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M E M O R A N D U M

TO: **Ms. Heather Vick**
Washington State Department of Ecology

DATE: **January 26, 2017**

FROM: **Joseph Ellingson and Charles Cacek**
SoundEarth Strategies, Inc.

SUBJECT: **Addendum to Cleanup Action Report**
Broadcast Apartments Property
1420 East Madison Street
Seattle, Washington
Voluntary Cleanup Program No. NW1621

SoundEarth Strategies, Inc. (SoundEarth) has prepared this Addendum to the Cleanup Action Report (SoundEarth 2016) on behalf of 1420 East Madison Street LLC, for the Property located at 1420 East Madison Street in Seattle, Washington (the Property). The cleanup action was performed as an independent remedial action in accordance with the Washington State Model Toxics Control Act (MTCA) Cleanup Regulation as established in Chapter 340 of Title 173 of the Washington Administrative Code. The Property is enrolled in the Washington State Department of Ecology's (Ecology) Voluntary Cleanup Program (No. NW1621). The cleanup action was completed in general accordance with activities described in the Revised Work Plan - Proposed Cleanup Action (CAP; EAI 2012) and Cleanup Action Plan Addendum (CAP Addendum; SoundEarth 2015).

This addendum was prepared to summarize the remedial injections that were completed prior to the remedial excavation. The cleanup action for the Property included conducting two in situ chemical oxidation (ISCO) events to reduce low-level 1,2-dichloroethane (EDC; also known as ethylene dichloride) concentrations in groundwater to below cleanup level. The ISCO events consisted of injecting hydrogen peroxide-activated sodium persulfate as an aqueous solution into monitoring wells MW01, MW05, MW06, and MW08.

These events were conducted in accordance with the CAP Addendum submitted to Ecology by SoundEarth on February 12, 2015. The CAP Addendum included the addition of remedial injection events ISCO in order to remediate groundwater on the Property prior to the excavation and subsequent redevelopment of the Property.

REMEDIAL INJECTION EVENTS

Two remedial injection events were conducted in May and September 2014, prior to the commencement of the remedial excavation activities. Prior to injecting, SoundEarth registered the injection wells with Ecology using the underground injection (UIC) control program.

Remedial Injection Design

There are two groundwater-bearing zones identified beneath the Property: a shallow, discontinuous, perched water-bearing zone at a maximum approximate depth of 18 feet below ground surface (bgs; perched interval) and a deeper, more continuous water-bearing zone encountered at a depth of approximately 31 feet bgs. The shallow perched water-bearing zone was the targeted treatment area for the remedial injections.

The remedial injection solution selected was a 12 percent solution of hydrogen peroxide-activated sodium persulfate to enhance the chemical oxidation of chlorinated solvents. Once dissolved and activated, sodium persulfate decomposes into powerful radicals and readily oxidizes dissolved volatile organic compounds, such as EDC. SoundEarth calculated the mass of chemical oxidant needed to reduce EDC to below cleanup level. Based on stoichiometry and assuming 50 percent of the sodium persulfate becomes radical and reacts with EDC, an estimated 28 pounds of sodium persulfate is required to oxidize one pound of EDC. However, since persulfate also reacts with natural organics present in the soil, a conservative soil oxidant demand (SOD) factor of 1 gram of persulfate per kilogram of soil (2 pounds of persulfate per ton of soil) was assumed in the injection volume calculations. Approximately 0.002 pounds of aqueous-phase EDC was estimated to be present beneath the Property, based on the results of the 2014 groundwater sampling. Considering the SOD and estimated mass of EDC, a theoretical persulfate mass requirement of approximately 1,740 pounds was calculated, to be delivered by injecting eleven 150-gallon batches of 12 percent sodium persulfate solution into monitoring wells MW01, MW05, and MW08.

Field Activities

Two injection events were conducted at the Property: one in May and one in September 2014. The locations of monitoring wells and other Property features are shown on Figure 1.

