URS

CLEANUP ACTION PLAN
RESAW BUILDING
FORMER WELCO WOOD PRODUCTS FACILITY
6615 172ND STREET NE
ARLINGTON, WASHINGTON

PREPARED FOR:
WELCO LUMBER COMPANY
URS PROJECT NO. 33763011

May 1, 2012

May 1, 2012

Mr. Dick Stroble
Welco Lumber Company
780 West Highway 108
Shelton, WA 98584

Cleanup Action Plan
Resaw Building
Former Welco Wood Products Facility
6615 172nd Street NE, Arlington, WA
URS Job No.: 33763011

Dear Mr. Stroble:

URS Corporation (URS) is pleased to submit this Cleanup Action Plan (CAP) to Welco Lumber Company (Welco) presenting the proposed additional soil and groundwater remedial actions to address pentachlorophenol and tetrachloroethene concentrations in groundwater exceeding applicable Washington State Department of Ecology (Ecology) Model Toxics Control Act cleanup levels at the former Welco Wood Product Facility located in Arlington, Washington. This CAP presents the scope of work to be implemented by the ISCO contractor (ISOTEC) and by URS to document the performance of the additional groundwater treatment cleanup action at the subject property under the oversight of Ecology's Voluntary Cleanup Program.

We trust this document meets your requirements. Please do not hesitate to contact us if you have any questions or require additional information. With your approval, this CAP will be delivered to Ecology with a request to meet with Ecology Site Manager, Ms. Glynis Carrosino, to discuss its contents.

Respectfully submitted,

URS CORPORATION

David Raubvogel
Senior Geologist

Paul E Kalina

Paul E. Kalina, PE
Senior Engineer

Copy: Ms. Jenny Testrake, Real Estate Portfolio Mgr, LN Real Estate LLC

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1.0 INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

This Cleanup Action Plan presents URS Corporation's (URS') Cleanup Action Plan (CAP) for the former Welco Lumber Company (Welco) wood products facility (subject property/site) located at 6615 172nd Street NE in Arlington, Washington (Figure 1). The CAP has been prepared on behalf of Welco, the former site owner/operator. The subject property is currently owned by LN Real Estate LLC (LN) and is presently vacant. This CAP describes the additional remedial actions to be undertaken to address pentachlorophenol (PCP) and tetrachloroethene (PCE) in groundwater in the vicinity of the former Resaw building (Figure 1). URS conducted soil and groundwater investigations and remedial actions at the facility in 2004 and 2005 to address PCP and PCE concentrations in the soil and groundwater that exceed applicable Washington State Department of Ecology (Ecology) Model Toxics Control Act (MTCA) cleanup levels (CULs). A cleanup action consisting of soil excavation and groundwater treatment using in-situ chemical oxidation (ISCO) was performed in 2005. Subsequent compliance monitoring performed in 2006, 2010 and 2011 indicated that selected monitoring wells remain above the applicable CULs for PCP and PCE. Additional groundwater remediation is proposed to address these contaminants of concern. A brief summary of the prior investigations and remedial actions implemented at the subject property is provided below. This CAP also outlines the proposed purpose and scope of an ISCO Work Plan and a Performance and Confirmational Groundwater Monitoring Plan.

1.2 BACKGROUND

URS completed a Phase I Environmental Site Assessment at the site in 2001 (URS, 2001) that identified areas of potential concern, which were assessed during subsequent Phase II investigations and supplemental site investigations (URS, 2003 and 2004a). PCP and PCE contamination identified beneath and downgradient (northwest) of the former Resaw Building was evaluated during multiple investigations which included the installation of thirteen groundwater monitoring wells (Figure 1). The PCP soil contamination source area measured approximately 3,800 square feet and the groundwater contamination plume extended approximately 450 feet to the northwest. Remedial action alternatives were assessed, and the selected option consisted of excavation of the source area soils followed by ISCO treatment of the groundwater (URS, 2004b). Approximately 1,740 tons of impacted soils were removed within the source area (Figure 1) and disposed of at a licensed landfill facility.

Subsequently, two ISCO groundwater treatment events were conducted in late September/early October 2004, and in February 2005. URS retained In-Situ Oxidative Technologies Incorporated (ISOTEC) of Arvada, Colorado to perform the ISCO treatment which used a modified Fenton's reagent-based oxidation technology and entailed injecting with hydrogen peroxide and an iron catalyst solution into the saturated zone soils. Groundwater performance monitoring results are summarized on Figure 1 and are presented in Table 1. Groundwater monitoring performed in July 2006 detected PCP and PCE concentrations above applicable CULs at monitoring wells MW-8S; MW-9; MW-10; MW-11 and MW-12. Additional remedial actions were being considered at that time but were not implemented in 2006.

Groundwater sampling conducted four years later in July 2010 (Figure 1) indicated that PCP concentrations had declined in all of the wells in which PCP was previously detected, but remained above the MTCA Method B CUL in selected monitoring wells (Table 1). PCE concentrations detected in MW-9 had also generally declined, but also remained above the MTCA Method A CUL. Based on the 2010 groundwater monitoring results, an assessment of additional groundwater treatment options was performed with the remedial objective of achieving Ecology MTCA Method A/B CULs and obtaining regulatory closure from Ecology under the Voluntary Cleanup Program (VCP). The property was entered into Ecology's VCP on June 22, 2011 (VCP Project No.: NW2481).

Another round of groundwater sampling was performed in July 2011 to further establish baseline groundwater conditions prior to the future groundwater treatment. These results are also summarized in Table 1 and are shown on Figure 1. PCP and PCE concentrations were generally consistent with the previous sampling event. In December 2011, LN engaged GeoEngineers to perform additional soil and groundwater sampling in the vicinity of the Former Resaw building to further characterize PCE concentrations previously detected in the vicinity of monitoring well MW-9. Six Geoprobe borings (GEI-4 through GEI-9) were advanced upgradient and downgradient of MW-9 (Figure 1) and southwest of the Resaw building (GEI-8 and GEI-9). Groundwater samples were analyzed for volatile organic compounds (VOCs). Vertical profile sampling was also performed at boring location GEI-7 near monitoring well MW-9 and included samples collected at 10 feet, 20 feet, 30 feet and 40 feet below ground surface (bgs). PCE was detected at GEI-7 (Figure 1) at a concentration of 7.2 micrograms (ug)/l at 10 feet bgs; 2.1 ug/l at 20 feet bgs; ND at 30 feet bgs and 0.44 ug/l at 40 feet bgs. PCE was detected at 5.7 ug/l at GEI-5 located approximately 70 feet downgradient (northwest) of MW-9 (Figure1). Geoprobe boring GEI-4 completed approximately 40 feet downgradient of GEI-5 did not detect PCE in groundwater. PCE was also not detected in the two Geoprobe borings (GEI-8 and GEI-9) completed southwest of the Former Resaw building.

2.0 PURPOSE AND SCOPE

The objectives of the additional cleanup action will be to further treat PCP- and PCE-impacted groundwater and saturated zone soils to meet applicable CULs. To accomplish this objective, a third ISCO groundwater and saturated soil treatment is proposed. The following sections present an overview of the components contained in this CAP.

2.1 IN-SITU CHEMICAL OXIDATION WORK PLAN

As presented in Appendix A, a third ISCO treatment will be performed used to further treat affected groundwater and saturated zone soils. The groundwater and saturated soils treatment using modified Fenton's reagent-based technology will be implemented by ISOTEC of Arvada, Colorado. The proposed methods and procedures are outlined in the ISOTEC's ISCO Work Plan provided in Appendix A.

2.2 PERFORMANCE AND CONFIRMATIONAL GROUNDWATER MONITORING PLAN

The Performance and Confirmational Groundwater Monitoring Plan (PCGMP), provided as Appendix B, details the sampling and data collection methods to be employed as part of the groundwater monitoring and sampling performed at the site. The PCGMP will be implemented following the completion of the ISCO treatment presented in Section 2.1 of this CAP. The purpose of performance monitoring is to monitor the effectiveness of the cleanup in site groundwater following ISCO treatment. The need for additional ISCO treatments will be assessed based on the results of the performance monitoring. Confirmational monitoring will then be conducted to confirm that the levels of PCP and VOCs remain stable and do not rebound above applicable levels, as described in the PCGMP.

2.3 HEALTH AND SAFETY PLANS

Site-specific Health and Safety Plans will be prepared by both URS and ISOTEC which will govern the monitoring work conducted by URS and the implementation of the ISCO treatment event being performed by ISOTEC. All field work will be performed in accordance with these plans and all applicable regulatory requirements.

3.0 REFERENCES

URS, 2001. *Phase I Environmental Site Assessment Welco Lumber Facility, 6615 172nd Street NE, Arlington, Washington.* August.

URS, 2003. *Phase II Site Investigation, Welco Wood Products Facility, Arlington Washington*. July.

URS, 2004a. *PCP Investigation, Resaw Building, Welco Wood Products Facility, Arlington Washington*. September.

URS, 2004b. Remedial Action Plan *Resaw Building, Welco Wood Products Facility, Arlington Washington*. September

Washington State Department of Ecology, 1995. *Guidance on Sampling and Data Analysis Methods*. Publication No. 94-49; January.

Washington State Department of Ecology, 2001. *MTCA Cleanup Regulations Chapter 173-340 WAC.* February.

