FINAL

Remedial Design/Remedial Action Work Plan for the Wyoming County Fire Training Area Wethersfield, New York

Prepared For:

Wyoming County
143 North Main Street
Warsaw, New York 14569

Prepared By:

URS Corporation
77 Goodell Street
Buffalo, New York 14203

June 2006

G3800D

URS

July 27, 2006

Linda Ross
Project Manager
New York State Department of Environmental Conservation
Division of Environmental Remediation, Region 9
270 Michigan Avenue
Buffalo NY 14203-2999

RE: Wyoming County Fire Training Center
Remedial Design/Remedial Action Work Plan

Dear Ms. Ross:

URS Corporation – New York (URS), on behalf of Wyoming County, is pleased to submit two copies of the "*Final Remedial Design/Remedial Action Work Plan for the Wyoming County Fire Training Center*". The report has been prepared in accordance with the requirements of the New York State Department of Environmental Conservation (NYSDEC) Draft DER-10 Technical Guidance for Site Investigation and Remediation, December 2002 and discussions with the Department.

This Work Plan presents the design for the selected remedial alternative and provides a description of the procedures for implementing the remedial action.

Should you have any questions regarding the Work Plan or require additional information please do not hesitate to call me

Sincerely,

URS CORPORATION

Robert R. Henschel, P.G.
Sr. Project Manager

/dth

cc: D. Simmons – Hancock & Estabrook
C. O'Connor - NYSDOH
File: 11172991 (C-1)

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FINAL

REMEDIAL DESIGN / REMEDIAL ACTION WORK PLAN

FOR THE

WYOMING COUNTY FIRE TRAINING CENTER

WETHERSFIELD, NEW YORK

VOLUNTARY CLEANUP (SITE V-00604)

PREPARED FOR:

WYOMING COUNTY

143 NORTH MAIN STREET

WARSAW, NEW YORK 14569

PREPARED BY:

URS CORPORATION

77 GOODELL STREET

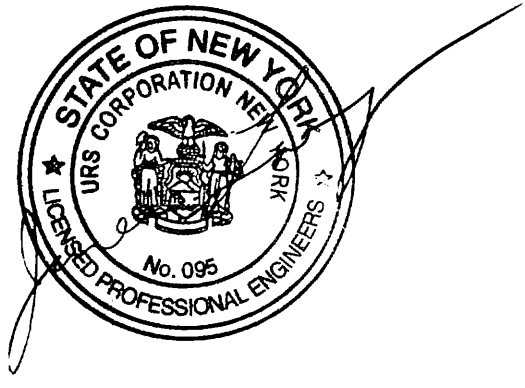
BUFFALO, NEW YORK 14203

ROBERT R. HENSCHEL, P.G.
PROJECT MANAGER

(716) 856-5636

JUNE 2006

This Remedial Design/Remedial Action Work Plan has been prepared by qualified individuals familiar with the relevant environmental regulations working under my direction. Information used in the development of this work plan was collected by URS using subcontractors, the findings from previous studies at the site, and our own staff. The recommendations included herein provide the basis for the responsible remediation of this site.



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ACRONYM LIST

AMSL	above mean sea level
AOC	area of concern
AST	above ground storage tank
bgs	below ground surface
CAMP	Community Air Monitoring Plan
CFR	Code of Federal Regulations
cm/sec	centimeters per second
COI	constituents of interest
County	Wyoming County
CQA	construction quality assurance
DER-10	Draft Technical Guidance for Site Investigation and Remediation
EPA	Environmental Protection Agency
FCR	field change request
gpm	gallons per minute
HASP	Health and Safety Plan
IRM	Interim Remedial Measures
ISO	in-situ chemical oxidation
µg/l	micrograms per liter
µg/kg	micrograms per kilogram
NCR	non-conformance report
NWECC	Nature's Way Environmental Consultants and Contractor's Inc.
NYCRR	New York Code Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health

OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
PRW	permeable reactive wall
RAS	Remedial Action Selection report
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
SCG	standards, criteria and guidance
SHI	Supplemental Hydrogeologic Investigation
SHIWP	Supplemental Hydrogeologic Investigation Work Plan
SPCC	Spill Prevention, Control and Countermeasures
SVE	soil vapor extraction
TAGM	Technical and Administrative Guidance Memorandum
TCLP	toxicity characteristic leaching procedure
TDC	Transportation and Disposal Coordinator
TOC	total organic carbon
TOGS	Technical and Operational Guidance Series
URS	URS Corporation
USDOT	United States Department of Transportation
VCA	Voluntary Cleanup Agreement
VCP	Voluntary Cleanup Program
VOC	volatile organic compound
WCFTC	Wyoming County Fire Training Center

1.0 INTRODUCTION

1.1 General

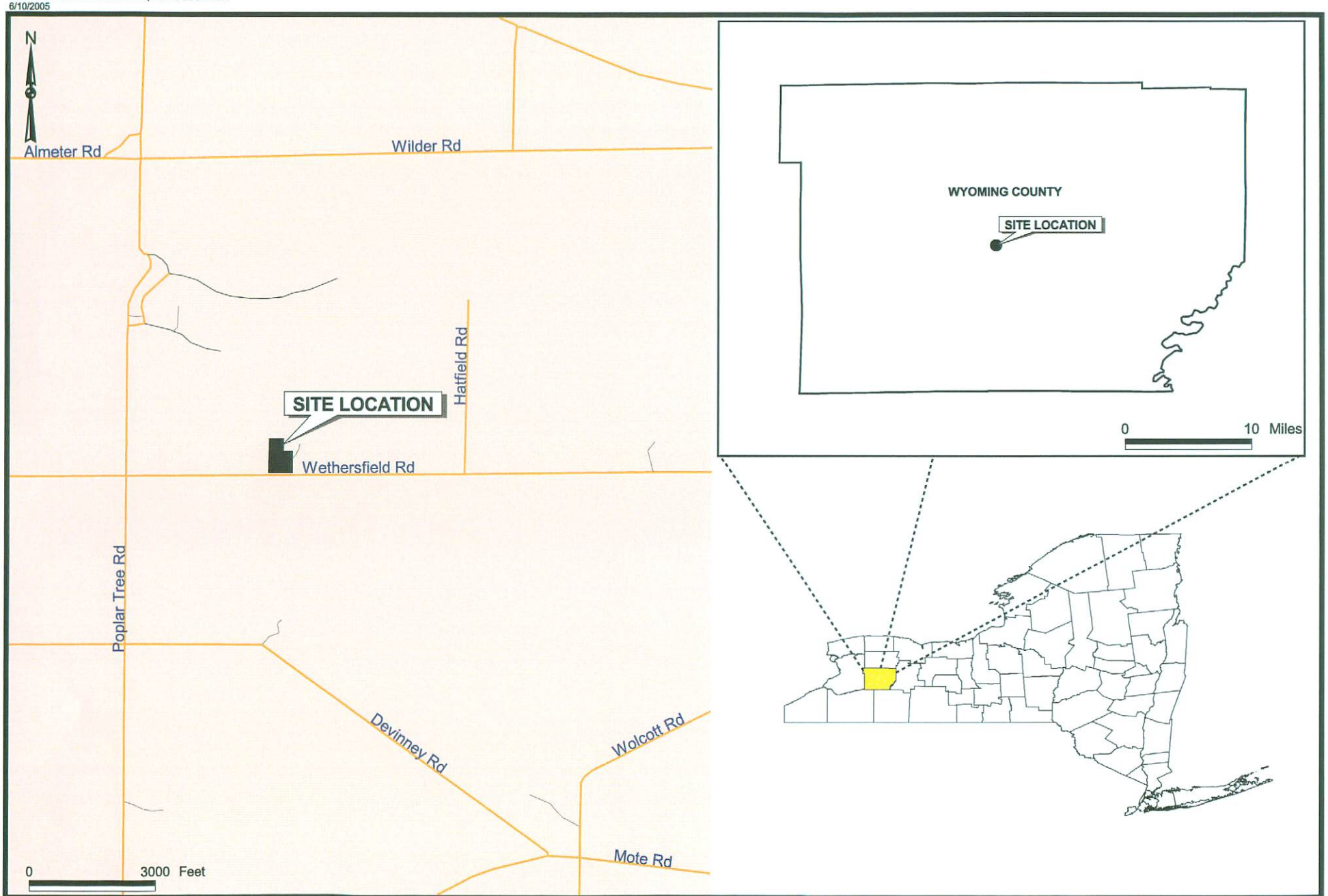
Wyoming County (County) operated a fire training center located at 3651 Wethersfield Road in the Town of Wethersfield, New York (Figure 1-1). Remedial activities consisting of drum removal, AST removal and contaminated soil excavation were conducted at the Site in July/August of 2001. A site investigation program, conducted in September/October of 2001, identified four areas of concern (AOCs) where soils were contaminated with volatile organic compounds (VOCs) consisting primarily of toluene, tetrachloroethene (PCE) and PCE breakdown compounds. Additionally, the data showed that groundwater at the Site and the two adjacent County-owned parcels located immediately east of the Site, had also been impacted by VOCs. These two parcels, formerly known as the Agro and Weber properties, were acquired by the County in October, 2003.

URS Corporation (URS) conducted a formal interim remedial measure (IRM) consisting of the removal of contaminated soil in the four AOCs at the Site in September – November, 2003. This IRM effectively removed the known source areas for VOCs in soils at the Site, with the exception of a limited amount of soil at depths greater than 11 feet in Area 2 under the former South Fire Pit.

URS subsequently conducted a Supplemental Hydrogeologic Investigation (SHI) from June to August 2004 to further delineate the nature and extent of groundwater contamination associated with historical operations at the Fire Training Center. The results of the SHI indicated that there were no exceedances of the standards, criteria and guidance (SCG) values for soils either on- or off-site. Slight exceedances of the SCGs for vinyl chloride and tetrachloroethene were observed in sediment and surface water, respectively in the Rear Pond.

With regards to groundwater, there were one or more exceedances of the SCGs in an approximately 200-foot wide zone oriented northwest-southeast, originating at the four AOCs.

N:\11172991.00000\DB\Gis\site.apr SITE LOCATION
6/10/2005



URS

WYOMING COUNTY FIRE TRAINING CENTER
SITE LOCATION MAP

FIGURE 1-1

The groundwater contamination is wholly contained within what is now County owned properties, with the exception of one monitoring well and a spring, located just southeast of the site boundary. Generally, the VOC concentrations in the groundwater are highest in the area immediately downgradient of the operational area of the Wyoming County Fire Training Center (WCFTC) and decrease significantly further to the southeast, such that they are only slightly above the SCGs at the extreme southeastern (i.e. offsite) end of the zone. The potable water supply wells for the two neighboring downgradient residential parcels (i.e. Schell and Becker properties) have not been impacted.

A Remedial Action Selection (RAS) Report subsequently was prepared by URS (September, 2005) in accordance with the requirements of the New York State Department of Environmental Conservation (NYSDEC) "*Draft DER-10 Technical Guidance for Site Investigation and Remediation*" as it relates to Voluntary Cleanup Program (VCP) sites, dated December 25, 2002. As outlined in Section 4.0 – Remedy Selection, the action selection process consisted of the following steps: 1) identification of remedial action objectives; 2) identification and evaluation of remedial action alternatives; and, 3) selection and documentation that the selected remedy is compliant with the applicable criteria.

The remedial alternative described in the RAS Report includes the installation of a Permeable Reactive Wall (PRW) across the flow path of contaminated groundwater in the southeast corner of the Site (Area 1) and the use of In-Situ Oxidation (ISO) treatment of groundwater in the area underlying the former South Fire Pit and immediately east, in the vicinity of MW-07 (Area 2), as defined herein. Additionally, a long term monitoring program will be implemented to monitor the effectiveness of the remedial action.

1.2 Purpose

URS has prepared this Remedial Design/Remedial Action (RD/RA) Work Plan (Work Plan) in accordance with the requirements of NYSDEC DER-10. The purpose of this Work Plan is to provide guidelines for remediation of VOC contamination in groundwater in the two impacted areas (i.e. Area 1 and Area 2) of the Site.

This Work Plan was developed with sufficient detail to serve as a construction work plan while satisfying the guidance provided in Section 5.3 of NYSDEC DER-10.

URS will serve as the lead engineer (Engineer) for this project. Nature's Way Environmental Consultants and Contractors (NWECC), of Crittenden, New York, will serve as the construction contractor (Contractor) responsible for conducting the majority of the remedial activities for the Volunteer.

2.0 SITE DESCRIPTION

2.1 Site Description

The WCFTC is located at 3651 Wethersfield Road in the Town of Wethersfield, Wyoming County, New York (Figure 1-1). The facility is on the north side of Wethersfield Road approximately one-half mile east of the intersection with Poplar Hill Road.

The overall WCFTC facility includes several permanent structures/installations and is completely enclosed by a perimeter chain link fence. The main features of the operational WCFTC facility are the Training Center Building and attached garage in the southwest section of the property, two smaller support buildings, a storm water retention pond and several fire training structures across the remaining portions of the property. The Site, prior to investigation and completion of the IRM, included a former steel aboveground storage tank (AST) used for storage of flammable liquids; two sub-grade concrete fire pits connected to the AST via underground piping and, a drum storage area utilized for storage of drums containing flammable liquids. The AST, fire pits, underground piping and drum storage area were all located on about one acre in the eastern portion of the WCFTC facility (Figure 2-1), the Site.

In October 2003, the County acquired the neighboring Agro and Weber properties. The former Agro property, adjacent to the eastern and northern boundaries of the operational WCFTC facility (Figure 2-1), has approximately two hundred feet of frontage on Wethersfield Rd. and widens to the east and west some distance from the road. The former Weber property, 3689 Wethersfield Rd., is situated immediately to the east of the former Agro property (Figure 2-1) and has similar frontage. Both properties have been unoccupied since the County purchase. The former Agro property includes two ponds, one immediately north of the north fire pit (Rear Pond) and a larger pond in the northeast corner of the property (North Pond). The former Weber property included a residence, which was razed by fire in May 2004 with all remnants removed and excavated to grade in June 2004.

Legend

- Residential Pumping Well
- Spring Location
- Property Line

250 0 250 Feet

WYOMING COUNTY FIRE TRAINING CENTER
SITE PLAN

URS

FIGURE 2-1

N:\11172991.00000\DB\Gis\wyoming.apr SITEPLAN (11x17L)
4/18/2006

The Schell property, 3695 Wethersfield Road, is the closest occupied residence to the WCFTC being located immediately east of the former Weber property. The Becker residence is situated on the south side of Wethersfield Road, approximately 1,000 feet to the southeast of the operational WCFTC facility.

The site topography is generally flat, with a graded bank along the eastern boundary. To the east and northeast, across the former Agro and Weber properties, the topography slopes more steeply to the northeast. Vegetative cover in the operational WCFTC facility consists primarily of turf grass. Surrounding land uses are generally agricultural and recreational with low-density residential housing distanced along Wethersfield Road.

The WCFTC was operated by the County commencing in the 1970's. Flammable liquids consisting of solvents, petroleum products, paint thinners, degreasers, etc. were brought to the Site and stored in the AST and/or in drums of various sizes in the unlined drum storage area. Liquids from the AST were conveyed to two subgrade concrete-lined fire pits (i.e. north and south pits) via an underground steel piping/valve system. Liquids from the drums were manually fed into the fire pits. The flammable liquids were ignited and subsequently extinguished during fire training exercises.

In 2002, the County executed a Voluntary Cleanup Agreement (VCA) with the state of New York. Subsequent to signing the VCA, the County developed an IRM Work Plan to address the four AOCs in May 2003 which following approval, was implemented in September 2003.

2.2 Summary of Remedial Investigations

The nature and extent of environmental conditions at the Site were characterized through the completion of several site investigations from 2001 to 2005. Based on the results of the investigations, former AST areas, former fire pit areas, former drum storage areas, and areas containing affected groundwater have been identified and fully delineated. The site investigations conducted at the Site are summarized below.

- 2001 - NWECC identified four AOCs wherein the soils were contaminated with VOCs consisting primarily of toluene, tetrachloroethene (PCE) and PCE breakdown compounds. These AOCs include the Former AST Area (AOC-1), the South Fire Pit (AOC-2), the North Fire Pit (AOC-3) and the Former Drum Storage Area (AOC-4) (Figure 2-1). Additionally, the data showed that groundwater at the Site and the two adjacent County-owned parcels located immediately east of the Site, had also been impacted by VOCs.

- 2001 - NWECC conducted remedial activities at the Site that consisted of drum removal, AST removal and contaminated soil excavation.

- 2003 - URS retained by Wyoming County to provide site investigation, remedial design and remedial construction oversight.

- 2003 – URS implemented IRM activities following NYSDEC approval of the IRM Work Plan consisting of excavation of VOC-contaminated soils from the four AOCs, and placement of the contaminated soils in three onsite soil vapor extraction (SVE) cells.

- 2004 – URS conducted a supplemental hydrogeologic investigation (SHI), to further delineate the nature and extent of VOC contamination identified in groundwater during the initial site investigations. Additionally, the SHI was designed to provide sufficient information to evaluate whether or not the IRM (contaminated soil removal) was successful in reducing and/or eliminating source contaminants, to provide data to allow for an evaluation of the need for additional investigation, and to develop potential remedial alternatives, as necessary.

- 2005 - URS conducted additional confirmatory soil sampling at the request of the NYSDEC. At the same time, a round of groundwater elevation readings was obtained and sampling of selected groundwater monitoring wells was performed.

2.2.1 Nature and Extent of Contamination

The results of the IRM and SHI are presented in, "*Interim Remedial Measures and Supplemental Hydrogeologic Investigation Report of the Wyoming County Fire Training Area, Wethersfield, New York*" dated November 2004 (Revised January 2005).

The results of the SHI and supplemental sampling activities are summarized below. The sampling locations are shown on Figure 2-2.

2.3 Applicable Standards, Criteria, and Guidance

The analytical data obtained from soils, sediment, and groundwater were compared to appropriate New York State standards, criteria, and guidance (SCG) values. For soils, the NYSDEC Technical Administrative Guidance Memorandum (TAGM) 4046: *Determination of Soil Cleanup Objectives and Cleanup Levels*, January 1994/January 2000 (TAGM 4046) were utilized.

Sediment results were compared to NYSDEC Division of Fish, Wildlife and Marine Resources *"Technical Guidance for Screening Contaminated Sediments"*, 1993, updated on January 25, 1999 (TGSCS). Criteria for the protection of human health bioaccumulation were selected for sediment screening using an assumed total organic carbon (TOC) concentration of 1% by weight (i.e. 10 grams per kilogram).

NYSDEC Division of Water Technical and Operational Guidance Series (TOGS) (1.1.1) *"Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations"* (April, 2000) were the agreed SCGs for groundwater and surface water.

N

NORTH POND

WYOMING COUNTY FIRE TRAINING CENTER

LIMITS OF COUNTY PROPERTY

SHOOTING RANGE BUILDING

MW-05

REAR POND

MW-23

ROCK WELL2

SED-01/SW-01

MW-06

MW-22

MW-02

MW-08

MW-01 (DESTROYED)

FORMER AGRO PROPERTY

CINDER BLOCK TRAINING CENTER

SB-03

SB-02

SB-04

SB-01

MW-03

MW-07

MW-21

MW-20

MW-04

MW-19

ARGO-1

FORMER WEBER PROPERTY

MAIN BUILDING

DRIVEWAY

FRONT POND

MW-18

WEBER WELL

ROCK WELL1

MW-09 (DESTROYED)

MW-10

RESW-01

SCHELL HOUSE

FORMER WEBER HOUSE

MW-16

MW-14

MW-17

MW-15

WETHERSFIELD ROAD

MW-11

MW-12

MW-13

SPRING

BASEMENT SEEP

BECKER RESIDENCE

UNDERGROUND PIPE

FORMER SUPPLY WELL

BECKER WELL

SED-02/SW-02

SCHELL POND

BECKER POND

BECKER POND

Legend

- Existing Monitoring Well
- Spring Location
- Existing Water Supply Well
- Surface Water/Sediment Sample Location
- Soil Boring Location

250 0 250 Feet

WYOMING COUNTY FIRE TRAINING CENTER
SUPPLEMENTAL HYDROGEOLOGIC INVESTIGATION
SAMPLING LOCATIONS

URS

FIGURE 2-2

N:\11172991.00000\DB\Gis\wyoming.apr MONITORING WELL/SURFACE WATER SAMPLING LOCATIONS
4/19/2006

2.3.1 Soil/Sediment Analytical Results

Sediment Samples

Analytical results of the three sediment samples collected during the SHI (Table 2-1) indicated detectable concentrations solely of vinyl chloride at a single location (Rear Pond) at a concentration of 28 µg/kg in SED-01, which exceeded the SCG criteria of 0.7µg/kg. The presence of only vinyl chloride at low concentration in the absence of parent (tetrachloroethene and trichloroethene) and transitional (1,1,1,2-tetrachloroethane and 1,2-dichloroethene) compounds is strong evidence for the end-stage of natural attenuation in contaminated sediment and the absence of contaminant replenishment from source areas.

Sub-Surface Soil Samples

Analytical results for the sub-surface soil samples collected during the SHI (Table 2-2 and Figure 2-3) indicate barely detectable levels of three VOCs in three of the seventeen borings. In the MW-15 sample, 1,1,1-trichlorethane and 1,2-dichloroethene (*cis*) were detected with estimated concentrations of 5 and 6 µg/kg, respectively. In the SB-03 sample, 1,1,1-trichloroethane was estimated at 2 µg/kg and in SB-04 dichlorodifluoromethane was estimated at 9 µg/kg. These concentrations are just slightly above detection limits and well below the applicable SCGs. These data indicate that the extent of soil contamination is limited to those areas previously identified during the initial site investigations (NWECC, 2001). Of specific interest, there were no exceedances in the vicinity of the fire training building as indicated by results from SB-01 through SB-04. Additionally, there were no detectable compounds in any of the off-site sampling locations (i.e. Schell and Becker properties), which demonstrates that VOC contamination in soil at concentrations that exceed the SCGs does not extend beyond the boundaries of the Site.

TABLE 2-1
SEDIMENT ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			BECKER POND	SED-01	SED-02
Sample ID			Sediment Pond Inlet	SED-01 REAR POND	SED-02 SCHEL PD
Matrix			Sediment	Sediment	Sediment
Depth Interval (ft)			-	-	-
Date Sampled			02/25/04	06/04/04	06/04/04
Parameter	**Units**	**Criteria***			
Volatile Organic Compounds					
1,1-Dichloroethane	UG/KG	-		3 J	
1,2-Dichloroethene (trans)	UG/KG	-		4 J	
Toluene	UG/KG	-		3 J	
Vinyl chloride	UG/KG	0.7		28	
Total Volatile Organic Compounds	UG/KG	-	ND	38	ND

*Criteria- NYSDEC Technical Guidance for Screening Contaminated Sediments, January 25, 1999. Criteria are based on an assumed Total Organic Carbon (TOC) content of 1%.

Flags assigned during chemistry validation are shown.

Concentration Exceeds Criteria

Only Detected Results Reported.

TABLE 2-2
SUBSURFACE SOIL ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			MW-11	MW-12	MW-13	MW-14	MW-15
Sample ID			MW-11 9.0-10.0	MW-12 10.0-11.0	MW-13 12.0-12.5	MW-14 9.5-10.0	MW-15 12.0-13.0
Matrix			Soil	Soil	Soil	Soil	Soil
Depth Interval (ft)			9.0-10.0	10.0-11.0	12.0-12.5	9.5-10.0	12.0-13.0
Date Sampled			06/03/04	06/03/04	06/02/04	06/02/04	06/02/04
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1-Trichloroethane	UG/KG	800					5 J
1,2-Dichloroethene (cis)	UG/KG	300					6 J
Dichlorodifluoromethane	UG/KG	-					
Total Volatile Organic Compounds	UG/KG	-	ND	ND	ND	ND	11

*Criteria- NYSDEC TAGM: Determination of Soil Cleanup Objectives and Cleanup Levels; HWR-94-4046 January 24, 1994 (Revised).

Flags assigned during chemistry validation are shown.

Concentration Exceeds Criteria

Only Detected Results Reported.

TABLE 2-2
SUBSURFACE SOIL ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			MW-16	MW-17	MW-18	MW-19	MW-20
Sample ID			MW-16 8.5-9.5	MW-17 12.5-13.5	MW-18 12.5-13.0	MW-19 8.5-9.5	MW-20
Matrix			Soil	Soil	Soil	Soil	Soil
Depth Interval (ft)			8.5-9.5	12.5-13.5	12.5-13.0	8.5-9.5	8.0-9.0
Date Sampled			06/03/04	06/03/04	06/03/04	06/02/04	06/04/04
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1-Trichloroethane	UG/KG	800					
1,2-Dichloroethene (cis)	UG/KG	300					
Dichlorodifluoromethane	UG/KG	-					
Total Volatile Organic Compounds	UG/KG	-	ND	ND	ND	ND	ND

*Criteria- NYSDEC TAGM: Determination of Soil Cleanup Objectives and Cleanup Levels; HWR-94-4046 January 24, 1994 (Revised).

Flags assigned during chemistry validation are shown.

Concentration Exceeds Criteria

Only Detected Results Reported.

TABLE 2-2
SUBSURFACE SOIL ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			MW-21	MW-22	MW-23	SB-01	SB-02
Sample ID			MW-21 9.0-9.5	MW-22 14.25-.75	MW-23 13.5-14.0	SB-01	SB-02
Matrix			Soil	Soil	Soil	Soil	Soil
Depth Interval (ft)			9.0-9.5	14.3-14.8	13.5-14.0	9.0-10.0	13.0-14.0
Date Sampled			06/01/04	06/01/04	06/02/04	06/03/04	06/03/04
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1-Trichloroethane	UG/KG	800					
1,2-Dichloroethene (cis)	UG/KG	300					
Dichlorodifluoromethane	UG/KG	-					
Total Volatile Organic Compounds	UG/KG	-	ND	ND	ND	ND	ND

*Criteria- NYSDEC TAGM: Determination of Soil Cleanup Objectives and Cleanup Levels; HWR-94-4046 January 24, 1994 (Revised).

Flags assigned during chemistry validation are shown.

Concentration Exceeds Criteria

Only Detected Results Reported.

