Manager for adherence to the scope of work and for consistency. Concerns identified as a result of this review

will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation process.

Where appropriate, field data forms and calculations will be processed and included in appendices to the appropriate report (when generated). The original field logs, documents, and data reductions will be kept in the project file at the ARCADIS offices in Cranbury or Edison, New Jersey.

5.5.2 Laboratory Data Reporting

Analytical results will be provided by the laboratory in a digital format. The data packages will be examined to insure that the correct analyses were performed for each sample submitted and that all of the analyses requested on the chain of custody form were performed. If discrepancies are noted, the Quality Assurance Coordinator will be notified and will promptly follow up with the laboratory to resolve any issues.

If validation is required, each data package will be validated in accordance with the procedures presented in this QAPP. Data that do not meet the specified standards will be flagged pending resolution of the issue. The flag will not be removed from the data until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of that data may not necessarily be restricted.

Following completion of the data validation, the data review will be used to populate the appropriate database tables. This format specifies one data record for each constituent and each sample analyzed. Specific fields include:

- Sample identification number
- Date sampled
- Date analyzed
- Parameter name
- Analytical result
- Units
- Detection limit
- Qualifier(s)

The individual electronic data deliverables (EDDs) supplied by the laboratory in either an ASCII comma-separated value (CSV) format or in a Microsoft Excel worksheet, will be loaded into the appropriate database. The EDD format can be found in **Table 3**. Analytical data that cannot be provided by the laboratory in electronic format will be entered manually. Hand-keyed data will be reviewed for accuracy. After entry into the

database, the EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data were received.

The laboratory is responsible for preparing NYSDEC ASP Category B data packages for all samples within 14 calendar days from sample receipt.

All data reports for all parameters will include, at a minimum, the following items:

Narrative – Summary of activities that took place during the course of sample analysis, including the following information:

- laboratory name and address
- date of sample receipt
- cross reference of laboratory identification number to contractor sample identification
- analytical methods used
- deviations from specified protocol
- corrective actions taken

Included with the narrative will be any sample handling documents, including field and internal chain of custody forms, air bills, and shipping tags.

Analytical Results – Reported according to analysis type, including the following information, as acceptable:

- sample ID
- laboratory ID
- date of collection
- date of receipt
- date of extraction
- date of analysis
- detection limits
- dilution factor

Sample results on the report forms will be corrected for dilutions. Unless otherwise specified, results will be reported uncorrected for blank contamination.

The data for the analyses will be expanded to include all supporting documentation necessary to provide a Category B package. This additional documentation will include, but is not limited to, all raw data required to recalculate any result, including printouts, chromatograms, and quantitation reports. The report also will include

standards used in calibration and calculation of analytical results; sample extraction, digestion, and other preparation logs; standard preparation logs; instrument run logs; and moisture content calculations.

5.6 Project File

Project documentation will be placed in project files according to ARCADIS' protocol for document management at the ARCADIS offices in Cranbury and Edison, New Jersey. Project files typically consist of the following components:

- Agreements/Proposals (filed chronologically)
- Change Orders/Purchase Orders (filed chronologically)
- Invoices (filed chronologically)
- Project Management (filed by topic)
- Correspondence (filed chronologically)
- Notes and Data (filed by topic)
- Public Relations Information (filed by topic)
- Regulatory Documents (filed chronologically)
- Marketing Documents (filed chronologically)
- Draft Reports/Presentations (filed chronologically)
- Final Reports/Presentations (filed chronologically)
- Documents Prepared by Others (filed chronologically)

Final reports (including QA Reports) are filed in a designated folder within the project file. Analytical laboratory documentation (when received) and field data will also be filed in a designated folder within the project file. Filed materials may be removed and signed out by authorized personnel on a temporary basis only.

6. Sampling Process Design

Information regarding the sampling design and rationale and associated sampling locations can be found in the SMP and FSP.

7. Sampling Method Requirements

Groundwater and air quality samples will be collected, as described in the SMP. The approximate sample quantities and field quality control samples are shown in **Table 4**. The SMP and FSP also contain the procedures that will be followed to perform field measurements; and handle, package, and ship collected samples.

8. Sample Handling and Custody Requirements

8.1 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for the samples are shown in **Table 5**.

The analytical laboratory will supply appropriate sample containers and preservatives, as necessary. The bottles will be purchased pre-cleaned to USEPA Office of Solid Waste and Emergency Response Directive 9240.05A requirements. The field personnel will be responsible for properly labeling containers and preserving samples (as appropriate).

8.2 Packing, Handling, and Shipping Requirements

Sample packaging and shipment procedures are designed to confirm that the samples will arrive at the laboratory, with the chain of custody intact.

Groundwater samples will be packaged for shipment as outlined below:

- Confirm that all sample containers have the sample labels securely affixed to the container with clear packing tape.
- Check the caps on the sample containers to confirm that they are properly sealed.
- Complete the chain of custody form with the required sampling information and confirm that the recorded information matches the sample labels. (Note: If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the chain of custody prior to this transfer. The appropriate personnel will sign and date the chain of custody form to document the sample custody transfer.)
- Using duct tape, secure the outside drain plug at the bottom of the cooler.
- Wrap sample containers in bubble wrap or other cushioning material.
- Place 1 to 2 inches of cushioning material at the bottom of the cooler.
- Place the sealed sample containers into the cooler.

- Place ice in ziplog bags or plastic bags and seal. Place loosely in the cooler.
- Fill the remaining space in the cooler with cushioning material.
- Place chain of custody forms in a plastic bag and seal. Tape the forms to the inside of the cooler lid.
- Close the lid of the cooler, lock, and secure with duct tape.
- Wrap strapping tape around both ends of the cooler at least twice.
- Mark the cooler on the outside with the following information: shipping address, return address, “Fragile” labels, and arrows indicating “this side up.” Cover the labels with clear plastic tape. Place a signed custody seal over the cooler lid.

All samples will be packaged by field personnel and transported as low-concentration environmental samples. Sample coolers will be shipped to arrive at the laboratory the morning after sampling (priority overnight). All shipments will be accompanied by the chain of custody form identifying the contents. The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by common carrier, a bill of lading should be used. Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the chain of custody form, as long as the forms are sealed inside the sample cooler and the custody seals remain intact.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage. Trip blank(s) of analyte-free water will be provided by the laboratory and included in each cooler containing aqueous samples to be analyzed for VOCs.

Procedures for packing, handling, and shipping environmental samples are included in the FSP.

8.3 Field Custody Procedures

The objective of field sample custody is to confirm that samples are not tampered with from the time of sample collection through the time of transport to the analytical laboratory. Persons will have “custody of samples” when the samples are in their physical possession, in their view after being in their possession, or in physical

possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

Field custody documentation consists of both field logbooks and field chain of custody forms.

8.3.1 Field Logbooks

Field logbooks will provide the means of recording data collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in a secure location when not in use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- person to whom the logbook is assigned
- logbook number
- project name
- project start date
- end date

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling team personnel, and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink, and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Whenever a sample is collected or a measurement is made, a detailed description of the location of the station shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, as well as with the date of calibration.

Samples will be collected following the sampling procedures documented in the FSP. The equipment used to collect samples will be noted, as well as with the time of

sampling, sample description, depth at which the sample was collected, volume, and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

8.3.2 Sample Labeling

Preprinted sample labels will be affixed to sample bottles prior to delivery at the sampling site. The following information is required in each sample label.

- project
- date collected
- time collected
- location
- sampler
- analysis to be performed
- preservative
- sample number

8.3.3 Field Chain of Custody Forms

Completed chain of custody forms will be required for all samples to be analyzed. Chain of custody forms will be initiated by the sampling crew in the field. The chain of custody forms will contain the sample's unique identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. The original chain of custody form will accompany the samples to the laboratory. Copies of the chain of custody will be made prior to shipment (or multiple copy forms used) for field documentation. The chain of custody forms will remain with the samples at all times. The samples and signed chain of custody forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., FedEx) or hand delivered to a mobile or permanent laboratory, or placed in secure storage.

Sample labels will be completed for each sample using waterproof ink, unless prohibited by weather conditions. The labels will include sample information, such as sample number and location, type of sample, date and time of sampling, sampler's name or initials, preservation, and analyses to be performed. The completed sample labels will be affixed to each sample bottle and covered with clear tape.

Whenever samples are collocated with a source or government agency, a separate Sample Receipt will be prepared for those samples and marked to indicate with whom the samples are being collocated. The person relinquishing the samples to the facility or agency should request the representative's signature, acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.

8.4 Management of Investigation-Derived Materials and Wastes

Management of investigation-derived materials and wastes will be performed consistent with the USEPA guidance Guide to Management of Investigation-Derived Wastes (USEPA, 1992a). Disposable equipment (including personal protective equipment) and debris will be containerized and appropriately labeled during the sampling events, and will be disposed of accordingly. All purged groundwater and water generated during equipment decontamination will be containerized and temporally staged onsite in a 55-gallon drum, and will be disposed of appropriately based on analytical results.

8.5 Laboratory Custody Procedures

8.5.1 General

Upon sample receipt, laboratory personnel will be responsible for sample custody. A field chain of custody form will accompany all samples requiring laboratory analysis. Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for maintaining sample integrity.

8.5.2 Sample Receipt and Storage

Upon sample receipt, the laboratory sample custodian will verify the package seal, open the package, verify the sample integrity, and compare the contents against the field chain of custody. If a sample container is broken, the sample is in an inappropriate container, has not been preserved by appropriate means, or if there is a discrepancy between the chain of custody and the sample shipment, ARCADIS will be notified. The laboratory sample custodian will then log the samples in, assign a unique laboratory identification number to each, and label the sample bottle with the laboratory identification number. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory information management system. If the sample

container is broken, the sample is in an inappropriate container, or has not been preserved by appropriate means, ARCADIS will be notified.

8.5.3 Sample Chain of Custody and Documentation

Laboratory chain of custody and documentation will follow procedures consistent with Exhibit F of the NYSDEC ASP 2005.

8.5.4 Sample Analysis

Analysis of an acceptable sample will be initiated by worksheets that contain all pertinent information for analysis. The analyst will sign and date the laboratory chain of custody form when removing the samples from storage.

Samples will be organized into sample delivery groups (SDGs) by the laboratory. An SDG may contain up to 20 field samples (field duplicates, trip blanks, and rinse blanks are considered field samples for the purposes of SDG assignment). All field samples assigned to a single SDG shall be received by the laboratory over a maximum of 7 calendar days, and must be processed through the laboratory (preparation, analysis, and reporting) as a group. Every SDG must include a minimum of one site-specific matrix/matrix spike duplicate (MS/MSD) pair, which shall be received by the laboratory at the start of the SDG assignment.

Each SDG will be self-contained for all of the required QC samples. All parameters within an SDG will be extracted and analyzed together in the laboratory. At no time will the laboratory be allowed to run any sample (including QC samples) at an earlier or later time than the rest of the SDG. These rules for analysis will confirm that the QC samples for an SDG are applicable to the field samples of the same SDG and that the best possible comparisons can be made.

8.5.5 Sample Storage Following Analysis

The remaining samples will be maintained by the laboratory for 1 month after the final report is delivered to ARCADIS. After this period, the samples will be disposed of in accordance with applicable rules and regulations.

9. Analytical Procedures

9.1 Field Analytical Procedures

Field analytical procedures may include colorimetric methods and the measurement of pH, ORP, turbidity, temperature, conductivity, dissolved oxygen, and groundwater levels. Specific field measurement protocols are provided in the FSP.

9.2 Laboratory Analytical Procedures

- The methods listed below include the range of analyses expected to be performed. The associated laboratory SOP can be found in **Appendix B**.

- Laboratory analytical requirements presented in the sub-sections below include a general summary of requirements, specifics related to each sample medium to be analyzed, and details of the methods to be used for this project. USEPA SW-846 methods with NYSDEC ASP 2005 Revision, QA/QC, and reporting deliverables requirements will be used for all analytes.

9.2.1 General

The following tables summarize general analytical requirements:

Table	Title
Table 2	Parameters, Methods, and Target Reporting Limits
Table 4	Sample Quantities and Quality Control Frequencies
Table 5	Sample Containers, Preservation Methods, and Holding Times
Table 6	Analytical Quality Control Limits

9.2.2 Sample Metrics

9.2.2.1 Groundwater

Analyses in this category will relate to groundwater samples. Analyses will be performed following the methods listed in **Table 2** and quality control frequencies listed in **Table 4**. Results will be reported in units presented in **Table 2**.

9.2.2.2 Air

Analyses in this category will relate to air samples. Analyses will be performed following the USEPA method for TO-15. Results will be reported in micrograms per cubic meter (ug/m^3) and parts per billion by volume (ppbv).

9.2.3 Analytical Requirements

The primary sources to describe the analytical methods to be used during the monitoring activities are provided in USEPA SW-846 Test Methods for Evaluating Solid Waste with NYSDEC ASP 2005 Revision, QA/QC and reporting deliverables requirements. Detailed information regarding QC procedures, including MS/MSDs, blanks, and surrogate recoveries, is provided in NYSDEC, ASP 2005 Revision, Exhibit E.

10. Quality Control Requirements

10.1 Quality Assurance Indicators

The overall QA objective for this QAPP is to develop and implement procedures for sampling, chain of custody, laboratory analysis, instrument calibration, data reduction and reporting, internal QC, audits, preventive maintenance, and corrective action such that valid data will be generated. These procedures are presented or referenced in the following sections of the QAPP. Specific QC checks are discussed in Sections 10.3 and 10.4.

QA indicators are generally defined in terms of six parameters:

1. representativeness
2. comparability
3. completeness
4. precision
5. accuracy
6. sensitivity

Each parameter is defined below. Specific objectives for the site actions are set forth in other sections of this QAPP, as referenced below.

10.1.1 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability. The monitoring activities have been designed to assess the presence of the constituents at the time of sampling. The SMP presents the rationale for sample quantities and location. The FSP and this QAPP present field sampling methodologies and laboratory analytical methodologies. The use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements are intended to provide representative data.

10.1.2 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between the monitoring activities, and to the extent possible, with existing data will be maintained through consistent sampling and analytical methodology set forth in the FSP and this QAPP, SW-846 analytical methods with NYSDEC ASP Revision 2005 QA/QC requirements and Category B reporting deliverables, and through use of QA/QC procedures and appropriately trained personnel.

10.1.3 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an monitoring event compared to the amount that was expected to be obtained under normal conditions. This will be determined upon assessment of the analytical results, as discussed in Section 17.

10.1.4 Precision

Precision is the measure of reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the project objectives. To maximize precision, sampling and analytical procedures will be followed. All work for the monitoring activities will adhere to established protocols presented in the SMP and FSP. Checks for analytical precision will include the analysis of MSDs, laboratory duplicates, and field duplicates. Checks for field measurement precision will include obtaining duplicate field measurements. Further discussion of precision QC checks is provided in Sections 10.4.

10.1.5 Accuracy

Accuracy is the deviation of a measurement from the true value of a known standard. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, internal standards, MS, blank spikes, and surrogates (system monitoring compounds) will be used to assess the accuracy of the laboratory analytical data. Further discussion of these QC samples is provided in Section 10.4.

10.1.6 Sensitivity

Sensitivity is the ability of the instrument or method to detect target analytes at the levels of interest. The method reporting limits and the performance criteria are provided in **Table 2**.

10.2 Decision Rule

The decision on whether data can be used will be based on the validation results. Following validation, the data will be flagged, as appropriate, and any use restrictions noted. The sampling plan has been devised so that the loss of any single data point will not hinder description of the distribution of potential COCs. Given this, a reasonable decision rule would be that 90% of the data points not be rejected and deemed unusable.

10.3 Field Quality Control Checks

10.3.1 Field Measurements

To verify the quality of data using field instrumentation, duplicate measurements will be obtained and reported for all field analytical measurements.

10.3.2 Sample Containers

Certified, clean sample containers in accordance with Exhibit I of the NYSDEC ASP Revision 2005 (Eagle Picher pre-cleaned containers or equivalent) will be supplied by the laboratory.

10.3.3 Field Duplicates

Field duplicates will be collected from the different site materials to verify the reproducibility of the sampling methods. Field duplicates collected for VOC analysis will be collected as discrete samples from the same location. In general, field duplicates will be analyzed at a 5% frequency (every 20 samples) for the chemical constituents. **Table 4** provides an estimated number of field duplicates to be prepared for each applicable parameter.

10.3.4 Rinse Blanks

Rinse blanks are used to monitor the cleanliness of the sampling equipment and the effectiveness of the cleaning procedures. Rinse blanks will be prepared and submitted for analysis once per day. Rinse blanks will be prepared by filling sample containers with analyte-free water (supplied by the laboratory) which has been routed through a cleaned sampling device. When dedicated sampling devices or sample containers are used to collect the samples, rinse blanks will not be necessary. **Table 4** provides an estimated number of rinse blanks collected during the monitoring activities.

10.3.5 Trip Blanks

Trip blanks will be used to assess whether site samples have been exposed to non-site-related volatile constituents during storage and transport. Trip blanks will be analyzed at a frequency of once per day, per cooler containing groundwater samples to be analyzed for VOCs. A trip blank will consist of a container filled with analyte-free water (supplied by the laboratory), which remains unopened with field samples throughout the sampling event. Trip blanks will only be analyzed for aqueous VOCs. **Table 4** provides an estimated number of trip blanks collected for each matrix and parameter during the monitoring activities.

10.4 Analytical Laboratory Quality Control Checks

Internal QC procedures are specified in the analytical methods. These specifications include the types of QC checks required (method blanks, reagent/preparation blanks, MS/MSDs, calibration standards, internal standards, surrogate standards, the specific calibration check standards, laboratory duplicate/replicate analysis), compounds and concentrations to be used, and the QC acceptance criteria.

10.4.1 Method Blanks

Sources of contamination in the analytical process, whether specific analyses or interferences, need to be identified, isolated, and corrected. The method blank is useful in identifying possible sources of contamination within the analytical process. For this reason, it is necessary that the method blank is initiated at the beginning of the analytical process and encompasses all aspects of the analytical work. As such, the method blank would assist in accounting for any potential contamination attributable to glassware, reagents, instrumentation, or other sources which could affect sample analysis. One method blank will be analyzed with each analytical series associated with no more than 20 samples.

10.4.2 Matrix Spike/Matrix Spike Duplicates (MS/MSD)

MS/MSDs will be used to measure the accuracy of analyte recovery from the sample matrices and will be site-specific. MS/MSD pairs will be analyzed at a 5% frequency (every 20 samples or once every week, whichever comes first).

When MS recoveries are outside quality control limits, associated control sample and surrogate spike recoveries will be evaluated, as applicable, to attempt to verify the reason for the deviation and determine the effect on the reported sample results. **Table 4** presents an estimated number of MS and MSD analyses for each applicable parameter.

10.4.3 Surrogate Spikes

Surrogates are compounds which are unlikely to occur under natural conditions that have properties similar to the analytes of interest. This type of control is primarily used for organic samples analyzed by gas chromatography/mass spectrometry (GC/MS) and gas chromatography (GC) methods and is added to the samples prior to purging or extraction. The surrogate spike is utilized to provide broader insight into the proficiency and efficiency of an analytical method on a sample-specific basis. This control reflects analytical conditions that may not be attributable to sample matrix.

If surrogate spike recoveries exceed specified quality control limits, the analytical results need to be evaluated thoroughly in conjunction with other control measures. In the absence of other control measures, the integrity of the data may not be verifiable and reanalysis of the samples with additional control may be necessary.

Surrogate spike compounds will be selected utilizing the guidance provided in the analytical methods.

10.4.4 Calibration Standards

Calibration check standards analyzed within a particular analytical series provide insight regarding the instruments' stability. A calibration check standard will be analyzed at the beginning and end of an analytical series, or periodically throughout a series containing a large number of samples.

In general, calibration check standards will be analyzed after every 12 hours or more frequently, as specified in the applicable analytical method. In analyses where internal standards are used, a calibration check standard will only be analyzed in the beginning

of an analytical series. If results of the calibration check standard exceed specified tolerances, then all samples analyzed since the last acceptable calibration check standard will be reanalyzed.

Laboratory instrument calibration standards will be selected utilizing the guidance provided in the analytical methods, as summarized in Section 12.

10.4.5 Internal Standards

Internal standard areas and retention times will be monitored for organic analyses performed by GC/MS methods. Method-specified internal standard compounds will be spiked into all field samples, calibration standards, and quality control samples after preparation and prior to analysis. If internal standard areas in one or more samples exceed the specified tolerances, the cause will be investigated, the instrument will be recalibrated if necessary, and all affected samples may be reanalyzed.

The acceptability of internal standard performance will be determined using the guidance provided within the analytical methods.

10.4.6 Reference Standards/Control Samples

Reference standards are standards of known concentration and independent in origin from the calibration standards. The intent of reference standard analysis is to provide insight into the analytical proficiency within an analytical series. This includes the preparation of calibration standards, the validity of calibration, sample preparation, instrument set up, and the premises inherent in quantitation. Reference standards will be analyzed at the frequencies specified within the analytical methods.

10.5 Data Precision Assessment Procedures

Field precision is difficult to measure because of temporal variations in field parameters. However, precision will be controlled through the use of experienced field personnel, properly calibrated meters, and duplicate field measurements. Field duplicates will be used to assess precision for the entire measurement system, including sampling, handling, shipping, storage, preparation, and analysis.

Laboratory data precision for organic analyses will be monitored through the use of MSDs, laboratory duplicate, and field duplicates as identified in **Table 5.**

The precision of data will be measured by calculation of the relative percent differences (RPDs) of duplicate sample sets.

The RPD can be calculated by the following equation:

$$RPD = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:

A = analytical result from one of two duplicate measurements
B = analytical result from the second measurement

Precision objectives for MSD and laboratory duplicate analyses are identified in the NYSDEC ASP Revision 2005.

10.6 Data Accuracy Assessment Procedures

The accuracy of field measurements will be controlled by experienced field personnel, properly calibrated field meters, and adherence to established protocols. The accuracy of field meters will be assessed by review of calibration and maintenance logs.

Laboratory accuracy will be accessed via the use of MSs, surrogate spikes, internal standards, and reference standards. Where available and appropriate, quality assurance Performance Standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated in terms of percent recovery as follows:

$$\% \text{ Recovery} = \frac{A-X}{B} \times 100$$

Where:

A = value measured in spiked sample or standard
X = value measured in original sample
B = true value of amount added to sample or true value of standard

This formula is derived under the assumption of constant accuracy over the original and spiked measurements. If any accuracy calculated by this formula is outside of the acceptable levels, data will be evaluated to determine whether the deviation represents unacceptable accuracy, or variable, but acceptable accuracy. Accuracy objectives for MS recoveries and surrogate recovery objectives are identified in the NYSDEC ASP, 2005 Revision.

10.7 Data Completeness Assessment Procedures

Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{number valid results}}{\text{total number of results generated}} \times 100$$

As general guidelines, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

11. Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Preventive maintenance schedules have been developed for both field and laboratory instruments. A summary of the maintenance activities to be performed is presented below.

11.1 Field Instruments and Equipment

Prior to any field sampling, each piece of field equipment will be inspected to confirm that it is operational. If the equipment is not operational, it must be serviced prior to use. Leased equipment should also be inspected upon delivery. All meters that require charging or batteries will be fully charged or have fresh batteries. If instrument servicing is required, it is the responsibility of the appropriate Task Manager or field personnel to follow the maintenance schedule, arrange for prompt service and/or equipment replacement.

Field instrumentation to be used in this study includes meters to measure pH, ORP, turbidity, temperature, conductivity, dissolved oxygen, and groundwater levels. Field equipment also includes sampling devices for groundwater. A logbook will be kept for each field instrument. Each logbook contains records of operation, maintenance, calibration, and any problems and repairs. The Task Manager will review calibration and maintenance logs.

11.1.1 Equipment Maintenance

Consultant-/subcontractor-owned or leased equipment maintenance shall be in accordance with the manufacturer's instructions. Leased equipment should be received in good operation condition and should be accompanied with the appropriate maintenance and calibration logs as applicable.

All measuring and test equipment to be used in support of the monitoring and remediation activities that directly affect the quality of the analytical data shall be subject to preventative maintenance measures that minimize equipment downtime. Equipment will be examined to verify that it is in operating condition. This includes checking the manufacturer's operating manual to ensure that all maintenance requirements are being observed. If applicable, field notes from previous sampling events will be reviewed to ensure that any prior equipment problems are not overlooked and that any necessary repairs to equipment have been carried out. Field equipment returned from a site will be inspected to confirm that it is in working order. The inspection will be recorded in the field logbook, as appropriate. It will also be the

obligation of the last user to record any equipment problems in the logbook. Non-operational field equipment will either be repaired or replaced. Appropriate spare parts will be made available for field meters.

11.2 Laboratory Instruments and Equipment

Laboratory instrument and equipment documentation procedures include details of any observed problems, corrective measure(s), routine maintenance, and instrument repair (which will include information regarding the repair and the individual who performed the repair).

Preventive maintenance of laboratory equipment generally will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired immediately by in-house staff or through a service call from the manufacturer.

11.2.1 Instrument Maintenance

Maintenance schedules for laboratory equipment adhere to the manufacturer's recommendations. Records reflect the complete history of each instrument and specify the time frame for future maintenance. Major repairs or maintenance procedures are performed through service contracts with manufacturer or qualified contractors. Paperwork associated with service calls and preventative maintenance calls will be kept on file by the laboratory.

Laboratory Systems Managers are responsible for the routine maintenance of instruments used in the particular laboratory. Any routine preventative maintenance carried out is logged into the appropriate logbooks. The frequency of routine maintenance is dictated by the nature of samples being analyzed, the requirements of the method used, and/or the judgment of the Laboratory Systems Manager.

All major instruments are backed up by comparable (if not equivalent) instrument systems in the event of unscheduled downtime. An inventory of spare parts is also available to minimize equipment/instrument downtime.

11.2.2 Equipment Monitoring

On a daily basis, the operation of balances, incubators, ovens, refrigerators, and water purification systems will be checked and documented. Any discrepancies will be immediately reported to the appropriate laboratory personnel for resolution.

12. Instrument Calibration and Frequency

12.1 Field Equipment Calibration Procedures and Frequency

Specific procedures for performing and documenting calibration and maintenance for the equipment measuring conductivity, temperature, pH, and groundwater levels are provided in the FSP. Calibration checks will be performed daily when measuring pH, ORP, turbidity, temperature, conductivity, and dissolved oxygen. Field equipment operation, calibration, and maintenance procedures are provided in the FSP. Field personnel are responsible for ensuring that a master calibration log is maintained following the procedures specified for each measuring device. Where applicable, each log will include, at a minimum, the following information:

- Name of device and/or instrument calibrated;
- Device/instrument serial/identification numbers;
- Calibration method;
- Tolerance;
- Calibration standard used;
- Frequency of calibration;
- Date(s) of calibration(s); and
- Name of person(s) performing calibration(s).

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated at the intervals specified by the manufacturer or more frequently, and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer or leasing company for service or replacement. Equipment found to be out of tolerance during the period of use shall be removed from the field and measuring and testing activities performed using the equipment shall be addressed via the corrective action system described in Section 15.3 of this QAPP.

12.2 Laboratory Equipment Calibration Procedures and Frequency

Instrument calibration will follow the specifications provided by the instrument manufacturer or specific analytical method used. The analytical methods for target constituents are identified separately below.

Volatile Organics

Equipment calibration procedures will follow guidelines presented in NYSDEC ASP 2005 Revision, Exhibit E, Part II, Section 2.0.

When analyses are conducted according to the USEPA SW-846 methods, the calibration procedures and frequencies specified in the applicable method will be followed, as noted in the attached SOP (**Appendix B**). For analyses governed by SOPs, see the appropriate SOP for the required calibration procedures and frequencies. Records of calibrations will be filed and maintained by the laboratory. These records will be subject to quality assurance audit. For all instruments, the laboratory will maintain trained repair staff with in-house spare parts or will maintain service contracts with vendors.

All standards used in the calibration of equipment are traceable, directly or indirectly, to National Institute of Standards and Technology (NIST). All standards received shall be logged into standard receipt logs maintained by the individual analytical groups. Each group shall maintain a standards log which tracks the preparation of standards used for calibration and quality control purposes.

13. Inspection/Acceptance Requirements for Supplies and Consumables

All supplies to be used in the field and laboratory will be available when needed. They will be free of target chemicals and interferences. All reagents will be tested prior to use with site samples. All standards will be verified against a second source standard. The laboratory will follow a “first in first out” procedure for the storage and use of all consumables to minimize the risk of contamination and degradation. The various supplies and consumables required on-site are noted in the various field SOPs included FSP.

14. Data Management

The purpose of the data management is to confirm that all of the necessary data are accurate and readily accessible to meet the analytical and reporting objectives of the project. The field investigations will encompass a large number of samples and analytes from a large geographic area. Due to the large amount of resulting data, the need arises for a structured, comprehensive, and efficient program for management of data.

The data management program established for the project includes field documentation and sample QA/QC procedures, methods for tracking and managing the data, and a system for filing all site-related information. More specifically, data management procedures will be employed to efficiently process the information collected such that the data are readily accessible and accurate. These procedures are described in detail in the following section.

The data management plan has five elements: 1) sample designation system; 2) field activities; 3) sample tracking and management; 4) data management system; and 5) document control and inventory.

14.1 Sample Designation System

A concise and easily understandable sample designation system is an important part of the project sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy re-sampling of select locations to evaluate data gaps, if necessary. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sample collected.

14.2 Field Activities

Field activities designed to gather the information necessary to make decisions require consistent documentation and accurate record keeping. During site activities, standardized procedures will be used for documentation of field activities, data security, and quality assurance. These procedures are described in further detail in the following subsections.

14.2.1 Field Documentation

Complete and accurate record keeping is a critical component of the field monitoring activities. When interpreting analytical results and identifying data trends, investigators realize that field notes are an important part of the review and validation process. To confirm that all aspects of the field activities are thoroughly documented, several different information records, each with its own specific reporting requirements, will be maintained, including:

- field logs
- instrument calibration records
- chain of custody forms

A description of each of these types of field documentation is provided below.

Field Logs

The personnel performing the field activities will keep field logs that detail all observations and measurements made during the monitoring activities. Data will be recorded directly into site-dedicated, bound notebooks, with each entry dated and signed. To confirm at any future date that notebook pages are not missing, each page will be sequentially numbered. Erroneous entries will be corrected by crossing out the original entry, initialing it, and then documenting the proper information. In addition, certain media sampling locations will be surveyed to accurately record their locations. The survey will be done by the licensed surveyor. The surveyor will supply the sampling location coordinates to the Database Administrator.

Instrument Calibration Records

As part of data quality assurance procedures, field monitoring and detection equipment will be routinely calibrated. Instrument calibration confirms that equipment used is of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. Calibration procedures for the various types of field instrumentation are described in Section 12.1. In order to demonstrate that established calibration procedures have been followed, calibration records will be prepared and maintained to include, as appropriate, the following:

- calibration date and time
- type and identification number of equipment
- identification of individual(s) performing calibration

- reference standards used
- calibration data
- information on calibration success or failure

The calibration record will serve as a written account of monitoring or detection equipment QA. All erratic behavior or failures of field equipment will be subsequently recorded in the calibration log.

Chain of Custody Forms

Chain of custody forms are used as a means of documenting and tracking sample possession from time of collection to the time of disposal. A chain of custody form will accompany each field sample collected, and one copy of the form will be filed in the field office. All field personnel will be briefed on the proper use of the chain of custody procedure. A more thorough description of the chain of custody forms is located in the Standard Operating Procedures.

14.2.2 Data Security

Measures will be taken during the field monitoring activities to confirm that samples and records are not lost, damaged, or altered. When not in use, all field notebooks will be stored at the field office in a locked, fireproof cabinet. Access to these files will be limited to the field personnel who utilize them.

14.3 Sample Management and Tracking

A record of all field documentation, as well as analytical and QA/QC results, will be maintained to confirm the validity of data used in the site analysis. To effectively execute such documentation, carefully constructed sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of chain of custody forms, as described in Section 8.3.3. The completed COC forms associated with samples collected will be faxed to the QA Manager (QAM). Copies of all completed COC forms will be maintained in the project office. The laboratory shall verify receipt of the samples electronically (via email) on the following day.

When analytical data are received from the laboratory, the QAM will review the incoming analytical data packages against the information on the chains of custody to confirm that the correct analyses were performed for each sample and that results for

all samples submitted for analysis were received. Any discrepancies noted will be promptly followed-up by the QAM.

14.4 Data Management System

In addition to the sample tracking system, a data management system will be implemented. The central focus of the data management system will be the development of a personal computer-based project database. The project database, to be maintained by the Database Administrator, will combine pertinent geographical, field, and analytical data. Information that will be used to populate the database will be derived from three primary sources: surveying of sampling locations, field observations, and analytical results. Each of these sources is discussed in the following sections.

14.4.1 Computer Hardware

The database will be constructed on Pentium7-based personal computer work stations connected through a Novell network server. The Novell network will provide access to various hardware peripherals, such as laser printers, backup storage devices, image scanners, modems, etc. Computer hardware will be upgraded to industrial and corporate standards, as necessary, in the future.

14.4.2 Computer Software

The database will be written in Microsoft Access, running in a Windows operating system. Custom applets, such as CDs importing programs, will be written in either Microsoft VBA or Microsoft Visual Basic. Tables and other database reports will be generated through Access in conjunction with Microsoft Excel, Microsoft Word, and/or Seagate Crystal Reports. These software products will be upgraded to current industrial standards, as necessary.

14.4.3 Surveying Information

The existing and proposed new monitoring wells and monitoring points will be surveyed. Each location will be surveyed to ensure accurate documentation of sample locations for mapping and GIS purposes (if appropriate).The surveying activities that will occur in the field will consist of the collection of information that will be used to compute a northing and easting in state plane coordinates for each sample location and the collection of information to compute elevations relative to the National Geodetic Vertical Datum of 1988 for select sample locations, as appropriate. All field

books associated with the surveying activities will be stored as a record of the project activities.

Conventional surveying techniques will be used to gather information, such as the angle and distance between the sample location and the control monument, as well as point attributes. Control monuments will be established using global positioning system techniques. The surveying software allows the rapid computation of a location's state plane coordinates.

Differential leveling techniques will be used to gather information to be used to compute a sample location's elevation. During the differential leveling process, which includes at least one benchmark of known elevation, detailed field notes will be kept in a field book.

14.4.4 Field Observations

An important part of the information that will ultimately reside in the data management system for use during the project will originate in the observations that are recorded in the field.

Following each sampling event, a status memorandum may be prepared by the field personnel who performed the sampling activities. The purpose of the status memo is to present a summary and a record of the sampling event. Topics to be discussed include the locations sampled, the sampling methodologies used, QA/QC procedures, blind duplicate and MS/MSD sample identification numbers, equipment decontamination procedures, personnel involved in the activity, and any other noteworthy events that occurred.

Status memos are valuable tools to keep project personnel informed on the details of the field activities and are also invaluable during the development of the final report. Each status memo will be reviewed for accuracy and completeness by the respective sampling activity manager. Following the approval and finalization of each memo, the status memo will be used to transfer field observations into the data management system.

All pertinent field data will be manually entered into the appropriate database tables from the chain of custody forms and field notebooks.

14.4.5 Analytical Results

Analytical results provided by the laboratory will generally be available in both a digital and a hard copy format. Upon receipt of each analytical package, the original chain of custody form will be placed in the project files. The data packages will be examined to confirm that the correct analyses were performed for each sample submitted and that all of the analyses requested on the chain of custody form were performed. If discrepancies are noted, the QAM will be notified and will promptly follow up with the laboratory to resolve any issues.

Where appropriate, the data packages will be validated in accordance with the procedures presented in Section 18. Any data that does not meet the specified standards will be flagged pending resolution of the issue. The flag will not be removed from the data until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of that data may not necessarily be restricted.

Following completion of the data validation (if necessary), the digital files of analytical data will be processed to populate the appropriate database tables. Specific fields include:

- sample identification number
- date sampled
- date analyzed
- parameter name
- analytical result
- units
- detection limit
- qualifier(s)

The individual electronic data deliverables (EDDs) supplied by the laboratory in a Microsoft Excel worksheet, will be loaded into the appropriate database table. Any analytical data that cannot be provided by the laboratory in electronic format will be entered manually.

After entry into the database, the EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data have been received.

14.4.6 Data Analysis and Reporting

The database management system will have several functions to facilitate the review and analysis of the data. Several output functions that have been developed by ARCADIS will be appropriately modified for use in the data management system.

A valuable function of the data management system will be the generation of tables of analytical results from the project databases. The capability of the data management system to directly produce tables reduces the redundant manual entry of analytical results during report preparation and precludes transcription errors that may occur otherwise. This data management system function creates a digital comma-delimited ASCII file of analytical results and qualifiers for a given media. The ASCII file is then processed through a spreadsheet, which transforms the comma-delimited file into a table of rows and columns. Tables of analytical data will be produced as part of the reporting of data, and the generation of the Technical Memorandum.

Another function of the data management system will be to create digital files of analytical results and qualifiers suitable for transfer to mapping/presentation software. A function has been created by ARCADIS that creates a digital file consisting of sample location number, state plane coordinates, sampling date, and detected constituents and associated concentrations and analytical qualifiers. The file is then transferred to an AutoCAD work station, where another program has been developed to plot a location's analytical data in a "box" format at the sample location (represented by the state plane coordinates). This routine greatly reduces the redundant keypunching of analytical results and facilitates the efficient production of interpretative and presentation graphics.

The data management system also has the capability of producing a digital file of select parameters that exists in one or more of the databases. This type of custom function is accomplished on an interactive basis and is best used for transferring select information into a number of analysis tools, such as statistical or graphing programs.

14.5 Document Control and Inventory

ARCADIS maintains project files at its Cranbury and Edison, New Jersey offices as discussed in Section 5.6.

15. Assessment and Response Actions

Performance and systems audits will be completed in the field and the laboratory during the assessment activities, as described below.

15.1 Field Audits

The following field performance and systems audits will be completed during this project.

15.1.1 Performance Audits

The appropriate Task Manager will monitor field performance. Field performance audit summaries will contain an evaluation of field measurements and field meter calibrations to verify that measurements are taken according to established protocols. The ARCADIS QAM will review all field reports and communicate concerns to the ARCADIS Project Manager and/or Task Managers, as appropriate. In addition, the ARCADIS QAM will review the rinse and trip blank data to identify potential deficiencies in field sampling and cleaning procedures.

15.1.2 Internal Systems Audits

A field internal systems audit is a qualitative evaluation of all components of field QA/QC. The systems audit compares scheduled QA/QC activities from this document with actual QA/QC activities completed. The appropriate Task Manager will periodically confirm that work is being performed consistent with the SMP, FSPand the HASP.

15.2 Laboratory Audits

The laboratory will perform internal audits consistent with NYSDEC ASP, 2005 Revision, Exhibit E.

In addition to the laboratory's internal audits and participation in state and federal certification programs, the laboratory sections at the laboratory are audited by representatives of the regulatory agency issuing certification. Audits are usually conducted on an annual basis and focus on laboratory conformance to the specific program protocols for which the laboratory is seeking certification. The auditor reviews sample handling and tracking documentation, analytical methodologies, analytical supportive documentation, and final reports. The audit findings are formally documented and submitted to the laboratory for corrective action, if necessary.

ARCADIS reserves the right to conduct an on-site audit of the laboratory prior to the start of analyses for the project. Additional audits may be performed during the course of the project, as deemed necessary.

15.3 Corrective Action

Corrective actions are required when field or analytical data are not within the objectives specified in this QAPP, FSP or the SMP. Corrective actions include procedures to promptly investigate, document, evaluate, and correct data collection and/or analytical procedures. Field and laboratory corrective action procedures are described below.

15.3.1 Field Procedures

When conducting the field work, if a condition is noted that would have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action implemented will be documented on a Corrective Action Report Form and reported to the appropriate ARCADIS Project Manager and Task Manager.

Examples of situations that would require corrective actions are provided below:

- Protocols, as defined by this QAPP, FSP or the SMP have not been followed.
- Equipment is not in proper working order or properly calibrated.
- QC requirements have not been met.
- Issues resulting from performance or systems audits.

Project personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities.

15.3.2 Laboratory Procedures

In the laboratory, when a condition is noted to have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action to be taken will be documented and reported to the appropriate Project Manager and Task Manager.

Corrective action may be initiated, at a minimum, under the following conditions:

- Specific laboratory analytical protocols have not been followed.
- Predetermined data acceptance standards are not obtained.
- Equipment is not in proper working order or calibrated.
- Sample and test results are not completely traceable.
- QC requirements have not been met.
- Issues resulting from performance or systems audits.

Laboratory personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities.

16. Reports to Management

16.1 Internal Reporting

The analytical laboratory will submit analytical reports to ARCADIS for review. If required, ARCADIS will, in turn, submit the reports to the data validator for review. Supporting data (i.e., historic data, related field or laboratory data) will also be reviewed to evaluate data quality, as appropriate. The ARCADIS QAM will incorporate results of the data validation reports (if required) and assessments of data usability into a summary report (if required) that will be submitted to the ARCADIS Project Manager and appropriate Task Managers. If required, this QAPP will be filed in the project file at ARCADIS' office and will include the following:

1. Assessment of data accuracy, precision, and completeness for both field and laboratory data.

2. Results of the performance and systems audits.

3. Significant QA/QC problems, solutions, corrections, and potential consequences.

4. Analytical data validation report.

16.2 Reporting

Upon receipt of the ASP – Category B Data Package from the laboratory, the ARCADIS QAM will determine if the data package has met the required DQOs. The analytical data package will be submitted to the ARCADIS Project or Task Manager and the analytical data will be incorporated into a tabulated format.

17. Data Review, Validation, and Verification

After field and laboratory data are obtained, the data will be subject to the following:

1. Reduction, or manipulation mathematically, or otherwise into meaningful and useful forms
2. Review
3. Organization, interpretation, and reporting
4. Data validation

17.1 Field Data Reduction, Validation, and Reporting

17.1.1 Field Data Reduction

Information that is collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks, log sheets, and/or other appropriate forms. Such data will be reviewed by the appropriate Task Manager for consistency and for adherence to the SMP and this QAPP. Any concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation process.

17.1.2 Field Data Review

Field data calculations, transfers, and interpretations will be conducted by the field personnel and reviewed for accuracy by the appropriate Task Manager and the QAM. Task Managers will recalculate at least 5 percent of all data reductions. Field documentation and data reduction prepared by field personnel will be reviewed by the appropriate Task Manager and QAM. All logs and documents will be checked for:

- General completeness
- Readability
- Usage of appropriate procedures
- Appropriate instrument calibration and maintenance

- Reasonableness in comparison to present and past data collected
- Correct sample locations
- Correct calculations and interpretations

17.1.3 Field Data Reporting

Where appropriate, field data forms and calculations will be processed and included in appendices to the reports. The original field logs, documents, and data reductions will be kept in the project file at the ARCADIS offices in Cranbury and Edison, New Jersey.

17.2 Laboratory Data Reduction, Review, and Reporting

17.2.1 Laboratory Data Reduction

The calculations used for data reduction will be specified in each of the analytical methods referenced previously. Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Raw data will be entered into permanently bound laboratory notebooks. The data entered are sufficient to document all factors used to arrive at the reported value.

Concentration calculations for chromatographic analyses will be based on response factors. Quantitation will be performed using either internal or external standards. Non-aqueous values will be reported on a dry-weight basis. Unless otherwise specified, all values will be reported uncorrected for blank contamination.

17.2.2 Laboratory Data Review

All data will be subject to multi-level review by the laboratory. The group leader will review all data reports prior to release for final data report generation, and the laboratory director will review a cross section of the final data reports. All final data reports are reviewed by the laboratory QAM prior to shipment to ARCADIS.

If discrepancies or deficiencies exist in the analytical results, then corrective action will be taken, as discussed in Section 15. Deficiencies discovered as a result of internal data review, as well as the corrective actions to be used to rectify the situation, will be documented on a Corrective Action Form. This form will be submitted to the ARCADIS Project Manager.

18. Validation and Verification Methods

Data validation entails a review of the QC data and the raw data to verify that the laboratory was operating within required limits, the analytical results are correctly transcribed from the instrument, and which, if any, environmental samples are related to any out-of-control QC samples. The objective of data validation is to identify any questionable or invalid laboratory measurements.

Data validation will consist of data screening, checking, reviewing, editing, and interpreting to document analytical data quality and determine if the quality is sufficient to meet the DQOs.

The data validator will use the most recent versions of the USEPA functional guidelines for data validation with NYSDEC ASP 2005 Revision, QA/QC and reporting deliverables requirements available at the time of project initiation and for the entire duration of the project, as guidance, where appropriate.

The data validator will verify reduction of laboratory measurements and laboratory reporting of analytical parameters are in accordance with the procedures specified for each analytical method (i.e., perform laboratory calculations in accordance with the method-specific procedure).

If required, upon receipt of the laboratory data, the following reduction, validation, and reporting scheme will be executed by the data validator:

1. Laboratory data will be screened to confirm that the necessary QC procedures (e.g., detection limit verification, initial calibration, continuing calibration, duplicates, spikes, blanks) have been performed. QC information not included or of insufficient frequency will be identified in the validation report, including a discussion of the implications.

2. QC supporting information will subsequently be screened to identify QC data outside established control limits. If out-of-control data are discovered, documentation of appropriate corrective action will be reviewed. Out-of-control data without appropriate corrective action shall result in designation of the affected data as qualified or rejected, as appropriate.

   It should be noted that the existence of qualified results does not automatically invalidate data. This point is repeatedly emphasized in the USEPA functional guidelines for data validation and is inherently acknowledged by the very existence

of the data validation/flagging guidelines. The goal to produce the best possible data does not necessarily mean producing data without QC qualifiers. Qualified data can provide useful information.

Resolution of any issues regarding laboratory performance or deliverables will be handled between the data validator, laboratory Project Manager, and the ARCADIS Project Manager.

Upon completion of the data validation (if required), a data usability summary report addressing the following topics will be prepared.

- assessment of the data package
- description of any protocol deviations
- failures to reconcile reported and/or raw data
- assessment of any compromised data
- laboratory case narrative
- overall appraisal of the analytical data
- table of site name, sample quantities, data submitted to the laboratory, year of protocol used, matrix, and fractions analyzed

19. Reconciliation with User Requirements

The data results will be examined to determine the performance that was achieved for each data usability criteria. The performance will then be compared with the project objectives. Of particular note will be samples at or near action levels. All deviations from objectives will be noted. Additional action may be warranted when performance does not meet performance objectives for critical data. Action options may include any or all of the following:

- retrieval of missing information
- request for additional explanation or clarification
- reanalysis of sample from extract (when appropriate)
- recalculation or reinterpretation of results by the laboratory

These actions may improve the data quality, reduce uncertainty, and may eliminate the need to qualify or reject data.

If these actions do not improve the data quality to an acceptable level, the following actions may be taken:

- extrapolation of missing data from existing data points
- use of historical data
- evaluation of the critical/noncritical nature of the sample

If the data gap cannot be resolved by these actions, an evaluation of the data bias and potential for false negatives and positives can be performed. If the resultant uncertainty level is unacceptable, then the following action must be taken:

- additional sample collection and analysis

20. References

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Table 1 Groundwater Monitoring Matrix - Full-Scale ISCO Remediation, Former Dover Electronics Site, Kirkwood, New York

Injection Well ID No.	Monitoring Points		Monitoring Schedule	
	Shallow Zone	Intermediate Zone	VOC Analysis	Field Parameters
IJ-1	MP-5, MP-6S, IJ-5	MP-6D	Bi-monthly for the first 6 months, quarterly for the next 6 months, and semi-annual thereafter at all monitoring points	Daily for the first week, weekly for the next two months, monthly for the following 4 months, and bi-monthly thereafter at all monitoring points
IJ-2	MP-4, MP-12, IJ-4	--		
IJ-3	MP-4, MW-7A, IJ-1, IJ-4	MP-6D		
IJ-4	MP-5, MP-12	--		
IJ-5	Offline for the first year			
IJ-7	MP-4, MP-11, IJ-1, IJ-4	--		
IJ-8	MP-4, MP-5, IJ-1, IJ-4	--		
IJ-9	MP-4, MP-13, MW-7A, IJ-1	MP-6D		
IJ-10	MP-5, MP-6S, MP-14, IJ-5	--		
MW-24	MP-11, MW-16	--		
IJ-6	MW-28, MW-30, MP-8S	MP-8D, MP-10D, MW-25	Quarterly for the first year and semi-annual thereafter	Monthly for the first 6 months and quarterly for the next 6 months

Notes:

1. All monitoring points listed in the table will be sampled for VOCs (Site-Specific Parameter List [SSPL]) and/or field parameters based on the proposed monitoring schedule.
2. Field parameters including pH, specific conductivity, and redox will be collected using a down-hole water quality instrument and manganese and permanganate using a colorimeter.
3. IJ-1, IJ-4, and IJ-10 will be used as monitoring points for the 1st Quarter of operations.

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Table 2. Parameters, Methods, and Quantitation Limits, Former Dover Electronics Site, Kirkwood, New York

Analyte	Groundwater (µg/L)		
	Criteria[2]	Laboratory MDL	Laboratory RL
Volatile Organic Compounds 8260 [1]			
Tetrachloroethene (PCE)	5.00	0.43	5.0
Trichloroethene (TCE)	5.00	0.63	5.0
1,1,1-trichloroethane (1,1,1-TCA)	5.00	0.45	5.0
1,1-dichloroethene (1,1-DCE)	5.00	0.59	5.0
cis-1,2-dichloroethene (1,2-DCE)	5.00	0.48	5.0
trans-1,2-Dichloroethene	5.00	0.45	5.0
1,1-dichloroethane (1,1-DCA)	5.00	0.64	5.0
Vinyl chloride	2.00	0.52	5.0

Notes:

[1] Methods are from USEPA, 1996.

[2] The criteria for groundwater is from NYSDEC TOGS 1.1.1 Water Guidance Values.

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Table 3. Electronic Data Deliverable (EDD) Format, Former Dover Electronics Site, Kirkwood, New York

SampleDate	Date sample drawn or recorded.
SampledBy	The party who is in charge of this sampling work.
SampleLocation	Site where sample was collected. Note: this name must correctly match existing naming in the database, must be added as a new name, or it will kick out as an exception in quality assurance. If unknown, please use FieldSampleID.
FieldSampleID	Original sample identification from the chain of custody.
Parameter	Parameter name, note: this name must correctly match existing naming in the database, must be added as a new name, or it will kick out as an exception in quality assurance.
Units	Units of measurement for the analyzes or reading recorded.
TextResult	This is a text representation of the analyzes result. These values are not used for any of the analytical tools provided with GEMS. Because of the ability to include both numbers and text in a text field, this field is often used for custom reports and queries that require that type of formatting.
NumericResult	This numeric value represents either the actual numeric result or the minimum detection limit. This field is used to verify analytical result vs. established limits for actual or potential ascendances.
Medium	The primary function of this field is to provide an identifier that allows the user to lump certain types of data for querying. It is typically set to be the sample medium, i.e. soil, sediment, water, air, etc.
SampBegDepth	Depth of the top of the boring interval for soil and sediment data and depth of top of screen for groundwater data.
SampEndDepth	Depth of the bottom of the boring interval for soil and sediment data and depth of bottom of screen for groundwater data.
Modifier	Lab code for QA/QC data (e.g., FB, EB, DUP, MS, MSD, LCS, LCSD)
CustomFlag	Used to flag surrogates (e.g., SURR)
Laboratory	Laboratory that performed the testing.
LabSampID	Sample ID that was assigned by the laboratory.
PrepType	Method used to prepare the sample for analysis
AnalysisDate	Date data analysis was performed by the laboratory.
ExtractedDate	The date when the sample was extracted by the lab
ReceivedDate	The date when the sample was received by the lab
Instrument	Instrument used to measure sample's concentration of a particular parameter.
AnalysisType	Type of analysis (e.g., dilutions, re-analyses or re-extracts).
Method	Analytical method used to perform the analysis.
CAS	Text representation of the analytical result parameter CAS number where available. Not all analytical data has appropriate CAS numbers. This number is included for reference and is not used for any analytic analysis of result.
Qualifier	A qualification code furnished by the laboratory that qualifies the analytical results for an individual or group or parameters.
DilFactor	Dilution factor applied to the sample.
MDL	Method Detection Limit
RDL	Reporting Limit
PQL	Practical Quantitation Limit

Table 3. Electronic Data Deliverable (EDD) Format, Former Dover Electronics Site, Kirkwood, New York

TotalOrDissolved	Sample total or dissolved (T or D)
ReportableResult	Reportable result (Yes/No)
ResultError	Result Error (two sigma error for radiochemistry results)
PercentageMoisture	Percent moisture in solid (soil & sediment) samples.
QCSpikeAdded	Amount of spike or surrogate compound added
QCSpikeRemoved	Amount of spike or surrogate compound removed
QCSpikeRecovered	Amount of spike or surrogate compound recovered
SDG	Sample Delivery Group. Usually from Chain of Custody.
LotID	Lot ID assigned by some laboratories for internal tracking.
BatchID	Batch ID assigned by laboratories for internal tracking.
ValidationDate	Date data was validated
ValidatedBy	Person who performed the data validation
PreValidationFlag	Validated qualifier or flag value BEFORE it was changed by the validator
PreValidationResult	Validated result value BEFORE it was changed by the validator
Source	This is the source of the data for this row. It may include a file name for electronic import data or a sensor identification for automated data collection systems.
EventCode	Name of the sampling program under which samples were collected
Comment	General comment field, validator may use record validation rationale
LogDateTime	Date record entered into database

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Table 4. Environmental and Quality Control Sample Analysis, Former Dover Electronics Site, Kirkwood, New York

	Estimated Environ. Sample Quantity	Field QC Analyses						Laboratory QC Sample						Total
		Trip Blank		Rinse Blank		Field Duplicate		Matrix Spike		Matrix Spike Duplicate		Lab Duplicate		
		Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	
Groundwater - Full Scale ISCO Monitoring														
VOCs (SW846 8260)	127	1/day	TBD	1/day	TBD	1/20	7	1/20	7	1/20	7	NA	--	148
Groundwater - Long Term Semi-Annual Monitoring														
VOCs (SW846 8260)	104	1/day	16	1/day	16	1/20	6	1/20	6	1/20	6	NA	--	154

Notes:
1. Sample counts are an approximation. Quantity is estimated for the first two-year operation.
2. Samples will be sent to Columbia Analytical Services, Rochester, NY.

1/day = One rinse blank per day or one per 20 samples, whichever is more frequent. Rinse blanks not required when dedicated sampling equipment is used.
Freq = Frequency.
No. = Number.
TBD = To be determined

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Table 5. Sample Containers, Preservation, and Holding Times, Former Dover Electronics Site, Kirkwood, New York

	Parameter	Method	Bottle Type	Preservation	Holding Time
Groundwater					
Wells with no presence of permanganate	VOCs	8260 [1]	3 x 40-ml glass vial	HCl to pH <2; Cool to 4°C±2°C	14 days to analysis
Wells with presence of permanganate	VOCs	8260 [1]	3 x 40-ml glass vial	Sodium Thiosulfate; Cool to 4°C±2°C	7 days to analysis

Notes:

Waste and Emergency

2. All holding times are measured from date of collection.

°C = Degrees Celsius.

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Table 6. Analytical Quality Control Limits, Former Dover Electronics Site, Kirkwood, New York

Parameter	Accuracy - % Recovery			Precision - RPD		
	Surrogate [1,2]	MS/MSD [1]	LCS [1]	MS/MSD [1]	Lab Duplicate	Field Duplicate
Groundwater						
Tetrachloroethene (PCE)	85-122	70-130	70-130	30	30	50
Trichloroethene (TCE)	85-122	70-130	70-130	30	30	50
1,1,1-trichloroethane (1,1,1-TCA)	85-122	70-130	70-130	30	30	50
1,1-dichloroethene (1,1-DCE)	85-122	70-130	70-130	30	30	50
cis-1,2-dichloroethene (1,2-DCE)	85-122	70-130	70-130	30	30	50
trans-1,2-Dichloroethene	85-122	70-130	70-130	30	30	50
1,1-dichloroethane (1,1-DCA)	85-122	70-130	70-130	30	30	50
Vinyl chloride	85-122	70-130	70-130	30	30	50

Notes:

[1] Control limits are laboratory calculated control limits.

Appendix A

Sample Chain of Custody

Columbia Analytical Services

800.695.7222
www.caslab.com

CHAIN of CUSTODY

Page ___ of ___

Client:

Project:

Method of Shipment

Project Manager

Telephone No.

Fax No.

Special Detection Limit/Reporting

Sample I.D.	Lab Sample No.	No. of Containers	Matrix: Soil	Matrix: Water	Matrix: Air	Matrix: Other	Prsv.: Yes	Prsv.: No	Sampling Date	Sampling Time															Turn Around Time (working days)

MARKS

Sample Received Intact: Yes No

Temperature received: Ice No ice

Relinq. by sampler (Sign & Print Name)	Date	Time	Received by (Sign & Print Name)		
Relinquished by	Date	Time	Received by		
Relinquished by	Date	Time	Received by		
Relinquished by	Date	Time	Received by laboratory	Date	Time

Lab Work No.

Appendix B

Laboratory Standard Operating Procedures

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STANDARD OPERATING PROCEDURE

VOLATILE ORGANIC COMPOUNDS BY GC/MS

VOC-8260B

Revision 10

September 15, 2009

Effective Date:_____

Approved By: _____ _____
Supervisor Date

_____ _____
Quality Assurance Program Manager Date

_____ _____
Technical Director Date

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1 Mustard Street, Suite 250
Rochester, New York 14609

Annual review of this SOP has been performed and the SOP still reflects current practice.
Initials: _____ Date: _____
Initials: _____ Date: _____
Initials: _____ Date: _____

DOCUMENT CONTROL
NUMBER: _____
Initials: _____ Date: _____

*See DOD Summary Attachment for DOD Specific Criteria

1. SCOPE AND APPLICATION

This SOP is used to determine the concentration of volatile organic compounds (VOCs) in water and soil, sediment and sludge using USEPA methods 8260B, 5030B, and 5035A. Method 5035A is discussed in a separate SOP (VOC-5035A). The use of this method for low concentrations by SIM Mode is discussed in Attachment I. This method may also be applicable to various types of aqueous and nonaqueous waste samples. Appendix C of the Quality Assurance Manual (QAM) lists the compounds that are routinely determined by this method with the associated Reporting Limits and Quality Control Limits for water and soil matrices. The reported compound list and reporting limits may be adjusted if required for specific project requirements and supported by a current detection and quantitation studies. The method can quantitate most volatile organic compounds with a boiling point <200°C.

2. METHOD SUMMARY

2.1. This method gives gas chromatographic/mass spectrometric (GC/MS) conditions for the detection of parts per billion (ppb) levels of volatile organic compounds. A sample aliquot is injected into the gas chromatograph (GC) by the purge and trap method. The compounds are separated on a small bore fused silica capillary column. The compounds are detected by a mass selective detector (MSD), which gives both qualitative as well as quantitative information.

2.2. Lower reporting limits can be achieved by purging a volume larger than the standard 5 mL discussed herein. With a larger purge volume (10 or 25 mL), all reporting limits listed in Appendix C of the QAM would become half or one-fifth the listed value, respectively. All internal, surrogate, and matrix spike solutions are prepared in the same manner discussed herein, but when spiked into a larger sample volume the actual concentrations are diluted by a factor of two or five, respectively. Since the initial and continuing calibration standards would also require a larger purge, the range of calibration is decreased by the appropriate factor.

2.3. In the purge and trap process an inert gas, helium, is bubbled through the sample aliquot, at room temperature. This gas stream sweeps the volatile organic compounds out of the aqueous phase and into the gas stream - it purges the compounds out of the sample. The gas stream then passes through a sorbent column which selectively adsorbs (traps) these compounds out of the helium. After the purging sequence is done, the sorbent column (the trap) is heated and backflushed onto the GC column. The GC column separates the compounds and passes them onto the MSD for identification and quantification.

2.4. Method Summary for SIM mode is discussed in Attachment I.

3. DEFINITIONS

3.1. **Analysis Window** - Samples are analyzed in a set referred to as "a window". The window begins with the injection of the tune verification standard. Standards, required QC samples and samples may be run for 12-hours in this window. A new window must be opened to continue analysis.

3.2. **Initial Calibration Curve** – analysis of analytical standards for a series of different specified concentrations; used to define the linearity and dynamic range of the response of the detector to the target compounds.

3.3. **Laboratory Control Sample (LCS) or Reference Standard** – An aliquot of analyte-free water or other blank matrix to which known quantities of analytes of interest from a second source are added in the laboratory. The LCS is analyzed the same as a sample. Its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate measurements. The LCS contains a full list of compounds. The LCS is evaluated for all client targets in the batch, however only a subset of compounds designated to represent the targets is typically reported.

3.4. **Matrix Spike/ Matrix Spike Duplicate Analysis (MS/MSD)** – An aliquot of a sample to which known amounts of compounds of interest from a second source are added in the laboratory prior to analysis. The MS/MSD are analyzed the same as a sample. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the compounds determined by the analysis. Percent recoveries are calculated for each of the analytes detected. The relative percent difference between the samples is calculated and used to assess analytical precision. The concentration of the spike should be at 5-10 times the reporting limit or at levels specified by a project analysis plan. The LCS is evaluated for all of the targets for which the system is calibrated. Corrective action is taken if acceptance criteria is not met for targets in the client's target list.

3.5. **Method Blank (MB)** - A volume of analyte-free water treated and analyzed exactly the same as a sample. The purpose of the blank is to determine if any of the analytes of interest or other interferences are present in the analytical system, particularly in regards to carry-over of analytes from highly contaminated samples into other analyses.

3.6. **Percent Drift or Percent Difference (%D) -** Used to compare two values, the percent difference indicates both the direction and the magnitude of the comparison, i.e., the percent difference may be either negative, positive, or zero. (In contrast, see relative percent difference).

3.7. **% Relative Standard Deviation (%RSD):** statistical measure of variation. Used in this method to measure the relative variation of initial calibration standards. Calculated by dividing the standard deviation of the individual response factors by the average response factor and multiplying by 100 to express as a percentage.

3.8. **Relative Percent Difference (RPD)** – The absolute value of the difference of two values divided by the average of the same two values. Used to compare the precision of the analysis. The result is always a positive number.

3.9. **Surrogate** - Surrogates are organic compounds which are similar to the analytes of interest in chemical composition, and chromatography, but which are not normally found in environmental samples. The purpose of the surrogates is to help determine matrix effects and to evaluate the preparation and analysis of samples. These compounds were spiked into all blanks, standards, and samples prior to analysis. Percent recovery is calculated for each surrogate.

3.10. **Internal Standards** - Internal standards are organic compounds which are similar to the analytes of interest but which are not found in the samples. The chosen internal standards are used to calibrate the instrument's response.

3.11. **Batch** – group of samples (not to exceed 20) of the same matrix analyzed together within sequence. See ADM-BATCH for further discussion.

3.12. **Independent Calibration Verification (ICV)** - Verification of the ratio of instrument response to analyte amount. ICV solutions (also referred to as laboratory control samples or reference samples) are made from a stock solution which is different from the stock used to prepare calibration standards (Second Source).

3.13. **Continuing Calibration Verification Standard (CCV)** - A standard injected into the instrument at specified intervals and is used to verify the initial calibration. The source of this standard is the same as that used for calibration purposes.

3.14. **4-Bromofluorobenzene (BFB) Tune Standard** – 50 ng (on-column) of BFB (a solution in methanol) is analyzed to open an analysis window.

3.15. **Limit of Quantitation (LOQ) –** The minimum levels, concentrations, or quantities of a target that can be reported with a specified degree of confidence. For DOD, the lowest concentration that produces a quantitative result within specified limits of precision and bias. The LOQ shall be set at or above the concentration of the lowest initial calibration standard.

3.16. **Limit of Detection (LOD) –** An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory – dependent. For DOD, the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate (Type II error) is 1%.

3.17. **Target Analyte –** a compound of interest for which the method is capable of measuring. The compounds that the client requests to be reported.

3.18. **TCL** –Target compound List as defined by the most recent EPA Contract Lab Protocol (CLP) Statement of Work (SOW). A "Non-TCL" compound is one that is not on the TCL, but may be a Target Analyte.

4. INTERFERENCES

Interferences include but are not limited to impurities in the inert purge gas, dirty plumbing/purge vessels, cross contamination of highly contaminated samples, in transport and storage, and carry over from one analysis to subsequent ones.