Table 1
Summary of Groundwater Analytical Results
Welco Lumber
Arlington, Washington

Sample ID	Sample Date	PCP (ug/l)	Volatile Organic Compounds (ug/l)										
			PCE	**Benzene**	**cis-1,2-DCE**	**TCE**	**Isopropylbenzene**	**N-Propylbenzene**	**1,3,5-Trimethylbenzene**	**1,2,4-Trimethylbenzene**	**tert-Butylbenzene**	**sec-Butylbenzene**	**Styrene**
MW-1	12/22/03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-2	12/22/03	**2.08**	0.420	ND	0.220	ND	ND	ND	ND	ND	ND	ND	ND
	6/3/2004	**1.17**	2.51	ND	0.380	0.220	ND	ND	ND	ND	ND	ND	ND
	9/7/2004	ND	0.61	ND	0.53	ND	ND	ND	ND	ND	ND	ND	ND
	9/27/2004[1]	**2.58**	NA	ND	NA	NA	NA	NA	NA	NA	ND	NA	ND
	11/19/2004	**0.6**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/27/2005	**0.5**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/21/2005	ND	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/20/2005	ND	**6**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/19/2005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/3/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/18/2006	ND	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/15/2010[5,6]	ND	2.4	1.4	ND	ND	ND	ND	ND	ND	ND	ND	0.64 J
	7/5/2011	ND	1.08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-3	12/22/2003[4]	NA	NA	ND	NA	NA	NA	NA	NA	NA	ND	NA	ND
	11/18/2004	**1.4**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/26/2005	ND	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	ND
	4/20/2005	**1.1**	NA	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND
	7/20/2005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/20/2005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/2/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/18/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/15/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-4	12/22/2003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-5	6/3/2004[4]	**33.9**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	9/7/2004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	9/27/2004[1]	ND	NA	ND	NA	NA	NA	NA	NA	NA	ND	NA	ND
	11/18/2004	**2.5**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/27/2005	ND	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	ND
	4/21/2005	**1.2**	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	ND
	7/21/2005	**1.2**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/19/2005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/2/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/19/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/16/2010	0.11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MTCA Method A or B Groundwater Cleanup Level		0.219 (B)	5 (A)	5 (A)	16 (B)	5 (A)	800 (B)	800 (B)	80 (B)	NE	NE	NE	1,600 (B)

Table 1
Summary of Groundwater Analytical Results
Welco Lumber
Arlington, Washington

Sample ID	**Sample Date**	**PCP (ug/l)**	**Volatile Organic Compounds (ug/l)**										
			PCE	**Benzene**	**cis-1,2-DCE**	**TCE**	**Isopropylbenzene**	**N-Propylbenzene**	**1,3,5-Trimethylbenzene**	**1,2,4-Trimethylbenzene**	**Tert-Butylbenzene**	**S-Butylbenzene**	**Styrene**
MW-6	6/3/2004[4]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	9/7/2004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	9/27/2004[1]	ND	NA	ND	NA	NA	NA	NA	NA	NA	ND	NA	ND
	11/18/2004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/26/2005	ND	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	ND
	4/21/2005	ND	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	ND
MW-7	6/3/2004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	9/7/2004	ND	0.220	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/19/2004	**0.5**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/26/2005	**1.1**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/30/2005	**1.3**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/21/2005	**1.3**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/20/2005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/2/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/18/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/15/2010[6]	0.21	0.85 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/5/2011	**0.478**	0.87 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-8S	9/7/2004	**235 J**	ND	ND	ND	ND	ND	ND	ND	ND	1.39	8.73	ND
	11/18/04	**11**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/27/2005	**6.9**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/20/2005	**4.8**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/21/2005	**12**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/19/2005	**95**	ND	ND	ND	ND	13 J	ND	ND	ND	3 J	15 J	ND
	2/3/2006	**23**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/19/2006	**15**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/16/2010[5,6]	**0.60**	ND	**6.1**	ND	ND	ND	ND	ND	ND	ND	ND	3.2
	7/5/2011	**1.88**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-8D	11/18/04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/27/2005	**0.7**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/20/2005	**1.2**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/21/2005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/19/2005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/3/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/19/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/5/2011	0.133	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MTCA Method A or B Groundwater Cleanup Level		0.219 (B)	5 (A)	5 (A)	16 (B)	5 (A)	800 (B)	800 (B)	80 (B)	NE	NE	NE	1,600 (B)

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Sample ID	Sample Date	PCP (ug/l)	Volatile Organic Compounds (ug/l)										
			PCE	Benzene	cis-1,2-DCE	TCE	Isopropylbenzene	N-Propylbenzene	1,3,5-Trimethylbenzene	1,2,4-Trimethylbenzene	Tert-Butylbenzene	S-Butylbenzene	Styrene
MW-9	9/7/04	ND	**94.6**	ND	ND	**3.93**	ND	ND	ND	ND	ND	ND	ND
	9/27/2004[1]	**3.84**	NA	ND	NA	NA	NA	NA	NA	NA	ND	NA	ND
	11/19/04	**1.2**	**22**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/26/2005	**0.9**	**27**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/21/2005	**1.5**	**36**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/20/2005	**1.3**	**30**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/19/2005	**2.6**	**25**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/3/2006	**2.6**	**26**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/18/2006	**2.2**	**28**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/15/2010[2]	ND	**15**	ND	ND	**2.4**	ND	ND	ND	ND	ND	ND	ND
	7/5/2011	**0.485**	**9.72**	ND	ND	**0.990 J**	ND	ND	ND	ND	ND	ND	ND
MW-10	11/18/04	**44**	ND	ND	ND	ND	2	2	3	15	ND	4	ND
	1/26/2005	**12**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/21/2005	**3.2**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/20/2005	**3.9**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/20/2005	**3.4**	ND	ND	ND	ND	ND	ND	ND	3	ND	ND	ND
	2/3/2006	**2.5**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/18/2006	**2.7**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/16/2010	**0.28**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/5/2011	**0.471**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-11	11/19/04	**260**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/27/2005	**77**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/20/2005	**49**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/21/2005	**14**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/20/2005	**85**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/2/2006	**24**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/18/2006	**15**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/16/2010[3]	**10**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/5/2011[7]	**26.2**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-12	11/19/04	**4.4**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/27/2005	**3.6**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/20/2005	**4.3**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/20/2005	**3.4**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/20/2005	**3.0**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/2/2006	**3.8**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/18/2006	**3.4**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/15/2010	**0.35**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/5/2011	0.165	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MTCA Method A or B Groundwater Cleanup Level		0.219 (B)	5 (A)	5 (A)	16 (B)	5 (A)	800 (B)	800 (B)	80 (B)	NE	NE	NE	1,600 (B)

Table 1
Summary of Groundwater Analytical Results
Welco Lumber
Arlington, Washington

__Notes:__

Numbers in b**old** font exceed a MTCA Cleanup Level.

Model Toxics Control Act (MTCA) Cleanup Regulation, WAC 173-340. MTCA Method A or B values are from Ecology website. CLARC tables downloaded July 2011 (https://fortress.wa.gov/ecy/clarc/reporting/CLARCReporting.aspx).

VOC analysis by EPA Method 8260B

Pentachlorophenol (PCP) analysis by EPA Method 8270SIM or 8151

cis-1,2-DCE = cis-1,2-Dichloroethene

NA - not analyzed or not available

ND - not detected

NE - not established

PCE - tetrachloroethene

TCE - trichloroethene

ug/L - micrograms per liter (parts per billion)

Initial ISCO treatment completed September 28 through October 4, 2004

[1] Sampling event conducted with a disposable bailer

[2] For sample MW-9 collected on 7/15/10, 2,4,6-trichlorophenol was detected at 0.51 ug/L. MTCA B level is 4 ug/L.

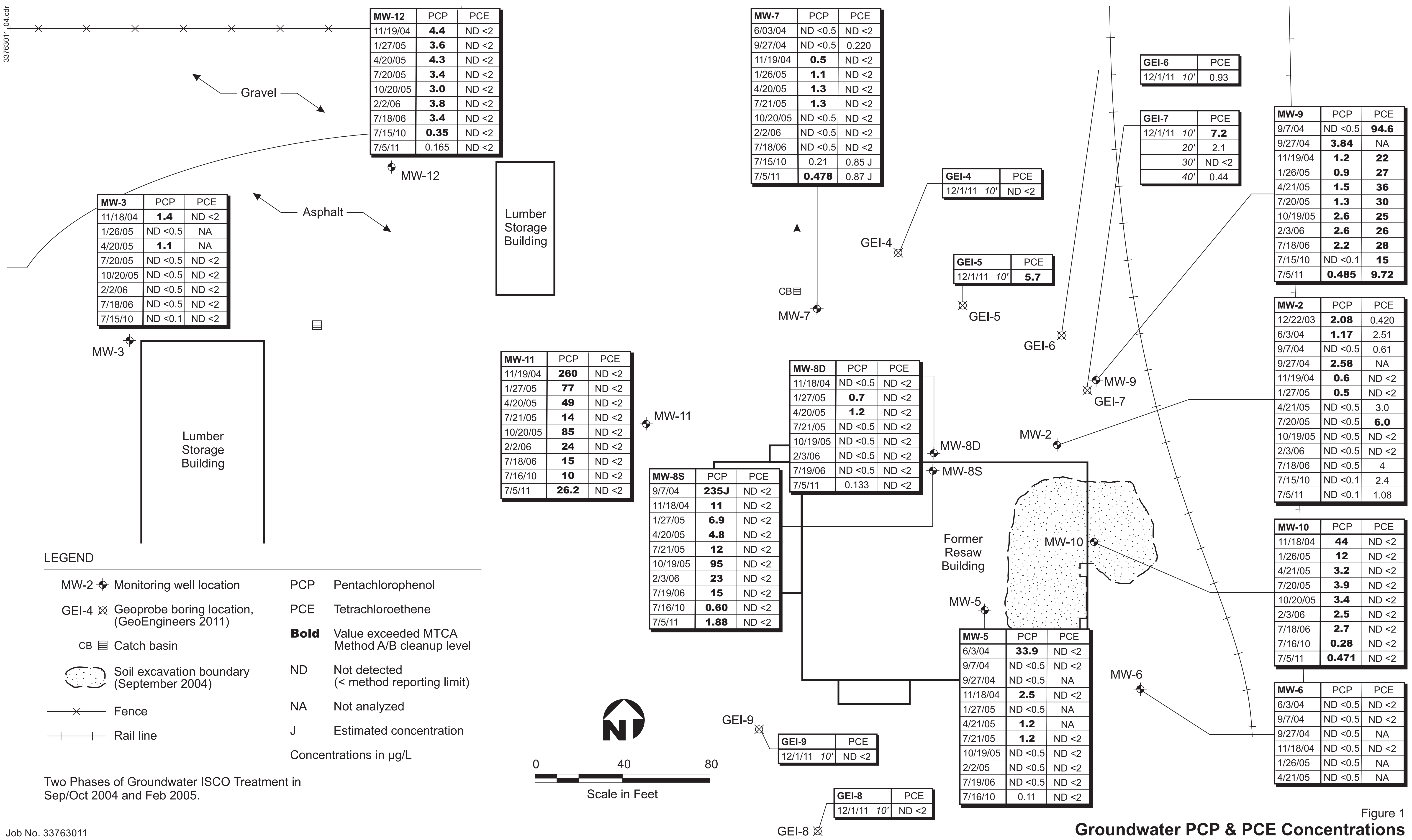
[3] For sample MW-11 collected on 7/16/10, 2,4,5-trichlorophenol was detected at 2.0 ug/L. MTCA B level is 800 ug/L.

[4] For these samples collected during 2003-2004, chloroform was detected in MW-3 at 0.350 ug/L, MW-5 at 0.270 ug/L, and MW-6 at 0.220 ug/L. MTCA B level is 7.17 ug/L.

[5] For these samples collected on 7/16/10, naphthalene was detected in MW-2 at 1.4 J ug/L and MW-8S at 5.3 ug/L. MTCA A/B level is 160 ug/L.

[6] For these samples collected on 7/16/10, toluene was detected in MW-2 at 2.5 ug/L, MW-7 at 0.82 J ug/L, and MW-8S at 11 ug/L. MTCA A level is 1000 ug/L.

[7] For this sample collected on 7/5/11, 2,3,4,6-tetrachlorophenol was detected in MW-11 at 5.01 ug/L. MTCA B level is 480 ug/L.