TABLE 2-2
SUBSURFACE SOIL ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			SB-03	SB-04
Sample ID			SB-03	SB-04
Matrix			Soil	Soil
Depth Interval (ft)			9.5-10.5	5.0-6.0
Date Sampled			06/03/04	06/03/04
Parameter	**Units**	**Criteria***		
Volatile Organic Compounds				
1,1,1-Trichloroethane	UG/KG	800	2 J	
1,2-Dichloroethene (cis)	UG/KG	300		
Dichlorodifluoromethane	UG/KG	-		9 J
Total Volatile Organic Compounds	UG/KG	-	2	9

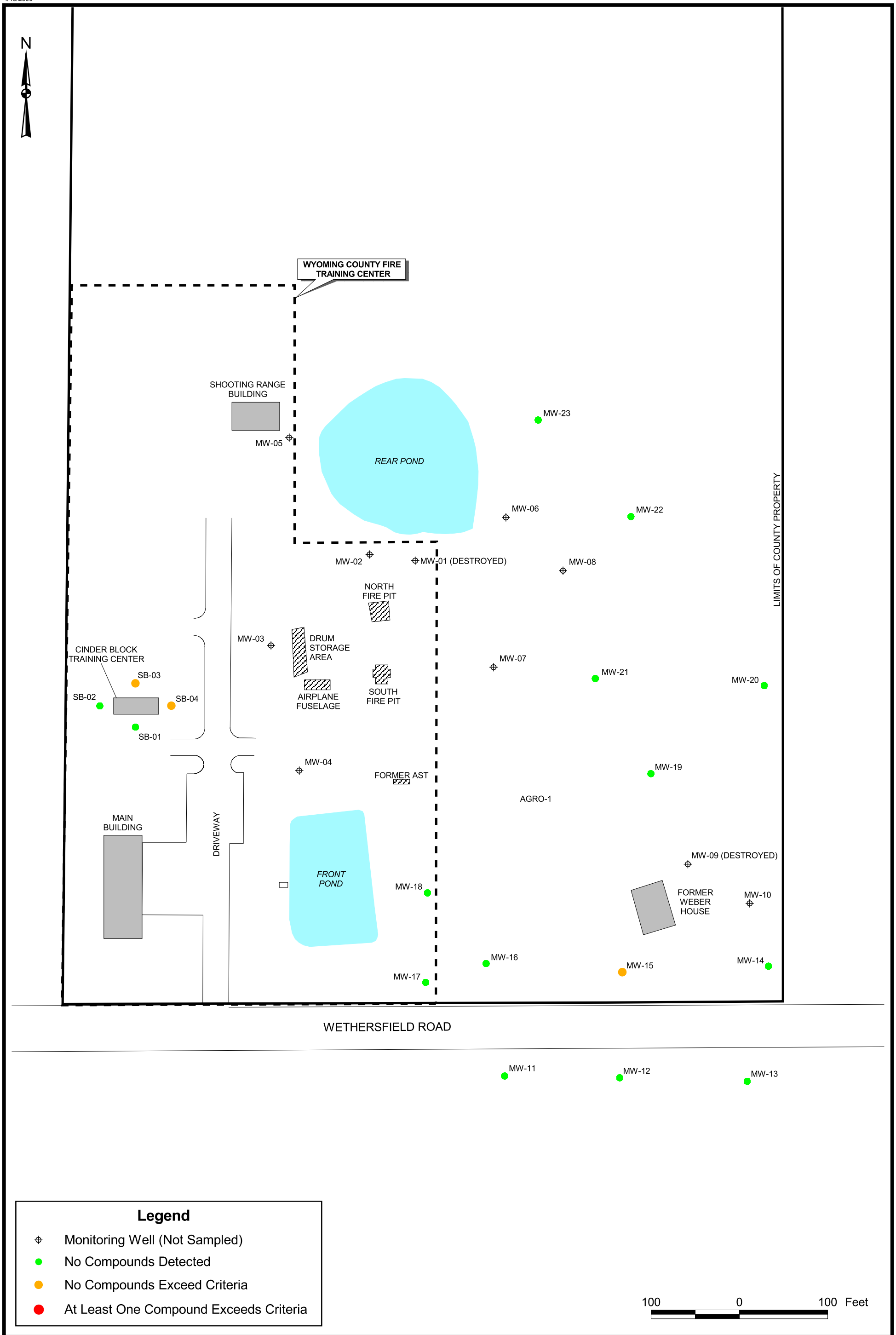
*Criteria- NYSDEC TAGM: Determination of Soil Cleanup Objectives and Cleanup Levels; HWR-94-4046 January 24, 1994 (Revised).

Flags assigned during chemistry validation are shown.

Concentration Exceeds Criteria

Only Detected Results Reported.

N:\11172991.00000\DB\Gis\wyoming.apr JUNE 2004 SOIL EXCEEDANCES
4/19/2006



URS

WYOMING COUNTY FIRE TRAINING CENTER
SOIL VOCs ANALYTICAL RESULTS (JUNE 2004)

FIGURE 2-3

2.3.2 Surface Water/Groundwater Analytical Results

Surface Water Samples

Results from the three surface water analytical samples (Table 2-3) indicate no detectable VOCs in the two off-site ponds and only three VOCs at detectable concentrations in the Rear Pond. Only a single compound (tetrachloroethene) slightly exceeded the SCG criteria of 5 µg/L in the Rear Pond. This result indicates that migration of VOC contamination to site surface water is very minimal. Inasmuch as the source of the VOCs was removed during the IRM, minimal or no additional migration of VOCs to surface water in the Rear Pond is anticipated.

No VOCs were detected in surface water samples in any of the offsite ponds (i.e. Schell and Becker ponds).

Shallow/Overburden Groundwater Samples

As part of the SHI and supplemental sampling programs, groundwater samples were collected from the existing and new groundwater monitoring wells, former/existing residential supply wells, springs and groundwater seeps and submitted for target compound list (TCL) VOC analysis. Results of the groundwater analytical testing for all sampling events are summarized in Table 2-4. Results from the September/November 2001 sampling event are presented in Figure 2-4. The June 2004 sampling event results are presented in Figure 2-5 and the February 2005 results are presented in Figure 2-6.

As indicated in Table 2-4 and Figure 2-5, no detectable concentrations of VOCs were noted in the June 2004 samples collected from the Schell and Becker residential wells (RESW–01 and Becker Well, respectively) and monitoring wells MW-03, -04, -05, -08, -11, -14, -20, -22 and –23. Detectable concentrations of VOCs, well below the applicable SCGs, were observed in monitoring wells MW-06, -13, -16, -17, -18 and -21. In the remaining samples collected from the dug well (AGRO-1), the former Weber residential well (Weber Well), monitoring wells MW-02,

TABLE 2-3
SURFACE WATER ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			BECKER POND	SW-01	SW-02
Sample ID			Pond Inlet	SW-01 REAR POND	SW-02 SCHELL PD
Matrix			Surface Water	Surface Water	Surface Water
Depth Interval (ft)			-	-	-
Date Sampled			02/25/04	06/04/04	06/04/04
Parameter	**Units**	**Criteria***			
Volatile Organic Compounds					
1,1,1-Trichloroethane	UG/L	5		2 J	
1,2-Dichloroethene (cis)	UG/L	5		3 J	
Tetrachloroethene	UG/L	5		12	
Total Volatile Organic Compounds	UG/L	-	ND	17	ND

*Criteria- NYSDEC TOGS (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. April 2000, Class GA.

Flags assigned during chemistry validation are shown.

Concentration Exceeds Criteria

Only Detected Results Reported.

TABLE 2-4
GROUND WATER ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			AGRO-1	AGRO-1	BAUMGERT_WELL	BECKER BASEMENT	BECKER SUPPLY
Sample ID			Argo-1 Dug Well	ARGO	BAUMGERT_WELL	Basement	Former Supply Well West
Matrix			Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)			-	-	-	-	-
Date Sampled			11/08/01	06/14/04	10/06/03	02/25/04	02/25/04
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1-Trichloroethane	UG/L	5	247.8	96			16
1,1,2-Trichloroethane	UG/L	1					
1,1-Dichloroethane	UG/L	5	67.4	110			1.7
1,1-Dichloroethene	UG/L	5		4 J			
1,2,4-Trimethylbenzene	UG/L	-		NA			
1,2-Dichloroethane	UG/L	0.6					
1,2-Dichloroethene (cis)	UG/L	5	46.8	160			5.2
Acetone	UG/L	50			NA	NA	NA
Benzene	UG/L	1					
Chloroethane	UG/L	5		22 J			
Dibromochloromethane	UG/L	50					
Ethylbenzene	UG/L	5					
m&p-Xylene	UG/L	-		NA	NA	NA	NA
Methyl tert-butyl ether	UG/L	10	5.0	5 J			
Methylene chloride	UG/L	5					
sec-Butylbenzene	UG/L	-		NA			
Tetrachloroethene	UG/L	5	148.9	100			0.7
Trichloroethene	UG/L	5		10			
Vinyl chloride	UG/L	2					
Total Volatile Organic Compounds	UG/L	-	515.9	507	ND	ND	23.6

*Criteria- NYSDEC TOGS (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. April 2000, Class GA.

Flags assigned during chemistry validation are shown.

(oval) Concentration Exceeds Criteria

U - Not detected above the reported quantitation limit.

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J - The reported concentration is an estimated value.

Only Detected Results Reported.

TABLE 2-4
GROUND WATER ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			BECKER WELL	BECKER WELL	MW-01	MW-02	MW-02
Sample ID			BECKER WELL	Tap Water In House	MW-01	MW-02	MW-02
Matrix			Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)			-	-	-	-	-
Date Sampled			10/06/03	02/25/04	09/28/01	09/28/01	06/14/04
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1-Trichloroethane	UG/L	5			378.6	45.3	9 J
1,1,2-Trichloroethane	UG/L	1			95.9		
1,1-Dichloroethane	UG/L	5			37.4	11.3	2 J
1,1-Dichloroethene	UG/L	5			23.3		
1,2,4-Trimethylbenzene	UG/L	-					NA
1,2-Dichloroethane	UG/L	0.6					
1,2-Dichloroethene (cis)	UG/L	5			1,296.2	273.9	23
Acetone	UG/L	50	NA	NA			
Benzene	UG/L	1					
Chloroethane	UG/L	5					
Dibromochloromethane	UG/L	50					
Ethylbenzene	UG/L	5					
m&p-Xylene	UG/L	-	NA	NA			NA
Methyl tert-butyl ether	UG/L	10					
Methylene chloride	UG/L	5					
sec-Butylbenzene	UG/L	-					NA
Tetrachloroethene	UG/L	5			4,069.1	371.0	15
Trichloroethene	UG/L	5			21.3	76.6	2 J
Vinyl chloride	UG/L	2					3 J
Total Volatile Organic Compounds	UG/L	-	ND	ND	5,921.8	778.1	54

*Criteria- NYSDEC TOGS (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. April 2000, Class GA.

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(oval) Concentration Exceeds Criteria

U - Not detected above the reported quantitation limit.

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Only Detected Results Reported.

TABLE 2-4
GROUND WATER ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			MW-03	MW-03	MW-04	MW-04	MW-05
Sample ID			MW-03	MW-03	MW-04	MW-04	MW-05
Matrix			Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)			-	-	-	-	-
Date Sampled			11/06/01	06/11/04	11/06/01	06/14/04	11/06/01
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1-Trichloroethane	UG/L	5					
1,1,2-Trichloroethane	UG/L	1					
1,1-Dichloroethane	UG/L	5					
1,1-Dichloroethene	UG/L	5					
1,2,4-Trimethylbenzene	UG/L	-		NA		NA	
1,2-Dichloroethane	UG/L	0.6					
1,2-Dichloroethene (cis)	UG/L	5					
Acetone	UG/L	50					
Benzene	UG/L	1					
Chloroethane	UG/L	5					
Dibromochloromethane	UG/L	50					
Ethylbenzene	UG/L	5					
m&p-Xylene	UG/L	-		NA		NA	
Methyl tert-butyl ether	UG/L	10					
Methylene chloride	UG/L	5					
sec-Butylbenzene	UG/L	-		NA		NA	
Tetrachloroethene	UG/L	5					
Trichloroethene	UG/L	5					
Vinyl chloride	UG/L	2					
Total Volatile Organic Compounds	UG/L	-	ND	ND	ND	ND	ND

*Criteria- NYSDEC TOGS (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. April 2000, Class GA.

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Concentration Exceeds Criteria

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D - Result reported from a secondary dilution analysis.

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Only Detected Results Reported.

TABLE 2-4
GROUND WATER ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			MW-05	MW-06	MW-06	MW-07	MW-07
Sample ID			MW-05	MW-06	MW-06	MW-07	MW-07
Matrix			Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)			-	-	-	-	-
Date Sampled			06/11/04	11/07/01	06/14/04	11/07/01	06/14/04
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1-Trichloroethane	UG/L	5		27.7		1,252.1	1,300 D
1,1,2-Trichloroethane	UG/L	1					
1,1-Dichloroethane	UG/L	5			2 J	155.2	69
1,1-Dichloroethene	UG/L	5					14
1,2,4-Trimethylbenzene	UG/L	-	NA		NA		NA
1,2-Dichloroethane	UG/L	0.6					
1,2-Dichloroethene (cis)	UG/L	5		21.4	4 J	2,132.9	730 D
Acetone	UG/L	50					
Benzene	UG/L	1				2.1	
Chloroethane	UG/L	5					23 J
Dibromochloromethane	UG/L	50					
Ethylbenzene	UG/L	5					
m&p-Xylene	UG/L	-	NA		NA		NA
Methyl tert-butyl ether	UG/L	10				2.9	
Methylene chloride	UG/L	5					
sec-Butylbenzene	UG/L	-	NA		NA		NA
Tetrachloroethene	UG/L	5		68.0		7,414.6	1,800 D
Trichloroethene	UG/L	5				148.7	49
Vinyl chloride	UG/L	2				5.1	12
Total Volatile Organic Compounds	UG/L	-	ND	117.1	6	11,113.6	3,997

*Criteria- NYSDEC TOGS (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. April 2000, Class GA.

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Only Detected Results Reported.

TABLE 2-4
GROUND WATER ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			MW-07	MW-08	MW-08	MW-09	MW-10
Sample ID			MW-07	MW-08	MW-08	MW-09	MW-10
Matrix			Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)			-	-	-	-	-
Date Sampled			02/09/05	11/07/01	06/14/04	11/07/01	11/08/01
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1-Trichloroethane	UG/L	5	1,000				
1,1,2-Trichloroethane	UG/L	1					
1,1-Dichloroethane	UG/L	5	66 J				
1,1-Dichloroethene	UG/L	5					
1,2,4-Trimethylbenzene	UG/L	-	NA		NA		
1,2-Dichloroethane	UG/L	0.6					
1,2-Dichloroethene (cis)	UG/L	5	1,100				
Acetone	UG/L	50					
Benzene	UG/L	1					
Chloroethane	UG/L	5					
Dibromochloromethane	UG/L	50					
Ethylbenzene	UG/L	5					
m&p-Xylene	UG/L	-			NA		
Methyl tert-butyl ether	UG/L	10					
Methylene chloride	UG/L	5	51 BJ				
sec-Butylbenzene	UG/L	-	NA		NA		
Tetrachloroethene	UG/L	5	2,200 E				
Trichloroethene	UG/L	5	65 J				
Vinyl chloride	UG/L	2					
Total Volatile Organic Compounds	UG/L	-	4,482	ND	ND	ND	ND

*Criteria- NYSDEC TOGS (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. April 2000, Class GA.

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Only Detected Results Reported.

TABLE 2-4
GROUND WATER ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			MW-10	MW-10	MW-11	MW-12	MW-12
Sample ID			MW-10	MW-10	MW-11	MW-12	MW-12
Matrix			Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)			-	-	-	-	-
Date Sampled			06/14/04	02/09/05	06/10/04	06/10/04	02/09/05
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1-Trichloroethane	UG/L	5	8 J			31	34
1,1,2-Trichloroethane	UG/L	1					
1,1-Dichloroethane	UG/L	5				4 J	
1,1-Dichloroethene	UG/L	5					
1,2,4-Trimethylbenzene	UG/L	-	NA	NA	NA	NA	NA
1,2-Dichloroethane	UG/L	0.6					
1,2-Dichloroethene (cis)	UG/L	5	6 J			20	18
Acetone	UG/L	50					
Benzene	UG/L	1					
Chloroethane	UG/L	5					
Dibromochloromethane	UG/L	50					
Ethylbenzene	UG/L	5					
m&p-Xylene	UG/L	-	NA		NA	NA	
Methyl tert-butyl ether	UG/L	10					
Methylene chloride	UG/L	5					
sec-Butylbenzene	UG/L	-	NA	NA	NA	NA	NA
Tetrachloroethene	UG/L	5	57			8 J	9 J
Trichloroethene	UG/L	5					
Vinyl chloride	UG/L	2					
Total Volatile Organic Compounds	UG/L	-	71	ND	ND	63	61

*Criteria- NYSDEC TOGS (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. April 2000, Class GA.

Flags assigned during chemistry validation are shown.

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Only Detected Results Reported.

TABLE 2-4
GROUND WATER ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			MW-13	MW-13	MW-14	MW-15	MW-15
Sample ID			MW-13	MW-13	MW-14	MW-15	MW-15
Matrix			Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)			-	-	-	-	-
Date Sampled			06/09/04	02/09/05	06/11/04	06/10/04	02/09/05
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1-Trichloroethane	UG/L	5	4 J			210 D	150
1,1,2-Trichloroethane	UG/L	1					
1,1-Dichloroethane	UG/L	5				22	17
1,1-Dichloroethene	UG/L	5				2 J	
1,2,4-Trimethylbenzene	UG/L	-	NA	NA	NA	NA	NA
1,2-Dichloroethane	UG/L	0.6					
1,2-Dichloroethene (cis)	UG/L	5	5 J			150	93
Acetone	UG/L	50					
Benzene	UG/L	1					
Chloroethane	UG/L	5				7 J	
Dibromochloromethane	UG/L	50					
Ethylbenzene	UG/L	5					
m&p-Xylene	UG/L	-	NA		NA	NA	
Methyl tert-butyl ether	UG/L	10					
Methylene chloride	UG/L	5					
sec-Butylbenzene	UG/L	-	NA	NA	NA	NA	NA
Tetrachloroethene	UG/L	5				100	84
Trichloroethene	UG/L	5				7 J	6 J
Vinyl chloride	UG/L	2					
Total Volatile Organic Compounds	UG/L	-	9	ND	ND	498	350

*Criteria- NYSDEC TOGS (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. April 2000, Class GA.

Flags assigned during chemistry validation are shown.

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Only Detected Results Reported.

TABLE 2-4
GROUND WATER ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			MW-16	MW-17	MW-18	MW-19	MW-19
Sample ID			MW-16	MW-17	MW-18	MW-19	MW-19
Matrix			Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)			-	-	-	-	-
Date Sampled			06/10/04	06/11/04	06/11/04	06/08/04	02/09/05
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1-Trichloroethane	UG/L	5	2 NJ			15	18
1,1,2-Trichloroethane	UG/L	1					
1,1-Dichloroethane	UG/L	5					
1,1-Dichloroethene	UG/L	5					
1,2,4-Trimethylbenzene	UG/L	-	NA	NA	NA	NA	NA
1,2-Dichloroethane	UG/L	0.6					
1,2-Dichloroethene (cis)	UG/L	5	2 J			8 J	10 J
Acetone	UG/L	50		9 J	9 J		
Benzene	UG/L	1					
Chloroethane	UG/L	5					
Dibromochloromethane	UG/L	50					
Ethylbenzene	UG/L	5					
m&p-Xylene	UG/L	-	NA	NA	NA	NA	
Methyl tert-butyl ether	UG/L	10				8 J	
Methylene chloride	UG/L	5					
sec-Butylbenzene	UG/L	-	NA	NA	NA	NA	NA
Tetrachloroethene	UG/L	5				6 J	9 J
Trichloroethene	UG/L	5					
Vinyl chloride	UG/L	2					
Total Volatile Organic Compounds	UG/L	-	4	9	9	37	37

*Criteria- NYSDEC TOGS (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. April 2000, Class GA.

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(oval) Concentration Exceeds Criteria

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J - The reported concentration is an estimated value.

Only Detected Results Reported.

TABLE 2-4
GROUND WATER ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			MW-20	MW-21	MW-22	MW-23	RESW-01
Sample ID			MW-20	MW-21	MW-22	MW-23	RESW-01 SCHELL
Matrix			Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)			-	-	-	-	-
Date Sampled			06/11/04	06/08/04	06/11/04	06/08/04	06/04/04
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1-Trichloroethane	UG/L	5		4 J			
1,1,2-Trichloroethane	UG/L	1					
1,1-Dichloroethane	UG/L	5					
1,1-Dichloroethene	UG/L	5					
1,2,4-Trimethylbenzene	UG/L	-	NA	NA	NA	NA	NA
1,2-Dichloroethane	UG/L	0.6					
1,2-Dichloroethene (cis)	UG/L	5		3 J			
Acetone	UG/L	50					
Benzene	UG/L	1					
Chloroethane	UG/L	5					
Dibromochloromethane	UG/L	50					
Ethylbenzene	UG/L	5					
m&p-Xylene	UG/L	-	NA	NA	NA	NA	NA
Methyl tert-butyl ether	UG/L	10					
Methylene chloride	UG/L	5					
sec-Butylbenzene	UG/L	-	NA	NA	NA	NA	NA
Tetrachloroethene	UG/L	5					
Trichloroethene	UG/L	5					
Vinyl chloride	UG/L	2					
Total Volatile Organic Compounds	UG/L	-	ND	7	ND	ND	ND

*Criteria- NYSDEC TOGS (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. April 2000, Class GA.

Flags assigned during chemistry validation are shown.

Concentration Exceeds Criteria

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D - Result reported from a secondary dilution analysis.

J - The reported concentration is an estimated value.

Only Detected Results Reported.

TABLE 2-4
GROUND WATER ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			SPRING	SPRING	SPRING	SPRING	SPRING
Sample ID			POND SPRING	SPRING	SPRING	SPRING	SPRING
Matrix			Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)			-	-	-	-	-
Date Sampled			10/06/03	10/06/03	11/18/03	02/26/04	02/09/05
Parameter	Units	Criteria*	(2-2)				
Volatile Organic Compounds							
1,1,1-Trichloroethane	UG/L	5		13	58 D	16	45
1,1,2-Trichloroethane	UG/L	1					
1,1-Dichloroethane	UG/L	5		9	7.6	1.7 U	8 J
1,1-Dichloroethene	UG/L	5		3.9	1.0		
1,2,4-Trimethylbenzene	UG/L	-			NA		NA
1,2-Dichloroethane	UG/L	0.6		0.5			
1,2-Dichloroethene (cis)	UG/L	5		39	40 D	5.2	
Acetone	UG/L	50	NA	NA		NA	
Benzene	UG/L	1					
Chloroethane	UG/L	5		2.7	1.9		
Dibromochloromethane	UG/L	50					
Ethylbenzene	UG/L	5					
m&p-Xylene	UG/L	-	NA	NA	NA		
Methyl tert-butyl ether	UG/L	10		0.5			
Methylene chloride	UG/L	5					6 BJ
sec-Butylbenzene	UG/L	-			NA		NA
Tetrachloroethene	UG/L	5		9.3	5.8 D	0.7	9 J
Trichloroethene	UG/L	5		1.9	1.0		
Vinyl chloride	UG/L	2					
Total Volatile Organic Compounds	UG/L	-	ND	79.8	115.3	23.6	68

*Criteria- NYSDEC TOGS (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. April 2000, Class GA.

Flags assigned during chemistry validation are shown.

( ) Concentration Exceeds Criteria

U - Not detected above the reported quantitation limit.

D - Result reported from a secondary dilution analysis.

J - The reported concentration is an estimated value.

Only Detected Results Reported.

TABLE 2-4
GROUND WATER ANALYTICAL RESULTS
WYOMING COUNTY FIRE TRAINING CENTER

Location ID			WEBER WELL	WEBER WELL	WEBER WELL
Sample ID			Weber House	Weber Test Well	WEBER
Matrix			Groundwater	Groundwater	Groundwater
Depth Interval (ft)			-	-	-
Date Sampled			09/28/01	11/16/01	06/14/04
Parameter	**Units**	**Criteria***			
Volatile Organic Compounds					
1,1,1-Trichloroethane	UG/L	5	576.3		3 NJ
1,1,2-Trichloroethane	UG/L	1			
1,1-Dichloroethane	UG/L	5	27.7		
1,1-Dichloroethene	UG/L	5			
1,2,4-Trimethylbenzene	UG/L	-	1.0		NA
1,2-Dichloroethane	UG/L	0.6			
1,2-Dichloroethene (cis)	UG/L	5	313.6		
Acetone	UG/L	50			
Benzene	UG/L	1	0.7		
Chloroethane	UG/L	5			
Dibromochloromethane	UG/L	50	6.2		
Ethylbenzene	UG/L	5	1.5		
m&p-Xylene	UG/L	-	8.4		NA
Methyl tert-butyl ether	UG/L	10			
Methylene chloride	UG/L	5			
sec-Butylbenzene	UG/L	-	1.0		NA
Tetrachloroethene	UG/L	5	1,525.9		9 NJ
Trichloroethene	UG/L	5	72.3		
Vinyl chloride	UG/L	2			
Total Volatile Organic Compounds	UG/L	-	2,534.6	ND	12

*Criteria- NYSDEC TOGS (1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. April 2000, Class GA.

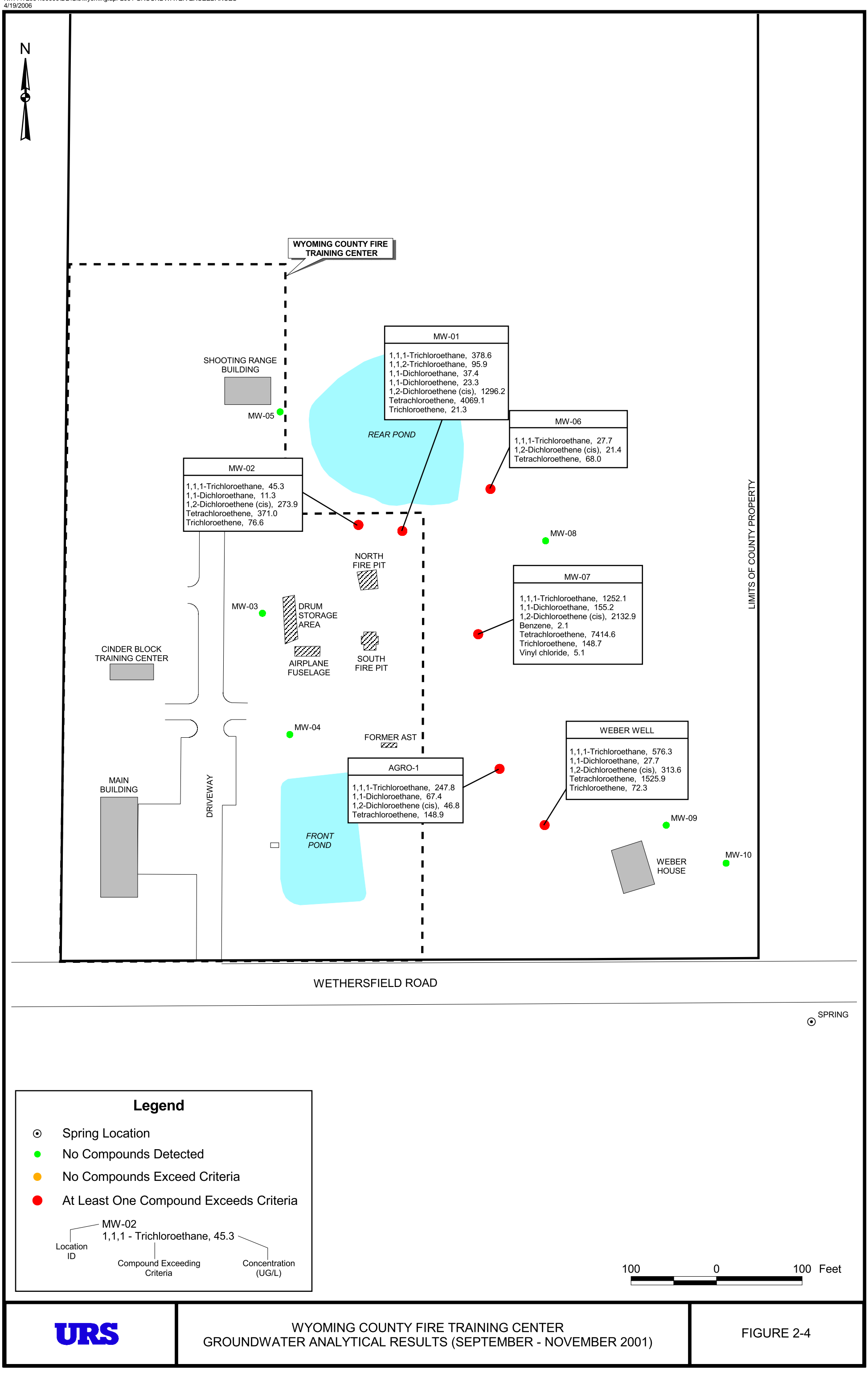
Flags assigned during chemistry validation are shown.