Upon arrival at the Property and prior to each injection event, initial depths to groundwater were measured at injection wells and adjacent monitoring wells to document changes in groundwater elevation as a result of the injection activities. Groundwater levels were measured relative to the top of well casing to an accuracy of 0.01 feet using an electronic water level meter. As required under the UIC registration, groundwater samples were collected from downgradient wells, MW06, MW09, MW11, and MW16, prior to and after injections, to monitor background sulfate concentrations. These wells were subsequently monitored quarterly to evaluate sulfate concentrations downgradient of the remedial injection treatment zone.

The injectate solution was mixed in 150-gallon batches into SoundEarth's single-point injection skid. The solution was then injected directly into the monitoring wells using a centrifugal pump. The pump applied pressures between 2 and 30 pounds per square inch, which was adjusted based on the injection rate. Three monitoring wells were injected into during each event—MW01, MW05, and MW08 in the first injection event and MW01, MW05, and MW06 in the second—for a total of four injection locations. MW08 was not used as an injection point in the second event because it required excessive pressure to accept the injectate solution. Injecting at high pressures can result in damage to well casings and potentially well failure. As a precautionary measure, MW06 was used as an alternative injection location for the second event. Approximately 3,600 gallons, or twenty-four 150-gallon batches, of hydrogen peroxide-activated sodium persulfate were injected into the groundwater treatment zone. A summary of the remedial injection data and volume of injectate per well point is provided in Table 1.

CONCLUSIONS

Based on post remedial injection laboratory analytical results for groundwater monitoring from March 2015, the concentration of EDC is below the MTCA Method A cleanup level for the majority of the groundwater treatment zone (Table 2). However, the March 2015 groundwater monitoring event indicated that two monitoring wells, MW05 and MW08, had concentrations of EDC that slightly exceeded the MTCA Method A cleanup level of 5 micrograms per liter (Table 2). In August 2015, 15 monitoring wells within the footprint of the excavation (MW01 through MW15) were decommissioned by a licensed engineer. The remaining monitoring well, MW16, is downgradient of the groundwater treatment zone and was nondetect for EDC in March 2015 (Figure 1; Table 2).

The development excavation removed all on-Property soils to elevation 341 feet above mean sea level, or depths ranging from about 27 to 42 feet bgs on the sloping Property. In addition, there was extensive construction dewatering of the deeper groundwater-bearing zone during the redevelopment excavation, using dewatering wells DW01 through DW05. At the peak of dewatering activities, approximately 10,000 gallons per day were being removed. A permanent dewatering system was installed as a part of building construction. The dewatering system includes drainage panels along the basement walls and sub-slab piping that directs water into the sub-slab sump. The sump water is then pumped off the Property into the combined sewer system. Currently, MW16 is dry, likely due to the building dewatering system within the shallow perched water-bearing zone. Post remedial action groundwater samples were collected from the intermediate water-bearing zone dewatering wells, DW02, DW03, and DW05, and all the samples were nondetect for EDC during the May 2016 groundwater sampling event (Figure 1; Table 2).

The cleanup action at the Property was performed in accordance with the Ecology-approved CAP (EAI 2012) and CAP Addendum (SoundEarth 2015). A complete discussion of the cleanup action implementation and the soil and groundwater performance and compliance monitoring is presented in the Cleanup Action Report (SoundEarth 2016).

The following conclusions are supported by the data generated during the implementation of the cleanup action at the Property:

- The nature and extent of releases of chemicals of concern (COCs) encountered within the Property boundaries have been fully characterized.
- COCs in soil have been removed and remediation levels have been met throughout the Property.
- All excavated soils were transported to an appropriate treatment, storage, and disposal facility.
- Shallow perched groundwater has been removed from the Property, and COCs are below applicable remediation levels in groundwater sampled from intermediate water-bearing zone wells across the Property.
- Deeper groundwater from the intermediate water-bearing zone below the source location is compliant with MTCA Method A cleanup levels.
- No further action is necessary for the COCs, and the Property no longer presents a threat to human health or the environment.

This memorandum supports SoundEarth request under the Cleanup Action Report for an opinion from Ecology to obtain a No Further Action determination for the cleanup action.