LEGEND

- MW-2 ⌖ Monitoring well location
- GEI-4 ⊗ Geoprobe boring location, (GeoEngineers 2011)
- CB ▤ Catch basin
- Soil excavation boundary (September 2004)
- —×— Fence
- —+— Rail line

PCP Pentachlorophenol
PCE Tetrachloroethene
Bold Value exceeded MTCA Method A/B cleanup level
ND Not detected (< method reporting limit)
NA Not analyzed
J Estimated concentration

Concentrations in µg/L

Two Phases of Groundwater ISCO Treatment in Sep/Oct 2004 and Feb 2005.

MW-12	PCP	PCE
11/19/04	**4.4**	ND <2
1/27/05	**3.6**	ND <2
4/20/05	**4.3**	ND <2
7/20/05	**3.4**	ND <2
10/20/05	**3.0**	ND <2
2/2/06	**3.8**	ND <2
7/18/06	**3.4**	ND <2
7/15/10	**0.35**	ND <2
7/5/11	0.165	ND <2

MW-3	PCP	PCE
11/18/04	**1.4**	ND <2
1/26/05	ND <0.5	NA
4/20/05	**1.1**	NA
7/20/05	ND <0.5	ND <2
10/20/05	ND <0.5	ND <2
2/2/06	ND <0.5	ND <2
7/18/06	ND <0.5	ND <2
7/15/10	ND <0.1	ND <2

MW-7	PCP	PCE
6/03/04	ND <0.5	ND <2
9/27/04	ND <0.5	0.220
11/19/04	**0.5**	ND <2
1/26/05	**1.1**	ND <2
4/20/05	**1.3**	ND <2
7/21/05	**1.3**	ND <2
10/20/05	ND <0.5	ND <2
2/2/06	ND <0.5	ND <2
7/18/06	ND <0.5	ND <2
7/15/10	0.21	0.85 J
7/5/11	**0.478**	0.87 J

GEI-4	PCE
12/1/11 *10′*	ND <2

GEI-5	PCE
12/1/11 *10′*	**5.7**

GEI-6	PCE
12/1/11 *10′*	0.93

GEI-7	PCE
12/1/11 *10′*	**7.2**
20′	2.1
30′	ND <2
40′	0.44

MW-9	PCP	PCE
9/7/04	ND <0.5	**94.6**
9/27/04	**3.84**	NA
11/19/04	**1.2**	**22**
1/26/05	**0.9**	**27**
4/21/05	**1.5**	**36**
7/20/05	**1.3**	**30**
10/19/05	**2.6**	**25**
2/3/06	**2.6**	**26**
7/18/06	**2.2**	**28**
7/15/10	ND <0.1	**15**
7/5/11	**0.485**	**9.72**

MW-11	PCP	PCE
11/19/04	**260**	ND <2
1/27/05	**77**	ND <2
4/20/05	**49**	ND <2
7/21/05	**14**	ND <2
10/20/05	**85**	ND <2
2/2/06	**24**	ND <2
7/18/06	**15**	ND <2
7/16/10	**10**	ND <2
7/5/11	**26.2**	ND <2

MW-8D	PCP	PCE
11/18/04	ND <0.5	ND <2
1/27/05	**0.7**	ND <2
4/20/05	**1.2**	ND <2
7/21/05	ND <0.5	ND <2
10/19/05	ND <0.5	ND <2
2/3/06	ND <0.5	ND <2
7/19/06	ND <0.5	ND <2
7/5/11	0.133	ND <2

MW-8S	PCP	PCE
9/7/04	**235J**	ND <2
11/18/04	**11**	ND <2
1/27/05	**6.9**	ND <2
4/20/05	**4.8**	ND <2
7/21/05	**12**	ND <2
10/19/05	**95**	ND <2
2/3/06	**23**	ND <2
7/19/06	**15**	ND <2
7/16/10	**0.60**	ND <2
7/5/11	**1.88**	ND <2

MW-2	PCP	PCE
12/22/03	**2.08**	0.420
6/3/04	**1.17**	2.51
9/7/04	ND <0.5	0.61
9/27/04	**2.58**	NA
11/19/04	**0.6**	ND <2
1/27/05	**0.5**	ND <2
4/21/05	ND <0.5	3.0
7/20/05	ND <0.5	**6.0**
10/19/05	ND <0.5	ND <2
2/3/06	ND <0.5	ND <2
7/18/06	ND <0.5	4
7/15/10	ND <0.1	2.4
7/5/11	ND <0.1	1.08

MW-10	PCP	PCE
11/18/04	**44**	ND <2
1/26/05	**12**	ND <2
4/21/05	**3.2**	ND <2
7/20/05	**3.9**	ND <2
10/20/05	**3.4**	ND <2
2/3/06	**2.5**	ND <2
7/18/06	**2.7**	ND <2
7/16/10	**0.28**	ND <2
7/5/11	**0.471**	ND <2

MW-5	PCP	PCE
6/3/04	**33.9**	ND <2
9/7/04	ND <0.5	ND <2
9/27/04	ND <0.5	NA
11/18/04	**2.5**	ND <2
1/27/05	ND <0.5	NA
4/21/05	**1.2**	NA
7/21/05	**1.2**	ND <2
10/19/05	ND <0.5	ND <2
2/2/05	ND <0.5	ND <2
7/19/06	ND <0.5	ND <2
7/16/10	0.11	ND <2

MW-6	PCP	PCE
6/3/04	ND <0.5	ND <2
9/7/04	ND <0.5	ND <2
9/27/04	ND <0.5	NA
11/18/04	ND <0.5	ND <2
1/26/05	ND <0.5	NA
4/21/05	ND <0.5	NA

GEI-9	PCE
12/1/11 *10′*	ND <2

GEI-8	PCE
12/1/11 *10′*	ND <2

Figure 1

Groundwater PCP & PCE Concentrations

Job No. 33763011

URS

Welco Lumber
Arlington, Washington

APPENDIX A

ISOTEC IN-SITU CHEMICAL OXIDATION REMEDIATION PROGRAM – THIRD EVENT WORK PLAN

IN-SITU CHEMICAL OXIDATION REMEDIATION PROGRAM – THIRD EVENT WORK PLAN

FORMER RESAW BUILDING –
WELCO LUMBER COMPANY WOOD PRODUCTS FACILITY
6615 172ND STREET NE
ARLINGTON, WASHINGTON

SEPTEMBER 20, 2011

PREPARED FOR

WELCO LUMBER COMPANY
P.O. BOX 125
MARYSVILLE, WASHINGTON 98270

PREPARED BY

IN-SITU OXIDATIVE TECHNOLOGIES, INC.
6452 FIG STREET, SUITE C
ARVADA, COLORADO 80004

ISOTEC PROJECT NO. 901089

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1.0 INTRODUCTION

In-Situ Oxidative Technologies, Inc. (ISOTEC) has been retained by Welco Lumber Company (Welco) to conduct the third injection application of the in-situ chemical oxidation (ISCO) soil and groundwater remediation program using modified Fenton's Reagent (ISOTEC Process) at Welco's former Wood Products Facility (Welco Facility) located at 6615 172nd Street NE, in Arlington, Washington, herein referred to as the "site" (**Figure 1**). This remediation program is being conducted under the Washington State Department of Ecology (Ecology) Voluntary Cleanup Program (VCP). The ISCO remediation program treatment area at the Welco Facility is located at the Former Resaw Building, which is situated along the southeastern portion of the Welco Facility (**Figure 1**). The contaminants of concern (COCs) include pentachlorophenol (PCP) and tetrachloroethene (PCE).

This work plan contains details on ISOTEC's approach for conducting the third injection application of the ISCO remediation program. ISOTEC's first and second injection events were performed in September and October of 2004 and February of 2005, respectively. The third injection event is proposed to address low concentrations of contaminants remaining in site soil and groundwater.

1.1 SITE-SPECIFIC CHARACTERIZATION

URS Corporation (URS) recently conducted groundwater sampling at the site that identified PCP and PCE concentrations in groundwater exceeding applicable cleanup levels. Maximum dissolved phase concentrations for PCP during the most recent groundwater sampling event (July 2011) were reported in MW-11 at 26.2 micrograms per liter (µg/L). Maximum dissolved phase concentrations for PCE during the July 2011 groundwater sampling event were reported in MW-9 at 9.72 µg/L (Figure 2).

The site soils are described by URS as interbedded brown to gray, silty sands and sandy silts to approximately 7 feet below ground surface (bgs). Medium to coarse sand with trace to little gravel is present from approximately 7 feet bgs to the maximum explored depth of 16.5 feet bgs. The depth to the groundwater in the area of the Resaw Building ranges from approximately 7.5 to 9.5 feet bgs.

The estimated treatment interval at the site is from approximately 7 feet (water table) to 17 feet bgs.

1.2 ISCO REMEDIATION PROGRAM OBJECTIVES

The original objective of the ISCO remediation program at this site during the initial two treatment events in 2004 and 2005 was to achieve PCP mass reduction within the saturated zone until dissolved contaminant concentrations met Ecology's Model Toxics Control Act (MTCA) Method B cleanup level for PCP of 0.729 µg/L. It is important to note that in 2011 Ecology lowered this cleanup level to 0.22 µg/L, but that the objective for this ISCO program is still to treat the core of the plume at concentrations exceeding a remediation level of 0.729 µg/L in order to treat both the dissolved and sorbed phases of contamination that continue to feed the remainder of the dissolved phase plume. Natural attenuation processes would then be expected to continue to reduce dissolved-phase PCP concentrations to below the current cleanup level of 0.22 µg/L.

A second objective of this program is to treat a separate smaller PCE groundwater plume at concentrations exceeding the MTCA Method A cleanup level of 5.0 µg/L (same cleanup level both in 2004/2005 and 2011).

2.0 TECHNOLOGY OVERVIEW

The ISOTEC process is an in-situ remedial technology that destroys organic contamination using Fenton’s reagent-based oxidation chemistry. Fenton’s chemistry was first documented by H.J.H. Fenton in 1894. It is characterized by the combination of soluble iron with low concentrations of hydrogen peroxide to produce hydroxyl radicals ($OH^{\bullet}$). These hydroxyl radicals are very powerful and short-lived oxidizers. Similar to the reaction of other oxidizers, the hydroxyl radicals attack the carbon double bonds of the chlorinated hydrocarbon molecule. Under certain conditions reductive species can also be formed by Fenton’s chemistry. This gives Fenton’s reagent two separate pathways to attack a wide range of contaminants. The summary equation for Fenton’s chemistry is shown below.

$$\mathbf{Fe^{+2} + H_2O_2 \rightarrow Fe^{+3} + OH^- + OH^{\bullet}}$$

Where H_2O_2 is hydrogen peroxide, Fe^{+2} is ferrous iron, Fe^{+3} is ferric iron, $OH^{\bullet}$ is hydroxyl free radical and OH^- is hydroxide ion.