Concentration Exceeds Criteria

U - Not detected above the reported quantitation limit.
D - Result reported from a secondary dilution analysis.
J - The reported concentration is an estimated value.

Only Detected Results Reported.

N:\11172991.00000\DB\Gis\wyoming.apr 2001 GROUNDWATER EXCEEDANCES
4/19/2006



Legend

- Spring Location
- No Compounds Detected
- No Compounds Exceed Criteria
- At Least One Compound Exceeds Criteria

MW-02
1,1,1 - Trichloroethane, 45.3

Location ID
Compound Exceeding Criteria
Concentration (UG/L)

100 0 100 Feet

URS

WYOMING COUNTY FIRE TRAINING CENTER
GROUNDWATER ANALYTICAL RESULTS (SEPTEMBER - NOVEMBER 2001)

FIGURE 2-4

N

WYOMING COUNTY FIRE TRAINING CENTER

SHOOTING RANGE BUILDING

MW-05

REAR POND

MW-23

MW-06

MW-22

MW-02

1,1,1-Trichloroethane, 9
1,2-Dichloroethene (cis), 23
Tetrachloroethene, 15
Vinyl chloride, 3

MW-01 (DESTROYED)

MW-08

LIMITS OF COUNTY PROPERTY

SCHELL POND

MW-07

1,1,1-Trichloroethane, 1300
1,1-Dichloroethane, 71
1,1-Dichloroethene, 14
1,2-Dichloroethene (cis), 730
Chloroethane, 23
Tetrachloroethene, 1800
Trichloroethene, 50
Vinyl chloride, 12

MW-03

MW-21

MW-20

CINDER BLOCK TRAINING CENTER

AGRO-1

1,1,1-Trichloroethane, 96
1,1-Dichloroethane, 110
1,2-Dichloroethene (cis), 160
Chloroethane, 22
Tetrachloroethene, 100
Trichloroethene, 10

MW-19

1,1,1-Trichloroethane, 15
1,2-Dichloroethene (cis), 8
Tetrachloroethene, 6

MW-04

MAIN BUILDING

DRIVEWAY

FRONT POND

WEBER WELL

Tetrachloroethene, 9

MW-09 (DESTROYED)

MW-10

1,1,1-Trichloroethane, 8
1,2-Dichloroethene (cis), 6
Tetrachloroethene, 57

RESW-01

SCHELL HOUSE

WEBER HOUSE

MW-18

MW-16

MW-17

MW-14

MW-15

1,1,1-Trichloroethane, 210
1,1-Dichloroethane, 22
1,2-Dichloroethene (cis), 150
Chloroethane, 7
Tetrachloroethene, 100
Trichloroethene, 7

SPRING

1,1,1-Trichloroethane, 16
1,2-Dichloroethene (cis), 5.2

WETHERSFIELD ROAD

MW-11

MW-13

MW-12

1,1,1-Trichloroethane, 31
1,2-Dichloroethene (cis), 20
Tetrachloroethene, 8

UNDERGROUND PIPE

FORMER BECKER SUPPLY WELL

1,2-Dichloroethene (cis), 5.2

BASEMENT SEEP

BECKER HOUSE

BECKER WELL

Legend

- Monitoring Well (Not Sampled)
- No Compounds Detected
- No Compounds Exceed Criteria
- At Least One Compound Exceeds Criteria

MW-12
Tetrachloroethene, 8

Location ID

Compound Exceeding Criteria

Concentration (UG/L)

Note:
(1) SPRING, RESW-01, BECKER SUPPLY WELL detections are from 02/04; the rest of the well detections are from 06/04.
(2) Spring Location was sampled on 10/03, 11/03, and 02/04.

125 0 125 Feet

WYOMING COUNTY FIRE TRAINING CENTER GROUNDWATER ANALYTICAL RESULTS (JUNE 2004)

URS

FIGURE 2-5

N:\11172391.00000\DB\Gis\wyoming.apr GROUNDWATER ANALYTICAL RESULTS (2004)
4/19/2006

N

WYOMING COUNTY FIRE TRAINING CENTER

SHOOTING RANGE BUILDING

MW-05

REAR POND

MW-23

ROCK WELL2

SW-01

MW-06

MW-22

MW-02

MW-01 (DESTROYED)

MW-08

MW-07

1,1,1-Trichloroethane, 1000
1,2-Dichloroethene (cis), 1100
1,1-Dichloroethane, 66
Methylene chloride, 51
Tetrachloroethene, 2200
Trichloroethene, 65

LIMITS OF COUNTY PROPERTY

SCHELL POND

MW-03

CINDER BLOCK TRAINING CENTER

MW-21

MW-20

MW-19

1,1,1-Trichloroethane, 18
1,2-Dichloroethene (cis), 10
Tetrachloroethene, 9

MW-04

AGRO-1

MAIN BUILDING

DRIVEWAY

FRONT POND

WEBER WELL

ROCK WELL1

MW-09 (DESTROYED)

RESW-01

SCHELL HOUSE

MW-18

WEBER HOUSE

MW-10

MW-16

MW-14

MW-17

MW-15

Tetrachloroethene, 84
1,1-Dichloroethane, 17
1,2-Dichloroethene (cis), 93
Trichloroethene, 6
1,1,1-Trichloroethane, 150

SPRING

Tetrachloroethene, 9
Methylene chloride, 6
1,1,1-Trichloroethane, 45
1,1-Dichloroethane, 8

WETHERSFIELD ROAD

MW-11

MW-13

MW-12

Tetrachloroethene, 9
1,1,1-Trichloroethane, 34
1,2-Dichloroethene (cis), 18

UNDERGROUND PIPE

FORMER BECKER SUPPLY WELL

BECKER HOUSE

BECKER WELL

Legend

- Monitoring Well (Not Sampled)
- No Compounds Detected
- No Compounds Exceed Criteria
- At Least One Compound Exceeds Criteria

MW-12
Tetrachloroethene, 9

Location ID

Compound Exceeding Criteria

Concentration (UG/L)

125 0 125 Feet

WYOMING COUNTY FIRE TRAINING CENTER GROUNDWATER ANALYTICAL RESULTS (FEBRUARY 2005)

URS

FIGURE 2-6

N:\1117299\1.00000\DBG\s\wyoming.apr FEBRUARY 2005 GROUNDWATER EXCEEDANCES
4/19/2006

-07, -10, -12, -15, and –19, and the spring located west of the Becker residence (Spring, Former Becker Supply Well), various individual VOC concentrations exceeded the SCGs criteria. Additionally, total VOC concentrations in these nine wells ranged from 12 to 3,951 µg/L (Table 2-4). As discussed, the "Former Becker Supply Well" is not an actual well, as it is directly connected to the spring located about 450 feet to the west via a buried steel pipe. Therefore the data for the Former Becker Supply Well is in fact indicative of the water quality at the spring, and the results are interchangeable.

There were only one or more exceedances of the SCGs in the spring and eight of the twenty six groundwater wells located in an approximately 200 foot wide zone oriented northwest-southeast, originating at the four AOCs. The groundwater contamination is wholly contained within what is now County owned properties, with the exception of monitoring well MW-12 and the Becker spring. Generally, the VOC concentrations in the groundwater are highest in the area immediately downgradient of the operational area of the WCFTC (i.e. MW-07 and AGRO-1) and decrease significantly further to the southeast, such that they are only slightly above the SCGs at the extreme southeastern end of the zone (i.e. MW-12 and Spring). The only exception is MW-15, wherein the VOC concentrations are comparable to those observed in the AGRO-1 well which is located upgradient of MW-15.

Comparisons of analytical results from monitoring wells sampled during both the 2001 and 2004 sampling events (i.e. MW-02, -03, -04, -05, -06, -07 and -08) indicate that there were significant reductions in the number and/or concentration of VOCs identified in the groundwater in 2004 as compared to 2001 (Table 2-4 and Figures 2-4 and 2-5). Typically, the total VOC concentrations observed in 2004 were 1 to 2 orders of magnitude lower than the concentrations observed in 2001 (e.g. 778 µg/L to 54 µg/L in MW-02, 177 µg/L to 6 µg/L in MW-06 and 11,114 µg/L to 3,951 µg/L in MW-07). This indicates that the IRM was successful in significantly reducing the source of VOC contamination in the four AOCs.

Increases in the concentrations of chloroethane in the dug well (AGRO-1) and MW-07 and vinyl chloride in MW-02 and MW-07 in the 2004 data as compared to the 2001 data, indicate that degradation of VOC contamination via natural attenuation processes is in progress (Table 2-4).

The results for the limited groundwater sampling event in February 2005 (i.e. MW-07, -10, -12, -13, -15, -19 and the spring) are presented in Table 2-4 and Figure 2-6. A comparison of the VOC data with the previous data from the June 2004 sampling event (Figure 2-5) indicated the following:

- MW-07 -showed a very slight increase in concentrations
- MW-19 (east property line) – showed no change in concentrations
- MW-10 and MW-15 (southeast corner of former Weber property) - both showed a substantial decrease in concentrations. MW-10 was ND, and MW-15 concentrations were about one-third lower.
- MW-12 and MW-13 (across road to south) - no change
- The spring (across road to southeast) - the concentrations were somewhat higher than those observed in June 2004, but are about one-half the total VOC concentration measured in November 2003, which may be due to sampling locations (the spigot near Becker House driveway at the end of underground pipe as opposed to directly at the Spring outlet).

In general the data indicated that contamination in the southeast corner of the property, and immediately offsite, was unchanged or had decreased near the property boundaries.

The only onsite or offsite receptor currently impacted by VOC-contaminated groundwater is the spring on the Becker property; which is directly connected via a pipe to a spigot located west of the Becker residence. This spigot is no longer used as a water supply source. A new well installed near the residence currently supplies potable water to the Becker residence. The county has offered the Becker Estate to install an additional pipe from the new well to the west spigot. The groundwater data for samples collected from the spring (Table 2-4) indicate that the number and/or concentrations of VOCs detected decreased significantly from October 2003 to February 2005. No detectable VOCs were reported in a sample collected from the new supply well.

The extent of groundwater contamination has been delineated along the north, west and northeast perimeter of the Site. Contamination detected in samples collected from MW-12, MW-15 and the spring are only slightly above the SCGs. It is likely that the groundwater contamination does not extend much beyond these locations.

The contamination detected at MW-7 and MW-19 are likely the result of contaminant migration under the influence of normal groundwater flow conditions at the Site. However, the presence of contamination at MW-12, MW-15, and the Becker spring due south/southeast of the former Weber house, is inconsistent with the existing hydrogeologic data. Whereas the contaminant distribution observed in the monitoring wells suggests a northwest-southeast groundwater flow direction, an overlay of surface topography and typical groundwater contours (Figure 2-7) indicate that groundwater and surface water flow at the Site are predominantly to the east, with some minor components to the northeast in the area between and east of the Front Pond and Rear Pond. There is no known historical source located hydraulically up gradient (i.e. west) of these wells that would be a source of the contamination at the measured concentrations. Regardless of source issues Wyoming County as Volunteer is addressing Becker related conditions in the Recommended Remedial Alternatives.

Deep Bedrock Aquifer

The analytical data showed that there were no VOCs detected in the deeper bedrock aquifer, indicating that it has not been impacted by historical activities at the Site.

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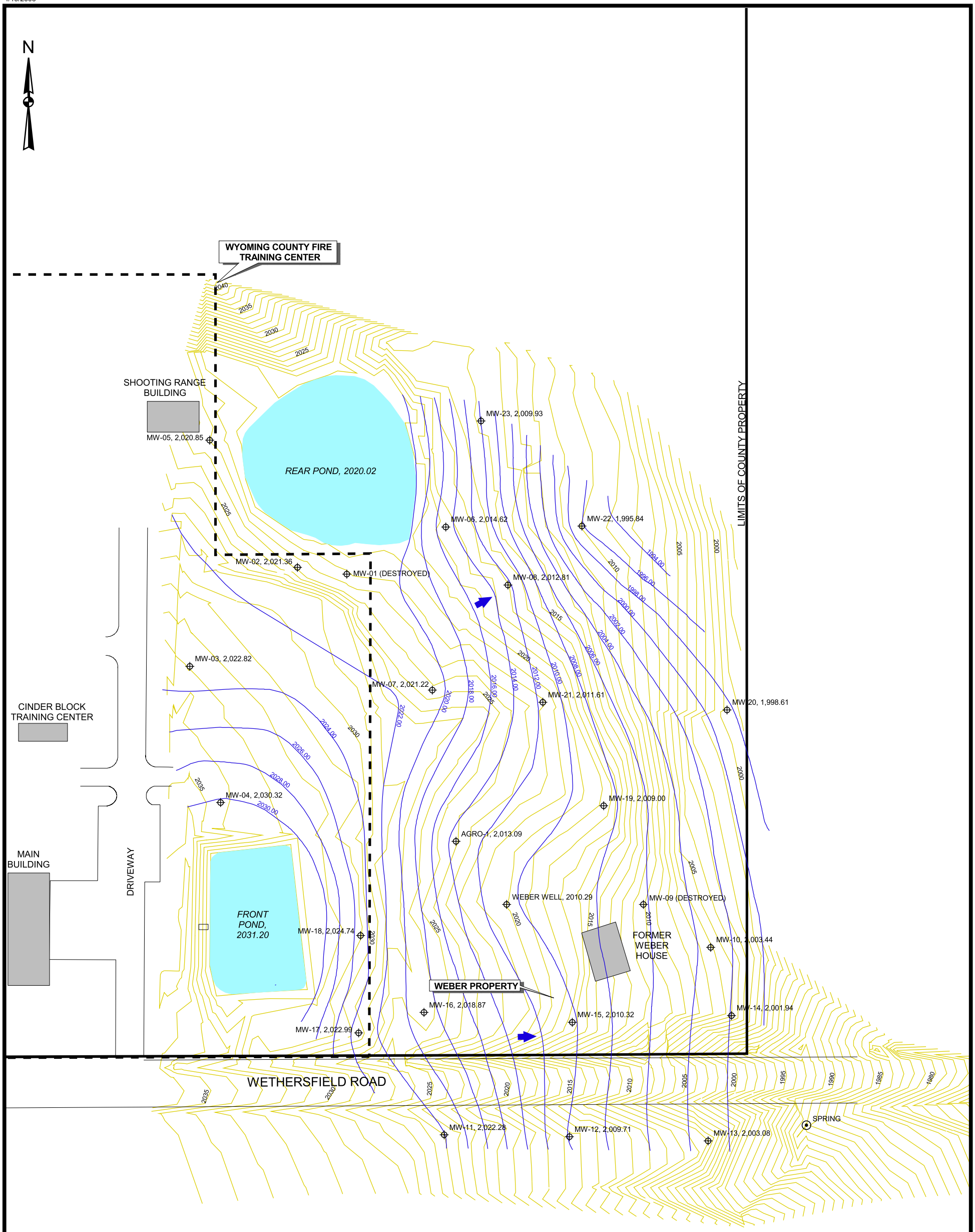
4/19/2006



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WYOMING COUNTY FIRE TRAINING CENTER
TOPOGRAPHIC AND GROUNDWATER ELEVATION
CONTOUR MAP (08/08/04)

FIGURE 2-7

3.0 PROPOSED REMEDIAL ALTERNATIVE

3.1 General

As outlined in the RAS Report, the proposed Remedial Alternative for the WCFTC will consist of installation of a permeable reactive wall (PRW) in the area of the offsite contamination (Area 1) and in situ chemical oxidation (ISO) in the area below the former South Fire Pit and around MW-07 (Area 2). Long-term monitoring will be utilized to gauge the effectiveness of the approach in reducing the residual VOC concentrations in these two areas and the Rear Pond. The monitoring also will include routine sampling of the water supply wells for the Schell and Becker residences.

3.2 Area 1 – Permeable Reactive Wall

In the southeast portion of the site, a PRW approximately 150 feet long will be installed beginning about 25 feet southwest of MW-15 and extending east parallel to Wethersfield Road. A second segment of the PRW, approximately 70 feet long, will be installed offsite about 50 feet east of MW-13 oriented perpendicular to Wethersfield Road. These locations are shown on Figure 3-1. The PRW will consist of a roughly one-foot wide trench excavated to a depth of about 10 feet below ground surface (bgs.), backfilled with a mixture of zero valent iron and sand in the bottom six feet. The excess excavated soils will be used to cap the trenches or remain on site for future use.

3.3 Area 2 – In-Situ Chemical Oxidation

For the VOC-contaminated soil below the former South Fire Pit, chemical-oxidizing reagents will be injected into the granular backfill that was placed in the excavation following removal of the contaminated soils. The oxidizing reagent consisting of a combination of hydrogen peroxide and *Klozur*™ persulfate will be injected via the 12-inch diameter corrugated,

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6/21/2006

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WYOMING COUNTY FIRE TRAINING CENTER

SHOOTING RANGE BUILDING

MW-05, 2,020.85

REAR POND, 2020.02

MW-23, 2,009.93

LIMITS OF COUNTY PROPERTY

MW-06, 2,014.62

MW-22, 1,995.84

MW-02, 2,021.36

MW-01 (DESTROYED)

MW-08, 2,012.81

NORTH FIRE PIT

AREA 2
(See Note 1)

MW-03, 2,022.82

DRUM STORAGE AREA

AIRPLANE FUSELAGE

SOUTH FIRE PIT

MW-21, 2,011.61

MW-20, 1,998.61

CINDER BLOCK TRAINING CENTER

MW-07, 2,021.22

MW-04, 2,030.32

FORMER AST

MW-19, 2,009.00

AGRO-1, 2,013.09

MAIN BUILDING

DRIVEWAY

WEBER WELL, 2010.29

MW-09 (DESTROYED)

FRONT POND, 2031.20

MW-18, 2,024.74

FORMER WEBER HOUSE

MW-10, 2,003.44

MW-16, 2,018.87

MW-15, 2,010.32

MW-14, 2,001.94

MW-17, 2,022.99

AREA 1
(See Note 2)

WETHERSFIELD ROAD

MW-11, 2,022.28

MW-12, 2,009.71

MW-13, 2,003.08

SPRING

Legend

- Monitoring Well
- Spring Location
- Permeable Reactive Wall Location
- Limit of In-Situ Chemical Oxidation
- 2010 Topographic Elevation Contour

Notes:
1) Injection points to be spaced on 20' x 20' centers to depth of 15 feet.
2) One foot wide trench to be excavated to approximate depth of 10 feet, mixture of sand and zero valent iron to be placed from 4 - 10 feet depth.

100 0 100 Feet

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WYOMING COUNTY FIRE TRAINING CENTER
PROPOSED REMEDIAL ALTERNATIVE

FIGURE 3-1

perforated polyethylene pipe that was installed vertically in the center of the excavation prior to backfilling. This pipe extends to the bottom of the excavation (i.e. about 11 feet).

In the area directly east of the former South Fire Pit and around MW-07 (Figure 3-1), chemical-oxidizing reagents will be injected into the contaminated groundwater plume via about 25 injection points, installed in a 20 X 20 foot grid pattern to a maximum depth of 15 feet. The oxidizing reagent consisting of a combination of Hydrogen Peroxide and *Klozur*™ persulfate will be injected in the zone from about 7 to 12 feet below ground surface (BGS). This zone extends from about the top of groundwater surface to the base of the contaminated soils identified in the borings and IRM excavations.

3.4 Design Basis

General design basis has been previously reported in the RAS Report. Design basis specifics for each of the two major components of the remediation plan are presented separately here:

3.4.1 Permeable Reactive Barriers

Use of permeable reactive walls for remediation of dissolved chlorinated solvents is a well established and commonly applied technology for Sites such as the WCFTC. The product to be utilized is ARS Technologies H-200 zero valent iron powder. Appendix A contains product information for ARS H-200. In addition, Appendix A contains an excerpt of USEPA's guidelines for Scoping calculations for permeable reactive barrier walls, which have been applied to the design for this site. Utilizing these guidelines, it was calculated that a total of approx. 6350 pounds of zero valent iron mixed on-site with approx. 47.5 cubic yards (96 tons) of concrete sand, will adequately address Site remediation requirements (see calculations in Appendix A).

3.4.2 Chemical Oxidation Through Activated Persulfate Injection

In-situ chemical oxidation for remediation of chlorinated solvents in groundwater is a well established and commonly applied technology. The primary oxidant to be utilized is FMC Corporation's (FMC) *Klozur*™ persulfate product, activated by an 8% hydrogen peroxide solution, also to be provided by FMC. Appendix B contains product information for Klozur. In addition, Appendix B contains calculations determining the proper quantities of oxidants necessary for remediation of the specified area of concern at the WCFTC Site, based on Site characteristics and contaminant concentrations. Based on the calculations, a total of approximately 4420 lbs. *Klozur*™ persulfate, and approximately 4100 gallons of 8% hydrogen peroxide solution will adequately address Site remediation requirements.

4.0 SCOPE OF WORK FOR THE REMEDIAL ACTION

4.1 Mobilization & Site Control

The Contractor (Nature's Way) will be responsible for mobilization and site setup. The Contractor will procure and transport the necessary resources to accommodate the project requirements (i.e. labor, materials, and equipment). The requirements include, but are not limited to, the information provided in this section. Other requirements not specifically provided herein, but necessary for the successful conduct and completion of the work, will be provided by the Owner or URS to the Contractor.

Site preparation activities include mobilizing equipment, materials, supplies, and personnel to the project site. These resources will be utilized to perform the following operations:

- Clearing of brush and vegetation as necessary to access the work areas. All materials are to be chipped and spread onsite, unless otherwise approved by URS.
- Installation of silt fences in Area 1 around the locations where the PRW trenches will be installed.
- Installation of five foot high, orange plastic construction safety fencing mounted on driven steel fence posts at 10 foot spacing around both work areas. Signs designating the work area as Hazardous and warning against trespass will be affixed to all sides of the fence during the construction period.
- Construction of temporary soil staging areas consisting of two layers of 6 mil plastic sheeting surrounded with silt fencing.
- Placement of polyethylene storage tank in Area 1 for temporary storage of collected groundwater.
- Construction of temporary decontamination pad for personnel and equipment.

- Mobilization of excavation and drilling equipment, dump trucks and necessary personnel.

- Establish air monitoring locations.

- Locate and mark underground utilities that may potentially be affected during site work

Anticipated equipment includes groundwater collection and storage equipment, air monitoring equipment, excavators, loaders, drill rig, pumps, mix tanks, distribution/injection piping, and dump trucks. Additional equipment will be required for personal safety, equipment decontamination, and field sampling.

4.2 Temporary Facilities

The Contractor shall prepare a site plan indicating the proposed location and dimensions of any area to be used by the Contractor, including any staging areas. Site workers will have access to, and may utilize, existing WCFTC bathroom and potable water facilities during Site operations. In addition, the County will make space available within the WCFTC building for a small Site Office/Work Area to be used by Project Management and NYSDEC personnel during work On-Site.

4.2.1 Employee Parking

Contractor employees shall park privately owned vehicles in a designated area on the WCFTC. This area will not be located on or immediately adjacent to Wethersfield Road.

4.2.2 Availability and Use of Utility Services

The Contractor is responsible for providing all temporary utility services required during construction. The Contractor has the option of utilizing utilities at the WCFTC with the approval of the County.

4.2.3 Protection and Maintenance of Traffic

During construction the Contractor shall maintain and protect traffic on Wethersfield Road. Measures for the protection and diversion of traffic, if necessary, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and directional signs, shall be in accordance with applicable State and local laws. The traveling public shall be protected from damage to person and property. The Contractor shall investigate the adequacy and allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations.

4.3 Contractor's Temporary Facilities

The Contractor's temporary facilities shall be established to facilitate safe work habits and efficient execution of the Work Plan. The minimum requirements for the Contractor's facilities follow.

4.3.1 Storage Areas

The Contractor shall designate a storage area in a portion of the WCFTC, as approved by the Owner. Materials shall not be stockpiled outside the designated area in preparation for the next day's work. Mobile equipment, such as excavators, drill rigs, and trucks, shall be parked within the designated area at the end of each work day, unless otherwise approved by URS.

4.3.2 Maintenance of Storage Area

The storage area will be kept in good repair. Should the Contractor elect to traverse, with construction equipment or other vehicles, grassed or unpaved areas that are not established roadways, such areas shall be protected as necessary to prevent rutting and the tracking of mud onto paved or established roadways.

4.3.3 Security Provisions

The Contractor shall be responsible for the security of its own equipment. If the WCFTC is used for staging or storage of equipment and supplies, the Contractor shall be responsible for securing all vehicle gates and man gates at the end of each work day.

4.3.4 Refueling Stations

The Contractor shall establish an equipment refueling station, as necessary, for the project. The refueling station shall be designed to contain the maximum volume of the fuel delivery vehicle or the equipment being refueled. Spill control equipment including shovels, brooms, absorbent materials, and waste containers shall be provided at the refueling station. If the total capacity of the equipment and any containers with capacities over 55-gallons at the site exceeds 1,320 gallons, the Contractor shall prepare a SPCC plan in accordance with 40 CFR Part 112.

4.3.5 Cleanup

Construction debris, waste materials, packaging material and the like shall be removed from the work site on a daily basis. Any dirt or mud that is tracked onto paved or surfaced roadways shall be cleaned daily. Stored material shall be neatly stacked when stored.

4.3.6 Restoration of Storage Area

Upon completion of the project and after removal of materials and equipment, the areas used by the Contractor for storage of equipment or materials, and transporting equipment and/or materials between work areas, shall be restored to original or better condition.

4.4 Erosion and Sediment Control

In accordance with *New York Guidelines for Urban Erosion and Sediment Control* (New York 1997), an erosion and sediment control plan must be prepared for any construction activity that exceeds 1 acre in size. Because the total proposed soil disturbance area is much less than 1 acre, a formal plan is not required. However, sediment and erosion controls will be incorporated into the overall scope of work as a Best Management Practice and to re-establish vegetation. Due to the nature of the project, the majority of storm water that contacts disturbed areas of the site (i.e., Area 1) will be trapped by the excavation and prevented from leaving the work area.

During construction activities, erosion and sediment controls will be incorporated to minimize storm water contacting disturbed areas and to control runoff. As stated in Section 4.1, silt fences shall be installed in Area 1 around the locations where PRW trenches are installed and around the soil staging area. In addition to the silt fence, the soil pile shall also be covered with tarps. Water that accumulates in the PRW trenches will be collected and stored pending disposal.

Additional erosion and sediment controls may be necessary after the PRW trenches have been backfilled. These controls include seeding and mulching all disturbed areas of the site that remain exposed to the elements.

4.5 Health and Safety Plan/Community Air Monitoring Plan

Residences within one-half mile of the Site will be notified, in writing, at least one week prior to performance of any intrusive site work. Based on the Site's size, location, and setting, no

impact to nearby residents is expected as a result of the planned Remedial Action. Notification, continuous downwind air monitoring for VOC's during intrusive (trench) Site work, and fugitive emissions control measures described below will assure that there will be no impact to residents.