Avoid using non-PTFE thread sealants, plastic tubing, and rubber components, since such materials out-gas organic compounds, which will concentrate in the trap during, purge operation.

If a sample containing low concentration of VOCs is analyzed immediately after a sample containing high concentration of VOCs, a blank may be analyzed between samples to rinse the system and avoid carry-over. If samples are being injected using a syringe, the syringe should also be rinsed with sufficient volumes of methanol or DI between samples. Screening samples using the PID or Hnu may also be used to avoid injecting sample with high VOC concentration.

Storage blanks (cooler blanks) are placed in the walk-in coolers containing samples to be tested for VOCs. These blanks are prepared, held/sampled, and analyzed according to VOC-BLANK.

Trip blanks are collected with aqueous samples and carried through the sampling, handling, and storage to check for contamination of volatile compounds capable of diffusion such as methylene chloride and fluorocarbons.

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5. SAFETY

Chemicals, reagents and standards must be handled as described in the CAS safety policies, approved methods and in MSDSs where available. Refer to the CAS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

The use of pressurized gases is required for this procedure. Care should be taken when moving cylinders. All gas cylinders must be secured to a wall or an immovable counter with a chain or a cylinder clamp at all times. Sources of flammable gases (e.g., pressurized hydrogen) should be clearly labeled.

The proper use of syringes should be part of employee training. Care should be taken to avoid personal injury as a result of improper handling techniques.

Refer to the Safety Manual for further discussion of general safety procedures and information.

6. SAMPLE CONTAINERS, COLLECTION, PRESERVATIONS, AND STORAGE

6.1. All sample containers for VOC analysis are purchased precleaned and certified from major lab equipment suppliers. All containers should be of glass or amber glass and equipped with a screw top cap and PFTE (Teflon) lined septa and capable of containing a minimum of 40 mL of aqueous sample or 2-4 oz. of soil sample. New lots of vials are routinely checked for cleanliness and target compound contamination.

6.2. Aqueous Samples

6.2.1. Aqueous Samples should be collected (received) in 40 ml VOA vials with zero headspace. Samples should be preserved to pH <2 with hydrochloric acid (Because 2-chloroethylvinyl ether degrades in the presence of acid, it is recommended that samples are not preserved if this is compound of concern). Ideally, three VOA vials will be received for each sample. Samples will be refrigerated to 0-6^{o}C upon sample login.

6.2.2. Aqueous sample bottles are slowly filled to just overflowing taking care not to flush out the preservative or to trap air bubbles in the samples. The bottles are sealed with PFTE lined septa toward the sample and inverted to check for air bubbles.

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6.3 Soil Samples

Soil samples are collected per individual state, agency, or QAP requirements. See State Summary spreadsheet in VOA lab office for details. The following options are available:

6.3.1 Option 1:

Soil jars with PFTE lined septa are used to collect soil samples. The soil is pressed into the jar to the top to eliminate any headspace.(New York State). Holding time is 14 days from sample collection to analysis.

6.3.2 Option 2.

Encore style sampler and capsules are sent to the field and a fraction of either approximately 5 gm or 25 gm are collected by field personnel and shipped back to the laboratory, chilled to 0-6°C while in transit. The laboratory then has 48 hrs from sampling to preserve the soil fractions in DI water for the low concentration fractions and Methanol for high concentration fraction.

6.3.3 Option 3.

The laboratory sends out pre-prepared vials which will not be opened upon receipt at the laboratory. See VOC-5035.

6.4 All samples (preserved waters and soils) must be stored at 0-6°C and must be analyzed within 14 days of collection. Aqueous samples not prepreserved with HCl must be analyzed within 7 days of collection. See SMO-GEN and SMO-ICOC for further discussion of sample handling, storage, and custody procedures.

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7. APPARATUS AND EQUIPMENT

7.1. See Appendix A of the Quality Assurance Manual for configuration of specific components, computer hardware and software, serial numbers and receipt of the major components of the instruments.

7.2. Gas chromatograph/Mass Selective Detector Systems

7.2.1. Gas Chromatograph - An analytical system complete with a temperature-programmable gas chromatograph suitable for splitless injection and all required accessories, including syringes, analytical columns, and gases.

7.2.2. GC Column Options:

- Hewlett Packard HP-624, 25 M, 0.2 mm ID fused silica, 1.12 micron film thickness, or equivalent;
- J&W DB624, 60 M, 0.32 mm ID fused silica, 1.8 micron film thickness, or equivalent;
- J&W DB624, 60 M, 0.25 mm ID fused silica, 1.0 micron film thickness, or equivalent;
- J&W DB624, 20 M, 0.18 mm ID fused silica, 1.0 micron film thickness, or equivalent.

7.2.3. Mass Spectrometer - HP5970B, HP5971, HP5972, or HP5973 - Capable of scanning from 35 to 300 amu every 2 second or less, using 70 volts (nominal) electron energy in the electron impact ionization mode.

7.2.4. Data System - A computer system interfaced to the mass spectrometer. The system allows the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer has software (HP Chemstation) that can search any GC/MS data file for ions of a specific mass and that can plot such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). The software allows integrating the abundances in any EICP between specified time or scan-number limits. The most recent version of the EPA/NIST Mass Spectral Library should also be available.

7.3. Appropriate analytical balance (0.0001 g recommended for standard preparation and 0.01 g for sample weighing), volumetric flasks, syringes, vials, and bottles for standards preparation. Calibrate the balance according to ADM-DALYCK.

7.4. Purge and Trap with Autosampler

7.4.1. Each volatile GC/MS analytical system uses a purge and trap concentrator system to introduce the sample onto the GC column. Each purge and trap has an autosampler (A/S) attached to run multiple samples, one at a time, and run unattended for extended periods of time.

7.4.2. Varian Archon autosamplers – these autosamplers add both Internal Standards and Surrogate Standards automatically from two individual receptacles, removing some of the inconsistencies related to the repetitive analyst setup of the older autosampler technology. In turn, the sample and standard preparation vary for both methods 5030 and 5035 using these autosamplers. The preparation of both samples and standards for method 8260B by 5030 and 5035 will be addressed below.

7.4.3. Centurian autosamplers – these autosamplers add both Internal Standards and Surrogate Standards automatically from two individual receptacles, removing some of the inconsistencies related to the repetitive analyst setup of the older autosampler technology. In turn, the sample and standard preparation vary using these autosamplers. The preparation of both samples and standards for method 8260B waters will be addressed below.

7.4.4. Adsorbent Traps: Supelco K-Traps Carboxen Vocarb 3000.

7.5. PH indicator Paper – wide range – examples: pHydrion by Mikro 1-12 or EMD colorpHast 0-14.

7.6. Appropriate volume gas tight syringes with certificate of accuracy.

7.7. Appropriate volume glassware (50 mL graduated cylinders) for diluting standards, soil extracts, etc. Cleaned according to section 8.

7.8. See VOC-5035 for further equipment related to soil sample collection, preservation, and extraction.

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8. PREVENTATIVE MAINTANENCE

Typical preventive maintenance measures include, but are not limited to, the following items:

- Check gas supply
- Change in-line filters, septum, gold seal, and injection port liner, as needed
- Clip column as needed
- Clean source

Specific instructions for these maintenance activities and other troubleshooting activities are found in the appropriate instrument manuals.

Maintenance log - All Preventive maintenance, as well as instrument repair, should be documented in the appropriate instrument maintenance log. Most routine maintenance and troubleshooting are performed by CAS staff. Other maintenance or repairs may, or may not require factory service, depending upon the nature of the task. Any maintenance performed by outside services must also be documented – either through notes in the log or through documents provided by the service. The log entries will include the date maintenance was performed, symptoms of the problem, serial numbers of major equipment upgrades or replacements. The datafile name of the first acceptable run after maintenance is to be documented in the maintenance log.

All syringes used for sample and standard preparation are monitored by the analyst for wear. Parts are replaced as needed to insure all syringes remain gas tight.

All glassware must be cleaned prior to use and includes the use of liquinox detergent, rinse 8-10 times with hot tap water, rinse 3 times with Millipore DI and 3 times with Purge and Trap grade Methanol.

9. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

9.1. Solvents must be of sufficient purity to permit usage without lessening the accuracy of the determination or introducing interferences. Solvents are to be checked for contamination before use. See ADM-CTMN.

- Methanol, purge and trap grade or equivalent. Purchased commercially. Store at room temperature for up to 3 years.

9.2. See VOC-5035 for preservatives.

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9.3. **Standards storage and expiration** – All of the standards in this SOP are stored in the freezer below -10°C and are allowed to warm to room temperature before using. Standards expire per the CAS expiration policy. These expirations are broken up by Prepared standards, Purchased standards, and Ampulated gas standards.

9.4. **Standards Preparation General Information and Disclaimers**

All of the preparation instructions are general guidelines. Other technical recipes may be used to achieve the same results. Example – a 20 mg/L standard may be made by adding 1 mL of 200 mg/L to 10 mLs or may be made by adding 4 mL of 50 mg/L to 10 mLs. The preparation depends upon the final volume needed and the initial concentration of the stock. Reasonable dilution technique is used.

The initial calibration curves given are typical, but also subject to variation due to targets and detection levels needed. The curves will always be at least 5 points. The lowest concentration level shall be at the method reporting level. The remaining levels should define the working linear range of the analytical system.

Vendors and vendors' products are sometimes listed for the ease of the analyst using this SOP, but products and purchased concentrations are examples only and subject to change at any time. All purchased standards are certified by the vendor. Certificates of Analysis are kept in the department until the standards are no longer being used – at which time they are archived with QA. Certificates of Analysis are available upon request. Purchased standards are routinely checked against an independent source for both analyte identification and analyte concentration.

All Standards must be traceable using the CAS lot system (ADM-DATANTRY).

All targets are routinely spiked in the LCS, MS, and MSD.

9.5. **Internal Standards and Surrogates** - The surrogates used are Dibromofluoromethane, toluene-d_8, 4-bromofluorobenzene, and 1,2-dichloroethane-d_4. The internal standards are pentafluorobenzene, 1,4-difluorobenzene, 1,4-dichlorobenzened$_4$ and chlorobenzene-d_5. All surrogates and internal standards are added to every standard, sample, blank and spike at 50 ug/L (5 ul of a 50 ppm working standard mix to 5.0 mL sample volume) for water and soils. The initial calibration standards have additional surrogate added to attain varied calibration concentration levels. 1,2-Dichlorethane-d4 is reported and evaluated only if requested, even though it is always added.

9.5.1. Stock standards (purchased) – used for both Archon and Centurian systems

9.5.1.1. Internal Standard Mix (2500 ug/mL) - Supelco 8260B Equity IS Mix.

9.5.1.2. Surrogate Mix (2500 ug/mL) –Ultra 8260B Surrogate Mix

9.5.2. Centurian Intermediate and Working Standards (prepared)

9.5.2.1. Centurian IS and Surr Intermediate Standards

9.5.2.1.1. Internal Standard Mix (500 ug/mL) – Dilute 1.0 mL of 2500 ug/mL Stock Internal Standard Mix to 5.0 mL with Methanol.

9.5.2.1.2. Surrogate Mix (500 ug/mL) – Dilute 1.0 mL of 2500 ug/mL Stock Surrogate Mix to 5.0 mL with Methanol.

9.5.2.2. Centurian IS and Surrogate Working standards (prepared)

9.5.2.2.1. Internal Standard Mix (50 ug/mL) – Dilute 500 uL of 500 ug/mL Internal Standard Mix to 5.0 mL with Methanol.

9.5.2.2.2. Surrogate Mix (50 ug/mL) – Dilute 500 uL of 500 ug/mL Surrogate Mix to 5.0 mL with Methanol.

9.5.2.2.3. Surrogate Mix (25 ug/mL) – Dilute 250 uL of 500 ug/mL Surrogate Mix to 5.0 mL with Methanol.

9.5.2.2.4. Combined Internal Standard/Surrogate Mix (50 ug/mL) – Dilute 500 uL of 500 ug/mL Intermediate Internal Standard Mix and 500 uL of 500 ug/mL Intermediate Surrogate Mix to 5.0 mL with Methanol.

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9.5.3. Archon IS/Surr Working Standard (prepared)

9.5.3.1. Combined Internal Standard/Surrogate Mix (250 ug/mL) – Dilute 1 mL of 2500 ug/mL Internal Standard Stock and 1 mL of 2500 ug/mL Surrogate Stock to 10 mLs with methanol.

9.5.3.2. This solution is placed into an autosampler vial that acts as a reservoir for the autosampler. 1 uL is automatically added to each injection (5 mL) for a concentration of 50 ug/L. The sample or standard is transferred from the Archon through a nickel transfer line, past a ported valve that is calibrated to deliver 1 uL of IS/Surr mix. The sample fraction is transferred to a fritted sparge chamber on the Tekmar 2016 concentrator at which time the sample or standard is purged on to the absorbent trap.

9.6. **Tune Standard** (10 ug/L) – dilute 1 uL of 500 ug/mL Working Surrogate Standard (the Surrogate standard contains the BFB needed for the Tune) to 50 mLs with DI.

9.6.1. For Waters – place the whole vial on the system.

9.6.2. For Soils – place 5 mLs of the solution into a vial and place on the system.

9.7. **Preparation of Primary Standards for 8260B Full List Targets**

9.7.1. Full List Stock Standard Solutions

9.7.1.1. Targets/Gases/APP-MANN Stock Standards

- Supelco 8-61339 (2000 ug/mL) – purchased
- Supelco 4-8799-0 (2000 ug/mL) – purchased
- Supelco 86-1298 (various levels) – purchased

9.7.1.2. HSL Stock Standards

- Supelco 46831-u (2000 ug/mL)
- Chloroprene (2000 ug/mL) – Supelco 86-1145
- Acrolein (approximately 32000 ppm) – made from neat - exact concentration calculated from exact mass added (recorded to 0.1 mg).

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9.7.1.3. Freons Plus Special Stock Standard

- Accustandard Primary Freons Custom 5-9219 (2000 ug/mL)
- 8260 Extras - Absolute 94237 (500-40000 ug/mL)

9.7.2. Full List Targets Working Solutions

9.7.2.1. Targets/Gases/App-MANN Higher Working solution (500-10000 ppm) – Dilute 1.25 mLs of each of the three Targets/Gases/App-MANN Stock solutions to 5.0 mLs with methanol.

9.7.2.2. HSL Working solution (500 ppm compounds and 2500 ppm acrolein) – Dilute 1.25 mLs of 2000 ppm Supelco 46831-u, 1.25 mLs of 2000 ppm chloroprene, and a volume (volume calculated to bring to desired concentration) of ~32000 ppm acrolein to 5.0 mLs with methanol.

9.7.2.3. Freons Plus Special Working Solution (500-40,000 ppm) – Dilute 1.25 mLs of 2000 ug/mL Freons Special Stock and 1.25 mL of 8260 Extras to 5.0 mLs with methanol.

9.7.2.4. Low Level Combined Working Solution – Dilute 10 uL of each of the above working solutions to 1.0 mLs with methanol.

9.7.3. Calibration Level Standards for waters by Archon (Example-varies by instrument)

Concentration of standard (VSTD)	0.5	1	2	5	10	20	50	100	150	200
Concentration of surrogate	50*	50*	50*	60	75	50*	50	100	150	200
Vol. Of low level combined working std.	5	10	20	0	0	0	0	0	0	0
Vol. of target/gases working std. (uL)	0	0	0	0.5	1	2	5	10	15	20
Vol. Of HSL working Std (uL)	0	0	0	0.5	1	2	5	10	15	20
Vol. Of Freons Special Std (uL)	0	0	0	0.5	1	2	5	10	15	20
Vol. Of 500 ppm Surrogate Stock (uL)	0	0	0	1	2.5	0	0	5	10	15

*Not used in the surrogate curve

Dilute the above volumes to 50 mLs with DI. Place each standard in its own vial. The Archon draws 5.0 mLs of the standard from the vial and adds 1 uL of the combined 50 ppm IS/Surr standard. Not all of the points are always used.

9.7.4. Calibration Level Standards for waters by Tekmar (Example-varies by instrument)

Concentration of standard (VSTD)	1	5	20	50	100	150	200
Final Concentration of surrogate (ppb)	50*	50*	20	50	100	150	200
Vol. of low level comb. working std. (uL)	10	0	0	0	0	0	0
Vol. Of targets/gases working std. (uL)	0	0.5	2	5	10	15	20
Vol. Of HSL working Std (uL)	0	0.5	2	5	10	15	20
Vol. Of Freons working Std (uL)	0	0.5	2	5	10	15	20
Vol. Of 500 ppm Surrogate Stock (uL)	0	0	2	0	5	10	15
Vol. Of 50 ppm IS stock (uL)	0	0	5	0	0	0	0

*Not used in the surrogate curve

Dilute the volumes above to 50 mLs with DI. Remove a 5.0 mL aliquot and add 5.0 uL of 50 ppm combined IS/Surr stock to all except the 20 ppb standard which already had the Internal Standards and Surrogates added. Purge 5.0 mLs.

9.7.5. Calibration Level Standards for Soils by Archon (Example-varies by instrument)

Concentration of standard (VSTD)	5	10	20	50	100	150	200
Concentration of surrogate	50*	50*	75	50	100	125	150
Vol. Of low level combined working std.without Freons (uL)	50	100	0	0	0	0	0
Vol. of target/gases working std. (uL)	0	0	2	5	10	15	20
Vol. Of HSL working Std (uL)	0	0	2	5	10	15	20
Vol. Of 500 ppm Surrogate Stock (uL)	0	0	2.5	0	5	7.5	10

*Not used in the surrogate curve

Dilute the above volumes to 50 mLs with DI. Transfer 5.0 mLs each standard to separate vials. The Archon adds 1 uL of the combined 50 ppm IS/Surr standard to the vial of the aqueous standard and purges directly in the vial. Not all of the points are always used.

When calibrating for the analysis of soils by 5035/8260B, the standard solution above must contain the same amount of Sodium Bisulfate as the samples being analyzed.

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9.8. Preparation of Secondary Standards for 8260B Full List Targets

9.8.1. Secondary Stock Standards

9.8.1.1. Secondary Targets/Gases

- Supelco 8-561298 – purchased
- Supelco 4-58799- purchased
- Supelco 8-561339 – purchased

9.8.1.2. Secondary HSL

- Supelco 456831-U- purchased
- Supelco 85561145 – purchased
- Acrolein - made from a second source of neat acrolein.

9.8.1.3. Secondary Freons

- Absolute 93034 (1000 ppm) – purchased
- Absolute 94236 8260B Extra Compound SS (2000-40,000).

9.8.2. Working Standards

- Secondary Targets/Gases (500-10,000 ppm)- Dilute 1.25 mLs of each of the Target/Gases purchased standards to 5.0 mL with methanol.

- Secondary HSL (500-2500 ppm) – Dilute 1.25 mLs of each of the purchased HSL standards and 0.390 mLs of the acrolein standard to 5.0 mLs with methanol.

- Secondary Freons Plus – Dilute 1.0 mL of 93034 (SS Freons – 1000 ppm) purchased standard and 94236 (SS Extras 2000-40000 ppm) standard to 5.0 mLs with methanol.

9.8.3. **ICV (50 ppb)**– Dilute 5.0 uL of Secondary Target/Gases Working stock, 5.0 uL of Secondary HSL Working Stock, and 12.5 uL of Secondary Freons Plus working stock to 50.0 mLs with DI.

9.8.4. **LCS (20 ppb)**- Dilute 2.0 uL of Secondary Target/Gases Working stock, 2.0 uL of Secondary HSL Working Stock, and 5 uL of Secondary Freons Plus working stock to 50.0 mLs with DI.

9.8.5. **MS/MSD (50 ppb)**- Add 5.0 uL of Secondary Target/Gases Working stock, 5.0 uL of Secondary HSL Working Stock, and 12.5 uL of Secondary Freons Plus working stock to 50.0 mLs of sample.

9.8.6. **Method Blank** – Analyze DI as a sample.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to the instructions in this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are only to be performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

11. PROCEDURE

11.1. Be sure the system has a current LOD and the analyst has a current Demonstration of Capability.

11.2. Sample Preparation –samples are screened according to VOC-SCREEN.

11.2.1. Water Samples

11.2.1.1. No preparation is generally required, other than dilution with reagent water to bring analytes into the upper half of the calibration range. Thus, a 5.0 mL sample volume is run straight from the sample vial for a 5.0 mL purge. Other purge volumes (10, 25 mLs for low level) may be used depending on client requirements.

11.2.1.2. After analysis, the pH of all water samples are to be checked with pH paper. The pH shall be noted in the run log. If the pH is not <2, file a pH discrepancy form and give to the Project Manager.

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11.2.1.3. Samples requiring dilutions due to targets above the linear range of the instruments are prepared as follows according to ADM-DIL:

11.2.1.3.1. (1/5) = 10 mL sample adjusted to 50 mL in a 50 mL ground glass graduated cylinder inverted once and transferred to a 40 mL VOA vial

11.2.1.3.2. (1/25) = 2.0 mL sample adjusted to 50 mL in a 50 mL ground glass graduated cylinder inverted once and transferred to a 40 mL VOA vial

11.2.1.3.3. (1/50) = 1.0 mL sample adjusted to 50 mL in a 50 mL ground glass graduated cylinder inverted once and transferred to a 40 mL VOA vial

11.2.1.4. Internal standards and surrogates are added to the diluted sample by the autosampler.

Note: At no time should less than 1 mL of the original sample fraction be used for the preparation of the diluted sample. This insures a representative fraction of sample is diluted.

11.2.2. Soil samples

11.2.2.1. Follow VOC-5035 for preparation of soils by 5035.

11.3. Instrument Performance Check –Tuning

11.3.1. Verify than the MS meets standard mass spectral abundance criteria prior to initiation of any samples by injecting the 4-bromofluorobenzene (BFB) tune standard. The tune standard must be analyzed at the beginning of the analytical sequence and every 12-hours of continuous analysis. The 12-hour clock starts at the time of the BFB injection. Evaluate the ion abundance using the following scenarios:

11.3.1.1. One scan at the apex, or one scan immediately preceding the apex or one scan immediately following the apex;

11.3.1.2. The mean of the apex and the immediate preceding or following scans;

11.3.1.3. The mean of the apex, immediately preceding scan, and immediately following scan;

11.3.1.4. Any of the three scenarios above with background subtraction. If background subtraction is necessary, a single scan, no more than 20 scans prior to the elution of BFB may be used. Do not background subtract part of the BFB peak.

11.3.2. Each volatile GC/MS system must meet the BFB ion abundance criteria shown in Table 1 for a 50 ng injection of BFB.

11.3.3. If tuning criteria cannot be met, the source may need cleaning, filaments replaced or other maintenance. Record the corrective action taken in the run log or maintenance log and re-inject the tune standard. Sample analysis may not proceed until the tune meets these criteria.

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11.4. Initial Calibration – follow ADM-ICAL.

11.4.1. Tune the instrument according to 11.3.

11.4.2. Run an instrument blank to demonstrate that the instrument is free of contamination before analyzing the standards.

11.4.3. A 5 point calibration must be analyzed. More points can be used for better response. The standards must be analyzed the same as the samples (example: if samples are to be heated, the standards are to be heated). Calibration levels are given in Section 9 depending on the client requirements. Analyze each calibration standard and tabulate the area response of the characteristic quantitation ions versus concentration for each compound, internal standards and surrogate. The low level standard used during calibration shall be the reporting level for the analysis. The midpoint standard of the initial calibration curve establishes the retention time window position for each analyte and surrogate.

11.4.4. The internal standards should permit most of the components of interest in a chromatogram to have retention times of 0.80 - 1.20, relative to one of the internal standards. Use the base peak ion from the specific internal standard as the primary ion for quantitation (see instrument specific addendum - attached). If interferences are noted, use the next most intense ion as the quantitation ion.

11.4.5. Calculate the response factors (RF) for each compound and surrogate relative to the specified internal standard by:

$$RF_x = \frac{(A_x)(C_{ISTD})}{(A_{ISTD})(C_x)}$$

Where:

A_x = Area of the characteristic quantitation ion for compound x.
A_{ISTD} = Area of the characteristic quantitation ion for the specified internal standard.
C_x = The concentration of the compound added (ppb).
C_{ISTD} = The concentration of the specified internal standard (ppb).

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11.4.6. Calculate the mean response factor $(\overline{RF_x})$ for each analyte and surrogate from the calibration levels. Calculate standard deviation (SD) and the percent relative standard deviations (%RSD) for each analyte from the mean with:

$$SD = \sqrt{\sum_{i=1}^{N} \frac{(RF_i - \overline{RF})^2}{N - 1}}$$

where:
RF_i = RF for each of the 5 calibration levels
RF = mean of 5 initial RFs for a compound.
N = Number of RF values (i.e., 5)

$$\%RSD = \frac{(SD)}{(\overline{RF_x})} 100.$$

where:
RSD = relative standard deviation.
RF = mean of 5 initial RFs for a compound.
SD = standard deviation of average RFs for a compound.

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11.4.7. Initial Calibration criteria

11.4.7.1. The % RSD should be less than 15% for each target compound. If the %RSD of any target is greater than 15%, see the options below.

11.4.7.2. If the % RSD for any target compound is 15% or less, linearity can be assumed over the calibration range, and the average relative response factor for each analyte and surrogate is used to quantitate sample analytes.

11.4.7.3. If the % RSD of any compound is > 15%, construct a linear regression calibration curve of area ratio (A/A_{is}) versus concentration using the equation of a line ($y=mx+b$). The origin may not be used as a calibration point and the required Correlation Coefficient must be ≥ 0.99*. If the Calibration Correlation is not met, linear regression may not be used to quantitate the target. See the option below. It is good lab practice to mark all target compounds on a curve to identify target compounds calculated using linear regression.

11.4.7.4. The response of 5 SPCC's (System Performance Check Compounds) must meet the following minimum $\overline{RF_x}$:

SPCC	**5 mL purge**	**25 mL purge**
Chloromethane	>0.10	>0.010
1,1-Dichloroethane	>0.10	>0.200
Bromoform	>0.10	>0.05
Chlorobenzene	>0.30	>0.500
1,1,2,2-Tetrachloroethane	>0.30	>0.100

11.4.7.5. Initial Calibration Verification Standard (ICV)- inject and analyze the ICV to verify the initial calibration immediately after the calibration. The % recovery must meet 70-130%* for all compounds.

11.4.8. Only after the calibration has passed all of the above criteria shall samples be analyzed.

*See DOD Summary Attachment for DOD Specific Criteria

11.5. Daily GC/MS Calibration and Analytical Sequence

11.5.1. The start of a 12-hour analysis window requires a check of the Mass Spec Detector's tune via an injection of 50 ng of BFB. The acceptance criteria must be met before client samples are analyzed.

11.5.2. CCV –

11.5.2.1. Frequency - After the tuning criteria have been verified, the initial calibration must be checked and verified by analyzing a midrange Continuing Calibration Verification Standard (CCV).

11.5.2.2. Concentration - The 50 ppb level is recommended. NELAC requires this calibration check standard to vary in concentration over time. An injection of the CCV and LCS standards shall satisfy this requirement as long as the standards are two different concentrations.

11.5.2.3. Limits and Corrective Action-

11.5.2.3.1. Each SPCC compound must meet it's minimum RF (see above). This is the same check that is applied to the initial calibration. If these criteria are not met, correct the problem and obtain a compliant CCV or recalibrate before sample analysis begins.

11.5.2.3.2. The CCC compounds (1,1-dichloroethene, Chloroform, 1,2-Dichloropropane, Toluene, Ethylbenzene, and Vinyl Chloride) are used to check the validity of the initial calibration. Calculate the %D for each compound using the calculations below. The %D for each CCC must meet ≤ 20% for the initial calibration to be valid (*all targets must be ≤ 20% for DOD).

11.5.2.3.2.1. For **linear regression calibrations** , calculate the percent drift using:

$$\%\ Drift = \frac{C_c - C_T}{C_T} x\ 100$$

where:

C_c = Calculated concentration of Calibration Check Compound standard.

C_T = Theoretical concentration of prepared standard.

*See DOD Summary Attachment for DOD Specific Criteria

11.5.2.3.2.2. For **calibrations based on RF**, calculate the percent difference using:

$$\%\ Difference = \frac{RF_v - \overline{RF}}{\overline{RF}} \times 100$$

where RF_v is the response factor from the analysis of the verification standard and $\overline{RF}$ is the mean response factor from the initial calibration.

11.5.2.4. If the CCC compounds are not included in the initial calibration, all compounds must meet the ≤ 20% criteria.

11.5.2.5. For all other TCL compounds, the %D should meet ≤25%. Two compounds may be greater than 25%D, however must not exceed 40%D for analysis to continue. It is good lab practice to maintain ≤20%D when a compound is positive in a sample to ensure accurate quantitation, but not required. For any non-TCL compound that exceeds 40%D, analyst discretion is advised in evaluating hits for that compound.

11.5.3. Internal Standards - If the tune criteria and the continuing calibration criteria are met, then evaluate the retention times of all compounds, surrogates, and internal standards against the initial calibration. If the retention time for any internal standard changes by more than 30 seconds from the current initial calibration mid-point standard, the system must be inspected for malfunctions and corrections must be made, as required. If the area for any of the internal standards changes by a factor of 2 (-50% to +100%) from the current initial calibration mid-point std., corrections must be made to the system. Reanalyze any samples associated with malfunctioning system.

11.5.4. Analyze the LCS. Evaluate the LCS according to the instructions in 12.

11.5.5. Analyze a method blank to check the system for contamination. Evaluate the MB according to the instructions in 12.

11.5.6. When all of the above criteria are met, client sample analysis may begin.

11.5.7. When purging 25 mL sample volumes to obtain lower detection limits, criteria from the EPA Statement of Work, OLC 02.1 shall be followed. See Table 3.

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11.6. Identification of Analytes and Data Interpretation, and Client Sample Analysis

11.6.1. Note that medium soils (prepared by method 5035) are run on water curves on any autosampler. Client samples are analyzed on an instrument running an appropriate calibration for the target compound list needed for the sample.

11.6.2. The qualitative identification of compounds determined by this method is based on retention time, and comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference mass spectrum. The reference mass spectrum must be generated by the laboratory using the conditions of this method. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Compounds should be identified as present when the criteria below are met. If there is no peak found for an analyte in the expected retention time window and the mass spectra does not match according to the below, then the analyte is "not found".

11.6.2.1. The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

11.6.2.2. The RRT of the sample component is within ± 0.06 RRT units of the RRT of the standard component.

11.6.2.3. The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum.

11.6.2.4. Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

11.6.2.5. Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When gas chromatographic peaks obviously represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra is important.

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11.6.2.6. Examination of extracted ion current profiles of appropriate ions can aid in the selection of spectra, and in qualitative identification of compounds. When analytes coelute (i.e., only one chromatographic peak is apparent), the identification criteria can be met, but each analyte spectrum will contain extraneous ions contributed by the coeluting compound.

11.6.3. For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification.

11.6.4. If the response for any quantitation ion exceeds the initial calibration curve range of the GC/MS system, dilute the sample (from a fresh vial if available) according to section 11.2 and ADM-DIL. If a fresh vial is not available, the use of a compromised vial must be documented in the runlog and on the case narrative (by use of a NCAR – see ADM-NCAR).

11.6.5. If the detector becomes saturated from a high concentration sample run a blank after the sample to demonstrate the instrument is free from carry-over. If there is contamination, take corrective action. The instrument must be demonstrated to be free from contamination before analysis may continue.

12. QA/QC REQUIREMENTS

12.1. **Method Blank** - For every 12-hour analysis window and for each analytical batch, after meeting the tune and continuing calibration criteria, at least one method blank must be run and reportable for each matrix. All blanks reported must be free from target analytes with the exception of known common laboratory contaminants. Acetone and Methylene Chloride must not be present at a level greater than 5 times the LOQ and all samples affected should be marked with the appropriate lab flag. Method blanks are considered free of contamination if the result is less than half of the reporting limit. Reanalyze the MB until the system is shown to meet these criteria. Reanalyze any samples associated with a non-compliant method blank.

Exception: if a target analyte is greater than five times the method blank contaminant, the analysis may continue since the sample concentration is high enough that possible contamination has not significantly affected its concentration.

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12.2. **LCS-**

12.2.1. **Frequency** - With each batch of samples (20 samples maximum), a minimum of one LCS for each matrix must be analyzed to ensure instrument performance. When batches are less than 20 samples, the LCS is performed on a per batch basis. The LCS is prepared by spiking a blank with the matrix spike solution, and going through the entire extraction and analysis. LCSs may be analyzed in duplicate to avoid discarding a sequence due to mishaps such as poor desorption, improper standard preparation, or poor injection. In order to be considered as duplicates, LCSs must be run together without samples or other QC in between. When duplicate LCSs are analyzed within the sequence, the following acceptance criteria have been established:

12.2.1.1. When the first LCS of the duplicate pair meets LCS criteria, this LCS is reported and used to verify continued performance. Continue with the sequence. The second is not evaluated or reported.

12.2.1.2. When the first LCS of the duplicate pair does not meet the LCS criteria and the second LCS does meet LCS criteria, the second LCS is reported and used to verify continued performance. If known, the cause of the first failure should be noted in the run log. Continue with the sequence. The first LCS is not reported.

12.2.1.3. When some or all compounds are outlying within the first or second or both LCSs, the results shall not be merged to report an acceptable LCS. If the outliers are high bias and the associated samples prior to and following the LCS are non-detect for those compounds, the LCS may be used to verify the performance and reported with the high bias. Otherwise the sequence is not valid since the LCS cannot be used to close the previous samples or open for the following samples. The unacceptable LCS and associated samples shall be reanalyzed.

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12.2.2. **Acceptance Criteria** –

12.2.2.1. Calculate percent recovery (%R) as follows:

$$\%R = X/TV \times 100$$

Where: X = Concentration of the analyte recovered
TV = True value of amount spiked

12.2.2.2. Acceptance criteria for lab control samples are listed in Appendix C of the Quality Assurance Manual*.

Exceptions:. Client-specific QAPP requirements also may superceed lab control limits listed in Appendix C of the Quality Assurance Manual.

12.2.3. **Corrective Action** - If the LCS recovery for any control analyte* fails acceptance limits, corrective action is required except as described below. If instrument corrective action is not applicable or ineffective, re-analysis of the associated samples is required. If any other analyte fails the acceptance limits, the analyst must evaluate the impact on data quality and take any necessary corrective action, which may include re-analysis of the associated samples. Project-specific requirements may require all compounds to be treated as control analytes, or dictate use of project acceptance criteria.

12.2.4. Sample analysis may continue under the following circumstances when controlled compound* recoveries fall outside the control limits listed in Appendix C of the Quality Assurance Manual.

- High outlying recovery associated with a non-detect sample result since the high bias would have negligible effect on non-detect sample results.
- Reanalysis would result in a worse quality scenario such as holding time issues or insufficient sample volume.
- Low outlying recoveries associated with non-detect sample results as long as the response factors for these compounds are adequate to show the compound's presence in the sample.

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12.3. **MS/MSD** –

12.3.1. **Frequency -** For each batch of samples (20 samples maximum), a minimum of one MS/MSD pair for each matrix must be analyzed to assess sample matrix and to ensure instrument performance. If there is not enough sample to process MS/MSD, a Blank Spike and Blank Spike Duplicate will be processed to show precision in the batch. See below.

12.3.2. **Recovery Limits -** The limits for MS recovery and MS/MSD RPD are given in Appendix C of the Quality Assurance Manual*.

12.3.3. **Recovery Corrective Action** -

12.3.3.1. Although all targets are evaluated, only the method specific compounds (1,1-Dichloroethene, trichloroethene, benzene, toluene, and chlorobenzene) are typically reported from the MS/MSD analyses. The results of the MS/MSD analysis is used for client assessment of sample matrix and is not used to control the analysis. Outlying MS/MSD recoveries associated with an acceptable LCS may indicate sample matrix interferences, but does not warrant reanalysis or confirmation. All data shall be reported with the appropriate flags or mentioned in the Case Narrative.

12.3.3.2. If the MS/MSD does not pass precision or accuracy requirements, evaluate the associated LCS. If the LCS passes QC requirements it is presumed that matrix has affected the spiked samples and the run may continue. If the concurrent LCS fails for the same compound or any other compound the validity of the LCS should be examined and any samples prior to the LCS and after the last CCV should be reanalyzed, including the MS/MSD.

12.3.4. **RPD Limits** – given in Appendix C of the Quality Assurance Manual

12.3.5. **RPD Corrective Action** - if the RPD value between samples or MS/MSD results exceed limits listed in Appendix C of the QAM, examine the chromatograms and benchsheets for potential matrix interferences. Examples may include product layers on aqueous samples that may result in non-homogenous subsampling, non-homogenous soil samples, chromatographic interferences resulting in poor peak resolution and inconsistent integrations, or poor purging efficiencies (indicated by surrogate recovery). Reanalyze the pair if deemed appropriate. The outlying RPD should be mentioned in the Case Narrative so that data may be flagged appropriately.

*See DOD Summary Attachment for DOD Specific Criteria

12.4. **BS/BSD** – (Blank Spike/Blank Spike DUP) - only run when there is insufficient sample for MS/MSD at the MS/MSD frequency. The RPD must meet RPD limits listed for the MS/MSD. If it does not, the outlying RPD must be mentioned in the case narrative.

12.5. **Calibration** - The acceptance criteria for tuning verification, initial, and continuing calibration verification are discussed in the procedure (Section 11).

12.6. **Surrogates and Internal Standards** –

12.6.1. **Frequency** – Added to all injections

12.6.2. **Acceptance Criteria** - The limits for surrogate recovery is given in Appendix C of the Quality Assurance Manual. Dichlorethane-d4 is evaluated and reported only if requested. The limit for internal standards is (-50% to 100%).

12.6.3. **Corrective Action** - When instances of Surrogate or internal area count failures occur, the associated sample is repeated and the results are compared. If the questioned samples fail a second analysis, the first run is reported to the client and the sample flagged with an "*" indicating a probable matrix interference exists. In the case where Tier package work is required and the appropriate forms need to be generated, the second analytical analysis is also reported to the client. If the second analysis passes, report these data.

12.6.4. If a surrogate(s) fails acceptance, the sample must be evaluated for matrix interferences and "historical results". Reanalyze the sample to confirm the interference. If needed contact client and flag the data in the report. If surrogates are diluted more than 10 times, report as "D", diluted below calibration. For package reports, include initial and confirmation analysis results. High outlying recoveries associated with non-detect sample results need not be reanalyzed. They need only be noted in the case narrative as high bias with non-detect results.

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13. DATA REDUCTION AND REPORTING

13.1. Calculations

The GC/MS data stations, in current use, all use the H-P RTE Integrator to generate the raw data used to calculate the standards $\overline{RF_x}$ values, the sample amounts, and the spike values. The software does three passes through each data file. The first two identify and integrate each internal standard and surrogate. The third pass uses the time-drift information from the first two passes to search for all method analytes in the proper retention times and with the proper characteristic quantitation ions. The primary and secondary quantitation ions are given in Table 2. The internal standard with which the analytes are associated changes with each column and is documented in the Initial Calibration Summary Report. The current associations per instrument are attached to this SOP in the Instrument Specific Addendum.

13.1.1. The results for a water sample are calculated as follows when $\overline{RF_x}$ is used:

$$A_x = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF_x})} \times DilFactor$$

Where:
A_x = the amount, in ppb, of the analytes in the sample;
$Resp_x$ = the peak area of the analytes of interest;
$Resp_{ISTD}$ = the peak area of the associated internal standard;
Amt_{ISTD} = the amount, in ppb, of internal standard added; and
$\overline{RF_x}$ the average response from the five-point for the analytes of interest.

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13.1.2. The results for a soil sample are broken into two types, the low-level type and the high-level type. The high level type may also be corrected for moisture in the methanol. At this time, the laboratory is only providing the moisture corrected results upon request.

13.1.2.1. The low-level type is a direct heated purge of soil and requires its own separate five-point. For soil, 5 grams is weighed out into the sample vial, and is purged with 5 mL of blank reagent water at a temperature of 40°C ±2°. The results for low-level soil work are calculated by taking the normal print out, in ppb, (see the water results outlined above) and correcting for the total, dry soil sample actually purged (the dry weight is determined according to GEN-DWPS in the General Chemistry Department and the 8260 correction is made in LIMS):

$$(A_x) * \frac{(5\ grams)}{(ASW_t\ gr)(\%\ Solids)} = A_x\ Low\text{-}Level\ Soil$$

Where:
A_x = the amount, in ppb, from the data station;
5 grams = the nominal amount of soil that is heated and purged;
ASW_t = the actual soil wet weight, in grams, that is purged
% Solids = the correction factor for dry weight in decimal form.

13.1.2.2. The high-level type is based on an extraction (see VOC-5035). A mass of soil (usually 4 g wet weight) is extracted with a volume (usually 5 mL) of purge-and-trap methanol. The extract is diluted with DI (Usually 100 uL of extract is diluted to 5 mL) and analyzed and calculated as follows:

$$(A_x)\left[\frac{(Dilution)(V_t)}{(ASW_t)(\%\ Solids)}\right] = High\text{-}Level\ Soil\ Amt(ug/kg).$$

Where:
A_x = the data station results, in ug/L;
Dilution = the dilution of the extract.
V_t = the amount (mL) of methanol used to extract the soil (usually 5 mL);
ASW_t = the actual wet weight of soil extracted (g)
% Solids = the dry soil correction in decimal form.

It should be noted that some states and governing agencies require differing amounts of soil and Methanol ratio be maintained these ratios are generally, 1:2.5, 1:2, 1:1. The amount of extract added is never greater than 100 ul per 5 mL DI. As an example, the Archon autosampler would require the addition of 1.0 mL to 49 mL DI. This is then transferred to a 40 mL VOA vial. See the included table in method 5035 for specific state regulation on soil to Methanol ratios.

13.1.3. Upon request: Solid samples with a significant moisture content (>10%), designated for volatile organic analysis, that are extracted prior to analysis in a water miscible solvent such as methanol are diluted by not only the methanol, but also the water in the soil. The total mixture (MeOH + soil water) volume can only be calculated based on the sample moisture present as determined by the % moisture determination. This total volume is then expressed as V_t in the sample concentration calculations provided above. This total solvent and water volume is calculated as follows:

$$V_t = mL\ methanol + \left[(1 - \%solids) * ASW_t\right]$$

13.2. All sample data and QC data, including calibration verification must reference the name (date or filename) of the ICAL on the raw data report.

13.3. Manual Integration – When the data system incorrectly quanititates or identifies analytes, manual integration is necessary. Data must be integrated consistently between standards, samples, and QC. See ADM-INT.

13.4. Reporting

Most reports are generated using STARLIMS. All data is transferred electronically from the instrument into STARLIMS. The data is reviewed by a qualified peer with applicable checklists (see ADM-DREV) before the data is acceptable and able to be reported to the client.

14. METHOD PERFORMANCE

Detection and Quantitation limits are determined according to the requirements in ADM-MDL. The supporting information is filed with the QA office.

Demonstration of Capability is performed upon instrument set-up , whenever a new analyst begins independent analysis, and annually thereafter according to ADM-TRANDOC and section 19 below. The documentation of this method performance is retained by the Quality Assurance office

Accuracy and Precision Data is available in SW-846 method 8260B.

15. WASTE MANAGEMENT AND POLLUTION PREVENTION

15.1. It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvent and reagents used in this method can be minimized when recycled or disposed of properly.

15.2. The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the CAS EH&S Manual.

15.3. Excess, unused sample and testing byproducts are disposed following the procedures in the *SMO-SPDIS*.

16. CORRECTIVE ACTION FOR OUT OF CONTROL DATA

If data is produced that is out of control, the samples are to be re-analyzed with in-control QA whenever possible. See corrective actions in Section 12 of this SOP and in the applicable Figures in Section 12 of the Quality Assurance Manual.

17. CONTINGENCIES FOR HANDLING OUT OF CONTROL OR UNACCEPTABLE DATA

If data is produced that is out of control and is not to be re-analyzed due to sample volume restrictions, holding times, or QC controls can not be met, follow the procedures in Section 15 of the Quality Assurance Manual.

18. REFERENCES

18.1. *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, USEPA SW-846, Third Edition, December 1996.

18.2. *D*OD *Quality Systems Manual for Environmental Laboratories* – Version 4.1, April 2009

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19. TRAINING OUTLINE

19.1. Read current SOP and applicable methodologies. Demonstrate a general understanding of the methodology and chemistry. Follow policies in ADM-TRANDOC.

19.2. Observe Sample Preparation and Analysis. Follow GC/MS Training Plan Form.

19.3. Participate in the methodology, documentation, and data reduction with guidance

19.4. Demonstrate Competency by performing the analysis independently. Analyze four replicates of the LCS. If recovery is within the limits of the LCS in Appendix C of the Quality Assurance Manual, complete Training Plan Form, summary spreadsheet, and IDC certificate and file with QA. An IDC study must be acceptable before the new analyst may analyze samples independently. Continuing Demonstration of Capability is demonstrated annually with the acceptable performance of a Proficiency sample, or new four replicate study.

20. METHOD MODIFICATIONS

None

21. INSTRUMENT-SPECIFIC ADDENDUM

Attached are the printouts from the GC/MS instruments running 8260B showing which analytes are associated with which internal standard. The instrument is the third item in the first line (Data File) of the report. Example: Data File: J:\ACQUDATA\MSVOA#. The internal standards are the first compound in each section (always have an AvgRF and CCRF of 1.000) and the associated analytes are listed below the internal standard

Attached are instrument specific operating conditions for this method.

22. ATTACHMENTS

Table 1 BFB Tune QC Criteria
Table 2 Characteristic Masses for Purgeable Organic Compounds
Attachment I SIM MODE
Attachment II CURRENT IS/ANALYTE ASSOCIATIONS PER INSTRUMENT
Attachment III Current Specific Operating Conditions
Attachment IV DOD Summary and QC Criteria

*See DOD Summary Attachment for DOD Specific Criteria

23. CHANGES FROM PREVIOUS REVISION

- Changed MRL to either LOQ or "Reporting Limit" throughout
- Changed MDL to either "Detection Limit" or LOD throughout
- Added SIM ions and dwell times
- Added Attachment for Instrument Specific Operating Conditions
- 9.3-Removed expirations and Referenced CAS Expiration Policy
- Updated DOD QSM references to version 4.1 – including change of ICV recovery limits from 75-125 to 80-120.

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*See DOD Summary Attachment for DOD Specific Criteria

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TABLE 1

4-BROMOFLUOROBENZENE CHARACTERISTIC ION ABUNDANCE CRITERIA

Mass/é ratio	Ion Abundance Criteria
50	15 - 40% of mass/é 95
75	30 - 60% of mass/é 95
95	base peak, 100% relative abundance
96	5 - 9% of mass/é 95
173	<2% of mass/é 174
174	>50% of mass/é 95
175	5 - 9% of mass/é 174
176	>95%; <101% of mass/é 174
177	5 - 9% of mass/é 176

*See DOD Summary Attachment for DOD Specific Criteria

Table2

CHARACTERISTIC MASSES (m/z) FOR PURGEABLE ORGANIC COMPOUNDS

Compound	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Acetone	58	43
Acetonitrile	41	40, 39
Acrolein	56	55, 58
Acrylonitrile	53	52, 51
Allyl alcohol	57	58, 39
Allyl chloride	76	41, 39, 78
Benzene	78	-
Benzyl chloride	91	126, 65, 128
Bromoacetone	136	43, 138, 93, 95
Bromobenzene	156	77, 158
Bromochloromethane	128	49, 130
Bromodichloromethane	83	85, 127
Bromoform	173	175, 254
Bromomethane	94	96
iso-Butanol	74	43
n-Butanol	56	41
2-Butanone	72	43
n-Butylbenzene	91	92, 134
sec-Butylbenzene	105	134
tert-Butylbenzene	119	91, 134
Carbon disulfide	76	78
Carbon tetrachloride	117	119
Chloral hydrate	82	44, 84, 86, 111
Chloroacetonitrile	48	75
Chlorobenzene	112	77, 114
1-Chlorobutane	56	49
Chlorodibromomethane	129	208, 206
Chloroethane	64 (49*)	66 (51*)
2-Chloroethanol	49	44, 43, 51, 80
Bis(2-chloroethyl) sulfide	109	111, 158, 160
2-Chloroethyl vinyl ether	63	65, 106
Chloroform	83	85
Chloromethane	50 (49*)	52 (51*)
Chloroprene	53	88, 90, 51
3-Chloropropionitrile	54	49, 89, 91
2-Chlorotoluene	91	126
4-Chlorotoluene	91	126
1,2-Dibromo-3-chloropropane	75	155, 157
Dibromochloromethane	129	127
1,2-Dibromoethane	107	109, 188
Dibromomethane	93	95, 174

*See DOD Summary Attachment for DOD Specific Criteria

Compound	Primary Characteristic Ion	Secondary Characteristic Ion(s)
1,2-Dichlorobenzene	146	111, 148
1,2-Dichlorobenzene-d_4	152	115, 150
1,3-Dichlorobenzene	146	111, 148
1,4-Dichlorobenzene	146	111, 148
cis-1,4-Dichloro-2-butene	75	53, 77, 124, 89
trans-1,4-Dichloro-2-butene	53	88, 75
Dichlorodifluoromethane	85	87
1,1-Dichloroethane	63	65, 83
1,2-Dichloroethane	62	98
1,1-Dichloroethene	96	61, 63
cis-1,2-Dichloroethene	96	61, 98
trans-1,2-Dichloroethene	96	61, 98
1,2-Dichloropropane	63	112
1,3-Dichloropropane	76	78
2,2-Dichloropropane	77	97
1,3-Dichloro-2-propanol	79	43, 81, 49
1,1-Dichloropropene	75	110, 77
cis-1,3-Dichloropropene	75	77, 39
trans-1,3-Dichloropropene	75	77, 39
1,2,3,4-Diepoxybutane	55	57, 56
Diethyl ether	74	45, 59
1,4-Dioxane	88	58, 43, 57
Epichlorohydrin	57	49, 62, 51
Ethanol	31	45, 27, 46
Ethyl acetate	88	43, 45, 61
Ethylbenzene	91	106
Ethylene oxide	44	43, 42
Ethyl methacrylate	69	41, 99, 86, 114
Hexachlorobutadiene	225	223, 227
Hexachloroethane	201	166, 199, 203
2-Hexanone	43	58, 57, 100
2-Hydroxypropionitrile	44	43, 42, 53
Iodomethane	142	127, 141
Isobutyl alcohol	43	41, 42, 74
Isopropylbenzene	105	120
p-Isopropyltoluene	119	134, 91
Malononitrile	66	39, 65, 38
Methacrylonitrile	41	67, 39, 52, 66
Methyl acrylate	55	85
Methyl-t-butyl ether	73	57
Methylene chloride	84	86, 49
Methyl ethyl ketone	72	43
Methyl iodide	142	127, 141

*See DOD Summary Attachment for DOD Specific Criteria

Compound	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Methyl methacrylate	69	41, 100, 39
4-Methyl-2-pentanone	100	43, 58, 85
Naphthalene	128	-
Nitrobenzene	123	51, 77
2-Nitropropane	46	-
2-Picoline	93	66, 92, 78
Pentachloroethane	167	130, 132, 165, 169
Propargyl alcohol	55	39, 38, 53
β-Propiolactone	42	43, 44
Propionitrile (ethyl cyanide)	54	52, 55, 40
n-Propylamine	59	41, 39
n-Propylbenzene	91	120
Pyridine	79	52
Styrene	104	78
1,2,3-Trichlorobenzene	180	182, 145
1,2,4-Trichlorobenzene	180	182, 145
1,1,1,2-Tetrachloroethane	131	133, 119
1,1,2,2-Tetrachloroethane	83	131, 85
Tetrachloroethene	164	129, 131, 166
Toluene	92	91
1,1,1-Trichloroethane	97	99, 61
1,1,2-Trichloroethane	83	97, 85
Trichloroethene	95	97, 130, 132
Trichlorofluoromethane	151	101, 153
1,2,3-Trichloropropane	75	77
1,2,4-Trimethylbenzene	105	120
1,3,5-Trimethylbenzene	105	120
Vinyl acetate	43	86
Vinyl chloride	62	64
o-Xylene	106	91
m-Xylene	106	91
p-Xylene	106	91
Internal Standards/Surrogates:		
Benzene-d_6	84	83
Bromobenzene-d_5	82	162
Bromochloromethane-d_2	51	131
1,4-Difluorobenzene	114	
Chlorobenzene-d_5	117	
1,4-Dichlorobenzene-d_4	152	115, 150
1,1,2-Trichloroethane-d_3	100	
4-Bromofluorobenzene	95	174, 176
Chloroform-d_1	84	
Dibromofluoromethane	113	

*See DOD Summary Attachment for DOD Specific Criteria

Compound	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Internal Standards/Surrogates		
Dichloroethane-d_4	102	
Toluene-d_8	98	
Pentafluorobenzene	168	
Fluorobenzene	96	77

* Characteristic ion for an ion trap mass spectrometer (to be used when ion-molecule reactions are observed).

*See DOD Summary Attachment for DOD Specific Criteria

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ATTACHMENT I
SIM MODE

*See DOD Summary Attachment for DOD Specific Criteria

SIM MODE

SCOPE

This SOP uses EPA method 8260B for the determination of low concentration levels of specific volatile organic compounds (VOCs) in aqueous, soil, sludge, sediment, and various types of waste. A mass spectrometer operating under the selective ion monitoring (SIM) mode is used for the analysis. The compounds that are routinely determined by this procedure are listed in SIM MODE Table 1. Other VOCs are available upon request. The list may be used in entirety or in part by meeting established method criteria for the compounds of interest. The reporting limit may be adjusted higher; however, the capability of achieving lower reporting limits for specific project requirements must be demonstrated.

METHOD SUMMARY

Gas chromatographic/mass spectrometric (GC/MS) conditions are detailed in the 8260B SOP. The compounds are detected by a mass selective detector (MSD) using the SIM mode. The retention time and the ratio of two characteristic ions of each analyte are used for identification. The response of either the primary ion or the secondary ion is used for quantitation. Additional ions may be used to confirm the presence of each compound.

PROCEDURE

All applicable procedure and quality control (QC) requirements discussed in the 8260B SOP apply, only the linear range reduces based upon level of quantitation requested. Thus associated QC (LCS, CCVs, MS/MSD, Internal Standards, and Surrogates) spiking concentrations also reduce in concentration. For example, a typical linear range may be 0.05-5.0ppb with internal and surrogate standards spiked at 1.0 ppb, the CCV spiked at 1.0ppb, and an LCS spiked at 0.5ppb. Preparation of standards need only to include the compounds of interest.

INTERFERENCES

Due to the low concentration levels being sought in SIM mode, cleanliness is extremely important to avoid laboratory contamination. Multiple instrument blanks are recommend to be analyzed prior to any SIM-mode analyses. Good laboratory practices must be maintained through out the preparation of standards and samples and analysis to avoid contamination.