Iron is used to catalyze the reaction. Maintaining iron in solution is important for the process to be successful in an in-situ application. To eliminate the necessity of performing the reaction under low pH conditions, as is the case with traditional Fenton’s chemistry; complexed iron is used in in-situ applications via the ISOTEC process. The hydrogen peroxide and dissolved iron solutions are injected through a site-specific delivery system providing sufficient distribution to selectively treat the area of concern. Reaction time is very fast, with oxidation capacity of the reagent being used up in a matter of a few days. Hydrogen peroxide breaks down into water and oxygen and the iron catalyst is oxidized and precipitates out of solution. It is important to note that the concentration of hydrogen peroxide will be relatively dilute, generally less than 17%, which eliminates the potential for significant exothermic reactions that are associated with higher concentrations of hydrogen peroxide. Experience with this process using low hydrogen peroxide concentrations and complexed iron has resulted in less than a 25^{o} F temperature increase in field applications.

Fenton-based oxidation processes have been shown to effectively treat a wide range of contaminants including hard-to-treat compounds such as chlorinated solvents, petroleum hydrocarbons, gasoline additives including benzene, toluene, ethylbenzene and xylenes (BTEX), and pesticides. Hydroxyl radicals and reductive species generated by the Fenton-based reagent will treat nearly all contaminants with carbon/carbon double bonds and single bonded contaminants with extractable hydrogen.

The stoichiometric relationship between benzene oxidation and hydrogen peroxide consumption can be predicted from the oxidative reaction:

$$C_6H_6 + H_2O_2 \rightarrow 6CO_2 + H_2O + 3H^+$$

Where C_6H_6 is benzene, H_2O_2 is hydrogen peroxide, CO_2 is carbon dioxide, and H^+ is hydrogen ion. Hydrogen peroxide not consumed in the above reaction will continue to oxidize the groundwater contaminants and will naturally degrade along with the contaminant to oxygen and water.

The ISOTEC process consists of injecting stabilized hydrogen peroxide and complexed iron catalysts into contaminated aquifers or vadose zones. As compared to conventional Fenton's Reagent which requires acidic conditions ($pH \leq 3$) the ISOTEC process is effective at neutral ($pH = 7$) conditions. This is an important consideration in full-scale application since acidifying an aquifer is typically impractical. ISOTEC's oxidation method utilizes a site-specific delivery system(s) designed to treat organic contaminants within an area of concern. ISOTEC oxidants and catalysts generate hydroxyl radicals, which react with the organic contaminants within the subsurface producing innocuous by-products such as carbon dioxide and water (and chloride ions if chlorinated compounds are being treated).

2.1 IN-SITU CHEMICAL OXIDATION OF CHLORINATED COMPOUNDS

The remediation process for treating chlorinated compounds in the subsurface is straight forward from a chemical standpoint but complicated in practice. The major oxidants available for in-situ application are:

- Fenton's Reagent,
- Modified Fenton's Reagent,
- Ozone,
- Permanganate,
- Persulfate, and
- Catalyzed persulfate.

These oxidants have varying oxidation potentials, or "oxidation strength". In simple terms, the oxidant contacts with the solvent and the solvent molecule is oxidized, gives up an electron, and forms new compounds from the original elements. For example, TCE oxidizes into carbon dioxide and chlorine ions. There can be short lived intermediaries, but they do not persist long enough to measure.

The remediation process is very simple for compounds in the dissolved phase. For instance, a beaker filled with a 5,000 ug/L solution of TCE in water can be oxidized by adding the appropriate mass of any of the above oxidants to non-detectable levels in a very short period, from hours to several days. Because of the varying oxidation potentials, the same is not true for a solution of TCA, only the Fenton's based oxidants and ozone will treat the dissolved TCA mass.

When treating in-situ however, many more factors are hindering the chemical oxidation process. The main complicating factors are:

- Distribution of contaminant,
- Distribution of oxidant,
- Presence of other compounds that consume oxidant,
- Contaminant phases, and
- Aqueous contact of contaminant and oxidant.

In short, it is more difficult to contact a molecule of oxidant with a molecule of contaminant, in-situ, since neither is evenly mixed in a beaker. These differences are not apparent in most laboratory studies because of the way the studies are conducted. Studies are often completed using only groundwater which eliminates almost all of the hindering factors. Even studies using soil and groundwater are generally set-up with excess groundwater to form slurry. This set-up not only mixes the contaminant and oxidant but also preferentially changes the NAPL and adsorbed contaminant phases into the dissolved phase, where they are easily contacted by the oxidant.

2.1.1 Distribution of Contaminant

Unlike the beaker example, contaminant mass in the subsurface is distributed heterogeneously and in unknown patterns and within varying lithologies. Although dissolved contaminant concentrations indicate the approximate location of a source zone, they cannot pinpoint the mass either vertically or laterally. Other investigative methods can help define the mass distribution. But ultimately, due to the migration patterns of the LNAPL, the exact area requiring treatment can be elusive. This causes the in-situ treatment process to be inclusive of large areas in order to be successful.

2.1.2 Distribution of Oxidant

Since the precise area of contaminant mass can only be generally defined, the oxidant must be uniformly delivered across complete target areas in order to be successful. If areas of mass are missed, either vertically or laterally, the plume persists and the remediation process stalls. For the short lived oxidants, Fenton's, modified Fenton's, ozone, and catalyzed persulfate, this step becomes very critical because the oxidant does not travel or disburse once injected. Therefore, these must be delivered uniformly across the treatment area.

The persistent oxidants, permanganate and persulfate, can move with groundwater and disperse by concentration gradient over time. Therefore, precise distribution across the plume is not as critical as with the short-lived oxidants. The concentration of the oxidant, however, does decrease during this process as it is consumed and diluted within groundwater.

2.1.3 Other Compounds that Consume Oxidant

Soil matrices are comprised of a mixture of materials, some of which can produce an oxidant demand. The foremost of these is organic carbon. Organic carbon is, for the most part, a solid. Oxidants are non-selective; they will address any organic compound with which they come in contact. In-situ, however, they are selective about the phase that the compound is in. An oxidant will address dissolved mass quickly and a solid more slowly as the oxidation process is an aqueous one. Therefore, organic carbon impacts the remediation process over time as opposed to the short term. This hinders the effectiveness of the persistent oxidants more than the short lived oxidants.

2.1.4 Aqueous Contact

The overwhelming portion of the oxidation process occurs in the aqueous phase. Contaminant dissolved in water contacts oxidant dissolved in water and the oxidation reactions occur. This is, for all practical purposes, an instantaneous process. The same is not true for contaminant mass that is present adsorbed to soil or found as NAPL. These two phases must be moved into the aqueous phase in order to be treated in a practical manner.

2.1.5 Mass Phase Changes

The only oxidant that actively transfers mass into the dissolved phase is modified Fenton's with neutral pH catalyst. The modified Fenton's process greatly disturbs the mass equilibrium between the phases. The hydroxyl radical oxidizes contamination in the dissolved phase while the superoxide radical desorbs mass from the adsorbed phase by interfering with the electrical (molecular) forces that cause molecules of contaminant to "stick" to grains of soil and organic carbon. In addition to these chemical processes, the reaction produces oxygen gas. As the peroxide decomposes it generates oxygen. This gas is produced within the individual pore spaces where the two reagents are mixed. As the gas bubbles are generated and then migrate vertically up through soil pores, a physical action occurs that mixes groundwater, disturbs soil "fines" (increasing turbidity) and dislodges residual NAPL. Mass is transferred from the adsorbed and NAPL phases into the dissolved phase through this physical agitation. Mass is also transferred from the NAPL phase to the adsorbed phase as the NAPL is mixed within the pore space and contacts more soil surface area.

These chemical and physical processes upset the phase equilibrium and can be observed as temporary increases in dissolved concentrations, especially early in the treatment program when the total mass is still at levels near the original mass. However, given that such a small percentage of the total mass exists in the dissolved phase, even an order of magnitude increase in the dissolved phase mass is still only a fraction of the total mass. As the total mass decreases with multiple injections, the post-injection increases in dissolved concentrations also decrease. Post-injection dissolved concentrations will remain elevated and out of equilibrium with the total mass even as the total mass approaches minimal levels. Only time will allow the dissolved mass and total mass to re-equilibrate through dilution, dispersion, re-adsorption and degradation. This time period varies depending on specific site conditions but has been observed to take from months up to quarters.

Other oxidants; permanganate, persulfate, catalyzed persulfate and ozone, can cause some mass transfer into the dissolved phase. However, this is due to the limited physical agitation caused by the injection process. Even injecting a gas, as is done to deliver ozone, does not cause a significant mass transfer due to the preferential pathways created during injection. These pathways limit the extent to which the gas bubbles move through individual pore spaces since the gas travels along the path of least resistance and is not generated in individual pore spaces.

For the short lived oxidizers, this means that the oxidant is injected and treatment occurs almost instantly. The oxidant is consumed and the treatment process is complete within several days if not hours. The modified Fenton’s process actively transfers mass from the adsorbed and NAPL phases in the aqueous phase where oxidation can occur. This process allows for significant mass destruction in a short period of time. Ozone and catalyzed persulfate do not actively transfer mass and therefore, treat primarily the dissolved mass present at the time of injection and do not address the larger mass present in the soil matrix.

The longer lasting oxidants, permanganate and persulfate, are injected and the dissolved mass is treated almost instantly. However, the oxidant can persist in the subsurface, if not immediately consumed, for weeks or months and continue to treat contaminant mass that transfers into the aqueous phase from the adsorbed or NAPL phases. Since these two oxidants do not actively desorb mass the treatment process is slow, relying on diffusion gradients between “clean” groundwater and the remaining contaminant mass to transfer mass into the dissolved phase. Anecdotal observations lead to this conclusion. If the oxidants did actively treat the adsorbed and NAPL components of the mass, why would they persist in the subsurface instead of being consumed by the remaining contaminant mass? Observations have shown repeatedly that after injection the dissolved contaminant concentration decreases drastically, often to non-detectable levels almost immediately. Yet, after the oxidant is depleted, or diluted, over several months the dissolved concentrations return to near baseline concentrations.

2.1.6 Oxidant Applications

The different oxidants can be useful in various applications. They can all be used to limit the down-gradient progress of a dissolved plume. In this application the dissolved component of the contaminant mass can be reduced at the property boundary to limit down-gradient migration of the additional dissolved mass. This will not significantly reduce the down-gradient total mass that is already present, but may temporarily reduce the dissolved concentrations.

If mass reduction is the goal then phase changes must occur. Modified Fenton’s is the only oxidant that actively transfers mass from the adsorbed and NAPL phases into the dissolved phase. The majority of the total mass, even in low concentration plumes, is found in the adsorbed and/or NAPL phases. If these are not addressed the groundwater plume will rebound to near original concentrations following consumption of the oxidant.