Attachments: Figure 1: Remedial Injection Layout—Chemical Oxidation
Table 1: Summary of Remedial Injection Data
Table 2: Summary of Groundwater Analytical Results

REFERENCES

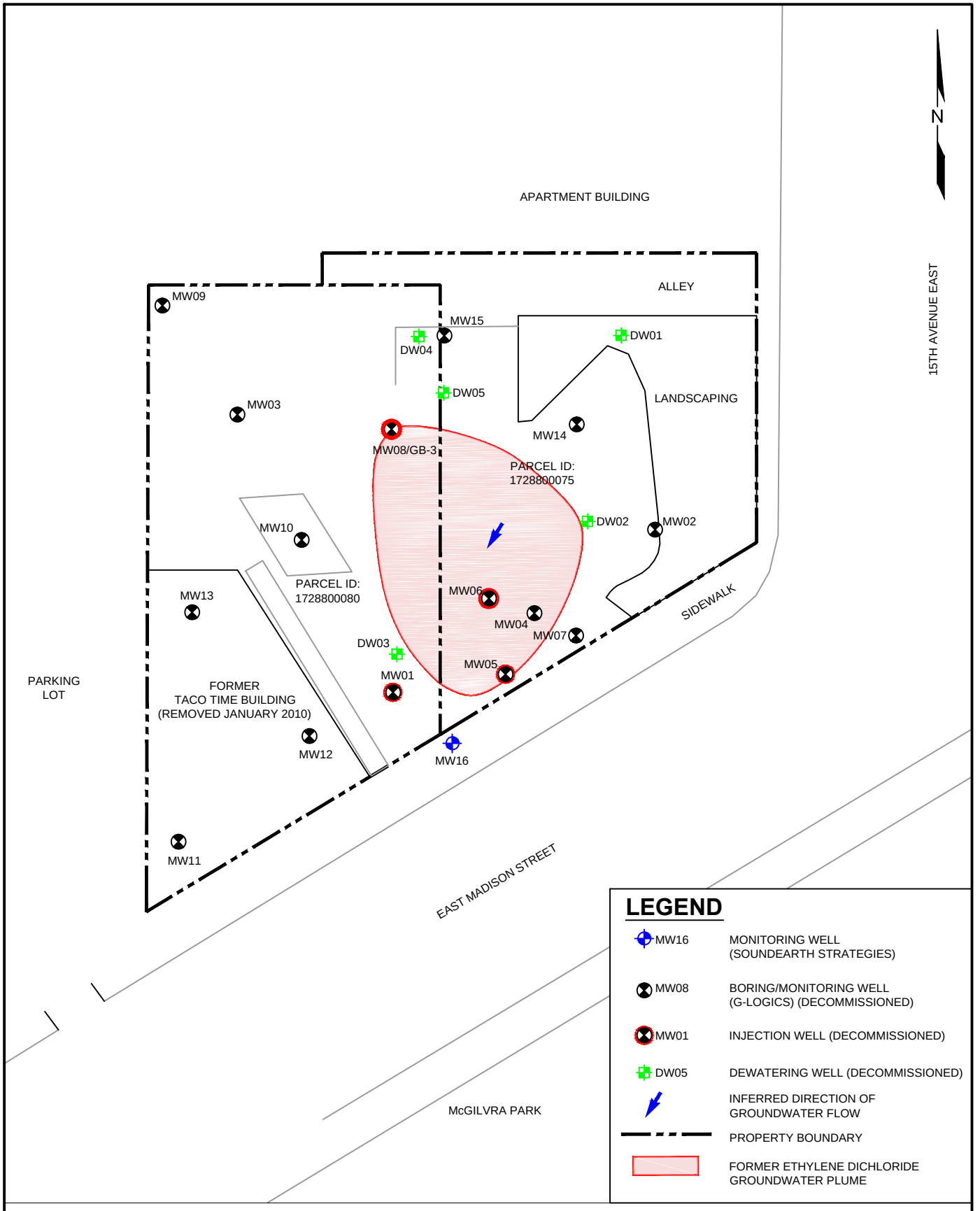
Environmental Associates, Inc. (EAI). 2012. Revised Work Plan - Proposed Cleanup Action *(VCP #NW1621), Taco Time Northwest Restaurant, 1420 East Madison Street, Seattle, Washington*. July 13.