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SIM MODE Table 1
List of Target Analytes, Reporting Levels, and Acquisition Details

SIM TARGET CPD.	Reporting Limit (ug/L)	IONS	DWELL TIME
(m+p) xylene	0.1	106,91	30
1,1-dichloroethene	0.1	96,61,98	30
1,2-dibromoethane	0.1	107,109	30
1,2-dichlorobenzene	0.1	146,111	30
1,2-dichloroethane	0.1	62,98	30
Carbon tetrachloride	0.1	117,119	30
Ethylbenzene	0.1	91,106	30
Methylene Chloride	0.1	84,49,86	30
o-xylene	0.1	106,91	30
Tetrachloroethene	0.1	166,168	30
Trichloroethene	0.1	95,130,132	30
Vinyl Chloride	0.1	62,64	30

*See DOD Summary Attachment for DOD Specific Criteria

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ATTACHMENT II

CURRENT IS/ANALYTE ASSOCIATIONS PER INSTRUMENT

*See DOD Summary Attachment for DOD Specific Criteria

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA3\DATA\103002\C5527.D Vial: 29
Acq On : 30 Oct 102 8:28 am Operator: DROOT
Sample : ccv Inst : MS #3
Misc : Multiplr: 1.00

Method : J:\ACQUDATA\MSVOA3\METHODS\EXP1021.M
Title : 8260voa
Last Update : Tue Oct 22 08:08:39 2002
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1		Pentafluorobenzene	1.000	1.000	0.0	107	0.00
2		Dichlorodifluoromethane	0.535	0.577	-7.9	126	0.03
3	p	Chloromethane	1.230	1.223	0.6	118	0.03
4	c	Vinyl Chloride	0.799	0.851	-6.6	131	0.02
5		Bromomethane	0.366	0.350	4.4	100	0.02
6		Chloroethane	0.458	0.497	-8.5	128	0.02
7		FREON 21	1.049	0.984	6.2	98	0.02
8		Trichlorofluoromethane	0.573	0.597	-4.2	127	0.00
9		Diethyl Ether	0.761	0.815	-7.0	119	0.02
10		FREON 123A	0.859	0.925	-7.7	119	0.02
11		Acrolein	0.155	0.165	-6.3	120	0.03
12		FREON 113	0.214	0.231	-8.3	137	0.00
13		FREON 123	0.811	0.857	-5.7	116	0.00
14	c	1,1-Diclethene	0.482	0.513	-6.4	129	0.02
15		Acetone	0.338	0.312	7.7	106	0.02
16		Iodomethane	0.272	0.283	-4.2	101	0.02
17		Carbon Disulfide	2.239	2.596	-16.0	120	0.00
18		2-PROPANOL	0.074	0.077	-3.7	113	0.03
19		Acetonitrile	0.172	0.181	-5.3	111	0.03
20		Allyl Chloride	0.372	0.407	-9.5	129	0.00
21		Methylene Chloride	0.731	0.745	-1.9	122	0.02
22		TBA	0.077	0.082	-6.8	117	0.03
23		Acrylonitrile	0.415	0.462	-11.3	122	0.00
24		Methyl-t-Butyl Ether	1.850	1.938	-4.7	118	0.02
25		trans-1,2-Dichloroethene	0.584	0.645	-10.3	130	0.00
26	p	1,1-Diclethane	1.239	1.316	-6.2	127	0.00
27		Vinyl Acetate	0.598	2.505	-319.0#	509#	0.00
28		2-Chloro-1,3-butadiene	1.027	1.174	-14.3	118	0.00
29		2,2-Dichloropropane	0.561	0.800	-42.8#	172	0.00
30		2-Butanone	0.610	0.664	-8.9	119	0.00
31		Ethyl Acetate	1.184	0.644	45.6#	60	-0.14
32		cis-1,2-Dichloroethene	0.658	0.705	-7.2	123	0.00
33		Propionitrile	0.146	0.160	-9.5	121	0.00
34		Methacrylonitrile	0.378	0.405	-7.3	122	0.00
35		Bromochloromethane	0.309	0.314	-1.5	116	0.00
36	c	Chloroform	0.985	1.018	-3.3	126	0.00
37		Tetrahydrofuran	0.398	0.403	-1.3	121	0.00
38		1,1,1-Trichloroethane	0.605	0.673	-11.1	132	0.00
39	I	1,4 - Difluorobenzene	1.000	1.000	0.0	106	0.00
40	s	surr4,Dibrflmethane	0.293	0.319	-9.0	106	0.00
41		Carbontetrachloride	0.228	0.253	-11.2	133	0.00

(#) = Out of Range
C5527.D EXP1021.M Wed Oct 30 09:29:20 2002 GCMS 10/30 Page 1

*See DOD Summary Attachment for DOD Specific Criteria

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA3\DATA\103002\C5527.D Vial: 29
Acq On : 30 Oct 102 8:28 am Operator: DROOT
Sample : ccv Inst : MS #3
Misc : Multiplr: 1.00

Method : J:\ACQUDATA\MSVOA3\METHODS\EXP1021.M
Title : 8260voa
Last Update : Tue Oct 22 08:08:39 2002
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
42		1,1-Dichloropropene	0.404	0.445	-10.2	136	0.00
43		Iso-Butyl Alcohol	0.030	0.031	-5.9	116	0.00
44		Benzene	1.337	1.412	-5.6	127	0.00
45	S	surr1,1,2-Diclethane	0.335	0.350	-4.5	108	0.00
46		1,2-Dichloroethane	0.427	0.408	4.6	116	0.00
47		N-Heptane	0.433	0.613	-41.7#	175	0.00
48		Trichloroethene	0.354	0.309	12.6	105	0.00
49	c	1,2-Diclpropane	0.447	0.467	-4.6	122	0.00
50		Methyl Methacrylate	0.317	0.353	-11.2	125	0.00
51		1,4-Dioxane	0.004	0.004	-3.5	121	0.00
52		Dibromomethane	0.228	0.226	0.7	114	0.00
53		Bromodichloromethane	0.409	0.415	-1.6	118	0.00
54		2-Nitropropane	0.116	0.137	-18.5	135	0.00
55		2-Chloroethylvinyl Ether	0.350	0.362	-3.4	115	0.00
56		cis-1,3-Dichloropropene	0.594	0.640	-7.7	125	-0.01
57	I	d5 - Chlorobenzene	1.000	1.000	0.0	114	0.00
58		4-Methyl-2-Pentanone	0.808	0.777	3.8	115	0.00
59	c	Toluene	1.356	1.374	-1.3	130	0.00
60		trans-1,3-Dichloropropene	0.584	0.600	-2.9	123	0.00
61		Ethyl Methacrylate	0.669	0.684	-2.2	124	0.00
62		1,1,2-Trichloroethane	0.336	0.330	1.8	119	0.00
63	s	surr3,Toluene-d8	1.247	1.292	-3.6	108	0.00
64	s	surr2,bfb	0.462	0.523	-13.3	117	0.00
65		Tetrachloroethene	0.268	0.276	-3.0	136	-0.01
66		2-Hexanone	0.530	0.532	-0.4	115	0.00
67		1,3-Diclpropane	0.710	0.708	0.3	121	-0.01
68		Dibromochloromethane	0.316	0.311	1.5	119	0.00
69		1,2-Dibromoethane	0.353	0.343	2.9	116	0.00
70	p	Chlorobenzene	0.790	0.790	0.1	128	0.00
71		1,1,1,2-Tetrachloroethane	0.270	0.272	-0.6	122	0.00
72	c	Ethylbenzene	1.371	1.417	-3.3	131	0.00
73		(m+p)Xylene	0.468	0.491	-4.9	134	0.00
74		o-Xylene	0.470	0.475	-1.0	129	0.00
75		Styrene	0.864	0.887	-2.6	129	0.00
76	p	Bromoform	0.206	0.213	-3.6	121	0.00
77		Isopropylbenzene	1.082	1.138	-5.1	132	0.00
78		Cyclohexanone	0.074	0.042	43.7#	70	0.00
79	I	d4 - Dichlorobenzene	1.000	1.000	0.0	117	0.00
80	p	1,1,2,2-Tetrachloroethane	0.954	1.208	-26.6#	162	0.00
81		Trans-1,4-Dichloro-2-butene	0.315	0.348	-10.5	143	0.00

(#) = Out of Range
C5527.D EXP1021.M Wed Oct 30 09:29:27 2002 GCMS Page 2

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA3\DATA\103002\C5527.D Vial: 29
Acq On : 30 Oct 102 8:28 am Operator: DROOT
Sample : ccv Inst : MS #3
Misc : Multiplr: 1.00

Method : J:\ACQUDATA\MSVOA3\METHODS\EXP1021.M
Title : 8260voa
Last Update : Tue Oct 22 08:08:39 2002
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

	Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
82	1,2,3-Trichloropropane	0.278	0.261	6.2	123	0.00
83	n-Propylbenzene	3.209	3.320	-3.5	135	0.00
84	Bromobenzene	0.704	0.671	4.7	122	0.00
85	1,3,5-Trimethylbenzene	1.762	1.811	-2.8	134	0.00
86	2-Chlorotoluene	1.983	1.995	-0.6	130	0.00
87	4-Chlorotoluene	2.213	2.193	0.9	129	0.00
88	tert-Butylbenzene	1.405	1.449	-3.1	137	0.00
89	1,2,4-Trimethylbenzene	1.773	1.785	-0.7	131	0.00
90	sec-Butylbenzene	2.198	2.283	-3.9	135	0.00
91	p-Isopropyltoluene	1.625	1.722	-6.0	139	0.00
92	1,3-Dclbenz	1.174	1.153	1.8	128	0.00
93	1,4-Dclbenz	1.214	1.149	5.4	124	0.00
94	n-Butylbenzene	1.614	1.780	-10.3	149	0.00
95	1,2-Dclbenz	1.154	1.118	3.2	125	0.00
96	1,2-Dibromo-3-chloropropane	0.172	0.166	3.8	124	0.00
97	Nitrobenzene	0.000	0.000	0.0	133	0.02
98	1,2,4-Tcbenzene	0.527	0.545	-3.5	133	0.00
99	Hexachlorobt	0.174	0.199	-14.6	147	0.02
100	Naphthalen	1.454	1.527	-5.0	133	0.00
101	1,2,3-Tclbenzene	0.482	0.497	-3.2	130	0.02
102	TOTAL XYLENE	0.000	0.000	0.0	0#	0.03

*See DOD Summary Attachment for DOD Specific Criteria

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA5\DATA\102902\A4331.D
Acq On : 30 Oct 102 12:23 am
Sample : CCV
Misc :

Vial: 85
Operator: B.ALLGEIER
Inst : 5971 - In
Multiplr: 1.00

Method : J:\ACQUDATA\MSVOA5\METHODS\EXP1021.M
Title : 8260voa
Last Update : Tue Oct 22 10:50:10 2002
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1		Pentafluorobenzene	1.000	1.000	0.0	89	0.02
2		Dichlorodifluoromethane	0.495	0.525	-6.1	93	0.00
3	p	Chloromethane	0.652	0.698	-7.1	92	0.00
4	c	Vinyl Chloride	0.495	0.527	-6.4	95	0.00
5		Bromomethane	0.363	0.339	6.7	88	0.00
6		Chloroethane	0.317	0.341	-7.4	96	0.00
7		Trichlorofluoromethane	0.583	0.653	-11.9	96	0.00
8		Diethyl Ether	0.395	0.407	-3.1	91	0.00
9		Acrolein	0.084	0.065	22.5	70	0.01
10		FREON 113	0.190	0.210	-10.6	97	0.01
11	c	1,1-Diclethene	0.364	0.374	-2.7	95	0.00
12		Acetone	0.156	0.168	-7.7	105	0.01
13		Iodomethane	0.444	0.605	-36.4#	98	0.00
14		Carbon Disulfide	1.649	1.758	-6.6	87	0.02
15		Acetonitrile	0.016	0.017	-5.3	94	0.00
16		Allyl Chloride	0.240	0.262	-9.3	91	0.00
17		Methylene Chloride	0.507	0.521	-2.8	92	0.02
18		TBA	0.039	0.038	1.7	86	0.00
19		Methyl-t-Butyl Ether	1.289	1.368	-6.1	93	0.00
20		Acrylonitrile	0.200	0.212	-6.4	93	0.00
21		trans-1,2-Dichloroethene	0.434	0.453	-4.3	93	0.02
22	p	1,1-Diclethane	0.963	1.054	-9.4	94	0.01
23		Vinyl Acetate	0.099	0.063	36.5#	55	0.01
24		2-Chloro-1,3-butadiene	0.782	0.875	-11.8	87	0.02
25		2,2-Dichloropropane	0.683	0.664	2.8	83	0.01
26		2-Butanone	0.318	0.330	-3.6	94	0.00
27		cis-1,2-Dichloroethene	0.494	0.528	-6.9	93	0.01
28		Propionitrile	0.076	0.079	-3.0	91	0.01
29		Methacrylonitrile	0.225	0.229	-1.8	92	0.00
30		Bromochloromethane	0.268	0.290	-8.5	96	0.02
31		Tetrahydrofuran	0.184	0.182	0.7	89	0.01
32	c	Chloroform	0.907	1.008	-11.1	97	0.00
33		1,1,1-Trichloroethane	0.645	0.725	-12.5	97	0.02
34		1,4-Difluorobenzene	1.000	1.000	0.0	93	0.00
35	s	surr4,Dibrflmethane	0.332	0.358	-7.9	94	0.00
36		Carbontetrachloride	0.303	0.332	-9.6	98	0.02
37		1,1-Dichloropropene	0.395	0.415	-5.0	94	0.00
38		Iso-Butyl Alcohol	0.014	0.012	12.9	77	0.02
39		Benzene	1.196	1.228	-2.7	92	0.00
40	s	surr1,1,2-Diclethane	0.364	0.411	-12.9	96	0.00
41		1,2-Dichloroethane	0.441	0.461	-4.6	98	0.00

(#) = Out of Range
A4331.D EXP1021.M Wed Oct 30 11:09:15 2002 Page 1

*See DOD Summary Attachment for DOD Specific Criteria

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA5\DATA\102902\A4331.D Vial: 85
Acq On : 30 Oct 102 12:23 am Operator: B.ALLGEIER
Sample : CCV Inst : 5971 - In
Misc : Multiplr: 1.00

Method : J:\ACQUDATA\MSVOA5\METHODS\EXP1021.M
Title : 8260voa
Last Update : Tue Oct 22 10:50:10 2002
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
42		Trichloroethene	0.280	0.320	-14.4	103	0.01
43	c	1,2-Diclpropane	0.378	0.391	-3.6	92	0.01
44		Methyl Methacrylate	0.232	0.232	-0.1	91	0.01
45		1,4-Dioxane	0.003	0.002	15.8	77	0.02
46		Dibromomethane	0.200	0.208	-3.9	94	0.01
47		Bromodichloromethane	0.411	0.463	-12.7	98	0.02
48		2-Nitropropane	0.092	0.098	-7.3	94	0.02
49		2-Chloroethylvinyl Ether	0.236	0.248	-5.0	94	0.02
50		cis-1,3-Dichloropropene	0.573	0.590	-3.0	91	0.02
51		4-Methyl-2-Pentanone	0.464	0.465	-0.2	94	0.00
52	c	Toluene	1.210	1.259	-4.1	92	0.00
53		trans-1,3-Dichloropropene	0.522	0.551	-5.5	92	0.00
54		Ethyl Methacrylate	0.478	0.502	-5.0	93	0.00
55		1,1,2-Trichloroethane	0.274	0.288	-5.3	94	0.02
56	s	surr3,Toluene-d8	1.138	1.200	-5.5	92	0.02
57	s	surr2,bfb	0.493	0.573	-16.2	97	0.02
58		d5-Chlorobenze	1.000	1.000	0.0	93	0.02
59		Tetrachloroethene	0.281	0.296	-5.6	95	0.00
60		2-Hexanone	0.319	0.315	1.3	95	0.02
61		1,3-Dichloropropane	0.550	0.558	-1.5	92	0.02
62		Dibromochloromethane	0.320	0.344	-7.7	98	0.02
63		1,2-Dibromoethane	0.293	0.303	-3.3	95	0.02
64	p	Chlorobenzene	0.807	0.832	-3.1	93	0.02
65		1,1,1,2-Tetrachloroethane	0.280	0.298	-6.2	96	0.02
66	c	Ethylbenzene	1.374	1.389	-1.1	90	0.02
67		(m+p)Xylene	0.484	0.487	-0.5	90	0.02
68		o-Xylene	0.485	0.501	-3.4	92	0.03
69		Styrene	0.832	0.861	-3.4	91	0.02
70	p	Bromoform	0.218	0.240	-10.1	97	0.02
71		Isopropylbenzene	1.230	1.293	-5.1	93	0.02
72		Cyclohexanone	0.000	0.000	0.0	90	0.02
73		d4-1,4-Dichlorobenzene	1.000	1.000	0.0	93	0.02
74	p	1,1,2,2-Tetrachloroethane	0.932	0.854	8.3	85	0.02
75		1,2,3-Trichloropropane	0.198	0.209	-5.3	94	0.02
76		Trans-1,4-Dichloro-2-Butene	0.241	0.243	-1.2	90	0.02
77		n-Propylbenzene	3.262	3.204	1.8	88	0.02
78		Bromobenzene	0.708	0.747	-5.6	97	0.02
79		1,3,5-Trimethylbenzene	1.790	1.633	8.8	82	0.02
80		2-Chlorotoluene	2.020	2.040	-1.0	91	0.02
81		4-Chlorotoluene	2.015	1.996	0.9	89	0.02

(#) = Out of Range
A4331.D EXP1021.M Wed Oct 30 11:09:19 2002 Page 2

*See DOD Summary Attachment for DOD Specific Criteria

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA5\DATA\102902\A4331.D Vial: 85
Acq On : 30 Oct 102 12:23 am Operator: B.ALLGEIER
Sample : CCV Inst : 5971 - In
Misc : Multiplr: 1.00

Method : J:\ACQUDATA\MSVOA5\METHODS\EXP1021.M
Title : 8260voa
Last Update : Tue Oct 22 10:50:10 2002
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

	Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
82	tert-Butylbenzene	1.636	1.632	0.3	88	0.02
83	1,2,4-Trimethylbenzene	1.680	1.511	10.1	79	0.02
84	sec-Butylbenzene	2.523	2.522	0.0	88	0.00
85	p-Isopropyltoluene	1.872	1.751	6.4	82	0.02
86	1,3-Dclbenz	1.269	1.276	-0.6	91	0.02
87	1,4-Dclbenz	1.270	1.252	1.4	89	0.02
88	n-Butylbenzene	1.703	1.490	12.5	76	0.02
89	1,2-Dclbenz	1.262	1.266	-0.3	90	0.02
90	1,2-Dibromo-3-chloropropane	0.154	0.166	-7.8	95	0.02
91	Nitrobenzene	0.000	0.000	0.0	83	0.02
92	1,2,4-Tcbenzene	0.580	0.529	8.7	83	0.02
93	Hexachlorobt	0.295	0.278	5.7	85	0.02
94	Naphthalen	1.235	1.181	4.3	85	0.00
95	1,2,3-Tclbenzene	0.537	0.500	7.0	82	0.00
96	TOTAL XYLENE	0.000	0.000	0.0	0#	-2.30#

(#) = Out of Range SPCC's out = 0 CCC's out = 0
A4331.D EXP1021.M Wed Oct 30 11:09:21 2002 Page 3

*See DOD Summary Attachment for DOD Specific Criteria

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA6\DATA\103002\Q9582.D Vial: 2
Acq On : 30 Oct 2002 10:26 am Operator: PDEPALMA
Sample : CCV Inst : GC/MS Ins
Misc : 8260B/OLM4.2 for W.A.P Multiplr: 1.00
MS Integration Params: INTP35.P

Method : J:\ACQUDATA\MSVOA6\METHODS\SOW1022W.M (RTE Integrator)
Title : EPA Method 8260B OLM4.2 CPD LIST
Last Update : Wed Oct 30 12:33:47 2002
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1		Pentafluorobenzene	1.000	1.000	0.0	55	-0.02
2		Dichlorodifluoromethane	0.410	0.504	-22.9	68	-0.02
3	P	Chloromethane	0.243	0.222	8.6	52	-0.01
4	c	Vinyl Chloride	0.241	0.225	6.6	51	-0.01
5		Bromomethane	0.173	0.167	3.5	56	-0.01
6		Chloroethane	0.149	0.138	7.4	50	-0.01
7		Trichlorofluoromethane	0.680	0.750	-10.3	60	-0.02
8	c	1,1-Diclethene	0.268	0.275	-2.6	57	-0.01
9		Freon 113	0.322	0.337	-4.7	58	-0.02
10		Acetone	0.109	0.104	4.6	55	-0.02
11		Carbon Disulfide	0.868	0.852	1.8	54	-0.02
12		Methyl Acetate	0.188	0.177	5.9	51	-0.02
13		Methylene Chloride	0.320	0.321	-0.3	56	-0.02
14		Methyl-t-Butyl Ether	1.146	1.168	-1.9	57	-0.02
15		trans-1,2-Dichloroethene	0.316	0.319	-0.9	55	-0.02
16	P	1,1-Diclethane	0.595	0.616	-3.5	58	-0.02
17		cis-1,2-Dichloroethene	0.351	0.373	-6.3	56	-0.02
18		2-Butanone	0.109	0.101	7.3	49#	-0.02
19	c	Chloroform	0.732	0.844	-15.3	63	-0.02
20		1,1,1-Trichloroethane	0.766	0.914	-19.3	65	-0.02
21		1,4-Difluorobenzene	1.000	1.000	0.0	50	-0.02
22	s	surr4,Dibrflmethane	0.318	0.356	-11.9	59	-0.02
23		Cyclohexane	0.412	0.385	6.6	50	-0.02
24		Carbontetrachloride	0.542	0.722	-33.2#	69	-0.02
25		Benzene	0.973	1.055	-8.4	55	-0.02
26		1,2-Dichloroethane	0.497	0.660	-32.8#	66	-0.01
27		Trichloroethene	0.286	0.350	-22.4	62	-0.02
28		Methyl Cyclohexane	0.406	0.407	-0.2	52	-0.02
29	c	1,2-Diclpropane	0.230	0.247	-7.4	53	-0.01
30		Bromodichloromethane	0.450	0.574	-27.6#	64	-0.02
31		cis-1,3-Dichloropropene	0.431	0.519	-20.4	60	-0.02
32		4-Methyl-2-pentanone	0.154	0.158	-2.6	49#	-0.01
33	s	SURR3,Toluene-d8	1.057	1.139	-7.8	55	-0.02
34	c	Toluene	1.073	1.176	-9.6	57	-0.02
35		trans-1,3-Dichloropropene	0.468	0.560	-19.7	59	-0.02
36		1,1,2-Trichloroethane	0.218	0.255	-17.0	58	-0.01
37		Dibromochloromethane	0.337	0.441	-30.9#	65	-0.01
38	s	SURR2,BFB	0.380	0.418	-10.0	61	-0.01
39		d5-Chlorobenzene	1.000	1.000	0.0	51	-0.01

(#) = Out of Range
Q9582.D SOW1022W.M Wed Oct 30 12:40:06 2002 Page 1

*See DOD Summary Attachment for DOD Specific Criteria

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA6\DATA\103002\Q9582.D Vial: 2
Acq On : 30 Oct 2002 10:26 am Operator: PDEPALMA
Sample : CCV Inst : GC/MS Ins
Misc : 8260B/OLM4.2 for W.A.P Multiplr: 1.00
MS Integration Params: INTP35.P

Method : J:\ACQUDATA\MSVOA6\METHODS\SOW1022W.M (RTE Integrator)
Title : EPA Method 8260B OLM4.2 CPD LIST
Last Update : Wed Oct 30 12:33:47 2002
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
40		Tetrachloroethene	0.285	0.375	-31.6#	65	-0.01
41		2-Hexanone	0.138	0.150	-8.7	53	-0.01
42		1,2-Dibromoethane	0.289	0.346	-19.7	58	-0.01
43	P	Chlorobenzene	0.819	0.997	-21.7	61	-0.01
44	c	Ethylbenzene	0.389	0.473	-21.6#	62	-0.01
45		(m+p)Xylene	0.465	0.554	-19.1	61	-0.01
46		o-Xylene	0.436	0.528	-21.1	63	-0.01
47		Styrene	0.737	0.896	-21.6	62	-0.01
48	P	Bromoform	0.267	0.371	-39.0#	67	-0.01
49		Isopropylbenzene	1.070	1.327	-24.0	64	-0.01
50		1,4-Dichlorobenzene-d4	1.000	1.000	0.0	55	-0.01
51	P	1,1,2,2-Tetrachloroethane	0.689	0.730	-6.0	56	-0.01
52		1,3-Diclbenzene	1.374	1.629	-18.6	66	-0.01
53		1,4-Diclbenzene	1.384	1.682	-21.5	68	-0.01
54		1,2-Diclbenzene	1.280	1.549	-21.0	68	-0.01
55		1,2-Dibromo-3-chloropropane	0.145	0.183	-26.2#	71	0.00
56		1,2,4-Tcbenzene	0.447	0.547	-22.4	71	0.00

(#) = Out of Range SPCC's out = 0 CCC's out = 1
Q9582.D SOW1022W.M Wed Oct 30 12:40:08 2002 Page 2

*See DOD Summary Attachment for DOD Specific Criteria

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA7\DATA\102202\V7572.D Vial: 2
Acq On : 22 Oct 2002 1:52 pm Operator: Herring
Sample : ccv Inst : GC/MS Ins
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P

Method : J:\ACQUDATA\MSVOA7\METHODS\EXP1004.M (RTE Integrator)
Title : 8260voa
Last Update : Fri Oct 04 19:07:24 2002
Response via : Multiple Level Calibration

R. Herring 10/22

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1		Pentafluorobenzene	1.000	1.000	0.0	105	-0.04
2		Dichlorodifluoromethane	0.555	0.598	-7.7	102	-0.03
3	p	Chloromethane	0.690	0.788	-14.2	113	-0.03
4	c	Vinyl Chloride	0.488	0.486	0.4	101	-0.02
5		Bromomethane	0.472	0.449	4.9	93	-0.04
6		Chloroethane	0.467	0.458	1.9	101	-0.03
7		FREON 21	1.108	1.121	-1.2	110	-0.03
8		Trichlorofluoromethane	0.733	0.733	0.0	102	-0.03
9		Diethyl Ether	0.570	0.561	1.6	100	-0.03
10		FREON 123A	0.826	0.826	0.0	112	-0.04
11		FREON 123	0.838	0.862	-2.9	111	-0.04
12		Acrolein	0.122	0.144	-18.0	110	-0.04
13		FREON 113	0.248	0.243	2.0	103	-0.04
14	c	1,1-Diclethene	0.535	0.537	-0.4	103	-0.04
15		Acetone	0.249	0.214	14.1	96	-0.04
16		2-Propanol	0.047	0.046	2.1	98	-0.03
17		Iodomethane	0.473	0.375	20.7	81	-0.04
18		Carbon Disulfide	2.168	2.321	-7.1	110	-0.04
19		Acetonitrile	0.179	0.165	7.8	100	-0.04
20		Allyl Chloride	0.345	0.325	5.8	100	-0.04
21		Methylene Chloride	0.723	0.688	4.8	103	-0.04
22		TBA	0.056	0.053	5.4	98	-0.04
23		Acrylonitrile	0.324	0.303	6.5	96	-0.04
24		Methyl-t-Butyl Ether	1.580	1.521	3.7	99	-0.04
25		trans-1,2-Dichloroethene	0.657	0.655	0.3	104	-0.04
26	p	1,1-Diclethane	1.122	1.108	1.2	100	-0.05
27		Vinyl Acetate	1.888	2.013	-6.6	107	-0.04
28		2-Chloro-1,3-butadiene	0.937	1.053	-12.4	117	-0.04
29		2,2-Dichloropropane	0.811	0.764	5.8	97	-0.05
30		2-Butanone	0.482	0.439	8.9	98	-0.05
31		Ethyl Acetate	0.000	0.000	0.0	98	-0.05
32		cis-1,2-Dichloroethene	0.741	0.728	1.8	103	-0.05
33		Propionitrile	0.116	0.110	5.2	97	-0.05
34		Methacrylonitrile	0.321	0.295	8.1	97	-0.05
35		Bromochloromethane	0.349	0.339	2.9	101	-0.05
36	c	Chloroform	1.037	1.025	1.2	100	-0.05
37		Tetrahydrofuran	0.276	0.255	7.6	95	-0.05
38		1,1,1-Trichloroethane	0.792	0.782	1.3	102	-0.05
39	I	1,4 - Difluorobenzene	1.000	1.000	0.0	106	-0.04
40	s	surr4,Dibrflmethane	0.356	0.358	-0.6	107	-0.05

(#) = Out of Range
V7572.D EXP1004.M Tue Oct 22 15:01:42 2002 Page 1

*See DOD Summary Attachment for DOD Specific Criteria

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA7\DATA\102202\V7572.D Vial: 2
Acq On : 22 Oct 2002 1:52 pm Operator: Herring
Sample : ccv Inst : GC/MS Ins
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P

Method : J:\ACQUDATA\MSVOA7\METHODS\EXP1004.M (RTE Integrator)
Title : 8260voa
Last Update : Fri Oct 04 19:07:24 2002
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
41		Carbontetrachloride	0.366	0.365	0.3	101	-0.06
42		1,1-Dichloropropene	0.486	0.466	4.1	101	-0.05
43		Iso-Butyl Alcohol	0.022	0.020	9.1	93	-0.04
44	s	sur1,1,2-Diclethane	0.343	0.336	2.0	104	-0.05
45		Benzene	1.521	1.452	4.5	102	-0.04
46		1,2-Dichloroethane	0.486	0.450	7.4	103	-0.04
47		N-Heptane	0.760	0.739	2.8	95	-0.04
48		Trichloroethene	0.389	0.382	1.8	104	-0.05
49	c	1,2-Diclpropane	0.481	0.442	8.1	100	-0.05
50		Methyl Methacrylate	0.312	0.288	7.7	93	-0.05
51		1,4-Dioxane	0.004	0.004	0.0	105	-0.05
52		Dibromomethane	0.296	0.279	5.7	101	-0.05
53		Bromodichloromethane	0.488	0.488	0.0	102	-0.05
54		2-Nitropropane	0.000	0.000	0.0	100	-0.05
55		2-Chloroethylvinyl Ether	0.347	0.327	5.8	103	-0.05
56		cis-1,3-Dichloropropene	0.664	0.651	2.0	102	-0.05
57	I	d5 - Chlorobenzene	1.000	1.000	0.0	107	-0.05
58		4-Methyl-2-Pentanone	0.704	0.651	7.5	98	-0.05
59	c	Toluene	1.607	1.590	1.1	102	-0.05
60		trans-1,3-Dichloropropene	0.637	0.613	3.8	100	-0.05
61		Ethyl Methacrylate	0.666	0.610	8.4	97	-0.05
62		1,1,2-Trichloroethane	0.361	0.347	3.9	100	-0.06
63	s	surr3,Toluene-d8	1.272	1.253	1.5	104	-0.05
64	s	surr2,bfb	0.517	0.522	-1.0	106	-0.05
65		Tetrachloroethene	0.405	0.399	1.5	101	-0.05
66		2-Hexanone	0.481	0.440	8.5	96	-0.05
67		1,3-Dichloropropane	0.729	0.671	8.0	99	-0.06
68		Dibromochloromethane	0.406	0.392	3.4	100	-0.06
69		1,2-Dibromoethane	0.446	0.423	5.2	98	-0.05
70	p	Chlorobenzene	1.055	1.027	2.7	101	-0.05
71		1,1,1,2-Tetrachloroethane	0.350	0.339	3.1	103	-0.06
72	c	Ethylbenzene	1.797	1.783	0.8	102	-0.05
73		(m+p)Xylene	0.657	0.640	2.6	101	-0.05
74		o-Xylene	0.656	0.632	3.7	102	-0.06
75		Styrene	1.160	1.115	3.9	98	-0.05
76	p	Bromoform	0.297	0.287	3.4	97	-0.05
77		Isopropylbenzene	1.610	1.605	0.3	102	-0.05
78		Cyclohexanone	0.071	0.040	43.7#	58	-0.05
79	I	d4 - Dichlorobenzene	1.000	1.000	0.0	106	-0.06

(#) = Out of Range
V7572.D EXP1004.M Tue Oct 22 15:01:43 2002 Page 2

*See DOD Summary Attachment for DOD Specific Criteria

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA7\DATA\102202\V7572.D Vial: 2
Acq On : 22 Oct 2002 1:52 pm Operator: Herring
Sample : ccv Inst : GC/MS Ins
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P

Method : J:\ACQUDATA\MSVOA7\METHODS\EXP1004.M (RTE Integrator)
Title : 8260voa
Last Update : Fri Oct 04 19:07:24 2002
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 25% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
80	p	1,1,2,2-Tetrachloroethane	1.195	1.129	5.5	97	-0.05
81		Trans-1,4-Dichloro-2-butene	0.329	0.300	8.8	95	-0.05
82		1,2,3-Trichloropropane	0.319	0.257	19.4	97	-0.05
83		n-Propylbenzene	4.441	4.412	0.7	104	-0.05
84		Bromobenzene	0.878	0.877	0.1	101	-0.05
85		1,3,5-Trimethylbenzene	2.551	2.491	2.4	99	-0.05
86		2-Chlorotoluene	2.817	2.778	1.4	101	-0.05
87		4-Chlorotoluene	2.662	2.590	2.7	101	-0.06
88		tert-Butylbenzene	2.158	2.132	1.2	102	-0.05
89		1,2,4-Trimethylbenzene	2.586	2.592	-0.2	100	-0.06
90		sec-Butylbenzene	3.621	3.540	2.2	100	-0.05
91		p-Isopropyltoluene	2.690	2.681	0.3	102	-0.06
92		1,3-Dclbenz	1.554	1.532	1.4	102	-0.05
93		1,4-Dclbenz	1.553	1.569	-1.0	107	-0.06
94		n-Butylbenzene	2.978	2.972	0.2	99	-0.05
95		1,2-Dclbenz	1.512	1.476	2.4	100	-0.05
96		1,2-Dibromo-3-chloropropane	0.245	0.206	15.9	98	-0.06
97		Nitrobenzene	0.000	0.000	0.0	93	-0.05
98		1,2,4-Tcbenzene	1.066	1.014	4.9	98	-0.07
99		Hexachlorobt	0.380	0.360	5.3	102	-0.07
100		Naphthalen	2.256	1.939	14.1	88	-0.07
101		1,2,3-Tclbenzene	0.933	0.878	5.9	97	-0.07

(#) = Out of Range SPCC's out = 0 CCC's out = 0
V7572.D EXP1004.M Tue Oct 22 15:01:43 2002 Page 3

*See DOD Summary Attachment for DOD Specific Criteria

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA8\DATA\101104\F1124.D Vial: 5
Acq On : 11 Oct 2004 11:43 am Operator: Herring
Sample : CCV Inst : GCMS#8
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P

Method : J:\ACQUDATA\MSVOA8\METHODS\WAT1008.M (RTE Integrator)
Title : 8260voa
Last Update : Mon Oct 11 18:55:59 2004
Response via : Multiple Level Calibration

RT 10/11

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1	I	Pentafluorobenzene	1.000	1.000	0.0	109	0.00
2		Dichlorodifluoromethane	0.569	0.646	-13.5	115	0.00
3	p	Chloromethane	0.886	0.863	2.6	110	0.00
4	c	Vinyl Chloride	0.674	0.712	-5.6	112	0.00
5		Bromomethane	0.382	0.442	-15.7	135	0.00
6		Chloroethane	0.442	0.438	0.9	113	0.00
7		FREON 21	1.314	1.362	-3.7	118	0.00
8		Trichlorofluoromethane	0.805	0.864	-7.3	115	0.00
9		Diethyl Ether	0.486	0.523	-7.6	117	0.00
10		FREON 123A	0.739	0.782	-5.8	118	0.00
11		FREON 123	0.810	0.824	-1.7	119	0.00
12		Acrolein	0.076	0.081	-6.6	124	0.00
13		FREON 113	0.214	0.218	-1.9	114	0.00
14	c	1,1-Diclethene	0.432	0.433	-0.2	113	0.00
15		Acetone	0.177	0.176	0.6	106	0.00
16		2-Propanol	0.023	0.019	17.4	98	0.01
17		Iodomethane	0.152	0.152	0.0	94	0.00
18		Carbon Disulfide	1.708	1.770	-3.6	120	0.00
19		Acetonitrile	0.050	0.057	-14.0	113	0.00
20		Allyl Chloride	0.250	0.285	-14.0	126	0.00
21		Methylene Chloride	0.615	0.609	1.0	116	0.00
22		TBA	0.034	0.033	2.9	107	0.00
23		Acrylonitrile	0.205	0.218	-6.3	119	0.00
24		Methyl-t-Butyl Ether	1.515	1.655	-9.2	120	0.00
25		trans-1,2-Dichloroethene	0.524	0.562	-7.3	111	0.00
26	p	1,1-Diclethane	1.086	1.152	-6.1	114	0.00
27		Vinyl Acetate	0.676	0.770	-13.9	128	0.00
28		2-Chloro-1,3-butadiene	0.981	1.102	-12.3	121	0.00
29		2,2-Dichloropropane	0.906	0.985	-8.7	121	0.00
30		2-Butanone	0.292	0.300	-2.7	118	0.00
31		cis-1,2-Dichloroethene	0.594	0.613	-3.2	116	0.00
32		Propionitrile	0.068	0.068	0.0	113	0.00
33		Methacrylonitrile	0.208	0.215	-3.4	120	0.00
34		Bromochloromethane	0.251	0.263	-4.8	118	0.00
35	c	Chloroform	1.012	1.058	-4.5	114	0.00
36		Tetrahydrofuran	0.165	0.181	-9.7	126	0.00
37		1,1,1-Trichloroethane	0.859	0.901	-4.9	115	0.00
38	I	1,4 - Difluorobenzene	1.000	1.000	0.0	111	0.00
39	s	surr4,Dibrflmethane	0.328	0.373	-13.7	125	0.00
40		cyclohexane	0.542	0.537	0.9	111	0.00

(#) = Out of Range
F1124.D WAT1008.M Mon Oct 11 19:23:33 2004 Page 1

*See DOD Summary Attachment for DOD Specific Criteria

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA8\DATA\101104\F1124.D Vial: 5
Acq On : 11 Oct 2004 11:43 am Operator: Herring
Sample : CCV Inst : GCMS#8
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P

Method : J:\ACQUDATA\MSVOA8\METHODS\WAT1008.M (RTE Integrator)
Title : 8260voa
Last Update : Mon Oct 11 18:55:59 2004
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
41		Carbontetrachloride	0.355	0.392	-10.4	115	0.00
42		1,1-Dichloropropene	0.443	0.470	-6.1	114	0.00
43		Iso-Butyl Alcohol	0.009	0.009	0.0	109	0.00
44	s	surr1,1,2-Diclethane	0.460	0.520	-13.0	122	0.00
45		Benzene	1.295	1.317	-1.7	113	0.00
46		1,2-Dichloroethane	0.503	0.517	-2.8	116	0.00
47		N-Heptane	0.685	0.701	-2.3	110	0.00
48		Trichloroethene	0.307	0.318	-3.6	115	0.00
49		methylcyclohexane	0.473	0.461	2.5	113	0.00
50	c	1,2-Diclpropane	0.355	0.369	-3.9	115	0.00
51		Methyl Methacrylate	0.195	0.212	-8.7	123	0.00
52		1,4-Dioxane	0.001	0.001	0.0	83	0.00
53		Dibromomethane	0.190	0.202	-6.3	118	0.00
54		Bromodichloromethane	0.443	0.461	-4.1	115	0.00
55		2-Nitropropane	0.120	0.126	-5.0	120	0.00
56		2-Chloroethylvinyl Ether	0.211	0.227	-7.6	130	0.00
57		cis-1,3-Dichloropropene	0.538	0.574	-6.7	117	0.00
58	I	d5 - Chlorobenzene	1.000	1.000	0.0	110	0.00
59		4-Methyl-2-Pentanone	0.389	0.410	-5.4	124	0.00
60	c	Toluene	1.370	1.427	-4.2	115	0.00
61		trans-1,3-Dichloropropene	0.536	0.563	-5.0	119	0.00
62		Ethyl Methacrylate	0.421	0.452	-7.4	120	0.00
63		1,1,2-Trichloroethane	0.246	0.257	-4.5	118	0.00
64	s	surr3,Toluene-d8	1.378	1.548	-12.3	123	0.00
65	s	surr2,bfb	0.550	0.627	-14.0	124	0.00
66		Tetrachloroethene	0.292	0.316	-8.2	115	0.00
67		2-Hexanone	0.260	0.285	-9.6	126	0.00
68		1,3-Dichloropropane	0.544	0.564	-3.7	116	0.00
69		Dibromochloromethane	0.284	0.312	-9.9	118	0.00
70		1,2-Dibromoethane	0.255	0.273	-7.1	118	0.00
71	p	Chlorobenzene	0.800	0.844	-5.5	113	0.00
72		1,1,1,2-Tetrachloroethane	0.291	0.291	0.0	115	0.00
73	c	Ethylbenzene	1.492	1.600	-7.2	113	0.00
74		(m+p)Xylene	0.518	0.570	-10.0	112	0.00
75		o-Xylene	0.506	0.551	-8.9	112	0.00
76		Styrene	0.868	0.969	-11.6	114	0.00
77	p	Bromoform	0.165	0.189	-14.5	123	0.00
78		Isopropylbenzene	1.321	1.449	-9.7	111	0.00
79		Cyclohexanone	0.024	0.018	25.0#	75	0.00

(#) = Out of Range
F1124.D WAT1008.M Mon Oct 11 19:23:35 2004 Page 2

Evaluate Continuing Calibration Report

Data File : J:\ACQUDATA\MSVOA8\DATA\101104\F1124.D Vial: 5
Acq On : 11 Oct 2004 11:43 am Operator: Herring
Sample : CCV Inst : GCMS#8
Misc : Multiplr: 1.00
MS Integration Params: RTEINT.P

Method : J:\ACQUDATA\MSVOA8\METHODS\WAT1008.M (RTE Integrator)
Title : 8260voa
Last Update : Mon Oct 11 18:55:59 2004
Response via : Multiple Level Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.50min
Max. RRF Dev : 20% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
81	p	1,1,2,2-Tetrachloroethane	0.703	0.720	-2.4	117	0.00
82		Trans-1,4-Dichloro-2-butene	0.213	0.229	-7.5	125	0.00
83		1,2,3-Trichloropropane	0.191	0.204	-6.8	122	0.00
84		n-Propylbenzene	3.430	3.625	-5.7	110	0.00
85		Bromobenzene	0.625	0.668	-6.9	116	0.00
86		1,3,5-Trimethylbenzene	2.128	2.293	-7.8	109	0.00
87		2-Chlorotoluene	2.012	2.113	-5.0	111	0.00
88		4-Chlorotoluene	2.347	2.487	-6.0	112	0.00
89		tert-Butylbenzene	1.845	1.930	-4.6	107	0.00
90		1,2,4-Trimethylbenzene	2.086	2.280	-9.3	109	0.00
91		sec-Butylbenzene	2.838	3.020	-6.4	105	0.00
92		p-Isopropyltoluene	2.245	2.384	-6.2	106	0.00
93		1,3-Dclbenz	1.151	1.214	-5.5	113	0.00
94		1,4-Dclbenz	1.174	1.203	-2.5	111	0.00
95		n-Butylbenzene	2.329	2.442	-4.9	104	0.00
96		1,2-Dclbenz	1.100	1.149	-4.5	111	0.00
97		1,2-Dibromo-3-chloropropane	0.099	0.114	-15.2	121	0.00
98		Nitrobenzene	0.000	0.000	0.0	126	0.00
99		1,2,4-Tcbenzene	0.575	0.624	-8.5	113	0.00
100		Hexachlorobu	0.288	0.295	-2.4	100	0.00
101		Naphthalen	1.278	1.562	-22.2#	118	0.00
102		1,2,3-Tclbenzene	0.516	0.587	-13.8	115	0.00

(#) = Out of Range SPCC's out = 0 CCC's out = 0
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*See DOD Summary Attachment for DOD Specific Criteria

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ATTACHMENT III

INSTRUMENT SPECIFIC OPERATING CONDITIONS

*See DOD Summary Attachment for DOD Specific Criteria

GCMS#5 OPERATING CONDITIONS

GC	Agilent 5890
Column	DB-624 0.25mm ID x 60m, 1.4um film
Carrier gas	Helium
Carrier gas mode	Constant Flow
Flow rate	0.9 mL/min
Injection port	Split/Splitless, no EPC
Split ratio	45:1
Injection port temp.	180 deg.C
Autosampler	Archon 51 position
Oven program	45 deg.C, hold 2.90 min. 8.0 deg.C/min to 200 deg.C, hold 4.0 min. 30 deg.C/min to 230 deg.C, hold 3.0 min.
Mass spectrometer	Agilent 5971
MS interface temp.	250 deg.C
MS source temp	NA
MS quad. temp	NA
Detection mode	EI full scan; mass range 35-300m/z

GCMS#6 OPERATING CONDITIONS

GC	Agilent 6890
Column	DB-VRX 0.18mm ID x 20m, 1.0um film
Carrier gas	Helium
Carrier gas mode	Ramped Flow
Flow rate	0.6 mL/min. for 5.0 min. 1.0mL/min. ramp to final flow of 1.0mL/min.
Injection port	Split/Splitless, EPC
Split ratio	75:1
Injection port temp.	180 deg.C
Autosampler	Archon 51 position
Oven program	45 deg.C, hold 5.0 min. 18.0 deg.C/min to 240 deg.C, hold 2.0 min.
Mass spectrometer	Agilent 5973
MS interface temp.	250 deg.C
MS source temp	240 deg.C
MS quad. temp	150 deg.C
Detection mode	EI full scan; mass range 35-300m/z

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GCMS#7 OPERATING CONDITIONS

GC	Agilent 5890
Column	DB-624 0.25mm ID x 60m, 1.4um film
Carrier gas	Helium
Carrier gas mode	Constant Flow
Flow rate	0.9 mL/min
Injection port	Split/Splitless, no EPC
Split ratio	45:1
Injection port temp.	180 deg.C
Autosampler	Archon 51 position
Oven program	45 deg.C, hold 2.90 min. 8.0 deg.C/min to 200 deg.C, hold 4.0 min. 30 deg.C/min to 230 deg.C, hold 3.0 min.
Mass spectrometer	Agilent 5971
MS interface temp.	250 deg.C
MS source temp	NA
MS quad. temp	NA
Detection mode	EI full scan; mass range 35-300m/z

GCMS#8 OPERATING CONDITIONS

GC	Agilent 5890
Column	DB-624 0.18mm ID x 20m, 1.0um film
Carrier gas	Helium
Carrier gas mode	Constant Flow
Flow rate	1.0 mL/min
Injection port	Split/Splitless, no EPC
Split ratio	60:1
Injection port temp.	180 deg.C
Autosampler	Centurion
Oven program	50 deg.C, hold 1.0 min. 16.0 deg.C/min to 190 deg.C, hold 0.0 min. 25 deg.C/min to 225 deg.C, hold 1.0 min.
Mass spectrometer	Agilent 5972
MS interface temp.	250 deg.C
MS source temp	NA
MS quad. temp	NA
Detection mode	EI full scan; mass range 35-300m/z

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GCMS#10 OPERATING CONDITIONS

GC	Agilent 6890
Column	DB-624 0.20mm ID x 25m, 1.12um film
Carrier gas	Helium
Carrier gas mode	Constant Flow
Flow rate	1.2 mL/min
Injection port	Split/Splitless, EPC
Split ratio	75:1
Injection port temp.	180 deg.C
Autosampler	Archon 51 position
Oven program	50 deg.C, hold 5.0 min. 20 deg.C/min to 170 deg.C, hold 0.0 min. 40 deg.C/min to 240 deg.C, hold 4.0 min.
Mass spectrometer	Agilent 5975
MS interface temp.	250 deg.C
MS source temp	230 deg.C
MS quad. temp	150 deg.C
Detection mode	EI full scan; mass range 35-300m/z

GCMS#12 OPERATING CONDITIONS

GC	Agilent 6890
Column	DB-624 0.20mm ID x 25m, 1.12um film
Carrier gas	Helium
Carrier gas mode	Constant Flow
Flow rate	1.2 mL/min
Injection port	Split/Splitless, EPC
Split ratio	75:1
Injection port temp.	180 deg.C
Autosampler	Archon 51 position
Oven program	50 deg.C, hold 5.00 min. 20 deg.C/min to 170 deg.C, hold 0.0 min. 40 deg.C/min to 240 deg.C, hold 4.0 min.
Mass spectrometer	Agilent 5973
MS interface temp.	250 deg.C
MS source temp	230 deg.C
MS quad. temp	150 deg.C
Detection mode	EI full scan; mass range 35-300m/z

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ATTACHMENT IV

DOD SUMMARY AND QC CRITERIA

*See DOD Summary Attachment for DOD Specific Criteria

*DOD SUMMARY

For work for the Department of Defense – the DOD Quality Systems Manual must be followed. The DOD Manual is based on the NELAC Standards with some additional requirements. The following are the requirements which are different or additional to routine analysis and must be followed for DOD work:

- Calibration Curve, Linear Regression: The correlation coefficient must be greater then or equal to 0.995.
- The Second Source Calibration Verification (ICV) must have a recovery of 80-120% of the true value.
- CCV - All targets and surrogates must be evaluated and must be ≤ 20%D
- The Method Blank must not have any hits above ½ the reporting limit. Common laboratory contaminants must not be above the reporting limit.
- Apply J flag to all hits between LOD and LOQ.
- The limits for surrogates, LCS, and MS are different from Appendix C of the QAM. Follow the DOD limits given in the following tables. All DOD targets are "control analytes" for DOD. All DOD targets are spiked and evaluated.

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*See DOD Summary Attachment for DOD Specific Criteria

presented in Table G-2. The lower control limit generated for alternative or modified methods must be greater than 10% to be considered acceptable.

G.6 Surrogates

The surrogate compounds for each method are added to all samples, standards, and blanks to assess the ability of the method to recover specific non-target analytes from a given matrix and to monitor sample-specific recovery. Control limits for these compounds were calculated in the same study as the other analytes on the target analyte lists. Below are the limits for some of the surrogates of Methods 8260, 8270, 8081, and 8082, based on 3 standard deviations around the mean (Table G-3). Sufficient data were not received for those analytes during the LCS study to perform statistically significant analyses. No ME limits are presented as marginal exceedances are not acceptable for surrogate spikes.

Note: DoD prefers the use of those surrogates not identified as poor performing analytes in Table G-2 above.

Table G-3. Surrogates

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
8260 Water:				
1,2-Dichloroethane-d_4	95	8	70	120
4-Bromofluorobenzene	98	7	75	120
Dibromofluoromethane	100	5	85	115
Toluene-d_8	102	6	85	120
8260 Solid:				
4-Bromofluorobenzene	101	6	85	120
Toluene-d_8	100	5	85	115
8270 Water:				
2-Fluorobiphenyl	79	10	50	110
Terphenyl-d_{14}	92	14	50	135
2,4,6-Tribromophenol	82	13	40	125
2-Fluorophenol	63	14	20	110
Nitrobenzene-d_5	76	11	40	110
8270 Solid:				
2-Fluorobiphenyl	72	10	45	105
Terphenyl-d_{14}	78	15	30	125
2,4,6-Tribromophenol	80	15	35	125
2-Fluorophenol	70	11	35	105
Phenol-d_5/d_6	71	10	40	100
Nitrobenzene-d_5	69	10	35	100
8081 Water:				
Decachlorobiphenyl	83	17	30	135
TCMX	81	19	25	140
8081 Solid:				
Decachlorobiphenyl	94	13	55	130
TCMX	97	9	70	125
8082 Water:				
Decachlorobiphenyl	88	15	40	135
8082 Solid:				
Decachlorobiphenyl	91	11	60	125

G.7 In-House LCS Control Limits

The acceptability of LCS results within any preparatory batch shall be based on project-specified limits or the following DoD-specified LCS control limits, if project-specific limits are not available. If DoD limits are not available, the laboratory must use its in-house limits for batch acceptance.

*See DOD Summary Attachment for DOD Specific Criteria

DoD strongly believes that it is important for laboratories to maintain their own in-house LCS limits. These in-house limits must be consistent with (i.e., within) the DoD limits (project-specific, if available; otherwise the following LCS-CLs). The laboratory in-house limits shall be calculated from the laboratory's historical LCS data in accordance with a documented procedure (e.g., SOP) that is consistent with good laboratory practice. That document must describe the process for establishing and maintaining LCS limits and the use of control charts.

The laboratory in-house limits are to be used for several purposes:

- Laboratories are expected to utilize their in-house limits as part of their quality control system, and to evaluate trends and monitor and improve performance.
- When a laboratory's in-house limits are outside the DoD control limits (upper and/or lower), they must report their in-house limits in the laboratory report (see Appendix E) even if the LCS associated with the batch fell within the DoD limits. Using this information, DoD will be able to determine how laboratory performance affects the quality of the environmental data.
- DoD may review the laboratory in-house limits and associated trends, as reflected in control charts, to determine whether the laboratory's overall performance is acceptable. If deemed unacceptable, this can allow DoD to decide not to use the laboratory again until substantial improvement has occurred.

Table G-4. LCS Control Limits for Volatile Organic Compounds SW-846 Method 8260 Water Matrix[2]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
1,1,1,2-Tetrachloroethane	105	8	80	130	75	135
1,1,1-Trichloroethane	100	11	65	130	55	145
1,1,2,2-Tetrachloroethane	96	11	65	130	55	140
1,1,2-Trichloroethane	100	8	75	125	65	135
1,1-Dichloroethane	101	11	70	135	60	145
1,1-Dichloroethene	99	10	70	130	55	140
1,1-Dichloropropene	102	10	75	130	65	140
1,2,3-Trichlorobenzene	99	14	55	140	45	155
1,2,3-Trichloropropane	98	9	75	125	65	130
1,2,4-Trichlorobenzene	100	11	65	135	55	145
1,2,4-Trimethylbenzene	103	10	75	130	65	140
1,2-Dibromo-3-chloropropane	91	14	50	130	35	145
1,2-Dibromoethane	100	7	80	120	75	125
1,2-Dichlorobenzene	96	9	70	120	60	130
1,2-Dichloroethane	100	10	70	130	60	140
1,2-Dichloropropane	100	8	75	125	65	135
1,3,5-Trimethylbenzene	102	10	75	130	65	140
1,3-Dichlorobenzene	100	8	75	125	65	130
1,3-Dichloropropane	100	9	75	125	65	135
1,4-Dichlorobenzene	99	8	75	125	65	130
2,2-Dichloropropane	103	11	70	135	60	150
2-Butanone	91	20	30	150	10	170

[2] A number of sporadic marginal exceedances of the control limits are allowed, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. LCS control limits are not available for Total Xylene. Xylene may be reported on a project-specific basis as a total number; however, for the purposes of the DoD QSM, it will be analyzed and reported as m,p-Xylene and o-Xylene. Additional limits for poor performing compounds can be found in section G.5 and for surrogate compounds in section G.6.

*See DOD Summary Attachment for DOD Specific Criteria

Table G-4. LCS Control Limits for Volatile Organic Compounds SW-846 Method 8260 Water Matrix[2] (continued)

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
2-Chlorotoluene	100	9	75	125	65	135
2-Hexanone	92	12	55	130	45	140
4-Chlorotoluene	101	9	75	130	65	135
4-Methyl-2-pentanone	96	13	60	135	45	145
Acetone	91	17	40	140	20	160
Benzene	102	7	80	120	75	130
Bromobenzene	100	8	75	125	70	130
Bromochloromethane	97	11	65	130	55	140
Bromodichloromethane	98	8	75	120	70	130
Bromoform	99	10	70	130	60	140
Bromomethane	88	19	30	145	10	165
Carbon disulfide	100	21	35	160	15	185
Carbon tetrachloride	102	12	65	140	55	150
Chlorobenzene	102	7	80	120	75	130
Chlorodibromomethane	96	13	60	135	45	145
Chloroethane	99	12	60	135	50	145
Chloroform	100	12	65	135	50	150
Chloromethane	83	15	40	125	25	140
cis-1,2-Dichloroethene	99	9	70	125	60	135
cis-1,3-Dichloropropene	100	10	70	130	60	140
Dibromomethane	101	8	75	125	65	135
Dichlorodifluoromethane	93	21	30	155	10	175
Ethylbenzene	100	9	75	125	65	135
Hexachlorobutadiene	97	15	50	140	35	160
Isopropylbenzene	101	9	75	125	65	135
m,p-Xylene	102	9	75	130	65	135
Methyl tert-butyl ether	94	10	65	125	55	135
Methylene chloride	96	14	55	140	40	155
Naphthalene	96	14	55	140	40	150
n-Butylbenzene	103	11	70	135	55	150
n-Propylbenzene	101	9	70	130	65	140
o-Xylene	100	7	80	120	75	130
p-Isopropyltoluene	102	10	75	130	65	140
sec-Butylbenzene	100	9	70	125	65	135
Styrene	100	11	65	135	55	145
tert-Butylbenzene	99	10	70	130	60	140
Tetrachloroethene	96	18	45	150	25	165
Toluene	100	7	75	120	70	130
trans-1,2-Dichloroethene	99	13	60	140	45	150
trans-1,3-Dichloropropene	98	15	55	140	40	155
Trichloroethene	99	9	70	125	60	135
Trichlorofluoromethane	103	15	60	145	45	160
Vinyl chloride	99	16	50	145	35	165

*See DOD Summary Attachment for DOD Specific Criteria

Table G-5. LCS Control Limits for Volatile Organic Compounds SW-846 Method 8260 Solid Matrix[3]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
1,1,1,2-Tetrachloroethane	100	9	75	125	65	135
1,1,1-Trichloroethane	101	11	70	135	55	145
1,1,2,2-Tetrachloroethane	93	13	55	130	40	145
1,1,2-Trichloroethane	95	11	60	125	50	140
1,1-Dichloroethane	99	9	75	125	65	135
1,1-Dichloroethene	100	12	65	135	55	150
1,1-Dichloropropene	102	11	70	135	60	145
1,2,3-Trichlorobenzene	97	12	60	135	50	145
1,2,3-Trichloropropane	97	11	65	130	50	140
1,2,4-Trichlorobenzene	98	11	65	130	55	140
1,2,4-Trimethylbenzene	100	12	65	135	55	145
1,2-Dibromo-3-chloropropane	87	16	40	135	25	150
1,2-Dibromoethane	97	9	70	125	60	135
1,2-Dichlorobenzene	97	7	75	120	65	125
1,2-Dichloroethane	104	11	70	135	60	145
1,2-Dichloropropane	95	8	70	120	65	125
1,3,5-Trimethylbenzene	99	11	65	135	55	145
1,3-Dichlorobenzene	98	9	70	125	65	135
1,3-Dichloropropane	100	8	75	125	70	130
1,4-Dichlorobenzene	98	9	70	125	65	135
2,2-Dichloropropane	101	11	65	135	55	145
2-Butanone	94	22	30	160	10	180
2-Chlorotoluene	98	10	70	130	60	140
2-Hexanone	97	16	45	145	30	160
4-Chlorotoluene	100	9	75	125	65	135
4-Methyl-2-pentanone	97	17	45	145	30	165
Acetone	88	23	20	160	10	180
Benzene	99	9	75	125	65	135
Bromobenzene[4]	93	9	65	120	55	130
Bromochloromethane	99	9	70	125	60	135
Bromodichloromethane	100	9	70	130	60	135
Bromoform	96	13	55	135	45	150
Bromomethane	95	21	30	160	10	180
Carbon disulfide	103	19	45	160	30	180
Carbon tetrachloride	100	11	65	135	55	145
Chlorobenzene	99	8	75	125	65	130
Chlorodibromomethane	98	11	65	130	55	140
Chloroethane	98	20	40	155	20	175

[3] A number of sporadic marginal exceedances of the control limits are allowed, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. LCS control limits are not available for Methyl tert-butyl ether and Total Xylene. Sufficient data to perform statistically significant analyses were not received for MTBE during the LCS study. Xylene may be reported on a project-specific basis as a total number; however, for the purposes of the DoD QSM, it will be analyzed and reported as m,p-Xylene and o-Xylene. Additional limits for poor performing compounds can be found in section G.5 and for surrogate compounds in section G.6.

[4] Provisional limits – outlier analyses during the LCS study resulted in LCS-CLs generated with data from fewer than four laboratories. Limits may be adjusted in the future as additional data become available.

*See DOD Summary Attachment for DOD Specific Criteria

Table G-5. LCS Control Limits for Volatile Organic Compounds SW-846 Method 8260 Solid Matrix[3] (continued)

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Chloroform	98	9	70	125	65	135
Chloromethane	90	13	50	130	40	140
cis-1,2-Dichloroethene	96	10	65	125	55	135
cis-1,3-Dichloropropene	99	9	70	125	65	135
Dibromomethane	100	9	75	130	65	135
Dichlorodifluoromethane[4]	85	17	35	135	15	155
Ethylbenzene	101	9	75	125	65	135
Hexachlorobutadiene	98	15	55	140	40	155
Isopropylbenzene	103	9	75	130	70	140
m,p-Xylene	102	8	80	125	70	135
Methylene chloride	97	14	55	140	40	155
Naphthalene	84	14	40	125	25	140
n-Butylbenzene	101	12	65	140	50	150
n-Propylbenzene	99	12	65	135	50	145
o-Xylene	101	8	75	125	70	135
p-Isopropyltoluene	104	10	75	135	65	140
sec-Butylbenzene	97	11	65	130	50	145
Styrene	101	9	75	125	65	135
tert-Butylbenzene	99	11	65	130	55	145
Tetrachloroethene	103	12	65	140	55	150
Toluene	99	9	70	125	60	135
trans-1,2-Dichloroethene	100	11	65	135	55	145
trans-1,3-Dichloropropene	96	10	65	125	55	140
Trichloroethene	101	8	75	125	70	130
Trichlorofluoromethane	106	27	25	185	10	215
Vinyl chloride	92	11	60	125	45	140

Table G-6. LCS Control Limits for Semivolatile Organic Compounds SW-846 Method 8270 Water Matrix[5]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Polynuclear Aromatics						
2-Methylnaphthalene	75.0	9.5	45	105	35	115
Acenaphthene	77.6	10.1	45	110	35	120
Acenaphthylene	78.5	9.4	50	105	40	115
Anthracene	83.0	9.7	55	110	45	120
Benz[a]anthracene	82.7	8.9	55	110	45	120
Benzo[a]pyrene	81.3	9.5	55	110	45	120

[5] A number of sporadic marginal exceedances of the control limits are allowed depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. LCS control limits are not available for Benzidine, 2,6-Dichlorophenol, and N-nitrosopyrrolidine. Sufficient data to perform statistically significant analyses were not received for those analytes during the LCS study. Additional limits for poor performing compounds can be found in section G.5.

*See DOD Summary Attachment for DOD Specific Criteria

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Demonstrate acceptable analytical capability	Prior to using any test method and at any time there is a significant change in instrument type, personnel, test method, or sample matrix.	QC acceptance criteria published by DoD, if available; otherwise, method-specific criteria.	Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see Section C.1.f).	NA.	This is a demonstration of analytical ability to generate acceptable precision and bias per the procedure in Appendix C. No analysis shall be allowed by analyst until successful demonstration of capability is complete.
LOD determination and verification (See Box D-13)					
LOQ establishment and verification (See Box D-14)					
Tuning	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be accepted without a valid tune.
Breakdown check (DDT Method 8270 only)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Correct problem then repeat breakdown check.	Flagging criteria are not appropriate.	No samples shall be run until degradation ≤ 20%.

*See DOD Summary Attachment for DOD Specific Criteria

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Minimum five-point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis.	1. Average response factor (RF) for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. SVOCs ≥ 0.050. 2. RSD for RFs for CCCs: VOCs and SVOCs ≤ 30% and one option below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression r ≥ 0.995; Option 3: non-linear regression–coefficient of determination (COD) $r^2 \geq 0.99$ (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until ICAL has passed. Calibration may not be forced through the origin.
Second source calibration verification (ICV)	Once after each ICAL.	All project analytes within ± 20% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until calibration has been verified.
Retention time window position establishment for each analyte and surrogate	Once per ICAL.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.	NA.	

*See DOD Summary Attachment for DOD Specific Criteria

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Evaluation of relative retention times (RRT)	With each sample.	RRT of each target analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL.	Flagging criteria are not appropriate.	Laboratories may update the retention times based on the CCV to account for minor performance fluctuations or after routine system maintenance (such as column clipping). With each sample, the RRT shall be compared with the most recently updated RRT. If the RRT has changed by more than ±0.06 RRT units since the last update, this indicates a significant change in system performance and the laboratory must take appropriate corrective actions as required by the method and rerun the ICAL to reestablish the retention times.
Continuing calibration verification (CCV)	Daily before sample analysis and every 12 hours of analysis time.	1. Average RF for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachlorolethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. SVOCs ≥ 0.050. 2. %Difference/Drift for all target compounds and surrogates: VOCs and SVOCs ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration).	DoD project level approval must be obtained for each of the failed analytes or corrective action must be taken. Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since last acceptable CCV.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

*See DOD Summary Attachment for DOD Specific Criteria

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Internal standards verification	Every field sample, standard, and QC sample.	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	If corrective action fails in field samples, apply Q-flag to analytes associated with the non-compliant IS. Flagging criteria are not appropriate for failed standards.	Sample results are not acceptable without a valid IS verification.
Method blank	One per preparatory batch.	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL (see Box D-1).	Correct problem, then see criteria in Box D-1. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
LCS containing all analytes to be reported, including surrogates	One per preparatory batch.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery. See Box D-3 and Appendix G.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available (see full explanation in Appendix G).	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix Spike (MS)	One per preparatory batch per matrix (see Box D-7).	For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.

*See DOD Summary Attachment for DOD Specific Criteria

Table F-4. Organic Analysis by Gas Chromatography/Mass Spectrometry (Methods 8260 and 8270) (continued)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Matrix spike duplicate (MSD) or sample duplicate	One per preparatory batch per matrix (see Box D-7).	MSD: For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits. MSD or sample duplicate: RPD ≤ 30% (between MS and MSD or sample and sample duplicate).	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	The data shall be evaluated to determine the source of difference.
Surrogate spike	All field and QC samples.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits.	For QC and field samples, correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	Apply Q-flag to all associated analytes if acceptance criteria are not met.	Alternative surrogates are recommended when there is obvious chromatographic interference.
Results reported between DL and LOQ	NA.	NA.	NA.	Apply J-flag to all results between DL and LOQ.	

*See DOD Summary Attachment for DOD Specific Criteria

ARCADIS

Appendix E

Field Sampling Plan

ARCADIS
Infrastructure, environment, buildings

Imagine the result

Dover Corporation

Field Sampling Plan

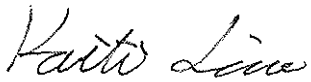
Full Scale In-Situ Chemical Oxidation
Kirkwood, Broome County, New York
Site Number (7-04-026)

February 2011

ARCADIS

Field Sampling Plan

Former Dover Electronics Site, Kirkwood, Broome County, New York



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1. Introduction

On behalf of Dover Corporation (Dover), ARCADIS of New York, Inc. (ARCADIS) has prepared this Field Sampling Plan (FSP) for remediation sampling activities at the former Dover Electronics site in Kirkwood, Broome County, New York (Site Number 7-04-026). The location of Former Dover Electronics Site is shown on **Figure 1**.

The site has been remediated in accordance with the NYSDEC-approved Remedial Action Report prepared by Blasland, Bouck and Lee (BBL) (July 2004). The following is a summary of the remedial actions and engineering and institutional controls currently in place or being implemented at the site.

- Groundwater – Full Scale In-Situ Chemical Oxidation

- Soil - Engineering and Institutional Controls (active sub-slab depressurization (ASD) system and deed notice)

During the implementation of the groundwater remediation actions, performance monitoring sampling activities will be performed in accordance with the Full Scale In-Situ Chemical Oxidation Design Report (ARCADIS 2010). Indoor air sampling activities will be performed to monitor the effectiveness of the active sub-slab depressurization (ASD) system in accordance with the approved Operation, Maintenance and Monitoring (OM&M) Plan (BBL 2005). The scope of this document encompasses all groundwater sampling activities to be conducted in support of remedial actions during the implementation and operation of the ISCO system as well as the indoor air sampling activities conducted to monitor the operation of engineering controls.

1.1 Field Sampling Plan Organization

A brief description of the organization/content of each section of this FSP is presented below:

- Section 1 – Introduction: This section provides site background information including site history, contaminants of concern, and site characteristics.

- Section 2 – Sampling Plan Objectives: This section provides a general explanation of the objectives of this FSP.

- Section 3 – Technical Approach for Sampling Activities: This section summarizes the methodologies that will be followed for conducting sampling activities at the site. These activities include: field parameters ground water monitoring, collection of groundwater samples and quality control samples, management of investigations derived waste, and indoor air sampling.

- Section 4 – Sample Handling and Analysis: This section provides procedures for sample handling, sample documentation, sample preservation, and sample shipment.

- Section 5 – References: This section lists the reference documents used to compile this FSP.

1.2 Site Location

The former Dover Electronics facility is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York. The facility is located on a site of approximately 9.58 acres in size. A site map is shown on **Figure 2**.

The property is situated in an industrial setting. Major plants in the area include: Truckstops of America Landfill (0.5 mile southeast), Frito Lay Plant (0.5 mile south), Universal Instruments (147 Industrial Park Drive, 0.5 mile east), Kason Industries (eastern property boundary), Consolidated Freightways (northern property boundary), and the Pilot Truck Stop to the south. Industrial properties surround the property to the north, east, and west.

The property consists of an industrial building with parking areas. The site had served as one of Universal Instruments' service facilities for product training, research and development, and Odd Form Assembly (OFA), which involves the engineering and assembly of non-standard/specialty circuit boards until 2007. In 2007 the facility was sold to Modern Marketing Concepts, Inc. (MMC). MMC handles outsourced customer service and product ordering for other companies.

1.3 Site History

The facility was first constructed in 1973, with subsequent additions built in 1978, 1982, and 1984. It has been occupied by Universal Instruments, Dover Electronics, and, most recently, MMC. In 1993, Dover Electronics was renamed Dovatron, Inc. (Dovatron). In 1995, Dovatron transferred its title to the facility to Universal Instruments.

In 1996, Dovatron changed its name to the DII Group. Later, the DII Group sold to Flextronics International, Inc. and Universal Instruments became a wholly-owned subsidiary to Dover Corporation. In 2007, Dover Technologies, Inc. (the parent company of Universal Instruments) sold the facility to MMC, who now owns and occupies the property.

Circuit board manufacturing processes used PCE as a cleaning solvent. Originally, the virgin PCE was stored in 55-gallon drums at an outside drum storage area. During the initial facility expansion, a ramp to the east-side overhead door served as the entry point for PCE drums. As production increased and the facility was again expanded, virgin PCE was stored in a 3,000-gallon aboveground storage tank that has since been removed. An aboveground 5,000-gallon waste PCE flux storage tank was also located on the site. In March 1993, the aboveground PCE system was dismantled. Two 480-gallon PCE tanks were reportedly dismantled and removed from the building interior at that time.

1.4 Site Geology and Hydrogeology

The site is immediately underlain by surficial soils that consist of various types of silty and gravelly loams that were reworked by cut and fill activities when the site was developed. These surficial soils are derived from the underlying till deposits, a dense soil/sediment type of glacial depositional environment origin.

Below the surficial soils, weathered till is encountered. The weathered till (a slightly decomposed version of the unweathered till) consists of light brown to brown, poorly sorted silts and fine sands that contain varying minor amounts of clay and fine gravel. Cobbles are rarely present. The weathered till is dense and appears to be unstratified. The weathered till unit has a thickness that ranges from 10 to 25 feet. As with the surficial soils above, the weathered till appears to be restricted as a geologic unit to the area of the Universal Instruments property. The weathered till does not extend onto the Pilot Truck Stop property, which occurs at an elevation lower than the Universal Instruments property.

The unweathered till is the next geologic unit encountered beneath the site. The unweathered till consists primarily of brown to olive-gray, poorly sorted silts and fine sands. The unweathered till contains lenses of clay-rich sediment and sand and fine gravel rich lenses. The unweathered till is very dense and has less fracturing. Its thickness ranges from less than 20 feet at the southern part of the site to greater than

80 feet at the northern part of the site. The contact with the overlying weathered till appears to be a gradational boundary rather than a sharp one.

The deepest layer encountered is a well-sorted, medium to coarse-grained sand unit that contains some fine gravel that was found at a depth of 50 feet below ground surface (bgs) at the MW-34 location on the Pilot Truck Stop property. This layer extended to the approximate termination of the boring at a depth of 56 feet.

Bedrock has not been encountered during drilling operations at the site or at the Pilot Truck Stop. Bedrock is believed to start at a depth around 115 feet bgs below the Universal Instruments building or approximately 80 feet bgs below the Pilot Truck Stop (Shield, 2000).

The movement of groundwater at the site is summarized below:

- Two distinct water-bearing zones exist with the first (uppermost) zone having shallow and intermediate parts and the lowermost deep zone constituting the second zone.
- Head differences within the first water-bearing zone vary, both spatially and temporally, with some well-pair locations having upward gradients and others downward gradients.
- There appears to be hydraulic communication between the two halves of the first water-bearing zone, but no hydraulic communication with the deeper water-bearing zone.

Groundwater flow directions are to the southwest within the first water-bearing zone, but vary slightly between the upper and lower halves of this zone.

The groundwater within the upper shallow zone flows toward the southwest with a hydraulic gradient that ranges from 0.046 to 0.196 ft/ft. This gradient range is illustrative of the permeability change in the shallow zone as groundwater moves from the dense, silty and clayey till beneath the Universal Instruments property into the more sandy area found beneath the Pilot Truck Stop. Groundwater within the intermediate zone flows toward the southwest as well, with a hydraulic gradient ranging from 0.019 to 0.063 ft/ft.