3.0 ISCO REMEDIATION PROGRAM – THIRD EVENT

ISOTEC has designed the third injection event for the ISCO remediation program at the site to address the areas with PCP and PCE exceeding applicable cleanup levels. During the third injection event, ISOTEC personnel will introduce a blend of modified Fenton's reagents into the subsurface using temporary direct-push injection screens.

3.1 PERMITS AND APPROVAL

ISOTEC has assumed that URS will obtain permission from property owners and complete public notification as necessary, prior to injection activities.

3.2 UTILITY SURVEY

During the ISCO remediation program, steps will be taken to ensure that the integrity of the utilities located at or near the treatment area are not disturbed by field activities. Utility verification and marking will be performed in accordance with the standard industry utility verification procedures. ISOTEC understands that URS will be responsible for utility identification and marking prior to the initiation of direct-push injection activities.

3.3 WATER SUPPLY

ISOTEC will require the use of an on-site water source during the ISCO remediation program. Specifically, up to 7,500 gallons of water per mobilization will be needed during the treatment program. ISOTEC has assumed that URS will obtain the necessary permits and/or permission from the applicable entities to use a water supply.

3.4 MOBILIZATION, DEMOBILIZATION AND STAGING AREA

Mobilization activities include transportation and staging of ISOTEC equipment, materials, instruments, personnel, and services required for implementing the remediation program. The equipment that will be transported to the site will include an ISOTEC box truck housing hoses, tanks, drums, a gas-powered air compressor and generator, electric mixers and pumps, and pneumatic pumps. The materials that will be transported to the site will include 25% to 35% hydrogen peroxide and dry catalyst required for reagent preparation. The hydrogen peroxide will be stored on-site in DOT-approved 55-gallon drums. As discussed, an on-site water supply will be required for reagent preparation.

Demobilization activities will include removal of all staged equipment, materials, instruments, personnel, and services from the treatment area. In addition, the activities will include decontamination of all equipment, drums, tanks and instruments. Demobilization activities will take place at the conclusion of the remediation program when any of the staged equipment, materials, instruments, personnel, and services are no longer needed to perform or monitor the remediation program. All non-regulated waste and debris generated during the injections will be removed.

The injection point locations will be plugged with bentonite and concrete or asphalt patches by the DPT drilling subcontractor at the completion of each injection event.

3.5 ISCO REMEDIATION PROGRAM DESIGN – THIRD EVENT

The treatment area at the site encompasses wells MW-8S, MW-9 and MW-11, and covers approximately 15,000 square feet (**Figure 2**). The target treatment interval for the third injection event will be from approximately 7 feet (water table) to 15 feet bgs.

ISOTEC will utilize direct-push technology (DPT) to introduce reagent at the site. During the third injection event, ISOTEC will inject reagents at approximately 24 direct-push injection locations. The number and spacing of the locations is based upon an anticipated 15-foot reagent distribution radius. A proposed third event injection location map is included as **Figure 3**.

3.6 DIRECT-PUSH INJECTION SCREEN INSTALLATION

ISOTEC will utilize DPT to install temporary injection screens in the plume core and plume margin. A DPT subcontractor, Cascade Drilling LP (Cascade) will use a direct-push rig to advance 1.5-inch diameter threaded steel rods to a desired depth within the target treatment interval. After a sufficient number of steel rods have been advanced into the subsurface to reach the desired depth, an ISOTEC designed injection screen will be lowered to the bottom of the rod string. While the injection screen is held in place, the rod string will be retracted to expose the screen to impacted soils in the target treatment interval. ISOTEC reagents will then be injected through the temporary injection screen and into the subsurface.

Specifically, once the DPT subcontractor has advanced direct-push rod to 15 feet bgs at the injection location a specially designed ISOTEC injection screen will be lowered to the bottom of the rod string. The DPT subcontractor will then retract 8 feet of direct push rod, exposing the screen to impacted soils and groundwater. This method of injection will deliver reagent across target treatment interval. A direct-push injection screen schematic for the ISCO remediation program is shown in **Figure 4**.

3.7 ISOTEC REAGENT PREPARATION

ISOTEC reagents consist of dilute hydrogen peroxide (oxidizer) and a site-specific chelated iron catalyst (catalyst). ISOTEC oxidizer consists of a pre-determined concentration of hydrogen peroxide and water. ISOTEC typically utilizes the oxidizer at varying concentrations ranging from 5% to 17%. For these injection events, ISOTEC will utilize an oxidizer concentration of 12% and ISOTEC catalyst 4260. 25% to 35%

hydrogen peroxide will be shipped directly to the site immediately prior to field injection activities and stored in a DOT approved 55 gallon drums. The 25% to 35% hydrogen peroxide will be diluted on-site to a 12% concentration. The hydrogen peroxide will be diluted in 300-gallon bulk tanks with water obtained on-site. The ISOTEC series catalysts consist of a chelated iron complex. The iron complex is similar, and at post-reaction concentrations comparable to that of naturally occurring metals within the soil matrix (i.e., ppm range). The catalyst will be shipped to the site in dry form and mixed on-site in 300-gallon bulk tanks with water obtained on-site. A reagent mixing schematic is included as **Figure 5**.

All reagents will be either injected during the remediation program or removed from the site at the completion of the third event.

3.8 INJECTION METHOD

ISOTEC reagents will be injected into the subsurface at the site using direct-push screens. The ISOTEC reagent injection is a five-step process. ISOTEC begins by injecting water into the subsurface, followed by catalyst or oxidizer. Water is then injected into the direct-push rod to flush the reagent away from the borehole. Following the water flush, either catalyst or oxidizer, whichever was not injected first, is injected into the subsurface. A final water injection is completed to flush the catalyst or oxidizer from the injection equipment. This process is repeated for injection location. An injection method schematic is shown in **Figure 6.**

Chemical application equipment consists of varying size storage containers, pneumatic double-diaphragm pumps, 3/4-inch diameter (3/4”) reinforced tubing, valves, and cam-lock connectors. Transfer of the reagents from the storage and/or mixing containers to the point of injection will be performed via a double-diaphragm pump. Reagents are conveyed through 3/4” reinforced tubing and connected to the probe rod with a wellhead containing ball valves, fittings and a pressure gauge.

3.9 INJECTION RATES AND PRESSURES

The ISOTEC process injection rate and volume are interrelated to the reaction rates of hydroxyl radicals with the contaminants, the distribution of contaminants in the subsurface, and the rate of hydrogen peroxide decomposition. The rate at which the ISOTEC reagents are injected into the subsurface is initially determined by the soil/aquifer characteristics. Based on the previous injection applications, ISOTEC expects injection flow rates of between 2 and 4 gallons per minute (gpm) and injection pressures of between 10 and 30 pounds per square inch (psi).

3.10 REAGENT QUANTITIES

The injection goal for total reagent volume is approximately 4,800 to 7,200 gallons per event. The goal for each of the 24 injections screens is approximately 200 to 300 gallons of total reagent per event. These volumes are based on the previous injection events conducted at the site. The actual volume of reagents used will depend upon the injection flow rate, pressure and radial effects noted during injection.

4.0 ISCO REMEDIATION MONITORING

The effectiveness of the ISCO remediation program should be monitored with groundwater samples collected from treatment area groundwater monitoring wells. URS should collect groundwater samples from the treatment area program monitoring wells following completion of the third injection event and then on a quarterly basis in order to evaluate treatment effectiveness. Samples should be analyzed for appropriate site COCs.

5.0 REPORT PREPARATION

Upon completion of the third injection event of the ISCO remediation program and receipt of all analytical data collected, ISOTEC will submit a report outlining details of the event. The report will detail the in-situ chemical oxidation process, field activities, and chemical analyses. Specifically, the ISOTEC reagent injection quantities, injection pressures, and injection rates will be discussed in the report and presented in tables. ISOTEC will discuss in detail analytical data obtained during the third event. Contaminant concentrations from will be discussed in the report, tabulated, and presented in figures. Finally, ISOTEC will discuss recommendations, if necessary, for the site.

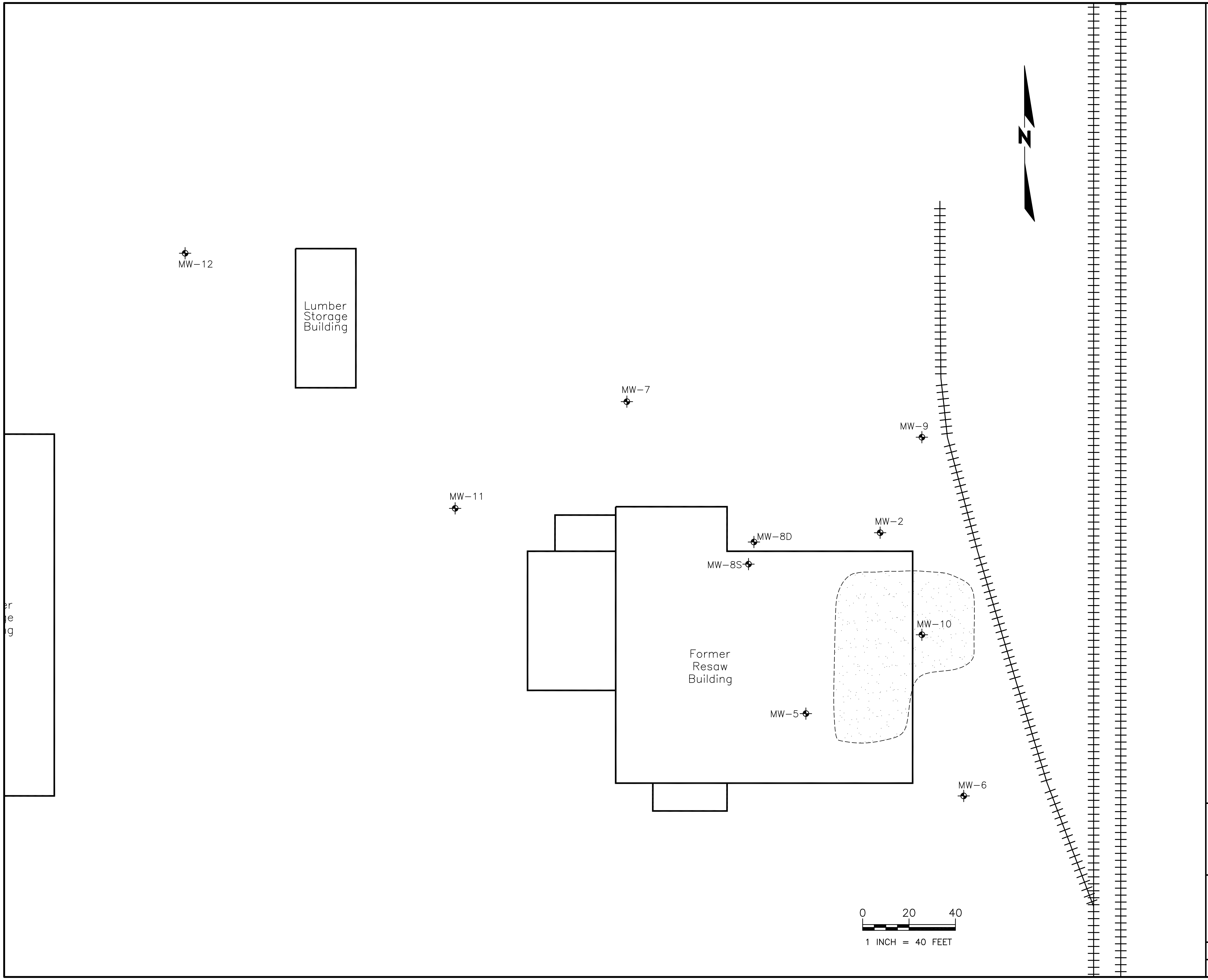
6.0 HEALTH AND SAFETY PLAN

A site-specific health and safety plan (HASP) for this project has been prepared by ISOTEC and is maintained on file. The ISOTEC HASP will be followed during the implementation of activities described herein. A typical ISOTEC injection team consists of a field supervisor, along with 1-2 field technicians. All members of the injection team have completed health and safety training consistent with the Occupational Safety and Health Act (Title 29 of the Code of Federal Regulations 1910.120) and have current certifications. The site supervisor has completed an additional eight hours of OSHA training. The HASP shall be revised and/or updated to reflect site conditions and activities, as necessary.