SoundEarth Strategies, Inc. (SoundEarth). 2015. *Cleanup Action Plan Addendum, Madison TT Property (VCP #NW1621), 1420 East Madison Street, Seattle, Washington*. February 12.

_____. 2016. *Cleanup Action Report, Broadcast Apartments Property, 1420 East Madison Street, Seattle, Washington*. August 17.

JME/CCC:dnm

FIGURE



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DATE: 1/10/17
DRAWN BY: JQC/JME/CD
CHECKED BY: SES
CAD FILE: 1002-003_UIC_SPI

PROJECT NAME: BROADCAST APARTMENTS PROPERTY
PROJECT NUMBER: 1002-003
STREET ADDRESS: 1420 EAST MADISON STREET
CITY, STATE: SEATTLE, WASHINGTON

FIGURE 1
REMEDIAL INJECTION LAYOUT
- CHEMICAL OXIDATION

1/26/2017
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TABLES

Table 1
Summary of Remedial Injection Data
Broadcast Apartments Property
1420 East Madison Street
Seattle, Washington

May 2014 Event			
Injection Point ID	**Date**	**Batch Total Injected** (gallons)	**Total Injected** (gallons)
MW01	05/19/14	150	841
	05/21/14	20	
		150	
		125	
	05/23/14	115	
		136	
		145	
MW05	05/21/14	150	448
		150	
	05/23/14	148	
MW08	05/21/14	130	204
		25	
	05/23/14	32	
		12	
		5	
Injection Event Number 1 - Volume			**1,493**
September 2014 Event			
Injection Point ID	**Date**	**Total Injected Per Batch** (gallons)	**Total Injected** (gallons)
MW01	09/22/14	30	1,031
		1	
		80	
	09/23/14	150	
		150	
	09/24/14	150	
		170	
		150	
		150	
MW05	09/22/14	12	767
		5	
	09/23/14	60	
		150	
		70	
	09/24/14	20	
		150	
		150	
		150	
MW06	09/22/14	18	318
	09/23/14	90	
		80	
	09/24/14	130	
Volume Injected			**2,116**
Total Volume Injected (both events)			**3,609**

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Table 2
Summary of Groundwater Analytical Results
Broadcast Apartments Property
1420 East Madison Street
Seattle, Washington

Well ID	Sample Date	Event Status	EDC[1] (micrograms per liter)
MW01	01/13/06	Pre-Injection	**53**
	02/02/06		**69**
	06/16/06		**54**
	06/16/06		**58**
	01/28/09		<1.0
	05/12/09		<1.0
	08/27/09		**23**
	03/02/10		**11**
	08/20/10		**18**
	03/15/12		**8.9**
	02/28/14		3.3
	08/14/14		**6.6**
	12/18/14	Post-Injection	1.3
	03/17/15		1.2
MW02	01/13/06	Pre-Injection	<2
	06/16/06		<2
	01/28/09		<1.0
	05/12/09		<1.0
	08/27/09		<1.0
	08/27/09		<1.0
	03/02/10		<1.0
	08/20/10		<1.0
MW03	01/13/06	Pre-Injection	3
	06/16/06		<2
	01/28/09		<1.0
	05/12/09		<1.0
	08/27/09		<1.0
	03/02/10		<1.0
	08/20/10		<1.0
MW04	06/17/06	Pre-Injection	**6.0**
	01/28/09		<1.0
	05/12/09		<1.0
	03/02/10		<1.0
	08/27/09		<1.0
	03/02/10		<1.0
	08/20/10		<1.0
MW05	06/16/06	Pre-Injection	**61**
	01/28/09		<1.0
	05/12/09		<1.0
	08/27/09		<1.0
	03/02/10		**8.1**
	03/15/12		**9.9**
	02/28/14		**11**
	08/14/14		**6.5**
	12/18/14	Post-Injection	2.3
	03/17/15		**6.2**
MTCA Method A Cleanup Level[2]			**5**