2. Sampling Plan Objectives

The objective of this FSP is to present the proposed technical approach for conducting field sampling activities at the Site. The FSP details the standard operating procedures (SOPs) that will be followed for collecting the samples, the sample handling and shipment, sample documentation, and the quality control (QC) criteria that will be adhered to during sampling activities.

Appropriate use of this document necessitates that it be used in conjunction with the Quality Assurance Project Plan (QAPP) (Appendix D of the ISCO Construction Package, dated February 2011), the Full Scale In-Situ Chemical Oxidation Design Report (ARCADIS 2011), the OM&M Work Plan (BBL 2005), the Site Management Plan (SMP) (Appendix C of the ISCO Construction Package), and the Health and Safety Plan (HASP) (Appendix F of the ISCO Construction Package).

3. Technical Approach for Sampling Activities

This section describes the methods to be used in conducting field activities at the site. This work could include:

- hydrogeologic data collection,
- indoor air sampling, and
- elevation surveys

This section also describes the collection procedures for field QC samples, the decontamination procedures for sampling equipment, and the management procedures for investigation-derived wastes (IDW).

3.1 Hydrogeologic Data Collection

As part of the remedial actions, hydrogeologic data will be collected. The work includes groundwater field parameter monitoring and collecting groundwater samples from selected existing and proposed monitoring wells and points. Collection of static water level measurements is described in Section 3.1.1. Field parameters will be measured using the procedures presented in Section 3.1.2. Groundwater samples will be using low-flow sampling procedures presented in Section 3.1.3.

3.1.1 Static Water Level and Well-Depth Measurements

Static water level and well-depth measurements at existing groundwater monitoring wells will be obtained using an electronic water level sounding device. Using a calibrated sounder, this procedure is accurate to ±0.01 ft. The tape will be washed with Alconox solution and rinsed with water from an approved source, cloth-wiped, and allowed to air dry between consecutive water level measurements. All measurements of the depth to groundwater and well depth will be referenced to a permanently marked reference point on the monitoring wells. Personnel will also note any physical changes to the well and the concrete pad. An evaluation of the condition of the monitoring wells will be conducted in accordance with SOP C.1 in Appendix A.

Prior to measurement, water levels in the monitoring wells will be allowed to stabilize for a minimum of 24 hours after well construction, development, or aquifer testing. When site conditions allow, water levels will be taken in a single round and prior to any groundwater sampling activities. All water levels measurement should be collected within a 24 hour period. Where possible, the work will proceed from the least to the

most contaminated wells. Collection of static water level and well-depth measurements will be conducted in accordance with SOP C.2 in Appendix A.

Well headspace should be monitored as a precautionary measure when the well cover is opened. Head space will be monitored by using a properly calibrated photo ionization detector (PID) and multi-gas meter before each injection event and/or sampling event. A PID will be used to determine the presence of VOCs in accordance with SOP B.1 in Appendix A. A multi gas meter will be used for health and safety purposes to monitor the presence of carbon monoxide (CO), oxygen (O_2), hydrogen sulfide (H_2S), and flammable gases (Lower Explosive Limit - LEL) in accordance with SOP B.2 in Appendix A.

3.1.2 Field Parameter Monitoring

Field parameter monitoring will be conducted during the pre-injection activities (baseline) and during the initial phase of ISCO remediation to assess the dispersion of the sodium permanganate into the target area. The field measurements will consist of oxidation reduction potential (ORP), specific conductivity, pH and manganese and permanganate using field colorimetric methods. Field parameter data can provide real-time indications of oxidant influence at monitoring locations during and following injection activities.

Headspace monitoring and water level measurement should be performed as described in Section 3.1.1 prior to start any field parameter monitoring. Specific conductivity, ORP, and pH will be measured using a down-hole water quality meter conducted in accordance with SOP B.3 and C.3 in Appendix A. The water quality meter should be properly calibrated prior use and it should be decontaminated with Alconox solution and clean water between measurements. Meter should be lowered to the target depth (middle of the screen interval) slow and steadily to avoid turbulence. Once the target depth has been reached, meter should be allowed to stabilize. Readings can be collected when specific conductance and temperature values remain within 3% and pH remains within 0.1 unit.

Manganese and permanganate concentration will be measured using a field colorimetric method in accordance with SOP B.4 in Appendix A. Sample will be collected as a grab sample by using a in accordance with SOP C.4 in Appendix A. Care must be taken to minimize water disturbance while collecting the sample. Sample should be kept in a cleaned plastic bottle and should be field filtered prior to start analyses to avoid interference due to the presence of suspended fine particle.

If the field parameter monitoring is taking place during a groundwater sampling event, samples should be collected using low-flow sampling techniques as described in the next section.

3.1.3 Low-flow Groundwater Sampling

Low-flow groundwater sampling minimizes the disturbance of any sediment in the monitoring well and the formation of any additional sediment. The goal of low-flow sampling is to collect more representative samples by matching the intake velocity of the sampling device with the natural groundwater flow velocity, thereby reducing sample disturbances. The primary advantage of this procedure is the collection of low turbidity samples (i.e., samples with low concentrations of suspended particles) and the reduction of sample aeration, resulting in samples which are more representative of true aquifer conditions. In most cases, low flow sampling also reduces the volume of groundwater purged from the well and associated disposal issues.

Low-flow groundwater sampling will be conducted in accordance with SOPs B.3, B.5, and C.5 in Appendix A. This sampling procedure involves removing groundwater from a monitoring well using a variable speed stainless-steel bladder pump placed at the screened interval. The pump intake will be kept at least two feet above the bottom of the monitoring well to prevent mobilization of any sediment present in the bottom of the well. The depth to which the pump is lowered and the sample collected will be recorded so that the pump can be placed in the same location during future sampling events. If the total depth of the groundwater monitoring well must be measured, this measurement should be collected at least 48 hours before groundwater sampling activities begin (i.e., placement of the sampling pump into the well). Care should be taken to minimize disturbance to the water column and to any particulates attached to the sides or at the bottom of the well.

Before pumping begins, the water level in the monitoring well will be measured. The water level will be measured at a minimum of every five minutes during pumping. Pumping rates will be less than 500 milliliters (mL) per minute but not less than 100 mL per minute. Ideally, a pumping rate will be maintained that results in a stabilized water level (less than 0.3 ft drawndown) in the monitoring well. Water quality parameters (i.e., pH, temperature, conductivity, dissolved oxygen [DO], turbidity, and oxidation-reduction potential [ORP]) will be measured every five to six minutes. Stabilization will be defined by the following variances between three successive readings: 10% for DO, and turbidity; 3% for specific conductance and temperature; 0.1 unit for pH; and 10 millivolts (mV) for ORP. If the field indicator parameters have not stabilized within the

percentages given above, purging will continue until one well volume has been removed or a purge time of four hours has been exceeded using a purge rate of 500 mL/min while not exceeding 0.3 ft of drawdown in the well.

Wells that yield less than 100 mL/min frequently incur significant drawdown during well purging. If drawdown occurs across the screened interval or open borehole of a well, VOC loss may result. The increased stress on a well caused by significant drawdown may also result in an increase in water turbidity. In such a case, sample collection may be conducted without regard to monitoring field indicator parameters associated with well stabilization. At a minimum, water-quality data, well-construction data, water-level data, and accurate well-yield data for each low-yielding well will need to be submitted to the regulatory agency prior to the development of an acceptable sampling procedure.

The low-flow sampling technique will be followed as specified by the United States Environmental Protection Agency (USEPA) Region I Low Stress (Low Flow) Purging and Sampling, Procedures for the Collection of Groundwater Samples from Monitoring Wells (USEPA SOP No. GW0001; July 30, 1996) (see Appendix B). If alternate groundwater sampling techniques (e.g., teflon bailers) are to be used, alternate groundwater sampling techniques will not be implemented without the review and approval of the NYSDEC.

3.2 Indoor Air Sampling

Indoor air sampling is conducted as part of the semi-annual indoor air monitoring program to monitor the effectiveness of the depressurization system. The indoor air sampling is conducted in accordance with the approved OM&M Plan (October 31, 2005) and Remedial Design Package (June 4, 2003). Indoor air samples will be collected for the analysis of volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). Indoor and ambient air sampling will be conducted in accordance with SOP D.1 in Appendix A.

Lab certified pre-cleaned six-liter SUMMA® canisters will be used to collect air sample at each location. An initial building survey is not required but any new chemicals observed in the building should be recorded in the field book. Any building use changes should be recorded as well. The air in the location of the sample and in the vicinity should be screened using a PID, prior placing the canister. SUMMA® canister serial number and flow controller number should be recorded in the field book and

COC form as well as the initial vacuum pressure and starting time. One outdoor ambient air sample will be collected concurrently with the indoor air sample.

Collection of the sample should be stop when the canister vacuum reaches approximately 5 inches of Hg (leaving some vacuum in the canister for QA/QC purposes). Final vacuum pressure and time should be also recorded in the field book and COC.

Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The canister does not require preservation with ice or refrigeration during shipment.

3.3 Sampling Location and Elevation Survey

A sampling location and elevation survey will be performed in newly installed or in wells where PVC casing has been modified due to repairs. Surveys should be completed by a surveyor who is licensed and registered in the State of New York. The latitude and longitude of each surveyed location will be tied to the North American Datum of 1983 (NAD83) and projected on the New York State Plane Coordinate System (Central Zone) in ft. Elevations for the natural ground surface at each surveyed location will be determined using the National Geodetic Vertical Datum of 1988 (NGVD 88) in ft. Measurements should be third order accuracy. Temporary monuments will be set and referenced for future recovery. All monuments will be described in the surveyor's notes and will consist of a permanent mark scribed on sidewalks, paved roads, or curbs. Sufficient descriptions will be provided to facilitate their recovery.

3.3.1 Monitoring Wells

The horizontal location of monitoring wells will be determined to within ±0.3 ft, while the elevations will be determined to within ±0.01 ft. The surveyor will measure the following three elevations: the top of the inner PVC casing, the top of the outer protective casing (on the lip, not the cap), and the ground surface elevation at the base of the concrete pad. Prior to the start of the survey, ARCADIS field staff should ensure that the surveyors are given the keys to the locking caps on the wells. The field staff will also instruct the surveyor to measure the elevation of the top of the inner PVC casing from the pre-marked point. This point will be used as a reference to measure subsequent groundwater elevations. The wellhead elevation and natural ground surface elevation will also be noted and recorded. A Survey Report should be submitted to ARCADIS by the surveying subcontractor.

3.4 Decontamination Procedures for Sampling and Heavy Equipment

Decontamination of sampling equipment will follow USEPA Region II guidance. The SOP E.1 for conducting decontamination operations is provided in Appendix A.

All decontamination-derived water will be placed in 55-gallon drums containers or in the onsite polyethylene storage tank. Soil or sludge wastes from decontamination of the drill rig will be also placed in 55-gallon drums and labeled.

3.4.1 Non-Aqueous Sampling Equipment

All surface soil and subsurface soil sampling equipment (e.g., stainless-steel bucket augers, split-spoons) will be decontaminated after each use according to the following procedure:

a. Wash and scrub low-phosphate detergent (e.g., alconox)

b. Rinse with demonstrated analyte-free distilled and deionized water.

c. Air dry

d. Wrap in aluminum foil (shiny side out)

3.4.2 Aqueous Sampling Equipment

Bladder pumps will be used for purging of monitoring wells when utilizing the low-flow method (see Section 3.1.3). The bladder pump will be decontaminated at the beginning of each day and after each well is sampled according to the following procedure:

1. Take pump apart and remove used bladder pump and plastic rings

2. Generous wash with water

3. Wash using Alconox or Liquinox plus distilled and deionized (ASTM Type II). Scrub all pump parts using the pump brushes for the surface of and holes of the pumps.

4. Rinse with distilled and deionized (ASTM Type II) water

5. Replace bladder pump and plastic rings

6. Air Dry.

The decontamination procedure for aqueous sampling equipment (i.e., pumps) listed above is consistent with the "between well-decon" specified by EPA in the *Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling SOP (March 1998)*. All remaining aqueous sampling equipment will be decontaminated according to the procedure listed above.

3.4.3 Heavy Equipment

All heavy equipment, such as the drill rig, and downhole drilling tools, will be decontaminated after each use. The decontamination procedure will include a high-pressure hot water wash, a high-pressure hot water rinse, and air drying. If the high-pressure hot water wash is insufficient to clean the heavy equipment, the equipment will be washed with a low-phosphate detergent (e.g., alconox) and scrubbed with brushes. The equipment will then be rinsed with approved water. Drilling equipment will be placed on clean polyethylene sheeting during transport and at the drill site. Decontamination of the heavy equipment will be performed at designated area and all water used for decontamination purposes should be contained placed in 55-gallon drums or in onsite storage tank.

3.5 Field Quality Control Samples

A description of the analytical methods and QA/QC procedures applicable to the site is included in more detail in the QAPP. Samples collected during field activities will be preserved and handled according to the preservation requirements provided in the QAPP.

3.5.1 Field Duplicate Samples

Field duplicate samples will be used to provide sampling precision as well as analytical precision. Duplicate samples will be collected at a frequency of one duplicate per 20 samples per sampling technique collected for each medium. Duplicate samples are defined as samples collected simultaneously from the same source under identical conditions.

3.5.2 Field Blanks

Field blanks will be collected to demonstrate that equipment used during the sampling activities and field conditions do not result in contamination of the sample from external sources. Field blanks will be prepared in the field using a contaminant-free (de-ionized or distilled water) water source. The field blank will be preserved, documented, shipped, and analyzed in the same manner as the samples it represents. Equipment blanks will be collected at a rate of 5 percent (1 per 20 field samples of similar matrix) of all samples collected.

3.5.3 Trip Blanks

Trip blanks are collected to establish that the transport of sample containers to and from the field does not result in contamination of the sample from external sources. Trip blanks will be included in all coolers containing samples requiring VOC determination. Trip blanks will be prepared by the laboratory by filling 40-mL vials with analyte-free water, sealed, and labeled in a clean area. A set of 2 or 3 analyte-free water filled VOC vials prepared by the lab will constitute a trip blank. The above protocol for trip blanks applies to both aqueous and non-aqueous samples. Trip blanks will be treated in the same manner as the VOC samples they represent.

3.6 Management of Investigation-Derived Wastes

This section provides specific procedures to be followed in the containerization, handling, and disposal of IDW generated during sampling and remedial action activities at the Sites. The only waste products generated on-site as a result of sampling activities will be well purge water, decontamination water and personal protective equipment (PPE) and disposable sampling equipment. Well purge and decontamination water will be accumulated within a designated 55-gallon plastic drum (properly labeled as non-hazardous waste) and stored on-site at Storage Deluxe. A permitted waste transporter (with a current 6 NYCRR Part 364 permit) will transfer the waste purge water to a vacuum truck used by the transporter for delivery offsite. Personal protective equipment and disposable equipment will be kept separately in garbage plastic bags. Plastic garbage bags will be disposed off-site at the end of the sampling.

In addition, soil cuttings and liquid wastes may be generated from drilling of boreholes during installation of the injection wells and monitoring points during the implementation of the full scale ISCO system. Once the drums are full, the

containerized waste will be sampled for waste characterization. Should wastes fail toxicity characterization leaching procedure (TCLP), they will be disposed off-site as hazardous waste. All non-hazardous and hazardous wastes will be disposed of off-site.

4. Sample Management and Analysis

The procedures described in this section ensure that once representative environmental samples are obtained, they are properly containerized, preserved, shipped, and otherwise handled in a manner that will maintain their chemical integrity. The use of these techniques will ensure the representativeness of a sample and significantly reduce the possibility of sample contamination from external sources. Additional information is also provided in the QAPP and the SOPs in Appendix A.

4.1 Sample Containers, Preservation, and Holding Times

4.1.1 Containers

All sample containers for off-site laboratory analysis will be cleaned prior to use, and these pre-cleaning requirements will meet or exceed USEPA requirements. A summary of the decontamination sequences for sampling containers is provided in the QAPP.

4.1.2 Sample Preservation and Holding Times

Chemical preservatives will be required for aqueous samples to retard degradation during shipment and storage prior to laboratory analysis. In addition to chemical preservatives, all samples for chemical analysis will be transported to the laboratory in temperature controlled coolers. The types of preservation required for samples collected during field sampling activities at the Sites, as well as holding times, are summarized in the QAPP. Wet ice will be used to maintain the internal cooler temperature at 4º ±2ºC.

4.2 Sample Documentation

Accountability for a sample begins when the sample is collected from its natural environment. A bound field logbook will be maintained to record the acquisition of each sample. Chain-of-custody records for all environmental samples and field QC samples, laboratory results, and any other data generated as a result of sampling activities at the Sites will be maintained on file. Copies will be provided for review by regulatory agencies as requested. Sampling locations will be noted on site drawings that will become part of the permanent project records. Monitoring well and injection well locations will be surveyed. This section describes the sample documentation that will be used at the site.

4.2.1 Field Logbook

Information pertinent to the sampling effort will be recorded in a bound logbook in accordance with SOP A.1 in Appendix A. Each page will be consecutively numbered. Entries will be made in indelible ink. The outside cover of the field logbook will contain the installation name. In addition, the mailing address and a point of contact will be written in the front inside cover of the logbook. At a minimum, entries in the field logbook will include the following:

- Time and date of sample collection;
- Field sample number;
- Detailed description of the sampling location;
- Identification of sampler;
- Type of sample (e.g., groundwater, IDW etc.);
- Requested analytes;
- Sampling methodology, including distinction between grab and composite sample;
- Sample preservation;
- QC samples associated with this sample;
- Sample shipment (e.g., name of the laboratory and cartage agent [Federal Express, United Parcel Service], etc.);
- Field measurements (e.g., PID, pH); and
- Names and initials of personnel conducting the sampling.

Sampling situations vary widely. No general rules can specify the extent of information that must be entered in a logbook. However, records should contain sufficient information so the sampling activity can be reconstructed without relying on the collector's memory.

No pages will be removed for any reason. If corrections are necessary, they will be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside it. The correction must be initialed and dated. Most corrected errors will require a footnote explaining the correction.

4.2.2 Field Sample Identification Protocols

Each sample will be identified by a unique sample identification number in the logbook and on the chain-of-custody record using an alphanumeric code. Field samples will be linked to geographic location via location codes. All field samples will be labeled as follows:

- Water sample IDs will end with the date in "(mmddyy)" format (e.g. MW-7(100107)).
- Blind duplicate samples will be labeled “DUP” and the date “(mmddyy)” (e.g. DUP(042510).
- Trip blank samples will be labeled “TB” and the date shipped “(mmddyy)” (e.g. TB(042510).

The location type codes are listed below:

MW - monitoring well;
IJ – Injection point
IA – Indoor Air
AA – Ambient Air
WC- Waste classification

In addition to the above classifications, the chain-of-custody will be completed to include both the Sample Type and Sample Matrix using the codes defined below. The sample matrix will be identified using the following codes:

IDW = Aqueous Investigation Derived Waste
SO = soil sample; and,
GW = groundwater.

Field duplicate samples will be given a "blind" unique number that is completely different from the original sample following the normal sample pattern. This number will be recorded in the field logbook so that the duplicates can be identified at a later date. Samples collected with an additional volume for matrix spike/matrix spike duplicates (MS/MSDs) will be designated on the chain-of-custody in the remarks column.

FD = field duplicate; and
TB = trip blank.

Chain-of-custody records will be completed and shipped with the samples to the laboratories. A copy of the chain-of-custody will be retained with the field records. If samples are shipped by commercial carrier, the shipping records will be maintained in the project files with the field records.

4.2.3 Sample Labeling

Sample labels or tags attached to or affixed around the sample container will be used to properly identify all samples collected in the field. Each sample container will be marked in ink with the following information:

- Unique field identification number for each sample,
- Date and time of sample collection,
- Preservative,
- Required analysis, and
- Sampler's initials.

ARCADIS field personnel will be required to write the sample ID on the samples label. Sample labels will be completed and affixed to the sample containers prior to collection or immediately following collection.

4.3 Sample Chain of Custody

A sample is considered to be in a person's custody if the sample is:

- In a person's actual possession;
- In view after being in a person's possession; and
- Locked up so that no one can tamper with it after having been in physical custody.

Evidence of sample custody shall be traceable from the time the cleaned sample containers leave the laboratory until filled sample containers are transmitted back to the on-site or off-site laboratory. To achieve this condition, custody seals and chain-of-custody documentation will accompany all sample containers.

4.3.1 Custody Seals

Custody seals are pre-printed, adhesive-backed seals with security slots designed to break if the seals are disturbed. After the cooler has been properly secured, custody seals will be placed across the hinges of the cooler in two places to ensure the integrity of the samples during shipment to the off-site laboratory. Custody seals will be signed and dated prior to the shipment of the samples. Upon receipt at the laboratory, the custodian checks the custody seal for tampering and documents on a cooler receipt form that seals on shipping coolers/boxes are intact.

4.3.2 Chain-of-Custody

A chain-of-custody form will be created at the time of sample collection and will include samples collected for analysis. All samples will be kept at 4º±2ºC from the time of sample collection until analysis. An example of a chain-of-custody form is provided in SOP A.2.

The chain-of-custody form must be fully completed by the ARCADIS field staff designated by the Task Manager as responsible for sample shipment to the appropriate laboratory for analysis. In addition, if samples are known to require rapid turnaround in the laboratory because of project time constraints or analytical concerns (e.g., extraction time or sample retention period limitations), the person completing the chain-of-custody record should note these constraints in the "Remarks" section of the custody record. The custody record should also indicate any special preservation techniques necessary, and clearly indicate field QC samples for MS/MSD trip blanks and field blanks. Copies of the chain-of-custody records are maintained with the project file. The original, fully executed chain-of-custody will be included in the hard copy report. Samples will be packaged and shipped according to the procedures provided in Section 4.4.

4.4 Sample Packaging and Shipment

This section describes the procedures that will be used for sample packaging and shipment.

4.4.1 Sample Packaging

Samples will be packaged carefully to avoid breakage or cross-contamination and will be shipped to the laboratory at proper temperatures. The following sample packaging guidelines will be followed:

- Ensure that sample containers have the sample labels securely affixed to the container with clear packing tape;
- Check the caps on the sample containers to ensure that they are properly sealed;
- Using duct tape, secure the outside drain plug at the bottom of the cooler;
- Place 1 to 2 inches of cushioning material at the bottom of the cooler;
- Place the sealed sample containers upright into the cooler, the sample bottles will be placed in the cooler in a manner to minimize potential cross-contamination;
- Sample bottles from specific sampling locations will be placed in the same cooler where possible;
- In cases where samples for volatile analysis will be shipped in several coolers on a single day, VOC vials may be consolidated into a single cooler to minimize the number of required trip blanks;
- Wet ice packaged in sealable, plastic bags will be used to cool samples during shipping. Ice will not to be used as a substitute for packing materials;
- Shipping coolers will be filled with packing materials (e.g. bubble wrap). Packing material may be placed between or wrapped around glass containers to prevent the bottles from shifting and to minimize potential breakage during shipping;
- Temperature blanks will be included in each cooler to allow the laboratory to check cooler/sample transportation upon receipt. Temperature blanks will consist of a 250 mL plastic bottle filled with deionized water. Temperature blanks may be provided by the laboratory or prepared in the field prior to sealing coolers;
- Under no circumstances will packing material such as sawdust or sand be used;

- A Chain-of-Custody Form will be placed in a sealable plastic bag and taped to the inside of the cooler lid;

- Close the lid of the cooler, lock, and secure with duct tape;

- Custody seals will be affixed to the sample cooler in such a way as to indicate any tampering during shipment and then dated and initialed; and

- Mark the cooler on the outside with the following information: shipping address, return address, "Fragile" labels, and arrows indicating “this side up;” cover the labels with clear plastic tape; place a signed custody seal over the cooler lid.

4.4.2 Sample Shipment

Sample coolers will be shipped to arrive at the laboratory the morning after sampling (priority overnight) or will be sent by a courier to arrive the same day. The laboratory will be notified of the sample shipment and the estimated date of arrival of the samples being delivered.

4.5 Sample Receipt

Samples delivered to the analytical laboratory will be accepted by the laboratory personnel. Samples can be accepted Monday through Friday. Special arrangements will be required if Saturday delivery is necessitated. Chain-of-custody for laboratory receipt will be established in the following manner:

1. The carrier and the time of arrival is documented in the daily receipt log. The number of items on the chain-of-custody is checked with the actual number received to ensure that all samples arrived.

2. Notation is made as to whether the shipping container (cooler) was sealed with custody seals.

3. The cooler is opened, and the condition of the cooler is recorded. The internal ambient temperature of the cooler is taken and the samples are itemized. Deviation from the chain-of-custody or the workplan, if any, will be noted and reported to the laboratory quality assurance (QA) Coordinator.

4. Lot numbers will be assigned to the samples. Reference to field numbers will be documented in the appropriate logbook. All data are entered into the computer tracking system with analyses required by holding-time specified dates.

The laboratory will perform preliminary extractions or analyses within the analytical method recommended holding times. The laboratory personnel are responsible for the care and custody of samples from the time of receipt until the sample is exhausted or disposed.

4.6 Sampling Method Requirements

ARCADIS will review the project requirements and determine the best technology to obtain the samples required for achieving the stated goals. Sampling activities sample types, numbers, and locations; and sampling equipment are identified in the Site Management Plan (SMP) and in the QAPP.

5. References

ARCADIS of New York, Inc. March 2010. Full Scale In-Situ Chemical Oxidation Design Report.

ARCADIS of New York, Inc. February 2011. Final In-Situ Chemical Oxidation Construction Package.

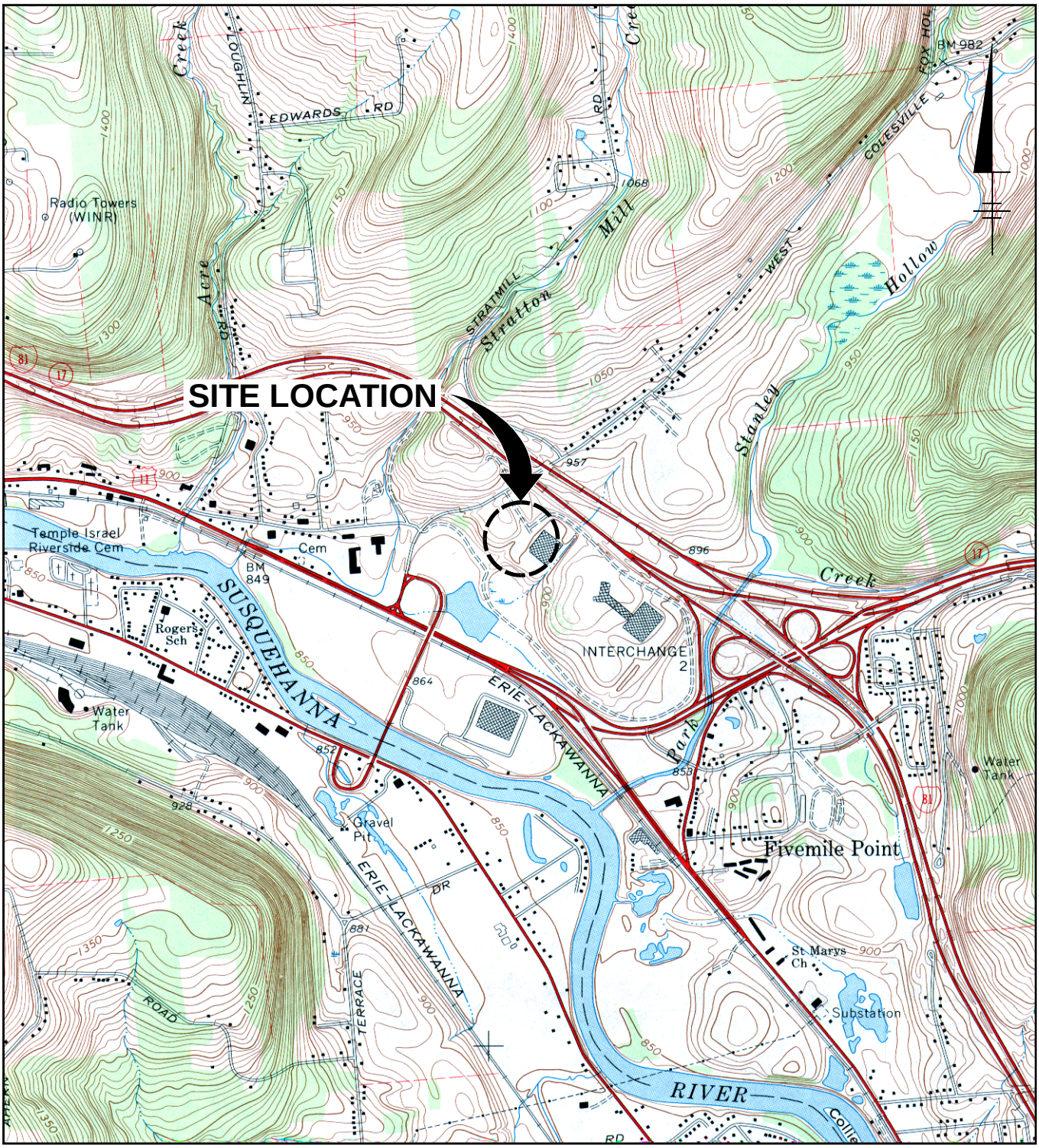
Blasland, Bouck and Lee, Inc. (ARCADIS). July 2004. Remedial Action Report.

Blasland, Bouck and Lee, Inc. (ARCADIS). October 2005. Operation, Maintenance and Monitoring Plan.

New York State Department of Environmental Conservation (NYSDEC). March 2000. Record of Decision: Dover Electronics Site, Kirkwood (T), Broome County, Site Number 7-04-026.

New York State Department of Environmental Conservation (NYSDEC). January 2001. Order on Consent: Index #B7-0515-97-05.

Shield Environmental Associates, Inc. July 2000. Remedial Investigation Report.



REFERENCE: Base Map Source USGS 7.5 Minute Quad. Series Binghamton East, New York, 1968, Photorevised 1976.

2000' 0 2000'

Approximate Scale: 1" = 2000'



AREA LOCATION

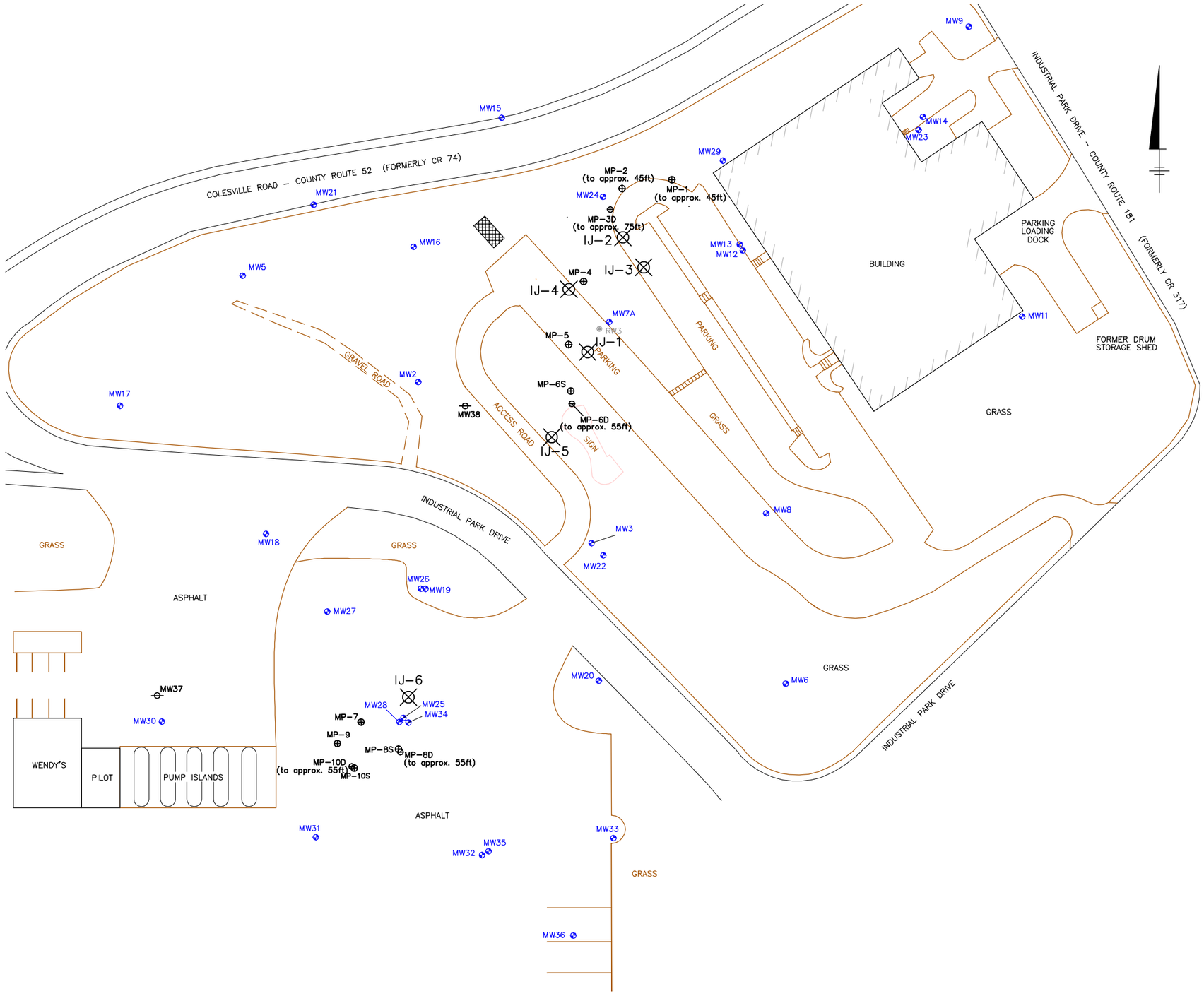
FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK

SITE LOCATION MAP

ARCADIS

FIGURE
1

7/11/08 CRA-85-TLF
00616/0001/00002/00616N01.CDR



LEGEND

- FORMER RECOVERY WELL
- EXISTING MONITORING WELL
- 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH
- TREATMENT BUILDING
- INJECTION TEST WELL

SOURCE:
BASEMAP FROM FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

0 120' 240'
GRAPHIC SCALE

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
-

SITE MAP

ARCADIS

FIGURE 2

CITY: CRA DIV/GROUP: 85 DB: TFATTO LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\BRIGHTON\RETURN-TO\Cranbury-NJ\NJ000616K009\000031\REPORT9-09\FROM-20080061680 1.dwg LAYOUT: LAYOUT1 SAVED: 7/28/2008 6:31 AM ACADVER: 17.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 12/16/2009 1:24 PM BY: FOX, AARON
XREFS: PROJECTNAME: ----
IMAGES:
00616X02

ARCADIS

Appendix A

Standard Operating Procedures

APPENDIX A

Section A: Documentation and Sample Shipping

SOP A.1 Chain-of-Custody Form
SOP A.2 Field Logbook

Section B: Field Measurements

SOP B.1 Photoionization Detector (MiniRAE 2000 PGM-7600)
SOP B.2 Combustible Gas/Oxygen/Carbon Monoxide Hydrogen Sulfide Monitor
SOP B.3 Environmental Monitoring System YSI600XLM/XL SONDE
SOP B.4 Colorimetric Method 8034 (HACH® DR/890)
SOP B.5 Turbiditymeter (LaMotte 2020)

Section C: Hydrogeologic Data Collection

SOP C.1 Evaluation of Existing Monitoring Wells
SOP C.2 Water Level and Well-Depth Measurements
SOP C.3 Down-Hole Groundwater Field Parameter Measurement
SOP C.4 Collection of Groundwater Samples with Bailers – Grab Sample
SOP C.5 Low-Flow Groundwater Sampling

Section D: Air Sample Collection

SOP D.1 Collection of Indoor and Ambient Air with Summa Steel Canisters

Section E: Decontamination

SOP E.1 Decontamination

STANDARD OPERATING PROCEDURE A.1
FIELD LOGBOOK

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for recording field survey and sampling information in a field logbook. This SOP is based on the technical requirements described in the NYSDEC guidance document draft *DER-10 Technical Guidance for Site Investigation and Remediation (November 2009)*. Data generated from the use of this SOP may be used to support the remediation groundwater monitoring activities and indoor air sampling.

2.0 Materials

a. Field logbook
b. Indelible black ink pen

3.0 Procedure

All information pertinent to a field survey or sampling effort will be recorded in a bound field logbook that should have numbered, water-resistant pages. The outside front cover of the logbook will contain the installation name and the project-specific sampling event (e.g., surface soil sampling). The inside front cover will include a mailing address and a point of contact. Each page will be consecutively numbered, dated, and initialed. All entries will be made in indelible black ink and all corrections will consist of line-out deletions that are initialed and dated. If only part of a page is used, the remainder of the page should have an "X" drawn across it. At a minimum, entries in the logbook will include the following:

- Unique, sequential field sample number
- Affiliation of persons contacted
- Name of person keeping log
- Names of all persons on site
- Purpose of visit
- Weather conditions
- Time of arrival and departure at the sampling location.
- Sampling rationale
- Location and description of each sampling point
- Details of the sample site (e.g., the elevation of the casing, casing diameter and depth, integrity of the casing)
- Type of sample (e.g., soil)
- Number, depth, and volume of sample collected
- Sampling methodology, including distinction between grab and composite sample
- Analyses to be performed on the sample
- Sample preservation
- Date and time of sample collection
- Sample shipment (e.g., name of the laboratory and cartage agent - Federal Express, United Parcel Service)
- Maps of the sampling site
- Field observations (e.g., weather, description of samples)

- Field instrument calibration information
- Name of collector
- All sample identification numbers
- Field screening measurements (e.g., PID)
- Signature and date by the personnel responsible for observations

Sampling situations vary widely. No general rules can specify the extent of information that must be entered in a logbook. However, records should contain sufficient information so that someone can reconstruct the sampling activity without relying on the collector's memory. The Task Manager will keep a master list of all field logbooks assigned to the sampling crew.

4.0 Maintenance

Not applicable.

5.0 Precautions

None.

6.0 References

NYSDEC 2009. *Draft DER-10 Technical Guidance for Site Investigation and Remediation*

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE A.2
CHAIN-OF-CUSTODY FORM

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for use of the Chain-of-Custody (COC) Form. Field personnel should be aware that a sample is considered to be in a person's custody if the sample is: (a) in a person's actual possession; (b) in view after being in a person's possession; (c) locked up so that no one can tamper with it after having been in physical custody. This SOP is based on the technical requirements in the NYSDEC guidance document draft *DER-10 Technical Guidance for Site Investigation and Remediation (November 2009)*. Data generated from the use of this SOP may be used to support the remediation groundwater monitoring activities and indoor air sampling.

2.0 Materials

a. Chain-of-Custody Form
b. Indelible black ink pen
c. Field logbook

3.0 Procedure

3.1 Enter the project number/P.O. number.

3.2 Give the project name.

3.3 Enter ARCADIS point of contact’s name and phone number (Project Manager or Task Manager).

3.4 Enter the names of the samplers.

3.5 List the field sample IDs.

3.6 Indicate the date of sample collection.

3.7 List the sampling times (military format) for all samples.

3.8 Indicate the matrix sampled (e.g., soil, water)

3.9 Specify the sample location.

3.10 List the analyses per sample location.

3.11 Enter the total number of containers per analysis.

3.12 List the preservation requirements for each analysis.

3.13 Sign, date, and time the "relinquished by" section.

3.14 Upon completion of the form, any unused space below the last row shall be crossed out with a diagonal line.

3.15 Retain one copy of the COC and affix the other copies to the inside of the sample cooler to be sent to the designated laboratory.

4.0 Maintenance

Not applicable.

5.0 Precautions

None.

6.0 References

None.

7.0 Attachments

Attachment A - Chain-of-Custody for Analytical Sampling

Columbia Analytical Services

800.695.7222
www.caslab.com

CHAIN of CUSTODY

Page ___ of ___

Client:

Project:

Method of Shipment

Project Manager

Telephone No.

Fax No.

Special Detection Limit/Reporting

Sample I.D.	Lab Sample No.	No. of Containers	Matrix: Soil	Matrix: Water	Matrix: Air	Matrix: Other	Prsv.: Yes	Prsv.: No	Sampling Date	Sampling Time															Turn Around Time (working days)

MARKS

Sample Received Intact: Yes No

Temperature received: Ice No ice

Relinq. by sampler (Sign & Print Name)	Date	Time	Received by (Sign & Print Name)		
Relinquished by	Date	Time	Received by		
Relinquished by	Date	Time	Received by		
Relinquished by	Date	Time	Received by laboratory	Date	Time

Lab Work No.

STANDARD OPERATING PROCEDURE B.1
PHOTOIONIZATION DETECTOR (MiniRAE 2000 PGM-7600)

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for field operations with a photoionization detector (MiniRAE 2000 PGM-7600). The photoionization detector (PID) is used to detect, measure, and provide a direct reading of the concentration of trace gases, particularly organics, in the atmosphere. The PID contains an ultraviolet light source that emits photons with an energy level high enough to ionize organics, but not high enough to ionize the primary components of atmospheric air (e.g., oxygen, nitrogen). The current produced by the ions released during ionization is measured and the corresponding concentration is displayed directly in parts per million (ppm). The concentration measurements are used to establish levels of protection and other control measures, such as action levels. The PID will not detect compounds above the ionization potential of the lamp used (e.g., methane).

2.0 Materials

a. MiniRAE 2000 PGM-7600 with 9.8, 10.6, or 11.7 eV ultraviolet lamp probe
b. Tedlar bag
c. Isobutylene (100 ppm) Calibration Gas

3.0 Procedure

3.1 Calibration

3.1.1 Entering into Programming Mode

3.1.1.1 Turn on the MiniRAE 2000 monitor and wait for the **"Ready.."** message or the instantaneous reading display **"0.0 ppm"** message displayed.

3.1.1.2 Press and hold down both **[N/-]** and **[Mode]** keys for three seconds to enter programming mode. This delay is to prevent the user from entering programming mode by accident.

3.1.1.3 The first menu item "Calibrate/select Gas?" will be displayed.

3.1.1.4 Press **[Y/+]** key to select the displayed menu item.

3.1.2 Fresh Air Calibration

3.1.2.1 The first sub-menu shows: "Fresh air Cal?". Make sure to stand in a open space with clean air.

3.1.2.2 Press the **[Y/+]** key, the display shows "zero in progress" followed by "wait.." and a countdown timer.

3.1.2.3 After about 15 seconds pause, the display will show the message "update data…zerored…reading = X.X ppm…" Press any key or wait about 20 seconds, the monitor will return back to "Fresh air Calibration?" submenu.

3.1.3 Span Calibration

3.1.3.1 The span gas can be filled into a Tedlar bag.

3.1.3.2 Connect the calibration adapter to the inlet port of the MiniRAE 2000 Monitor and connect the tubing to the Tedlar bag.

3.1.3.3 Press the **[N/-]** key to scroll to the next menu item of the programming menu.

3.1.3.4 Press the **[Y/+]** key at the "Span Cal?" to start the calibration. The display shows the gas name and the span of the corresponding gas.

3.1.3.5 The display shows "Apply gas now!" Turn on the valve of the span gas supply.

3.1.3.6 Display shows "wait…30" with a countdown timer showing the number of remaining seconds while the monitor performs the calibration.

3.1.3.7 To abort the calibration, press any key during the countdown. The display shows "Aborted!" and returns to "Span Cal?" sub-menu.

3.1.3.8 When the countdown timer reaches 0, the display shows the calibrated value.

Note: The reading should be very close to the span gas value.

3.1.3.9 During calibration, the monitor waits for an increased signal before starting the countdown timer. If a minimal response is not obtained after 35 seconds, the monitor displays "No Gas!" Check that the span gas valve is on and for lamp or sensor failure before trying again.

3.1.3.10 The calibration can be started manually by pressing any key while the "Apply gas now!" is displayed.

3.1.3.11 After a span calibration is completed, the display will show the message "Update Data Span Cal Done! Turn Off Gas."

3.1.3.12 Turn off the flow of gas. Disconnect the Tedlar bag from the MiniRAE2000 Monitor.

3.1.3.13 Press any key and it returns back to “Span Gas Cal?”

3.1.3.14 To exit programming mode, press the **[MODE]** key twice.

3.2 Operation

The **MiniRAE 2000** VOC monitor has two operation modes: **Survey** and **Hygiene** mode. The **Survey mode** allows the user to manually start and stop the monitoring/measuring operation and displays certain exposure values. In the **Hygiene mode,** the monitor runs continuously after the monitor is turned on. Refer to Section 4.7.1. for switching between the two modes.

3.2.1 Survey Mode

3.2.1.1 After the monitor is turned on, it runs through the start up menu. Then the message **“Ready…”** is displayed.

3.2.1.2 Press the **[MODE]** button to step through the Main Menu.

3.2.1.3 Press the **[Y/+]** button to proceed to take a measurement.

4.0 Maintenance

When the display shows a flashing message “Bat”, the battery requires recharging. It is recommended to recharge the MiniRAE 2000 monitor upon returning from fieldwork. The battery may be replaced in the field if required.

4.1 PID Sensor & Lamp Cleaning/Replacement

Note: Normally the cleaning procedure is not needed. Clean the PID sensor module, the lamp and the lamp housing only when one of the following happens:

- The reading is inaccurate even after calibration.
- The reading is very sensitive to air moisture.
- A chemical liquid has been sucked into the unit and damaged the unit.

If the lamp is operational, clean the lamp window surface and the lamp housing by wiping it with GC grade methanol using a cotton swab using moderate pressure. After cleaning, hold the lamp up to the light at an angle to detect any remaining film. Repeat the process until the lamp window is clean.

5.0 Precautions

5.1 The MiniRAE2000 PGM-7600 is designed to sample air or vapors only. DO NOT allow any liquids or low boiling vapors to get into the probe or meter assembly.

5.2 High concentrations of any gas will cause erroneous readings. High humidity can cause the instrument readings to vary significantly from the actual concentration of gases or vapors present. This is true even though the PID cannot react to water vapor.

5.3 High humidity or exposure to concentrations of low boiling vapors will contaminate the ion chamber, causing a steady decrease in sensitivity.

5.3 Turn the unit OFF when performing any maintenance operations.

6.0 References

RAE Systems, 2005. *MiniRAE2000 PGM-7600 Operation and Maintenance Manual.*

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE B.2
COMBUSTIBLE GAS/OXYGEN/CARBON MONOXIDE/HYDROGEN SULFIDE MONITOR
(VRAE Multigas Monitor PGM-7800 & 7840)

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for field operations with a combustible gas/oxygen/carbon monoxide/hydrogen sulfide monitor. The multigas monitor continuously and simultaneously monitors the level of ambient oxygen, hydrogen sulfide, carbon monoxide and combustible gases. All four of the gases are continuously being monitored and an alarm will sound if any of the gases reaches a preset unsafe limit. Combustible gases are displayed in percent of the lower explosive limit (LEL) in 1% increments, hydrogen sulfide (H_2S) in parts per million (ppm) in 1 ppm increments, carbon monoxide (CO) in 1 ppm increments and oxygen (OXY) in percent by volume in 0.1% increments. Information from the monitor is used to identify unsafe work areas (e.g., oxygen-deficient atmospheres, explosive atmospheres) and establish control measures, such as levels of protection.

2.0 Materials

a. VRAE Multigas Monitor or equivalent
b. Alkaline battery adapter
c. Water trap filter
d. Calibration gas

3.0 Procedure

3.1 Start Up

3.1.1 To turn on the VRAE multigas monitor, press the **[MODE]** key. The audio buzzer will beep once and the display will show “ON!” and then “Multigas Monitor Ver n.nn” to indicate the software version number. Serial number, current date and time, temperature of the monitor are displayed next. The monitor will then go through each sensor socket to check if a valid sensor is installed. If a new sensor is installed, a message to remind the user to calibrate the sensor will be displayed followed by a message that the alarm limits have been reset to default values for the new sensor. If a sensor reaches its expected end of life, a “Warranty Expired” message will be displayed. The sensor can be used beyond this date if it still calibrates properly and has enough resolution as testing by the raw readings.

3.1.2 Next, the monitor displays the preset alarm limits for each sensor, battery voltage, shut-down voltage, user mode, alarm mode, datalog mode, available data storage memory (in hours), datalog mode and datalog interval (in seconds). After a warm-up interval (default of 10 seconds), the VRAE monitor is ready to monitor gases and the display shows the instantaneous reading of the gas concentration in ppm.

3.1.3 To turn off the VRAE multigas monitor, press and hold the **[MODE]** key for 5 seconds. The monitor will beep once per second during the power-down sequence with a countdown timer showing the number of remaining seconds. The message "Off!..." flashes on the LCD display and the display will go blank, indicating that the monitor is turned off.

3.2 Operations

3.2.1 The VRAE multigas monitor offers three different user modes of operation: **Text** mode, **Display** mode, and **Program** mode.

3.2.1.1 The **text** mode is the simplest mode of operation. The monitor will display the sensor name after the monitor is turned on. The user can press the **[MODE]** key to see the instantaneous gas concentration readings, battery voltage, or enter the PC communication menu.

3.2.1.2 In the **display** mode, the VRAE multigas monitor displays eight different readings: instantaneous gas concentration, sensor name, Peak, minimum, STEL, TWA, battery voltage and shutdown voltage in volt, run time in hours and minutes and temperature in degrees F. In addition, there are up to five more displays to show datalog mode (or enable / disable datalogging operation in manual datalog mode), to show the LEL gas names, to show pump speed, and to print reading (Option) and to communicate with a PC.

3.2.1.3 In the **program** mode, the user can perform all of the functions of the display mode. In addition, the user can enter a **Programming Mode**. In the programming mode, the user can perform various functions, such as change sensor configurations, enter user information or calibrate the monitor.

3.2.2 To choose a specific display, press the **[MODE]** key one or more times until the desired display appears. The following are the brief explanations of each LCD display in the **text** mode or the **display** mode operation for the model PGM-7800. **For the model PGM-7840, the displays will be similar. However, the oxygen reading will be replaced by a toxic sensor reading, and the name "oxy" will be replaced by the name of the toxic sensor.**

3.2.2.1 The **instantaneous** reading is the actual gas concentration in parts per million (ppm) for toxic gases, % of volume for oxygen and % of volume or % of LEL for combustible gases. The reading is updated once per

second and is shown in the LCD display.

3.2.2.2 The **sensor names** are displayed as:

LEL: For combustible gas sensor
OXY: For oxygen sensor (not for PGM-7840)
CO, H_2S, etc.: For up to 3 toxic sensors (4 for PGM-7840)

3.2.2.3 The **peak** reading is the highest reading of each gas concentration since the monitor was turned on. The reading is updated at one-second intervals and is shown in the LCD display with "PEAK" message.

3.2.2.4 The **minimum** reading is the lowest reading of each gas concentration since the monitor was turned on. The reading is updated at one-second intervals and is shown in the LCD display with "MIN" message.

3.2.2.5 The **STEL** reading is the last 15-minute average reading of the gas concentration. The reading is updated once per minute and is shown in the LCD display with "STEL" message. For the first 15 minutes, "****" will be displayed. This reading applies to toxic gases only. The model PGM-7840 will have one more reading displayed on the right of the "STEL".

3.2.2.6 The **TWA** reading is the accumulated reading of the gas concentration divided by 8 hours since the monitor was turned on. The reading is updated once a minute and is shown in the LCD display with "TWA" message. This reading applies to toxic gases only. The model PGM-7840 will have one more reading displayed on the right side of the "TWA" or "AVG".

3.2.2.7 The **battery voltage** reading is the current battery voltage in volts. The reading is updated once per second and is shown in the LCD display. The shutdown voltage is also shown.

NOTE: A fully charged battery pack should show 4.8 volts or higher. When the battery voltage falls below 4.4 volts, a flashing "Bat" will appear as a warning message, plus a buzzer alarms every second. This means there is 20-30 minutes run time left before the monitor will be turned off automatically (when the battery voltage falls below 4.2 volts).

3.2.2.8 The **run time** reading is the accumulated "On" time in hours and minutes since the monitor was turned on. The reading is updated at one-minute intervals and is shown in the LCD display together with the current date, time and temperature.

3.2.2.9 The **datalog** menu shows the current datalog mode. If the VRAE monitor is non-datalog monitor, this menu will not show up. If manual datalog mode is selected, the menu will prompt the user to turn on or off datalogging. Pressing the **[Y/+]** key while "Start Datalog?" message is

displayed turns on the datalogging. Likewise, pressing the **[Y/-]** key while "Stop Datalog?" message is displayed will turn off the datalogging.

3.2.2.10 The monitor displays the selected **LEL gas name** if the combustible sensor is installed. When an LEL gas is selected, the "calculated" gas concentration, based on the built-in correction factor for that specific gas, will be displayed.

3.2.2.11 The monitor displays pump speed "High" or "Low." Press [Y/+] key to accept the displayed speed. Press [N/-] key to toggle the other speed.

3.2.2.12 From the LEL/VOL menu the user can select the operating mode of the LEL/TC sensor: "LEL", "VOL", or "Autorange".

3.2.2.13 If the serial printer option is enabled through the Pro-RAE suites, a new menu item is shown "Print Reading?" Connect a RAW specified serial printer to the serial port of the monitor. By pressing the "Y" key, the current instantaneous readings of the monitor will be printed out from the serial printer.

3.2.2.14 The **communicate with PC?** menu display allows the user to upload data from the VRAE to a Personal Computer (PC) or download configuration information from a PC to the VRAE.

Press the **[Y/+]** key and the LCD displays the message "Monitor will pause, OK?" to remind the users that during PC communication, there will be no real time monitoring of the gas concentration. Press **[Y/+]** key to proceed and the monitor enters the communication standby mode. The LCD then displays "Ready…" Connect the monitor to the serial port of a PC. The monitor is then ready to receive any command from the PC.

4.0 Maintenance

4.1 Calibration

In programming mode, the user may re-calibrate the sensors in the VRAE monitor. This is a two-point calibration process using "fresh air" and the standard reference gas (also known as Span Gas).

4.1.1 First, a "fresh air" that contains 20.9% and no detectable, toxic or combustible gas is used to set the zero point for each sensor. Then a standard reference gas, which contains a known concentration of a given gas, is used to set the second point of reference.

4.1.1.1 This procedure determines the zero point of the sensor calibration to curve. To perform fresh-air calibration, the calibration adapter and a bottle of "fresh air" (optional) are recommended.

4.1.1.2 "Calibrate Monitor?" is the first calibration sub-menu window. Press **[Y/+]** to perform calibration. The first sub-menu shows: "Fresh Air Calibration?"

4.1.1.3 If the "fresh air" bottle is available, snap in the calibration adapter over the inlet port of the VRAE Monitor and connect the other end of the tube to the fresh gas bottle. If the "fresh air" bottle is not available, simply leave the monitor in an area free of any detectable vapor.

4.1.1.4 Press the **[Y/+]** key to start "fresh air calibration" of the monitor. The display shows "zero… in progress" followed by the name of each sensor and the message "zeroed." The display should show a reading "0.0", or a very small number, for all sensors. For the oxygen sensor in model PGM-7800, it should show a "20.9" as the reading.

4.1.1.5 After about 30 seconds pause, the display will show the message "Zero Cal Done! Reading=" and the instantaneous fresh air readings.

4.1.1.6 Press either **[Y/+]** or **[MODE]** once and move to the next sub-menu "Vol% Zero Calibration?". Apply the Vol% Zero gas and press **[Y/+]** to start. The display shows "zero… in progress…" followed by "Zero cal done… Reading = 0".

4.1.1.7 Press either **[Y/+] or [MODE]** once and move to the next sub-menu "Multiple Sensor Calibration?"

4.1.2 Multiple Sensor Calibration

This function simultaneously determines the second point of calibration curves for multiple sensors in the monitor. A bottle of mixed standard reference gases is needed to perform this procedure. The user can choose several gas mixtures to be used in multiple-sensor calibration.

Snap in the calibration adapter over the gas inlet port of the VRAE Monitor and connect the tube to the mixed gas bottle.

4.1.2.1 Continuing from Section 4.1.1.7, the display should show "Multiple Sensor Calibration?" Press the **[Y/+]** key. The display shows all the pre-selected gases for the mixed gas bottle and "OK?" question. Press **[Y/+]** key to accept the multiple sensor selection and start the calibration, or press the **[N/-]** key to modify the sensor selection.

4.1.2.2 Turn on the valve of the mixed gas bottle to start the flow of the span gas. Display shows "Apply Mixed Gas" and will wait for the calibration gas to reach the sensor. When the calibration gas has reached the sensor, the display will show "calibration in progress… 60" with the countdown timer showing the number of remaining seconds while the monitor performs calibration. When the countdown timer reaches 0, the display shows the name of each sensor, the message "cal'ed!" and the

calibrated value for each gas. If no gas has reached the sensor after 60 seconds, the display will show “No gas flow…” and abort the calibration.

Note 1: The readings should be very close to the span gas values. After about 30 seconds pause, the display will show the message “Span Cal Done! Turn Off Gas”

Note 2: Some sensors, such as ammonia and chlorine dioxide, require longer equilibration times than 60 seconds. These sensors should be calibrated separately in a Single Sensor Calibration.

4.1.2.3 This completes the multiple sensor calibration procedure and moves to the next sub-menu item.

4.1.2.4 Turn off the flow of gas. Disconnect the calibration adapter from the VRAE Monitor.

4.1.2.5 Press the **[MODE]** key any time during step 4.1.2.2 to abort the calibration. If a sensor failed the calibration, the sensor name and an error message “failed, continue?” will appear. Press the **[N/-]** or **[MODE[** key to abort the calibration. Press the **[Y/+]** key to continue to the next sensor calibration. In either case, the calibration data for the current sensor is not changed.

From Step 4.1.2.1, if **[N/-]** is pressed, the display shows all the sensor names selected for multiple sensor calibration with the cursor blinking at the first sensor.

Press the **[Y/+]** key to select the sensor and the **[N/-]** key to de-select the sensor. A previously selected sensor will show an “*” next to the sensor name. A previously de-selected sensor will not show an “*” next to the sensor name.

4.1.2.6 Press the **[MODE]** key momentarily to move from one sensor location to the next one. Repeat Step 7 until all of the sensors that need to be calibrated during multiple sensor calibration are selected. Press and hold the **[MODE]** key for 1 second to save the new sensor selection.

4.1.2.7 The display shows “Save?” To confirm the new selection, press the **[Y/+]** key to accept the change and continue on with Step 4.1.2.2. Press the **[N/-]** key or the **[MODE]** key to discard the change and to continue on with Step 4.1.22.

4.1.3 Battery Replacement

When the display shows a flashing message “Bat”, the battery requires recharging. The battery may be replaced in the field (in an area known to be non-hazardous) if required.

4.1.4 Sensor Replacement

The toxic, combustible and oxygen sensors all have an expected operating life. Under normal operating condition, most sensors will lose their original sensitivity after the expected operating life and will need to be replaced.

Each sensor module in VRAE includes a non-volatile memory that records the manufacturing date of the sensor. In the diagnostic mode, the microprocessor will check the date code and display the expiration date of each sensor. The user should have the sensor replaced when the current date exceeds the expiration date of a sensor.

4.1.5 Sampling Pump Replacement

The sampling pump is positive displacement piston pump. When approaching the end of the specified lifetime of the pump, it will consume a higher amount of energy and reduce its sample draw capability significantly. When this occurs, it is necessary to replace the pump.

5.0 Precautions

5.1 To reduce the risk of electric shock, turn off power before removing the monitor cover. Never operate the monitor while the cover is removed. Remove monitor cover and sensor module only in an area known to be non-hazardous.

The model PGM-7800 and PGM-7840 equipment are classified as to intrinsic safety for use in class I, division 1, groups A, B, C, D, or non-hazardous locations only.

5.2 Use only RAE Systems battery packs, part Nos. 012-3050, 012-3051 or 012-3052. This instrument has not been tested in an explosive gas/air atmosphere having an oxygen concentration greater than 21%. Substitution of components may impair intrinsic safety. Recharge batteries only in non-hazardous locations.

5.3 Clean only with a damp cloth (static hazard).

5.4 Any rapid upscale reading, followed by a declining or erratic reading, may indicate a gas concentration above the upper scale limit that may be hazardous.

6.0 References

VRAE Multigas Monitor. *PGM-7800 & 7840 User's Manual.*

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE B.3
ENVIRONMENTAL MONITORING SYSTEM (YSI600XLM/XL SONDE)

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for field operations with an Environmental Monitoring System YSI600XLM/XL Sonde or equivalent. The 6-Series Environmental Monitoring Systems are multi-parameter, water quality measurement, and data collection systems. They are intended for use in research, assessment, and regulatory compliance applications. A sonde is a torpedo-shaped water quality monitoring device that is placed in the water to gather water quality data. Sondes may have multiple probes. Each probe may have one or more sensors that read water quality data. The parameters that the sonde may measure are:

- Dissolved oxygen
- Conductivity
- Specific conductance
- Salinity
- Temperature
- pH
- ORP

2.0 Materials

a. 600XL or 600XLM Sonde with Calibration Cup and Probe Guard
b. EcoWatch for Windows Software
c. Operations Manual
d. Guard for Probe Compartment
e. 6570 Maintenance Kit
f. Probes for the sonde
g. 5775 Membrane Kit
h. Flow cells for the probe
i. Cables for the sondes
j. Reagents (conductivity, pH, ORP)
k. YSI 650 Display
l. Personal protective equipment (e.g., latex or nitrile gloves, safety glasses, etc.) as specified in the Site Health and Safety Plan (HASP)

3.0 Procedure

3.1 Start-up

3.1.1 After connecting the sonde to the 650, press the **"ON"** button on the upper left of the 650 keypad to activate the 650.

3.1.2 Using the arrow keys, highlight the **SONDE RUN** entry in the Main 650 Menu and press the **ENTER** key. Readings from the 6-series sonde sensors will appear on the 650 Main display in real-time. The two windows at the top of the display give the capability of logging the displayed readings to either the 650 (top left) or the sonde (top right) memory and allow the user to activate the wiper on turbidity, chlorophyll, and rhodamine WT probes if they are present in the sonde.

3.2 Calibration

To ensure more accurate results, the calibration cup has to be rinsed with water, and then with a small amount of the calibration solution for the sensor that will be calibrated. Discard the rinse solution and add fresh calibrator solution.

3.2.1 Carefully immerse the probes into the solution and rotate the calibration cup to engage several threads. Supporting the sonde with a ring stand and clamp to prevent the sonde from falling over is recommended.

3.2.2 With the proper cable, proceed to the main menu from the sonde main menu and select **2-Calibrate**.

3.2.3 To select any of the parameters from the Calibrate menu, input the number that is next to the parameter. After a parameter has been chosen, some of the parameters will have a number that appears in parentheses. These are the default values and will be used during calibration if **ENTER** is pressed without inputting another value. Be sure not to accept default values unless they are correct. If no default value appears, type in a numerical value and press **ENTER**.

3.2.4 After inputting the calibration value, or accepting the default, press **ENTER**. A real-time display will appear on the screen. Carefully observe the stabilization of the readings of the parameter that is being calibrated. When the readings have been stable for approximately 30 seconds, press **ENTER** to accept the calibration. The calibrated value is bolded on the example screen on the following page.

3.2.5 Press **ENTER** to return to the Calibrate menu, and proceed to the next calibration.

NOTE: The recommended volumes for calibration solutions are: in upright position for conductivity 50 ml, pH 25 ml, ORP 25 ml; in upside-down position conductivity 50 ml, pH 50 ml, ORP 50 ml.

3.3 Conductivity

3.3.1 Carefully immerse the probe end of the sonde into the solution. Gently rotate and/or move the sonde up and down to remove any bubbles from the conductivity cell. The probe must be completely immersed past its vent hole. Using the recommended volumes from above should ensure that the vent hole is covered.

3.3.2 Allow at least one minute for temperature equilibration before proceeding.

3.3.3 From the Calibrate menu, select **Conductivity** to access the Conductivity calibration procedure and then **1-SpCond** to access the specific conductance calibration procedure.

3.3.4 Enter the calibration value of the standard (mS/cm at 25ºC) and press **ENTER**. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

3.3.5 Observe the readings under Specific Conductance or Conductivity and when they show no significant change for approximately 30 seconds, press **ENTER**. The screen will indicate that the calibration has been accepted and then press **ENTER** again to return to the calibrate menu.

3.3.6 Rinse the sonde in tap or purified water and dry the sonde.

3.4 Dissolved Oxygen

3.4.1 Place approximately 3 mm (• inch) of water in the bottom of the calibration cup.

3.4.2 Place the probe end of the sonde into the cup. Make certain that the DO and temperature probes are not immersed in the water.