ISOTEC personnel will create a work zone around the injection pathway system and monitoring wells as part of their standard field operating procedures, with minimal site disturbance required. All injection and mixing activities will take place within this area, if possible. Reagents will be prepared on-site. Additional chemical storage precautions during non-working hours, such as an on-site lockable container (box truck) will be supplied to minimize any possible contact. Personnel protective equipment (PPE) will consist mostly of chemical splash attire and items noted in the HASP. The site-specific HASP will be available on-site during all field operations.

The ISOTEC process was created based on numerous years of both academic and private research in the chemical oxidation field. ISOTEC personnel understand the potential dangers associated with oxidizers such as hydrogen peroxide and have completed extensive safety training.

FIGURES



LEGEND

☐ Existing Building

◌ Excavation Area (September 2004)

⌖ Groundwater Monitoring Well

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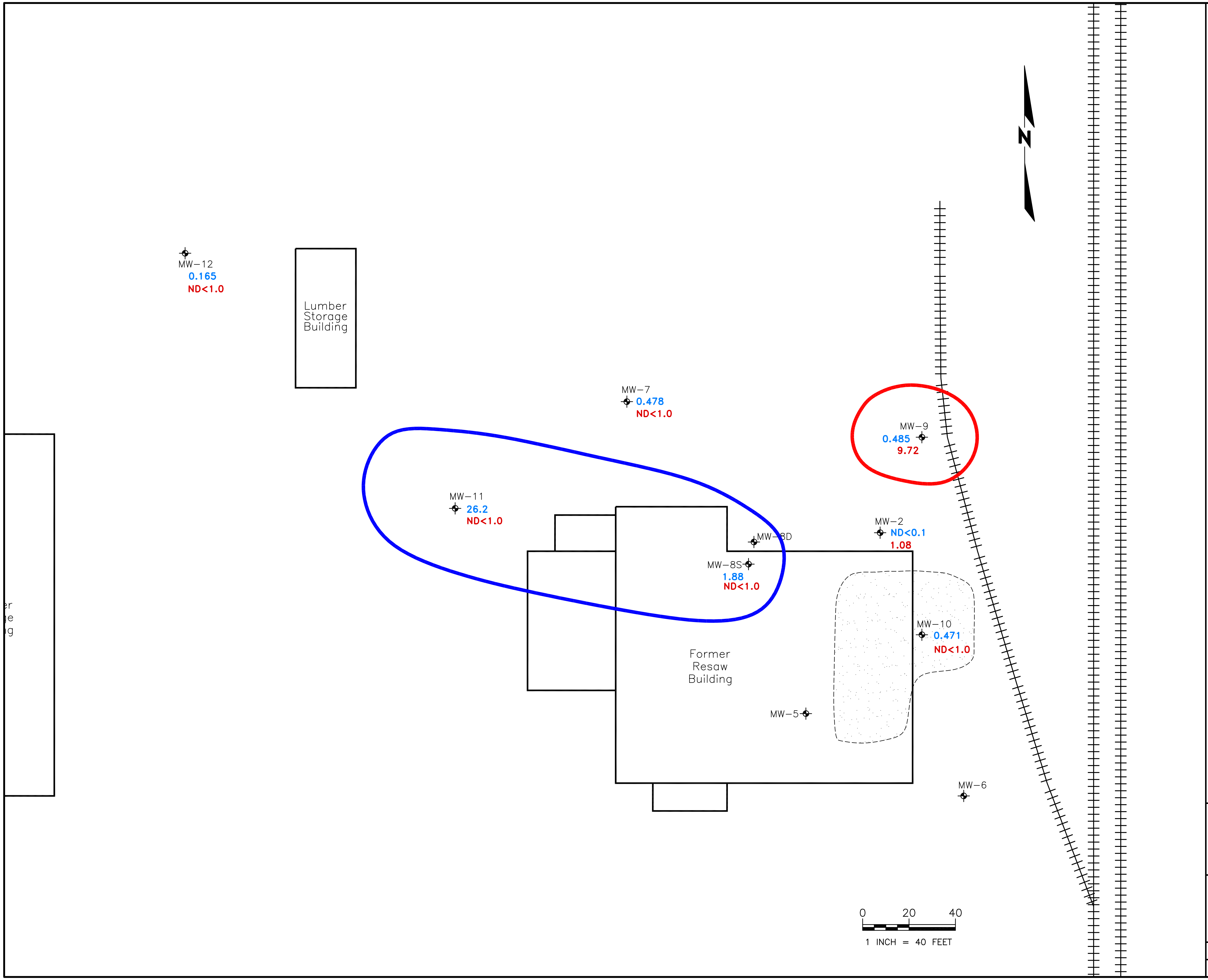
SITE PLAN
ISCO REMEDIATION PROGRAM – THIRD EVENT
Former Resaw Building
Welco Lumber Company
Arlington, Washington

DRAWN BY: KH	DATE: 9/9/11	FIGURE 1
CHECKED BY: SH	PROJECT NO: 901089	



LEGEND

☐	Existing Building
◌	Excavation Area (September 2004)
⌖	Groundwater Monitoring Well
PCP	Pentachlorophenol
PCE	Tetrachloroethene
ug/L	Micrograms Per Liter
ND	Not Detected (< method reporting limit)
1.88	PCP Concentration (July 2011)
9.72	PCE Concentration (July 2011)
—	Third ISCO Injection Event Core PCP Treatment Area (> 0.7 ug/L)
—	Third ISCO Injection Event PCE Treatment Area (> 5.0 ug/L)

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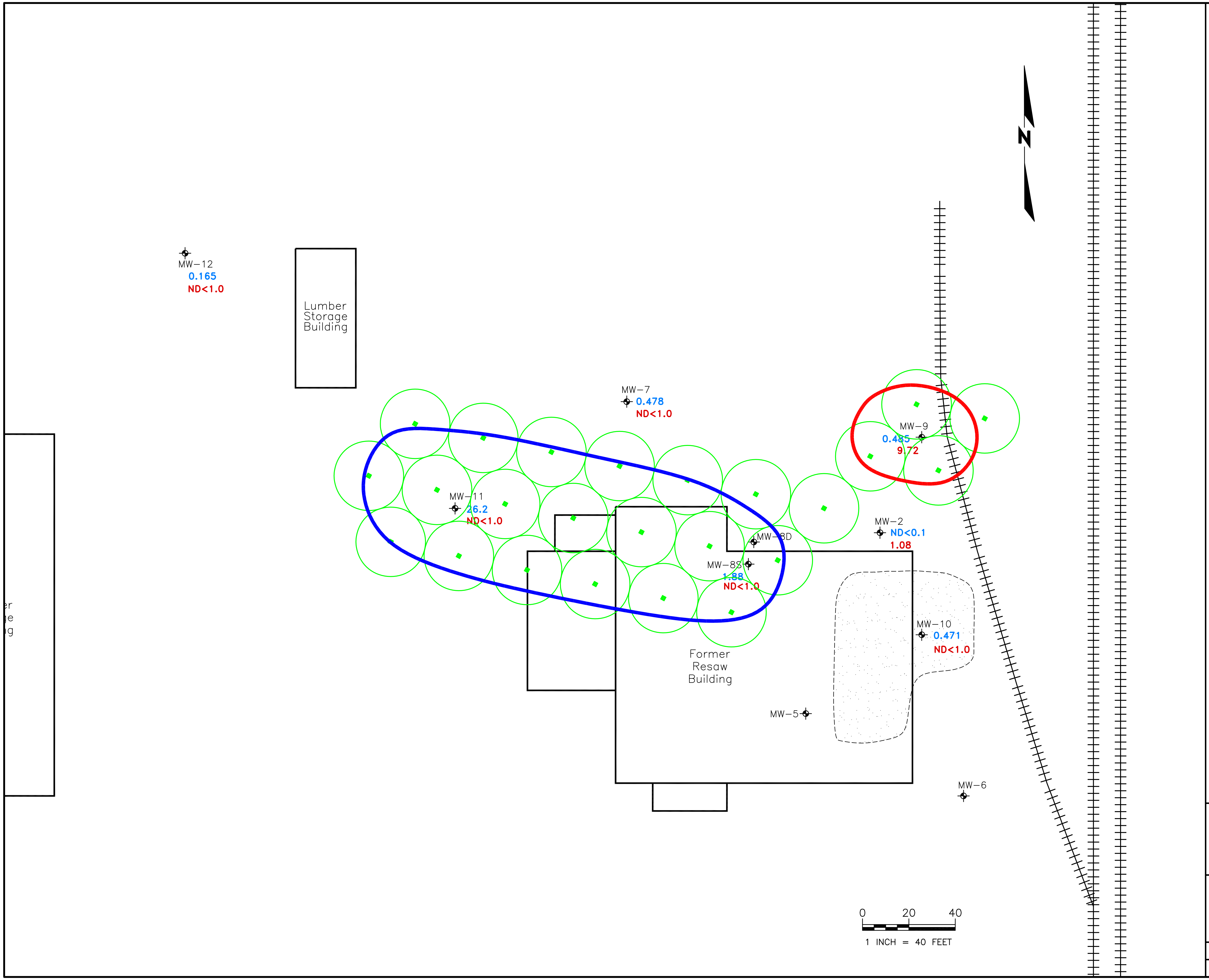
TREATMENT AREA MAP
ISCO REMEDIATION PROGRAM – THIRD EVENT
Former Resaw Building
Welco Lumber Company
Arlington, Washington