A Health and Safety Plan (HASP) has been prepared for the WCFTC Site, and is included in Appendix C. The HASP sets out personnel protection and action levels and establishes procedures and specifies H&S controls such as exclusion and decontamination zones. Compliance with the HASP will be maintained throughout the planned Remedial Action. It is expected that all intrusive Site work (i.e. trench excavation and potentially impacted soils handling operations) will be conducted under Level D, but PPE levels will be adjusted as per the HASP, based on air monitoring results.

Air monitoring will be conducted in accordance with the requirements of the HASP and Community Air Monitoring Program (CAMP), which is included in the HASP.

4.6 Equipment Decontamination

Vehicles and equipment that come into contact with affected media shall be decontaminated prior to leaving the site. The Contractor shall utilize procedures for decontamination of vehicles and equipment as outlined in the HASP.

4.7 Spill and Discharge Control

In addition to the requirements to prepare and implement a SPCC plan for the refueling station (Section 4.3.4), the Contractor shall prepare a Spill and Discharge Control Plan. The Spill and Discharge Control Plan is to be implemented in the event of an accidental release of potentially hazardous materials and shall contain the following elements:

- **Preventive Measures** – the Contractor shall provide methods, means, and facilities required to prevent contamination of soil, water, atmosphere, uncontaminated

structures, equipment, or material by the discharge of wastes from spills due to the Contractor's operations. Shovels, brooms, non-combustible sorbent materials, polyethylene sheeting, and PPE shall be maintained in accessible locations.

- **Emergency Measures** – the Contractor shall provide equipment and personnel to perform emergency measures required to contain any spillage and to remove spilled materials, soil, or liquids that become contaminated due to spillage. The collected spill materials shall be properly disposed of at the Contractor's expense.

- **Decontamination Measures** – the Contractor shall provide the equipment and personnel to perform decontamination measures that may be required to remove spillage from previously uncontaminated structures, equipment, or material. Disposal of decontamination residues and confirmation samples shall be performed at the Contractor's expense.

- **Notification Procedure** – the Contractor shall notify the Volunteer or URS immediately after the release of potentially hazardous materials as well as the National Response Center and NYSDEC Hotline, as required (applicable phone numbers must be listed in the HASP).

The Contractor will be responsible for implementing the site HASP and CAMP. The Contractor will be responsible for conducting air monitoring within his work zones and taking appropriate action based on the results. URS will provide perimeter air monitoring. During mobilization and site setup activities, equipment and materials for health and safety and air monitoring equipment will be transported to the site and assembled to satisfy the plan requirements.

5.0 REMEDIAL ACTIVITIES

The scope of work required to complete the remedial actions is described in the following sections:

5.1 Groundwater Management

Groundwater in the vicinity of Area 1 has been impacted with low levels of VOCs. Therefore, the Contractor shall remove groundwater entering the PRW trenches by vacuuming or pumping, as necessary to allow placement of the zero valent iron/sand mixture in the trenches. Groundwater removed from the PRW trenches shall be placed in temporary containers, and staged at the WCFTC pending analysis and onsite discharge or offsite disposal.

5.2 Soil Management

Soil excavated from the PRW trenches in Area 1 and drill cuttings from Area 2 may potentially be impacted with low levels of VOCs. Consequently, all soils excavated from the trenches and any drill cuttings will be screened by URS with a PID to determine the presence of any VOCs. If PID readings are > 10 ppm above background levels the soils will be transported and placed in the existing onsite SVE cells. If the PID readings are < 10 ppm, the soils will be stockpiled and used for backfill above the iron/sand layer in the PRW trenches. Any excess materials will be retained onsite for future use.

5.3 Waste Management

The Contractor shall be responsible for characterization, transportation and off-site disposal of any wastes or excess materials generated during the remedial activities (e.g. PPE, distribution piping, etc.). The Contractor shall coordinate the testing, transportation and off-site

disposal requirements associated with this project. The Contractor shall obtain approval from the disposal facility prior to transporting any materials offsite.

5.4 Transportation

The Contractor shall use New York Hazardous Waste Manifests for transporting RCRA hazardous wastes, if any are encountered and as required by 6 NYCRR Part 372.2 and any applicable local laws or regulations. Transportation shall also comply with all transportation regulations promulgated by the USDOT. The Contractor shall provide the EPA ID numbers, names, locations, and telephone numbers of each proposed waste transporter for approval by the URS. The Contractor shall ship RCRA hazardous wastes only to facilities that are properly permitted to accept such wastes and are approved by the URS.

A bill of lading or Non-Hazardous Waste Manifest that documents shipping information, including transporter and disposal facility names and locations, will accompany all non-hazardous shipments. The Contractor shall ship non-hazardous wastes only to facilities that are properly permitted to accept such waste and are approved by the Engineer.

5.5 Installation of the Permeable Reactive Barriers (Area 1)

The proposed permeable reactive barriers will consist of two separate 1.0 foot wide trenches, located as shown on Figure 3-1, excavated to a depth of approximately 10.0 feet bgs. Trenches will be excavated with a backhoe equipped with a 1.0 foot wide bucket, to the proper depth, with segregation of VOC-impacted soils from non-VOC-impacted soils based on PID readings. Potentially impacted soils (i.e. PID readings > 10 ppm) will be loaded directly into a dump truck, transported and placed in the existing onsite SVE cells. Non-VOC-impacted soils will be stockpiled adjacent to the excavation for use as backfill. As the trench is excavated, the iron/sand mixture will be placed as soon as practicable once the required excavation depth is reached, to minimize subsidence (cave-in) of the trench prior to treatment agent placement. The trench will be backfilled with the zero valent iron/sand mixture from approx. 10.0 feet bgs to 4.0

feet bgs, with backfilling completed to grade with the segregated, stockpiled, non-impacted soils. The sand/zero-valent iron mixture will be mixed on-site utilizing a concrete truck to perform thorough and uniform mixing. The trenches will be lightly compacted with the backhoe bucket as they are backfilled. It is expected that installation of the permeable reactive barrier walls at this Site will require approximately four days of Site work to accomplish.

5.6 Chemical Oxidation Through Activated Persulfate Injection (Area 2)

The chemical oxidant injection program will consist of injection of an activated (by hydrogen peroxide) persulfate solution into a total of 25 1-inch diameter PVC injection points to be installed in the area shown in Figure 3-1.

The oxidant injection points will be installed in the designated area on an approximately 20' X 20' grid, using an earthprobe. The 1-inch diameter Schedule 40 PVC injection points will be screened (0.040 slot) from 7.0 feet to 12.0 feet bgs, with solid riser to surface plus 1.0 foot. The chemical oxidants will be injected within the saturated zone, to a depth of approx. 12.0 feet bgs. A coarse sand filter pack will be installed surrounding the screened area of the injection points, which will then be completed by installation of a 1.0 foot' thick bentonite seal, and grouted to the ground surface with a cement-bentonite grout. It is expected that installation of the 25 injection points will require approximately three days of Site work to accomplish.

The persulfate (granular) and hydrogen peroxide (liquid) treatment agents will be delivered to the Site, and mixed in the appropriate proportions and quantities immediately prior to injection. As indicated in Appendix B, approximately 4000 lbs of persulfate and 2000 gallons of hydrogen peroxide will be utilized. The hydrogen peroxide solution will be stored onsite in the tank trailer in which it was delivered, until utilized and consumed. Injection of the chemical oxidant solution will be through manual, individual connection to the injection points with suitable hose and pipe fittings, equipped with pressure relief ports, at the rate of approx.10.0 gpm, at about 10 psi, through the use of a portable, compatible, Moyno or diaphragm pump equipped with 1-inch diameter hose. Based on the total gallons of oxidant solution calculated to be utilized at this Site (2000 gallons), and the objective of an even distribution of the treatment agents, and a

reserve of 250 gallons for injection to the South Fire Pit Area, each of the twenty-five injection points will receive a total of 70 gallons of oxidant solution. Injection will be initiated at the most down-gradient line of injection points, and then proceed to the most up-gradient injection points, progressing up-gradient until complete, to prevent mounding and potential spreading of contaminants beyond the injection/treatment area.

In addition, chemical oxidant injection will be performed in the South Fire Pit area, through gravity feed introduction of the oxidant solution into the 12-inch diameter corrugated, perforated Polyethylene well pipe located in the center of that area. This treatment point will receive a total of 250 gallons of oxidant solution over an approximately 2 hour period (approx. 2 gpm).

It is expected that mixing, distribution, and injection of chemical oxidants will require approximately three days of Site work to accomplish.

6.0 QUALITY CONTROL AND ASSURANCE

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system monitored by URS. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the contract requirements. The system shall cover all construction operations and shall be keyed to the proposed construct schedule. The work shall conform to the documents approved for construction including all work plans and drawings.

The Contractor and its subcontractors shall comply with the construction documents prepared by URS and HASP prepared by the Contractor, including the CAMP requirements. The Contractor is responsible for providing quality control during all phases of work. URS is responsible for quality assurance.

Changes significantly affecting the approved construction documents or project schedule shall be brought promptly to the attention of URS. Work found to be out of compliance with approved construction documents will be reviewed and halted, if necessary, until satisfactory resolution

6.1 Responsibilities

The principal organizations involved in implementing the remediation at the site include NYSDEC, Wyoming County, URS, and the Contractor. Specific responsibilities and authority are delineated below to establish the lines of communications required to produce an effective decision-making process during execution of the work.

6.1.1 Regulatory Agency

The lead regulatory agency involved with this project is the NYSDEC. In this capacity, the NYSDEC will review construction documents for conformance with applicable requirements. The NYSDEC has the authority to review and accept design revisions or requests for variances that are submitted after the construction documents have been approved.

6.1.2 Wyoming County

Wyoming County as Volunteer will be responsible for the proper permitting, design, and construction of the project. Wyoming County has retained URS as the project engineer and to confirm quality assurance. The Contractor will be placed under contract with the County following approval of the construction documents. Wyoming County has the authority to dismiss all non-regulatory organizations involved in the design, quality control and assurance, and construction.

6.1.3 URS

URS will function as Project Engineer and will provide construction quality assurance personnel. URS' responsibilities under these separate functions are defined below.

6.1.3.1 Project Engineer

As the Project Engineer, URS' primary responsibility will be to provide engineering technical support during construction. In this capacity, URS will be responsible for the monitoring of construction work and providing the Contractor with feedback from questions regarding the Work Plan. In addition, URS will be responsible for identifying, documenting and correcting any deviations, as necessary, and to request and receive NYSDEC approvals as may be required.

URS has the responsibility to review proposed design revisions associated with field changes that deviate from the Work Plan, and the authority to approve the revisions, and submit the proposed revisions to Wyoming County and the NYSDEC for approval. All field changes will be processed in accordance with established procedures (Section 6.3).

6.1.3.2 Construction Quality Assurance Inspector

URS will provide Construction Quality Assurance (CQA) during implementation of the remediation activities. The CQA inspector has the responsibility and authority to halt work that is not in conformance with the NYSDEC-approved Work Plan. The CQA inspector's responsibilities include:

- Review Work Plan for clarity and completeness so that the work can be implemented correctly in a timely fashion.
- Perform on-site inspections to ensure compliance with Work Plan.
- Verify that air monitoring activities have been properly documented.
- Document the results of all inspection, test, and monitoring activities.
- Report non-conforming conditions in accordance with the procedures explained in Section 6.4 as well as other deviations from the Work Plan to the Owner and NYSDEC.
- Verify the implementation of any corrective action measures.

6.1.3.3 Contractor

The Contractor's responsibility is to perform the work in accordance with the Work Plan. Construction personnel will coordinate their work with the URS CQA inspector.

6.2 Site Meetings

Periodic CQA meetings will be held during implementation and construction. However, due to the short duration of the project, it is anticipated that only one meeting will be held at the start of the project. Additional meetings will be held, if warranted during the project. As availability allows, meeting attendees will include the URS Project Manager, the CQA inspector, and the Contractor. Representatives of the NYSDEC and the County may also attend, as necessary, and timely notice of any meetings shall be distributed by URS.

6.2.1 Initial Construction Quality Assurance Meeting

The initial CQA meeting will be conducted on-site prior to initiating work. Subjects proposed to be covered during this meeting include:

- Providing appropriate parties with the NYSDEC-approved Work Plan and HASP.
- Resolving identified conflicts within the Work Plan.
- Reviewing the procedures and requirements for the tests and inspections to be performed.
- Reviewing methods for documenting and reporting inspection data (e.g. field book entries).
- Reviewing procedures for identifying and correcting deviations.
- Reviewing the HASP as needed.
- Conducting a site walkover to review and discuss work issues.
- Discussing the overall project schedule.

6.2.2 Daily Construction Quality Assurance

On a daily basis the CQA inspector will communicate with the Engineer to discuss project activities. Discussion topics will include:

- Previous activities and progress.
- Planned activities.
- Anticipated or potential construction issues.
- Review of testing procedures, submittals, or inspection activities.
- Coordination of CQA monitoring and inspection activities with the Contractor.

The CQA inspector will document the daily progress and activities. The documentation will be utilized in preparation of the Remedial Action Report at completion of the project.

6.3 Field Change Request Process

The purpose of this procedure is to describe the method for requesting acceptance for the implementation of field changes to the Work Plan and procedures applicable to the remedial action.

A Field Change Request (FCR) is a document used to request and acquire the necessary reviews and acceptance for implementing a field change involving design, process, or method. During the course of field activities, conditions may be encountered that necessitate a change in requirements affecting design, processes, or methods.

These changes may be necessary to correct or revise a design, institute an additional requirement, or request approval for relief from an existing requirement with suitable justification. Field changes may also be requested to address and acquire guidance for unforeseen

or unanticipated conditions, or to acquire acceptance for alternate methods or processes to be employed. A field change request (FCR) form (Appendix D) that includes a complete description of the requested change, seeks the necessary acceptance, and provides for disposition of the request and identifies affected documents is to be used for each proposed change.

6.4 Nonconformance Reporting

The purpose of this procedure is to establish and provide a system for identifying, reporting, evaluating, and dispositioning nonconforming items to prevent their inadvertent use or installation. This procedure applies to permanent installations and items of hardware or materials, which are procured, constructed, installed, or used in conjunction with remedial activities. This procedure does *not* apply to expendable tools, supplies, or temporary equipment, items or materials. A nonconformance is a deficiency in characteristic, documentation, or procedure that renders the quality of an item or material unacceptable or indeterminate. A disposition is a written order to correct or place a nonconforming condition into a conclusive form. Acceptable dispositions may require nonconforming conditions to be either required, reworked, scrapped, or used-as-is with suitable justification.

The CQA inspector initiating the Nonconformance Report (NCR; Appendix E) will provide a detailed description of the nonconforming condition(s), including any reference(s) to drawings, work plans, specifications, or procedures which may provide acceptance criteria for the item or material being reported. The CQA inspector, will maintain a log of NCRs.

If the NCR prompts any change to the intent of the construction documents, NYSDEC must approve of the change prior to implementation.

7.0 DEED RESTRICTIONS/ENVIRONMENTAL EASEMENTS

URS will work with the County and Counsel for the County to properly file easements or deed restrictions as required under the VCA. Evidence of the filing will be provided to the NYSDEC.

8.0 SCHEDULE

The schedule associated with implementation of the Work Plan for WCFTC is presented as Sheet 10. Major milestones that must be satisfied to accommodate the overall project schedule include the following:

- Submit draft RD/RA Work Plan to NYSDEC — May 5, 2006
- Establish contracts with Contractor — May 15, 2006
- Receive NYSDEC approval — Mid-June 2006
- Begin remediation — Mid- to Late June 2006
- Construction Completion Report — August 31, 2006
- Site Management Plan — October 31, 2006

9.0 PROJECT CLOSEOUT

As field work comes to an end, the URS will schedule a Site walk through with NYSDEC and County personnel. Any remaining work necessary to satisfy the intent of the Work Plan for WCFTC will be identified and documented for follow-up action.

A draft final Remedial Action Report will be prepared to include a description of activities conducted to comply with the requirements of this Work Plan. The report will include a certification by a Professional Engineer that the work was conducted in accordance with the approved Work Plan. Based on input from the NYSDEC, the report will be made final.

10.0 REFERENCES

Nature's Way Environmental Consultants & Contractors. 2002. – Subsurface Investigation Report – Wyoming County Fire Training Facility. January.

NYSDEC. 1994. Revised TAGM 4046 – Determination of Soil Cleanup Objectives and Cleanup Levels. Memo from Michael J. O'Toole. HWR-94-4046. January.

NYSDEC. 1998. Ambient Water Quality Standards and Guidance Values, Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1. October.

NYSDEC. 2002. Draft DER-10 Technical Guidance for Site Investigation and Remediation. December 25.

NYSDEC. 2002. Draft Voluntary Cleanup Program Guide. May.

NYSDEC. 2005. Voluntary Cleanup Agreement (Site V-00604)

New York Urban Soil Erosion and Sediment Control Committee. 1997. New York Guidelines for Urban & Sediment Control. April.

URS Corporation. 2003. Interim Remedial Measure Work Plan for Contaminated Soil Removal at the Wyoming County Fire Training Area – Wethersfield, New York. August.

URS Corporation. 2004. Work Plan for the Supplemental Hydrogeologic Investigation of the Wyoming County Fire Training Area – Wethersfield, New York. February.

URS Corporation. 2005. Interim Remedial Measures and Supplemental Hydrogeologic Investigation Report of the Wyoming County Fire Training Area – Wethersfield, New York. January.

URS Corporation. 2005. Remedial Action Selection Report for the Wyoming County Fire Training Area – Wethersfield, New York. September.

APPENDIX A

PERMEABLE REACTIVE WALL – PRODUCT INFORMATION AND CALCULATIONS

URS

Job Wyoming City Fire Training Ctr. Project No. 11172991.00000 Page 1 of ____
Description Conceptual Estimate Computed by SMM Date 6/5/06 Sheet ____ of ____
Permeable Reactive Wall Checked by RRH Date 6/26/06
Reference

Conceptual Estimate - PRW w/ Zero Valent IRON
(REF EPA/600/R-98/125) - (Ref 1)

- Design Basis

VOCS 1,1,1-TCA		50 ug/L
(PEB 2005 DATA)	(CIS) 1,2-DCE	8.6 ug/L
	PCE	9.2 ug/L
		67.8 ug/L TOTAL VOCS

$W/A = F\left(\frac{v\Lambda}{K_1}\right) \ln\left(C_o/C\right)$ → (See Ref 1)

where: W = Mass of zero valent iron
A = CROSS SECTIONAL AREA OF PLUME (LENGTH x WIDTH)
v = AVERAGE FLOW VELOCITY ($\frac{K_s}{n}$)
Λ = SOIL POROSITY
C_o = INITIAL CONCENTRATION (67.8 ug/L)
C = FINAL CONCENTRATION (5 ug/L - CLASS GA UNDER GROUNDWATER STD)
F = SAFETY FACTOR (3.5 RECOMMENDED FOR PARENT PRODUCT (ANY) REMEDIATION)
K_1 = 1st ORDER REACTION RATE CONSTANT
(TYPICALLY DETERMINED FROM COLUMN TEST.
REPORTED CONSTANTS ARE 0.1 cm/g.hr (TCE)
(Ref 1) - (REF EPA/600/R-98/125) 0.62 cm/g.hr (c-DCE)

* W/A will increase if significant intermediate products are generated (EPA/600/R-98/125)

* USE F = 10* (BE CONSERVATIVE - AS NO FACTORS FOR 1,1,1-TCA)

USE K_1 = 0.3 cm/g.hr (VALUE FOR 1,1,1-TCA UNAVAILABLE)

Job WYOMING CTY FIRE TRAINING CTR Project No. 11172991.00000 Sheet ____ of ____

Description CONCEPTUAL ESTIMATE Computed by SMM Date 6/5/06

PERMEABLE REACTIVE WALL Checked by RAH Date 6/26/06

Reference

$W/A = F\left(\frac{u\,n}{k_1}\right) \ln\left(\frac{C_0}{C}\right)$

$un = \frac{k \cdot i}{n}(cf) = ki$

$k = 1 \times 10^{-4}$ cm/sec

$i = 0.05$

u = AVERAGE FLOW VELOCITY

$u = \frac{ki}{n}$ (Darcy's Law)

n = SOIL POROSITY

k = CONDUCTIVITY TERM

i = HYDRAULIC GRADIENT

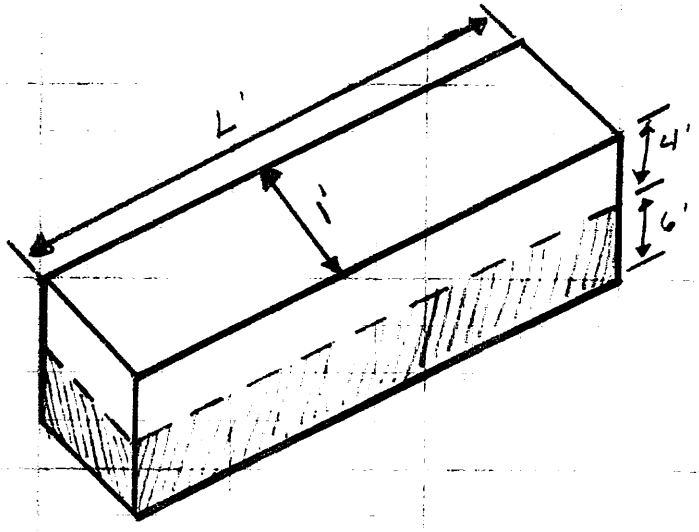
$ki = 5 \times 10^{-6}$ cm/sec $\cdot \frac{3600\ sec}{hr} = 1.8 \times 10^{-2}$ cm/hr

$W/A = 5\left(\frac{1.8 \times 10^{-2}\ cm/hr}{0.1\ cm^3/g \cdot hr}\right) \ln\left(\frac{67.5}{5}\right)$

$= 2.35\ g/cm^2 \times \left(\frac{2.048\ lb/ft^2}{1\ g/cm^2}\right) = 4.8\ lbs/ft^2$

* VERY CONSERVATIVE AS F.S. OF 5 WAS USED IN CALC AS OPPOSED TO 3.5 (TYP)

TYPICAL CONTINUOUS TRENCH



PRW (OFFSITE)

$A = 220' \times 6' = 1320\ ft^2$ (220' = TOTAL LENGTH)

$W = 1320\ ft^2 \times (4.8\ lb/ft^2) = 6{,}336\ lbs$

@ $1.70/lb = \$10{,}771.00$ ZVI COST. (ARS TECHNOLOGIES 2004)

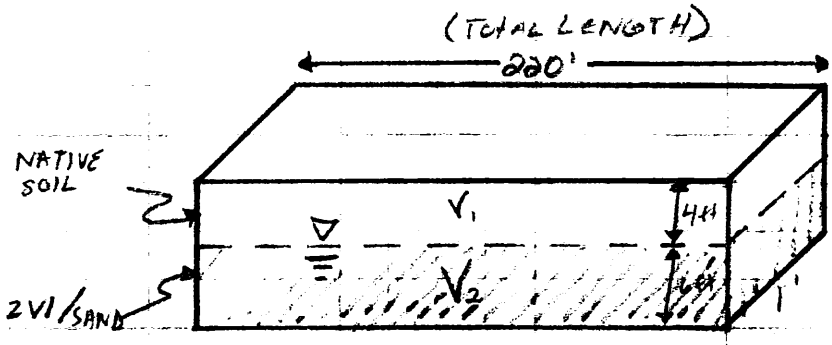
ZVI APPARENT DENSITY = 2.55 g/cm³ (ARS TECHNOLOGIES, INC.)

$2.55\ g/cm^3 \cdot \left(\frac{lb}{453.59\ g}\right) \cdot \left(\frac{28{,}316.8\ cm^3}{ft^3}\right) = 159.2\ lb/ft^3$

TRENCH DIMENSIONS / VOLUME

LENGTH = 220'
WIDTH = 1'
DEPTH = 10'

TOTAL VOLUME = L x W x D
= 220' x 1' x 10'
= 2200 ft³



$V_1 = 220' \times 4' \times 1'$
$= 880\ ft^3$

ASSUME 20% EXCESS DUE TO COMPACTION:

$880\ ft^3 \cdot (.2) = 176\ ft^3$

$V_2 = ZVI = \frac{12{,}672\ lbs}{159.2\ lb/ft^3} = 79.6\ ft^3$

TOTAL VOLUME = V_2 = 220' x 6 x 1' = 1320 ft³

SAND REQ'D = 1320 ft³ - 79.6 ft³ = 1240.4 ft³

EXCESS SOIL 176 ft³ + 1320 ft³ = 1496 ft³

→ TO BE STOCKPILED ON SITE OR DISPOSED

(NOTE: IF EXCAVATED MATERIAL IS SANDY ENOUGH, IT MAY BE POSSIBLE TO MIX IT WITH ZVI, AS OPPOSED TO PURCHASING OFFSITE SAND. HOWEVER, ONLY UNCONTAMINATED SOILS FROM THE VADOSE ZONE ARE TO BE USED, IF THE SOILS HAVE AN APPROPRIATE PERMEABILITY.)

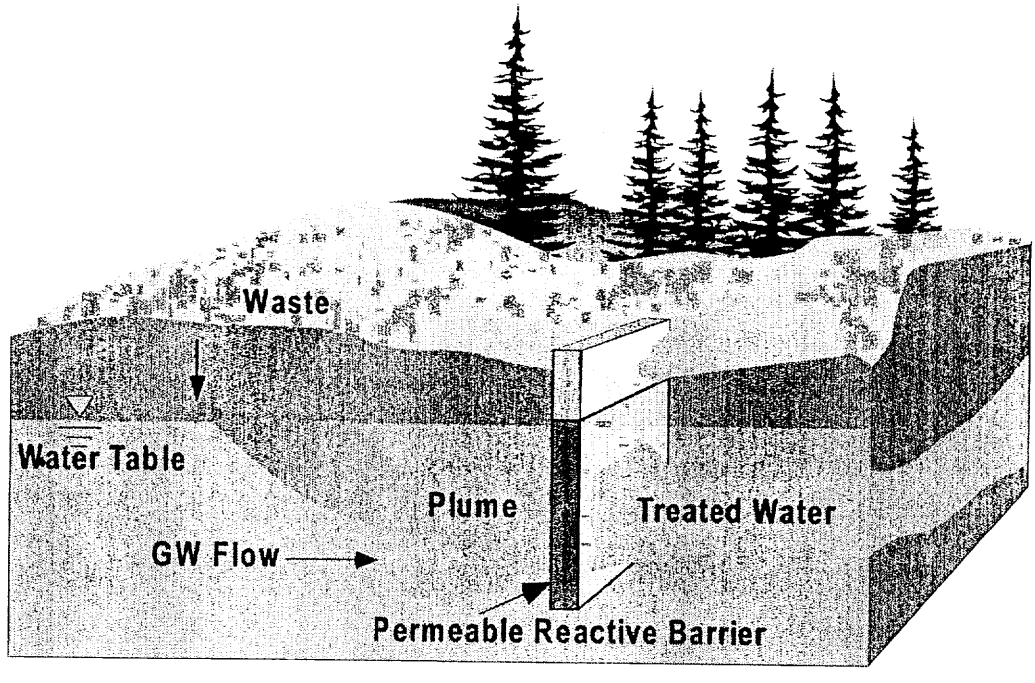
6/13

United States Environmental Protection Agency | Office of Research and Development Washington DC 20460 | Office of Solid Waste and Emergency Response Washington DC 20460 | EPA/600/R-98/125 September 1998

EPA

RTDF

Permeable Reactive Barrier Technologies for Contaminant Remediation



Appendix C. Scoping Calculations

Cost-effective use of permeable reactive barriers for ground-water treatment requires proper estimation of the amount of reactive material required and choosing the best means of emplacing it in the ground. The weight of reactive material per unit cross-section of the plume may be estimated from laboratory reaction kinetics data and basic knowledge of the plume and the remediation goals. The value of this parameter has implications regarding the choice of permeable barrier design and emplacement method. The use of tremie tubes, trenching machines, high-pressure jetting, and deep soil mixing may be appropriate for different situations, depending on the amount of reactive material required, the dimensions of the plume, and other factors. The specific application considered here is granular iron to treat ground water contaminated with chlorinated solvents, but the principles are applicable to other types of media and contaminants.