3.4.3 Engage only 1 or 2 threads of the calibration cup to ensure the DO probe is vented to the atmosphere.

3.4.4 Wait approximately 10 minutes for the air in the calibration cup to become water saturated and for the temperature to equilibrate.

3.5 pH 2-point

3.5.1 Using the correct amount of pH 7 buffer standard in a clean, dry or pre-rinsed calibration cup, carefully immerse the probe end of the sonde into the solution. Allow at least 1 minute for temperature equilibration before proceeding.

3.5.2 From the Calibrate menu, select **ISE1 pH** to access the pH calibration choices and then press **2-2 Point**.

3.5.3 Press **ENTER** and input the value of the buffer (7 in this case) at the prompt. Press **ENTER** and the current values of all enabled sensors will appear on the screen and change for approximately 30 seconds, press **ENTER**. The display will indicate that the calibration is accepted.

3.5.4 After the pH 7 calibration is complete, press **ENTER** again, as instructed on the screen, to continue.

3.5.5 Rinse the sonde in water and dry the sonde before proceeding to the next step.

3.5.6 Using the correct amount of an additional pH buffer standard into a clean, dry or pre-rinsed calibration cup, carefully immerse the probe end of the sonde into the solution. Allow at least 1 minute for temperature equilibration before proceeding.

3.5.7 Press **ENTER** and input the value of the second buffer at the prompt. Press **ENTER** and the current values of all enabled sensors will appear on the screen and will change with time as they stabilize in the solution.

3.5.8 Observe the readings under pH and when they show no significant change for approximately 30 seconds, press **ENTER**.

3.5.9 After the second calibration point is complete, press **ENTER** again, as instructed on the screen, to return to the Calibrate menu.

3.6 ORP

3.6.1 Select **5-ISE2 ORP** to calibrate the ORP sensor. Immerse the sonde in a solution with a known oxidation reduction potential value (e.g. Zobell solution) and press **ENTER**.

3.6.2 Enter the ORP value of the solution. Press **ENTER** and monitor the stabilization of the ORP and temperature readings.

3.6.3 After no changes occur for approximately 30 seconds, press **ENTER** to confirm the calibration. Then as instructed, press **ENTER** again and return to the Calibrate menu.

4.0 Maintenance

4.1 O-RING CARE AND MAINTENANCE

The 6-series sonde utilizes user-accessible o-rings as seals to prevent environmental water from entering the battery compartment and the sensor ports. Following the recommended procedures will assure that no problems occur with regard to water influx into the sonde. If the o-rings and sealing surfaces on the sondes are not maintained properly, it is possible that water can enter the battery compartment and/or sensor ports of the sonde.

4.2 SONDE PROBE PORTS

4.2.1 Whenever installing, removing or replacing a probe, it is extremely important that the entire sonde and all probes be thoroughly dried prior to the removal of a probe or probe port plug. This will prevent water from entering the port.

4.2.2 Once a probe or plug is removed, examine the connector inside the sonde probe port. If any moisture is present, use compressed air to completely dry the connector.

4.2.3 If the connector is corroded, return the sonde directly to YSI Customer Service. When reinstalling a probe or port plug, lightly grease the O-ring with lubricant supplied in the YSI 6570 Maintenance Kit.

4.3 CABLE CONNECTOR PORT

4.3.1 The cable connector port at the top of the sonde should be covered at all times. While communicating with the sonde, a cable should be installed and tightened in place. This will assure that a proper connection is being made and will prevent moisture and contaminants from entering.

4.3.2 When a communications cable is not connected to the cable connector port, the pressure cap supplied with the instrument should be securely tightened in place.

4.3.3 If moisture has entered the connector, dry the connector completely using compressed air, a clean cloth, or paper towel. Apply a very thin coat of lubricant from the 6570 Maintenance Kit to the O-ring inside the connector cap before each installation.

4.4 DO PROBES

4.4.1 For best results, the KCI solution and the Teflon membrane at the tip of the 6562 probe need to be changed prior to each sonde deployment and at least once every 30 days during the use of the sonde in sample studies. In addition, the KCI solution and membrane should be changed if (a) bubbles are visible under the membrane; (b) significant deposits of dried electrolyte are visible on the membrane or the O-ring; (c) if the probe shows unstable readings or other probe-related symptoms.

4.4.2 After removing the used membrane from the tip of the 6562 probe, examine the electrodes at the tip of the probe. If either or both of the silver electrodes are black in color, the probe should be resurfaced using the fine sanding disks that are provided in the 6035 reconditioning kit.

4.5 CONDUCTIVITY/TEMPERATURE PROBES

4.5.1 The opening that allows fluid access to the conductivity electrodes must be cleaned regularly. The small cleaning brush included in the 6570 Maintenance Kit is ideal for this purpose.

4.5.2 Dip the brush in clean water and insert it into each hole 15-20 times. In the event that deposits have formed on the electrodes, it may be necessary to use a mild detergent with the brush.

4.5.3 After cleaning, check the response and accuracy of the conductivity cell with a calibration standard.

4.6 pH AND COMBINATION pH-ORP PROBES

4.6.1 Cleaning is required whenever deposits or contaminants appear on the glass and/or platinum surfaces of these probes or when the response of the probe becomes slow.

4.6.2 Remove the probe from the sonde. Initially, simply use clean water and a soft clean cloth, lens cleaning tissue, or cotton swab to remove all foreign material from the glass bulb (6561 and 6565) and platinum bottom (6561).

4.6.3 Then use a moistened cotton swab to carefully remove any material that may be blocking the reference electrode junction of the sensor.

5.0 Precautions

- Reagents that are used to calibrate and check this instrument may be hazardous to human health.
- Some calibration standard solutions may require special handling.

6.0 References

Environmental Monitoring Systems, Inc. *YSI 600XLM/XL Sonde Owner's Manual*.

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE B.4
COLORIMETRIC METHOD 8034 (HACH® DR/890)

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for field operations with a HACH® colorimeter (Hach DR-890). This unit is to be used to quantify permanganate concentrations (MnO_4^-) in water samples.

2.0 Materials

a. Hach colorimeter (Hach DR/890 Colorimeter) for field permanganate testing.
b. Two clear sample cells to be used with the Hach colorimeter for field permanganate testing (Cat No. 24019-06)
c. Buffer Powder Pillows, citrate type for Manganese (Cat No. 21076-69)
d. 0.45 micron filters
e. Kimwipes® or equivalent
f. Dilution tools (e.g. pipette, graduated cylinder).
g. Distilled and deionized (ASTM Type II) water rinse.
h. Cleaned plastic bottles to collect samples to be analyzed.
i. 5-gal buckets with lids for liquid waste.
j. Eye wash station/bottles.
k. Personal protective equipment (e.g., latex or nitrile gloves, safety glasses, etc.) as specified in the Site Health and Safety Plan (HASP)

3.0 Procedure

The following procedure is based on HACH method 8034, High Range Manganese procedure. This procedure has been modified based on specification provided by HACH for the analysis of MnO_4^-. These analyses are to be conducted in real-time in the field. Measurements of samples with concentrations below 2.0 mg/L or above 20 mg/L are not recommended by the manufacture. For higher concentration solutions, dilutions will be necessary to create a solution within the operable range.

3.1 Collection and Filtration of Water Samples

Sampling should be performed in a way that as little time as possible should elapse between collecting and analyzing the sample. Samples must be collected in cleaned plastic bottles since manganese may be lost by adsorption to glass container walls.

Filtering separates particles from the aqueous sample; this is especially helpful when sample turbidity interferes with analysis. Therefore, water samples should be field filtered prior to start the analyses, Water samples are to be filtrated by passing the sample through a 0.45 micron filter. Avoid contaminating the sample with deionized water or membrane filters.

3.2 Equipment Set up (Zeroing)

3.2.1 Turn on the Hach colorimeter.

3.2.2 Press "**PRGM**" to enter the stored program number for manganese

3.2.3 Press "**41**" to select the manganese program. The display will show mg/L Mn and the zero icon.

3.2.4 Fill the first clean sample cell with 10 ml of groundwater to be used as blank to zero the instrument (Samples cell are marked with 10-, 20- and 25-mL fill lines). Groundwater to be used as blank should be free of permanganate (purple color). If a sample of groundwater free of permanganate is not available, use DI water as blank. Close the sample cell.

3.2.5 Wipe the outside walls of the sample cell with a moist cloth followed by the Kimwipes® to make sure the walls of the cell are free of smudges and fingerprints.

3.2.6 Tightly cover the sample cell with the instrument cap; place the sample cell with the blank into the cell holder. The cells should be placed in the instrument with the fill marks facing the user to minimize variability of measurements.

3.2.7 Press "**ZERO**". The cursor will move to the right, and then the display will show: **0.0 mg/L**. Remove the cell from the instrument and storage it. The equipment is now ready for use.

3.3 Sample Measurement Procedures

3.3.1 Open the second cleaned sample cell and place 10 ml of the sample to be measured in the cell. Add the contents of one **Buffer Powder Pillow, citrate type**, to the cell. Cap the cell and invert until the powder is dissolved.

3.3.2 Wipe the outside walls of the prepared sample cell with a moist cloth followed by the Kimwipes® to make sure the walls of the cell are free of smudges and fingerprints. Tightly cover the sample cell with the instrument cap. Place the sample cell into the cell holder.

3.3.3 Press the key "**READ**". The cursor will move to the right, and then the result in mg/L manganese will appear.

3.3.4 To read the concentration as manganese or MnO_4^- press "**CONC**". Record the reading in the logs.

3.3.5 If concentration is above 20 mg/L, follow the dilution procedures presented in Section 3.4.

3.4 Sample Dilution Procedures

If permanganate concentration is higher than 20 mg/L, the color in the sample may be too intense to be accurately measured by the instrument. Therefore, the sample must be diluted following the volumes indicated in Table 1 and in the steps below:

3.4.1 Select the adequate dilution factor from Table 1, using a total volume of 25 ml.

$$\frac{\text{Estimated Mn concentration*}}{\text{Desired concentration}} = \text{dilution factor;}$$

* obtained from step 3.3.4

3.4.2 Remove the corresponding volume of sample to be analyzed by using a pipette. Place the sample into a clean graduated cylinder (or volumetric flask for more accurate work).

$$\text{Sample volume} = \frac{\text{Total Volume}}{\text{Dilution factor}}$$

3.4.3 Fill the cylinder (or flask) to bring the volume up to 25 ml with deionized water

.

3.4.4. Use the diluted sample and repeat steps 3.3.1 through 3.3.4.

3.4.5 The final concentration of the sample is equal to the diluted sample reading multiplied by the multiplication factor shown in Table 1.

Sample Concentration (mg/L) = Reading of Diluted sample (mg/L) x Multiplication Factor

Note #1: Rinse the pipette or cylinder two or three times before filling. Never pipette chemical reagent solutions by mouth. When filling a pipette, keep the tip of the pipette below the surface of the sample, while the sample is drawn into the pipette.

Table 1. Sample Dilution Volumes and Multiplication Factor

Sample Volume (mL)	mL Deionized Water Used to Bring the Volume to 25 mL	Multiplication Factor
25.0	0.0	1
12.5	12.5	2
10.0	15.0	2.5
5.0	20.0	5
2.5	22.5	10
1.0	24.0	25
0.250	24.75	100

Example for Dilution Procedures

If the concentration in groundwater is estimated to be 50 mg/L, a dilution of 5 will bring the sample into the desired range

$$\frac{\text{50 mg/L}}{\text{10 mg/L}} = \text{5 (dilution factor);}$$

In this case, the corresponding volume of sample to be used is 5 ml

$$\text{Corresponding sample volume} = \frac{25\ \text{ml}}{5} = 5\ \text{ml}$$

3.5 Converting Manganese Concentrations

To report manganese concentrations as permanganate concentrations multiply the manganese concentrations measured in step 3.3.4 and follow the steps below:

- Multiply the Mn result by 2.165 to report as mg/L of MnO_4^-
- Multiply the Mn result by 2.876 to report as mg/L of $KMnO_4$
- Multiply the Mn result by 2.583 to report as mg/L of $NaMnO_4$

Note: If sample was diluted prior analyses, manganese (Mn) concentrations must be adjusted before converting.

4.0 Maintenance

None.

5.0 Precautions

None.

6.0 References

Pocket Colorimeter TM II Analysis Systems Instruction Manual, Aluminum, Manganese – High Range, Nitrate, Dissolved Oxygen. Hach Company, Method 8034 for Water and Wastewater. Manganese, High Range (0.2 to 20.0 mg/L)

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE B.5
TURBIDITYMETER (LaMotte 2020)

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for field operations with a turbiditymeter (LaMotte 2020). The turbiditymeter is used to detect, measure, and provide a direct reading of the cloudiness in water that can be caused by suspended and colloidal mater such as clay, silt, organic and inorganic matter and microscopic organisms. The meter will emit a light through a sample and the particles in the sample will cause the light to scatter. The higher the turbidity, the greater the amount of scatter.

2.0 Materials

a. LaMotte 2020
b. Turbidity tubes
c. Lint-free cloth

3.0 Procedure

3.1 Calibration

3.1.1 Select a LaMotte 2020 Standard in the range of the samples to be tested.

3.1.2 Fill a turbidity tube with the standard, cap, and wipe tube clean with a lint-free cloth.

3.1.3 Open the lid of the meter. Align the indexing arrow mark on the tube with the indexing arrow mark on the meter, and insert the tube into the chamber.

3.1.4 Close the lid. Push the **READ** button. If the displayed value is not the same as the value of the reacted standard (within the specification limits), continue with the calibration procedure.

3.1.5 Push the **CAL** button for 5 seconds until **CAL** is displayed. Release button. The display will flash. Adjust the display with the • and • buttons until the value of the standard is displayed.

3.1.6 Push the **CAL** button again to memorize the calibration. The 2020 display will stop flashing.

Note: The calibration procedure should be followed once per day. The calibration of the meter is independent of the operating mode.

3.2 Operation

3.2.1 Fill a clean container with at least 50 mL of sample water and cover. Set sample aside to allow sample to equilibrate to air temperature and let gases escape. Avoid contaminants. Analyze as soon as possible.

3.2.2 Rinse an empty turbidity tube with a portion of the sample. Shake out excess water.

3.2.3 Fill the turbidity tube to the neck by carefully pouring the sample down the side of the tube to avoid creating bubbles.

3.2.4 Cap the tube and wipe tube dry with a clean lint-free tissue.

3.2.5 Open the 2020 lid. Align the indexing arrow on the tube with the indexing arrow on the meter. Insert the turbidity tube into the chamber.

3.2.6 Close the lid. Push the **READ** button. The turbidity in NTU units will be displayed within 5 seconds.

3.2.7 The 2020 will turn off automatically 2 minutes after the last button push. To turn the meter OFF manually, hold the **READ** button down for at least 1 second. Release the button when OFF is displayed.

4.0 Maintenance

4.1 Replacing the battery

4.1.1 Open the battery compartment lid

4.1.2 Remove the 9-volt alkaline battery and disconnect the battery form the polarized plug.

4.1.3 Carefully connect the new battery to the polarized plug and insert it into the compartment.

4.1.4 Close the battery compartment lid.

4.2 Replacing the Lamp

The tungsten lamp included with the model 2020 has a life of approximately 800 hours. If the display becomes unstable when using LaMotte standards, have the lamp replaced and unit examined right away.

5.0 Precautions

5.1 The LaMotte 2020 should be kept dry at all times. This includes the carrying case, calibration chamber, and the turbidity tubes.

5.2 High concentrations of any gas will cause erroneous readings. High humidity can cause

the instrument readings to vary significantly from the actual concentration of gases or vapors present. This is true even though the PID cannot react to water vapor.

5.3 High humidity or exposure to concentrations of low boiling vapors will contaminate the ion chamber, causing a steady decrease in sensitivity.

5.3 Turn the unit OFF performing any maintenance operations.

6.0 References

LaMotte Company, 2004. LaMotte 2020 Instruction Manual.

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE C.1
EVALUATION OF EXISTING MONITORING WELLS

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for determining the validity of samples collected previously in existing monitoring wells and the utility of those wells for collecting additional samples.

2.0 Materials

a. Field logbook
b. Indelible black ink pen
c. Photoionization Detector (PID)
d. Personal protective equipment (e.g., latex or nitrile gloves, safety glasses, etc.) as specified in the Site Health and Safety Plan (HASP)
e. Electric water level indicator
f. Steel tape or folding ruler
g. Flashlight
h. Deionized or distilled water

3.0 Procedure

The following steps will help to insure that the required data are available to permit an evaluation of the utility of existing monitoring wells for collecting additional samples during RI activities.

3.1 Evaluate and review the original work plan for monitoring well installation (if available).

3.2 Review all available information concerning well construction. The physical features that must be identified and detailed, if available, include:

a. Well identification number, permit number, and location by referenced coordinates or by distance from prominent site features;

b. Installation dates, drilling methods, and contractors;

c. Depth to bedrock -- where rock cores were not taken, auger refusal, drive casing refusal or penetration test results (blow counts for split-spoon sampling) may be used to estimate bedrock interface;

d. Soil profile and stratigraphy;

e. Borehole depth and diameter;

f. Elevation of collar and top of well riser;

g. Depth of bottom of well;

h. Type of well materials, screen type and length, and elevation of top and bottom of screen; and

i. Elevation of tops and bottoms of well seals and elevation of top and bottom of gravel pack.

3.3 On-site inspection of existing monitoring wells. Features to be noted include:

a. The condition of the protective casing, cap, and lock;

b. The condition of the cement collar surrounding the protective casing;

c. The presence of depressions or standing water around the casing; and

d. The presence of any electrical cable and its connections.

3.4 Remove the lock and open the cap. Check for the presence of organic vapors with a PID to determine the appropriate worker safety level. The following information shall be recorded (preferably in the form of annotated sketches):

a. Cap function;

b. Physical characteristics and composition of the inner casing or riser, including inner diameter and annular space;

c. Presence of grout between the riser and outer protective casing and the existence of drain holes in the protective casing;

d. Presence of a riser cap, method of attachment to casing, and venting of the riser; and

e. Presence of dedicated sampling equipment; if possible, remove such equipment and inspect size, materials of construction, and condition.

3.5 Using a water level meter, record the depth to water in the well at the reference mark on the inner casing. With a weighted tape, measure the depth to the bottom of the well. Check the measured depth with the well completion depth on the applicable well construction form or field logbook. Note any differences between the well depths or other evidence (e.g., soft well bottom) that may indicate silt in the well.

4.0 Maintenance

Not applicable.

5.0 Precautions

5.1 Refer to the Site-specific Health and Safety Plan for appropriate health and safety precautions.

6.0 References

Barcelona, M.J., J.P. Gibb and R.A. Miller, 1983. *A Guide to the Selection of Materials for Monitoring Well Construction and Ground-Water Sampling*. SWS Contract Report 327, Illinois State Water Survey, Champaign, IL.

Ricci, E.D., 1985. *The Evaluation of an Existing Groundwater Monitoring Program*. Proceedings of the 6th Nat. Conf. on Management of Uncontrolled Hazardous Waste Sites, Nov. 4-6, 1985. pps. 84-87. HMCRI, Silver Spring, MD.

USEPA, 1987. *Data Quality Objectives*. OSWER Directive 9335.0-7B, March 1987.

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE C.2
WATER LEVEL AND WELL-DEPTH MEASUREMENTS

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for measuring water level and well depths in groundwater monitoring wells. Use of this SOP will provide data for the following uses: groundwater monitoring and remediation activities.

2.0 Materials

a. Water level indicator with cable measured at 0.01 foot increments
b. Plastic sheeting
c. Folding ruler or pocket steel tape
d. Field logbook
e. Photoionization Detector (PID)
f. Personal protective equipment (e.g., latex or nitrile gloves, safety glasses, etc.) as specified in the Site Health and Safety Plan (HASP)

3.0 Procedure

3.1 Preliminary Steps

3.1.1 Locate the well and verify its position on the site map. Record whether positive identification was obtained, including the well number and any identifying marks or codes contained on the well casing or protective casing.

3.1.2 Remove the well cap and check for organic vapors using a PID.

3.1.3 Locate and record the specified benchmark or survey point for the well, which may be a mark at the top of the casing or surveyors pin embedded in the protective structure. Determine from the records and record in the field logbook the elevation of this point. Measure and record the vertical distance from the bench mark to the top of the well casing to the nearest 0.01 feet. Measure and record the metal casing stick-up (the distance between the top of the casing and nominal ground (level).

3.1.4 Record any observations and remarks regarding the completion characteristics and well condition, such as evidence of cracked casing or surface seals, security of the well (locked cap), and evidence of tampering.

3.1.5 Keep all equipment and supplies protected from contamination. Use clean plastic sheeting around each well to prevent contact of the water level indicator with the ground. Keep the water level indicator probe in its protective case when not in use.

3.2 Operation

3.2.1 Remove the water level indicator probe from the case, turn on the sounder, and test check the battery and sensitivity scale by pushing the red button. Adjust the sensitivity scale until you can hear the buzzer.

3.2.2 Slowly lower the probe and cable into the well, allowing the cable reel to unwind. Continue lowering until the meter buzzes. Very slowly, raise and lower the probe until the point is reached where the meter just begins to buzz. Marking the spot by grasping the cable with the thumb and forefingers at the top of the casing, withdraw the cable and record the depth.

3.2.3 To measure the well depth, lower the probe until slack is noted in the cable. Very slowly raise and lower the cable until the exact bottom of the well is "felt." Measure and record the depth.

3.2.4 Withdraw the cable and probe and decontaminate according to SOP E.1.

3.3 Data Recording and Manipulation

Record the following computations:

- casing elevation = bench mark elevation + casing stick-up
- water level elevation = casing elevation - depth of water
- well bottom elevation = casing elevation - depth to bottom

4.0 Maintenance

4.1 Check the batteries of the water level indicator each time the instrument is used.

5.0 Precautions

5.1 Refer to the Site-specific health and Safety Plan for appropriate health and safety precautions.

6.0 References

None.

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE C.3
Down-Hole Groundwater Field Parameter Measurement

1.0 Scope and Application

This SOP provides procedures for collecting down-hole measurements of standard groundwater quality parameters such as pH, temperature, electrical conductivity, and dissolved oxygen and other parameters in wells or piezometers. The measurements are obtained with a portable field meter that can be lowered into the well on a cable. The data are shown visually on a hand-held display, and may be periodically saved into memory (i.e., data-logging) for later retrieval.

2.0 Materials

The following materials (or equivalent) shall be available for collecting down-hole measurements of standard groundwater quality parameters at monitoring and remediation wells:

a. Field logbook
b. Indelible black ink pen
c. Site plan, well construction records, prior groundwater sampling records (if available).
d. Personal protective equipment (e.g., latex or nitrile gloves, safety glasses, etc.) as specified in the Site Health and Safety Plan (HASP)
e. Water level indicator
f. Portable groundwater quality meter suitable for lowering into a well (YSI 600XL).
g. Cleaning equipment for decontamination, including containers and solutions as specified in the Field Sampling Plan (FSP) (e.g. alconox, DI water)

3.0 Procedure

3.1 Don appropriate PPE as required by the HASP

3.2 Calibrate the field meter prior to the commencement of the day's activities or according to manufacturer's specifications. Record calibration activities in the field logbook and include at a minimum (where applicable):

a. name of field meter calibrated

b. field meter serial/ID number

c. frequency of calibration

d. date of calibration

e. results of calibration

f. name of person performing calibration

g. identification and serial number of calibration fluid(s)

3.3 Record the site name, well identification, date and time of measurement, weather, absence/presence of odors, and other conditions in the field logbook and sampling logs.

3.4 Prepare the work area and open the well.

3.5 Record the well diameter, total depth, screened interval, and stickup height from the well construction details. Confirm the well diameter and stickup height.

3.6 Measure and record the depth to water and total well/piezometer depth. Compare current total depth measurement to previous total depth and/or the total depth from the well construction details. If total depth has decreased, note and record the thickness of apparent silt/sediment accumulation.

3.7 If the cable is marked in length units (e.g., feet, meters), monitor the depth of the instrument as it is lowered using the cable markings. If the cable is not marked, pre-measure the length of cable needed to reach the target depth with a measuring tape or water-level indicator cable. When referencing the depth based on the top of the riser, make sure to add the stickup height of the well riser (above ground surface) to the depth of the target depth below grade. (I.e., if the target depth is 50 feet and the stickup is 1.5 feet above grade, the cable will read 51.5 feet when the probe is at the target depth).

3.8 When the field meter reaches the target depth, secure the cable so that the field meter does not move from the target depth.

3.9 Display the water quality data according to the manufacturer's instructions.

3.10 Monitor the water quality parameters every two minutes for a maximum of ten minutes. The monitoring period can be shorter if the field parameters meet the following stabilization criteria over three consecutive readings:

a. ORP values remains within 10 unit
b. specific conductance and temperature values remain within 3%
c. pH remains within 0.1 unit

3.11 Record the stabilized values in the field book or sampling log.

3.12 Slowly remove the cable and field meter from the well.

3.13 Secure the well and properly dispose of personal protective equipment (PPE) and disposable equipment as specified in the FSP.

3.14 Complete decontamination procedures for the cable and field meter, as appropriate.

3.15 At the completion of the day's activities, perform a final calibration check of field instruments and record results.

3.16 The target depth of measurements is at the midpoint of the well screen or open interval,

taking siltation into account as necessary. If additional information is sought regarding vertical stratification of water quality, then measurements can be obtained at other depths.

3.17 Steadily and carefully lower the field meter to the target depth. Try to avoid creating turbulence in the water column while the field meter is being lowered.

4.0 Maintenance

The maintenance requirements for the above equipment generally involve decontamination or periodic cleaning, battery charging, and proper storage, as specified by the manufacturer. For operational difficulties, the equipment will be serviced by a qualified technician.

5.0 Precautions

Groundwater quality meters should not be allowed to contact non-aqueous phase liquids (NAPLs). Do not perform measurements with a down-hole meter at wells where light non-aqueous phase liquids (LNAPLs) is present, or lower the instrument into DNAPL (if present) at the bottom of the well.

6.0 References

Barcelona, M.J., J.P. Gibb and R.A. Miller, 1983. *A Guide to the Selection of Materials for Monitoring Well Construction and Ground-Water Sampling*. SWS Contract Report 327, Illinois State Water Survey, Champaign, IL.

Ricci, E.D., 1985. *The Evaluation of an Existing Groundwater Monitoring Program*. Proceedings of the 6th Nat. Conf. on Management of Uncontrolled Hazardous Waste Sites, Nov. 4-6, 1985. pps. 84-87. HMCRI, Silver Spring, MD.

USEPA, 1987. *Data Quality Objectives*. OSWER Directive 9335.0-7B, March 1987.

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE C.4
COLLECTION OF GROUNDWATER SAMPLES WITH BAILERS

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for the collection of groundwater samples using bailers with no purging of the monitoring well.

2.0 Material

a. Personal protective equipment (e.g., latex or nitrile gloves, safety glasses, etc.) as specified in the Site Health and Safety Plan (HASP)
b. Plastic sheeting
c. Photoionization Detector (PID)
d. Water-level indicator
e. Polyethylene bailer
f. Well keys
g. Nylon cord or polypropylene rope
h. Sample bottles and labels
i. Masking tape and measuring tape
j. Polyethylene tubing
k. Field logbook, field parameter forms, and chain-of-custody forms

3.0 Procedure

3.1 Upon opening a well, screen the breathing zone and well with a PID and FID.

3.2 Plastic sheeting will be placed around each well to prevent contamination of sampling equipment in the event that the equipment is dropped or otherwise comes in contact with the ground.

3.3 Obtained a depth to water measurement using a properly decontaminated water level indicator or oil-water level indicator.

3.4 Based on the depth to water and the total well depth (based on well log, accounting for the “stickup height above grade”), calculate the length of the water column and the depth to the midpoint of the saturated screened or open interval from the top of casing (call this distance Z).

NOTE: At least 14 days must be allowed to elapse between development of a well and pre-sample purging of the well.

3.5 Tie an appropriate length of new, disposable polyethylene or nylon rope to a new, disposable or properly decontaminated bailer and, using a tape measure, measure from the

midpoint of the bailer up the rope to the distance Z calculated above – mark the rope at this height with a knot or piece of masking tape. Avoid allowing the bailer or the rope to contact the ground surface by placing these on clean plastic sheeting next to the well, if necessary.

3.6 Slowly lower the bailer into the well; the rate of lowering should be no more than 0.5-ft per second within the water column. When the mark on the rope is at the top of casing, indicating that the midpoint of the bailer is at the midpoint of the saturated screened or open interval, slowly raise and retrieve the bailer from the well.

3.7 Fill sample bottles using the poly tip that comes with the bailer. If field filtering is required, connect the poly tip directly to the disposable filter and decant the water from the bailer into the filter and to the appropriate sample containers. If additional sample volume is required at a well, repeat Step 4; however, repeat deployment of the bailer should be avoided if possible because it could increase sample turbidity and compromise sample quality.

3.8 Cap the well, properly decontaminate the water level meter or interface probe, and dispose of waste materials.

4.0 Maintenance

Not applicable.

5.0 Precautions

5.1 Refer to the Site-specific Health and Safety Plan for appropriate health and safety precautions.

6.0 References

USATHAMA, 1990. *Installation Restoration Quality Assurance Program.*

NJDEP, 2005. *NJDEP Field Sampling Procedures Manual.*

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE C.5
LOW-FLOW GROUNDWATER SAMPLING

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for the collection of groundwater samples from monitoring wells and points using low-flow sampling techniques. Low-flow sampling minimizes the formation of sediment and minimizes subsequent disturbance of any sediment in the well. This procedure is appropriate for the collection of groundwater samples that will be analyzed for volatile organic compounds (VOCs), and other contaminants.

The goal of low-flow sampling is to collect more representative samples by matching the intake velocity of the sampling device with the natural groundwater flow velocity, thereby reducing sample disturbance. The primary advantage of this procedure is the collection of low turbidity samples (i.e., samples with low concentrations of suspended particles) and the reduction of sample aeration, resulting in samples that are more representative of true aquifer conditions. Use of this technique also eliminates the need for collecting and analyzing filtered metals samples, thus saving time and analytical costs. Low-flow sampling also, in most cases, reduces the volume of groundwater purged from a well and associated disposal issues.

This protocol has been developed in accordance with the United States Environmental Protection Agency (USEPA) Region I Low Stress (Low Flow) Purging and Sampling Procedures for the Collection of Groundwater Samples from Monitoring Wells (USEPA SOP No. GW0001; July 30, 1996). Both filtered and unfiltered groundwater samples may be collected using this low-flow sampling method. Filtered samples will be obtained using a 0.45-micron disposable filter. No wells will be sampled until well development has been performed, unless that well has been sampled or developed within the prior 1-year time period. Groundwater samples will not be collected within 1 week following well development.

2.0 Materials

a. Adjustable rate, bladder pump (e.g. QED SamplePro groundwater sampling pump or equivalent) constructed of stainless-steel. Submersible or peristaltic pumps may be used for inorganic sample collection.
b. Teflon or Teflon-lined polyethylene tubing to be used for purging and sampling each well. Tubing must be dedicated to a particular well. Consequently, the same tubing shall be used for purging and sampling.
c. Water level indicator, 0.01 foot accuracy (electronic preferred for tracking water level drawdown during all pumping operations).
d. A check valve to eliminate accidental drainage, subsequent aeration of the flow cell and to prevent backsurge of purged water.
e. A ¼-inch or 3/8-inch inside diameter, Teflon or stainless steel barbed “T” or “Y” fitting placed ahead of the flow-cell, to establish the line that will receive a needle valve for turbidity, general chemistry and analytical sample collection. The fitting must be decontaminated after each use.

f. A flow control stainless steel needle valve (preferred) or stainless steel/Teflon ball valve (optional) to be used at the port head of the flow cell when sampling to prevent back-pressure and air bubbles from forming in the tubing.
g. Flow measurement supplies (e.g., graduated cylinder or equivalent, and stop watch).
h. Car Battery.
i. QED pressure controller and air compressor.
j. Multiprobe with flow-through cell (the total capacity of which is less than 300 mL) and continuous readout display for pH, turbidity, specific conductance, temperature, oxidation/reduction potential (ORP), and dissolved oxygen (DO). Flow-through cells and continuous readout displays increase the accuracy of the method and generally decrease the effort and time necessary to perform the procedure. (Calibrate instrument according to manufacturer procedures for calibration)
k. Decontamination supplies.
l. Sample bottles, labels, and preservation supplies.
m. Field logbook, field parameter forms, and chain-of-custody forms.
n. Well construction data, location map, and field data from last sampling event.
o. Plastic sheeting to protect all down-hole sampling equipment from contact with potential sources of contamination.
p. Photoionization Detector (PID)
q. Personal protective equipment (e.g., latex or nitrile gloves, safety glasses, etc.) as specified in the Site Health and Safety Plan (HASP)
r. Approved site-specific work plan and HASP

3.0 Procedure

3.1 Preliminary Site Activities

3.1.1 Check well for damage or evidence of tampering, record pertinent observations in the field logbook.

3.1.2 Lay out plastic sheeting and set up monitoring and sampling equipment.

3.1.3 Don appropriate PPE.

3.1.4 Measure VOCs at the rim of the unopened well with a PID and record the reading in the field logbook.

3.1.5 Remove well cap.

3.1.6 Measure VOCs at the rim of the well with a PID instrument and record the reading in the field logbook.

3.1.7 If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Record all measurements from this mark.

3.1.8 Measure and record the depth to water (to 0.01 ft) in all wells to be sampled before any purging begins. If the total depth of the groundwater monitoring well must be measured, this measurement should be collected at least 48 hours before groundwater sampling activities begin (i.e., placement of the sampling

pump into the well). Care should be taken to minimize disturbance to the water column and to any particulates attached to the sides or at the bottom of the well. Based on previously measured well construction, determine equivalent volumes of water in the well based upon the following formula:

1 EV = volume in casing + volume in saturated sand pack. Therefore; if the **water table lies below the top of the sandpack**, use the following equation:

$1\ EV = (\Pi R_w^2 h_w) + (0.30\Pi(R_s^2 - R_w^2)h_w) * (0.0043)$

If the **water table lies above the top of the sandpack** use this equation:

$1\ EV = [(\Pi R_w^2 h_w) + (0.30\Pi(R_s^2 - R_w^2)h_s)] * (0.0043)$

where:

R_s = radius of sandpack in inches
R_w = radius of well casing in inches
h_s = height of sandpack in inches
h_w = water depth in inches
0.0043 gal/in^3
Assumed filter pack porosity = 30%

Tables and graphs showing equivalent volumes for typical well constructions are available.

3.1.9 On the day that the well is to be sampled, only the depth to groundwater will be measured to accurately calculate the volume of water contained within the well and borehole. The volume of water removed during purging will be measured and compared to the volume of water contained within the well and filter pack, as calculated by the above equations. The total well depth measurement will be measured prior to sample purging and collection activities because of the potential for entrainment of particulate matter into the water column. These measurements will be collected a week before sampling activities.

3.2 Purging and Sampling of Aqueous Liquids with Low-Flow Pump

3.2.1 Prepare and install pump in well: Non-dedicated bladder pumps will require a new Teflon® bladder and attachment of an air line, sample discharge line, and safety cable prior to placement in the well. Attach the air line tubing to the air port on the top of the bladder pump. Attach the sample discharge tubing to the water port on the top of the bladder pump. Care should be taken not to reverse the air and discharge tubing lines during bladder pump set-up as this could result in bladder failure or rupture. Attach and secure a safety cable to the eyebolt on the top of bladder pump (if present, depending on pump model used). Slowly lower pump, safety cable, and tubing into the well to a depth corresponding to the approximate center of the saturated screen section of the well. Take care to avoid twisting and tangling of safety cable, tubing, and electrical lines while lowering pump into well; twisted and tangled lines could result in the pump

becoming stuck in the well casing. Also, make sure to keep tubing and lines from touching the ground or other surfaces while introducing them into the well as this could lead to well contamination. If a peristaltic pump is being used, slowly lower the sampling tubing into the well to a depth corresponding to the approximate center of the saturated screen section of the well. The pump intake or sampling tube must be kept at least 2 feet above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well. The justification and subsequent determination of the depth to which the pump is lowered and the sample collected must be documented in the field logbook.

3.2.2 Secure the pump and the tubings to prevent the pump from moving vertically in the well during sampling. Connect the pump to other equipment. Connect the air line to the pump controller output port. The pump controller should then be connected to a supply line from an air compressor or compressed gas cylinder using an appropriate regulator and air hose. Take care to tighten the regulator connector onto the gas cylinder (if used) to prevent leaks. Teflon tape may be used on the threads of the cylinder to provide a tighter seal.

3.2.3 Before starting the pump, measure the water level again with the pump in the well.

3.2.4 Start pumping the well at 100 to 500 milliliters per minute (mL/min). Pump the initial purge water to waste in order to prevent any fouling of the flow-through cell. The water level should optimally be monitored continuously, but at a minimum, every five to six minutes during pumping. Ideally, a steady flow rate should be maintained that results in a stabilized water level (less than 0.3 ft variation). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (but not less than 100 mL/min) to ensure stabilization of the water level. However, care should be taken to maintain pump suction and to avoid the entrainment of air. Care should also be taken to avoid loss of pressure in the tubing line, cascading through the sand pack, or pumping the well dry. If drawdown rate exceeds 0.3 feet at a 100 mL/min flow rate, then a field decision should be rendered as to how far to allow drawdown to continue until sample collection. At no time should evacuation allow any portion of the well screen to be exposed (for wells screened below the water table) or bring the well to dryness.

3.2.5 During purging of the well, monitor and record the field indicator parameters every three to five minutes: turbidity, temperature, specific conductance, pH, ORP, and DO. The well is considered stabilized and ready for sample collection once the indicator parameters have stabilized for three successive readings as follows: 10% for DO and turbidity; 3% for specific conductance and temperature; 0.1 unit for pH; and 10 millivolts for ORP. Measurement of the indicator parameters should continue every three to five minutes. Measurements for DO and ORP must be obtained in a manner where the sample is not exposed to air prior to the measurement. Other parameters may be taken in a clean container, such as a glass beaker. If the field indicator parameters have not stabilized within the percentages given above, purging will continue until one

well volume has been removed or a purge time of 4 hours has been exceeded using a purge rate of 500 mL/min while not exceeding 0.3 ft of drawdown in the well.

3.2.6 Once field indicator parameters have stabilized, or a 4-hour time decision has been rendered, sampling can proceed. Do not adjust the flow rate; maintain the same pumping rate during sampling that was used to purge the well. Collect groundwater samples by diverting flow out of the unfiltered discharge tubing into the appropriate labeled sample container. If a flow-through analytical cell is being used to measure field parameters, the flow-through cell should be disconnected after stabilization of the field indicator parameters and prior to groundwater sample collection. Under no circumstances should analytical samples be collected from the discharge of the flow-through cell. When the container is full, tightly screw on the cap.

3.2.7 After collection of the samples, the pump's tubing shall be dedicated to the well for resampling (by hanging the tubing inside the well) or be discarded.

3.2.8 Measure and record well depth.

3.2.9 Secure the well.

3.2.10 Decontaminate the pump after each usage as described in FSP.

4.0 Maintenance

4.1 Refer to manufacturer's requirements for maintenance of the pumps and generators.

5.0 Precautions

5.1 Refer to the Site-specific Health and Safety Plan for appropriate health and safety precautions.

6.0 References

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7.0 Attachments

None.

STANDARD OPERATING PROCEDURE D.1
COLLECTION OF INDOOR AND AMBIENT AIR WITH SUMMA STEEL CANISTERS

1.0 Scope and Application

This standard operating procedure (SOP) describes the procedures to collect indoor air samples for the analysis of volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). The TO-15 method uses a 6-liter SUMMA® passivated stainless steel canister. An evacuated SUMMA® canister (<28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5.5 liters when allowed to fill to a vacuum of 2-7 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide compound detection limits of 0.5 parts per billion volumes (ppbv).

2.0 Materials

a. Photoionization detector (PID) with VOC detection limit capabilities in the ppb range.
b. 6-liter, stainless steel SUMMA® canisters (order at least one extra, if feasible);
c. Flow controllers with in-line particulate filters and vacuum gauges (flow controllers are pre-calibrated by the laboratory to specified sample duration [e.g., 8-hour, 24-hour]). Confirm with lab that flow controller comes with in-line particulate filter and pressure gauge (order an extra set for each extra SUMMA® canister, if feasible);
d. Breathing Zone Stand: Capable of supporting a particulate matter filter at a height of approximately 3-5 feet.
e. Appropriate-sized open-end wrench (typically 9/16-inch)
f. Particulate matter filter: A 2-µm sintered stainless steel in-line filter.
g. Camera (optional)
h. Chain-of-custody (COC) form
i. Combustible Gas Indicator (CGI)
j. Field logbook or Field log (attached)

Care should also be taken to ensure that the flow controller is pre-calibrated to the proper sample collection time (confirm with laboratory). Sample integrity is maintained if the sampling event is shorter than the target duration, but sample integrity can be compromised if the event is extended to the point that the canister reaches atmospheric pressure.

Care must be taken to minimize the potential for introducing interferences during the sampling event. As such, care must be taken to keep the canister away from heavy pedestrian traffic areas (e.g., main entranceways, walkways). Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens, wear/apply fragrances, or smoke cigarettes before and/or during the sampling event.

3.0 Procedure

Initial Building Survey

Indoor and ambient air sampling is being conducted in semiannual basis; therefore an initial building survey is not required. Any new chemicals observed in the building should be recorded in the field book. Any building use changes should be recorded as well.

Preparation of SUMMA®-Type Canister and Collection of Sample

3.1 Prior to sample collection, record the following information in the field logbook.

a. Name and title of author, date and time of entry, and physical/environmental conditions during the activity.
b. Purpose of the field activity.
c. Location of the sampling activity.
d. Name and title of the field crew.
e. Sample collection method.
f. Date and time of collection.
g. Sample identification number(s).
h. Summa canister lab ID number.
i. Field measurements, including temperature, cloud cover, humidity, wind speed/direction, PID reading, and CGI reading.
j. Summary of procedure for sample collection, documentation of SOP deviations, and scope of work changes.
k. Description of any photographs taken.

Note. Contact the local airport or other suitable information source [e.g., weatherunderground.com] to obtain the barometric pressure and humidity (if possible)

3.2 Choose the sample location in accordance with the sampling plan. Using the PID, screen indoor air in the location intended for sampling and the vicinity of potential VOC sources to preliminarily assess for the potential gross presence of VOCs. Record date, time, location, and PID readings in the field notebook.

3.3 Record SUMMA® canister serial number and flow controller number in the field notebook and COC form. Assign sample identification on canister ID tag, and record in the field notebook, sample collection log (Attachment A), and COC form.

3.4 Make and attach a label to the summa canister recording the following information:

a. Name and title of author.
b. Sample collection method.
c. Date and time of collection.
d. Sample identification number(s).
e. Summa canister lab ID number.

3.5 Remove the brass dust cap from the SUMMA® canister. Attach the flow controller with in-line particulate filter and vacuum gauge (leave swage-lock cap on the vacuum gauge

during this procedure) to the SUMMA® canister with the appropriate-sized wrench. Tighten with fingers first, then gently with the wrench. If a breathing zone sample is required, place the canister on a ladder, tripod, or other similar stand to locate the canister orifice 3 to 5 feet above ground or floor surface.

3.6 Open the SUMMA® canister valve to initiate sample collection. Record the date and local time (24-hour basis) of valve opening in the field notebook, sample collection log, and COC form

3.7 Record the initial vacuum pressure in the SUMMA® canister in the field notebook and COC form.

3.8 Take a photograph of the SUMMA® canister and surrounding area (if needed).

Termination of Sample Collection

3.9 Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the sampling interval (e.g., 8-hour).

3.10 Stop collecting the sample when the canister vacuum reaches approximately 2-7 inches of Hg (leaving some vacuum in the canister provides a way to verify if the canister leaks before it reaches the laboratory) or when the desired sample time has elapsed.

3.11 Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valve. Record the date, local time (24-hour basis) of valve closing in the field notebook, sample collection log, and COC form.

3.12 Remove the flow controller from the SUMMA® canister, reinstall brass plug on canister fitting, and tighten with wrench.

3.13 Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.

3.14 Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with string).

3.15 Complete COC form and place requisite copies in shipping container. Close shipping container and affix custody seal to container closure. Ship to laboratory via overnight carrier (e.g., Federal Express) for analysis.

3.5 Sample Preservation

3.5.1 Samples collected in canisters should be sent to the analytical laboratory with the canister valve closed and the sampling port capped. Samples must be accompanied by a chain-of-custody (COC) indicating sampling locations, sample numbers, date collected, sample matrix, and sample volumes. The COC should agree with the information on the summa canister label, and discrepancies must be noted on the COC at the time of receipt by the laboratory. In addition, any obvious physical damage or contamination (e.g., punctures) must also be recorded on the COC.

4.0 Maintenance

4.1 Contamination may occur in the sampling system if canisters are not properly cleaned before use. Therefore when procuring summa canisters from the contracted analytical laboratory, proof of summa canister decontamination shall be supplied with the canister. Additionally, all other sampling equipment (e.g., pump, flow controllers, tubing) should be kept clean or returned to the contracted laboratory for decontamination.

4.2 All sampling equipment and sampling media shall be protected from contact with any potentially contaminated surface soil or water. Sampling equipment shall be stored in clean areas and protected from dirt and water during transportation. Equipment may be periodically wiped clean with a clean cloth, but decontamination using solvents or liquids is to be avoided. Avoid contaminating sampling equipment or media with tape or marker fumes, snoop, or bare hands.

5.0 Precautions

5.1 Canister should be stored in a cool dry place and always be placed in their plastic shipping boxes during transport and storage.

6.0 References

Air Toxins, 1993. "Canisters and Tedlar Bags." Volume 1 of Air Toxins Guide to Air Sampling and Analysis. 2nd Edition, April 1993.

USEPA, 1992. Summa Canister Sampling: SOP #1704. USEPA, Office of Emergency and Remedial Response (PB92-963406).

USEPA, 1989. "Determination of Volatile Organic Compounds in Ambient Air Using SUMMA Passivated Canister Sampling and Gas Chromatographic Analysis." Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air.

7.0 Attachments

Attachment A - Indoor/Ambient Air Sample Collection Log

ATTACHMENT A

Indoor/Ambient Air Sample Collection Log

		Sample ID:	
Client:		**Outdoor/Indoor:**	
Project:		**Sample Intake Height:**	
Location:		**Miscellaneous Equipment:**	
Project #:		**Time On/Off:**	
Samplers:		**Subcontractor:**	

Instrument Readings:

Time	Canister Pressure (inches of HG)	Temperature (F or C)	Relative Humidity (%)	Air Speed (ft/min)	Pressure Differential (inches of H20)	PID (ppm or ppb)

SUMMA Canister Information: **Size (circle one): 1 L 6 L Canister ID:**_____

Flow Controller ID: _____

General Observations/Notes:

Please record current weather information including wind speed and direction, ambient temperature, barometric pressure, and relative humidity via suitable information source (e.g., weatherunderground.com).

STANDARD OPERATING PROCEDURE E.1
DECONTAMINATION

1.0 Scope and Application

All sampling equipment must be decontaminated following each use in order to prevent cross-contamination. This Standard Operating Procedure (SOP) describes the procedures to be followed for decontaminating sampling equipment.

2.0 Materials

a. Plastic sheeting
b. Buckets
c. Pre-sampled and approved water
d. Demonstrated analyte-free distilled and deionized water
e. Low phosphate detergent (i.e., alconox)
f. Aluminum foil
g. Personal protective equipment (e.g., latex or nitrile gloves, safety glasses, etc.) as specified in the Site Health and Safety Plan (HASP)

3.0 Procedure

3.1 Sample Bottles

At the completion of each sampling activity, the sample bottles must be decontaminated as follows:

1. Be sure that the bottle lids are on tight.

2. Wipe the outside of the bottle with a paper towel to remove excess soil or water.

3.2 Sampling Equipment

All sampling equipment will be decontaminated after each use in accordance with the following procedures.

3.2.1 All non-aqueous sampling equipment (e.g., trowels, split-spoons) will be decontaminated as follows:

1. Rinse equipment with pre-sampled and approved water.
2. Wash and brush the equipment with pre-sampled and approved water and low phosphate detergent (i.e., alconox).
3. Rinse equipment with demonstrated analyte-free distilled and deionized water.
4. Visual inspect equipment and repeat steps 2-3 if needed.
5. Allow equipment to air dry.
6. Wrap equipment in aluminum foil (shiny side out).

3.2.2 Bladder pumps used for the low-flow method will be decontaminated after each use according to the following procedure:

1. Take pump apart and remove used bladder pump and plastic rings
2. Generous wash with water
3. Wash using Alconox or Liquinox plus distilled and deionized (ASTM Type II). Scrub all pump parts using the pump brushes for the surface of and holes of the pumps.
4. Rinse with distilled and deionized (ASTM Type II) water
5. Replace bladder pump and plastic rings
6. Air Dry.

3.2.3 Field instrumentation for water quality measurements (i.e., multiprobe) will be rinsed with pre-sampled and approved water after each use.

3.2.4 Environmental sampling equipment used in field screening surveys (i.e., geophysical, soil-gas, radiation, and reconnaissance surveys) will be decontaminated using pre-sampled and approved water and alconox only.

3.2.5 All the decontamination fluid generated will be properly containerized and managed as detailed in SFP.

4.0 Maintenance

Not applicable.

5.0 Precautions

5.1 Once a piece of equipment has been decontaminated, be careful to keep it in such condition until needed.

5.2 Refer to the Site-specific Health and Safety Plan for appropriate health and safety precautions.

6.0 References

USEPA, 1989. *Region II CERCLA Quality Assurance Manual*. Revision 1.

7.0 Attachments

None.

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Appendix B

USEPA Low Stress (Low Flow) Purging and Sampling, Procedures for the Collection of Groundwater Samples from Monitoring Wells

Appendix C
US Environmental Protection Agency – Region II
Low Stress Groundwater Sampling Protocol

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II

GROUND WATER SAMPLING PROCEDURE
LOW STRESS (Low Flow) PURGING AND SAMPLING

I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region II standard method for collecting low stress (low flow) ground water samples from monitoring wells. Low stress Purging and Sampling results in collection of ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by minimizing stress on the geological formation and minimizing disturbance of sediment that has collected in the well. The procedure applies to monitoring wells that have an inner casing with a diameter of 2.0 inches or greater, and maximum screened intervals of ten feet unless multiple intervals are sampled. The procedure is appropriate for collection of ground water samples that will be analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and microbiological and other contaminants in association with all EPA programs.

This procedure does not address the collection of light or dense non-aqueous phase liquids (LNAPL or DNAPL) samples, and should be used for aqueous samples only. For sampling NAPLs, the reader is referred to the following EPA publications: DNAPL Site Evaluation (Cohen & Mercer, 1993) and the RCRA Ground-Water Monitoring: Draft Technical Guidance (EPA/530-R-93-001), and references therein.

II. METHOD SUMMARY

The purpose of the low stress purging and sampling procedure is to collect ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well casing.

Sampling at the prescribed (low) flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i.e., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing an additional filtered sample from the same well. Second, this procedure

minimizes aeration of the ground water during sample collection, which improves the sample quality for VOC analysis. Third, in most cases the procedure significantly reduces the volume of ground water purged from a well and the costs associated with its proper treatment and disposal.

III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include a) difficulty in sampling wells with insufficient yield; b) failure of one or more key indicator parameters to stabilize; c) cascading of water and/or formation of air bubbles in the tubing; and d) cross-contamination between wells.

Insufficient Yield

Wells with insufficient yield (i.e., low recharge rate of the well) may dewater during purging. Care should be taken to avoid loss of pressure in the tubing line due to dewatering of the well below the level of the pump's intake. Purging should be interrupted before the water level in the well drops below the top of the pump, as this may induce cascading of the sand pack. Pumping the well dry should therefore be avoided to the extent possible in all cases. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

Failure to Stabilize Key Indicator Parameters

If one or more key indicator parameters fails to stabilize after 4 hours, one of three options should be considered: a) continue purging in an attempt to achieve stabilization; b) discontinue purging, do not collect samples, and document attempts to reach stabilization in the log book; c) discontinue purging, collect samples, and document attempts to reach stabilization in the log book; or d) Secure the well, purge and collect samples the next day (preferred). The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

Cascading

To prevent cascading and/or air bubble formation in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain pump suction. Minimize the length and diameter of tubing (i.e., 1/4

or 3/8 inch ID) to ensure that the tubing remains filled with ground water during sampling.

Cross-Contamination

To prevent cross-contamination between wells, it is strongly recommended that dedicated, in-place pumps be used. As an alternative, the potential for cross-contamination can be reduced by performing the more thorough "daily" decontamination procedures between sampling of each well in addition to the start of each sampling day (see Section VII, below).

Equipment Failure

Adequate equipment should be on-hand so that equipment failures do not adversely impact sampling activities.

IV. PLANNING DOCUMENTATION AND EQUIPMENT

- Approved site-specific Field Sampling Plan/Quality Assurance Project Plan (QAPP). This plan must specify the type of pump and other equipment to be used. The QAPP must also specify the depth to which the pump intake should be lowered in each well. Generally, the target depth will correspond to the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump intake. In all cases, the target depth must be approved by the EPA hydrogeologist or EPA project scientist.

- Well construction data, location map, field data from last sampling event.

- Polyethylene sheeting.

- Flame Ionization Detector (FID) and Photo Ionization Detector (PID).

- Adjustable rate, positive displacement ground water sampling pump (e.g., centrifugal or bladder pumps constructed of stainless steel or Teflon). A peristaltic pump may only be used for inorganic sample collection.

- Interface probe or equivalent device for determining the presence or absence of NAPL.

- Teflon or Teflon-lined polyethylene tubing to collect samples for organic analysis. Teflon or Teflon-lined polyethylene, PVC, Tygon or polyethylene tubing to collect samples for inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.

- Water level measuring device, minimum 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).

- Flow measurement supplies (e.g., graduated cylinder and stop watch or in-line flow meter).

- Power source (generator, nitrogen tank, etc.).
- Monitoring instruments for indicator parameters. Eh and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. Specific conductance, pH, and temperature may be monitored either in-line or using separate probes. A nephalometer is used to measure turbidity.

- Decontamination supplies (see Section VII, below).

- Logbook (see Section VIII, below).

- Sample bottles.

- Sample preservation supplies (as required by the analytical methods).

- Sample tags or labels, chain of custody.

V. SAMPLING PROCEDURES

Pre-Sampling Activities

1. Start at the well known or believed to have the least contaminated ground water and proceed systematically to the well with the most contaminated ground water. Check the well, the lock, and the locking cap for damage or evidence of tampering. Record observations.

2. Lay out sheet of polyethylene for placement of monitoring and sampling equipment.

3. Measure VOCs at the rim of the unopened well with a PID and FID instrument and record the reading in the field log book.

4. Remove well cap.

5. Measure VOCs at the rim of the opened well with a PID and an FID instrument and record the reading in the field log book.

6. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Note that the reference point should be surveyed for correction of ground water elevations to the mean geodesic datum (MSL).

7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled prior to purging. Care should be taken to minimize disturbance in the water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.

8. If desired, measure and record the depth of any NAPLs using an interface probe. Care should be taken to minimize disturbance of any sediment that has accumulated at the bottom of the well. Record the observations in the log book. If LNAPLs and/or DNAPLs are detected, install the pump at this time, as described in step 9, below. Allow the well to sit for several days between the measurement or sampling of any DNAPLs and the low-stress purging and sampling of the ground water.

Sampling Procedures

9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified for that well in the EPA-approved QAPP or a depth otherwise approved by the EPA hydrogeologist or EPA project scientist. The pump intake must be kept at least two (2) feet above the bottom of the well to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. Record the depth to which the pump is lowered.

10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

11. Purge Well: Start pumping the well at 200 to 500 milliliters per minute (ml/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water

level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO) approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

    ±0.1 for pH
    ±3% for specific conductance (conductivity)
    ±10 mv for redox potential
    ±10% for DO and turbidity

    Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

13. Collect Samples: Collect samples at a flow rate between 100 and 250 ml/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. VOC samples must be collected first and directly into sample containers. All sample containers should be filled with minimal turbulence by allowing the ground water to flow from the tubing gently down the inside of the container.

    Ground water samples to be analyzed for volatile organic compounds (VOCs) require pH adjustment. The appropriate EPA Program Guidance should be consulted to determine whether pH adjustment is necessary. If pH adjustment is necessary for VOC sample preservation, the amount of acid to be added to each sample vial prior to sampling should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 ml). Ground water purged from the well prior to sampling can be used for this purpose.

14. Remove Pump and Tubing: After collection of the samples, the tubing, unless permanently installed, must be properly discarded or dedicated to the well for resampling by hanging the tubing inside the well.

15. Measure and record well depth.

16. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The appropriate EPA Program Guidance should be consulted in preparing the field QC sample requirements of the site-specific QAPP.

All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples should be collected during the sampling event:

- Field duplicates
- Trip blanks for VOCs only
- Equipment blank (not necessary if equipment is dedicated to the well)

As noted above, ground water samples should be collected systematically from wells with the lowest level of contamination through to wells with highest level of contamination. The equipment blank should be collected after sampling from the most contaminated well.

VII. DECONTAMINATION

Non-disposable sampling equipment, including the pump and support cable and electrical wires which contact the sample, must be decontaminated thoroughly each day before use ("daily decon") and after each well is sampled ("between-well decon"). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using "daily decon" procedures (see #17, below) prior to their initial use. For centrifugal pumps, it is strongly recommended that non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use ("daily decon").

EPA's field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.) must be

decontaminated after each well is sampled ("between-well decon," see #18 below).

17. **Daily Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Disassemble pump.

E) Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

F) Rinse pump parts with potable water.

G) Rinse the following pump parts with distilled/ deionized water: inlet screen, the shaft, the suction interconnector, the motor lead assembly, and the stator housing.

H) Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO_3).

I) Rinse impeller assembly with potable water.

J) Place impeller assembly in a large glass bleaker and rinse with isopropanol.

K) Rinse impeller assembly with distilled/deionized water.

18. **Between-Well Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5

minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

VIII. FIELD LOG BOOK

A field log book must be kept each time ground water monitoring activities are conducted in the field. The field log book should document the following:

- Well identification number and physical condition.
- Well depth, and measurement technique.
- Static water level depth, date, time, and measurement technique.
- Presence and thickness of immiscible liquid layers and detection method.
- Collection method for immiscible liquid layers.
- Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- Well sampling sequence and time of sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations of sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.

IX. REFERENCES

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Appendix F

Health and Safety Plan

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Infrastructure, environment, buildings

Imagine the result

Dover Corporation

Environmental Health and Safety Plan (E-HASP)

Dover Kirkwood Site

February 2011

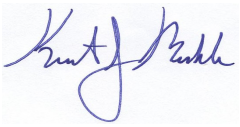
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Environmental Health and Safety Plan (E-HASP)

Dover Kirkwood Site



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1. Introduction

All work on this project will be carried out in compliance with ARCADIS' Health and Safety policies and procedures, and the Occupational Safety and Health Administration's Hazardous Waste Operations and Emergency Response regulation 29 CFR 1910.120. The design of this health and safety plan (HASP) conforms to the requirements of the ARC HSFS010 (HASP H&S Procedure). Specific health and safety information for the project is contained in this HASP. All personnel working on hazardous operations or in the area of hazardous operations shall read and be familiar with this HASP before doing any work. All project personnel shall sign the certification page acknowledging that they have read and understand this HASP.

Changes in the scope of the project or introduction of new hazards to the project shall require revision of the HASP by the HASP writer and reviewer, and approval by the Project Manager. The HASP Addendum Form and log table are included as **Appendix A**.

2. Project Site History and Requirements

2.1 Site Background

The former Dover facility is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York. The facility is located on a site approximately 9.58 acres in size. A site location map is shown in **Figure 1** and **Figure 2**.

The property is situated in an industrial setting. Major plants in the area include: Truckstops of America Landfill (0.5 mile southeast), Frito Lay Plant (0.5 mile south), Universal Instruments (147 Industrial Park Drive, 0.5 mile east), Kason Industries (eastern property boundary), Consolidated Freightways (northern property boundary), and the newly developed Pilot Truck Stop to the south. Industrial properties surround the property to the north, east, and west. The property consists of an industrial building with parking areas. The site had served as one of Universal Instruments' service facilities with the site's uses including product training, research and development, and Odd Form Assembly (OFA), which involves the engineering and assembly of non-standard/specialty circuit boards until 2007. In 2007 the facility was sold to Modern Marketing Concepts, Inc. (MMC). MMC handles outsourced customer service and product ordering for other companies.

Previous circuit board manufacturing processes used tetrachloroethene (PCE) as a cleaning solvent. Originally, the virgin PCE was stored in 55-gallon drums at an outside drum storage area. During the initial facility expansion, a ramp to the east-side overhead door served as the entry point for PCE drums. As production increased and the facility was again expanded, virgin PCE was stored in a 3,000-gallon aboveground storage tank that has since been removed. An aboveground 5,000-gallon waste PCE flux storage tank was also located on the site. In March 1993, the aboveground PCE system was dismantled. Two 480-gallon PCE tanks were reportedly dismantled and removed from the building interior at that time.

2.2 Site Description

Site Type: (Check as many as applicable}

x	Active	x	Secure	x	Industrial		Landfill		Service station
	Inactive		Unsecured	x	Commercial		Well field		Water work
			Uncontrolled		Residential		Railroad		Undeveloped
Other specify:									

2.3 List of Project Tasks and Scope of Work

Task 1 – Site Reconnaissance/Utility Locate -- A site reconnaissance will be conducted to identify and verify the location, placement, and pathway of all utilities, pipelines, sumps and other underground structures that may exist in the areas where the subsurface intrusive activities will occur on-site.

Task 2 – Injection/Monitoring Well Installation -- Four new infiltration wells (IJ-7, IJ-8, IJ-9 and IJ-10) and four new monitoring points (MP-11 through MP-14) will be installed at the site prior to the implementation of full-scale in-situ chemical oxidation (ISCO) injection. The proposed well locations are shown on **Figure 3**. The borings will be drilled with hollow-stem augers to create a pilot boring in the initial 10 to17 feet, depending on the total depth of the boring, and mud rotary into the final 25 or 28 feet of boring to minimize borehole wall damage and clay smearing. A polymer mud will be used during the rotary drilling process. The infiltration wells will be completed within a vault to provide access for infiltration lines and fittings, and for future maintenance activities. A minimum of 24 hours after the infiltration wells are installed, they will be developed by surging and pumping until a minimum of 10 well volumes has been removed.

Task 3 – Installation of In-Situ Chemical Oxidation System -- An ISCO system including a 6,500-gallon feed tank, secondary containment, chain link fence, a valve box, and associated piping will be installed at the site. All associated distribution piping will be placed below ground. The ISCO system layout is shown on **Figure 3**.

Task 4 – In-Situ Chemical Oxidation Injection:

Source Area: The 5% sodium permanganate solution will be prepared onsite by adding potable water from a nearby fire hydrant to 40% sodium permanganate solution delivered by Carus Chemical. The oxidant will be mixed in the 6,500 gallon capacity feed tank. The solution will be fed by gravity into each infiltration well. The volume of oxidant liquid delivered into the subsurface will be approximately 33,500 gallons in total per year in source area. Delivery will be by a pulsed distribution, 5 events per year for gravity feed and 4 events per year for manual infiltration, through two arrays of injection wells/points. ARCADIS will fill the feed tank with 6,500 gallons of 5% sodium permanganate solution approximately every 10 weeks (32,500 gallons per year).

For infiltration wells MW-24, IJ-1, IJ-4 and IJ-10, approximately 60 gallons of 5% sodium permanganate solution will be introduced manually into each infiltration well on a quarterly basis (total of 960 gallons per year).

Pilot Truck Stop Area: ISCO treatment in the Pilot Truck Stop Area will utilize the existing infiltration well from field testing (IJ-6). A 5% sodium permanganate solution will be manually introduced into the IJ-6 riser pipe. Approximately 135 gallons of 5% sodium permanganate solution will be introduced manually into IJ-6 on a quarterly basis (total of 540 gallons per year).