DRAWN BY: KH	DATE: 9/9/11	FIGURE
CHECKED BY: SH	PROJECT NO: 901089	2



LEGEND

▭	Existing Building
⬚	Excavation Area (September 2004)
⌖	Groundwater Monitoring Well
PCP	Pentachlorophenol
PCE	Tetrachloroethene
ug/L	Micrograms Per Liter
ND	Not Detected (< method reporting limit)
1.88	PCP Concentration (July 2011)
9.72	PCE Concentration (July 2011)
—	Third ISCO Injection Event Core PCP Treatment Area (> 0.7 ug/L)
—	Third ISCO Injection Event PCE Treatment Area (> 5.0 ug/L)
◆	Proposed 3rd Event Injection Locations (30–Foot Center Based On 15–Foot ROI)
○	Assumed 15–foot Radius of Influence

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PROPOSED INJECTION LOCATION MAP
ISCO REMEDIATION PROGRAM – THIRD EVENT
Former Resaw Building
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Arlington, Washington

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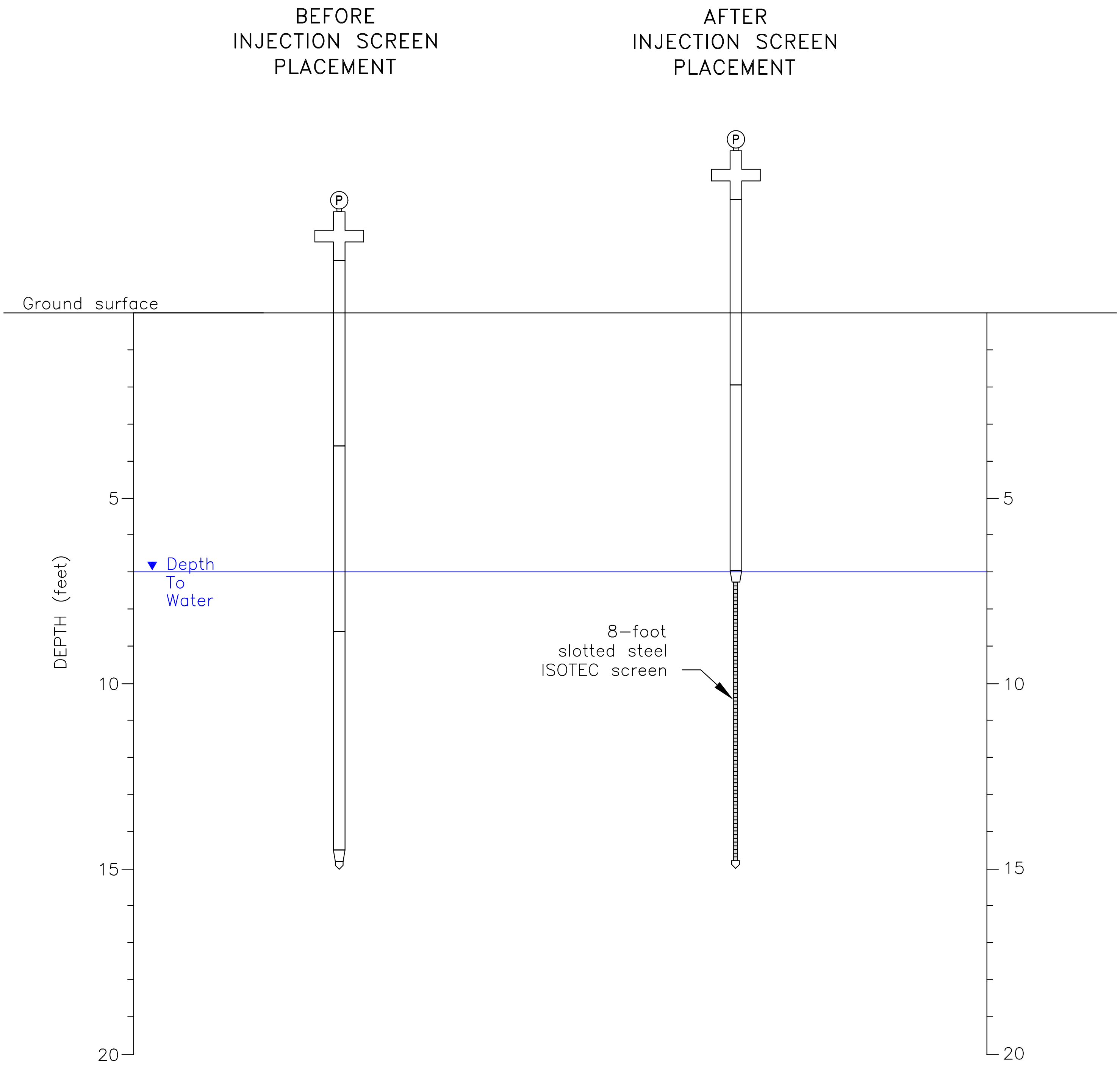
CHECKED BY: SH	PROJECT NO: 901089	



BEFORE INJECTION SCREEN PLACEMENT

AFTER INJECTION SCREEN PLACEMENT

NOTES

1. Each injection location will be screened from approximatley 7 (water table) to 15 feet bgs.

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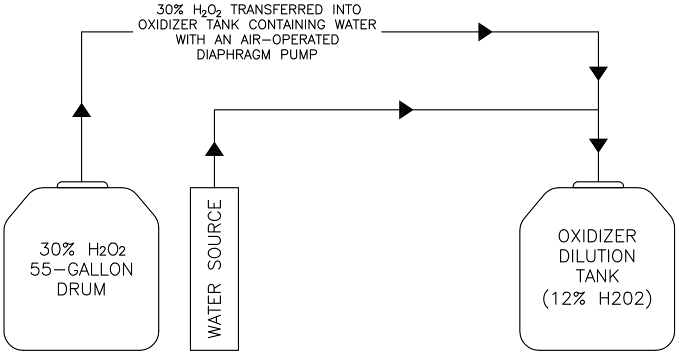
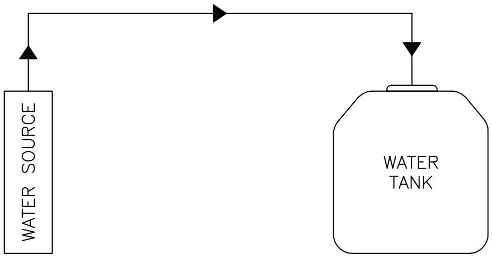
DIRECT-PUSH INJECTION SCREEN SCHEMATIC
ISCO REMEDIATION PROGRAM - THIRD EVENT
Former Resaw Building
Welco Lumber Company
Arlington, Washington

DRAWN BY: TE	DATE: 9/9/11	FIGURE 4
CHECKED BY: SH	PROJECT NO: 901089	

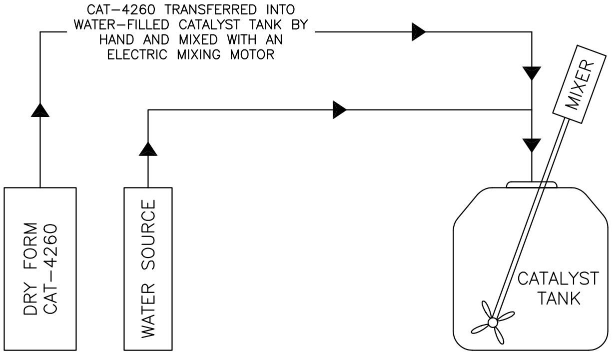
OXIDIZER TANK POCEDURES



WATER TANK PROCEDURES



CATALYST TANK PROCEDURES



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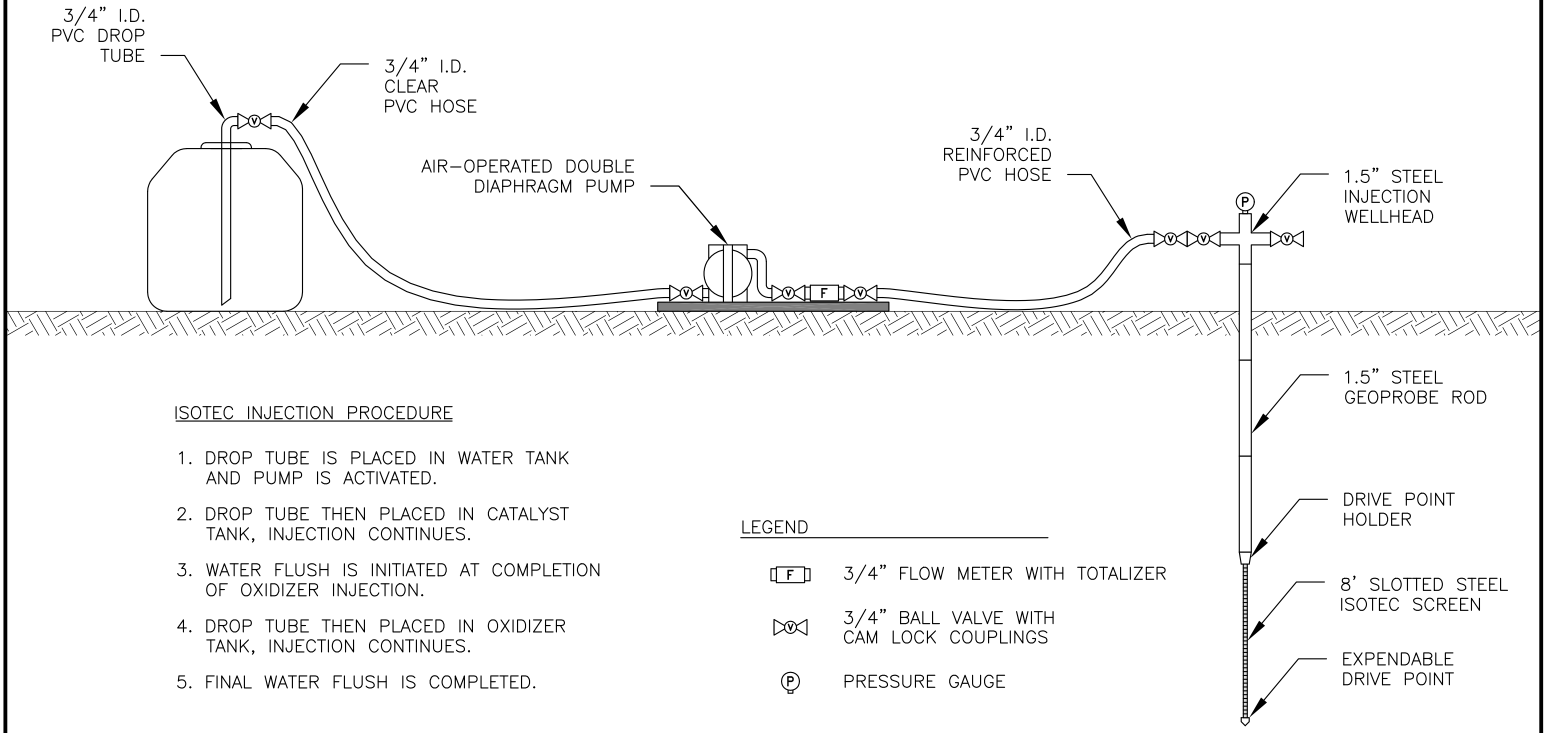
REAGENT MIXING SCHEMATIC
ISCO REMEDIATION PROGRAM – THIRD EVENT
Former Resaw Building
Welco Lumber Company
Arlington, Washington