Reaction rate parameters from laboratory studies of iron-mediated degradation of a variety of chlorinated solvents have appeared in the literature in the past several years (Johnson et al., 1996; Shoemaker and al., 1996). The work of Johnson et al. (1996) has been especially helpful in establishing the high degree of consistency between kinetics data obtained from batch and column studies. By expressing rate data in a way that accounts for the iron surface area concentration, it was demonstrated that results reported in the literature varied by less than had previously been thought. This makes it possible to obtain a fairly reliable estimate of the iron requirement for a potential application even before site specific laboratory feasibility tests are conducted. The bulk of the data reviewed by Johnson et al. suggest a surface-area-specific rate parameter (k_{SA}) of about 0.2 $cm^3\ h^{-1}\ m^{-2}$ for TCE and of about 0.04 $cm^3\ h^{-1}\ m^{-2}$ for cDCE. For the examples considered here, 1.0 m^2/g will be used for the specific surface area, a value typical of the granular irons which currently appear to be the most practical for permeable barrier applications. Further, the rate of reaction will be decreased by 50% to adjust for subsurface temperatures being lower than room temperature (Sivavec and Horney, 1995). Therefore, the effective rate parameter to be used is 0.1 $cm^3\ g^{-1}\ h^{-1}$ for TCE and 0.02$cm^3\ g^{-1}\ h^{-1}$ for DCE.

Two example cases are considered below. The first and simplest involves degradation of a chlorinated compound (e.g., TCE) where the levels of intermediate products (e.g., DCE) are low enough that they do not influence the iron requirement. The second case involves significant generation of an intermediate product that degrades more slowly than the parent and thereby determines how much iron is required.

Case 1: Parent Products Only

The rate of reaction may be expressed as

1st order rx rate parameter

iron mass/solution volume

$$\frac{dP}{dt} = -k_1 \rho_m P \tag{39}$$

where P is the concentration of dissolved chlorocarbon, t is the contact time between the dissolved chlorocarbon and iron particles, k_1 is the first-order rate parameter, and ρm is the mass of zero-valent iron particles per solution volume. This equation may be integrated to give

$$\ln\left(\frac{P_0}{P}\right) = -k_1 \rho_m t \tag{40}$$

where P_0 is the initial concentration of dissolved chlorocarbon. In a batch laboratory experiment, k_1 may be derived from the slope of a semi-log plot of P_0/P vs. time.

For the case of steady-state flow in a packed bed reactor, an expression analogous to Equation 40 may be derived by expressing the residence time (t) as the product of the bed void fraction (ε) and the reactor volume (V), divided by the liquid flowrate through the bed, yielding

$$\ln\left(\frac{P_0}{P}\right) = \frac{k_1 \rho_m \varepsilon V}{Q} \tag{41}$$

The term $\rho_m \varepsilon V$ is the mass of zero-valent iron, W, that the fluid encounters as it flows through the bed. With this substitution, and by representing the flowrate as the product of the cross-sectional plume area (A), the soil porosity (n), and the average flow velocity (u), the amount of iron required per unit cross-section of plume to effect a desired decrease in chlorocarbon concentration may be expressed as

$$\frac{W}{A} = \frac{un}{k_1} \ln\left(\frac{P_0}{P}\right) \quad (42)$$

This is a useful expression because it allows estimates to be made without assuming a particular design (such as funnel-and-gate) or calculating parameters such as residence time, but rather expresses a key aspect of the design (W/A) in the most fundamental terms. However, it does not reflect uncertainties and fluctuations in parameter values that must be considered in any design. These can be accounted for in terms of a factor of safety (F) which increases the amount of reactive material employed:

$$\frac{W}{A} = F\frac{un}{k_1} \ln\left(\frac{P_0}{P}\right) \quad (43)$$

A Monte-Carlo simulation has been developed to estimate appropriate factors of safety for permeable reactive barrier systems (Eykholt, 1997). With influent concentrations varying 10%, the reaction rate parameter varying 30%, and the ground-water velocity varying 100%, achieving a 1000-fold decrease in contaminant concentration with 95% confidence was found to require a safety factor of 3.5.

As shown in Table 9, calculations based on a safety factor of 3.5 and a range of practical values for reaction rate parameters and ground-water velocities suggest that W/A should be expected to vary from as little as about 20 lb/ft² to perhaps 1,000 lb/ft².

Case 2: Significant Intermediate Generation

If significant amounts of intermediate products are generated during the degradation of a parent chlorinated compound, the slower rate of degradation of the intermediate product may be the factor that determines how much iron is required (Focht et al., 1996). The kinetics of intermediate product generation and degradation may be expressed as

$$\frac{dP}{dt} = -k_1 \rho_m P \quad (44)$$

$$\frac{dD}{dt} = \alpha k_1 \rho_m P - k_2 \rho_m D \quad (45)$$

Table 9. Required Weight-per-Area (W/A) of Granular Iron. Calculated with n=0.33, P_0/P=1000, and F=3.5. Information and Equations from Appendix C.

k_1 ($cm^3\ g^{-1}\ h^{-1}$)	u (ft/day)	W/A (lb/ft^2)
0.1	0.1	21
	0.25	52
	0.5	100
	1	210
0.02	0.1	100
	0.25	260
	0.5	520
	1	1000

where D is the concentration of the intermediate product, α is the fraction of parent compound which appears as the intermediate product, and k_2 is the rate parameter for intermediate product degradation. These equations can be solved to yield

$$D = \left(D_0 + \frac{\alpha k_1 P_0}{k_1 - k_2} \right) e^{-k_2 \rho_m t} - \frac{\alpha k_1 P_0}{k_1 - k_2} e^{-k_1 \rho_m t} \quad (46)$$

where D_0 is the initial concentration of the intermediate product.

For most situations involving chlorinated compounds, k_2 is substantially less than k_1. For the time domain where net degradation of the intermediate product is occurring, the first term on the right side of Equation 46 dominates, therefore the concentration is approximated as

$$D \approx \left(D_0 + \frac{\alpha k_1 P_0}{k_1 - k_2} \right) e^{-k_2 \rho_m t} \quad (47)$$

Making the same substitutions used in deriving Equation 42 yields

$$\frac{W}{A} \approx F \frac{nu}{k_2} \ln \left(\frac{D_0}{D} + \frac{\alpha k_1 P_0 / D}{k_1 - k_2} \right) \quad (48)$$

As TCE degrades, DCE and vinyl chloride often appear in solution at concentrations corresponding to a few percent of the TCE originally present (Focht et al., 1996). Depending on the actual amount of conversion (α) and the values of the other parameters, Equation 48 may indicate the need for more reactive material than would be suggested by Equation 42. For example, with no intermediate products initially present and with $k_2/k_1 = 0.2$, α=0.03, and a remediation goal of $P_0/D = 1{,}000$, Equation 48 will indicate a weight-per-area that is 2.6 times the amount calculated with Equation 42.

Evaluation of Existing Iron Permeable Barriers Systems

The iron PRBs installed to date range in weight-per-area from 19 to 850 lb/ft² (Table 10), in good agreement with the calculations of the previous section.

Table 10. Summary Information on Full-Scale Permeable Reactive Barriers Using Fe(0).

Site	Iron (tons)	Capture Area (ft²)	W/A (lb/ft²)
Coffeyville, KS	70	7500	19
Belfast, N. Ireland	15	650	46
Denver, CO	580	11,700	99
Elizabeth City, NC	300	2900	210
Mountainview, CA	90	660	270
Lowry AFB, CO	45	270	330
Upstate NY	45	270	380
Moffett AFB, CA	96	475	400
Somersworth, NH	65	250	520
Sunnyvale, CA	220	520	850

Each of these W/A values can be understood in site-specific terms. Those sites with low W/A are examples of sites with low ground-water velocity and without significant concerns regarding slow-reacting intermediate products. The Sunnyvale, California, site has a high W/A value for several reasons. First, the reaction rate parameter (k) is low because the principal contaminants, DCE and VC, degrade much slower than TCE. Second, the ground-water velocity is relatively high, at approximately 0.8 ft/day. The safety factor applied in this case was 4 (Warner et al., 1995).

Cost Estimation

Characterizing a plume in terms of the weight-per-area of reactive material required lends itself to evaluating costs on a per-area basis. Installation costs for impermeable barriers are often expressed in this manner. For example, shallow impermeable barriers are often quoted to cost between \$10/ft² and \$25/ft² excluding mobilization. In this section, it is shown how this practice may be extended to permeable reactive barriers.

Many of the iron PRBs installed thus far are of the funnel-and-gate design, in which one or more discrete permeable trenches ("gates") is installed along with impermeable containment walls ("funnels") to direct ground water through the gate. The funnel-and-gate cost analysis presented here will focus on three elements: the iron itself, the creation of the gate, and the funnel. All incremental cost components will be expressed on a per-area basis. It is important to understand that these costs are on the basis of the total cross-sectional area of the plume being treated, not the area of the gate.

The cost of reactive material on a per-area basis is simply the product of its cost per weight and the weight-per-area (W/A) required:

$$\begin{pmatrix}\text{Reactive materials}\\ \text{cost per plume}\\ \text{cross}-\text{sectional}\\ \text{area}\end{pmatrix} = (Cost\ per\ weight) \times \left(\frac{W}{A}\right) \tag{49}$$

A typical price for the granular iron currently being used for PRBs is \$375/ton. This translates into incremental costs of \$9/ft² for a W/A of 50 lb/ft², \$47/ft² for a W/A of 250 lb/ft², and \$188/ft² for a W/A of 1,000 lb/ft².

The cost of installing a gate is most readily quoted on a per-volume basis. To obtain the gate cost on the basis of plume cross-sectional area, this value is multiplied by the required gate volume per plume area. The gate volume required per plume area is simply W/A divided by the bulk density of granular iron. So,

$$\begin{pmatrix}\text{Gate installation}\\ \text{cost per plume}\\ \text{cross}-\text{sectional area}\end{pmatrix} = \begin{pmatrix}\text{Installation cost}\\ \text{per volume}\end{pmatrix} \times \frac{W/A}{\rho_b} \tag{50}$$

where ρ_b is the bulk density of granular iron, typically about 160 lb/ft³. In most funnel-and-gate systems installed thus far, gate installation has proved expensive. By using a trench box method and confined entry procedures for the final stages of installation, costs of \$1,000/yd³ have not been unusual. This corresponds to a cost of \$12/ft² to install 50 lb/ft² of iron gate, \$58/ft² to install 250 lb/ft² and \$231/ft² to install 1,000 lb/ft².

Tables 11 and 12 present cost estimates for several scenarios. In each table, costs are estimated for three values of W/A: 50, 250, and 1,000 lb/ft². For Table 11, relatively high installation costs are used: \$25/ft² for funnels and \$1,000/yd³ for gates. For Table 12, significantly lower costs were assumed: \$10/ft² for funnels and \$200/yd³ for gates.

Comparing Tables 11 and 12 demonstrates that there is considerable incentive for employing less costly means of installing both the impermeable and permeable components of funnel-and-gate systems. Further cost savings may be realized in some cases by designing continuous PRBs, thereby eliminating the gate installation cost altogether, assuming that the costs of installing continuous permeable barriers are similar to the costs of installing impermeable barriers (funnels).

Table 11. Cost Elements of Funnel and Gate Systems: High Estimate (Gate @ $1000/yd³; Funnel @ $15/ft²)

		Incremental Costs ($/ft²)	
Component	W/A = 50 lb/ft²	W/A = 250 lb/ft²	W/A = 1000 lb/ft²
Iron	9	47	188
Install gate	12	58	231
Funnel	25	25	25
Sum	46	130	444

Table 12. Cost Elements of Funnel and Gate Systems: Low Estimate (Gate @ $200/yd³; Funnel @ $10/ft²)

		Incremental Costs ($/ft²)	
Component	W/A = 50 lb/ft²	W/A = 250 lb/ft²	W/A = 1000 lb/ft²
Iron	9	47	188
Install gate	2	12	46
Funnel	10	10	10
Sum	21	69	244

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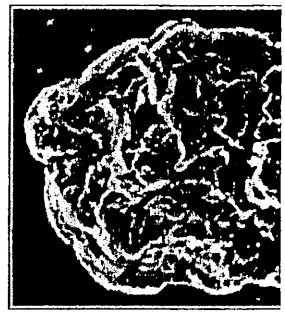

Sponge Iron Parti

The H-200 is a proprietary high reactivity zero-valent iron powder exclusively available through ARS Technologies. Directly reduced from iron ores, it contains no trace elements at toxic levels that may be found in waste iron stocks from which conventional iron filings originate. The H-200 is CODEX certifiable (Food-Grade) due to its high purity.

As a result of its production process, the H-200 contains internal porosities, which greatly enhance its surface area and, therefore, reactivity. Carbon molecules and other inclusions found within its structural matrix (not as a separate phase), have been theorized to further enhance its reactivity exceeding that of similar siz powder.

Used properly, the H-200 can reduce various chlorinated contaminants as well as immob hazardous metals such as arsenic, chromium or lead. It may be applied for insitu remedi injection, mixing or other emplacement techniques or used as part of an exsitu process ir treatment processes.

Trace Elements		
ppm (wgt.)		
Li = 32	Cr = 25	Sn = 4
Be = 0.28	Co = 180	Hg = <0.1
B = 6.5	Cu = 12	Bi = <0.01
Na = 45	Ga = 100	Pd = <0.1
Al = 1500	As = 8	Ag = 1.2
Ca = 500	Zr = 7.6	Cd = <0.1
Ti = 1000	Mo = 5	Mg = 1800
V = 1500	Ge = 15	Si = 400
Mn = 800	Se = <0.05	Sc = 4.5
Ni = 230	Nb = <0.5	Sb = 1.3
Zn = 4	In = <0.1	Pb = <0.05

Chemical Analysis	
wt%	
Carbon	0.25
Sulfur	0.01
Oxygen	1.2
Hydrogen Loss	1.0

Analysis performed using glow discharge mass spectrometry

Physical Properties	
Aparent Density, g/cu.cm	2.55
Surface Area, sq.m/g	0.1
Particle Size sieve analysis, wt%	

*

>100 mesh	Trace
>140	4
>200	25
>230	16
>325	25
Pan	28
Laser Diffraction Micrometre	
D10	45
D50	85
D90	140

APPENDIX B

IN-SITU CHEMICAL OXIDATION – PRODUCT INFORMATION AND CALCULATIONS

URS

Page 1 of 5

Job WYOMING CITY FIRE TRAINING CT | Project No. 11172991.00000 | Sheet ___ of ___

Description CONCEPTUAL ESTIMATE IN-SITU CHEMICAL OXIDATION | Computed by RRH | Date 6/13/05

Checked by KTS | Date 6/29/05

Reference

USE OF CHEMICAL OXIDATION AROUND MW-07

① SIZE OF AREA 100' x 100' = 10,000 ft²

② TREATMENT HORIZON - DEPTH TO GW - 3-4' AVG
- BOTTOM OF AOC EXC - 11-12'
→ INJECT FROM ± 7-12'
SILTY SAND THICKNESS 5'

③ POROSITY - SILT/SAND/CLAY ASSUME 30%

④ CONTAMINANT MASS

VOCs IN GW ug/L		
	1,1,1-TCA	1100
	1,1-DCA	75
	1,2-DCE	1200
	PCE	2200
	TCE	68
		4643 = 4.6 mg/L

TOTAL VOLUME OF GROUNDWATER

10,000 ft² x 5' THICK x 0.30 POROSITY = 15,000 cf

15,000 ft³ x 7.48 GAL/ft³ x 3.7854 L/GAL = 424,722 L

x 4.6 mg/L = 1,953,721 mg VOC

= 1,954 gms x 1/453.6 gm = 4.31 lbs. VOCs

* ASSUME NO CONTRIBUTION OF CONTAMINANTS FROM SOILS/NAPL IN THIS AREA

(5) NATURAL OXIDANT DEMAND (NOD)

THE NATURAL OXIDANT DEMAND (NOD) IS A MEASURE OF THE NATURALLY OCCURRING OXYGEN DEMAND IN THE AQUIFER AND MAY BE SIGNIFICANT IF ORGANIC MATTER IS PRESENT SUCH AS A PEAT LAYER. THIS PARAMETER MAY BE DETERMINED THROUGH SAMPLING AND ANALYSIS AND GENERALLY CAN VARY BETWEEN 1 AND 50 GRAMS PER KILOGRAM (g/kg) OF SOIL.

NO SPECIFIC TESTING WAS PERFORMED AT THIS SITE. HOWEVER, BASED ON THE SOIL BORINGS COMPLETED AT THE SITE AND VISUAL OBSERVATIONS, THE SOILS IN THE PROPOSED TREATMENT ZONE CONSIST PRIMARILY OF SAND, SILT AND GRAVEL AND ARE DEVOID OF ANY ORGANIC MATERIAL. BASED ON OUR EXPERIENCE WITH SIMILAR SOILS, THE NOD VALUES ARE TYPICALLY IN THE 1-2 g/kg RANGE.

FOR THIS SITE, WE HAVE MADE THE CONSERVATIVE ASSUMPTION THAT THE NOD VALUE WILL BE 4 g/kg.

AS IS TYPICALLY DONE TO CALCULATE THE ACTUAL EFFECTIVE NOD IT WAS ASSUMED THAT 10 PERCENT OF THE AQUIFER NOD IS ACCESSIBLE TO THE OXIDANT. THEREFORE, THE TOTAL NOD WAS CALCULATED TO BE ≈ 2200 lbs.

SOIL VOLUME/WGT = 10,000 ft² X 5' THICK = 50,000 cf

X 1cy/27cf = 1851.8 cy.

ASSUMING 1.5 T/cy X 1.5 TON/1cy X 2000 lbs/TON = 5,555,555 lbs

10% AVAILABILITY X .10 X 1 kg/2.205 lbs X 4 g/kg = 1,007,811 gms

X 1 lb/453.6 gms = 2222 lbs.

(6) AVERAGE STOICHIOMETRIC OXIDANT DEMAND

USING AN AVERAGE STOICHIOMETRIC OXIDANT DEMAND OF 6.8 POUNDS OF SODIUM PERSULFATE PER POUND OF VOC, THE THEORETICAL CHEMICAL OXIDANT DEMAND WAS CALCULATED TO BE ≈ 29 POUNDS

$$4.31 \text{ lbs VOCs} \times 6.8 \frac{\text{lbs } Na_2S_2O_8}{1 \text{ lb VOC}} = 29.31 \text{ lbs } Na_2S_2O_8$$

(7) FACTOR OF SAFETY

THE FACTOR OF SAFETY IS AN ARBITRARY NUMBER BETWEEN 1 AND 10 USED TO BUILD IN A CONTINGENCY RELATED TO UNCERTAINTIES INHERENT IN THE DATA AND ASSUMPTIONS MADE AS WELL AS THE GENERAL UNPREDICTABILITY OF THE CHEMICAL OXIDATION PROCESS. A FACTOR OF SAFETY OF 2 WAS USED FOR THIS SITE. THE CALCULATED OXIDANT DEMAND BASED ON A FACTOR OF SAFETY OF 2 WAS 4500 lbs.

$$FS = 2 \times (2222 \text{ lbs} + 29.3 \text{ lbs}) = 4503 \text{ lbs}$$

(8) HYDROGEN PEROXIDE ACTIVATION

FMC RECOMMEND USING ~ 0.71 lbs of 47% HYDROGEN PEROXIDE SOLUTION PER POUND OF POTASSIUM PERSULFATE. THIS EQUATES TO:

$$H_2O_2 = 4500 \text{ lbs } Na_2S_2O_8 \times 0.71$$
$$= 3195 \text{ lbs} \times 1 \text{ GAL}/1.54 \text{ lbs}$$
$$= 2075 \text{ GALLONS.}$$

FMC
Environmental Solutions

July 20, 2006

Klozur™ Activated Persulfate Demand Calculations

Customer: URS

Contact: Bob Henschel

Site Information:

Parameter	Unit	Value
Area of Treatment	ft x ft	100 x 100
Depth of Treatment Zone	ft	5
Assumed Porosity	%	30
Calculated Soil Volume	yd^3	1,296
Calculated GW Volume	gal	112,215
Assumed Soil Density	lb / yd^3	3,000
Calculated Amount of Soil	tons	1,944
Assumed Soil Oxidant Demand (SOD)	g Klozur™ / kg soil	1

Contaminant Information:

Contaminant	Soil Concentration (ppm)	GW Concentration (ppm)	Calculated Total Amount of Contaminant (lbs)
PCE	---	1.2	1.12
TCA	---	1.1	1.03
DCA	---	.075	0.07
DCE	---	1.2	1.12
TCE	---	.068	0.068

Klozur™ Demand:

Demand from contaminant	23	lb
Demand from SOD	3,889	lb
Total Klozur™ demand	3,912	lb

pab-eit

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July 20, 2006

- **Calculation for Peroxide demand:**

based on recommended peroxide to persulfate mole ratio of 5:1
calculated peroxide demand (100% basis) = 2,793 lbs
calculated gallons of 17% hydrogen peroxide = 1,814 gallons

pricing available on request

Pros: utilized for all types of contaminants
available from FMC

Cons: short subsurface lifetime of peroxide
may generate off-gassing and heat

Note: these calculations are based on stoichiometry, and do not take into account the kinetics, or speed of the reaction, and represent the minimum required to mineralize the contaminants. As a result, these calculations should be used as a general approximation for initial economic assessment. FMC recommends that oxidant demand and treatability testing be performed to verify the quantities of oxidant needed.

pab-eit

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Oxidation of Volatile Organic Compounds and Compounds of Concern

Technical Bulletin

Persulfate Chemistry

Klozur™ persulfate is a stable, highly soluble, crystalline material, which upon activation generates the sulfate radical, a very strong oxidant, capable of oxidizing a broad range of recalcitrant compounds.

$$S_2O_8^{-2} \xrightarrow{activation} 2SO_4^- \bullet$$

$$SO_4^- \bullet + e^- \rightarrow SO_4^{-2} \qquad E^O = \sim 2.6v$$

The persulfate anion itself is a strong oxidizer,

$$S_2O_8^{-2} + 2H^+ + 2e^- \rightarrow 2HSO_4^{-2}$$

$$E^0 = 2.1v$$

providing an alternate mechanism for oxidation.

Activation of persulfate to form the sulfate radical can be accomplished by heating or by catalysis with transition metals. In addition, FMC has a patent pending for the combination of chelated-metal complexes with persulfate, which can destroy compounds of interest.

The by-product of persulfate reaction with target species is sodium sulfate. The EPA has listed a secondary drinking water standard for sulfates with an SMCL of 250 mg/L, a result of the fact that sulfates may impart a salty taste to drinking water.

As with any strongly oxidizing chemical, sodium persulfate should be handled and stored with the appropriate care to ensure a safe working environment. FMC is the only persulfate manufacturer to measure the thermal properties of its product to assess its stability prior to shipping. Please refer to the product MSDS or call FMC for proper handling and storage practices.

General Guideline to Persulfate Reactivity to VOC's

FMC funded research at both the University of Connecticut and Environmental Resources Management to investigate the ability of sodium persulfate to remediate a broad spectrum of contaminants.

All studies were conducted in sealed "volatile organic analysis" jars with zero headspace, using aqueous media. Multiple contaminants were tested within the same sample jar. Analyses were performed via GC techniques. Table 1 lists the parameters utilized in the studies and the key for Table 2, which contains the results for a variety of compounds of interest.

Color Code	Persulfate concentration (g/L)	Temperature (C)	Length of study
Pink	1	20	72 hrs
Red	1	40	72 hrs
Green	9	40	72 hrs
Purple	11	RT	3 days
Blue	11	RT	14 days
Orange	11	35 or 45	20 days
Brown	14	RT	21 days
Black	11	RT	90 days

Table 1: Experimental parameters and guide to results.

These results should be used as a guideline and do not guarantee efficacy in actual, field-use applications. Treatability studies for your specific contaminant in the actual soil or water matrix are recommended.

Document: 08-04-AOD-DC. For questions, please contact the Environmental Industry Team (EIT) at 866-860-4760.

FMC

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Table 2: Guidelines to the Reactivity of Klozur™ Persulfate for Specific Compounds. Blank spaces indicate no data available at this time. **Amount of VOC Decomposition: Y > 85%, 35% < P < 85%, N < 35%.**

Contaminant	Room Temp	Heat 35 C	Heat 40 C	Heat 45 C	Fe^{+2}	FMC Catalyst
acenaphthene	Y				Y	
acenaphthylene	Y				Y	
acetone			Y			
benzene	P Y	P	Y Y	Y	Y Y	Y
bromobenzene	P		Y Y			
bromochloromethane	N		N N			
bromodichloromethane	N		Y N		Y	Y
bromoform	N		Y P			
bromomethane	N		N P			
t-butyl alcohol (TBA)					Y	P
n-butylbenzene (n, s, t)	P		Y Y			
carbon tetrachloride	N	Y		Y	N N	P
chlorobenzene	N Y	Y	Y Y	Y	Y Y	Y
chloroethane	N		N N			
chloroform	N N	P	N N	Y	P N	N
chloromethane	N		N N			
4-chloro-3-methyl phenol	Y				Y	
2-chlorophenol	Y				Y	
chlorotoluene (2 & 4)	P		Y Y			
dibromochloromethane	N		Y N			
1,2-dibromoethane	N		N N			
dibromomethane	N		N N			
dichlorobenzene (1,2 & 1,3)	N		Y P		Y	Y
1,4-dichlorobenzene	N Y		Y Y			
dichlorodifluoromethane	N		N N			
1,1-dichloroethane (DCA)	N		N N		Y	N
1,2-dichloroethane (DCA)	N N	P	N N	Y	Y P	N
1,1-dichloroethene	N		Y Y		Y	Y
1,2-dichloroethene (c & t) (DCE)	N Y	Y	Y P	Y	Y Y	Y
dichloromethane	N		N N			
2,4-dichlorophenol	Y				Y	
2,2-dichloropropane	P		Y Y			
1,1-dichloropropene	P		Y Y			
1,3-dichloropropene (c & t)	N		Y Y			
2,4-dinitrophenol	P				P	
1,4-dioxane	N				P Y	Y
ethylbenzene	P Y	Y	Y Y	Y	Y Y	Y
fluorene	Y				Y	
hexachlorobutadiene	N		Y P			
methylene chloride	N	P		Y	P	N
methyl-t-butyl ether (MTBE)	P				Y Y	Y
4-methyl-2-pentanone					Y	Y
n-hexane	N				Y	Y
naphthalene	P N		Y Y		P	
4-nitrophenol	N				P	
pentachlorophenol	Y				Y	
phenanthrene	Y				Y	
phenol	Y				Y	Y
propylbenzene (n and iso)	P		Y Y			
4-iso-propyltoluene	P		Y Y			
styrene	P		Y Y			
1,1,1,2-tetrachloroethane	N		P N			
1,1,2,2-tetrachloroethane	N		N N			
Tetrachloroethene (PCE)	N Y	Y	Y P	Y	Y Y	Y
tetrachloromethane	N		Y N			
toluene	P Y	Y	Y Y	Y	Y Y	Y
1,2,4-trichlorobenzene	N Y		Y P		Y	Y
1,2,3-trichlorobenzene	N		P N			
1,1,1-trichloroethane (TCA)	N N	P	N N	Y	N Y	N
1,1,2-trichloroethane (TCA)	N N		N N		N	N
trichloroethene (TCE)	N Y	Y	Y P	Y	Y Y	Y
trichlorofluoromethane	N		N N			
1,2,3-trichloropropane	N		N N			
trimethylbenzene (1,2,4 & 1,3,5)	P		Y Y			
vinyl chloride	N Y		Y P		Y	Y
xylene (m, o, p)	P Y	Y	Y Y	Y	Y Y	Y

Although the above information accurately reflects the results of the tests performed, we make no warranty or representation, express or inferred and nothing contained herein should be construed as to guaranteeing actual results in field use or permission or recommendation to infringe any patent. No agent, representative or employee of this company is authorized to vary any of the terms of this notice.