Task 5 – Baseline/Performance Monitoring:

Baseline Monitoring: Baseline groundwater conditions for benchmarking full-scale ISCO remediation progress will be pegged to the results of the March 2010 groundwater sampling event; the assumed groundwater sampling event that will precede full-scale ISCO start up. During the March 2010 groundwater sampling event, samples will be collected from all site monitoring wells and monitoring points that are west of the facility building. All wells and monitoring points will be gauged for depth to water. The low-flow purging method will be utilized to collect groundwater. The groundwater samples will be analyzed for the site- specific parameter list (SSPL) VOCs, which include: tetrachloroethene (PCE); trichloroethene (TCE); 1,1,1-trichloroethane (1,1,1-TCA); 1,1-dichloroethene (1,1-DCE); cis-1,2-dichloroethene (1,2-DCE); trans 1,2-DCE; 1,1-dichloroethane (1,1-DCA); and vinyl chloride.

In addition to the baseline groundwater data collected during the treatment area characterization, baseline field parameter data will be collected. Monitoring wells and points MP-4, MP-5, MP-6S and MP-6D, MW-7A, and infiltration wells IJ-1, IJ-4, and IJ-9 will be used to establish the site baseline pre-full scale remedy implementation for field parameters.

These points will also be used for visual observation and field measurements after the oxidant infiltration starts. The field measurements will consist of oxidation reduction potential (ORP), specific conductivity, pH and manganese and permanganate using colorimetric methods. This pre-injection field parameter monitoring will occur 24 hours prior to the start of oxidant infiltration.

Performance Monitoring: Monitoring wells and points MP-4, MP-5, MP-6S, MP-6D, MP-11, MP-12, MP-13, and MP-14, MW-7A, and infiltration points IJ-1, IJ-4, and IJ-10 will be used to monitor the progress of injected solution for the first 90 days after which

the infiltration points will revert to use as points for manual infiltration of permanganate on a quarterly basis. These points will be use for collecting groundwater samples for visual observation and field measurements. The field measurements will consist of ORP, specific conductivity, pH using a down-hole water quality meter and manganese and permanganate measured using colorimetric methods. Initially, field parameter monitoring will be conducted at the specified points daily for the first week, weekly for the next two months and monthly for the following four months. Thereafter, the monitoring points will be checked on a bi-monthly basis for field parameters

PCE and other SSPL compound concentrations in groundwater will be checked at the monitoring points on a bi-monthly basis for the first 6 months of ISCO operations via the collection of groundwater samples. Groundwater samples will be collected in accordance with the requirements for the site. Monitoring points which contain visibly purple colored water will be sampled and preserved with sodium thiosulfate in the field. After six months, PCE analysis will be conducted solely as part of the semi-annual groundwater sampling program.

Field parameter monitoring will be conducted monthly for the first 6 months using MW-25, MW-28, MP-8S, MP-8D, MP-10D and MW-30 and quarterly for the next 6 months. Field parameter monitoring will be discontinued thereafter. VOC monitoring will be conducted on a quarterly basis for the first year using MW-25, MW-28, MP-8S, MP-8D, MP-10D and MW-30 and semi-annually, thereafter. Groundwater samples showing visible purple color will be collected and persulfated with sodium thiosulfate in the field. Then the samples will be submitted to the laboratory for analysis.

Task 6 – System Operation and Maintenance (O&M) -- Pressure gauges at source area infiltration wells will be periodically checked. In addition, the feed tank will need periodic refilling, high and low fill probes will need checking; infiltration well and piping manifold vaults will need checking; heat trace, pressure gauges, and tank condition will need monitoring, and security fencing will require monitoring. The primary operational activity will consist of sodium permanganate delivery to the site by tanker truck, transfer of 40% sodium permanganate solution to the feed tank, and dilution to 5% via mixing with hydrant water.

The ISCO system will have few mechanical parts. Parts that may need cleaning, repair or replacement will consist of liquid level probes, valves, and pressure gauges. Heating tape for aboveground piping may need periodic repair or replacement. Aboveground piping could become damaged and need repair or replacement. The feed tank will require monitoring for condition, as will the security fencing.

Infiltration rates into the various infiltration wells will require monitoring to assess whether rates are slowing due to plugging of the casing slots.

Task 7 – Soil Cap Monitoring and Maintenance

There are eight areas of the site where PCE-affected soils are capped. The PCE-affected soils are capped by asphalt, concrete, or a minimum of 3 feet of clean soil. The capped areas and the type of cap are listed below.

1. 1978 and 1984 Building Addition Area – 6-inch thick concrete slab
2. Area 1 of **Figure 4** – soil, mulch, and landscaping
3. Area 2 of **Figure 4** – asphalt (driveway)
4. Area 3 of **Figure 4** – soil with grass surface
5. Area 4 of **Figure 4** – soil with grass surface (drainage ditch)
6. Area 5 of **Figure 4** – soil with grass surface (drainage ditch)
7. Area 6 of **Figure 4** – soil with grass surface (drainage ditch)
8. Area 7 of **Figure 4** – asphalt (parking lot)

These capped areas will be inspected monthly to check that the cap is being maintained in good condition. With respect to asphalt and concrete caps, the area surface will be visually checked for subsidence/settlement, excessive wear and/or cracking, and for breaches (such as pot holes). Areas with soil cover will be checked for subsidence/settlement, missing vegetative cover and/or excessive erosion. Construction activities (authorized or unauthorized) that have or may interfere with cap integrity will be noted.

Task 8 – Active-Slab Depressurization (ASD) System operations, Maintenance, and Indoor Air Monitoring

Construction of the ASD system occurred during June 2003. The ASD system was installed within the 1978 and 1984 additions to see if it could be helpful in reducing indoor air concentrations of PCE within the building. Four extraction points, ASD-1 through ASD-4, were installed at the approximate locations shown on **Figure 5**. The ASD system has only one mechanical part, the suction fan. The fan does not require maintenance and has an expected operational life of 7 to 8 years. Other systems components, such as piping, gauges, and wiring could be inadvertently damaged or broken by other site activities. During inspections these features will be checked for damage. Broken or damaged parts of the system will be repaired or replaced.

The ASD system will be checked daily by MMC personnel on-site to verify that it is operating. Vacuum readings on the system shall be recorded weekly by ARCADIS.

Indoor air quality samples shall be collected within the facility building semi-annually (March/April and September) at five locations with one background sampling location outside the building. All sampling locations for indoor air quality monitoring are shown on **Figure 5**. Indoor air quality is monitored through the collection of 8-hour time-weighted averaged (TWA) samples. The indoor air samples are collected in summa canisters following procedures provided by the analytical laboratory. The indoor air samples shall be analyzed by an NYSDEC and NYSDOH approved analytical laboratory using USEPA method TO-15.

3. ARCADIS Organization and Responsibilities

3.1 Project Manager/Task Manager

In planning and preparation of this project, the project manager and/or task manager has completed the project-specific H&S Stewardship Checklist & Project Hazard Analysis Worksheet. The project Hazard Analysis Worksheet was completed using the Hazard Analysis Risk Control (HARC) ranking process (ARCADIS H&S Procedure ARC HSMS002) (see Section 4 of this HASP). Additional responsibilities of the project manager and task manager are as follows:

- Review all applicable H&S Procedures, and ensure that project activities conform to all requirements.
- Obtain client-specific health and safety information and communicate with the client on health and safety issues.
- Communicate with the Site Safety Officer (SSO) on health and safety issues.
- Allocate resources for correction of identified unsafe work conditions.
- Ensure ARCADIS site workers have all training necessary for the project.
- Report all injuries, illnesses and near-misses to the Client H&S Resource or Project H&S Manager (PHSM), lead incident investigations, and ensure that any recommendations made are implemented.

3.2 Other Project Team Responsibilities

Additional personnel designated to carry out H&S job functions for the project, and their responsibilities are listed below. The same person may fill more than one role:

ARCADIS Project Team	Responsibility and Tasks
TBD	**SSO** • Reviews and works in accordance with the components of this HASP. • Ensures that this HASP is available to and reviewed by all site personnel including subcontractors. • Ensures that necessary site-specific training is performed (both initial and "tailgate" safety briefings. • Ensures site visitors have been informed of the hazards related to ARCADIS work, and have signed the Site Visitors Log. • Ensures that work is performed in a safe manner and has authority to stop work when necessary to protect workers and/or the public. • Coordinates activities during emergency situations. • Ensures that all necessary permits and safety information provided by the client is disseminated to other site personnel and is maintained in an organized manner. • Communicates with the PM, Client H&S Resource and/or the PHSM on health and safety issues. • Reports all injuries, illnesses and near-misses to the PM, Client H&S Resource and PHSM. • Ensures that necessary safety equipment is maintained and used at the site. • Contacts a health and safety professional for assistance in establishing the respiratory cartridge change schedule as required.
TBD	**Site Workers** • Reads and works in accordance with the components of this HASP. • Reports all unsafe working conditions to the SSO. • Reports all injuries, no matter how minor, to the SSO. • Works in a safe manner. • Signs the HASP acceptance log in Appendix E.

ARCADIS Project Team	Responsibility and Tasks
Lauren Edwards	**Project Health and Safety Manager (PHSM)** The PHSM oversees all aspects of the site safety program, and prepares site-specific health and safety guidance documents or addenda to this plan. The PHSM does not report to the Project Manager, and is separately accountable to the ARCADIS project team for site health and safety. The PHSM acts as the sole contact to regulatory agencies on matters of safety and health. Other responsibilities include: • Overall authority for health and safety compliance and HASP conformance for the project. • General health and safety program administration. • Conducts project health and safety audits as warranted. • Determines the level of personal protection required. • Updates equipment or procedures based on information obtained during site operations. • Establishes air-monitoring parameters based on expected contaminants. • Assists in injury, illness and near-miss investigations and follow-up.
H&S Staff	**Client Health and Safety Resource** The designated Client H&S Resource is responsible for : • Assisting the SSO in issues as they arise. • Performing site audits and assessments. • Assisting with near-miss/incident investigations. • Serves as the liaison with corporate during H&S regulatory issues as they may arise.

4. Hazard Control

Figure A. HARC- Risk Assessment Matrix (H&S Procedure ARC HSMS002)

Risk Assessment Matrix		Likelihood Ratings**				
Consequences Ratings*		A	B	C	D	E
People	Property	Never heard of in the world	Heard of incident in industry	Incident has occurred in ARCADIS Group	Happens several times a year in ARCADIS OpCo	Happens several times a year at ARCADIS Worksite
0 - No health effect	0 - No damage	Low	Low	Low	Low	Low
1 - Slight health effect	1 - Slight damage	Low	Low	Low	Low	Low
2 - Minor health effect	2 - Minor damage	Low	Low	Low	Medium	Medium
3 - Major health effect	3 - Local damage	Low	Low	Medium	Medium	High
4 - PTD or 1 fatality	4 - Major damage	Low	Medium	Medium	High	High
5 - Multiple fatalities	5 - Extensive damage	Medium	Medium	High	High	High

4.1 Job Loss Analyses (JLAs), H&S Procedures and PPE

A JLA has been completed for each safety critical task, and are included in **Appendix C**. Hazards identified on the Project Hazard Analysis Worksheet are addressed in the JLAs as well as control methods to protect employees and property from hazards. The JLA also lists the type of personal protective equipment (PPE) required for the completion of the project. A detailed list of PPE for the project is located in **Appendix D**.

ARCADIS H&S Procedures applicable to this project are listed below. These procedures should be reviewed by the project manager, task manager and site personnel. The Client H&S Resource should be contacted with any questions concerning the procedures.

- **ARC HSFS019 – Utility Location**
- **ARC HSIH003 – Benzene**
- **ARC HSCS005 – Excavation and Trenching**

- **ARC HSFS006 – Electrical Safety**
- **ARC HSFS004 – Control Of Hazardous Energy (Lockout/Tagout)**

4.2 Field Health & Safety Handbook

The Field H&S Handbook is an ARCADIS document containing information about topic-specific health and safety requirements for the field. This handbook contains relevant general topics and is used as part of the overall HASP process. To aid in the consistency of the HASP process the handbook will be used as an informational source in conjunction with this HASP. The following four (4) handbook sections are minimally required reading for this project:

- Section III-F. General Housekeeping, Personal Hygiene and Field Sanitation
- Section III-G. Site Security, Work Zone and Decontamination for HAZWOPER Sites
- Section III-GG. HAZWOPER and HAZMAT Response
- Section III-II. Drums and other Material Handling

The following handbook sections are additional required reading for this project:

- **Section II-H. Stop Work Authority**
- **Section III-A. Daily Safety Meetings/Tailgates**
- **Section III-H. Personal Safety and Other Unique Site Conditions**
- **Section III-N. Biological Hazards**
- **Section III-M. Heat and Cold Stress**
- **Section III-N. Biological Hazards**
- **Section III-L. Noise**
- **Section III-R. Personal Protective Equipment (ARCHSGE015)**

- **Section III-Z. Control of Hazardous Energy (ARCHSSF003)**
- **Section III-AA. Electrical Safety (ARCHSFS006)**
- **Section III-CC. Hand and Power Tools**
- **Section III-EE. Ergonomics**
- **Section III-FF. Site Storage of Hazardous Chemicals, Gases and Solvents**
- **Section III-LL. Traffic Control (ARCHSFS017)**
- **Section III-MM. Utility Locate (ARCHSF019)**
- **Section III-U. Driving**
- **Section IV-E. Heavy Equipment (ARCHSCS006)**
- **Section IV-D. Excavation/Trenching (ARCHSCS005)**

5. Hazard Communication (HazCom)

All project required chemicals must be handled in accordance with OSHA 29 CFR 1910.1200, ARCADIS-HazCom Procedure (ARC HSGE007), and the requirements outlined in the Field H&S Handbook. Table 1 lists all chemicals that will be brought and stored on the site. Material Safety Data Sheets (MSDS) for chemicals brought on site are included in **Appendix E**.

Table 1. Master Chemical and Storage List

Chemical Name	Estimated Quantity	Chemical Storage Location
HCl	<2mL	Sample containers
Methanol	<2mL	Sample Containers
Liquinox (detergent)	1 liter	Decon kit in truck bed
Calibration Gases (Isobutylene & Mixed Gas)	~5 liters	ARCADIS Vehicle/ Job Site Trailer
5% Sodium Permanganate Solution	6,500 gallons	Feed tank stored onsite.
Sodium Thiosulfate (200 g/L)	1 L	ARCADIS Vehicle

5.1 Chemical Hazards

Air monitoring will be conducted as outlined in this HASP to collect exposure data for chemicals of concern (COC) or for chemicals brought onsite for use. Table 2 lists the properties of chemicals that will be encountered at the site.

Table 2. Chemical Hazard Information

Chemical Name	IP (eV)	Odor Threshold (ppm)	Routes of Entry/ Exposure Symptoms	8-hr TWA[1] (ppm)	IDLH (NIOSH) (ppm)	STEL (ppm)	Source TLV/PEL
Benzene	**9.24 eV**	**1.5 ppm**	**Inhalation, Absorption, Ingestion, Contact with Skin/Eyes. Irritation to the eyes, skin, nose, respiratory system; dizziness, headache,**	**0.1 ppm**	**500 ppm**	**2.5 ppm**	**PEL**

			nausea, staggered gait; anorexia, lassitude; dermatitis; bone marrow depression; [carcinogen].				
1,1-Dichloroethene (1,1-DCE)	**9.65 eV**	**190 ppm**	**Inhalation, Ingestion, Contact with Skin/Eyes. Irritation to the eyes, respiratory system; CNS depression.**	**200 ppm**	**1000 ppm**	**NA**	**TLV**
Trichloroethene (TCE)	**9.45 eV**	**110 ppm**	**Inhalation, Absorption, Ingestion, Contact with Skin/Eyes. Irritation to the eyes, skin; headache, visual disturbance, lassitude, dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmia, paresthesia; liver injury; [carcinogen].**	**10 ppm**	**1000 ppm**	**25 ppm**	**TLV**
Tetrachloroethene (PCE)	**9.32 eV**	**1.0 ppm**	**Inhalation, Absorption, Ingestion, Contact with Skin/Eyes. Irritation to the eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoherent; headache, drowsiness; skin erythema (skin redness); liver damage; [carcinogen]**	**25 ppm**	**150 ppm**	**100 ppm**	**TLV**
Cis-1,2-Dichloroethene (cis-1,2-DEC)	**9.65 eV**	**0.085 ppm**	**Inhalation, Ingestion, Contact with Skin/Eyes. Irritation to the eyes, respiratory system; CNS depression.**	**200 ppm**	**1000 ppm**	**NA**	**TLV**
Vinyl Chloride (VC)	**9.99 eV**	**3000 ppm**	**Inhalation, Contact with Skin/Eyes (Liquid). Lassitude; abdominal**	**1ppm**	**NA**	**NA**	**TLV**

			pain, GI bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [carcinogen].				
1,1-Dichoroethane (1,1-DCA)	**11.06 eV**	**120 ppm**	**Inhalation, Ingestion, Contact with Skin/Eyes. Irritation to the eyes; CNS depression; liver, kidney, lung damage.**	**100 ppm**	**3000 ppm**	**NA**	**TLV**
1,1,1-trichloroethane (1,1,1-TCA)	**11.00 eV**	**44 ppm**	**Inhalation, Ingestion, Skin/Eye Contact. Irritation to the eyes, skin; headache, lassitude (weakness, exhaustion), central nervous system depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage.**	**350 ppm**	**700 ppm**	**NA**	**TLV**
trans 1,2-dichloroethylene	**9.65 eV**	**0.085 ppm**	**Inhalation, Ingestion, Contact with Skin/Eyes. Irritation to the eyes, respiratory system; CNS depression.**	**200 ppm**	**1000 ppm**	**NA**	**TLV**

[1]The TLV (Threshold Limit Value) from the American Conference of Governmental Industrial Hygienists (ACGIH) is listed unless the PEL (Permissible Exposure Limit), designated by OSHA, is lower.

See Section 7 for information on air monitoring requirements.

6. Tailgate Meetings

Tailgate safety briefings will be conducted at least daily at the beginning of the work day, or as tasks/hazards change. Each tailgate safety briefing will be documented on the form included in **Appendix E**.

7. Personal Exposure Monitoring and Respiratory Protection

Personal and area exposure monitoring will be documented on the Real Time Exposure Monitoring Data Form provided in **Appendix E**. All monitoring equipment will be maintained and calibrated in accordance with manufacturer's recommendations. All pertinent monitoring data will be logged on the form and maintained on site for the duration of project activities. Calibration of all monitoring equipment will be conducted daily and logged on the same form.

Table 3 lists exposure monitoring requirements and associated action levels for site exposure hazards (e.g. chemical, noise, radiation, etc).

Table 3. Exposure Monitoring Requirements

TASKS 2, 3, 5, 6, 7 and 9 – Is exposure monitoring required for the completion of this project? ☒ YES ☐ NO If yes, complete the following:				
Exposure Hazard	**Monitoring Equipment**	**Monitoring Frequency**	**Action Level**	**Required Action**
Total Hydrocarbons	Photo ionization detector (PID) (10.6 eV lamp or greater)	Continuous in breathing zone	• 0.5 ppm > 0.5 ppm > 0.5 ppm, • 20 ppm > 20 ppm ≥ 200 ppm	Normal operations Begin Monitoring for benzene with colorimetric tubes Normal operations Upgrade to level C PPE Stop work and investigate cause of reading; contact ARCADIS SSO/PM.
Benzene	Colorimetric tube	As dictated by total hydrocarbons action level above	• 0.5 ppm > 0.5 ppm, • 1.0 ppm > 1.0 ppm	Normal operations Upgrade to level C PPE Stop work and investigate cause of reading; contact ARCADIS SSO/PM.
Vinyl Chloride	Colorimetric tube	As dictated by total hydrocarbons action level above	• 0.5 ppm > 0.5 ppm, • 1.0 ppm > 1.0 ppm	Normal operations Upgrade to level B PPE Stop work and investigate cause of reading; contact ARCADIS SSO/PM

Particulate	MIE PDR 1000 Data RAM	Continuous in breathing zone	2.5 mg/m^3 (sustained for 5 minutes)	Institute wetting procedures. If wetting techniques fail to keep below action level, Stop Work. Contact SSO/PM. If exceedences continue reassess hazards/implement engineering controls.
Oxygen	Monitor-MULTI GAS METER	Continuous in breathing zone Prior and during excavation entry	≤ 19.5% > 19.5% to < 23.5% ≥ 23.5%	Stop work, evacuate confined spaces/work area, investigate cause of reading, and ventilate area Normal operations Stop work, evacuate confined spaces/work area, investigate cause of reading, and ventilate area
Flammable Vapors (LEL)	Monitor-MULTI GAS METER	Continuous in breathing zone Prior and during excavation entry	< 10% LEL ≥ 10% LEL	Normal operations Stop work, ventilate area, investigate source of vapors
Carbon Monoxide	Multi-Gas Meter	Continuous in breathing zone Prior and during excavation entry	0 ppm to ≤ 20 ppm > 20 ppm	Normal operations Stop work, evacuate confined spaces/work area, investigate cause of reading, and ventilate area
Hydrogen Sulfide	Multi-Gas Meter	Continuous in breathing zone Prior and during excavation entry	0 ppm to ≤ 5 ppm > 5 ppm	Normal operations Stop work, evacuate confined spaces/work area, investigate cause of reading, and ventilate area

TASK 4 – Is exposure monitoring required for the completion of this project?

☒ YES ☐ NO If yes, complete the following:

Exposure Hazard	Monitoring Equipment	Monitoring Frequency	Action Level	Required Action

Total Hydrocarbons	Photo ionization detector (PID) (10.6 eV lamp or greater)	Continuous in breathing zone	• 0.5 ppm > 0.5 ppm > 0.5 ppm, • 20 ppm > 20 ppm ≥ 200 ppm	Normal operations Begin Monitoring for benzene with colorimetric tubes Normal operations Upgrade to level C PPE Stop work and investigate cause of reading; contact ARCADIS SSO/PM.
Benzene	Colorimetric tube	As dictated by total hydrocarbons action level above	• 0.5 ppm > 0.5 ppm, • 1.0 ppm > 1.0 ppm	Normal operations Upgrade to level C PPE Stop work and investigate cause of reading; contact ARCADIS SSO/PM.
Vinyl Chloride	Colorimetric tube	As dictated by total hydrocarbons action level above	• 0.5 ppm > 0.5 ppm, • 1.0 ppm > 1.0 ppm	Normal operations Upgrade to level B PPE Stop work and investigate cause of reading; contact ARCADIS SSO/PM
Particulate	MIE PDR 1000 Data RAM	Continuous in breathing zone	2.5 mg/m3 (sustained for 5 minutes)	Institute wetting procedures. If wetting techniques fail to keep below action level, Stop Work. Contact SSO/PM. If exceedences continue reassess hazards/implement engineering controls.

TASKS 1 & 8 – Is exposure monitoring required for the completion of this project? ☐ YES ☒ NO If yes, complete the following:				
Exposure Hazard	**Monitoring Equipment**	**Monitoring Frequency**	**Action Level**	**Required Action**

7.1 Respirator Cartridge Change Schedule

With the exception of protection against particulates*, if the action plan outlined above calls for an upgrade to an air-purifying respirator (for protection against organic vapors and other gaseous chemicals), the following will apply:

- The respirator cartridge will be equipped with an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant; or

- If there is no ESLI appropriate for a contaminant, the project will implement a change schedule for cartridges to ensure that they are changed before the end of their service life.

In general, air-purifying respirator cartridges must be replaced at the expiration of its service life or at the end of each shift, whichever comes first. If an exposure to any one of the organic vapors and other gaseous chemicals is in excess of their respective PEL and the cartridge is not equipped with an ESLI, then a Cartridge Change Schedule must be developed. The project's SSO must contact the Client H&S Resource to develop the schedule.

**Note – A Cartridge Change Schedule is not necessary for cartridges used in the protection against particulates provided that the cartridges are changed out when there is a perceived resistance in breathing experienced by the user.*

8. Medical Surveillance

Medical surveillance requirements for the project are provided on the Project Manager/Task Manager H&S Stewardship Checklist & Project Hazard Analysis Worksheet (**Appendix B**). All medical surveillance requirements as indicated on the worksheet must be completed and site personnel medically cleared before being permitted on the project site.

9. General Site Access and Control

The SSO will coordinate access and control security at the work site. As the work dictates, the SSO will establish a work area perimeter. The size of the perimeter will be based on the daily task activities and will be discussed with all project personnel during the tailgate meeting and then documented on the tailgate meeting form. Control zones for Level C or above will be demarcated by either visual or physical devices and will be monitored for effectiveness by the SSO.

Only authorized personnel will be allowed beyond the perimeter. Other site workers and visitors to the site should be kept out of the work site. If visitors need access to the site, the SSO will escort the visitor at all times. All visitors will log in and out with the SSO. The visitor log sheet is included in **Appendix E**.

10. Decontamination Control Zones and Procedures

Part of required reading for this HASP includes reviewing the Field H&S Handbook, Section III-G Site Security, Work Zones and Decontamination for HAZWOPER site zones. The decontamination procedures outlined in the Field H&S Handbook are provided for typical Level D and Level C ensembles.

The zones for Level C and above will be designated by traffic cones, barricades, signs, caution tape, or other means effective in identifying the different areas. The SSO will establish control boundaries for the exclusion zone, contamination reduction zone, and the support zone. The zones will be identified by the SSO during tailgate meetings and documented on the meeting form. Entrance and exit to the exclusion zone will only be through controlled access points established for each work area.

11. Emergency Action Plan (EAP)

In the event that an injury, over-exposure or spill has occurred, an EAP will be implemented. **Appendix F** provides the EAP and notifications for the project. All employees working on this project must be shown the location and proper use of all emergency equipment prior to beginning work on the project.

12. Client-Specific Health and Safety Requirements

ARCADIS project personnel must comply with the client's specific H&S requirements at all times.

13. Department of Transportation (DOT) Dangerous Goods Shipping Requirements

ARCADIS has policies in place for transporting small quantities of hazardous materials and for offering for shipping via ground or air. These policies are designed to meet the applicable requirements. As such, only ARCADIS staff that have been trained in the proper methods to prepare and ship hazardous materials are authorized to do so. Tasks associated with the packaging, labeling, marking, and preparation of hazardous materials for shipping or transport must have all appropriate and applicable training.

13.1 Materials of Trade (MOT)

DOT allows for a small amount of hazardous materials that are used in or an inherent part of our work to be transported in company vehicles. This includes things like gasoline, paint, small compressed gas cylinders, calibration gas, etc. To transport these:

- Staff will complete Materials of Trade training.
- Vehicles used in transportation to and from off-site work locations will be in conformance with ARCADIS vehicle safety procedures.

Hazardous materials will be transported as described above as a result of the activities covered in this HASP. Site personnel who transport materials mentioned above will complete the Hazardous Materials Transportation Form included in **Appendix E**.

13.2 Department of Transportation

Staff who collect, prepare, package, mark, label, complete shipping declarations, offer shipments to a transporter, directly transport or are engaged in other activities associated with the transportation of Hazardous Materials (referred to as Dangerous Goods in Canada and by the International Air Transport Association [IATA]) will have appropriate and applicable training. DOT requires all individuals who participate in hazmat shipping including activities such as completing the paperwork (but not signing it), filling a container with a hazardous material (including filling a drum with drill cuttings or purge water), marking, labeling, and packaging the hazardous material, etc., have awareness level training on the DOT requirements. DOT

requires additional job function training for those who conduct specific activities including:

- Staff who have to sign shipping papers or manifests, are listed as the 24-hour emergency contacts on shipping and have the responsibility for identifying, classifying, packaging, marking, and labeling HazMat packages, and/or are directing or overseeing others who do these tasks will become certified through the completion of additional training.

- The above training allows the offering employee to ship only by ground. If the shipment is to be offered for air transport, additional training is required.

Shipments as described above will be made as a result of the activities covered in this HASP. Site personnel shipping hazardous materials will complete the Hazardous Materials Shipment Form included in **Appendix E**.

14. Loss Prevention System™ (LPS™) and Loss Prevention Observations (LPOs)

As part of any project, no matter how simple or complex, LPOs should be conducted when practical and when able to integrate into normal business activities. LPOs should be scheduled based on the risk of the tasks being performed, and should be conducted for different tasks and at different times. Completion of LPOs should be documented on the tailgate meeting form.

The following table outlines the LPO plan for the project:

Identified Task for LPO	Schedule Date	Observer Name	Observee Name	Feedback Supervisor Name
Site Recon/Utility Survey	TBA			
ISCO System Installation	TBA			
Injection and Monitoring Well Installation	TBA			
ISCO System Start-Up	TBA			
Performance Monitoring	TBA			
Indoor Air Monitoring	September 2010			
Semi-Annual Groundwater Monitoring	September 2010			

15. Subcontractors

A copy of this HASP is to be provided to all subcontractors prior to the start of work so that the subcontractor is informed of the hazards at the site. While the ARCADIS HASP will be the minimum health and safety requirements for the work completed by ARCADIS and its subcontractors, each subcontractor, in coordination with ARCADIS health and safety personnel, is expected to perform its operations in accordance with its own HASP, policies and procedures unique to the subcontractor's work to ensure that hazards associated with the performance of the work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to ARCADIS for review prior to the start of on-site activities.

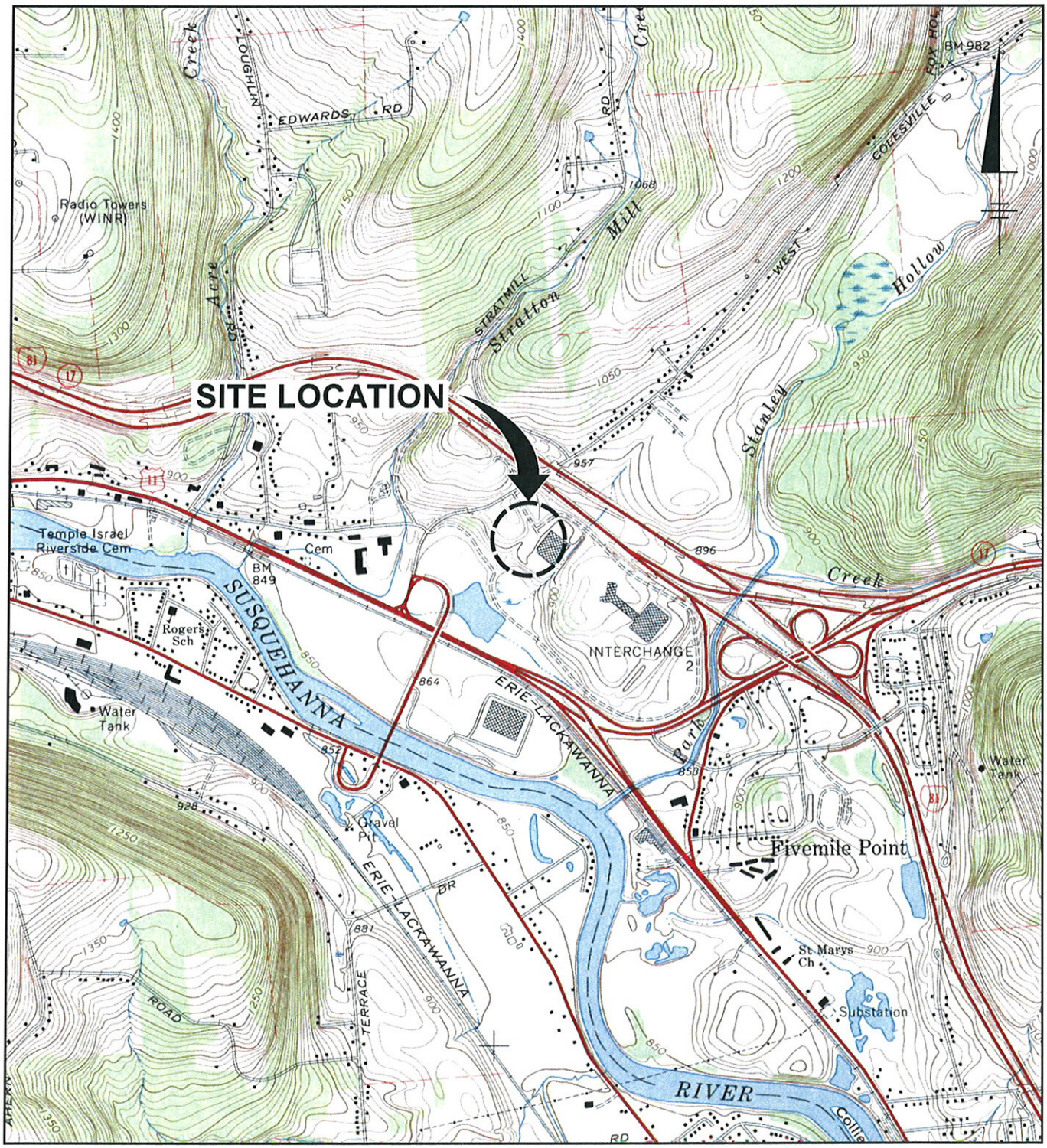
In the event that the subcontractor's procedures/requirements conflict with requirements specified in this HASP, the more stringent guidance will be adopted after discussion and agreement between the subcontractor and ARCADIS project health and safety personnel. Hazards not listed in this HASP, but known to the subcontractor or known to be associated with the subcontractor's services, must be identified and addressed to the ARCADIS project or task manager and SSO prior to beginning work operations.

If the subcontractor prefers to adopt this HASP, the **"Subcontractor Acknowledgement Memo" must be signed and dated by the subcontractor's management and placed in the project file.** Once the signed memo is received by the project manager, an electronic version of our HASP can be submitted to the subcontractor to use as their own. Subcontractors working at the site will need to have this plan with them, and will also need to sign the Subcontractor HASP receipt signature page of the ARCADIS HASP (**Appendix E**). Subcontractors are responsible for the H&S of their employees at all times, and have the authority to halt work if unsafe conditions arise.

The Project/Task Manager and SSO (or authorized representative) has the authority to halt the subcontractor's operations and to remove the subcontractor or subcontractor's employee(s) from the site for failure to comply with established health and safety procedures or for operating in an unsafe manner.

16. Project Personnel HASP Certification

All site project personnel will sign the certification signature page provided in **Appendix E** of this HASP.



REFERENCE: Base Map Source USGS 7.5 Minute Quad. Series Binghamton East, New York, 1968, Photorevised 1976.

2000' 0 2000'

Approximate Scale: 1" = 2000'



AREA LOCATION

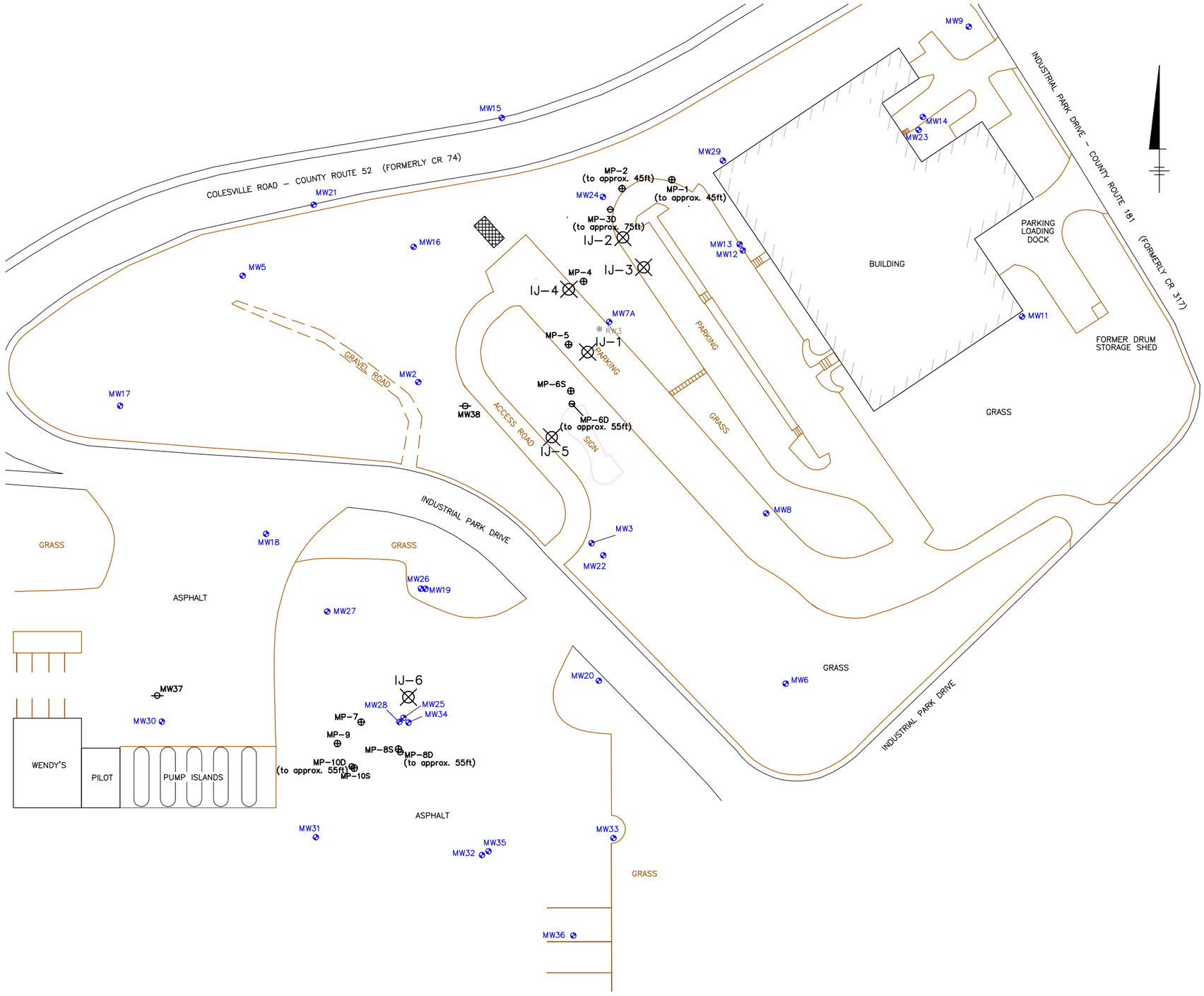
FORMER DOVER ELECTRONICS FACILITY
KIRKWOOD, NEW YORK

SITE LOCATION MAP

ARCADIS

FIGURE
1

7/11/08 CRA-85-TLF
00616/0001/00002/00616N01.CDR



LEGEND

- FORMER RECOVERY WELL
- EXISTING MONITORING WELL
- 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH
- TREATMENT BUILDING
- INJECTION TEST WELL

SOURCE:
BASEMAP FROM FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

0 120' 240'
GRAPHIC SCALE

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
-

SITE MAP

ARCADIS

FIGURE 2

CITY: CRA DIV/GROUP: 85 DB: TFATTO LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\BRIGHTON\RETURN-TO\Cranbury-NJ\NJ000616K009\000031\REPORT9-09\FROM-20080061680 1.dwg LAYOUT: LAYOUT1 SAVED: 7/28/2008 6:31 AM ACADVER: 17.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 12/16/2009 1:24 PM BY: FOX, AARON
XREFS: PROJECTNAME: ----
IMAGES:
00616X02

PROPOSED CHAIN LINK FENCE
PROPOSED PIPING TRENCH
PROPOSED SODIUM PERMANGANATE TANK
PROPOSED BELOW GRADE DISTRIBUTION BOX LOCATION
COLESVILLE ROAD - COUNTY ROUTE 52 (FORMERLY CR 74)
HIGHWAY BOUNDARY
NYSE&G EASEMENT POLE LINE
12" PVC
INDUSTRIAL
COOLING TOWER
CB-2077
MH
NYSEG
CB-2044
MW9
MW14
MW23
MW15
MW21
MW29
E5
CB-1547
CB-1534
MP-2 (to approx. 45ft)
MP-1 (to approx. 45ft)
MW24
MP-3D (to approx. 75ft)
IJ-7
APPROXIMATE LOCATION OF 15" ~ 13" CSP STORMWATER LINE (INACTIVE)
CB-1535
CB-1536
IJ-2
CB-1537
IJ-8
MW16
MP-11
MW13
MW12
BUILDING
PARKING LOADING DOCK
MW5
IJ-3
IJ-9
MP-4
IJ-4
MW11
MW7A
MP-12
MP-5
IJ-10
IJ-1
PARKING
MP-13
GRAVEL ROAD
MW2
MP-14
MP-6S
MW38
ACCESS ROAD
MP-6D (to approx. 55ft)
SIGN
IJ-5
GRASS
HIGHWAY BOUNDARY
MW8
MW18
GRASS
MW3
MW22
INDUSTRIAL PARK DRIVE
MW26
MW19
MW27
HIGHWAY BOUNDARY

LEGEND

- PROPOSED INJECTION WELL
- PROPOSED MONITORING POINTS
- PROPOSED CHAIN LINK FENCE
- PROPOSED PIPING TRENCH
- PROPOSED BELOW GRADE DISTRIBUTION BOX
- EXISTING MONITORING WELL
- 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH
- INJECTION TEST WELL
- EXISTING TREATMENT BUILDING
- EXISTING FIRE HYDRANT
- POWER POLE (APPROXIMATE LOCATION)
- GW GUIDE WIRE (APPROXIMATE LOCATION)
- MH MANHOLE (APPROXIMATE LOCATION)
- CB CATCH BASINS (APPROXIMATE LOCATION)
- HIGHWAY BOUNDARY (APPROXIMATE LOCATION)
- UNDERGROUND PIPING (APPROXIMATE LOCATION)

0 40' 80'
GRAPHIC SCALE

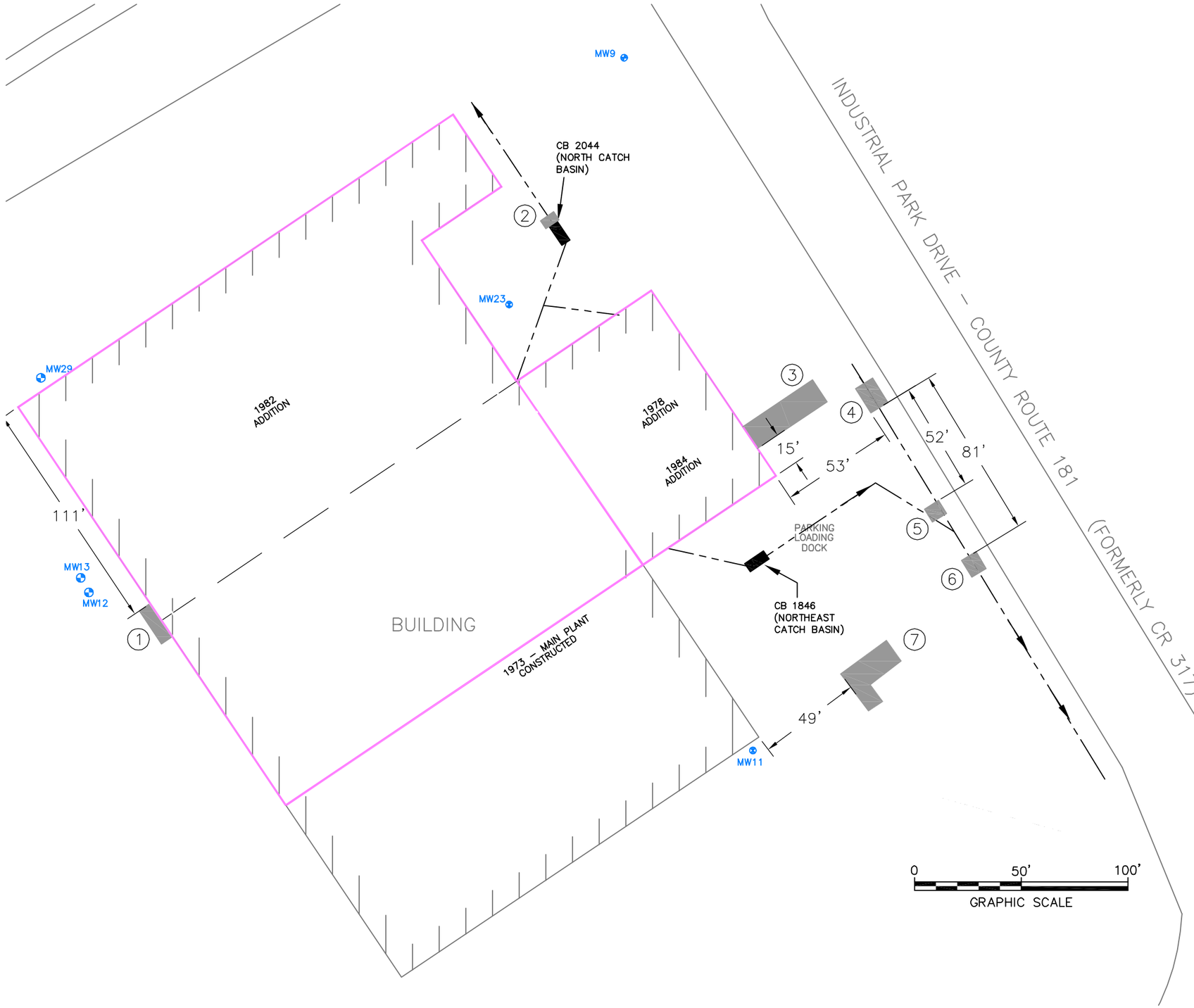
UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
HEALTH AND SAFETY PLAN

IN-SITU CHEMICAL OXIDATION FULL SCALE SYSTEM LAYOUT PLAN

ARCADIS

FIGURE 3

CITY:MAHWAH DIV/GROUP:ENVCAD DB:JG LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\Mahwah\ACTIN\J000616\K010\000112010_HASP\FIG 3.dwg LAYOUT: 3 SAVED: 7/28/2010 1:44 PM ACADVER: 17.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ARCADIS.CTB PLOTTED: 7/28/2010 1:44 PM BY: GONZALEZ, JAMES
XREFS: 00616X02
IMAGES: PROJECTNAME: ----
1799_001_Page_1.jpg
INFERRED SPREAD.jpg



LEGEND

- EXISTING MONITORING WELL
- BUILDING DEED NOTICE AREAS
- EXTERIOR DEED NOTICE AREAS

DEPTH TO PCE–AFFECTED SOIL

1. 4 FEET
2. 6 FEET
3. 8 FEET
4. 8 FEET
5. 5 FEET
6. 7 FEET
7. 3 FEET

SOURCE:
FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

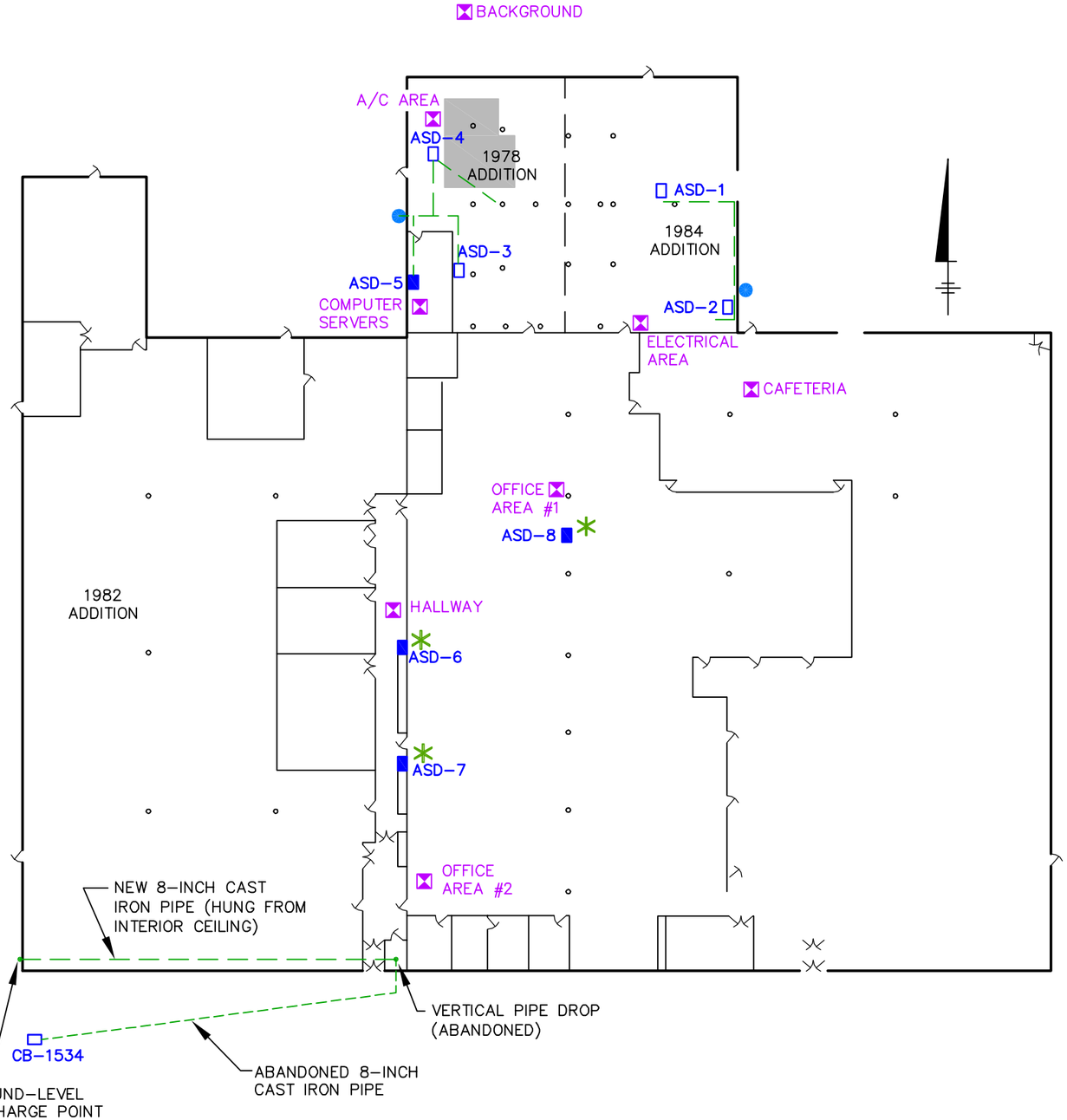
UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW JERSEY
HEALTH AND SAFETY PLAN

DEED NOTICE AREAS

ARCADIS

FIGURE
4

CITY: CRANBURY-NJ DIV/GROUP: ENVCAD DB: TFATTO LD: PIC: PM: S.ALBRIGHT TM: KLIAO LYR: ON=*;OFF=*REF*
G:\ENVCAD\CRANBURY\ACTIVE\000616\K010\000010\HASP\000616G002.dwg LAYOUT: 4 SAVED: 7/28/2010 11:45 AM ACADVER: 17.0S (LMS TECH) PAGESETUP: CRA-LB-PDF PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 7/28/2010 11:46 AM BY: FATTO, TRACEY
XREFS: IMAGES: PROJECTNAME: --
000616X04



LEGEND:

- ACTIVE SUB-SLAB DEPRESSURIZATION POINT LOCATION
- NEW ACTIVE SUB-SLAB DEPRESSURIZATION POINT LOCATION
- PIPING RUN
- VERTICAL BUILDING POST
- EXTERIOR FAN AND EXHAUST LOCATION
- INACCESSIBLE AREA
- INDOOR AIR SAMPLING LOCATION
- DEDICATED FAN LOCATED ON RISER PIPE

SOURCE:

BUILDING LAYOUT DIGITIZED FROM PHOTOCOPY OF DRAWING FAXED FROM UNIVERSAL INSTRUMENTS CORPORATION FACILITIES DEPARTMENT. NO FILE NAME OR SCALE PROVIDED.

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
HEALTH AND SAFETY PLAN

ASD SYSTEM AND INDOOR AIR SAMPLING LOCATIONS

ARCADIS

FIGURE
5

CITY:GRANBURY-NJ DIV/GROUP:ENVCAD DB:TFATTO LD: PIC: PMG:ALBRIGHT TM:KLIAO LYR:ON=*;OFF=*REF*
G:\ENVCAD\GRANBURY\ACTIVE\600616K01\000001\ASP\00616G01.dwg LAYOUT: 5 SAVED: 7/28/2010 11:45 AM ACADVER: 17.0S (LMS TECH) PAGESETUP: CRA-LB-PDF PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 7/28/2010 11:45 AM BY: FATTO, TRACEY
XREFS: IMAGES: PROJECTNAME: --

ARCADIS

Appendix A

HASP Addendum Pages and Log Table

ARCADIS

Addendum Page

This form should be completed for new tasks associated with the project. The project manager and/or task manager should revise the Project Hazard Analysis Worksheet with the new task information and attach to this addendum sheet. JSAs should be developed for any new tasks and attached as well.

Review the addendum with all site staff, including subcontractors, during the daily tailgate briefing, and complete the tailgate briefing form as required. Attach a copy of the addendum to all copies of the HASP including the site copy, and log in the Addendum Log Table A-1 on the next page.

Addendum Number: _____ Project Number: _____

Date of Changed Conditions: _____ Date of Addendum: _____

Description of Change that Results in Modifications to HASP:

Signed: _____
Project Manager

Signed: _____
Site Safety Officer

Signed: _____
H&S Plan Writer

Signed: _____
H&S Plan Reviewer

ARCADIS

Addendum Log Table

Addendums are to be added to every copy of the HASP, and logged on Table A-1 to verify that all copies of the HASP are current:

Table A-1 Addendum Log Table

Addendum Number	Date of Addendum	Reason for Addendum	Person Completing Addendum
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Make additional copies of this form as necessary.

ARCADIS

Appendix B

Project Hazard Analysis Worksheet

ARCADIS US Project Manager and Task Manager/Principal-In-Charge H&S Stewardship Checklist

Project Hazard Analysis Page

Project Name:	**Dover Kirkwood Site**		**Project Number:**	**NJ000616.K009.00003**	
Client:	**Dover Corporation**		**Principal-In Charge:**	**Gregory Albright**	
Project / Task Manager:	**Kaiti Liao**	**Completed By:**	**Lauren Edwards**	**Date:**	**9-Nov-09**

ARCADIS Project Hazard Analysis Worksheet

TRACK

Recognize and Assess the Hazards for the Project

For each potential hazard, determine the worst case conditions for the entire project and all of the tasks and assess them using High (H), Medium (M), Low (L). Use the drop down list in each "Assess" cell. If a hazard is not expected on the site, leave the "Assess" box blank.

	Recognize the Hazards	Assess	Recognize the Hazards	Assess	List Types of other Physical Hazards Below
Physical Hazards:	Heat	Low	Holes/Pits	Low	
	Cold	Low	Ionizing Radiation		
	Noise	Medium	Non-ionizing Radiation		
	Walking/Working surfaces (includes slip/trip/fall & floor/wall openings)	High	Electricity	Medium	
	Visible Dust	Low	Poor lighting	Low	
	LASER		Severe Weather	Low	
	Other:		Overhead Hazards	Low	
	Other:		None: Mark with an "X"		

Control the Hazard: (Briefly describe how the identified hazards will be controlled)

Chemical Hazards:	Flammable/ Combustible	Low	Corrosive	High	List the Names of the Major Chemicals Below
	Compressed gas		Toxic		
	Explosive		Highly toxic		
	Organic peroxide		Irritant		
	Oxidizer	High	Sensitizer		
	Water reactive		Carcinogen		
	Unstable reactive		Mutagen		
	Dust/Fumes/ Particulates	Medium	None: Mark with an "X"		

Control the Hazard: (Briefly describe how the identified hazards will be controlled)

Environmental/ Equipment Hazards:	Heavy machinery	High	Cranes/Hoists/Rigging		List Types of Other Environmental / Equipment Hazards Below
	Trenching/excavation	High	Ladders		
	Docks – marine operations		Scaffolding		
	Construction activities	Low	Manlifts		
	Diving operations		Welding		
	Drilling	High	Gas cylinders		
	Forklifts		Roadway work	Low	
	Water operations work		Railroad work		
	Heights (fall protection)		Mining work		
	Overhead/ Underground utilities	High	Energized / Pressurized equip (LO/TO)	Medium	
	Confined spaces		Drums and containers	Low	
	Power tools	Low	Other		
	Other		None: Mark with an "X"		

Control the Hazard: (Briefly describe how the identified hazards will be controlled)

Biological Hazards	Animal/Human fluids or blood		Contaminated Needles		**List Types of Other Biological Hazards Below**
	Animal/Human tissue(s)		Live Bacterial Cultures		
	Poisonous/irritating plants		Insects/rodents/snakes		
	Other:		None: Mark with an "X"		
Control the Hazard: (Briefly describe how the identified hazards will be controlled)					
Ergonomic Hazards	Repetitive motion	**Low**	Limited movement	**Low**	**List Types of Other Ergonomic Hazards Below**
	Awkward position	**Low**	Forceful exertions		
	Heavy lifting	**Low**	Vibration	**Low**	
	Frequent lifting	**Low**	Other:		
	Other:		None: Mark with an "X"		
Control the Hazard: (Briefly describe how the identified hazards will be controlled)					
Personal Safety/Security	Personal safety	**Low**	Employees working early/late	**Low**	**List Types of Other Personal Safety / Security Hazards Below**
	Security issue	**Low**	Potentially dangerous wildlife		
	Project site in isolated area	**Medium**	Guard or stray dogs in area		
	Employees working alone	**Low**	No/limited cell phone service		
	Fatigue	**Low**	Other:		
	Other		None: Mark with an "X"		
Control the Hazard: (Briefly describe how the identified hazards will be controlled)					
Driving Safety	Driving early/late	**Low**	City driving	**Low**	**List Types of Other Driving Hazards Below**
	Driving long trips	**Low**	Pulling a trailer		
	Driving off-road	**Low**	ATV driving:		
	Bad weather driving	**Low**	Other		
	Other		None: Mark with an "X"		
Control the Hazard: (Briefly describe how the identified hazards will be controlled)					
Training Required	40 hour HAZWOPER	**Yes**	Bloodborne pathogens		**List Types of Other Training Required Here**
	24 hour HAZWOPER		Confined space		
	HAZWOPER site supervisor		Lockout/tagout	**Yes**	If performing work on remediation system that requires LOTO
	OSHA 30 hour Construction		Electrical Safety	**Yes**	If performing work on electrical components of the remediation syste
	OSHA 10 hour Construction		Fire Extinguishers	**Yes**	
	PPE	**Yes**	Fall Protection		
	Respiratory protection		Noise exposure		
	Chemical hygiene		Forklifts		
	Hazard communication	**Yes**	Asbestos		
	Hazardous waste		Lead		
	First-aid/CPR	**Yes**	Cadmium		
	DOT/IATA hazmat transportation	**Yes**	SPCC		
	MSHA		Radiation safety		
	Diving		Client specific		
	FRA		None: Mark with an "X"		
Medical Screening	Medical Surveillance Exam (HAZWOPER)	**Yes**	Other hazardous substance		**List Types of other Medical Screening Here**
	Pulmonary Function Test if wearing respirator and employee not part of HAZWOPER		Audiometric test if noise is a hazard and employee not part of HAZWOPER		
	Client required drug and/or alcohol testing		Blood and/or urine screening		
	Hepatitis B Immunization (or declination on file)		None: Mark with an "X"		

ARCADIS

Appendix C

JLAs

Job Loss Analysis

General

Client Name	ARCADIS
JSA ID	44
Job Name	Environmental-Drilling, soil sampling, well installation
Task Description	drilling with drill rig
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC Name	
Project Manager	NO PROJECT MANAGER
Status Name	(3) Completed
Cretaion Date	2/4/2009 7:25:55 AM

User Roles

Role	Employee	Due Date	Completed	Approve	Supervisor	Active Employee
Created By	Coppola, Mija	2/6/2009	2/4/2009		Leichner III, Charles	True
Developer (Primary Contact)	Coppola, Mija	2/7/2009	2/4/2009		Leichner III, Charles	True
Developer	Moyers, Samuel	2/7/2009	2/4/2009		Coppola, Mija	True
HASP Reviewer	Coppola, Mija	2/6/2009	2/2/2009	True	Leichner III, Charles	True

Reviewer Comments

Role	Employee	Approval Status	Completed Date	Comments
HASP Reviewer	Coppola, Mija	Approve	02/02/2009	

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Set up necessary traffic and public access controls	1	Struck by vehicle due to improper traffic controls	Use a buddy system for placing site control cones and/or signage. Position vehicle so that you are protected from moving traffic. Wear Class II traffic vest	
2	Utility Clearance	1	Potential to encounter underground or aboveground utilities while drilling	Complete utility clearance in accordance with the ARCADIS H&S procedure	ARCADIS H&S Procedure ARCHSFS019
3	General drill rig operation	1	Excessive noise is generated by rig operation.	When the engine is used at high RPMs or soil samples are being collected, use hearing protection.	
		2	During drill rig operation, surfaces will become hot and cause burns if touched, and COCs in the soils more readily vaporize generating airborne contaminates.	Due to friction and lack of a drilling fluid, heat will be produced during this method. Mainly drill augers. Be careful handling split spoons. Wear proper work gloves. When soils and parts become heated, the COC could volatilize. Air monitoring should always be performed in accordance with the HASP.	

3	General drill rig operation	3	Moving parts of the drilling rig can pull you in causing injury. Pinch points on the rig and auger connections can cause pinching or crushing of body parts.	Stay at least 5 feet away from moving parts of the drill rig. Know where the kill switch is, and have the drillers test it to verify that it is working. Do not wear loose clothing, and tie long hair back. Avoid wearing jewelry while drilling. Cone off the work area to keep general public away from the drilling rig	
		4	Dust and debris can cause eye injury and soil cuttings and/or water could contain COCs.	Wear safety glasses and stay as far away from actual drilling. W operation as practicable. Wear appropriate gloves to protect from COCs.	
		5	Drilling equipment laying on the ground (i.e. augers, split spoons, decon equipment, coolers, etc), create a tripping hazard. Water from decon buckets generate mud and cause a slipping hazard.	Keep equipment and trash picked up, and store away from the primary work area.	
		6	The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
4	Mudd rotary drilling	1	The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
		2	This technology uses fluid, which collects with sediments in large basin. Fluid can splash out and cause slipping/mud hazard. Liquid mixture can splash into your eyes.	Wear rubber boots if needed, and keep clear of muddy/wet area as much as practicable. If area becomes excessively muddy, consider mud spikes or covering the area with a material that improves traction. Wear safety glasses.	
5	Hollow stem auger drilling	1	All hazards in step 3 apply. Additionally,The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
6	Air rotary drilling	1	this drilling method works with high air pressure and can generate flying debris that can strike your body or get debris in your eyes.	When the drill rig is being driven into media, it will produce flying debris. The flaps behind the drill rig should stay closed whenever possible to reduce the risk of flying debris. Safety glasses and hard hat should always be worn when the drill rig is operating. When penetrating asphalt protect surrounding cars that may be present to avoid debris damage to paint or winshields.	
		2	The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
		3	When drilling through bedrock prior to groundwater dust can be produced from pulverization. Inhalation of dusts/powder can occur	Supplemental water should be used to manage dust creation and/or dust masks if necessary.	

7	Reverse rotary drilling	1	This method will use fresh water to pump out drill cuttings through the center of the casing. Water/sediment mixture is generated and could cause contact with impacted soils or groundwater	Ensure the pit construction can hold the amount of cuttings that are anticipated. Air monitoring should also be used of pit area	
		2	Fire hydrants are often used for water source. Hydrants deliver water at high pressure. Pressurized water can cause flying parts/debris and excessive slipping hazards.	Water usage from fire hydrants should be cleared with local muncipalities prior to use. Only persons that know how to use the hydrant should be performing this task. Ensure all connections are tight, and hose line is not run over to cut by traffic. Any leaks from the hydrant should be reported immediately.	
		3	Settling pit construction can cause tripping hazard from excavated soils, and plastic sheeting can cause slipping.	cone off the area to keep the general public/visitors away from the settling pit. Ensure proper sloping of excavation.	
		4	The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
8	Rotosonic drilling	1	Fire hydrants are often used for water source. Hydrants deliver water at high pressure. Pressurized water can cause flying parts/debris and excessive slipping hazards.	Water usage from fire hydrants should be cleared with local muncipalities prior to use. Only persons that know how to use the hydrant should be performing this task. Ensure all connections are tight, and hose line is not run over to cut by traffic. Any leaks from the hydrant should be reported immediately	
		2	This method requires a lot of clearance. The drill head can turn 90 degrees to attach to the next drill flight or casing. This usually requires a large support truck to park directly behind the rig. As the drill head raises the new casing flight is angled down at the same time until it can be turned completely vertical.	Ensure sufficient overhead clearance.	
		3	Heavy lifting of cores can cause muscle strain.	Always use 2 people to move core containers. Use caution moving core samples to layout area. Plan layout area to ensure adequate aisle space between core runs for logging. Keep back straight and use job rotation.	
		4	The rotosonic drill head can move very quickly up and down while working on a borehole. Moving parts can strike someone or catch body parts	The operator and helper must communicate and stay clear of the path of the drill head. The drill utilizes two large hydrualic clamps to continuously hold casings while load/unloading previous casings. Do not wear loose clothing.	
9	Direct push drilling	1	The drill rods will be handled by workers most of the time rather than the rig doing it, therefore pinch points can cause lacerations and crushing of fingers/body parts.	Keep a minimum of 5 feet away from drill rig operation and moving parts.	