DRAWN BY: KH	DATE: 9/8/11	FIGURE 5
CHECKED BY: SH	PROJECT NO: 901089	

REAGENT INJECTION DIAGRAM



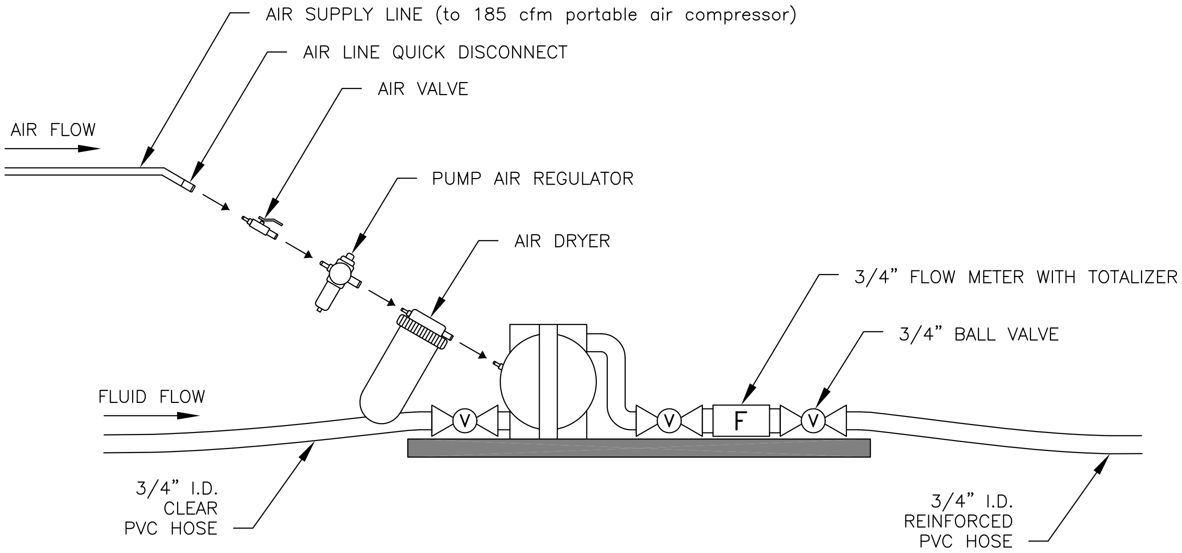
ISOTEC INJECTION PROCEDURE

1. DROP TUBE IS PLACED IN WATER TANK AND PUMP IS ACTIVATED.
2. DROP TUBE THEN PLACED IN CATALYST TANK, INJECTION CONTINUES.
3. WATER FLUSH IS INITIATED AT COMPLETION OF OXIDIZER INJECTION.
4. DROP TUBE THEN PLACED IN OXIDIZER TANK, INJECTION CONTINUES.
5. FINAL WATER FLUSH IS COMPLETED.

LEGEND

[F]	3/4" FLOW METER WITH TOTALIZER
⋈V	3/4" BALL VALVE WITH CAM LOCK COUPLINGS
Ⓟ	PRESSURE GAUGE

INJECTION PUMP INSTALLATION



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INJECTION METHOD SCHEMATIC
ISCO REMEDIATION PROGRAM – THIRD EVENT
Former Resaw Building
Welco Lumber Company
Arlington, Washington

DRAWN BY: KH	DATE: 9/8/11	FIGURE 6
CHECKED BY: SH	PROPOSAL NO: 901089	

APPENDIX B

PERFORMANCE AND CONFIRMATIONAL GROUNDWATER MONITORING PLAN

APPENDIX B

PERFORMANCE AND CONFIRMATIONAL GROUNDWATER MONITORING PLAN

B.1 PERFORMANCE GROUNDWATER MONITORING PLAN

Performance groundwater monitoring will be implemented to assess the progress and effectiveness of the third ISCO treatment event planned for the area beneath and downgradient of the former Welco Resaw building. The sampling procedures and frequency are provided below.

B1.1 Groundwater Sampling Procedures

Groundwater samples will be collected from existing monitoring wells summarized in Table B-1 in conformance with Ecology's Guidance on Sampling and Data Analysis Methods (Ecology, 1995). Prior to sampling, the depth to groundwater will be measured in the monitoring well. The monitoring well will be purged and sampled using low-flow groundwater sampling procedures in general conformance with U.S. Environmental Protection Agency (EPA) guidelines (EPA, 1996). Appropriate quality assurance/quality control measures will be instituted during the groundwater sampling. Sample collection information and sample locations will be recorded on the chain-of-custody (COC) form. The project name, location, station, date and time of collection, number of containers, types of analysis, and sampler's signature and date will be completed on the COC form. The sampler will retain one copy of the COC and two copies will accompany the samples to the laboratory. At the completion of sampling each day, the field logs will be finalized and sample labels will be checked against the COC forms and field logbooks. Samples will be stored in cooled ice chests and transported to the analytical laboratory under strict chain-of-custody protocol. An Ecology-accredited laboratory will conduct the analytical testing of the groundwater samples for PCP (EPA Method 8041A ECD) and VOCs (EPA Method 8260B). In addition, samples collected from monitoring wells MW-3, 4, 11 and 12 will be analyzed for dissolved chromium (Cr) and arsenic (As) by EPA Method 200.8 during the initial sampling event.

B1.2 Groundwater Sampling Frequency and Reporting

Prior to conducting the ISCO treatment, site monitoring wells outlined above will be sampled to provide baseline data regarding the levels of PCP and VOCs in the groundwater. The wells were last sampled in July 2011. The first post treatment sampling event will be completed approximately 3 months following the ISCO groundwater treatment and performance groundwater monitoring will be conducted on a quarterly basis thereafter. The groundwater sampling results will be provided to Ecology in a technical memorandum at the end of each quarterly sampling event.

It is anticipated that performance groundwater sampling will be conducted for four quarters or until the concentrations of PCP/PCE in the groundwater are below the applicable cleanup levels. Once the performance groundwater sampling indicates that the PCP and VOC concentrations are below cleanup levels, confirmational monitoring will be conducted as described below.

B2 CONFIRMATIONAL GROUNDWATER MONITORING

Confirmational groundwater monitoring will be implemented to confirm the long-term effectiveness of the remedial actions taken at the site. The sampling procedures and frequency are provided below.

B2.1 Groundwater Sampling Procedures

Groundwater samples will be collected from monitoring wells outlined in Table B-1 in conformance with Ecology guidelines. The samples will be collected in accordance with the procedures outlined above in Section B1.1. An Ecology-accredited laboratory will conduct the analysis of the groundwater samples for PCP and VOCs.

B2.2 Groundwater Sampling Frequency and Reporting

Confirmational groundwater sampling events will be conducted on a quarterly basis for a period of approximately one year following the completion of the performance monitoring. The number of monitoring wells sampled and the frequency of sampling may be modified based on the results of the performance monitoring. The groundwater sampling results will be provided to Ecology at the end of one year as part of URS' final report. The report will contain data summary tables, laboratory analytical reports and our conclusions regarding the groundwater PCP and PCE concentration trends and completeness of the prior remedial actions.

Generally Ecology requires that the results of four consecutive quarterly sampling events be below the applicable cleanup levels as a condition to terminating the long term compliance monitoring. Welco may petition Ecology for either reduced sampling frequency or to terminate monitoring before the termination date as specified herein if the sampling results are in compliance with the cleanup levels referenced above prior to the specified termination date.

Table B-1
Proposed Performance and Compliance Groundwater Monitoring Program
Former Welco Wood Products Facility
Arlington, Washington

Sample No	Well ID	Well Location	Well Screen Interval (ft, bgs)	Top of Casing Elevation[1] (ft, msl)	DTW (ft, bgs)	Turb	DO	ORP	Temp	pH	Cond	Treated Area[3]	Analysis
					10/19/05							Y / N	
	MW-1	**West of Treatment Area?**	5 ~ 15	98.67	NA							N	x
1	**MW-2**	**10 ft NE of Resaw Bldg**	3 ~ 13	100.59 [2]	9.72	X	X	X	X	X	X	Y	PCP (8041A ECD), VOC (8260B)
	MW-3	**300 ft WNW of Resaw Bldg**	4 ~ 14	98.02 [2]	8.83							N	As/Cr (EPA 200.8) (+) *
	MW-4	**West of Treatment Area?**	4 ~ 14	94.39	NA							N	As/Cr (EPA 200.8) (+) *
	MW-5	**SE Interior of Resaw Bldg**	5 ~ 15	100.78 [2]	9.98							N	*
	MW-6	**25 ft ESE of Resaw Bldg**	5 ~ 15	100.82 [2]	NA							N	*
2	**MW-7**	**50 ft NW of Resaw Bldg**	4 ~ 14	99.07 [2]	8.83	X	X	X	X	X	X	Y	PCP (8041A ECD), VOC (8260B)
3	**MW-8S**	**N Interior of Resaw Bldg**	6 ~ 16	99.96	9.32	X	X	X	X	X	X	Y	PCP (8041A ECD), VOC (8260B)
4	**MW-8D**	**5 ft N of 8S & Resaw Bldg**	25 ~ 30	100.05	9.44	X	X	X	X	X	X	Y	PCP (8041A ECD), VOC (8260B)
5	**MW-9**	**35 ft NE of Resaw Bldg**	6 ~ 16	100.29	9.42	X	X	X	X	X	X	Y	PCP (8041A ECD), VOC (8260B)
6	**MW-10**	**5 ft E of Resaw Bldg**	7 ~ 17	101.11	9.97	X	X	X	X	X	X	Y	PCP (8041A ECD), VOC (8260B)
7	**MW-11**	**50 ft NW of Resaw Bldg**	7 ~ 17	98.74	8.76	X	X	X	X	X	X	Y	PCP (8041A ECD), VOC (8260B) As/Cr (EPA 200.8) (+)
8	**MW-12**	**220 ft NW of Resaw Bldg**	7 ~ 17	97.81	8.36	X	X	X	X	X	X	N	PCP (8041A ECD), VOC (8260B) As/Cr (EPA 200.8) (+)

Notes:

x = not to be sampled; * = not to be sampleds as 4 quarters below Method A/B
DTW ft, bgs = Depth to Water in feet below ground surface
ft, msl = feet above mean sea level
NA = not available

[1] Well casing elevations surveyed by Hammon Collier Wade Livingstone on December 22, 2003, May 28, 2004 and November 2004.