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Technical Bulletin

FMC's patent pending activation chemistries provide unrivaled power and performance in the subsurface for ISCO applications

Klozur™ sodium persulfate upon activation generates the sulfate radical ($SO_4^{\bullet-}$), a very strong oxidant capable of oxidizing a broad range of recalcitrant compounds of concern (CoC's). Although heat or Fe(II) salts can be used to activate persulfate, heat activation may not be a practical solution, and the performance of Fe(II) may be hindered by availability in the groundwater. FMC has tested certain chemical activators, which in combination with **Klozur™** persulfate destroy many of the most recalcitrant compounds. FMC has patents pending for use of combinations of these chemical activators with persulfate. These activator chemistries for **Klozur ™** persulfate include:

- **Chelated Metal Activators** — Improved transportability
- **H_2O_2 Activation** — Dual oxidant combination for oxidation of recalcitrant CoC's
- **Alkaline Activation** — pH control for the formation of energetic persulfate radicals

Choosing the right chemical activator for use with **Klozur ™** persulfate is a function of several factors, including the effectiveness against CoC's and subsurface conditions. Table 1 shows the general effectiveness of the activated persulfate chemistries for various classes of CoC's, as determined in aqueous solutions under laboratory conditions (heat and Fe(II) activation methods also included).

Chemistry	BTEX	chlorinated ethenes	chlorinated ethanes	MTBE	PCB	1,4 dioxane
Un-activated Sodium Persulfate	Y	N	N	N	N	N
Sodium Persulfate + Fe(II)	Y	Y	N	Y	?	Y
Sodium Persulfate + Heat	Y	Y	Y	Y	Y	Y
Klozur™ Activated Persulfate with Chelated Metals	Y	Y	N	Y	?	Y
Klozur ™ Activated Persulfate with Hydrogen Peroxide Activation	Y	Y	Y	Y	?	?
Klozur ™ Activated Persulfate with Alkaline Activation	Y	Y	Y	Y	Y	Y

Table 1: General Effectiveness of "Klozur™ Persulfate" Activator Chemistries for Broad Classes of Contaminants of Concern (Y – generally effective, N – generally not effective, ? – data not yet available).

Document: 03-03-AOD-DD. For questions, please contact the Environmental Industry Team (EIT) at 888-880-4760.

APPENDIX C

HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN
FOR
CONTAMINATED SOIL REMOVAL AND REMEDIAL ACTIVITIES
AT THE
WYOMING COUNTY FIRE TRAINING AREA
WETHERSFIELD, NEW YORK

Prepared For:

WYOMING COUNTY
143 NORTH MAIN STREET
WARSAW, NEW YORK 14569

Prepared By:

URS CORPORATION – NEW YORK
77 GOODELL STREET
BUFFALO, NEW YORK 14203

JUNE 2006

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FIGURES

TABLES

C1.0 INTRODUCTION

Wyoming County (County) has operated a fire training center located at 3651 Wethersfield Road in the Town of Wethersfield, New York (Figure C1-1). Remedial activities consisting of drum removal, AST removal and contaminated soil excavation were conducted at the site in July/August of 2001. A site investigation program, conducted in September/October of 2001, identified four areas of concern (AOCs) wherein the soils were contaminated with volatile organic compounds (VOCs) consisting primarily of toluene, tetrachloroethene (PCE) and its breakdown compounds. Additionally, the data showed that groundwater at the site and the two adjacent County-owned parcels located immediately east of the site, had also been impacted by VOCs. These two parcels, formerly known as the Agro and Weber properties, were acquired by the County in October, 2003.

URS coordinated a formal interim remedial measure (IRM) consisting of the removal of contaminated soil in the four AOCs was conducted at the site in September – November, 2003. This IRM effectively removed the known source areas for VOCs in soils at the site.

URS Corporation (URS) was also retained to develop and implement a Supplemental Hydrogeologic Investigation Work Plan to further delineate the nature and extent of groundwater contamination associated with historical operations at the Fire Training Center. The scope of the Supplemental Investigation includes the installation of piezometers and monitoring wells, collection and analysis of groundwater samples, and evaluation of data.

C1.1 Site Description

The Wyoming County Fire Training Center (WCFTC) facility is located on the north side of Wethersfield Road approximately one-half mile east of the intersection of Poplar Hill Road in the Town of Wethersfield, Wyoming County (Figure C1-1).

The overall WCFTC facility includes several permanent structures/installations and is completely enclosed by a chain link fence about its perimeter. The main features of the WCFTC facility are the Training Center building and attached garage in the southwest section of the property, two smaller support buildings, a storm water retention pond and several fire training

structures across the remaining portions of the property. The site, prior to site remediation activities included a steel AST used for storage of flammable liquids, two subgrade concrete fire pits connected to the AST via underground piping and, a drum storage area that was utilized for storage of drums containing flammable liquids. These features are all located on about one acre in the eastern portion of the WCFTC facility (Figure C1-2), the site.

The site topography is generally flat, with a graded bank along the eastern boundary. Vegetative cover consists primarily of turf grass. The property to the east and northeast slopes more steeply to the northeast.

Surrounding land uses are generally agricultural and recreational with low-density residential housing along Wethersfield Road. The two neighboring parcels to the east, formerly known as the Agro and Weber properties (Figure C1-2), were recently acquired by the County. As a result, the seasonal home and permanent residence located on these parcels are no longer occupied. The former Agro property, adjacent to the eastern and northern boundaries of the WCFTC, has approximately two-hundred feet of frontage on Wethersfield Rd. and widens to the east and west some distance from the road. The former Weber property, 3689 Wethersfield Rd., is situated immediately to the east of the former Agro property and occupies similar frontage.

The Becker property, 3718 Wethersfield Road, is the closest occupied residence to the WCFTC. The Becker residence is situated on the south side of Wethersfield Road, approximately 1,000 feet to the southeast.

A mixture of vegetation is present on nearby parcels, ranging from mature trees to brush and lawn areas. There are two ponds present on the Agro property, the closest being located immediately northeast of the subject property.

The site and immediately surrounding properties are depicted on Figure C1-2.

In 2002, the County executed a Voluntary Cleanup Agreement (VCA) for the site with the state of New York.

C1.2 Purpose

Based on the data from the previous investigations, the probable extent of soil contamination at the site has been adequately delineated. The purpose of this IRM is to remove contaminated soils that may be providing an ongoing "source" of contaminants to the shallow groundwater.

C1.3 Anticipated Field Activities

This Health and Safety Plan (HASP) includes appropriate health and safety procedures to be followed by all URS Corporation (URS) personnel during interim remedial measure activities at and in the vicinity of the former fire training center located at 3651 Wethersfield Road, Town of Weathersfield, Wyoming County, New York. Anticipated field activities at the site will include:

- Setting up of support facilities/mobilization/demobilization
- Direct push (geoprobe) and/or rotary drilling methods
- Groundwater monitoring well/piezometer installation, development and sampling
- Real time air monitoring

The procedures presented in this plan comply with the following regulatory or guidance documents:

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH-0028	2002 TLVs and BEIs – Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.
ACGIH-0376	Guide to Occupational Exposure Values – 2002.
ACGIH-0460	Guidelines for the Selection of Chemical Protective Clothing, 3rd Edition.

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR Part 1904	Recording and Reporting Occupational Injuries and Illnesses.
29 CFR Part 1910	Occupational Safety and Health Standards, especially Part 1910.120-Hazardous Waste Site Operations and Emergency Response.
29 CFR Part 1926	Safety and Health Regulations for Construction, especially Part 1926.65-Hazardous Waste Site Operations and Emergency Response.
49 CFR Part 171	General Information, Regulations, and Definitions.
49 CFR Part 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA)

No Publication No.	(1984) Standard Operating Safety Guides, Office of Emergency and Remedial Response.
USEPA Order 1440.2	(1981) Health and Safety Requirements for Employees Engaged in Field Activities.

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH Pub. No. 85 115	(October 1985) NIOSH/OSHA/USCG/USEPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.
NIOSH Pub. No. 97-140	(June 1997) NIOSH Pocket Guide to Chemical Hazards.

URS personnel who will be involved in intrusive activities on site have completed the appropriate waste site worker training as required by OSHA 1910.120(e)(2), 1910.120(e)(3), and 1910.120(e)(8), as applicable, and the required medical surveillance as required by OSHA 1910.120(f).

C2.0 RESPONSIBILITIES

The following is a summary of the health and safety responsibilities of various project personnel.

C2.1 Project Health and Safety Officer

The responsibilities of the Project Health and Safety Officer (HSO) are to develop and coordinate the Site Health and Safety Program, and to provide necessary direction and supervision to the Site HSO. The Project HSO will conduct the initial site-specific training session (Onsite Health and Safety Briefing), and will review and confirm changes in personal protection requirements when site conditions are found to be different from those originally anticipated.

C2.2 Site Health and Safety Officer

The responsibilities of the Site HSO are as follows:

- Implement this HASP
- Enforce day-to-day health and safety protocols in effect on the site
- Require that all URS workers who will be involved in intrusive activities on the site have had appropriate waste site worker training and medical examinations, and review and maintain training and medical certifications on site
- Require that all personnel entering the site understand the provisions of this HASP
- Conduct periodic training sessions in proper use and maintenance of personal protective equipment and safety practices
- Conduct periodic emergency response drills
- Conduct daily health and safety meetings each morning
- Direct and advise onsite URS personnel, visitors, and subcontractor HSO on all aspects, especially changes, related to health and safety requirements at the site
- Conduct necessary health and safety monitoring
- Administer the air monitoring program

- Monitor site conditions and determine all necessary changes in levels of personal protection and, if warranted, execute work stoppages
- Report changes in site conditions and changes in personal protection requirements to the Project HSO
- Prepare accident/incident reports

The Site HSO reports directly to the Project HSO. URS will designate a qualified backup for the Site HSO prior to the initiation of onsite activities.

C2.3 Field Team Personnel

Field team personnel will be responsible for understanding and complying with site health and safety requirements. Field team personnel on site will be trained in first aid and CPR, and will be certified by the American Red Cross. Field team personnel will have completed the required waste site worker training to comply with 29 CFR, Part 1910.120.

C3.0 TRAINING REQUIREMENTS

All personnel conducting field activities on site are required to be certified in health and safety practices for hazardous waste operations as specified in the Federal OSHA Regulations (29 CFR 1910.120) (revised March 6, 1990). Paragraph (e) (2) of the above-referenced regulations requires that each employee, at the time of job assignment, receive a minimum of 40 hours of initial instruction off the site, and a minimum of three days of supervised field experience.

Paragraph (e) (3) of the above-referenced regulations requires that all onsite management and supervisory personnel directly responsible for, or who supervise employees engaged in hazardous waste operations, must initially receive eight hours of additional specialized training. Management and supervisory training must emphasize health and safety practices related to managing hazardous waste work.

Paragraph (e)(8) of the above-referenced regulations requires that workers and supervisors receive eight hours of refresher training annually on the items specified in Paragraph (e)(1) and/or (e)(3).

Additionally, all personnel must receive adequate site-specific training, in the form of an Onsite Health and Safety Briefing given by the Project HSO prior to participating in onsite field work. This will involve a review of this Health and Safety Plan with emphasis on the following:

- Protection of the adjacent community from hazardous substances which may be released during intrusive activities
- Attention to health effects and hazards of substances known to be present on site
- Attention to physical hazards on site, and the importance of knowing proper means of avoiding these hazards
- Health hazards, protective measures, emergency and first aid measures, fire and explosion information, reactivity, incompatible materials, and emergency procedures

for spills of hazardous chemicals brought onto the site for use during normal field operations

- Hazards and protection against heat/cold
- The need for vigilance in personal protection, and the importance of attention to proper use, fit, and care of personal protective equipment
- The effectiveness and limitations of personal protective equipment
- Prescribed decontamination procedures
- Site control, including work zones, access, and security
- The proper observance of daily health and safety practices, such as the entry and exit of work zones and site, proper hygiene during lunch, break, etc.
- Recognition in oneself or in others of physical conditions requiring immediate medical attention, and application of simple first aid measures
- Emergency procedures to be followed (with rehearsals) in cases of fire, explosion, or sudden release of hazardous gases

Health and Safety Meetings will be conducted daily by the Site HSO and will cover protective clothing and other equipment to be used that day, potential chemical and physical hazards, emergency procedures, and conditions and activities from the previous day.

All visitors entering the Exclusion Zone or Contamination Reduction Zone will be required to receive the necessary site-specific training from the Site HSO and must be equipped with the proper personal protective equipment.

C4.0 MEDICAL SURVEILLANCE REQUIREMENTS

All URS personnel who engage in onsite activities for 30 days or more per year participate in the Medical Surveillance Program, which involves undergoing a medical examination once every year. The examination must be conducted by a physician who is board-certified in occupational medicine. The physician will have been made familiar with the job-related duties of each worker examined. All URS project personnel involved in onsite activities at the site will participate in the Medical Surveillance Program as required by 29 CFR 1910.120(f) and 10 CFR 20.

Components of the Medical Surveillance Program are shown in Table C4-1. The physician must state whether the individual is fit to conduct work on hazardous waste sites using personal protection, or whether he or she must work within certain restrictions; personnel may be excluded from this site for medical reasons. Copies of the medical examination reports will be given to each employee who will be encouraged to forward copies to their personal physician.

Any person exposed to high levels of hazardous substances will be required to undergo a repeat medical exam at or before the conclusion of the project to determine possible health impacts. Any person suffering a lost-time injury or illness must have medical approval prior to returning to work on site. When employment is terminated for any reason, the employee must receive an exit medical examination.

All medical records will be held by the employer for the period of employment plus at least 30 years, in accordance with OSHA regulations on confidentiality and any other applicable regulations and will be made available to OSHA upon request.

TABLE C4-1

COMPONENTS OF MEDICAL SURVEILLANCE PROGRAM

- Medical and occupational history
- Physical examination, with particular attention to the cardiopulmonary system, general physical fitness, skin, blood-forming, hepatic, renal, and nervous systems
- Urinalysis, to include:
    - radiological bioassay
    - color
    - appearance
    - specific gravity
    - pH
    - ketones
    - protein
    - glucose
    - blood
    - bilirubin
    - leukocyte esterase
    - nitrite
    - white blood cell (WBC) count
    - red blood cell (RBC) count
    - casts
    - bacteria
    - epithelial cells
    - crystals
    - yeasts
- Blood analysis, to include:
    - complete blood count
    - hemoglobin
    - albumin, globulin, total protein
    - bilirubin - direct and total
    - g-glutamyl transpeptidase
    - serum glutamic oxalacetic transaminase
    - lactic dehydrogenase
    - alkaline phosphatase
    - sodium
    - potassium
    - chloride
    - magnesium
    - calcium
    - phosphorus
    - uric acid
    - blood urea nitrogen (BUN)
    - creatinine

TABLE C4-1 (continued)

- cholesterol
- triglycerides
- glucose
- iron
- heavy metals - arsenic, lead, mercury, and zinc protoporphyrin

- Pulmonary function test

- Additional tests as appropriate, including:
  - chest X-ray
  - electrocardiogram
  - stress test

C5.0 SITE HAZARD EVALUATION

C5.1 Chemical Hazards

The primary chemicals of concern on site are volatile organic compounds (VOCs), based on detections of these compounds in soil and groundwater samples from previous investigations. In addition, chemicals used to reduce the concentrations of the VOCs in the groundwater, sodium persulfate ($Na_2S_2O_8$) and hydrogen peroxide (H_2O_2), also pose chemical hazards. The health and safety characteristics and occupational exposure values of these compounds are summarized in Table C5-1. The risk of exposure to these contaminants can be by the dermal or respiratory route, depending on the type of contaminant and activity being conducted.

C5.2 Physical Hazards

Physical hazards range from the dangers of tripping and falling on uneven ground to those associated with the operation of heavy equipment such as drilling rigs. Physical hazards also include scattered debris, scrap metal, and concrete.

Field activities that involve drilling involve contact with various types of machinery. At least two people on site must be currently American Red Cross-certified in first aid and CPR. Personnel trained and certified in first aid should be prepared to take care of cuts and bruises as well as other minor injuries. A first aid kit approved by the American Red Cross will be present and available during all field activities.

Animals and some insects may bite and thereby pose a health hazard in the form of irritation, illness, or poisoning. Anyone bitten should be given immediate first aid as necessary, and shall be transported to the nearest medical facility (if necessary). Members of the field investigation team will be properly briefed regarding the potential for encountering insects and animals. The potential threat of the deer tick and the possibility of contracting Lyme disease is a serious matter. The likelihood of contracting Lyme disease will be greatly decreased by field personnel wearing long pants, long sleeved shirts, and hard hats. All field personnel will be instructed to take a shower daily upon returning to the hotel or place of residence to further decrease the likelihood of contracting Lyme disease.

TABLE C5-1

HAZARD CHARACTERISTICS OF CHEMICAL CONTAMINANTS ON SITE

Substance	Toxicity/Carcinogenicity	Occupational Exposure Values*
Ethylbenzene	Moderately toxic by ingestion, inhalation, and skin contact. Irritant and narcotic in high concentrations. Confirmed animal carcinogen.	100 ppm (TLV-TWA and PEL) 125 ppm (STEL) [1] (TLV)
Tetrachloroethylene (Perchloroethylene)	Moderately toxic. Irritating to skin and eyes. Confirmed animal carcinogen.	25 ppm (TLV-TWA) 100 ppm (PEL and STEL [1] (TLV)) 200 ppm (Ceiling) [2] (PEL)
Toluene	Moderate toxicity via the oral, inhalation, and intraperitoneal routes, low toxicity via the dermal route.	50 ppm (Skin) [3] (TLV-TWA) 200 ppm (PEL) 300 ppm (Ceiling) [2] (PEL)
Xylenes	Moderate toxicity via the oral, inhalation, intraperitoneal, and subcutaneous routes.	100 ppm (TLV-TWA and PEL) 150 ppm (STEL) [1] (TLV)
Sodium Persulfate	Moderately toxic. Airborne dust may be irritating to eyes, nose, lungs, throat and skin upon contact.	0.1 mg/m^3 (TLV-TWA)
Hydrogen Peroxide	Moderately toxic by ingestion, inhalation, and skin contact. Causes chemical burns of the eyes, skin, and respiratory tract at concentrations above 10%.	1 ppm (TLV-TWA and PEL) 1.4 mg/m^3 (TLV-TWA and PEL) 75 ppm (IDLH) [4]

* Occupational Exposure Values (TLVs and PELs) are 8-hour Time-Weighted Averages (TWAs) unless otherwise noted.

NOTES:

(1) STEL – 15 minute TWA exposure which should not be exceeded at any time during a work day.
(2) Ceiling – The concentration that should not be exceeded during any part of the working exposure.
(3) Skin-Listed substances followed by the designation "skin" refer to the potential significant contribution to the overall exposure by the cutaneous route, including mucous membranes and the eyes, either by contact with vapors or, or probable greater significance, by direct contact with the substance.
(4) IDLH – Immediately Dangerous to Life and Health

Definitions

Permissible Exposure Limits (PELs) – Measure of toxicity of a substance, exposure limits that are published and enforceable by the Occupational Safety and Health Administration (OSHA) as legal standards, cannot be exceeded, 8 hour exposure is assumed, expressed as concentration of a substance per unit air volume, mg/m^3, ppm.

Threshold Limit Values (TLVs) – Refers to airborne concentrations of substances as issued by the American Conference of Governmental Industrial Hygienists (ACGIH) and represents conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect.

TABLE C5-1 (Continued)

Threshold Limit Value – Time Weighted Average (TLV-TWA) – The Time-Weighted Average concentration for a conventional 8-hour work day and a 40-hour workweek, to which it is believed nearly all workers may be repeatedly exposed, day after day, without adverse effect.

References

- American Conference of Governmental Industrial Hygienists. *Guide to Occupational Exposure Values-2002*. Cincinnati, Ohio.
- American Conference of Governmental Industrial Hygienists. *2002 TLVs and BEIs - Threshold Limit Values for Chemical Substances and Physical Agents,* Cincinnati, Ohio.
- 29 CFR, Part 1910.1000, Tables Z-1 and Z-2, Limits for Air Contaminants, July 1, 1995.
- National Institute for Occupational Safety and Health. *NIOSH Pocket Guide to Chemical Hazards*. Publication No. 97-140, June 1997. Cincinnati, Ohio.
- Hawley, Gessner G. *The Condensed Chemical Dictionary*, Tenth Edition, New York: Van Nostrand Reinhold, 1981.
- Sax, R. Irving. *Dangerous Properties of Industrial Materials*, Sixth Edition, New York: Van Nostrand Reinhold, 1984.

Improper lifting by workers is one of the leading causes of industrial injuries. Therefore, all members of the field crew should be trained in the proper methods of lifting heavy objects. All workers should be cautioned against lifting objects too heavy for one person.

C6.0 TEMPERATURE STRESS

C6.1 Heat Stress

The combination of high ambient temperature, high humidity, physical exertion, and personal protective apparel which limits the dissipation of body heat and moisture can cause heat stress. The Site HSO is responsible for monitoring heat stress in the field team personnel.

The following prevention, recognition, and treatment strategies will be implemented to protect personnel from heat stress. Personnel will be trained to recognize the symptoms of heat stress, implement proper preventative measures, and apply the appropriate treatment.

A. Prevention

1. Provide plenty of liquids. Available in the Support Zone will be a 50% solution of fruit punch in water, or the like, or plain water.

2. Provide cooling devices. A portable, pump-activated sprayer and containers of tap water will be available in the Contamination Reduction Zone to reduce body temperature, cool protective clothing, and/or act as a quick-drench shower in case of an exposure incident.

3. Adjust the work schedule. During hot summer days, labor-intensive tasks which pose a high potential risk of heat stress can be performed during the coolest part of the day.

B. Recognition and Treatment

Any person who observes any of the following forms of heat stress, either in themselves or in another worker, will report this information to the Site HSO immediately after implementing treatment, if possible.

1. Heat Rash (prickly heat):

Cause: Continuous exposure to hot and humid air, aggravated by chafing clothing.

Symptoms: Eruption of red pimples around sweat ducts, accompanied by intense itching and tingling.

Treatment: Remove source of irritation and cool the skin with water or wet cloths.

2. Heat Syncope (fainting):

Cause: Sun rays beating down on victim's head and prolonged upright position can lead to mild dehydration and contraction of the blood vessels resulting in a temporary deficiency in flow of blood to the brain.

Symptoms: Brief loss of consciousness.

Treatment: Have the worker assume a horizontal position and drink one to two liters of fluid (not alcohol). Elevate the legs and cover the head.

3. Heat Cramps (heat prostration):

Cause: Profuse perspiration accompanied by inadequate replenishment of body water and electrolytes.

Symptoms: Sudden development of pain and/or muscle spasms in the abdominal region.

Treatment: Move the worker to the Contamination Reduction Zone. Remove protective clothing. Provide fluids orally. Decrease body temperature and allow a period of rest in a cool location.

4. Heat Exhaustion (heat toxemia, sunstroke):

Cause: Overexertion in a hot environment and profuse perspiration accompanied by inadequate replenishment of body water and electrolytes. Warning – this is a serious condition.

Symptoms: Muscular weakness, fatigue, staggering gait, nausea, dizziness, shallow breathing, pale and clammy skin, and approximately normal body temperature.

Treatment: Perform the following while simultaneously making arrangements for transport to a medical facility: Move the worker to the Contamination Reduction Zone. Remove protective clothing. Lie the worker down on his or her back, in a cool place, and raise the feet 6 to 12 inches. Keep warm, but loosen all clothing. If conscious, provide sips of a salt water solution using one teaspoon of salt in 12 ounces of water. Transport the worker to a medical facility.

5. Heat Stroke:

Cause: Same as heat exhaustion. This is an extremely serious condition.

Symptoms: Dry, red, hot skin, dry mouth, dizziness, nausea, headache, rapid pulse high temperature. Temperature continues to rise unless treatment is implemented.

Treatment: The basic principle is to lower the body temperature rapidly.

1. Move the victim out of the sun.
2. Remove clothes.
3. Soak victim completely with water; wet hair as well.

4. Place victim in front of a fan or in a breeze, if possible.
5. If ice is available, apply directly to the victim, especially under the arms and on the head.
6. Monitor body temperature with available thermometers. Temperature should start to decrease within minutes.
7. As temperature approaches 101°F, stop cooling measures and initiate transport to a hospital or declare an emergency response. The temperature should continue to fall, often to subnormal, during this period.

Other considerations in treating heat stroke are:

1. Rub skin briskly during cooling process.
2. If cardiac arrest occurs, perform CPR (ONLY IF CERTIFIED) and continue cooling.
3. If a seizure occurs, continue cooling; the seizure will stop.
4. No drugs of any kind are to be given to the victim.

C. Heat Stress - Predisposing Factors

Preventing heat stress is clearly preferred to treatment. The following factors increase the individual's risk of heat stress:

- Physically unfit
- Age
- Not accustomed to heat
- Sunburn

- Alcohol and drugs
- Dehydration
- Heavy or non-breathable clothing
- Not covering one's head

C6.2 Cold Stress

Personnel can be susceptible to cold stress while conducting field work during cold weather months. To guard against cold stress and to prevent cold injuries, appropriate warm clothing should be worn, warm shelter must be previously identified and readily available, rest periods should be adjusted as needed, and the physical conditions of onsite field personnel should be closely monitored. All personnel working on site must be able to recognize the signs and symptoms of cold stress and apply first aid as needed. The Site HSO is responsible for monitoring the signs and symptoms of cold stress among field personnel.

The development of cold stress and cold injuries is influenced by three factors: the ambient temperature, the velocity of the wind, and the amount of sunshine. Fingers, toes, and ears are the most susceptible parts of the body affected by cold.

A. Frost Nip:

Cause: Frost nip is the first sign of frostbite and is the only form of local cold injury that can be definitively treated in the field.

Symptoms: A whitened area of the skin which is slightly burning or painful.

Treatment: Rewarming the affected part.

B. Frost Bite:

Cause: Local damage is caused by exposure to low temperature environmental conditions. It results at temperatures when ice crystals form, either superficially or deeply, in the fluids and

underlying soft tissues of the skin. The nose, cheeks, ears, fingers, and toes are most commonly affected.