9	Direct push drilling	2	The direct push rigs are uaually meant to fit in spaces where larger rig can't. Tight spaces can pin workers.	Do not put yourself between the rig and a fixed object. Use Spotters or a tape measure to ensure clearances in tight areas. Pre-plan equipment movement from one location to the next.	
		3	some direct push equipment is controlled by wireless devices. These controls can fail and equipment can strike workers or cause damage to property.	The drill rig should be used in a large open area to test wireless controls prior to moving to boring locations. The operator of the rig will test the kill switch with wireless remote prior to use. Operator will stay in range of rig while moving so that wireless signal will not be too weak and cause errors to the controls.	
		4	Sampling sleeves must be cut to obtain access to soil. Cutting can cause lacerations.	Preferably let the driller cut the sleeves open. Many drillers have holders for the sleeve to allow for stability when cutting. If we cut the sleeves, use a hook blade, change blade regularly, and cut away from the body.	
10	Rock Coring	1	flying debris can hit workers or cause debris to get in eyes.	Rock chips or overburden may become airborne from drilling method. Wear safety glasses and hard hat and remain at a safe distance from back of drill rig.	
		2	Heavy lifting of cores can cause muscle strain.	Always use 2 people to move core containers. Use caution moving core samples to layout area. Plan layout area to ensure adequate aisle space between core runs for logging. Keep back straight and use job rotation.	
11	Sample collection and processing	1	Injuries can result from pinch points on sampling equipment, and from breakage of sample containers.	Care should be taken when opening sampling equipment. Look at empty containers before picking them up, and do not over-tighten container caps. Use dividers to store containers in the cooler so they do not break.	Sample cooler handling JLA
		2	lifting heavy coolers can cause back injuries	Use two people to move heavy coolers. Use proper lifting techniques.	Sample cooler handling JLA
12	Monitoring well installation	1	Same hazards as in Step 3 with general drill rig operation	See step 3	
		2	monitoring well construction materials can clutter the work area causing tripping hazards.	Well construction materials should be picked up during the well installation process.	
		3	Heavy lifting can cause muscle strains, and cutting open bags can cause lacerations.	Well construction materials are usually 50 lbs or greater. Team lift or use drill rig to hoist bags. Always use work gloves while cutting open bags.	
		4	Well pack material (i.e. sand, grout, bentonite) can become airborne and get in your eyes.	Wear safety glasses for protection from airborne sand and dust.	
		5	Cutting the top of the well to size can cause jagged/sharp edges on the top of the well casing.	Wear gloves when working with the top of the well casing, and file any sharp jagged edges that resulted from cutting to size.	
13	Soil cutting and purge water management	1	Moving full drums can cause back injury, or pinching/crushing injury.	Preferably have the drilling contractor move full drums with their equipment. If this is not practicable, use lift assist devices such as drum dollys, lift gates, etc. Employ proper lifting techniques, and perfrom TRACK to identify pinch/crush points. Wear leather work gloves, and clear all walking and work areas of debris prior to moving a drum.	Drum handling JLA

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)		Required
Hand Protection	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Required
Miscellaneous PPE	traffic vest--Class II or III		Required
Respiratory Protection	dust mask		Recommended

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)		Required
Miscellaneous	fire extinguisher		Required
Miscellaneous	first aid kit		Required
Personal	eye wash (specify type)	bottle	Required
Traffic Control	traffic cones		Required

Job Loss Analysis

General

Client Name	GERAGHTY & MILLER
JSA ID	49
Job Name	Environmental-Soil sampling/well installation - manual
Task Description	hand augering
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC Name	
Project Manager	NO PROJECT MANAGER
Status Name	(3) Completed
Creation Date	2/6/2009

User Roles

Role Name	Employee	Due Date	Completed	Approve	Supervisor	Active Employee	Comments	Comment Date
Created By	Coppola, Mija	2/8/2009	2/6/2009		Leichner III, Charles	True		
Developer (Primary Contact)	Coppola, Mija	2/9/2009	2/6/2009		Leichner III, Charles	True		
HASP Reviewer	Coppola, Mija	2/8/2009	2/6/2009	True	Leichner III, Charles	True		2/6/2009 12:24:12 PM

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Sampling set-up	1	Underground utilities could be encountered during hand augering	Follow the utility location policy and procedure.	Utility Location Policy ARCHSF019
		2	Muscle strains can occur from lifting heavy equipment in and out of vehicle	Park as close as possible to the sampling locations. Use lifting techniques as outlined in the Field H&S Handbook.	
		3	slips/trips/falls could occur from uneven walking and working surfaces	Remove any gravel or debris from sample location. Gravel will get stuck in auger or will continue to fall back down in hole. A five gallon bucket with the bottom cut out will retain gravel from falling back down in the hole.	

2	Installation of hand auger boring	1	Muscle Strains from pulling/pushing could occur when installing the boring, and when removing the auger from the hole	Stretch out Arms/Back/Shoulder Muscles prior to beginning. Using firm grip on handle, slowly turn auger and progress downward in 6" increments.Slowly pull auger from hole, use legs to pull auger out of hole. If water is encountered, a suction will be created when trying to remove the auger. Ask for assistance from another worker if you can't remove safely on your own.	
		2	Hand strain and blisters could develop from prolonged hand augering	Select proper gloves for task, usually leather type work gloves or mechanics style gloves. If hot spots develop on hands (Hot Spots are where blisters start to form) readjust gloves or change to better padded glove. If blisters begin to form, stop work so as not to worsen blistering.	
		3	Over-exertion could occur when trying to force an auger forward if there is refusal.	If refusal occurs, Stop Work. Remove Auger from hole and check hole with flashlight if possible. DO NOT overexert by using excessive force	
		4	Fatigue can occur due to strenuous nature of hand augering activities	Take rest breaks as needed or switch out task with another employee.	
3	Collect Sample Soil Sample	1	Staff can come into contact with impacted soils	Wear chemical protective gloves as outlined in the HASP, and wear safety glasses.	
		2	Sharp edges and broken glassware can cause lacerations	Discard any broken sample containers or glass. Do not overtighten sample containers.	
		3	Containerizing and moving soil cuttings can cause muscle strains	Dispose of left over soil cuttings in a drum or bucket and dispose properly. Only fill buckets half full due to weight and strength of bucket. Wear leather work gloves and use good lifting techniques when handling buckets.	
4	Decon Hand Auger	1	Exposure to COCs while deconing equipment.	Wear chemical protective gloves as outlined in the HASP, and wear safety glasses.	
		2	Cleaning solutions can splash while deconing equipment	Use PPE as outlined in the HASP, and try to minimize splashing.	
		3	The end of the hand auger has sharp edges, and lacerations can occur	Use brush to scrub off soils and not hands. Do not reach into the nose (the end with teeth) of the auger with hand.	
5	Fill in Sample Location	1	Open boreholes are a trip hazard	Fill in hole with sand or bentonite. Pack down chips as best as possible. Add a bit of DI Water to make chips swell and fill hole completely.	
		2	Muscle strain can occur from lifting bags of sand and/or bentonite.	Use proper lifting techniques as detailed in the Field H&S handbook	
6	Installation of Temporary Piezometer/Well	1	Excessive noise can occur form driving well casing with hammer or macrocore sampler.	Wear hearing protection device.	see Concrete work JLA
		2	Body parts or onlookers can be struck when using hand tools	Check swing radius above and around before driving well casing in bore hole. Wear leather gloves and safety glasses.	
		3	Muscle strains can occur when pulling/pushing well materials into place	Stretch out Arms/Back/Shoulder Muscles prior to beginning. Take frequent breaks as fatigue sets in and if muscle cramps occur.	

6	Installation of Temporary Piezometer/Well	4	Edges of PVC well casings have sharp edges especially when they have been cut, which can cause lacerations.	File the tops of well casings after they have been cut. Wear leather work gloves.	see Concrete work JLA
		5	Debris in the eyes can occur when working with soil, grout, and bentonite	Use disposable dust mask if excessive dust is created.	

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)		Required
	work gloves (specify type)		Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Required
Miscellaneous PPE	traffic vest--Class II or III		Required
Respiratory Protection	dust mask		Recommended

Supplies

Type	Supply	Description	Required
Decontamination	Decon supplies (specify type)		Required
Miscellaneous	first aid kit		Required
Personal	eye wash (specify type)	bottle	Required
Traffic Control	traffic cones		Required

Job Loss Analysis

General

Client Name	ARCADIS
JSA ID	21
Job Name	General Industry-Roadway work
Task Description	Roadway work
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC Name	
Project Manager	NO PROJECT MANAGER
Status Name	(3) Completed
Cretaion Date	1/29/2009 8:13:32 PM

User Roles

Role	Employee	Due Date	Completed	Approve	Supervisor	Active Employee
Created By	Coppola, Mija	1/31/2009	1/29/2009		Leichner III, Charles	True
Developer (Primary Contact)	Coppola, Mija	2/1/2009	1/29/2009		Leichner III, Charles	True
HASP Reviewer	Coppola, Mija	1/31/2009	1/29/2009	True	Leichner III, Charles	True

Reviewer Comments

Role	Employee	Approval Status	Completed Date	Comments
HASP Reviewer	Coppola, Mija	Approve	01/29/2009	
Quality Reviewer	Coppola, Mija	Quality	01/30/2009	test

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Deployment and removal of traffic control devices	1	Lifting hazards and awkward body positions from moving warning signs and control devices	Avoid excessive force pushing or pulling devices from vehicle; use the buddy system for heavier items; lift with legs and not back; avoid lifting and twisting motions.	ARCADIS H&S Handbook section III LL
		2	Struck by vehicle during placement	Wear high visibility clothing and Class II (minimum) traffic vest. Choose lime green color to avoid motorist confusion with traffic barrels. Always face oncoming traffic, use spotter if performing work that keeps focus off traffic. Ensure vehicle equipped with light bars and/or other warning devices and ensure they are activated, including vehicle flashers.	ARCADIS H&S Handbook section III LL
		3	Increased risk of injury (ergonomic from reacted moving or impact from increased vehicle exposure) from poor traffic control planning and implementation	Develop traffic control plan consistent with Manual of Uniform Traffic Control Devices, ensure lane closure tapers are computed properly, place devices in a manner that offers protection as other devices are deployed, place early warning devices first to warn drivers of pending work zone.	ARCADIS H&S Handbook section III LL

2	Flagger activities	1	Struck by vehicle while performing activity	Always face oncoming traffic, wear high visibility clothing described in step 1 above. Flaggers to be properly trained in proper flagging technique, if using paddles, ensure correct paddle warning displayed.	Certain states require flagger training: www.flagger.com
		2	Fatigue form standing in one position for extended periods of time.	Use job rotation when practical, shift weight form one leg to the other periodically, wear comfortable boots.	Certain states require flagger training: www.flagger.com
		3	Dehydration, heat stress (summer months), cold stress (winter months), sunburn, windburn	Ensure drinking water is in immediate vicinity of the flagger, check with flagger periodically to evaluate signs of heat or cold stress, avoid caffeine or sugary drinks during hot or cold weather, schedule work for worker to eat at regular intervals, wear sun block	Certain states require flagger training: www.flagger.com
		4	Struck by debris off roadway from passing vehicles	Be aware of hazard and be vigilant for debris, wear eye protection at all times.	Certain states require flagger training: www.flagger.com
3	Working in work zone	1	Struck by vehicle while performing work	Always stay behind protective barriers or channeling devices, never park vehicle that exposes workers to on coming traffic outside of barriers and channeling devices. Wear clothing and PPE described in step one above. Park vehicles within work zone to act as barriers to oncoming traffic when possible.	
		2	Struck by equipment in work area	Establish eye contact with all equipment operators when entering equipment operating radius, wear high visibility clothing and PPE as described in step one above. Park project vehicle away form active work are but still in work zone barriers or channeling devices.	
		3	Slips, trips and falls on wet or uneven surfaces in road right of way.	Wear proper footwear with good tread and ankle support. Plan route when walking on sloped surfaces, when walking along roadway stay as far off roadway as possible to avoid falling into traffic if tripping.	

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required
Miscellaneous PPE	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Communication Devices	walkie talkie	if using flaggers	Required
Miscellaneous	fire extinguisher		Required
Miscellaneous	first aid kit		Required
Traffic Control	traffic cones		Required

Job Loss Analysis

General

Client Name	ARCADIS
JSA ID	344
Job Name	Construction-Heavy equipment operation
Task Description	heavy equipment operations
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC Name	
Project Manager	NO PROJECT MANAGER
Status Name	(3) Completed
Creation Date	5/29/2009

User Roles

Role Name	Employee	Due Date	Completed	Approve	Supervisor	Active Employee	Comments	Comment Date
Created By	Coppola, Mija	5/29/2009	5/29/2009		Leichner III, Charles	True		
Developer (Primary Contact)	Coppola, Mija	5/29/2009	5/29/2009		Leichner III, Charles	True		
HASP Reviewer	Moyers, Samuel	6/12/2009	6/15/2009	True	Coppola, Mija	True		6/15/2009 10:26:27 AM

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Loading and Unloading Equipment from transport vehicles.	1	Stake or impact hazards from moving equipment	Stand clear of equipment loading or unloading form transport vehicles	FHSHB Section IV (E); ARCHSF019, FHSHB Section III(MM)
		2	Equipment damage from improper removal or placement on vehicle	Ensure any ramps used are rated for weight and properly placed and secure prior to moving equipment across, ensure trailers being loaded or unloaded are properly secured against movement.	
		3	Overhead utility contact for equipment with booms or extensions	Plan position of transport vehicle to maintain safe distance (>20 ft) from all overhead lines and structures, Use spotters since operator focus may be on vehicle alignment with ramps or other ground level distractions.	

1	Loading and Unloading Equipment from transport vehicles.	4	Ascending/Descending equipment cab.	Do not hurry through task, wear footwear with good tread and ankle support, maintain 3 points of contact while accessing or egress equipment, no jumping off trailers or truck beds.	FHSHB Section IV (E); ARCHSF019, FHSHB Section III(MM)
2	Pre-operation inspection	1	Pinch hazards to hands	Wear gloves appropriate for hazard while maintaining dexterity. Keep hand in field of vision and watch for and keep hands clear of obvious hazards like door or cover closures. Do not hurry during the removal or placement of covers or equipment components.	
		2	Head injury from striking equipment covers or components	Wear hard hat, stay focused on surroundings, avoid standing or raising up suddenly especially if door cover is overhead.	
		3	Exposure to engine fluids or lubricants	Wear protective gloves, ensure MSDS is available for engine fluids and lubricants, promptly wash exposed skin, contact WorkCare immediately for any situation where diesel is injected under the skin.	
		4	Awkward body positions and twisting	Plan inspection activity and do not hurry through task, stretch before crawling or squatting. Avoid overreaching.	
		5	Entanglement in equipment components.	Do not circumvent protective guards or shields, ensure equipment is not operational (LOTO if necessary) when accessing engine compartment if intrusion required.	
3	Equipment operation	1	Strike or impact hazards with other workers, equipment or structures.	Keep eyes moving and watch for unanticipated worker movement. Keep workers 15 ft from any extendable area of the equipment, Maintain 360 degrees of awareness and ensure adequate communication method with other workers. All workers to know emergency STOP hand signals. all back up alarms to be functional.	
		2	Utility contact (subsurface or above ground)	Follow utility clearance procedure prior to any intrusive work with equipment. Immediately stop work if any unusual or unanticipated condition encountered.	
		3	Rollovers on slopes or from improper usage	Follow equipment manufacturer instructions for use on slopes or load capacities, wear seatbelt at all times, Ensure all outriggers, if equipped are properly deployed on stable surface.	
		4	Noise from engine or work activity	Wear hearing protection as required, keep equipment well maintained.	
		5	Slips and falls from accessing or egress from equipment	Maintain 3 points of contact when access or egress equipment, keep any ladder or steps on equipment clean and dry to extent practical, ensure equipment doors, if present, are in good working order.	
		6	Exposure to tools and metal edges and damaged metal resulting in cuts lacerations to hands during maintenance	Wear protective gloves that allow for good dexterity. Mitigate sharp surfaces to extent practical.	

3	Equipment operation	7	Pinch/crush hazards to hands from doors or covers	wear gloves appropriate for hazard while maintaining dexterity, Watch for and keep hands clear of obvious hazards like door or cover closures. Do not hurry during the removal or placement of covers or equipment components.	
		8	Contact stress to knees and hands	Use padding or knee pads if kneeling on hard surfaces for an extended period of time. Avoid placing weight on hands for extended periods of time.	
4	Maintenance	1	Awkward body positions and twisting	Plan inspection activity and do not hurry through task, stretch before crawling or squatting. Avoid overreaching.	
		2	Excessive force turning bolts or lifting heavy components, decontamination activities.	Use automated methods to loosen tight bolts, do not use excessive force or torque when using hand tools. Do not use "cheater bars"	
		3	Contact with engine fluids or lubricants	Wear protective gloves, ensure MSDS is available for engine fluids and lubricants, promptly wash exposed skin, contact WorkCare immediately for any situation where diesel is injected under the skin.	
		4	Flying debris during gross decontamination or cleaning activities	Wear adequate eye and face protection when removing soils or solid media form tracks, buckets, or other component of equipment using pressure washer.	
		5	Entanglement in equipment components.	Do not circumvent protective guards or shields, ensure equipment is not operational (LOTO if necessary) when accessing engine compartment if intrusion required.	
		6	Exposure of hands and arms to hot engine components	Take the time to allow the engine to cool, wear protective gloves and forearm protection.	
		7	Struck by moving equipment or boom extensions	Keep at least 15 ft from any extendable area of the equipment, if entering within 15 ft, establish and maintain contact with equipment operator, ear high visibility clothing or work vest.	
5	Working in proximity to heavy equipment	1	Equipment damage from moving equipment	Keep other equipment not required for work outside of heavy equipment work area in all directions. Flag or mark with high visibility markings, cones, etc., any required equipment near the ground	
		2	Noise hazards from equipment operation	Wear hearing protection and increase distance if work activity permits.	

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)		Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs	as needed	Recommended

Supplies

Type	Supply	Description	Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)		Required

Job Loss Analysis

General

Client Name	ARCADIS
JSA ID	37
Job Name	Environmental-Introductions - carbon source or chemical
Task Description	Introductions
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC Name	
Project Manager	NO PROJECT MANAGER
Status Name	(3) Completed
Cretaion Date	2/2/2009 11:52:10 AM

User Roles

Role	Employee	Due Date	Completed	Approve	Supervisor	Active Employee
Created By	Coppola, Mija	2/4/2009	2/2/2009		Leichner III, Charles	True
Developer (Primary Contact)	Coppola, Mija	2/5/2009	2/2/2009		Leichner III, Charles	True
HASP Reviewer	Coppola, Mija	2/4/2009	2/2/2009	True	Leichner III, Charles	True

Reviewer Comments

Role	Employee	Approval Status	Completed Date	Comments
HASP Reviewer	Coppola, Mija	Approve	02/02/2009	great job

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Site reconnaissance and walk-around	1	Slips/trips/falls can occur from uneven ground surface, slippery walkways or from tripping over equipment.	Survey the site upon arrival. Note any site conditions that may pose a potential hazard, and make note of any changes since the last injection event.	JLA-Roadway Work ARCHSFS017
		2	Site workers or equipment can be struck by site vehicular traffic	Wear Class II traffic vest and cone off the work area. Follow the JLA and Field H&S Handbook for roadway work. Plan the location where the injection trailer will be set up making sure to not block any ingress/egress to the site.	JLA-Roadway Work ARCHSFS017
2	Setting up the injection trailer.	1	Pinch points on the trailer can cause hand injury.	Wear leather work gloves.	
		2	Heavy equipment can fall and strike personnel	Make sure jack stands, if present, are secured on the injection trailer. Make sure that the wheels of the trailer have been chocked prior to trailer operation. Level trailer utilizing jack stands.	
		3	Truck and/or trailer becomes stuck on soft or uneven ground causing potential property damage and impact injury to workers during extraction.	Plan trailer setup and factor weight of full tanks when accessing and egressing from injection areas, ensure adequate hose lengths are available to pump solutions to wells in soft ground areas from stable road surface other firm surface.	

3	Load, unload and set up of required PPE, equipment including waterline hoses, injection hoses, flow meters and supplies in/out of vehicle or storage area.	1	Lifting equipment can cause back/shoulder/arm strains	Use proper lifting techniques. Request assistance when lifting heavy equipment. If injection pumps need to be fueled, then complete fueling before placing pumps on trailer.	
		2	Trip hazards over dragging and unsecured hoses	Keep coiled hoses ends secured to coil when loading and unloading, stop and pick up dangling hoses that could be a trip hazard when carrying.	
4	Connecting the water supply and molasses supply to the injection trailer.	1	Lifting hazards can cause muscle strains	Do not lift more than your personal limits. Use a second person if needed. Lift with your knees not your back.	
		2	Possible pressure build up can result in equipment failure or flying objects that can cause personal injury	Check equipment and valves before making connections. Check that water and molasses supply valves are in off position. Make the hose connections and secure the cam locks with counter pins. Open supply valves slowly to avoid damage to hoses or personnel. Check supply lines and valves for leaking after water/molasses supply is on. Tether hose connections if securing devices are not present.	
5	Connect the injection trailer to a power supply.	1	Electrocution or power surge resulting in equipment damage, injury or loss of life.	Inspect power cords for evidence of damage to the wire or connector. If damage is present, do not use power cord. Inspect connection of power supply for evidence of damage. Use GFI 'pigtail'.	
		2	Misuse of generator can cause electrocution, fire, or equipment failure	If using generator on injection trailer inspect components for damage. Check oil/fuel levels and fill if necessary. Inspect injection trailer control panel for evidence of damage to switches, circuits or breakers before connecting power. Connect power cord then power supply.	
6	Connecting the injection flow meters to the injection wells.	1	Pressure build up in wells can cause well caps to fly off causing head or body injury.	When opening injection wells, be sure your body is not over the well when opening. Wells should have been constructed with a pressure relief valve (or retrofitted). Turn the pressure relief valve to release build-up of pressure within the well, and listen for pressure escaping from the well. Be sure that safety glasses are worn and your head is facing away from the well when opening.	
7	Filling the tanks on the injection trailer.	1	Pressure can build up in the hoses and tanks, and tanks can overflow with the mixture causing slippery walking surfaces	Open all valves slowly when filling the tanks on the injection trailer. Maintain a visual on the tank levels so they do not overflow. Use buckets to collect any residual solutions that might drain from the system during filling.	
		2	Falls from trailer tank when placing or removing fill hoses	Maintain 3 points of contact when climbing on trailer. Do not hurry through task. Do not jump from top of trailer tank to ground. Use trailer plumbing to fill from ground level when trailer design permits.	

7	Filling the tanks on the injection trailer.	3	Lifting hazards from adding carbon source materials using non bulk containers or moving pumps to transfer materials from bulk containers.	If system is equipped with hoists, take the time to use them to lift non-bulk materials to top of tank. Do not short cut or bypass mixing system protocols to save time. Use buddy system or mechanical aids to move large pumps.	
8	Pump solution into wells and read pressure and flow gauges.	1	Pressure can build up resulting in hose or flow meter failure leading to possible injury.	Start injections at low flow rate and adjust as needed. Secure cam locks to hoses or flow meters with counter pins. Never place any body part directly over well head.	
		2	Pressure can build up resulting in hose or flow meter failure leading to possible injury.	Monitor pressures and stress points of the system during injection (connections, valves, threaded fittings, etc.). When injection is complete, ensure there is no pressure prior to disassembly. If injecting into bedrock, utilize fittings at the well head that will allow you to seal off residual pressure in the well before disconnecting hoses.	
		3	Slips/trips/falls can occur due to hoses laying on the ground resulting in injury.	Practice good housekeeping techniques. For hoses used during introductions, avoid walking over hoses as much as practicable. Use high visibility marking and warning devices and secure hose if travelling across a designated facility walking area.	
9	Clean equipment	1	Slips/trips/falls can occur from water and soap causing slippery surfaces. Tripping can occur from equipment being laid out for cleaning.	Be aware of surroundings when cleaning equipment. Maintain good footing and walk slowly on wet/slippery surfaces.	
		2	Heavy lifting of equipment can cause muscle strain.	Use proper lifting techniques. Request assistance when lifting heavy equipment.	
10	Site restoration/loading of equipment.	1	Tripping can occur on equipment laying on the ground	Secure all equipment after use. Leave the site clean and free from any trash or debris. Secure all wells, gates and entrances to the site.	
		2	Heavy lifting can cause muscle strain.	Use proper lifting techniques when loading equipment.	
11	Inspect injection trailer and demob from site.	1	Improperly loading the trailer can cause flying debris on the roadway. Improper trailer connections can cause the trailer to detach during the demob.	Follow JLA for Driving-Commercial Motor Vehicle. Be sure all line items on the check list are satisfactory before departing from the site.	JLA for Driving-Commercial Motor Vehicles

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)		Required
Head Protection	hard hat		Required
Miscellaneous PPE	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Miscellaneous	fire extinguisher		Required
Miscellaneous	first aid kit		Required
Personal	eye wash (specify type)	for chemical injections	Required
Traffic Control	traffic cones		Required

Job Loss Analysis

General

Client Name	ARCADIS
JSA ID	45
Job Name	Environmental-Groundwater Sampling and free product recovery
Task Description	groundwater sampling
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC Name	
Project Manager	NO PROJECT MANAGER
Status Name	(3) Completed
Cretaion Date	2/4/2009 9:12:19 AM

User Roles

Role	Employee	Due Date	Completed	Approve	Supervisor	Active Employee
Created By	Coppola, Mija	2/6/2009	2/4/2009		Leichner III, Charles	True
Developer (Primary Contact)	Coppola, Mija	2/7/2009	2/4/2009		Leichner III, Charles	True
HASP Reviewer	Coppola, Mija	2/6/2009	2/6/2009	True	Leichner III, Charles	True

Reviewer Comments

Role	Employee	Approval Status	Completed Date	Comments
HASP Reviewer	Coppola, Mija	Approve	02/06/2009	

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Stage at pre-determined sampling location and set up work zone and sampling equipment	1	personnel could be hit by vehicluar traffic.	Set-up cones and establish work area. Position vehicle so that field crew is protected from site traffic. Unload as close to work area as safely possible.	
		2	Sampling equipment, tools and monitoring well covers can cause tripping hazard	Keep equipment picked up and use TRACK to assess and changes	
2	Open wells to equilibrate and gauge wells	1	When squatting down, personnel can be difficult to see by vehicular traffic.	Wear Class II traffic vest if wells are located proximal to vehicular traffic. Use tall cones and the buddy system if practicable.	
		2	pinchpoints on well vault can pinch or lacerate fingers	Use correct tools to open well vault/cap. Wear leather gloves when removing well vault lids, and chemical protective gloves while guaging. Wear proper PPE including safety boots, knee pads and safety glasses.	
		3	Lifting sampling equipment can cause muscle strain	Unload as close to work area as safely possible; use proper lifting and reaching techniques and body positioning; don't carry more than you can handle, and get help moving heavy or awkward objects.	

2	Open wells to equilibrate and gauge wells	4	Pressure can build up inside well causing cap to release under pressure	Keep head away from well cap when removing. If pressure relief valves are on well use prior to opening well	
3	Begin Purging Well and Collecting Parameter Measurements	1	Electrical shock can occur when connecting/disconnecting pump from the battery.	Make sure equipment is turned off when connecting/disconnecting. Wear leather gloves. Use GFCIs when using powered tools and pumps. Do not use in the rain or run electrical cords through wet areas.	
		2	purge water can spill or leak from equipment	Stop purging activities immediately, stop leakage and block any drainage grate with sorbent pads. Call PM to notify them of any reportable spill.	
		3	Water spilling on the ground can cause muddy/slippery conditions	Be careful walking in work area when using plastic around well to protect from spillage	
		4	lacerations can occur when cutting materials such as plastic tubing	When cutting tubing, use tubing cutter. No open fixed blades should ever be used. When possible wear work gloves, leather type.	
		5	purge water can splash into eyes	Pour water slowly into buckets/drums to minimize splashing. Wear safety glasses	
4	Collect GW or Free Product Sample	1	Working with bailer rope can cause rope burns on hands.	Slowly raise and lower the rope or string for the bailer. Wear appropriate gloves for the task.	
		2	sample containers could break or leak preservative	Discard any broken sampleware or glass properly. Do not overtighten sample containers. Wear chemical protective gloves	
5	Recovery of Free Product from well	1	exposure to free product	Additional chemical protection may be necessary based on the type of product. Additionally, safety goggles, a faceshield, or respiratory protection may be required. Verify in the HASP.	
6	Staging of Well Purge water and/or Free Product	1	Muscle strains can occur when moving purge water or drums	If using buckets, do not fill buckets up to the top. Always keep lid on buckets when traveling or moving them to another location. Only half fill buckets so when dumping the buckets weigh less. See drum handling JLA for movement of drums.	Drum handling JLA

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	Required		Required
Foot Protection	Required		Required
Hand Protection	Required		Required
Hand Protection	Required	leather	Required
Head Protection	Required		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)		Required
Miscellaneous	fire extinguisher		Required
Miscellaneous	first aid kit		Required
Personal	eye wash (specify type)	bottle	Required
Traffic Control	traffic cones		Required

Job Loss Analysis

General

Client Name	ARCADIS
JSA ID	166
Job Name	Environmental-Sample cooler handling
Task Description	Sample cooler handling
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC Name	
Project Manager	NO PROJECT MANAGER
Status Name	(3) Completed
Cretaion Date	5/1/2009 8:07:23 PM

User Roles

Role	Employee	Due Date	Completed	Approve	Supervisor	Active Employee
Created By	Coppola, Mija	5/11/2009	5/11/2009		Leichner III, Charles	True
Developer (Primary Contact)	Coppola, Mija	5/11/2009	5/11/2009		Leichner III, Charles	True
HASP Reviewer	Moyers, Samuel	5/25/2009	5/13/2009	True	Coppola, Mija	True

Reviewer Comments

Role	Employee	Approval Status	Completed Date	Comments
HASP Reviewer	Moyers, Samuel	Revise	05/11/2009	Kevlar is required? Leather work gloves are listed. i suggest just leather gloves.
HASP Reviewer	Moyers, Samuel	Approve	05/13/2009	

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Transfer field samples to sample packing area	1	Lifting heavy coolers may result in muscle strain especially to lower back.	Use proper lifting techniques and keep back straight. Use buddy system for large coolers, Use mechanical aids like hand trucks if readily available to move coolers. Do not over fill coolers with full sample containers for temporary movement to the sample prep area. Ensure an adequate supply of sample coolers are in field	
		2	Hazards to hands from broken glass caused by over tightening lids or improper placement in cooler	Inspect all bottles and bottle caps for cracks/leaks before and after filling container. Do not over tighten sample lids. Clean up any broken bottles immediately, avoid contact with sample preservatives. Wear leather gloves when handling broken glass.	
		3	Exposure to chemicals (acid preservatives or site contaminants) on the exterior of sample bottles after filling.	Wear protective gloves for acid preservatives and safety glasses with side shields during all sample container handling activities (before and after filling), Once filled follow project specific HASP PPE requirements for skin and eye protection.	

1	Transfer field samples to sample packing area	4	Samples containing hazardous materials may violate DOT/IATA HazMat shipping regulations	All persons filling a sample bottle or preparing a cooler for shipment must have complete ARCADIS DOT HazMat shipping training. Compare the samples collected to the materials described in the Shipping Determination for the Project and ensure consistent. Re perform all Shipping determinations if free product is collected and not anticipated during planning.	
2	Sample cooler selection	1	Sample coolers with defective handles, lid hinges, lid hasps cracked or otherwise damaged may result in injury (cuts to hands, crushing of feet if handle breaks etc)	Only use coolers that are new or in like new condition, No rope handled coolers unless part of the manufacturer's handle design.	ARCADIS Shipping Guide US-001
		2	Selection of excessively large coolers introduces lifting hazards once the cooler is filled.	Select coolers and instruct lab to only provide coolers of a size appropriate for the material being shipped. For ordinary sample shipping sample coolers should be 48 quart capacity or smaller to reduce lifting hazards.	ARCADIS Shipping Guide US-001
3	Pack Samples	1	Pinch points and abrasions to hands from cooler lid closing unexpectedly	Beware that lid could slam shut; block/brace if needed; be wary of packing in strong winds. New coolers may be more prone to self closing, tilt cooler back slightly to facilitate keeping lid open.	
		2	Awkward body positions and contact stress to legs and knees when preparing coolers on irregular or hard ground surfaces.	Plan cooler prep activities. Situate cooler where neutral body positions can be maintained if practical, like truck tailgate. Avoid cooler prep on gravel rough surfaces unless knees and legs protected during kneeling.	
		3	Frostbite or potential for oxygen deficiency when packing with dry ice. Contact cold stress to fingers handling blue ice or wet ice	Dry ice temperature is -109.30F. Wear thermal protective gloves. DO NOT TOUCH with bare skin! Dry ice sublimates at room temp and could create oxygen deficiency in closed environment. Maintain adequate ventilation! Do not keep dry ice in cab of truck. Wear gloves when handling blue ice or gaging wet ice. Dry Ice is DOT regulated for air shipping, follow procedures in Shipping Determination.	
4	Sealing, labeling and Marking Cooler	1	Cuts to hands and forearms from strapping tape placement or removing old tape and labels	Do not use a fixed, open-blade knife to remove old tags/labels, USE SCISSORS or other safety style cutting device. Only use devices designed for cutting. Do not hurry through task.	
		2	Lifting and awkward body position hazards from taping heavy coolers, dropping coolers on feet during taping.	Do not hurry through the taping tasks, ensure samples in cooler are evenly distributed in cooler to reduce potential for overhanging cooler falling off edge of tailgate/table when taping.	
		3	Improper labeling and marking may result in violation of DOT/IATA Hama shipping regulations delaying shipment or resulting in regulatory penalty	Do not deviate from ARCADIS Shipping Guide or Shipping Determination marking or labeling requirements.	
5	Offering sample cooler to a carrer or lab couriour for shipment.	1	Lifting heavy coolers may result in muscle strain especially to lower back.	See lifting hazard controls above.	

5	Offering sample cooler to a carrer or lab couriour for shipment.	2	Carrier refusal to accept cooler may cause shipping delay and/or result in violation of DOT HazMat shipping regulations.	Promptly report all rejected and refused shipments to the ARCADIS DOT Program Manager. Do Not re-offer shipment if carrier requires additional labels markings or paperwork inconsistent with your training or Shipping Determination without contacting the ARCADIS DOT Compliance Manager.	

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	Required		Required
Hand Protection	Required	nitrile	Required
Hand Protection	Required	leather	Required

Supplies

Type	Supply	Description	Required
Miscellaneous	Other	Scissors	Required

Job Loss Analysis

General

Client Name	ARCADIS
JSA ID	15
Job Name	General Industry-Driving - passenger vehicles
Task Description	Driving Passenger Vehicle or Pick Up Truck
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC Name	
Project Manager	NO PROJECT MANAGER
Status Name	(3) Completed
Cretaion Date	1/29/2009 2:10:18 PM

User Roles

Role	Employee	Due Date	Completed	Approve	Supervisor	Active Employee
Created By	Coppola, Mija	1/31/2009	1/29/2009		Leichner III, Charles	True
Developer (Primary Contact)	Coppola, Mija	2/1/2009	1/29/2009		Leichner III, Charles	True
HASP Reviewer	Coppola, Mija	1/31/2009	1/29/2009	True	Leichner III, Charles	True

Reviewer Comments

Role	Employee	Approval Status	Completed Date	Comments
HASP Reviewer	Coppola, Mija	Approve	01/29/2009	

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Preforming Pre-trip inspections	1	Cuts scrapes to hands and fingers checking engine fluids	Use TRACK to plan inspection activity in the engine compartment. Wear protective gloves if reaching in poorly illuminated areas of the engine.	
		2	Pinch crush hazards to hands and fingers checking engine fluids or closing doors.	Identify and keep hands fingers away from pinch hazards from doors and vehicle hood or tailgate (if present).	
		3	Awkward body positions checking tires, spare tire, undercarriage, or engine compartment.	Maintain neutral body positions and avoid awkward reaches under the vehicle or in engine compartment.	
		4	Failure to inspect vehicle emergency equipment may result in extensive vehicle damage or delay treatment in the event of injury	Conduct equipment inspections by visibly inspecting fire extinguisher and first aid kit for cleanliness, in date items/tags, readiness for use.	
2	Vehicle loading and unloading	1	Object placement obstructing rear, side or blindspot view	Avoid placing objects in manner that does not obstruct view, brake equipment down to smaller more managebale size to keep low profile in vehicle. If hanging clothes in vehicle place in amnner that does not obstruct blind spots	

2	Vehicle loading and unloading	2	Unsecure objects causing pedal, steering or gear shift obstruction or injury during vehicle operation.	Secure all loads in vehicle (both in the bed of trucks and in passenger cabin) to prevent unanticipated movment or shifting that could injure driver, passenger, or affect safe operation of vehicle.	
		3	Obstuction of vehicle safety equipment caused by object placment in vehicle.	Keep emergency equipment clear and unobstructed to ensure ready availablity.	
3	Vehicle operation	1	Failure to use Smith System "5-Keys" increases risk of accident and injruy.	Use Smith System "5-Keys", maintain space cushion around vehicle, maintain 4 second rule and add (second for each addtional hazard (wet roads, snow, etc). Brake gradual, keep eyes moving, check mirrors every 6-8 seconds, use turn signals, focus on relavent objects, use early lane positioning when approaching turns.	
		2	Injury or death from failure to wear seatbelt	Always wear seatbelts even if driving short distances off of a public roadway.	
		3	Cell phone use increases risk of accidnt and injury	Avoid using cell phones in any capacity when operating a vehicle, check client for cell use on project sites and follow requirements. Follow all local laws.	
		4	Use of radar detectors encourages speeding resulting in increased risk for accident or injury	Use of radar detectors and similar devices is prohibited.	
4	Routine maintenance	1	Pinch crush hazards to hands and fingers replacing engine fluids or closing doors/hood.	Inspect and indetify pinch and crush hazards and keep hands/fingers clear when closing hood, tailgates, or doors.	
		2	Burn hazards to hand form checking/replacing fluids in engine compartment	When practical allow engine to cool prior to servicing or adding fluids. Use protective gloves.	
		3	Vehicle damage from improper fuse replacement	Never replace a fuse with a higher amperage than the one being replaced. Only replace fuses of type being replaced.	
		4	Failing to use Wright Express for vehicles equipped with fuel card impairs maintenace tracking that could affect vehicle safety	If vehicle is assigned a Wright Express Card, use the card so accurate maintenance tracking can be performed by LeasePlan.	

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fire extinguisher		Required
Miscellaneous	first aid kit		Required
Traffic Control	Other	Roadway emergency kit	Required

ARCADIS

Appendix D

PPE Equipment List

ARCADIS

PPE CHECKLIST

R = Equipment required to be present on the site. **O** = Optional equipment. Subcontractors must have the same equipment listed here as a minimum.

Description (Put Specific Material or Type in Box)	Level Of Protection		
	D	C	B
Body			
Coveralls	O		
Chemical Protective Suit (include type in cell, e.g., Tyvek, Saranex, PVC,	R (when mixing ISCO materials)	R	
Splash Apron			
Rain Suit	O		
Traffic Safety Vest (reflective)	R		
Head			
Hard Hat (if does not create other hazard)	R (when with drill rigs/heavy equipment	R	
Head Warmer (depends on temperature and	O		
Eyes & Face			
Safety Glasses (incorporate sun protection as	R		
Goggles (based on hazard)	R (when mixing ISCO materials)		
Splash Guard (based on hazard)	R (when mixing ISCO materials)		
Ears			
Ear Plugs	R (when with drill rigs/heavy equipment)		
Ear Muffs	O		
Hands and Arms			
Outer Chemical Resistant Gloves (specify the type of glove based on chemical	R (when mixing ISCO materials)	R	
Inner Chemical Resistant Gloves	R	R	
Insulated Gloves	O		
Work Gloves*	R		
Foot			
Safety Boots (steel toe and shank)	R	R	
Rubber, Chemical Resistant Boots			
Rubber Boots			
Disposable Boot Covers		O	
Respiratory Protection			
1/2 Mask APR			
Full Face APR	O (have onsite)	O	

Description (Put Specific Material or Type in Box)	Level Of Protection		
	D	C	B
Dust Protection	R (during ISCO system construction)		
Powered APR			
SCBA			

ARCADIS

Appendix E

Forms and MSDSs

ARCADIS

Document Control Number:TGM - _____

TGM + *project number plus date as follows: xxxxxxxx.xxxx.xxxxx - dd/mm/year*

TAILGATE HEALTH & SAFETY MEETING FORM

This form documents the tailgate meeting conducted in accordance with the Project HASP. Personnel who perform work operations on-site during the day are required to attend this meeting and to acknowledge their attendance, at least daily.

Project and Client Name:			**Project Location:**
Date:	**Time:**	**Conducted by:**	**Signature/Title:**
Company:		**Client Contact:**	**Subcontractor companies:**

TRACKing the Tailgate Meeting

Think through the Tasks (list the tasks for the day):

1 _____ 3 _____ 5 _____

2 _____ 4 _____ 6 _____

SIMOPS - If there are any simultaneous operations (**SIMOPS**) occurring during ARCADIS activities, please check here: ☐ If there are no SIMOPS, write "None" here: _____

If yes, describe SIMOPS here: _____

Name of SIMOPS Coordinator: _____ Company: _____

Permits - check the activities to be conducted that require the issuance of a permit:

	Permit #		Permit #		Permit #
☐ Energy Isolation (LOTO)		☐ Ground Disturbance		☐ Hot Work	
☐ Lifting Operations		☐ Overhead Utilities		☐ Working at Height	
				☐ Confined Space	

Answer and discuss the following with Tailgate attendees. Check if yes :

☐ Have RA's been validated on site?	☐ Any new RA's needed for new tasks?	☐ Does any work activity require MOC?
☐ If MOC yes, notify client as needed	☐ Have field staff participated in the RA?	☐ Staff understand risks and controls?
☐ Competent person involved in RA?	☐ Staff members are familiar with EAP?	☐ Staff knows today's muster points?
☐ All equipment checked & OK?	☐ Staff has appropirate PPE?	☐ Each task risk assessed (RA)?

Recognize the hazards (check all those that are discussed) and **A**ssess the Risks (Low, Medium, High-circle risk level) - Provide an overall assessment of hazards to be encountered today and briefly list them under the hazard category.

☐ Gravity	(L M H)	☐ Motion	(L M H)	☐ Mechanical	(L M H)
☐ Electrical	(L M H)	☐ Pressure	(L M H)	☐ Environment	(L M H)
☐ Chemical	(L M H)	☐ Biological	(L M H)	☐ Radiation	(L M H)
☐ Sound	(L M H)	☐ Personal Safety	(L M H)	☐ Driving	(L M H)

Continue TRACK Process on Page 2

ARCADIS Document Control Number:TGM - _____

TAILGATE HEALTH & SAFETY MEETING FORM - Pg. 2

Control the hazards (Check all and discuss those methods to control the hazards that will be implemented for the day): Review the HASP, applicable JSAs, and other control processes. Discuss and document any additional control processes.

- [x] **STOP WORK AUTHORITY** (Must be addressed in every Tailgate meeting-*See below*)

☐ Elimination	☐ Substituion	☐ Isolation
☐ Engineering controls	☐ Administrative controls	☐ Monitoring
☐ General PPE Usage	☐ Hearing Conservation	☐ Respiratory Protection
☐ Personal Hygiene	☐ Exposure Guidelines	☐ Decon Procedures
☐ Emergency Action Plan	☐ Fall Protection	☐ Work Zones/Site Control
☐ JSA to be developed/used ***(specify)***	☐ LPO conducted ***(specify job/JSA)***	☐ Other ***(specify)***

_____ _____ _____

_____ _____ _____

Post Daily Activities Review - (Check those that are applicable and explain:)

- ☐ Lessons learned and best practices learned today: _____
- ☐ Incidents that occurred today: _____
- ☐ Any Stop Work interventions today? _____
- ☐ Corrective/Preventive Actions needed for future work: _____
- ☐ Any other H&S issues: _____

Signature and Certification Section - Site Staff and Visitors

I know the hazards:

By signing, you are stating:

1. You have been involved in the RA and understand the hazards and risk controls for each task
2. You understand the permits required for certain tasks as applicable
3. You are aware you should not do a task that has not been assessed
4. You are aware of your obligation to STOP WORK

I arrived and departed fit for duty

5. You are physically and mentally fit for duty
6. You are not under the influence of any substance that could affect your ability to work safely
7. You are aware of your responsibility to bring any illness, injury or fatigue issue you may have to the attention of the Field Supervisor or SSO
8. You signed out uninjured unless you have otherwise informed the field supervisor or SSO

Signatures are required by all persons involved in work or who may become affected by a SIMOPS situation.

Name/Company/Signature	Initial & Sign in Time that I am Fit	Initial & Sign out Time that I am Fit	I have read and understand the HASP

Visitors Name/Co - not involved in work

	In	Out
	In	Out
	In	Out

I will STOP the job any time anyone is concerned or uncertain about safety.

I will STOP the job if anyone identifies a hazard or additional mitigation not recorded in the site, project, job or task risk assessment.

I will be alert to any changes in personnel, conditions at the work site or hazards not covered by the original risk assessments.

If it is necessary to **STOP THE JOB,** I will reassess the task hazards and mitigations; and then amend the risk assessements as needed.

Keep H&S 1st in all things

Real Time Exposure Monitoring Data Collection Form

Document all air monitoring conducted on the Site below. Keep this form with the project file.

Site Name: _____ Date: _____

Instrument: _____ Model: _____ Serial #: _____

Calibration Method: (Material used settings, etc.)	
Calibration Results:	
Calibrated By:	

Activity Being Monitored	Compounds/Hazards Monitored	Time	Reading	Action Required? Y/N

Describe Any Actions Taken as a Result of this Air Monitoring and Why (does it match Table 5-1):

_____

_____

Employee Signature Form

I certify that I have read, understand, and will abide by the safety requirements outlined in this HASP.

Printed Name	Signature	Date

Subcontractor Acknowledgement: Receipt of HASP Signature Form

ARCADIS claims no responsibility for the use of this HASP by others although subcontractors working at the site may use this HASP as a guidance document. In any event, ARCADIS does not guarantee the health and/or safety of any person entering this site. Strict adherence to the health and safety guidelines provided herein will reduce, but not eliminate, the potential for injury at this site. To this end, health and safety becomes the inherent responsibility of personnel working at the site.

Printed Name	Company	Signature	Date

Visitor Acknowledgement and Acceptance of HASP Signature Form

By signing below, I waive, release and discharge the owner of the site and ARCADIS and their employees from any future claims for bodily and personal injuries which may result from my presence at, entering, or leaving the site and in any way arising from or related to any and all known and unknown conditions on the site.

Name	Company	Reason for Visit	Date/Time On Site	Date/Time Off Site

Hazardous Materials Transportation Form

	Vehicle (place X in box)	Type (pick-up, car, box truck, etc.)
Personal		
Rental		
ARCADIS owned/leased		
Government owned		
Trailer		

Materials Transported	Quantity	Storage/Transport Container

List Trained Drivers:

_____

_____

Hazardous Materials Shipment Form

Material Description and Proper Shipping Name (per DOT or IATA)	Shipment Quantity	DOT Hazard Classification	Shipment Method (air/ground)

List Shipper (i.e., who we are offering the shipment to):

_____

_____

List Trained Employee(s):

_____

_____

RemOx® L
ISCO Reagent

EC- SAFETY DATA SHEET according to Regulation (EC) № 1907/2006 of the European Parliament and of the Council, of 18 December 2006 concerning REACH

Material Safety Data Sheet

Section 1 Chemical Product and Company Identification

PRODUCT NAME: RemOx® L ISCO Reagent **TRADE NAME:** RemOx® L ISCO Reagent	**Revision Date: January 2010**

USES OF SUBSTANCE: RemOx® L ISCO Reagent is a liquid oxidant recommended for in-situ and ex-situ remediation of sites that require a strong oxidant.

COMPANY NAME (Europe): CARUS EUROPE	**COMPANY ADDRESS:** C/SECUNDINO ROCES, 3-Planta 1ª-Oficina 14 33428 Cayes – Llanera, Asturias - Spain **INFORMATION:** (34) 985-785-513 (34) 985-785-513 **EMERGENCY TELEPHONE:** (34) 985-785-513
COMPANY NAME (US): CARUS CORPORATION	**COMPANY ADDRESS:** 315 Fifth Street Peru, IL 61354, USA **INFORMATION:** (815)-223-1500 www.caruscorporation.com (Web) salesmkt@caruscorporation.com (Email) **EMERGENCY TELEPHONE:** (800) 435 –6856 (USA) (800) 424-9300 (CHEMTREC, USA) (815-223-1500 (Other countries)

Section 2 Hazards Identification

1. Eye Contact
   RemOx® L ISCO Reagent is damaging to eye tissue on contact. It may cause burns that result in damage to the eye.
2. Skin Contact
   Momentary contact of solution at room temperature may be irritating to the skin, leaving brown stains. Prolonged contact is damaging to the skin.
3. Inhalation
   Acute inhalation toxicity data are not available. However, airborne concentrations of RemOx® L ISCO Reagent in the form of mist may cause irritation to the respiratory tract.
4. Ingestion
   RemOx® L ISCO Reagent if swallowed, may cause burns to mucous membranes of the mouth, throat, esophagus, and stomach.

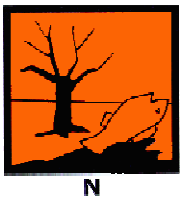
Section 3 Hazardous Ingredients

Material or Component	CAS No.	%	Hazard Data
Sodium Permanganate	10101-50-5	40	**PEL/C** 5 mg Mn per cubic meter of air **TLV-TWA** 0.2 mg Mn per cubic meter of air

HAZARD SYMBOLS:


O


Xn


N

RISK PHRASES:

8 Contact with combustibles may case fire.
22 Harmful if swallowed.
50/53 Very toxic to aquatic organisms, may cause long-term effects in the aquatic environment.

SAFETY PHRASES:

17 Keep away from combustible materials.
24/25 Avoid contact with skin and eyes.
26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice

Section 4 First Aid Measures

1. Eyes
   Immediately flush eyes with large amounts of water for at least 15 minutes holding lids apart to ensure flushing of the entire surface. Do not attempt to neutralize chemically. Seek medical attention immediately. Note to physician: Decomposition products are alkaline.
2. Skin
   Immediately wash contaminated areas with water. Remove contaminated clothing and footwear. (Caution: Solution may ignite certain textiles). Wash clothing and decontaminate footwear before reuse. Seek medical attention immediately if irritation is severe and persistent.
3. Inhalation
   Remove person from contaminated area to fresh air. If breathing has stopped, resuscitate and administer oxygen if readily available. Seek medical attention immediately.
4. Ingestion
   Never give anything by mouth to an unconscious or convulsing person. If person is conscious, give large quantities of water or milk. Seek medical attention immediately.

Section 5 Fire Fighting Measures

NFPA* HAZARD SIGNS:

Health Hazard	1	=	Materials which under fire conditions would give off irritating combustion products. (less than 1 hour exposure) Materials which on the skin could cause irritation.
Flammability Hazard	0	=	Materials that will not burn.
Reactivity Hazard	0	=	Materials which in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water.
Special Hazard	OX	=	Oxidizer

***National Fire Protection Association 704**

FIRST RESPONDERS:
Wear protective gloves, boots, goggles, and respirator. In case of fire, wear positive pressure breathing apparatus. Approach incident with caution. Use 2004 Emergency Response Guidebook (U.S. DOT RSPA, TC and STC). Guide No. 140. (http://hazmat.dot.gov/pubs/erg2004/erg2004.pdf).

FLASHPOINT	None
FLAMMABLE OR EXPLOSIVE LIMITS	Lower: Nonflammable Upper: Nonflammable
EXTINGUISHING MEDIA	Use large quantities of water. Water will turn pink to purple if in contact with RemOx® L ISCO Reagent. Dike to contain. Do not use dry chemicals, CO_2Halon® or foams.
SPECIAL FIREFIGHTING PROCEDURES	If material is involved in fire, flood with water. Cool all affected containers with large quantities of water. Apply water from as far as a distance as possible. Wear self-contained breathing apparatus and full protective clothing.
UNUSUAL FIRE AND EXPLOSION	Powerful oxidizing material. May decompose spontaneously if exposed to heat (135°C/275°F). May be explosive in contact with certain other chemicals (Section 10). May react violently with finely divided and readily oxidizable substances. Increases burning rate of combustible material. May ignite wood and cloth.

Section 6 Accidental Release Measures

PERSONAL PRECAUTIONS

Personnel should wear protective clothing suitable for the task. Remove all ignition sources and incompatible materials before attempting clean up.

ENVIRONMENTAL PRECAUTIONS:

Do not flush into sanitary sewer system or surface water. If accidental release into the environment occurs, inform the responsible authorities. Keep the product away from drains, sewers, surface and ground water and soil.

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

Contain spill by collecting the liquid in a pit or holding behind a dam (sand or soil). Dilute to approximately 6% with water, and then reduce with sodium thiosulfate, a bisulfite or ferrous salt solution. The bisulfite or ferrous salt may require some dilute sulfuric acid (10% w/w) to promote reduction. Neutralize with sodium carbonate to neutral pH, if acid was used. Decant or filter and deposit sludge in approved landfill. Where permitted, the sludge may be drained into sewer with large quantities of water. To clean contaminated floors, flush with abundant quantities of water into sewer, if permitted by federal, state, and local regulations. If not, collect water and treat as above.

Section 7 Handling and Storage

WORK/HYGIENIC PRACTICES
Wash hands thoroughly with soap and water after handling RemOx® L ISCO Reagent. Do not eat, drink or smoke when working with RemOx® L ISCO Reagent . Wear proper protective equipment. Remove clothing, if it becomes contaminated.

VENTILATION REQUIREMETNS
Provide sufficient mechanical and/or local exhaust to maintain exposure below the TLV/TWA.

CONDITIONS FOR SAFE STORAGE
Store in accordance with NFPA 430 requirements for Class II oxidizers. Protect containers from physical damage. Store in a cool, dry area in closed containers. Segregate from acids, peroxides, formaldehyde, and all combustible, organic, or easily oxidizable materials including antifreeze and hydraulic fluid.

Section 8 Exposure Controls and Personal Protection

RESPIRATORY PROTECTION
In cases where overexposure to mist may occur, the use of an approved NIOSH-MSHA mist respirator or an air supplied respirator is advised. Engineering or administrative controls should be implemented to control mist.

EYE
Faceshield, goggles, or safety glasses with side shields should be worn. Provide eyewash in working area.

GLOVES
Rubber or plastic gloves should be worn.

OTHER PROTECTIVE EQUIPMENT
Normal work clothing covering arms and legs, and rubber, or plastic apron should be worn. Caution: If clothing becomes contaminated, wash off immediately. Spontaneous ignition may occur with cloth or paper.

Section 9 Physical and Chemical Properties

APPEARANCE AND ODOR	Dark purple solution, odorless
BOILING POINT, 760 mm Hg	105 °C
VAPOR PRESSURE (mm Hg)	760 mm at 105ºC
SOLUBILITY IN WATER % BY SOLUTION	Miscible in all proportions

PERCENT VOLATILE BY VOLUME	61% (as water)
EVAPORATION RATE	Same as water
FREEZING POINT	-15.0 °C
SPECIFIC GRAVITY	1.36-1.39
pH	5-9
OXIDIZING PROPERTIES	Strong oxidizer. May ignite wood and cloth.
EXPLOSIVE PROPERTIES	Explosive in contact with sulfuric acid or peroxides, or readily oxidizable substances.

Section 10 Stability and Reactivity

STABILITY	Under normal conditions, the material is stable.
CONDITIONS TO AVOID could	Contact with incompatible materials or heat (135°C / 275ºF) result in violent exothermic chemical reaction.
INCOMPATIBLE MATERIALS	Acids, peroxides, formaldehyde, antifreeze, hydraulic fluids, and all combustible organic or readily oxidizable materials, including metal powders. With hydrochloric acid, toxic chlorine gas is liberated.
HAZARDOUS DECOMPOSITION PRODUCTS	When involved in a fire, liquid permanganate may form corrosive fumes.
CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION	Material is not known to polymerize.

Section 11 Toxicological Information

SODIUM PERMANGANATE: Acute oral LD_{50} not known.

1. Acute toxicity

Irritating to body tissue with which it comes into contact. No acute toxicity data is available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate. The toxicity data for potassium permanganate is given below:

Ingestion:
LD 50 oral rat: 780 mg/kg male (14 days); 525 mg/kg female (14 days).
Harmful if swallowed. ALD: 10g. Ingestion may cause nausea, vomiting, sore throat, stomach-ache and eventually lead to a perforation of the intestine. Liver and kidney injuries may occur.

Skin contact:
LD 50 dermal no data available.

The product may be absorbed into the body through the skin. Major effects of exposure: severe irritation, brown staining of skin.

Inhalation:
LC 50 inhal. no data available.
The product may be absorbed into the body by inhalation. Major effects of exposure: respiratory disorder, cough.

2. Chronic toxicity
No known cases of chronic poisoning due to permanganates have been reported. Prolonged exposure, usually over many years, to heavy concentrations of manganese oxides in the form of dust and fumes may lead to chronic manganese poisoning, chiefly involving the central nervous system.

3. Carcinogenicity
Sodium permanganate has not been classified as a carcinogen by ACGIH, NIOSH, OSHA, NTP, or IARC.

4. Medical Conditions Generally Aggravated by Exposure
Sodium permanganate solution will cause further irritation of tissue, open wounds, burns or mucous membranes.

Section 12 Ecological Information

Entry to the Environment
Permanganate has a low estimated lifetime in the environment, being readily converted by oxidizable materials to insoluble MnO_2.

Bioconcentration Potential
In non-reducing and non-acidic environments MnO_2 is insoluble and has a very low bioaccumulative potential.

Aquatic Toxicity
No data.

Section 13 Disposal Considerations

Waste Disposal

RemOx® L ISCO Reagent, once it becomes a waste, is considered a D001 hazardous (ignitable) waste. For disposal of RemOx® L ISCO Reagent solutions, follow procedures in Section 6 and deactivate the permanganate to insoluble manganese dioxide. Dispose of it in a permitted landfill. Contact Carus Chemical Company for additional recommendations.

Section 14 Transport Information

USA (land, D.O.T.)	**Proper Shipping Name:**	49 CFR172.101 Permanganates, inorganic, aqueous solution, n.o.s .(contains sodium permanganate
	Hazard Class:	49 CFR172.101….Oxidizer
	ID Number:	49 CFR172.101….UN 3214
	Packing Group:	49 CFR172.101….II
	Division:	49 CFR172.101….5.1

European Labeling in accordance Road/Rail Transport (ADR/RID)	**ID Number:**	UN 3214
	ADR/RID Class	5.1
	Description of Goods:	Permanganates, inorganic, aqueous solution, n.o.s (contains sodium permanganate)
	Hazard Identification No.	50
European Labeling in accordance with EC directive (Water, I.M.O.)	**Proper Shipping Name:**	Permanganates, inorganic, aqueous solution, n.o.s (contains sodium permanganate)
	Hazard Class:	Oxidizer
	ID Number:	UN 3214
	Packing Group:	II
	Division:	5.1
	Marine Pollutant:	No
European Labeling in accordance with EC directive (Air, I.C.A.O.)	**Proper Shipping Name:**	Permanganates, inorganic, aqueous solution, n.o.s (contains sodium permanganate)
	Hazard Class:	Oxidizer
	ID Number:	UN 3214
	Packing Group:	II
	Division:	5.1

Section 15 Regulatory Information (Sodium Permanganate)

TSCA	Listed in the Toxic Substances Control Act (TSCA) Chemical Substance Inventory.
CERCLA	Not listed.
RCRA	Oxidizers such as RemOx® L ISCO Reagent solution meet the criteria of ignitable waste. 40 CFR 261.21.
SARA TITLE III Information	
Section 302/303	Extremely hazardous substance: Not listed
Section 311/312	Hazard categories: Fire, acute and chronic toxicity.
Section 313	RemOx® L ISCO Reagent contains 40% manganese compounds as part of the chemical and is subject to the reporting requirements of Section 313 of Title III, Superfund Amendments and Reauthorization Act of 1986 and 40 CFR 372.
FOREIGN LIST	Canadian Non-Domestic Substance List , EINECS

Section 16 Other Information

NIOSH	National Institute for Occupational Safety and Health
MSHA	Mine Safety and Health Administration
OSHA	Occupational Safety and Health Administration
NTP	National Toxicology Program

IARC	International Agency for Research on Cancer
PEL	Permissible Exposure Limit
C	Ceiling Exposure Limit
TLV-TWA	Threshold Limit Value-Time Weighted Average
CAS	Chemical Abstract Service
EINECS	Inventory of Existing Chemical Substances (European)

Chithambarathanu Pillai (S.O.F.)
January 2010

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Responsible Care®
Good Chemistry at Work

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Sodium Thiosulfate
SOD8600

Section 1 - Chemical Product and Company Identification 61

Material Name: Sodium Thiosulfate **CAS Number:** 7772-98-7
Chemical Formula: $Na_2O_3S_2$
EINECS Number: 231-867-5
ACX Number: X1000149-3
Synonyms: AMETOX; ANTICHLOR; CHLORINE CONTROL; CHLORINE CURE; DECLOR-IT; DISODIUM SALT; DISODIUM THIOSULFATE; S-HYDRIL; HYPO; SODIUM HYPOSULFITE; SODIUM OXIDE SULFIDE; SODIUM THIOSULFATE; SODIUM THIOSULFATE ANHYDROUS; SODIUM THIOSULPHATE; SODOTHIOL; SULFOTHIORINE; THIOSULFURIC ACID,DISODIUM SALT
General Use: Used widely as bleaching agent, an ingredient in photographic fixer solutions, for extraction of silver from ores, as a mordant in dyeing and printing textiles, reducers in chrome dyeing, in leather manufacture and a reagent in analytical and organic chemistry.
Antidote for cyanide poisoning.

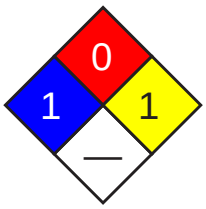
Section 2 - Composition / Information on Ingredients

Name	CAS	%
sodium thiosulfate	7772-98-7	>98

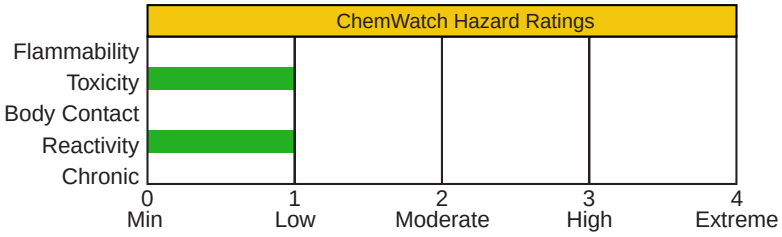
OSHA PEL **NIOSH REL**

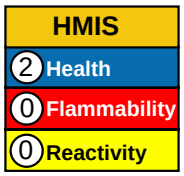
ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White powder or crystals; almost odorless. Mildly irritating to eyes/skin/respiratory tract. Also causes: nausea, abdominal cramping, diarrhea, GI irritation, allergic contact dermatitis. Chronic effects: chronic dermatitis.

Potential Health Effects

Target Organs: skin, eyes, mucous membranes, upper respiratory system, gastrointestinal (GI) tract
Primary Entry Routes: inhalation, ingestion
Acute Effects

Inhalation: The dust may be discomforting to the upper respiratory tract.
Persons with impaired respiratory function, airway diseases, and conditions such as emphysema or chronic bronchitis may incur further disability if excessive concentrations of particulate are inhaled.

Eye: The material is moderately discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

Skin: The material is moderately discomforting to the skin.
Solution of material in moisture on the skin or in perspiration may increase irritant effects.
Open cuts, abraded or irritated skin should not be exposed to this material.

Ingestion: The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed in large quantity.