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Broadcast Apartments Property
1420 East Madison Street
Seattle, Washington

Well ID	Sample Date	Event Status	EDC[1] (micrograms per liter)
MW06	06/16/06	Pre-Injection	**32**
	01/28/09		<1.0
	05/12/09		<1.0
	08/27/09		**7.0**
	03/02/10		**15**
	03/15/12		<1
	02/28/14		<1
	09/18/14		1.5[4]
	12/18/14	Post-Injection	1.2
	03/17/15		<1
MW07	01/28/09	Pre-Injection	<1.0
	05/12/09		<1.0
	08/27/09		1.2
	03/02/10		0.71[J]
MW08	01/28/09	Pre-Injection	<1.0
	05/12/09		<1.0
	08/27/09		**8.4**
	03/02/10		**8.2**
	08/20/10		**7.6**
	03/15/12		**7**
	02/28/14		**5.7**
	08/14/14		<1
	12/18/14	Post-Injection	2.2
	03/17/15		**5.9**
MW09	01/28/09	Pre-Injection	<1.0
	05/12/09		<1.0
	08/27/09		<1.0
	03/02/10		<1.0
	03/13/14		<1
	05/19/14		--
	08/14/14		<1
	12/18/14	Post-Injection	<1
	03/17/15		<1
MW10	01/28/09	Pre-Injection	<1.0
	05/12/09		<1.0
	08/27/09		<1.0
	03/02/10		<1.0
	03/02/10		--
	03/15/12		<1
	02/28/14		<1
MW11	01/28/09	Pre-Injection	<1.0
	03/02/10		<1.0
	03/15/12		<1
	02/28/14		<1
	05/19/14		--
	08/14/14	Post-Injection	--
	12/18/14		--
MTCA Method A Cleanup Level[2]			**5**

Table 2
Summary of Groundwater Analytical Results
Broadcast Apartments Property
1420 East Madison Street
Seattle, Washington

Well ID	Sample Date	Event Status	EDC[1] (micrograms per liter)
MW12	01/28/09	Pre-Injection	0.75[J]
	08/20/10		<1.0
	03/15/12		<1
	02/28/14		<1
MW13	01/28/09	Pre-Injection	<1.0
MW14	08/20/10	Pre-Injection	<1.0
	03/15/12		<1
MW15	08/20/10	Pre-Injection	<1.0
	02/28/14		<1
MW16	03/13/14	Pre-Injection	<1
	08/14/14		<1
	09/22/14		--
	12/18/14	Post-Injection	<1
	03/17/15		<1
DW02[3]	02/15/16	Post-Injection	**5.7**
	04/22/16		<0.1
	05/10/16		<1
	05/17/16		<1
DW03[3]	02/15/16	Post-Injection	2.3
	05/10/16		<1
	05/17/16		<1
DW05[3]	05/10/16	Post-Injection	<1
	05/17/16		<1
MTCA Method A Cleanup Level[2]			**5**

NOTES:

Red denotes concentration in excess of MTCA Method A Cleanup Level for Groundwater.

Samples collected by SoundEarth analyzed by Friedman & Bruya, Inc. of Seattle, Washington.

[1]Analyzed by U.S. Environmental Protection Agency Method 8260C.

[2]MTCA Cleanup Regulation, Method A Cleanup Levels, Table 720-1 of Section 900 of Chapter 173-340 of the Washington Adiminstrative Code, revised November 2007.

[3]Grab groundwater sample; collected prior to stabilization of water quality parameters.

-- = not measured or not analyzed

< = not detected above the applicable laboratory reporting limit

EDC = 1,2-dichloroethane (ethylene dichloride)

MTCA = Washington State Model Toxics Control Act

Laboratory Note:

[J]Estimated value