Symptoms: Skin is cold, hard, white, and numb. There may also be blisters. The affected parts will feel intensely cold; however, there may not be any pain. The victim may not know that he or she is frost-bitten.

As time goes on, the victim may experience mental confusion and impairment of judgment. The victim may stagger and eyesight may fail. The victim may fall and become unconscious. Shock is evident and breathing may cease. If death occurs, it is usually due to heart failure.

Treatment: Generally, definitive thawing should not be performed in the field, because if re-freezing occurs, it could result in severe damage. The victim should be transported to a medical facility after the following measures are instituted:

Do Not:

- Do not walk on a thawed foot or toes or use thawed hands.
- Do not allow victim to smoke or drink alcohol.
- Do not rub affected area with anything.
- Do not break any blisters.
- Do not apply heat of any kind.

Do:

- Do place victim in protected environment.
- Do prevent further heat loss (warmer clothes).
- Do protect from further damage (warm covering).

C. Mild Hypothermia:

Symptoms: The single most important sign of mild hypothermia is a change in behavior. Some signs that can be observed are:

- Decrease in work efficiency
- Decreased level of communication
- Forgetfulness
- Poor judgment
- Poor motor skills (difficulty in handling objects, dropping tools)

The target organ of mild hypothermia is the brain. During mild hypothermia, most of the body's protective mechanisms for temperature control are intact. Shivering is usually present and "goose flesh" and pale skin persist. When asked directly, the victim will usually say that he feels cold. A worker impaired by mild hypothermia can be a danger to himself and co-workers.

Treatment:

- The victim should be moved indoors or into a heated vehicle.
- Remove all wet or damp clothing, dry skin, and apply dry clothing.
- The head should be covered with a hat or blanket.
- Blankets should be put on the victim.
- The victim should be given hot fluids (no alcohol).
- If possible, monitor the victim's temperature at 15-minute intervals.

D. Moderate Hypothermia: For field purposes, this may be defined as the stage at which the patient is clearly incapable of functioning effectively, but is conscious.

Symptoms: The victim's body temperature is well below normal and some mental changes may occur which include:

- Disorientation to people, place, and time

- Hallucinations
- Inappropriate laughing or crying
- Bizarre behavior for that individual

During moderate hypothermia, shivering is absent, "goose flesh" disappears, and the heart rate may slow down. The victim does not "feel" cold.

Treatment:

- First, treat the patient for mild hypothermia.
- Provide warming with hot blowers or heaters.
- Use human body heat.
- Watch for signs of returning to normal (e.g., shivering, goose flesh, teeth chattering).
- Monitor mental status.

After these steps are initiated, the victim should be taken to a medical facility. The patient should not return to work for at least 48 hours.

E. Severe Hypothermia:

Symptoms: Characterized by a decrease in the body temperature which results in a deep coma in which even vital signs become very weak and finally undetectable. Most occupational cases occur when the victim is alone or lost. These victims, for all practical purpose, appear to be dead, but the saying "not dead until warm and dead" applies to severe hypothermia. Many of these victims can survive.

Treatment:

1. The patient is not to be considered dead.
2. Remove wet clothes, dry skin, and apply dry clothes.
3. Activate rewarming.
4. Prepare to transfer the victim to a medical facility.

5. If the patient is pulse-less and is not breathing, perform CPR (ONLY IF CERTIFIED), while enroute to the medical facility.

6. Very cold victims often tolerate long periods of arrest, even without CPR. The victim must be handled very carefully because of extreme susceptibility to even minor trauma.

C7.0 SITE CONTROL

In order to keep unauthorized personnel from entering the work area during, drilling and environmental sampling activities, and for good control of overall site safety, three work zones will be established. The three work zones are the Support Zone, the Contamination Reduction Zone, and the Exclusion Zone. Actual Exclusion Zone size will be determined by optimal size of work area and by local obstructions.

C7.1 Support Zone

The Support Zone for the project will be established in a URS cargo van. The support facilities will contain personal protective equipment (disposable suits, gloves, boots, etc.), a first aid kit, a fire extinguisher, a stretcher, an eyewash station, sampling equipment, sample containers, and 50% solution of fruit punch or the like in water (or plain drinking water).

C7.2 Contamination Reduction Zones

A Mobile Contamination Reduction Zone will lie adjacent to the Exclusion Zone. During drilling operations, materials brought to the surface may come in contact with workers' boots or protective clothing and equipment. A mobile decontamination area will be set up adjacent to any soil handling areas. All personnel will be required to decontaminate themselves and light equipment prior to leaving the Exclusion Zone.

C7.3 Exclusion Zone

The Exclusion Zone is the area around investigative activities. The exact size of any Exclusion Zone will be determined by optimal size of work area and by local obstructions. All personnel leaving the Exclusion Zone will be required to do so via the Mobile Contamination Reduction Zone, and to carry out proper decontamination procedures.

C7.4 Site Visitation

It is possible that officials from NYSDEC and other regulating bodies and jurisdictions will visit the site during operations. It is also possible that an OSHA representative will wish to inspect the operations. All such officials must meet the requirements of OSHA-approved training and site-specific training before going into any Exclusion Zone. All visitors must read this HASP prior to entering an Exclusion Zone. Visitors other than NYSDEC, OSHA, New York State Department of Health (NYSDOH), or Town or County government representatives will be subject to the additional requirement of having to receive written permission from Wyoming County to enter an Exclusion Zone. A Daily Site Visitors Log will be kept and all visitors to the site will sign in and provide their affiliation, the date of visit, affirmation that they have read and understood the HASP, arrival time, departure time, and purpose of visit.

C8.0 PERSONAL PROTECTION

Since personnel working on site may be exposed to chemical contaminants released during investigative activities, may come in contact with contaminants in soils or groundwater, or may come in contact with $Na_2S_2O_8$ or H_2O_2, various levels of protection must be available. Components of all levels of personal protection that will be available are listed in Table C8-1. The anticipated levels of protection for various field activities are given in Table C8-2.

In the event that unexpected levels of organic vapors are encountered or when working in the vicinity of open containers of $Na_2S_2O_8$ or H_2O_2, any personnel working at Level D or D+ protection will don their respirators (change to Level C). The Site HSO will consult with the Project HSO to decide if and when Level D or D+ protection may be resumed, or if a higher level of personal protection is required.

Some modification in safety equipment (e.g., switching from poly-coated disposable coveralls to standard disposable coveralls) may be implemented in order to balance concerns for full contaminant protection against concerns for the possibility of heat stress resulting from the need to wear more restrictive protective equipment. Such modifications may be implemented only if approved in advance by the Site HSO, following consultation with the Project HSO. Protective equipment which fully complies with the requirements of all required levels of protection will be immediately available at all times on the site.

Level C respiratory protection will normally be provided using NIOSH-approved full-face respirators, with Type GMC-H combination filter cartridges approved for removal of organic vapors, particulates, gases, and fumes. The filter cartridges will be changed at the end of each work day or when breakthrough occurs, whichever comes first. All URS field team members will have been fit-tested for respirators using irritant smoke prior to project assignment. Due to difficulties in achieving a proper seal between face and mask, persons with facial hair will not be allowed to work in areas requiring respiratory protection.

TABLE C8-1

COMPONENTS OF PERSONAL PROTECTION LEVELS

Level D Protection	Level D+ Protection	Level C Protection
• **ANSI-Approved Safety glasses with shields (or goggles)**	• ANSI-Approved Safety glasses with side shields (or goggles)	• Level D+ items, adding:
• ANSI-Approved Hard hat	• ANSI-Approved Hard hat	• Full-face air-purifying respirator (to be worn)
• Ordinary coveralls	• Face shield (optional)	• Duct-taping of gloves and boots to disposable coveralls
• **Ordinary work gloves**	• Disposable poly-coated coveralls (Tyvek or equivalent)	
• **ANSI-Approved Steel-toe, steel-shank work shoes or boots (chemical resistant)**	• Inner gloves of snug-fitting latex or vinyl	
• Outer boots or neoprene or butyl rubber (optional)	• Outer gloves of neoprene or nitril	
	• Outer boots of neoprene or butyl rubber	
	• ANSI-Approved Steel-toe, steel-shank work shoes or boots (chemical resistant)	
	• **Full-face air-purifying respirator (immediately available)**	

1. The use of optional equipment is dependent upon site conditions.
2. Respirator to be fitted with NIOSH-approved Type GMC-H combination respirator cartridges approved for organic vapors, particulates, gasses, and fumes.

TABLE C8-2

PLANNED LEVELS OF PERSONAL PROTECTION FOR EACH MAJOR ACTIVITY

Field Activity	Level of Protection*
A. Non-Intrusive Activities	
1. Setting up Support Facilities/Mobilization/Demobilization	D
2. Land Surveying	D
3. Support Zone Activities	D
B. Intrusive Activities	
1. Drilling and Well Installation	D/D+
2. Well Development	D/D+
3. Environmental Sampling	D/D+
4. Equipment Decontamination	D/D+
5. Chemical Injection	D+/C

* These are the levels of protection at which work will commence during the various activities on the site. Due to onsite conditions, and as directed by the Site Health and Safety Officer, it may become necessary to upgrade, or it may be possible to downgrade, the level of personal protection.

C9.0 AIR MONITORING

Real-time air monitoring will be performed during all investigative and remediation activities by trained URS personnel. While sampling and remediation activities are in progress, monitoring frequencies will be as summarized in Table C9-1. Air monitoring equipment will be calibrated daily and all data will be recorded in the field notebook and transferred to Instrument Reading Logs. Each day, investigative activities will not begin until the instruments are calibrated and background levels are taken and recorded. Air will be monitored for total volatile organic vapors with a photoionization detector (PID) (MiniRAE™ 2000, or equivalent). Explosive atmosphere, oxygen content, carbon monoxide, and hydrogen sulfide (LEL/O_2/CO/H_2S) levels will be monitored with a multi-gas meter (MSA© Watchman Multigas Monitor, or equivalent). Particulates will be monitored using a MIE pDR-1000AN dust/aerosol monitor, or equivalent. All real-time air monitoring results and meteorological data (e.g., temperature range, wind speed, wind direction, etc. obtained from onsite measurements and/or national weather service, radio, or airport) will be recorded in the field notebook and will be transferred to Instrument Reading Logs.

C9.1 Total Volatile Organic Vapors

Air monitoring for total volatile organic vapors will be performed during all investigative and remediation activities using a PID (MiniRAE™ 2000, or equivalent). When readings less than 1 part per million (ppm) above background in the breathing zone are observed consistently, monitoring will take place at least every 10 minutes or for every sample retrieved and Level D protection will be utilized. When readings between 1 ppm and 5 ppm above background in the breathing zone are observed consistently, monitoring will be continuous and Level D+ protection will be utilized. If readings from 5 to 10 ppm above background in the breathing zone are observed, and all other action levels indicate that intrusive or remedial activities can proceed, monitoring will be continuous and Level C protection will be utilized. If volatile organic vapor readings exceed 10 ppm above background in the breathing zone, or other instrument readings necessitate work suspension, intrusive and remedial activities will be halted and the level of protection used by onsite personnel will be reassessed. Monitoring frequencies during investigative activities will be as summarized in Table C9-1.

TABLE C9-1
ACTION LEVELS DURING INVESTIGATIVE ACTIVITIES

Organic Vapors (PID)	Combustibles	Oxygen	Hydrogen Sulfide	Particulates	Responses
0-1 ppm Above Background, Sustained Reading	0-10% LEL	19.5-23.5%	0-5 ppm	<0.10 mg/m³	• Continue soil handling activities. • Level D protection. • Continue monitoring every 10 minutes or whenever an odor is detected.
1-5 ppm Above Background, Sustained Reading	0-10% LEL	19.5-23.5%	5-10 ppm	0.10–0.25 mg/m³	• Continue soil handling activities. • Level D+ protection. • Continuous monitoring for organic vapors in the work area and at the Exclusion Zone perimeter. • Continuous monitoring for LEL, O_2, and H_2S in the work area.
5-10 ppm Above Background Sustained Reading	0-10% LEL	19.5 – 23.5%	5-10 ppm	0.25-1.0 mg/m³	• Continue soil handling activities. • Level C protection. • Continuous monitoring for organic vapors in the work area and at the Exclusion Zone perimeter. • Continuous monitoring for LEL, 0_2, and H_2S in the work area. • Employ dust suppression measures if particulate readings >0.25 mg/m³ above background are sustained over 15 minute period.
>10 ppm Above Background, Sustained Reading	>10% LEL	<19.5% or >23.5%	>10 ppm	>1.0 mg/m³	• Temporarily suspend soil handling activities. • Withdraw from area; shut off all engine ignition sources. • Continuous monitoring for organic vapors at Exclusion Zone perimeter if organic vapor readings >10 ppm. • Continuous LEL monitoring in breathing zone if LEL reading >10%. • Employ dust suppression measures if particulate readings >0.25 mg/m³ above background are sustained over 15 minute period. • Consult with Project HSO.

Notes:

Air monitoring for action levels will occur in the breathing zone.
If action levels for any one of the monitoring parameters is exceeded, the appropriate responses listed in the right hand column should be taken.

C9.2 LEL/O_2/CO/H_2S Monitoring

A MSA© Watchman Multigas Monitor, or equivalent, will be used to monitor for explosive atmosphere, percent oxygen, carbon monoxide, and hydrogen sulfide content. Readings greater than 10% LEL, less than 19.5% oxygen, greater than 23.5% oxygen, greater than 35 ppm carbon monoxide, or greater than 10 ppm hydrogen sulfide will require temporary suspension of intrusive or remedial activities until the Project HSO determines a safe re-entry level.

C9.3 Particulate Monitoring

A MIE pDR-1000AN dust/aerosol monitor, or equivalent, will be used to monitor for particulate matter less than 10 microns in diameter (PM_{10}). Readings greater than 0.1 mg/m^3 will require temporary suspension of intrusive or remedial activities until the Project HSO determines a safe re-entry level.

C9.4 Work Stoppage Responses

The following responses will be initiated whenever one or more of the action levels necessitating a work stoppage is exceeded:

- The Site HSO will be consulted immediately.
- All personnel (except as necessary for continued monitoring and contaminant mitigation, if applicable) will be cleared from the work area (e.g., from within the Exclusion Zone).

Any chemical release to air, water, or soil must be reported to the Site HSO at once. Any exposure resulting from protective equipment failure must be immediately reported to the Site HSO and to the Project HSO in writing within 24 hours.

C9.5 Community Air Monitoring Plan

Based on the Site's size, location, and setting, no impact to nearby residents is expected as a result of the planned supplemental investigation. There are only two occupied residences within ½ mile of the work area, and these are located at least 150 feet from the boundary of the proposed work areas. Nonetheless, as a precautionary measure, residences within one-half mile will be notified, in writing, at least one week prior to the performance of any intrusive site work. Notification, continuous downwind air monitoring for volatile organic vapors during Site work, and fugitive emissions control measures described below will assure no measurable impacts.

Real time air monitoring will be conducted in the active work zone (i.e. 25 foot radius from boring location) with a PID and a dust/aerosol monitor during all intrusive and remedial operations. If total volatile organic vapors exceed 5 ppm above background levels in the work zone or PM_{10} levels exceed 0.1 mg/m3 above background levels in the work zone, work activities will be halted until volatile organic vapor levels fall below 5 ppm, particulate levels fall below 0.1 mg/m^3, or PPE will be upgraded in accordance with the Site Specific Health and Safety Plan (SSHASP).

Additionally, air monitoring will be initiated at the perimeter of the site or 200 feet, whichever is less, downwind from the active work area. If total volatile organic vapors exceed 5 ppm above background levels, intrusive or remedial activities will be halted and monitoring will be continued under the provisions of a Vapor Emission Response Plan (Section C9.4.1). The Vapor Emission Response Plan includes an intensification of perimeter monitoring and a temporary shut down of investigation or remediation activities. When the volatile organic vapor levels drop below 5 ppm above background, work activities can resume. If organic vapor levels are greater than 5 ppm above background, but are less than 25 ppm above background in the active work zone, activities can resume provided the volatile organic vapor levels at the site perimeter or 200 feet downwind of the active work zone, whichever is less, is below 5 ppm above background.

Respirable dust (particulate) must be monitored at one upwind and one downwind location during all intrusive or remedial activities. Temporary particulate monitoring stations will be set up and moved to the appropriate locations on a daily basis based on wind direction. If

downwind particulate levels exceed the upwind particulate levels by 0.1 mg/m^3, then dust suppression measures must be employed.

Any air monitoring that results in a work stoppage will be reported to the NYSDEC, the New York State Department of Health (NYSDOH) and the County.

C9.5.1 Vapor Emission Response Plan

If the ambient air concentration of volatile organic vapors exceeds 5 ppm above background at the perimeter of the Active Work Zone, work activities will be halted and monitoring continued or PPE will be upgraded in accordance with SSHASP. If the volatile organic vapor level decreases below 5 ppm above background, work activities can resume. If the volatile organic vapor levels are greater than 5 ppm over background but less than 10 ppm over background at the perimeter of the Active Work Zone activities can resume provided the volatile organic vapor level at the site perimeter or 200 feet downwind of the Active Work Zone or half the distance to the nearest residential or commercial structure, whichever is less, is below 5 ppm over background.

If the volatile organic vapor level is above 10 ppm at the perimeter of the Active Work Zone, activities must be shut down. When work shutdown occurs, downwind air monitoring as directed by the Site HSO will be implemented to ensure that vapor emission does not impact the nearest residential or commercial structure at levels exceeding those specified in the Major Vapor Emission Response Plan (Section C9.4.2).

C9.5.2 Major Vapor Emission Response Plan

If any volatile organic vapor levels greater than 5 ppm over background are identified at the site perimeter or 200 feet downwind from the Active Work Zone or half the distance to the nearest residential or commercial property, whichever is less, all intrusive or remedial activities will be halted.

If, following the cessation of intrusive or remedial activities, or as the result of an emergency, volatile organic vapor levels persist above 5 ppm above background at the site

perimeter, 200 feet downwind from the Active Work Zone or half the distance to the nearest residential or commercial property, then the air quality will be monitored within 20 feet of the perimeter of the nearest residential or commercial structure (20-foot zone).

If efforts to abate the emission source are unsuccessful and volatile organic vapor levels approaching 5 ppm persist for more than 30 minutes in the 20-foot zone, then the Major Vapor Emission Response Plan shall automatically be placed into effect. Also, the Major Vapor Emission Response Plan shall be immediately placed into effect if 20-foot zone volatile organic vapor levels are greater than 10 ppm above background.

Upon activation of the Major Vapor Emission Response Plan, the following activities will be undertaken.

- All Emergency Response authorities will immediately be contacted by the Site HSO and advised of the situation.
- Air monitoring will be conducted at 30-minute intervals within the 20-foot zone. If two successive readings below action levels are measured, air monitoring may be halted or modified by the Sit HSO.

C9.6 Calibration of Air Monitoring Instruments

Photoionization Detector: The photoionization detector will be calibrated to a benzene surrogate daily (prior to field activities) and the results will be recorded in the field notebook and transferred to Instrument Reading Logs.

LEL/O_2/CO/H_2S Meter: Once a day, the LEL/O_2/CO/H_2S meter will be calibrated to a methane gas, carbon monoxide, and hydrogen sulfide gas standard. Prior to each use, the oxygen sensor will be air-calibrated at an upwind location. This calibration involves adjusting the meter to read 20.9%, the concentration of oxygen in ambient air.

C10.0 DECONTAMINATION PROCEDURES

C10.1 Decontamination of Personnel

Non-disposable protective clothing, boots, and gloves, will be decontaminated in the Contamination Reduction Zone before entering the Support Zone by a thorough soap-and-water wash. Personnel performing intrusive tasks involving handling of contaminated soils will be advised that all clothing worn under protective clothing (i.e., underwear, shirts, socks, trousers) should be laundered separately from street clothing before re-wearing. If protective clothing is breached and personal clothing becomes contaminated, the personal clothing will be disposed.

C.10.2 Decontamination of Equipment

Decontamination of sampling equipment by soap-and-water wash will take place in the Contamination Reduction Zone. Other light equipment (such as tools, containers, monitoring instruments, radios, clipboards, etc.) will be segregated and deposited on plastic drop cloths or in plastic-lined containers placed in the Contamination Reduction Zone and will be wiped off with damp cloths.

Decontamination of heavy equipment and vehicles, will be carried out on a decontamination pad by high-pressure water in the Contamination Reduction Zone. Appropriate personal protection equipment (PPE) must be used during all decontamination activities.

C11.0 STANDARD OPERATING PROCEDURES, ENGINEERING CONTROLS, AND WORK PRACTICES

C11.1 Project Safety Goal

Safety is URS's highest priority. The firm has established a goal of zero accidents for this project. The process of planning the project work will be done in a manner that will identify, evaluate, and control the site hazards and help realize the goal of zero accidents.

C11.2 Safety Equipment

Activities performed at the site will require, at the minimum, the use of personal protective safety equipment or Level D PPE.

C11.2.1 Hard Hats

Hard hats complying with ANSI Code Z89.1 must be worn properly, with the brim facing forward, at all times in the work zones at the site; they may be removed only inside designated office or break areas. Hard hats will be stored outside the work area to decrease the chance of contamination when not in use.

C11.2.2 Hearing Protection

Hearing protection will be provided and worn if noise levels reach or exceed 85 dB(A). Hearing protection must be able to lower noise levels to below 85 dB(A). Ear plugs will be discarded after each use unless they are fitted to an individual or are designed for reuse, in which case an individual may reuse his or her own ear plugs. Earmuffs may be reused after proper cleaning and decontamination. Earmuffs will be stored outside the work area to decrease the chance of contamination when not in use.

C11.2.3 Work Gloves

Work gloves must be worn when handling soil or materials in the work area. The gloves must be puncture-resistant to glass, sharps, or other objects that may be encountered during removal. The gloves cannot interfere with a worker's dexterity. Work gloves may be reused.

C11.2.4 Steel-Toed Safety Shoes

All personnel involved in onsite work activities must wear steel-toed safety shoes.

C11.2.5 Safety Glasses

Safety glasses will be worn at all times in the work zones; safety glasses may be removed only inside designated break areas or when wearing respiratory protection. Safety glasses must be cleaned and decontaminated periodically. Safety glasses must be stored outside the work area to decrease the chance of contamination when not in use.

C11.3 Fire Prevention and Protection

This section details fire prevention and protection procedures/resources at the project:

- The Fire Department is the available fire-fighting services.
- There will be fire extinguishers mounted on all drilling equipment, as well as in vehicles.
- There will be no smoking in work areas. Smoking will only be permitted in designated areas.
- At a minimum, one fire extinguisher rated at least I0- A:B:C will be located in each work area.

- All fire extinguishers will be inspected monthly by site personnel and annually by licensed personnel.

Project personnel are only permitted to extinguish fires in their incipient stages and only if they have received fire extinguisher training within the last year. Fighting fires is prohibited by project personnel and will only be performed by the local fire department.

C11.4 Housekeeping

Housekeeping will be a priority at the project site. The following provisions will be in place to ensure that housekeeping is maintained at a high standard:

- The importance of housekeeping and the expectation that good housekeeping will be maintained will be a regular topic of the morning safety meetings.
- Job sites will be cleaned up on a daily basis.
- Subcontractors will be informed of their responsibilities to maintain their housekeeping.
- Adequate trash receptacles will be positioned at several locations and regularly emptied. Contaminated trash must be segregated from sanitary trash for proper disposal. Hazardous waste containers will be labeled according to Resource Conservation and Recovery Act (RCRA) regulations.
- Housekeeping is an operational/safety item that will be regularly considered during routine inspections.

C11.5 Operation of Motor Vehicles

All URS personnel and subcontractors operating motor vehicles in the investigation area site will hold a valid driver's license and comply with the requirements of all federal, state, and local traffic regulations. Only vehicles that are in good condition and safe to operate will be used.

All personnel will drive defensively and wear seat belts while vehicles are in motion. Since backing accidents are the type of accident most frequently associated with this type of project, the following guidelines will be observed:

- Backing of vehicles will be avoided when possible. If this type of maneuver is unavoidable, extra care will be taken while backing vehicles.
- When parking vehicles, vehicles will be backed into the space whenever possible.
- If a parked vehicle must be backed out, the driver will physically walk to the back of the vehicle to observe the area before entering the vehicle.
- Spotters will be used to back vehicles whenever possible.

C11.6 First Aid and Medical Facilities

A first aid kit will be provided and maintained in the URS vehicle. Emergency phone numbers will be posted in the vehicle. A map showing the route to the nearest hospital is presented in Figure C11-1. The name, address, and telephone number of the hospital is:

Wyoming County Community Hospital
400 N. Main Street
Warsaw, New York
(585) 786-2233

C11.7 General Work Practices

The following list presents general work rules that will be enforced by the Project Manager (PM) and Site HSO. Personnel will comply with the applicable requirements stated below.

- Employees will not be allowed on site without the prior knowledge and consent of the PM.

- Onsite personnel must use the buddy system when wearing respiratory protective equipment.

- Only those vehicles and equipment required to complete work tasks should be permitted within the Exclusion Zone (backhoes, dump trucks, and similar heavy equipment). All non-essential vehicles should remain within the Support Zone.

- Loose jewelry, clothing, or long hair is not permitted on or near equipment with moving parts.

- Wind indicators will be set up so as to be visible from the Exclusion Zone.

- Personnel will not enter a restricted area unless authorized and all personnel will enter work areas only through the Contamination Reduction Zone. All personnel leaving an Exclusion Zone must exit through the CRZ.

- All personnel going on site must be thoroughly briefed on anticipated hazards, and trained on equipment to be worn, safety procedures, emergency procedures, and communications.

- All regulated work zones, as established on the site, will be observed. All required PPE will be worn prior to entering these zones.

- Whenever possible, contact with contaminated (or potentially contaminated) surfaces will be avoided-walk around (not through) puddles and discolored surfaces, and do not kneel or set equipment on potentially contaminated ground.

- Containers, such as drums, will be moved only with the proper equipment and will be secured to prevent dropping or loss of control during transport.

- Field survey instruments, such as PIDs, should be covered with plastic or similar covering to minimize the potential for contamination.

- Legible and understandable labels will be affixed prominently to the containers of waste materials.

- Food, beverages, unapplied cosmetics, and tobacco products will not be allowed in regulated work zones. These are only allowed in designated areas.

- No matches or lighters will be permitted in the Exclusion Zone or Contamination Reduction Zone.

- Beards, facial hair, or other facial obstructions that interfere with respirator fit will not be permitted.

- Field crewmembers will be familiar with the physical characteristics of the site operations including:

  - Wind direction in relation to the contaminated area;
  - Accessibility to associates, equipment, and vehicle;
  - Areas of known or suspected contamination;
  - Work zones;
  - Communications;
  - Site access, and
  - Nearest water sources.

- The number of personnel and equipment in the Exclusion Zone should be minimized but only to the extent consistent with workforce requirements of safe site operations.

- Field personnel are to observe each other for signs and symptoms of toxic material exposures. These signs and symptoms include, but are not limited to:

  - Changes in complexion and skin discoloration.
  - Changes in coordination.
  - Changes in demeanor.
  - Excessive salivation and papillary response.
  - Changes in speech pattern.

- Field personnel are to advise each other of nonvisible effects of toxic material exposures such as:

  - Headaches.
  - Dizziness.
  - Nausea.
  - Blurred vision.
  - Cramps.
  - Irritation of eyes, skin, or respiratory tract.

- Any detected effects of toxic exposure will be reported to the Site HSO immediately.