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Ingestion can cause irritation of the gastrointestinal tract and purging.
Diarrhea may occur from ingestion of large quantities. In treatment of cyanide poisoning, 12.5 gm. has been injected intravenously without ill-effect.
Thiosulfate salts are poorly absorbed from the alimentary tract and as a consequence act as an osmotic cathartic.
Absorbed thiosulfates are remarkably inert and are distributed in extracellular fluids where they may cause osmotic disturbances.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: No human exposure data available. For this reason, health effects described are based on experience with chemically-related materials.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water. Consider drinking water to remove dust from throat.
Seek medical attention if irritation or discomfort persist.

Eye Contact: Immediately hold the eyes open and flush with fresh running water.
Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.
Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water.
Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

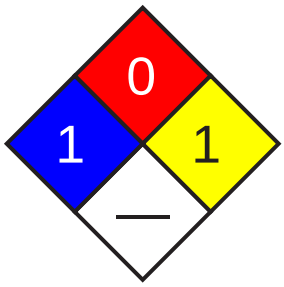
Autoignition Temperature: Not applicable

LEL: Not applicable

UEL: Not applicable

Extinguishing Media: There is no restriction on the type of extinguisher which may be used.

General Fire Hazards/Hazardous Combustion Products: The material is not readily combustible under normal conditions. However, it will breakdown under fire conditions and the organic component may burn.
Not considered to be a significant fire risk.
Heating may cause expansion and violent bursting - rupture of containers.
May emit acrid smoke.
Decomposition will occur at high temperatures and may produce fumes of Flammable hydrogen sulfide (H_2S).



Fire Diamond

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear impervious gloves and safety glasses.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up.
Place spilled material in clean, dry, sealable, labeled container.

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or

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waterways.
Stop leak if safe to do so.
Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Neutralize/decontaminate residue.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing dust. Limit all unnecessary personal contact.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. When handling DO NOT eat, drink or smoke.
Always wash hands with soap and water after handling.
Avoid physical damage to containers. Use good occupational work practices.
Observe manufacturer's storing and handling recommendations.

Recommended Storage Methods: Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Glass container or Plastic container or Plastic drum or Polylined drum.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved dust respirator.
Correct fit is essential to obtain adequate protection.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Neoprene rubber gloves or rubber gloves or PVC gloves.
Protective footwear.

Other: Overalls. Barrier cream.
Ensure that there is ready access to eye wash unit.

Glove Selection Index:

NATURAL RUBBER..... Best selection
NEOPRENE..... Best selection
NITRILE..... Best selection
NITRILE+PVC..... Best selection
PVC..... Best selection

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear to white crystals or granules with no odor. Insoluble in alcohol. Slowly decomposes in aqueous solution.

Physical State: Divided solid
Vapor Pressure (kPa): Not applicable
Vapor Density (Air=1): Not applicable
Formula Weight: 158.10
Specific Gravity (H_2O=1, at 4 °C): 1.7
Evaporation Rate: Not applicable
pH: Not applicable
pH (1% Solution): 6.5-8.0 (5% sol)
Boiling Point: 100 °C (212 °F)
Freezing/Melting Point: 48 °C (118.4 °F)
Volatile Component (% Vol): Negligible
Decomposition Temperature (°C): >100 C
Water Solubility: Practically insoluble in water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Contact with acids produces toxic fumes, i.e. sulfur dioxide (SO_2).
Avoid storage with acids, metal nitrites, sodium nitrite, halogens and oxidizing agents.

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Section 11 - Toxicological Information

Toxicity
Oral (human) TD_{Lo}: 300 mg/kg/7d

Irritation
Nil reported

See *RTECS* XN 6476000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.
Small quantities may be discharged to sewer with a large excess of water.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: None

Section 15 - Regulatory Information

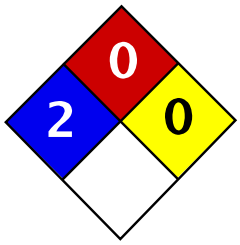
EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

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Health	2
Fire	0
Reactivity	0
Personal Protection	G

Material Safety Data Sheet
Tetrachloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Tetrachloroethylene

Catalog Codes: SLT3220

CAS#: 127-18-4

RTECS: KX3850000

TSCA: TSCA 8(b) inventory: Tetrachloroethylene

CI#: Not available.

Synonym: Perchloroethylene; 1,1,2,2-Tetrachloroethylene; Carbon bichloride; Carbon dichloride; Ankilostin; Didakene; Dilatin PT; Ethene, tetrachloro-; Ethylene tetrachloride; Perawin; Perchlor; Perclene; Perclene D; Percosolvel; Tetrachloroethene; Tetraleno; Tetralex; Tetravec; Tetroguer; Tetropil

Chemical Name: Ethylene, tetrachloro-

Chemical Formula: C2-Cl4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Tetrachloroethylene	127-18-4	100

Toxicological Data on Ingredients: Tetrachloroethylene: ORAL (LD50): Acute: 2629 mg/kg [Rat]. DERMAL (LD): Acute: >3228 mg/kg [Rabbit]. MIST(LC50): Acute: 34200 mg/m 8 hours [Rat]. VAPOR (LC50): Acute: 5200 ppm 4 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (anticipated carcinogen) by NTP.
MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast.
TERATOGENIC EFFECTS: Not available.

DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to kidneys, liver, peripheral nervous system, respiratory tract, skin, central nervous system (CNS).
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with skin. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, metals, acids, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 25 (ppm) from OSHA (PEL) [United States]
TWA: 25 STEL: 100 (ppm) from ACGIH (TLV) [United States]
TWA: 170 (mg/m3) from OSHA (PEL) [United States]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Ethereal.

Taste: Not available.

Molecular Weight: 165.83 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 121.3°C (250.3°F)

Melting Point: -22.3°C (-8.1°F)

Critical Temperature: 347.1°C (656.8°F)

Specific Gravity: 1.6227 (Water = 1)

Vapor Pressure: 1.7 kPa (@ 20°C)

Vapor Density: 5.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 5 - 50 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.4

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Miscible with alcohol, ether, chloroform, benzene, hexane.
It dissolves in most of the fixed and volatile oils.
Solubility in water: 0.015 g/100 ml @ 25 deg. C
It slowly decomposes in water to yield Trichloroacetic and Hydrochloric acids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Oxidized by strong oxidizing agents.
Incompatible with sodium hydroxide, finely divided or powdered metals such as zinc, aluminum, magnesium, potassium, chemically active metals such as lithium, beryllium , barium.
Protect from light.

Special Remarks on Corrosivity: Slowly corrodes aluminum, iron, and zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 2629 mg/kg [Rat].
Acute dermal toxicity (LD50): >3228 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 5200 4 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (Some evidence.) by NTP.
MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast.
May cause damage to the following organs: kidneys, liver, peripheral nervous system, upper respiratory tract,

skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of inhalation.
Slightly hazardous in case of skin contact (permeator), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Publishe Lethal Dose/Conc:
LDL [Rabbit] - Route: Oral; Dose: 5000 mg/kg
LDL [Dog] - Route: Oral; Dose: 4000 mg/kg
LDL [Cat] - Route: Oral; Dose: 4000 mg/kg

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects(teratogenic).
May affect genetic material (mutagenic).
May cause cancer.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Causes skin irritation with possible dermal blistering or burns. Symtoms may include redness, itching, pain, and possible dermal blistering or burns. It may be absorbed through the skin with possible systemic effects. A single prolonged skin exposure is not likely to result in the material being absorbed in harmful amounts.
Eyes: Contact causes transient eye irritation, lacrimation. Vapors cause eye/conjunctival irritation. Symptoms may include redness and pain.
Inhalation: The main route to occupational exposure is by inhalation since it is readily absorbed through the lungs. It causes respiratory tract irritation, . It can affect behavior/central nervous system (CNS depressant and anesthesia ranging from slight inebriation to death, vertigo, somnolence, anxiety, headache, excitement, hallucinations, muscle incoordination, dizziness, lightheadness, disorentiation, seizures, enotional instability, stupor, coma). It may cause pulmonary edema
Ingestion: It can cause nausea, vomiting, anorexia, diarrhea, bloody stool. It may affect the liver, urinary system (proteinuria, hematuria, renal failure, renal tubular disorder), heart (arrhythmias). It may affect behavior/central nervous system with symptoms similar to that of inhalation.
Chronic Potential Health Effects:
Skin: Prolonged or repeated skin contact may result in excessive drying of the skin, and irritation.
Ingestion/Inhalation: Chronic exposure can affect the liver(hepatitis,fatty liver degeneration), kidneys, spleen, and heart (irregular heartbeat/arrhythmias, cardiomyopathy, abnormal EEG), brain, behavior/central nervous system/peripheral nervous system (impaired memory, numbness of extremeties, peripheral neuropathy and other

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 18.4 mg/l 96 hours [Fish (Fatthead Minnow)]. 18 mg/l 48 hours [Daphnia (daphnia)]. 5 mg/l 96 hours [Fish (Rainbow Trout)]. 13 mg/l 96 hours [Fish (Bluegill sunfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Tetrachloroethylene UNNA: 1897 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Tetrachloroethylene
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Tetrachloroethylene
Connecticut hazardous material survey.: Tetrachloroethylene
Illinois toxic substances disclosure to employee act: Tetrachloroethylene
Illinois chemical safety act: Tetrachloroethylene
New York release reporting list: Tetrachloroethylene
Rhode Island RTK hazardous substances: Tetrachloroethylene
Pennsylvania RTK: Tetrachloroethylene
Minnesota: Tetrachloroethylene
Michigan critical material: Tetrachloroethylene
Massachusetts RTK: Tetrachloroethylene
Massachusetts spill list: Tetrachloroethylene
New Jersey: Tetrachloroethylene
New Jersey spill list: Tetrachloroethylene
Louisiana spill reporting: Tetrachloroethylene
California Director's List of Hazardous Substances: Tetrachloroethylene
TSCA 8(b) inventory: Tetrachloroethylene
TSCA 8(d) H and S data reporting: Tetrachloroethylene: Effective date: 6/1/87; Sunset date: 6/1/97
SARA 313 toxic chemical notification and release reporting: Tetrachloroethylene
CERCLA: Hazardous substances.: Tetrachloroethylene: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects.
R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
S23- Do not breathe gas/fumes/vapour/spray
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S37- Wear suitable gloves.
S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References: Not available.

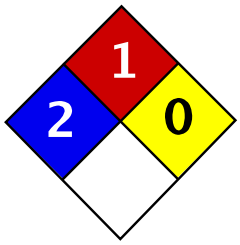
Other Special Considerations: Not available.

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Health	2
Fire	1
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Trichloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Trichloroethylene

Catalog Codes: SLT3310, SLT2590

CAS#: 79-01-6

RTECS: KX4560000

TSCA: TSCA 8(b) inventory: Trichloroethylene

CI#: Not available.

Synonym:

Chemical Formula: C2HCl3

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Trichloroethylene	79-01-6	100

Toxicological Data on Ingredients: Trichloroethylene: ORAL (LD50): Acute: 5650 mg/kg [Rat]. 2402 mg/kg [Mouse]. DERMAL (LD50): Acute: 20001 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 420°C (788°F)

Flash Points: Not available.

Flammable Limits: LOWER: 8% UPPER: 10.5%

Products of Combustion: These products are carbon oxides (CO, CO2), halogenated compounds.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the

product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Carcinogenic, teratogenic or mutagenic materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 50 STEL: 200 (ppm) from ACGIH (TLV)
TWA: 269 STEL: 1070 (mg/m3) from ACGIH
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 131.39 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 86.7°C (188.1°F)

Melting Point: -87.1°C (-124.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.4649 (Water = 1)

Vapor Pressure: 58 mm of Hg (@ 20°C)

Vapor Density: 4.53 (Air = 1)

Volatility: Not available.

Odor Threshold: 20 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, acetone.

Solubility:
Easily soluble in methanol, diethyl ether, acetone.
Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity:
Extremely corrosive in presence of aluminum.
Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): 2402 mg/kg [Mouse].
Acute dermal toxicity (LD50): 20001 mg/kg [Rabbit].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH.
The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Passes through the placental barrier in human. Detected in maternal milk in human.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Trichloroethylene : UN1710 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Trichloroethylene
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Trichloroethylene
Pennsylvania RTK: Trichloroethylene
Florida: Trichloroethylene
Minnesota: Trichloroethylene
Massachusetts RTK: Trichloroethylene
New Jersey: Trichloroethylene
TSCA 8(b) inventory: Trichloroethylene
CERCLA: Hazardous substances.: Trichloroethylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC).
CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R36/38- Irritating to eyes and skin.
R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

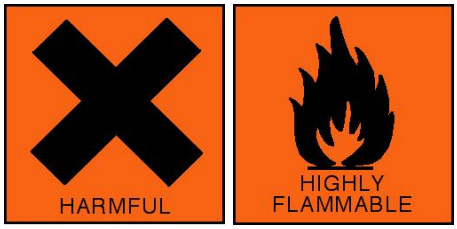
Other Special Considerations: Not available.

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Safety data for cis-1,2-dichloroethylene



Glossary of terms on this data sheet.

The information on this web page is provided to help you to work safely, but it is intended to be an overview of hazards, not a replacement for a full Material Safety Data Sheet (MSDS). MSDS forms can be downloaded from the web sites of many chemical suppliers.

General

Synonyms: (Z)-1,2-dichloroethene, cis-1,2-dichloroethene
Molecular formula: $C_2H_2Cl_2$

CAS No: 156-59-2
EC No: 205-859-7

Physical data

Appearance: colourless liquid
Melting point: -80 C
Boiling point: 60 C
Vapour density:
Vapour pressure: 200 mm Hg at 25 C
Specific gravity: 1.284
Flash point: 4 C
Explosion limits: 9.7 - 12.8 %
Autoignition temperature: 460 C
Water solubility: slight

Stability

Stable, but may decompose slowly on exposure to light, air or moisture. Incompatible with bases, oxidizing agents, sodium, sodium hydroxide, potassium hydroxide, copper, copper alloys, most metals. Highly flammable.

Toxicology

Harmful if swallowed, inhaled, or absorbed through skin. Irritant. Narcotic. Suspected carcinogen.

Toxicity data

(The meaning of any abbreviations which appear in this section is given here.)
IHL-MUS LCLO 65000 mg/m3/2h
IHL-CAT LCLO 20000 mg/m3/6h

Risk phrases

(The meaning of any risk phrases which appear in this section is given here.)
R11 R20 R21 R22 R36 R37 R39.

Transport information

(The meaning of any UN hazard codes which appear in this section is given here.)
Hazard class 3.0. Packing group II. UN No 1150.

Personal protection

Safety glasses, good ventilation.

Safety phrases

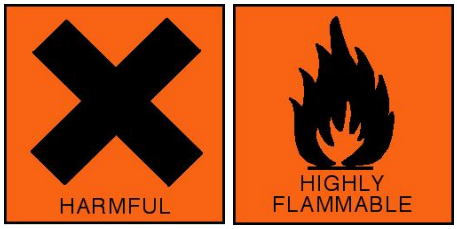
(The meaning of any safety phrases which appear in this section is given here.)
S16 S26.

[Return to Physical & Theoretical Chemistry Lab. Safety home page.]

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Safety data for trans-1,2-dichloroethylene



Glossary of terms on this data sheet.

The information on this web page is provided to help you to work safely, but it is intended to be an overview of hazards, not a replacement for a full Material Safety Data Sheet (MSDS). MSDS forms can be downloaded from the web sites of many chemical suppliers.

General

Synonyms: (E)-1,2-dichloroethene, trans-1,2-dichloroethene, trans-acetylene dichloride, 1,2-trans-dichloroethylene, 1,2-trans-dichloroethene, trans-1,2-DCE, Vertrel CCA
Use: Solvent, synthetic agent, constituent of perfumes
Molecular formula: $C_2H_2Cl_2$
CAS No: 156-60-5
EC No: 205-860-2

Physical data

Appearance: colourless liquid
Melting point: -50 C
Boiling point: 48 C
Vapour density:
Vapour pressure: 5.2 PSI at 20 C
Specific gravity: 1.257
Flash point: 6 C
Explosion limits: 9.7 - 12.8%
Autoignition temperature:

Stability

Incompatible with oxidizing agents, bases. Stable, but may decompose on exposure to air, moisture or light. Highly flammable.

Toxicology

Harmful if swallowed or inhaled, and in contact with skin. Narcotic. Irritant.

Toxicity data

(The meaning of any toxicological abbreviations which appear in this section is given here.)

ORL-RAT 1235 mg kg^{-1}

IHL-HMN TCLO 4800 mg m^{-3}/10m

IPR-RAT LD50 7536 mg kg^{-1}

ORL-MUS LD50 2122 mg kg^{-1}

Risk phrases

(The meaning of any risk phrases which appear in this section is given here.)
R11 R20 R21 R22 R36 R37 R38.

Transport information

(The meaning of any UN hazard codes which appear in this section is given here.)
UN No 1150. Hazard class 3.0. Packing group II

Personal protection

Safety glasses, adequate ventilation.

Safety phrases

(The meaning of any safety phrases which appear in this section is given here.)
S16 S26 S36.

[Return to Physical & Theoretical Chemistry Lab. Safety home page.]

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Material Safety Data Sheet

1. Product and Company Identification

Product name : **Vinyl Chloride**

Chemical formula : C-H2-C-H-Cl

Synonyms : 1-Chloroethylene; 1-Chloroethene; Chloroetheylene; Chloroethene; Chlorethene; Chlorethylene; Ethylene Monochloride; Monochloroethylene; Monochloro ethene; Monochloroethene; Vinyl chloride monomer; Vinyl chloride, Inhibited; Vinyl C Monomer

Company : Specialty Gases of America, Inc
6055 Brent Dr.
Toledo, OH 43611

Telephone : 419-729-7732

Emergency : 800-424-9300

2. Composition/Information on Ingredients

Components	CAS Number	% Volume
Vinyl Chloride	75-01-4	99+%
Phenol	108-95-2	< 0.1%
Inhibitors	Not assigned	< 0.1%

3. Hazards Identification

Emergency Overview

Harmful if swallowed, skin irritation, eye irritation, central nervous system depression, cancer hazard (in humans).
Flammable gas. May cause flash fire. May polymerize. Containers may rupture or explode.

Potential Health Effects

Inhalation : Irritation, nausea, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, disorientation, joint pain, loss of coordination, hearing loss, lung congestion. May cause impotence, bluish skin color, blood disorders, liver damage, cancer in long term exposure.

Eye contact : Irritation, eye damage.

Skin contact : Irritation, blisters.

Ingestion : Frostbite. May cause cancer in long term exposure.

Chronic Health Hazard : None known.

4. First Aid Measures

General advice : None.

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting upper and lower eyelids, until no evidence of chemical remains. Then get medical attention

immediately.

Skin contact	:	If frostbite or freezing occur, immediately flush with plenty of lukewarm water (105 – 115 F; 41 – 46 C). DO NOT USE HOT WATER. If warm water is not available, gently wrap affected parts in blankets. Get immediate medical attention.
Ingestion	:	If a large amount is swallowed, get medical attention.
Inhalation	:	If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

5. Fire-Fighting Measures

Suitable extinguishing media	:	Carbon dioxide, regular dry chemical. Large fires: Use regular foam or flood with fine water spray.
Specific hazards	:	Severe fire hazard. Severe explosion hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive. Electrostatic discharges may be generated by flow or agitation resulting in ignition or explosion.
Fire fighting	:	Move container from fire area if it can be done without risk. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after the fire is out. If this is impossible, then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Stop leak if possible without personal risk. Let fire burn unless leak can be stopped immediately. For smaller tanks or cylinders, extinguish and isolate from other flammables. Evacuation radius: 800 meters (1/2 mile). Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Evacuate if fire gets out of control or containers are directly exposed to fire. Evacuation radius: 500 meters (1/3 mile). Consider downwind evacuation if material is leaking.

6. Accidental Release Measures

Personal precautions	:	None.
Environmental precautions	:	None.
Methods for cleaning up	:	Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Keep unnecessary people away, isolate hazard area and deny entry. Remove sources of ignition. Ventilate closed spaces before entering. Notify local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304) If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).
Additional advice	:	None.

7. Handling and Storage

Handling

Secure cylinder when using to protect from falling. Use suitable hand truck to move cylinders.

Storage

Store in accordance with all current regulations and standards. Protect from physical damage. Store outside or in a detached building. Inside storage: Store in a cool, dry place. Store in a well-ventilated area. Avoid heat, flames, sparks and other sources of ignition. Grounding and bonding required. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101. See original container for storage recommendations. Keep separated from incompatible substances.

8. Exposure Controls / Personal Protection

Exposure limits

1.0 ppm OSHA TWA
5 ppm OSHA ceiling 15 minute(s)
0.5 ppm OSHA action level
1 ppm ACGIH TWA
NIOSH TWA (lowest feasible concentration)

Engineering measures

Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust or process ventilation system. Ensure compliance with applicable exposure limits.

Personal protective equipment

Respiratory protection	:	The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA. 10 p/m – Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive-pressure mode in combination with a separate escape supply. Any supplied-air respirator with a full facepiece that is operated in pressure-demand or other positive-pressure mode. Any chemical cartridge respirator with cartridge(s) providing protection against this material. 25 p/m – Any powered, air-purifying respirator with a tight-fitting facepiece and cartridge(s) providing protection against this substance. Any air-purifying respirator with a full facepiece, a canister providing protection against this substance, and a high-efficiency particulate filter. 100 p/m – Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply. Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode. Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode. 1000 p/m – Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply. Any supplied-air respirator operated in a continuous-flow mode. Any supplied-air respirator with a full facepiece. Any supplied-air respirator operated in a continuous-flow mode. 3600 p/m – Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply. For unknown concentrations or immediately dangerous to life or health – Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.
Hand protection	:	For the gas: Wear appropriate chemical resistant gloves. For the liquid: Wear insulated gloves.
Eye protection	:	Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.
Skin and body protection	:	Wear appropriate chemical resistant clothing.

9. Physical and Chemical Properties

Form	:	Gas.
Color	:	Colorless.
Odor	:	Faint odor, sweet odor.
Molecular weight	:	62.50
Vapor pressure	:	2515.6 mmHg @ 21.1 C
Vapor density	:	2.2 (air = 1)
Specific gravity	:	0.9106 (water = 1)
Boiling point	:	9 F (-13 C)
Freezing point	:	-245 F (-154 C)
Water solubility	:	0.25%
Evaporation rate	:	Not applicable.

10. Stability and Reactivity

Stability	:	May polymerize. Avoid contact with light or storage and use above room temperatures.
Conditions to avoid	:	Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat.
Materials to avoid	:	Metal carbide, metals, oxidizing materials, peroxides.
Hazardous decomposition products	:	Thermal decomposition products: halogenated compounds, oxides of carbon, phosgene.

11. Toxicological Information

Toxicity Data

18 pph/15 minute(s) inhalation-rat LC50; 500 mg/kg oral-rat LD50

Acute Health Hazard

Ingestion	:	Toxic.
Inhalation	:	Relatively non-toxic.
Skin	:	None.

12. Ecological Information

Ecotoxicity Data

Fish toxicity	:	388000 ug/L 10 month(s) LETH (Mortality) Northern pike (Esox lucius)
Invertebrate toxicity	:	41.74 ug/L 72 day(s) (Residue) Mosquito (Culex pipiens quinquefasciata)
Algal toxicity	:	41.74 ug/L 72 day(s) (Residue) Green algae (Oedogonium cardiacum)

13. Disposal Considerations

Waste from residues / unused products	:	Dispose in accordance with all applicable regulations. Hazardous Waste Number(s): D043. Hazardous Waste Number(s): D040. Dispose of in accordance with U.S. EPA 40 CFR 262 for concentrations at or above the Regulatory level. Regulatory level- 0.2 mg/L. U043.
Contaminated packaging	:	Return cylinder to supplier.

14. Transport Information

DOT (US only)

Proper shipping	:	Vinyl chloride, stabilized

name
Class : 2.1
UN/ID No. : UN1086
Labeling : Flammable Gas

Further information
Cylinders should be transported in a secure upright position in a well ventilated truck.

15. Regulatory Information

OSHA Process Safety (29 CFR 1910.119) Hazard Class(es)
Not regulated.

TCSA
Material is listed in TSCA inventory.

SARA Title III Section 302 Extremely Hazardous Substances (40 CFR 355.30)
Not regulated.

SARA Title III Section 304 Extremely Hazardous Substances (40 CFR 355.40)
Not regulated.

SARA Title III SARA Sections 311/312 Hazardous Categories (40 CFR 370.21)
Acute: Yes
Chronic: Yes
Fire: Yes
Reactive: Yes
Sudden Release: Yes

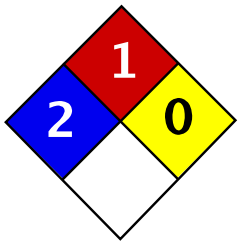
SARA Title III Section 313 (40 CFR 372.65)
Vinyl Chloride

CERCLA Sections 102a/103 Hazardous Substances (40 CFR 302.4)
Vinyl Chloride: 1 lbs RQ
Phenol: 1000 lbs RQ

16. Other Information

Prepared by : Specialty Gases of America, Inc.
For additional information, please visit our website at www.americangasgroup.com.





Health	2
Fire	1
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
1,1,1-Trichloroethane MSDS

Section 1: Chemical Product and Company Identification

Product Name: 1,1,1-Trichloroethane

Catalog Codes: SLT4180, SLT2167, SLT3460

CAS#: 71-55-6

RTECS: KJ2975000

TSCA: TSCA 8(b) inventory: 1,1,1-Trichloroethane

CI#: Not available.

Synonym:

Chemical Formula: CH3CCl3

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{1,1,1-}Trichloroethane	71-55-6	100

Toxicological Data on Ingredients: 1,1,1-Trichloroethane: ORAL (LD50): Acute: 9600 mg/kg [Rat]. 6000 mg/kg [Mouse]. DERMAL (LD50): Acute: 15800 mg/kg [Rabbit]. VAPOR (LC50): Acute: 18000 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of eye contact (irritant), of ingestion. Hazardous in case of skin contact (irritant, permeator), of inhalation. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to lungs, the nervous system, liver, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 537°C (998.6°F)

Flash Points: Not available.

Flammable Limits: LOWER: 7.5% UPPER: 12.5%

Products of Combustion: These products are carbon oxides (CO, CO2), halogenated compounds.

Fire Hazards in Presence of Various Substances: Slightly flammable to flammable in presence of oxidizing materials, of acids, of alkalis.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.
Slightly explosive to explosive in presence of oxidizing materials, of acids, of alkalis.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Combustible materials should be stored away from extreme heat and away from strong oxidizing agents.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 350 STEL: 440 CEIL: 440 (ppm) from ACGIH (TLV) [1995]
TWA: 1900 STEL: 2460 CEIL: 2380 (mg/m3) from ACGIH [1995]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 133.41 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: 74.1°C (165.4°F)

Melting Point: -32.5°C (-26.5°F)

Critical Temperature: Not available.

Specific Gravity: 1.3376 (Water = 1)

Vapor Pressure: 100 mm of Hg (@ 20°C)

Vapor Density: 4.6 (Air = 1)

Volatility: Not available.

Odor Threshold: 400 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 6000 mg/kg [Mouse].
Acute dermal toxicity (LD50): 15800 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 18000 ppm 4 hour(s) [Rat].

Chronic Effects on Humans: The substance is toxic to lungs, the nervous system, liver, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of ingestion.
Hazardous in case of skin contact (irritant, permeator), of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Detected in maternal milk in human.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : 1,1,1-Trichloroethane : UN2831 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: 1,1,1-Trichloroethane
Massachusetts RTK: 1,1,1-Trichloroethane
TSCA 8(b) inventory: 1,1,1-Trichloroethane
SARA 313 toxic chemical notification and release reporting: 1,1,1-Trichloroethane
CERCLA: Hazardous substances.: 1,1,1-Trichloroethane

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC).

DSCL (EEC):
R38- Irritating to skin.
R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

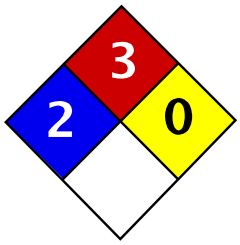
Other Special Considerations: Not available.

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Last Updated: 11/06/2008 12:00 PM

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Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
1,1-Dichloroethane MSDS

Section 1: Chemical Product and Company Identification

Product Name: 1,1-Dichloroethane

Catalog Codes: SLD3280

CAS#: 75-34-3

RTECS: KI0175000

TSCA: TSCA 8(b) inventory: 1,1-Dichloroethane

CI#: Not available.

Synonym:

Chemical Name: 1,1-Dichloroethane

Chemical Formula: C2-H4-Cl2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{1,1-}Dichloroethane	75-34-3	100

Toxicological Data on Ingredients: 1,1-Dichloroethane: ORAL (LD50): Acute: 725 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified 2 (Reasonably anticipated.) by NTP. A4 (Not classifiable for human or animal.) by ACGIH.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Classified Development toxin [POSSIBLE].
The substance is toxic to kidneys, lungs, liver, central nervous system (CNS).
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 458°C (856.4°F)

Flash Points: CLOSED CUP: -17°C (1.4°F). OPEN CUP: -6°C (21.2°F).

Flammable Limits: LOWER: 5.6% UPPER: 11.4%

Products of Combustion: These products are carbon oxides (CO, CO2), halogenated compounds.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth,

sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents, alkalis.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 250 (ppm) from ACGIH (TLV) [1999]
TWA: 100 (ppm) from OSHA (PEL)
Australia: TWA: 200 (ppm)
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Oily liquid.)

Odor: Chloroform like odor (Slight.)

Taste: Not available.

Molecular Weight: 98.96 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 57.3°C (135.1°F)

Melting Point: -96.9°C (-142.4°F)

Critical Temperature: 261.5°C (502.7°F)

Specific Gravity: 1.175 (Water = 1)

Vapor Pressure: 180 mm of Hg (@ 20°C)

Vapor Density: 3.44 (Air = 1)

Volatility: Not available.

Odor Threshold: 120 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties:
Partially dispersed in diethyl ether.
See solubility in water, diethyl ether.

Solubility: Partially soluble in diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents, alkalis.

Corrosivity: Corrosive in presence of aluminum.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Will attack some forms of plastic and rubber

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 725 mg/kg [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2 (Reasonably anticipated.) by NTP. A4 (Not classifiable for human or animal.) by ACGIH.
DEVELOPMENTAL TOXICITY: Classified Development toxin [POSSIBLE].
The substance is toxic to kidneys, lungs, liver, central nervous system (CNS).

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification:
CLASS 3: Combustible liquid with a flash point greater than 37.8C (100F).
Marine pollutant

Identification: : 1,1-Dichloroethane : UN2362 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65 (no significant risk level): 1,1-Dichloroethane
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: 1,1-Dichloroethane
Rhode Island RTK hazardous substances: 1,1-Dichloroethane
Pennsylvania RTK: 1,1-Dichloroethane
Florida: 1,1-Dichloroethane
Minnesota: 1,1-Dichloroethane
Massachusetts RTK: 1,1-Dichloroethane
New Jersey: 1,1-Dichloroethane
New Jersey spill list: 1,1-Dichloroethane
TSCA 8(b) inventory: 1,1-Dichloroethane
TSCA 8(a) PAIR: 1,1-Dichloroethane
TSCA 8(d) H and S data reporting: 1,1-Dichloroethane: June 1999
TSCA 12(b) one time export: 1,1-Dichloroethane
SARA 313 toxic chemical notification and release reporting: 1,1-Dichloroethane: 1%
CERCLA: Hazardous substances.: 1,1-Dichloroethane: 1000 lbs. (453.6 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):

R11- Highly flammable.
R22- Harmful if swallowed.
R37/38- Irritating to respiratory system and skin.
R41- Risk of serious damage to eyes.
R52- Harmful to aquatic organisms.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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Safety data for 1,1-dichloroethylene



Glossary of terms on this data sheet.

The information on this web page is provided to help you to work safely, but it is intended to be an overview of hazards, not a replacement for a full Material Safety Data Sheet (MSDS). MSDS forms can be downloaded from the web sites of many chemical suppliers.

General

Synonyms: 1,1-dce, NCI-C54262, vinylidene chloride, sconatex, asym-dichloroethylene, 1,1-dichloroethene, VDC, vinylidene dichloride
Molecular formula: $C_2H_2Cl_2$

CAS No: 75-35-4
EC No: 200-864-0
Annex I Index No: 602-025-00-8

Physical data

Appearance: colourless liquid
Melting point: -122 C
Boiling point: 31.7 C
Vapour density: 3.46 g/l
Vapour pressure: 500 mm Hg at 20 C
Density (g cm^{-3}): 1.218
Flash point: -10 C
Explosion limits: 6.5 - 15.5%
Autoignition temperature:
Water solubility: moderate

Stability

Stable. Very flammable - note low flash point. Vapour may travel considerable

distances to a source of ignition. Incompatible with strong oxidizing agents, alcohols, halides, sopper, aluminium. Rapidly absorbs oxygen from the air and forms explosive peroxides. Light and water promote self-polymerisation. May form explosive mixtures with air. Usually inhibited with a small amount (ca. 0.02%) of hydroquinone monomethyl ether.

Toxicology

Poison. Harmful if ingested, inhaled or absorbed through the skin. An experimental carcinogen, tumorigen, neoplastigen and teratogen. May cause systemic effects if inhaled. May cause reproductive damage. Note that a maximum exposure limit is defined for this material for use in the UK.

Toxicity data

(The meaning of any abbreviations which appear in this section is given here.)
IHL-HMN TCLO 25 ppm

ORL-RAT LD50 200 mg kg^{-1}

ORL-MUS LD50 194 mg kg^{-1}

IVN-DOG LDLO 225 mg kg^{-1}

Risk phrases

(The meaning of any risk phrases which appear in this section is given here.)
R12 R20 R40. (Note: Annex I does not quote risk phrase R19. However, this material is reported to form peroxides when stored in contact with the air and should be handled as though R19 applies.)

Transport information

(The meaning of any UN hazard codes which appear in this section is given here.)
UN No 1303. Hazard class 3. Packing group I.

Personal protection

Safety glasses, gloves, good ventilation. Treat as a possible carcinogen. Remove all sources of ingition, including hot plates, from working area.

Safety phrases

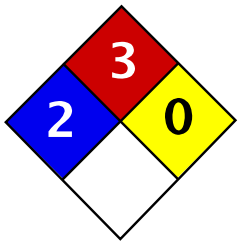
(The meaning of any safety phrases which appear in this section is given here.)

[Return to Physical & Theoretical Chemistry Lab. Safety home page.]

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Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Benzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Benzene

Catalog Codes: SLB1564, SLB3055, SLB2881

CAS#: 71-43-2

RTECS: CY1400000

TSCA: TSCA 8(b) inventory: Benzene

CI#: Not available.

Synonym: Benzol; Benzine

Chemical Name: Benzene

Chemical Formula: C6-H6

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Benzene	71-43-2	100

Toxicological Data on Ingredients: Benzene: ORAL (LD50): Acute: 930 mg/kg [Rat]. 4700 mg/kg [Mouse]. DERMAL (LD50): Acute: >9400 mg/kg [Rabbit]. VAPOR (LC50): Acute: 10000 ppm 7 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of eye contact (irritant), of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC.
MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE].
The substance is toxic to blood, bone marrow, central nervous system (CNS).
The substance may be toxic to liver, Urinary System.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 497.78°C (928°F)

Flash Points: CLOSED CUP: -11.1°C (12°F). (Setaflash)

Flammable Limits: LOWER: 1.2% UPPER: 7.8%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat.
Slightly flammable to flammable in presence of oxidizing materials.
Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.
Explosive in presence of oxidizing materials, of acids.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Extremely flammable liquid and vapor. Vapor may cause flash fire.
Reacts on contact with iodine heptafluoride gas.

Dioxygenyl tetrafluoroborate is as very powferful oxidant. The addition of a small particle to small samples of benzene, at ambient temperature, causes ignition.
Contact with sodium peroxide with benzene causes ignition.
Benzene ignites in contact with powdered chromic anhydride.
Virgorous or incandescent reaction with hydrogen + Raney nickel (above 210 C) and bromine trifluoride.

Special Remarks on Explosion Hazards:
Benzene vapors + chlorine and light causes explosion.
Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate.
Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion.
Interaction of nitryl perchlorate with benzene gave a slight explosion and flash.
The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene.
Peroxodisulfuric acid is a very powferful oxidant. Uncontrolled contact with benzene may cause explosion.
Mixtures of peroxomonsulfuric acid with benzene explodes.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 0.5 STEL: 2.5 (ppm) from ACGIH (TLV) [United States]
TWA: 1.6 STEL: 8 (mg/m3) from ACGIH (TLV) [United States]
TWA: 0.1 STEL: 1 from NIOSH
TWA: 1 STEL: 5 (ppm) from OSHA (PEL) [United States]
TWA: 10 (ppm) from OSHA (PEL) [United States]
TWA: 3 (ppm) [United Kingdom (UK)]
TWA: 1.6 (mg/m3) [United Kingdom (UK)]
TWA: 1 (ppm) [Canada]
TWA: 3.2 (mg/m3) [Canada]
TWA: 0.5 (ppm) [Canada]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor:
Aromatic. Gasoline-like, rather pleasant.
(Strong.)

Taste: Not available.

Molecular Weight: 78.11 g/mole

Color: Clear Colorless. Colorless to light yellow.

pH (1% soln/water): Not available.

Boiling Point: 80.1 (176.2°F)

Melting Point: 5.5°C (41.9°F)

Critical Temperature: 288.9°C (552°F)

Specific Gravity: 0.8787 @ 15 C (Water = 1)

Vapor Pressure: 10 kPa (@ 20°C)

Vapor Density: 2.8 (Air = 1)

Volatility: Not available.

Odor Threshold: 4.68 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Miscible in alcohol, chloroform, carbon disulfide oils, carbon tetrachloride, glacial acetic acid, diethyl ether, acetone.
Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles.

Incompatibility with various substances: Highly reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Benzene vapors + chlorine and light causes explosion.
Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate.
Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion.
Interaction of nitryl perchlorate with benzene gave a slight explosion and flash.
The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene.
Peroxodisulfuric acid is a very powferful oxidant. Uncontrolled contact with benzene may cause explosion.
Mixtures of peroxomonsulfuric acid with benzene explodes.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 930 mg/kg [Rat].
Acute dermal toxicity (LD50): >9400 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 10000 7 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC.
MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast.
DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE].
Causes damage to the following organs: blood, bone marrow, central nervous system (CNS).
May cause damage to the following organs: liver, Urinary System.

Other Toxic Effects on Humans:
Very hazardous in case of inhalation.
Hazardous in case of skin contact (irritant, permeator), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (female fertility, Embryotoxic and/or foetotoxic in animal) and birth defects.
May affect genetic material (mutagenic).
May cause cancer (tumorigenic, leukemia))
Human: passes the placental barrier, detected in maternal milk.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Causes skin irritation. It can be absorbed through intact skin and affect the liver, blood, metabolism,and urinary system.
Eyes: Causes eye irritation.
Inhalation: Causes respiratory tract and mucous membrane irritation. Can be absorbed through the lungs. May affect behavior/Central and Peripheral nervous systems (somnolence, muscle weakness, general anesthetic, and

other symptoms similar to ingestion), gastrointestinal tract (nausea), blood metabolism, urinary system.
Ingestion: May be harmful if swallowed. May cause gastrointestinal tract irritation including vomiting. May affect behavior/Central and Peripheral nervous systems (convulsions, seizures, tremor, irritability, initial CNS stimulation followed by depression, loss of coordination, dizziness, headache, weakness, pallor, flushing), respiration (breathlessness and chest constriction), cardiovascular system, (shallow/rapid pulse), and blood.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Benzene UNNA: 1114 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Benzene
California prop. 65 (no significant risk level): Benzene: 0.007 mg/day (value)
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Benzene
Connecticut carcinogen reporting list.: Benzene
Connecticut hazardous material survey.: Benzene
Illinois toxic substances disclosure to employee act: Benzene
Illinois chemical safety act: Benzene
New York release reporting list: Benzene
Rhode Island RTK hazardous substances: Benzene
Pennsylvania RTK: Benzene
Minnesota: Benzene
Michigan critical material: Benzene
Massachusetts RTK: Benzene
Massachusetts spill list: Benzene
New Jersey: Benzene
New Jersey spill list: Benzene
Louisiana spill reporting: Benzene
California Director's list of Hazardous Substances: Benzene

TSCA 8(b) inventory: Benzene
SARA 313 toxic chemical notification and release reporting: Benzene
CERCLA: Hazardous substances.: Benzene: 10 lbs. (4.536 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable.
R22- Harmful if swallowed.
R38- Irritating to skin.
R41- Risk of serious damage to eyes.
R45- May cause cancer.
R62- Possible risk of impaired fertility.
S2- Keep out of the reach of children.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S39- Wear eye/face protection.
S46- If swallowed, seek medical advice immediately and show this container or label.
S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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ARCADIS

Appendix F

Emergency Action Plan and Route to Hospital

EMERGENCY ACTION PLAN

Emergency Contact List

Emergency Contact	Phone
Local Police	911 (if appropriate) and 607-778-1911
Local Ambulance	911 (if appropriate) and 607-772-6565
Local Fire Department	911 (if appropriate) and 607-775-24111
Local Hospital – **Binghamton General Hospital**	607-762-2200
Local Weather Data	www.weather.com
Poison Control	800.332.3073
National Response Center (all spills in reportable quantities)	800.424.8802
U.S. Coast Guard (spills to water)	800.424.8802
Project Manager – **Gregory Albright**	609-860-0590
Site Manager – **Kaiti Liao**	267-285-1822
H&S Manager – **Lauren Edwards**	317-236-5205
Client Contact – **Robert Gan**	908-672-0285

List the Emergency Notification Procedure for the project:

Step 1:Dial 911 (if necessary) and/or Work Care 800-455-6155
Step 2:Contact PIC/PM/TM
Step 3:Contact H&S
Step 4:Contact Near Loss Reporting Hotline 866-242-4304

If emergency attention is not needed but professional medical attention is necessary, the employee will be taken to (see hospital route):

Medical Facility: Binghamton General Hospital
Address: 10-42 Mitchell Ave
Binghamton, NY
Phone Number: 607-762-2200

Emergency Supplies and Equipment List

Emergency Supplies and Equipment (check all that apply)	Location on Project Site
☒ First Aid Kit (type):	Vehicle/Field Kit
☒ Fire Extinguisher	Vehicle
☒ Mobile Phone ☐ Satellite Phone	Vehicle
☒ Traffic Cones	Vehicle
☐ Walkie Talkies	
☒ Water or Other Fluid Replenishment	Vehicle/Field Kit
☐ Eye Wash/Quick Drench Station	
☒ Eye Wash Bottle	Vehicle/Field Kit
☒ Wash and Dry Towelettes	Vehicle/Field Kit
☒ Sunscreen (SPF 15 or higher)	Vehicle/Field Kit
☒ Insect Repellant	Vehicle/Field Kit
☐ Chemical Spill Kit	
☐ *Other (specify):*	

ARCADIS
Infrastructure, environment, buildings

Imagine the result

Dover Corporation

Community Air Monitoring Plan

Former Dover Electronics Site
Kirkwood, Broome County, New York
Site Number (7-04-026)

February 2011

ARCADIS

Kaiti Liao
Project Engineer

Gregory R. Albright, P.G.
Principal Geologist/Project Manager

Community Air Monitoring Plan

Former Dover Electronics Site

Prepared for:
Dover Corporation

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Our Ref.:
NJ000616.K010

Date:
February 2011

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Figures

Figure 1 Site Plan

Figure 2 In-Situ Chemical Oxidation Full Scale System Layout Plan

1. Introduction

ARCADIS U.S., Inc. (ARCADIS), on behalf of Dover Corporation (Dover), has prepared this Community Air Monitoring Plan (CAMP) for the proposed groundwater remedial system construction activities to be conducted at the former Dover Electronics site located at 29 Industrial Park Drive, Kirkwood, Broome County, New York. **Figure 1** depicts the site location. This CAMP (which is presented as Appendix G to the In-Situ Chemical Oxidation [ISCO] Construction Package) will be implemented during the system construction activities which involve excavation of site soils and other intrusive subsurface field activities.

As indicated in the ISCO Construction Package, an ISCO groundwater remedial system is proposed to be constructed/installed along the west side of the main building and the upper parking lot area. The location of the proposed groundwater remedial system is shown on Figure 2. The construction activities will include piping trench excavation, construction of a below grade vault box, soil removal, stockpile and disposal, injection and monitoring well installations, and backfilling and restoration. The detailed construction activities are discussed in Section 2 of the ISCO Construction Package. In accordance with the historical soil investigation and remedial action reports and Soils Management Plan (Blasland, Bouck and Lee [BBL] 2004), the trench and vault box areas are not within the areas containing tetrachloroethene (PCE)-affected soils.

The purpose of this CAMP is to provide a measure of protection for the downwind community (i.e., offsite receptors, including residents, businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminants releases that may be a direct result of the intrusive subsurface activities. In addition, a CAMP helps to confirm that work activities did not spread contamination off-site through the air. This CAMP has been prepared in accordance with the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan, dated June 2000 and the New York State of Department of Environmental Conservation (NYSDEC) Draft DER-10 Technical Guidance for Site Investigation and Remediation, dated November 2009.

2. Air Monitoring Procedures for Intrusive Activities

Per the NYSDOH Generic Community Air Monitoring Plan, a CAMP requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in

progress at contaminated sites. Because ground intrusive activities (e.g. soil excavation and handling, trenching, and well installations) will be conducted during the construction, continuous monitoring will be required for all ground intrusive activities. It is proposed that a minimum of four temporary monitoring stations will be positioned around the intrusive activity work areas, consisting of an upwind and downwind location and on both sides of the work area. As work and weather conditions changes, the monitoring locations will be adjusted to accommodate the site conditions.

The following sections describe the specific monitoring procedures for particulates and VOCs.

2.1 Particulate Monitoring

The particulate monitoring will be conducted during all ground intrusive activities. The monitoring will be performed continuously using both real-time monitoring equipment and visual observations. At each monitoring station, monitoring equipment capable of measuring particulate matter smaller than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes or less, will be set up at heights approximately 4 feet to 5 feet above land surface (i.e., the breathing zone). The equipment will also be equipped with an audible alarm to indicate exceedance of the action level. An audible alarm on the downwind particulate monitoring device will be set at 100 micrograms per cubic meter (• g/m^3) above the background level (i.e., the upwind location). Upwind concentrations will be measured at the start of each workday and periodically throughout the day to establish background conditions.

The wind direction will be recorded to ensure that CAMP equipment is located appropriately based upon the wind direction. The particulate monitoring equipment will be calibrated at the start of each day and throughout the day if it is necessary.

The monitoring response levels and actions are summarized below.

- If the downwind PM-10 particulate level is 100 • g/m^3 greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques shall be employed. Work may continue with dust suppression techniques, provided that downwind PM-10 particulate levels do not exceed 150 • g/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

- After implementation of dust suppression techniques, if downwind PM-10 particulate levels are greater than 150 • g/m^3 above the upwind level for 15-minute average, work must be stopped and the activities shall be reevaluated. Work can resume provided that dust suppression techniques and/or other control measures reduce the downwind PM-10 particulate level to within 150 • g/m^3 of the upwind level successfully and prevent visible dust migration.

- There may be situations where visible dust is generated by excavation activities and migrates to downwind locations but is not detected by the monitoring equipment at or above the action levels. Therefore, if visible dust is observed leaving the working area, dust suppression techniques will be employed.

The locations of monitoring equipment and all air monitoring data will be recorded in the onsite files and will be available for NYSDEC and NYSDOH personnel to review.

2.2 Volatile Organic Compound Monitoring

VOCs will be monitored at the downwind perimeter of the immediate work area on a continuous basis. The VOC monitoring component of the CAMP will only be implemented at the work areas that are known or suspected to contain VOCs. Upwind concentrations will be measured at the start of each workday and periodically thereafter (not less than three times per day) to establish background conditions. The monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment (An RAE Systems MiniRAE 2000 VOC monitor using Photoionization detector [PID] or equivalent) will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the response levels specified below.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities in the area of concern must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind perimeter of the work area or half the distance to the nearest potential receptor is below 5 ppm over background for the 15-minute average.

- If the organic vapor level is more than 25 ppm at the perimeter of the work area, activities must be shutdown.

The locations of monitoring equipment and all air monitoring data will be recorded in the onsite files and will be available for NYSDEC and NYSDOH personnel to review.

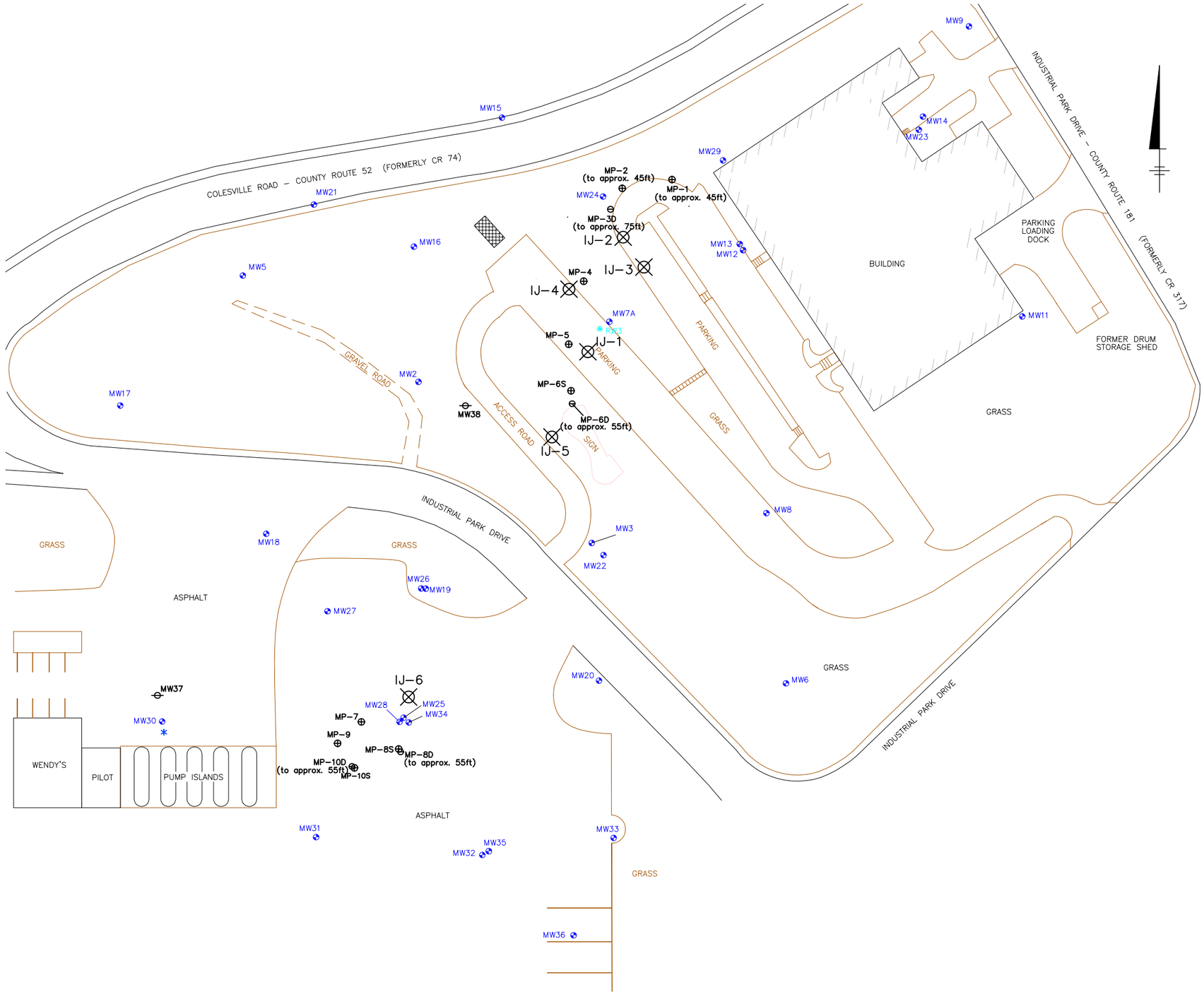
3. References

ARCADIS of New York, Inc., *In-Situ Chemical Oxidation Construction Package*. (February 2011)

Blasland, Bouck and Lee, *Soils Management Plan*. (December 2004)

New York State Department of Environmental Conservation. *DER-10 Technical Guidance for Site Investigation and Remediation.* (November 2009).

New York State Department of Health. *Generic Community Air Monitoring Plan.* (June 2000).



LEGEND

- EXISTING MONITORING WELL
- 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH
- TREATMENT BUILDING
- INFILTRATION TEST WELL

SOURCE:

BASEMAP FROM FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

0 120' 240'

GRAPHIC SCALE

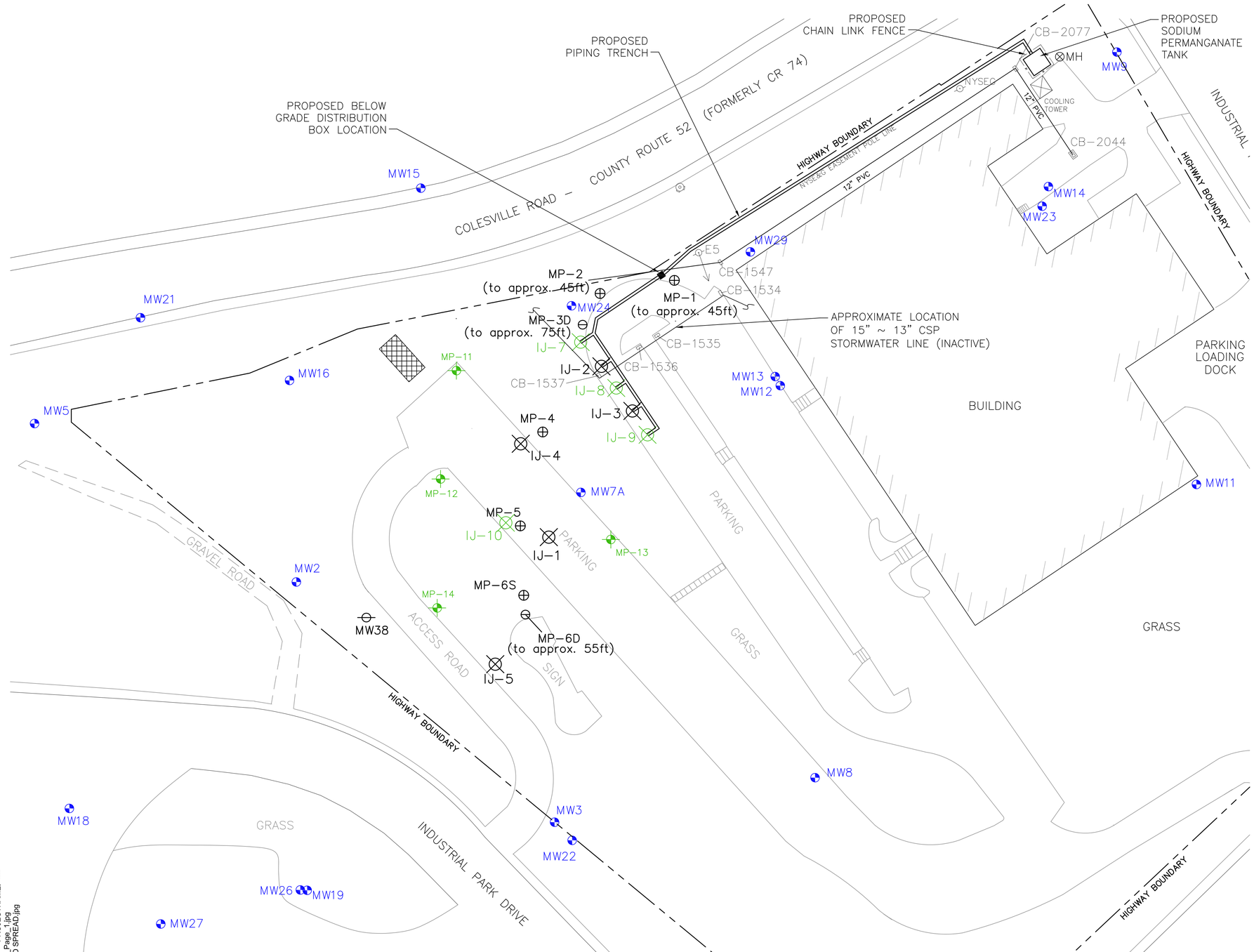
UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
COMMUNITY AIR MONITORING PLAN

SITE MAP

ARCADIS

FIGURE
1

CITY: CRANBURY-NJ DIV/GROUP: ENVCAD DB: TFATTO LD: PIC: PM:G.ALBRIGHT TM: K.LIAO LYR:ON=*;OFF=*REF*
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XREFS: IMAGES: PROJECTNAME: ---
000616X02



LEGEND

- PROPOSED INJECTION WELL
- PROPOSED MONITORING POINTS
- PROPOSED CHAIN LINK FENCE
- PROPOSED PIPING TRENCH
- PROPOSED BELOW GRADE DISTRIBUTION BOX
- EXISTING MONITORING WELL
- 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH
- INJECTION TEST WELL
- EXISTING TREATMENT BUILDING
- EXISTING FIRE HYDRANT
- POWER POLE (APPROXIMATE LOCATION)
- GW GUIDE WIRE (APPROXIMATE LOCATION)
- MH MANHOLE (APPROXIMATE LOCATION)
- CB CATCH BASINS (APPROXIMATE LOCATION)
- HIGHWAY BOUNDARY (APPROXIMATE LOCATION)
- UNDERGROUND PIPING (APPROXIMATE LOCATION)

0 40' 80'
GRAPHIC SCALE

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
COMMUNITY AIR MONITORING PLAN

IN-SITU CHEMICAL OXIDATION FULL SCALE SYSTEM LAYOUT PLAN

ARCADIS

FIGURE 2

CITY:MAHWAH DIV/GROUP:ENVCAD DB:JG LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\Mahwah\ACTNU0006616\K01000001\2010_CAM\PIFIG 2.dwg LAYOUT: 2 SAVED: 7/28/2010 1:46 PM ACADVER: 17.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ARCADIS.CTB PLOTTED: 7/28/2010 1:46 PM BY: GONZALEZ, JAMES
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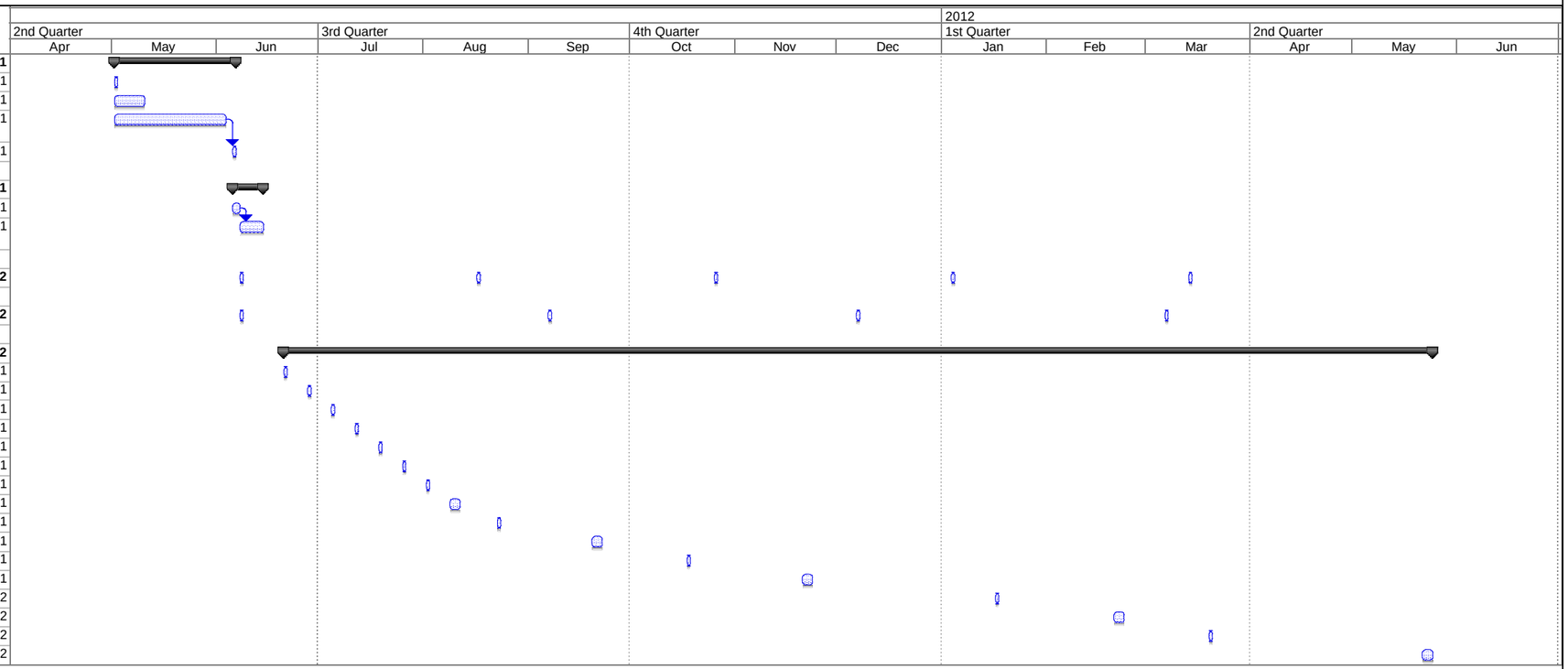
ARCADIS

Appendix H

Proposed Schedule

Proposed Schedule for Full Scale ISCO System Installation and First Year Operation and Monitoring
Former Dover Electronics Site
Kirkwood, New York

ID	Task Name	Duration	Start	Finish
1	**Installation of Injection System**	**26 days**	**Mon 5/2/11**	**Mon 6/6/11**
2	Utility Survey	1 day	Mon 5/2/11	Mon 5/2/11
3	Injection and Monitoring Well Installation	7 days	Mon 5/2/11	Tue 5/10/11
4	Tank Installation, Trenching, Pipe Installation	25 days	Mon 5/2/11	Fri 6/3/11
5	Site Survey (As-Built)	1 day	Mon 6/6/11	Mon 6/6/11
6				
7	**System Start-Up Test**	**7 days**	**Mon 6/6/11**	**Tue 6/14/11**
8	Pre-Injection Field Parameter Monitoring	2 days	Mon 6/6/11	Tue 6/7/11
9	ISCO Injection at MMC (Solution Preparation and System Start-Up Test and Monitoring)	5 days	Wed 6/8/11	Tue 6/14/11
10				
11	**ISCO Injection at MMC**	**201 days**	**Wed 6/8/11**	**Wed 3/14/12**
17				
18	**ISCO Injection at Pilot Truck Stop**	**196 days**	**Wed 6/8/11**	**Wed 3/7/12**
23				
24	**Performance Monitoring**	**243 days**	**Tue 6/21/11**	**Thu 5/24/12**
25	Month 1 Monitoring - Event 1	1 day	Tue 6/21/11	Tue 6/21/11
26	Month 1 Monitoring - Event 2	1 day	Tue 6/28/11	Tue 6/28/11
27	Month 1 Monitoring - Event 3	1 day	Tue 7/5/11	Tue 7/5/11
28	Month 1 Monitoring - Event 4	1 day	Tue 7/12/11	Tue 7/12/11
29	Month 2 Monitoring - Event 1	1 day	Tue 7/19/11	Tue 7/19/11
30	Month 2 Monitoring - Event 2	1 day	Tue 7/26/11	Tue 7/26/11
31	Month 2 Monitoring - Event 3	1 day	Tue 8/2/11	Tue 8/2/11
32	Month 2 Monitoring - Event 4	3 days	Tue 8/9/11	Thu 8/11/11
33	Month 3 Monitoring	1 day	Tue 8/23/11	Tue 8/23/11
34	Month 4 Monitoring	3 days	Tue 9/20/11	Thu 9/22/11
35	Month 5 Monitoring	1 day	Tue 10/18/11	Tue 10/18/11
36	Month 6 Monitoring	3 days	Mon 11/21/11	Wed 11/23/11
37	Month 8 Monitoring	1 day	Tue 1/17/12	Tue 1/17/12
38	Month 9 Monitoring	3 days	Tue 2/21/12	Thu 2/23/12
39	Month 10 Monitoring	1 day	Tue 3/20/12	Tue 3/20/12
40	Month 12 Monitoring	3 days	Tue 5/22/12	Thu 5/24/12



Project: Proposed Dover Kirkwood ISCO
Date: Wed 3/2/11

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