- If onsite activities, including decontamination, continue later than dusk, adequate lighting must be provided.

- Field activities will be suspended during severe weather such as high winds, thunderstorms, lightning, tornado warnings, and winter storm warnings.

- Damaged PPE or clothing will be immediately repaired or replaced, as appropriate.

- Personnel must thoroughly wash their hands and face before eating, smoking, drinking, or applying cosmetics.

- Unauthorized removal of materials from the site is prohibited.

- Spills will be prevented to the extent possible. In the event that a spill occurs, contain liquid if possible.

- Splashing of contaminated materials will be prevented.

- Possession of controlled substances and prohibited items, such as alcohol, firearms, or weapons, while working on site is strictly prohibited.

- Operations involving the potential for fire hazards will be conducted in a manner that will minimize the risk of fire.

- Overhead and underground utility hazards will be identified or located prior to conducting operations.

C12.0 EMERGENCY PROCEDURES

The most likely incidents for which emergency measures might be required are:

- an exposure-related worker illness
- a sudden release of hazardous gases/vapors during drilling
- an explosion or fire occurring during drilling
- slipping, tripping, or falling resulting in personal injury
- spill of contaminated liquid or solid

Emergency procedures established to respond to these incidents are covered under the sections that follow.

C12.1 Communications

Communications will be centered in the field vehicle, which will contain cellular telephones for direct outside communications with emergency response organizations.

C12.2 Escape Routes

Flags will be positioned around the site to indicate wind direction. In the event of a sudden release of hazardous gases, or a fire, all personnel will be required to move upwind or at 90 degrees away from the location of the release or fire, toward the site exit point. This may require personnel to move from the Exclusion Zone directly into an offsite area without proper decontamination. At the conclusion of the emergency, they should perform proper decontamination.

C12.3 Evacuation Signal

In the event of a sudden release or fire requiring immediate evacuation of the site, three quick blasts will be sounded on an air horn. The horns will be kept in a conspicuous place for quick access by personnel. An air horn will also be kept in the Contamination Reduction Zone.

Wyoming County and the Project HSO will be notified by telephone, and later by written report, whenever a site evacuation is executed.

C12.4 Other Signals

Emergency hand signals for use by personnel wearing air-purifying respirators are summarized in Table C12-1.

C12.5 Fire

In the event of a fire that cannot be controlled with available equipment, the local fire department (Warsaw Village Town Hall Fire) will be summoned immediately by the Site HSO or his designee, who shall apprise them of the situation upon their arrival. Wyoming County will also be notified. (See Table C12-2 for telephone numbers of emergency response agencies.)

C12.6 First Aid

At the startup of field activities, the Project HSO will contact hospital personnel regarding the potential hazards at the site. First aid for personal injuries will be administered, if possible, at the site by the Site HSO or his designee. If a site worker should require further treatment, he or she will be transported to the hospital in the URS vehicle located on site or an ambulance will be summoned.

All accidents, however insignificant, will be reported to the Site HSO, who will report the accident to the Project HSO. All personnel designated to administer first aid will have received a minimum of eight hours training in first aid and CPR, and be certified by the American Red Cross.

In the event of a serious personal injury requiring offsite medical attention, the injured person will first be moved to the Contamination Reduction Zone, where an attempt will be made to go through the decontamination procedures, including removal of protective clothing. If the injury is life-threatening, decontamination will be of secondary importance, and the injured party will be taken directly to the hospital. If a head, neck, back or spinal injury is suspected, the injured person will not be moved and an ambulance will be summoned to the site.

TABLE C12-1

EMERGENCY HAND SIGNALS

• Hand gripping throat	- Can't breathe.
• Grip partner's wrist, or place both hands around wrist	- Leave area immediately, no debate!
• Hands on top of head	- Need assistance.
• Thumbs up	- I am all right, OK, I understand.
• Thumbs down	- No, negative.

TABLE C12-2

EMERGENCY TELEPHONE NUMBERS

Emergency Response Agencies	
Fire-Warsaw Village Town Hall Fire	585-786-2468
Police-Wyoming County Sheriff	585-786-8989
New York State Police (Nunda)	585-468-3800
Medical Facilities	
Wyoming County Community Hospital 400 N. Main Street Warsaw, New York	585-786-2233
Environmental and Health Agencies	
New York State Department of Environmental Conservation Regional Headquarters	716-851-7200
New York State Department of Health Toxic Substances	716-847-4385
URS Corporation	
Robert Henschel, Project Manager	716-856-5636
Steve Sherman, Project Health and Safety Officer	716-856-5636
Tim Burmeier, Site Health and Safety Officer	716-856-5636
(Cellular telephone numbers for field personnel will be provided at startup of field activities.)	
Client Representatives	
Jim Reger, Wyoming County Emergency Services	585-786-8867
Doug Berwanger, Wyoming County, Board of Supervisors Chairman	585-786-8800

In the event of a serious personal injury requiring offsite medical attention, the injured person will first be moved to the Contamination Reduction Zone, where an attempt will be made to go through the decontamination procedures, including removal of protective clothing. If the injury is life-threatening, decontamination will be of secondary importance, and the injured party will be taken directly to the hospital. If a head, neck, back, or spinal injury is suspected, the injured person will not be moved and an ambulance will be summoned to the site.

C12.7 Emergency Assistance

The name, telephone number, and location of police, fire, hospital, and other agencies whose services might be required, or from whom information might be needed, will be kept in the support zone. The list is presented in Table C12-2. A map showing the route to the nearest hospital is presented in Figure C11-1.

If an ambulance should have to be called to the site, the injured person should meet the ambulance outside the Exclusion Zone if possible. If a head or spinal injury is suspected or the person is unconscious for any reason, medical personnel may have to come into the Exclusion Zone.

C12.8 Spills

The potential for spills to occur during onsite work at the site is minimal, since the direct handling of hazardous waste containers (drums, tanks, etc.) is not expected to be part of the scope of work. In the event that residual materials are spilled on site, the following procedures will be implemented:

C12.8.1 Liquid Spills

If a liquid (decontamination water, well development water, etc.) is spilled on a permeable surface, 2 inches of surface soil will be removed where the spill occurred and drummed. The area will later be either backfilled with clean soil or regraded. If liquid is spilled on an impermeable surface, a sorbent material will be applied to the spill area. The sorbent material will be swept up and drummed, and the spill area washed down with clean water.

C12.8.2 Soil Spills

Contaminated soil spilled on a permeable surface will be shoveled into a drum, and the top 2 inches of soil where the spill occurred will also be removed and drummed. The area will then be either backfilled with clean topsoil or regraded. If soil is spilled on an impermeable

surface, the material will be shoveled (or swept) back into a drum, and the area washed with clean water.

C12.9 Accident Investigation and Reporting

C12.9.1 Accident Investigation

All accidents requiring first aid which occur incidental to activities on site will be investigated. Standard OSHA formats will be used for reporting any accidents/injuries/illness that occur on the site. The investigation format will be as follows:

- interviews with witnesses,
- pictures, if applicable, and
- necessary actions to alleviate the problem.

C12.9.2 Accident Reports

In the event that an accident or some other incident such as an explosion or exposure to toxic chemicals occurs during the course of the project, the Project HSO and Wyoming County will be telephoned within one hour and receive a written notification within 24 hours. The report shall include the following items:

- Name, telephone number, and location of the contractor, if not URS personnel.
- Name and title of person(s) reporting.
- Date and time of accident/incident.
- Location of accident/incident, (i.e., building number, facility name).
- Brief summary of accident/incident giving pertinent details including type of operation ongoing at the time of the accident/incident.
- Cause of accident/incident.
- Casualties (fatalities, disabling injuries).
- Details of any existing chemical hazard or contamination.
- Estimated property damage, if applicable.

- Nature of damage; effect on contract schedule.
- Action taken by contractor/URS to ensure safety and security.
- Other damage or injuries sustained (public or private).

C13.0 CONFINED SPACE ENTRY

Because it is not presently part of the scope of work, confined space entry requirements will not be necessary. If it does become necessary, the Wyoming County will be notified prior to any confined space entry and all confined space entry will be performed in accordance with 29 CFR 1910.146.

MATERIAL SAFETY DATA SHEET

Klozür™

MSDS Ref. No.: 7775-27-1-12
Date Approved: 02/22/2005
Revision No.: 1

This document has been prepared to meet the requirements of the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200; the Canada's Workplace Hazardous Materials Information System (WHMIS) and, the EC Directive, 2001/58/EC.

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	Klozür™
SYNONYMS:	Sodium Persulfate, Sodium Peroxydisulfate; Disodium Peroxydisulfate
GENERAL USE:	In situ and ex situ chemical oxidation of contaminants and compounds of concern for environmental remediation applications.

MANUFACTURER

FMC CORPORATION
Active Oxidants Division
1735 Market Street
Philadelphia, PA 19103
(215) 299-6000 (General Information)

EMERGENCY TELEPHONE NUMBERS

(800) 424-9300 (CHEMTREC - U.S.)
(303) 595-9048 (Medical - Call Collect)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

- White, odorless, crystals
- Oxidizer.
- Decomposes in storage under conditions of moisture (water/water vapor) and/or excessive heat causing release of oxides of sulfur and oxygen that supports combustion. Decomposition could form a high temperature melt. See Section 10 ("Stability and Reactivity").

POTENTIAL HEALTH EFFECTS: Airborne persulfate dust may be irritating to eyes, nose, lungs, throat and skin upon contact. Exposure to high levels of persulfate dust may cause difficulty in breathing in sensitive persons.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS#	Wt.%	EC No.	EC Class
Sodium Persulfate	7775-27-1	>99	231-892-1	Not classified as hazardous

4. FIRST AID MEASURES

EYES: Flush with plenty of water. Get medical attention if irritation occurs and persists.

SKIN: Wash with plenty of soap and water. Get medical attention if irritation occurs and persists.

INGESTION: Rinse mouth with water. Dilute by giving 1 or 2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. See a medical doctor immediately.

INHALATION: Remove to fresh air. If breathing difficulty or discomfort occurs and persists, contact a medical doctor.

NOTES TO MEDICAL DOCTOR: This product has low oral toxicity and is not irritating to the eyes and skin. Flooding of exposed areas with water is suggested, but gastric lavage or emesis induction for ingestions must consider possible aggravation of esophageal injury and the expected absence of system effects. Treatment is controlled removal of exposure followed by symptomatic and supportive care.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Deluge with water.

FIRE / EXPLOSION HAZARDS: Product is non-combustible. On decomposition releases oxygen which may intensify fire. Presence of water accelerates decomposition.

FIRE FIGHTING PROCEDURES: Do not use carbon dioxide or other gas filled fire extinguishers; they will have no effect on decomposing persulfates. Wear full protective clothing and self-contained breathing apparatus.

FLAMMABLE LIMITS: Non-combustible

SENSITIVITY TO IMPACT: No data available

SENSITIVITY TO STATIC DISCHARGE: Not available

6. ACCIDENTAL RELEASE MEASURES

RELEASE NOTES: Spilled material should be collected and put in approved DOT container and isolated for disposal. Isolated material should be monitored for signs of decomposition (fuming/smoking). If spilled material is wet, dissolve with large quantity of water and dispose as a hazardous waste. All disposals should be carried out according to regulatory agencies procedures.

7. HANDLING AND STORAGE

HANDLING: Use adequate ventilation when transferring product from bags or drums. Wear respiratory protection if ventilation is inadequate or not available. Use eye and skin protection. Use clean plastic or stainless steel scoops only.

STORAGE: Store (unopened) in a cool, clean, dry place away from point sources of heat, e.g. radiant heaters or steam pipes. Use first in, first out storage system. Avoid contamination of opened product. In case of fire or decomposition (fuming/smoking) deluge with plenty of water to control decomposition. For storage, refer to NFPA Bulletin 430 on storage of liquid and solid oxidizing materials.

COMMENTS: VENTILATION: Provide mechanical general and/or local exhaust ventilation to prevent release of dust into work environment. Spills should be collected into suitable containers to prevent dispersion into the air.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
Sodium Persulfate	0.1 mg/m^3 (TWA)		

ENGINEERING CONTROLS: Provide mechanical local general room ventilation to prevent release of dust into the work environment. Remove contaminated clothing immediately and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Use cup type chemical goggles. Full face shield may be used.

RESPIRATORY: Use approved dust respirator when airborne dust is expected.

PROTECTIVE CLOTHING: Normal work clothes. Rubber or neoprene footwear.

GLOVES: Rubber or neoprene gloves. Thoroughly wash the outside of gloves with soap and water prior to removal. Inspect regularly for leaks.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR:	None
APPEARANCE:	White crystals
AUTOIGNITION TEMPERATURE:	Not applicable. No evidence of combustion up to 800°C. Decomposition will occur upon heating.
BOILING POINT:	Not applicable
COEFFICIENT OF OIL / WATER:	Not applicable
DENSITY / WEIGHT PER VOLUME:	Not available
EVAPORATION RATE:	Not applicable (Butyl Acetate = 1)
FLASH POINT:	Non-combustible
MELTING POINT:	Decomposes
ODOR THRESHOLD:	Not applicable
OXIDIZING PROPERTIES:	Oxidizer
PERCENT VOLATILE:	Not applicable
pH:	typically 5.0 - 7.0 @ 25 °C (1% solution)
SOLUBILITY IN WATER:	73 % @ 25 °C (by wt.)
SPECIFIC GRAVITY:	2.6 (H_2O=1)
VAPOR DENSITY:	Not applicable (Air = 1)
VAPOR PRESSURE:	Not applicable

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID:	Heat, moisture and contamination.
STABILITY:	Stable (becomes unstable in presence of heat, moisture and/or contamination).
POLYMERIZATION:	Will not occur
INCOMPATIBLE MATERIALS:	Acids, alkalis, halides (fluorides, chlorides, bromides and iodides), combustible materials, most metals and heavy metals, oxidizable materials, other oxidizers, reducing agents, cleaners, and organic or carbon containing compounds. Contact

with incompatible materials can result in a material decomposition or other uncontrolled reactions.

HAZARDOUS DECOMPOSITION PRODUCTS: Oxygen that supports combustion and oxides of sulfur.

COMMENTS: PRECAUTIONARY STATEMENT: Pumping and transport of Klozür persulfate requires appropriate precautions and design considerations for pressure and thermal relief.

Decomposing persulfates will evolve large volumes of gas and/or vapor, can accelerate exponentially with heat generation, and create significant and hazardous pressures if contained and not properly controlled or mitigated.

Use with alcohols in the presence of water has been demonstrated to generate conditions that require rigorous adherence to process safety methods and standards to prevent escalation to an uncontrolled reaction.

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11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: Non-irritating (rabbit) [FMC Study Number: ICG/T-79.029]

SKIN EFFECTS: Non-irritating (rabbit) [FMC Study Number: ICG/T-79.029]

DERMAL LD_{50}: > 10 g/kg [FMC Study Number: ICG/T-79.029]

ORAL LD_{50}: 895 mg/kg (rat) [FMC Study Number: ICG/T-79.029]

INHALATION LC_{50}: 5.1 mg/l (rat) [FMC I95-2017]

SENSITIZATION: May be sensitizing to allergic persons. [FMC Study Number: ICG/T-79.029]

TARGET ORGANS: Eyes, skin, respiratory passages

ACUTE EFFECTS FROM OVEREXPOSURE: Dust may be harmful and irritating. May be harmful if swallowed.

CHRONIC EFFECTS FROM OVEREXPOSURE: Sensitive persons may develop dermatitis and asthma [Respiration 38:144, 1979]. Groups of male and female rats were fed 0, 300 or 3000 ppm sodium persulfate in the diet for 13 weeks, followed by 5000 ppm for 5 weeks. Microscopic examination of tissues revealed some injury to the gastrointestinal tract at the high dose (3000 ppm) only. This effect is not unexpected for an oxidizer at high concentrations. [Ref. FMC I90-1151, Toxicologist 1:149, 1981].

CARCINOGENICITY:

NTP:	Not listed
IARC:	Not listed
OSHA:	Not listed
OTHER:	ACGIH: Not listed

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12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION:

Bluegill sunfish, 96-hour LC_{50} = 771 mg/L [FMC Study I92-1250]
Rainbow trout, 96-hour LC_{50} = 163 mg/L [FMC Study I92-1251]
Daphnia, 48-hour LC_{50} = 133 mg/L [FMC Study I92-1252]
Grass shrimp, 96-hour LC_{50} = 519 mg/L [FMC Study I92-1253]

CHEMICAL FATE INFORMATION: Biodegradability does not apply to inorganic substances.

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13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Dispose as a hazardous waste in accordance with local, state and federal regulatory agencies.

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14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

PROPER SHIPPING NAME:	Sodium Persulfate
PRIMARY HAZARD CLASS / DIVISION:	5.1 (Oxidizer)
UN/NA NUMBER:	UN 1505
PACKING GROUP:	III
LABEL(S):	5.1 (Oxidizer)
PLACARD(S):	5.1 (Oxidizer)
MARKING(S):	Sodium Persulfate, UN 1505
ADDITIONAL INFORMATION:	Hazardous Substance/RQ: Not applicable

49 STCC Number: 4918733

This material is shipped in 225 lb. fiber drums, 55 lb. poly bags and 1000 - 2200 lb. IBC's (supersacks).

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

PROPER SHIPPING NAME: Sodium Persulfate

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) / INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

PROPER SHIPPING NAME: Sodium Persulfate

OTHER INFORMATION:

Protect from physical damage. Do not store near acids, moisture or heat.

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15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355, APPENDIX A):
Not applicable

SECTION 311 HAZARD CATEGORIES (40 CFR 370):
Fire Hazard, Immediate (Acute) Health Hazard

SECTION 312 THRESHOLD PLANNING QUANTITY (40 CFR 370):
The Threshold Planning Quantity (TPQ) for this product, if treated as a mixture, is 10,000 lbs; however, this product contains the following ingredients with a TPQ of less than 10,000 lbs.:
None

SECTION 313 REPORTABLE INGREDIENTS (40 CFR 372):
Not listed

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT)

CERCLA DESIGNATION & REPORTABLE QUANTITIES (RQ) (40 CFR 302.4):
Unlisted, RQ = 100 lbs., Ignitability

TSCA (TOXIC SUBSTANCE CONTROL ACT)

TSCA INVENTORY STATUS (40 CFR 710):

Listed

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
RCRA IDENTIFICATION OF HAZARDOUS WASTE (40 CFR 261):
Waste Number: D001

CANADA

WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM):

Product Identification Number: 1505
Hazard Classification / Division: Class C (Oxidizer), Class D, Div. 2, Subdiv. B. (Toxic)
Ingredient Disclosure List: Listed

INTERNATIONAL LISTINGS

Sodium persulfate:
Australia (AICS): Listed
China: Listed
Japan (ENCS): (1)-1131
Korea: KE-12369
Philippines (PICCS): Listed

HAZARD, RISK AND SAFETY PHRASE DESCRIPTIONS:

EC Symbols: (Not classified as hazardous)

EC Risk Phrases: (Not classified as hazardous)

EC Safety Phrases: (Not classified as hazardous)

16. OTHER INFORMATION

HMIS

Health	1
Flammability	0
Physical Hazard	1
Personal Protection (PPE)	J

Protection = J (Safety goggles, gloves, apron & combination dust & vapor respirator)

HMIS = Hazardous Materials Identification System

Degree of Hazard Code:
4 = Severe

3 = Serious
2 = Moderate
1 = Slight
0 = Minimal

NFPA

Health	1
Flammability	0
Reactivity	1
Special	OX

SPECIAL = OX (Oxidizer)

NFPA = National Fire Protection Association

Degree of Hazard Code:
4 = Extreme
3 = High
2 = Moderate
1 = Slight
0 = Insignificant

REVISION SUMMARY:
New MSDS

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Material Data Safety Sheet (MSDS): HYDROGEN PEROXIDE

1. Product Identification

MSDS Name: **Hydrogen Peroxide** (30% in Water) (Without Stabilizer), Reagent ACS

Synonyms: Carbamide Peroxide, Hydrogen Dioxide, Hydroperoxide, Urea Peroxide.
Company Identification: Acros Organics N.V.
One Reagent Lane
Fairlawn, NJ 07410
For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

2. Composition/Information on Ingredients

CAS#	Chemical Name	%	EINECS#
7722-84-1	Hydrogen peroxide	30-50%	231-765-0
7732-18-5	Water	Balance	231-791-2

Hazard Symbols: C
Risk Phrases: 34

3. Hazards Identification

EMERGENCY OVERVIEW
Appearance: APHA: 10 max.
Danger! Strong oxidizer. Contact with other material may cause a fire. Harmful if inhaled. Corrosive. Causes eye and skin burns. May cause severe respiratory tract irritation with possible burns. May cause severe digestive tract irritation with possible burns.
Target Organs: None known.

Potential Health Effects
Eye:
Causes eye burns. Produces irritation, characterized by a burning sensation, redness, tearing, inflammation, and possible corneal injury.
Skin:
Causes skin burns.
Ingestion:
May cause severe and permanent damage to the digestive tract. Causes gastrointestinal tract burns. May cause perforation of the digestive
tract. May cause severe digestive tract irritation with abdominal pain, nausea, vomiting and diarrhea.
Inhalation:
Harmful if inhaled. May cause irritation of the respiratory tract with burning pain in the nose and throat, coughing, wheezing,
shortness of breath and pulmonary edema. Causes chemical burns to the respiratory tract. May cause ulceration of nasal tissue, insomnia, nervous tremors with numb extremities, chemical pneumonia, unconsciousness, and death.
Chronic:
Prolonged or repeated skin contact may cause dermatitis.

4. First Aid Measures

Eyes:
Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower lids. Get medical aid
immediately. Do NOT allow victim to rub or keep eyes closed. Extensive irrigation is required (at least 30 minutes).
Skin:
Get medical aid immediately. Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing
and shoes. Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists. Wash clothing before reuse. Destroy contaminated shoes.
Ingestion:
Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately. Call a poison control center.
Inhalation:
Get medical aid immediately. Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid. DO NOT use mouth-to-mouth respiration.
Notes to Physician:
Treat symptomatically and supportively.

5. Fire Fighting Measures

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full
protective gear. Oxidizer. Greatly increases the burning rate of combustible materials. Containers may explode in the heat of a fire. Some oxidizers may react explosively with hydrocarbons(fuel).

Extinguishing Media:
Do NOT get water inside containers. Cool containers with flooding quantities of water until well after fire is out. For small fires DO NOT use dry chemicals, carbon dioxide, halon or foams. USE WATER ONLY. For large fires flood fire with water from a distance.

Autoignition Temperature: Not available.
Flash Point: Not available.
NFPA Rating: Not published.
Explosion Limits, Lower: N/A
Upper: N/A

6. Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:
Clean up spills immediately, observing precautions in the Protective Equipment section. Flush spill area with water. Provide ventilation.

7. Handling and Storage

Handling:
Keep container tightly closed. Do not get on skin or in eyes. Do not ingest or inhale. Use with adequate ventilation. Do not store near combustible materials. Discard contaminated shoes.

Storage:
Keep container closed when not in use. Store in a cool, dry, well-ventilated area away from incompatible substances. Corrosives area. Refrigerator (approx 4^{a}C). Do not get water inside containers.

. Exposure Controls/Personal Protection

Engineering Controls:
Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Hydrogen peroxide	1 ppm ; 1.4 mg/m3	1 ppm TWA; 1.4 mg/m3 TWA; 75 ppm IDLH	1 ppm TWA; 1.4 mg/m3 TWA

OSHA Vacated PELs:
Hydrogen peroxide: 1 ppm TWA; 1.4 mg/m3 TWA

Personal Protective Equipment

Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin:
Wear appropriate protective gloves to prevent skin exposure.
Clothing:
Wear appropriate protective clothing to prevent skin exposure.
Respirators:
Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149.
Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

9. Physical and Chemical Properties (Hydrogen Peroxide)

Appearance:	Liquid
Odor:	Odorless
Solubility:	Miscible
Density:	1.2000g/cm3
pH:	Slightly acidic
% Volatiles by volume @ 21C (70F):	Not available
Boiling Point:	114 deg C
Melting Point:	-50 deg C
Vapor Density (Air=1):	Not available
Vapor Pressure (mm Hg):	1 mbar @ 30 deg C
Evaporation Rate (Butyl Acetate=1):	Not available
Viscosity:	1.245cP

Molecular Formula: H2O2
Molecular Weight: 34.00

10. Stability and Reactivity

Chemical Stability: Decomposes slowly to release oxygen.

Conditions to Avoid: Incompatible materials, light, metals, excess heat, combustible materials, reducing agents, alkaline materials, strong oxidants.

Incompatibilities with Other Materials: Acids, bases, brass, copper, bronze, chromium trioxide, iron, lead, silver, zinc.

Hazardous Decomposition Products: Irritating and toxic fumes and gases, oxygen, hydrogen gas.

Hazardous Polymerization: Has not been reported

11. Toxicological Information

RTECS#:
CAS# 7722-84-1: MX0899000 MX0900000
CAS# 7732-18-5: ZC0110000
LD50/LC50:
CAS# 7722-84-1: Inhalation, rat: LC50 =2 gm/m3/4H; Oral, mouse: LD50 = 2 gm/kg; Skin, rat: LD50 = 4060 mg/kg.
CAS# 7732-18-5: Oral, rat: LD50 = >90 mL/kg.
Carcinogenicity:
Hydrogen peroxide -
ACGIH: A3 - Animal Carcinogen
IARC: Group 3 carcinogen
Epidemiology:
No information available.
Teratogenicity:
No information available.
Reproductive Effects:
No information available.
Neurotoxicity:
No information available.
Mutagenicity:
No information available.
Other Studies:
No data available.

12. Ecological Information

Ecotoxicity:
Not available.
Environmental Fate:
Not available.
Physical/Chemical:
Not available.
Other:
Not available.

13. Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.
RCRA D-Series Maximum Concentration of Contaminants: None listed.
RCRA D-Series Chronic Toxicity Reference Levels: None listed.
RCRA F-Series: None listed.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

16. Other Information

MSDS Creation Date: 2/07/1996 Revision #5 Date: 1/23/1998

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

APPENDIX D

FIELD CHANGE REQUEST FORM

URS Corporation

77 Goodell Street
Buffalo, New York 14203
Telephone: (716)-856-5636
Fax: (716)-856-2545

FIELD CHANGE REQUEST

Field Change No.:_____
Project:_____
Contractor:_____ Contract:_____

Gentlemen:

This is a Field Change Request and may involve a change in the Contract price or Contract completion time.
In addition to the items included in the Contract Drawings, Specifications and Bulletins additional work is being added to this project.

DESCRIPTION OF CHANGE IN PROJECT APPROACH/SCOPE:

REASON FOR CHANGE:

DRAWING AND/OR SPECIFICATION REFERENCE:

DISTRIBUTION:

USED BY:_____
Residential Engineer

DATE:_____

APPENDIX E

NON-CONFORMANCE REPORT FORM

URS Corporation

77 Goodell Street
Buffalo, New York 14203
Telephone: (716)-856-5636
Fax: (716)-856-2545

NON-CONFORMANCE REPORT

Non-Conformance Report No.:_____
Project:_____
Contractor:_____ Contract:_____

Project Name:		Date:
Responsible Activity:		
Description of Discrepancy:		
Disposition:		
URS Inspector:	Date:	

Root Cause:		
Corrective/Preventive Action:		
Responsible for C/A:	Title:	Date:
Approved by URS Inspector:	Title:	Date:

DISTRIBUTION:

_____
_____
_____

USED BY:_____
Residential Engineer

DATE:_____