



South Carolina Department of Health  
and Environmental Control

## ANNOUNCEMENT OF PROPOSED PLAN

The South Carolina Department of Health and Environmental Control (DHEC or the Department) recently completed an evaluation of cleanup alternatives to address contamination at the Hitachi Electronic Devices (Hitachi) Site. This Proposed Plan identifies the Preferred Alternative for cleaning up the contaminated soil and groundwater and provides the reasoning for this preference. In addition, this Plan includes summaries of other cleanup alternatives evaluated. These alternatives were identified based on information gathered during environmental investigations conducted by Hitachi pursuant to Voluntary Cleanup Contract 97-5303-RP, dated December 8, 1997, between Hitachi and the Department.

The Department is presenting this Proposed Plan to inform the public of our activities, to gain public input, and to fulfill the requirements of CERCLA Section 117(a) and National Contingency Plan Section 300.430(f)(2). This Proposed Plan summarizes information that can be found in greater detail in the Feasibility Study (FS) report (Revised February 2013) and other documents contained in the Administrative Record file. The Department encourages the public to review these documents to gain a comprehensive understanding of the Site and activities that have been conducted.

The Department will select a final remedy after reviewing and considering comments submitted during the 30-day public comment period. The Department may modify the Preferred Alternative or select another response action presented in this Proposed Plan based on new information or public comments. Therefore, the public is encouraged to review and comment on all the alternatives presented in this Proposed Plan.

### DHEC's Preferred Cleanup Summary

Soil Cleanup: DHEC's preferred soil remedial alternative, Alternative S4, consists of the installation of a Soil Vapor Extraction (SVE) system in the former TCE (trichloroethylene) reclamation tank area and the area north of the former Thermal Treatment Zone (TTZ). The SVE system "pulls" contaminated vapors from the subsurface soils to the surface where they will be treated (depending on the concentration) prior to discharge.

Groundwater Cleanup: DHEC's preferred groundwater remedial alternative, Alternative GW4A, consists of In-Situ Chemical Oxidation (ISCO) using potassium permanganate in the source area and In-Situ Chemical Reduction (ISCR) using zero valent iron (ZVI) in the dissolved plume.

The remaining pages provide additional details of the Proposed Plan.

## Proposed Plan for Site Remediation

**Hitachi Electronic Devices Site**  
575 Mauldin Road, Greenville, South Carolina

April 2013

### MARK YOUR CALENDAR

#### ☐ PUBLIC MEETING:

**When:** Tuesday April 9, 2013, 6:30pm  
**Where:** J.L. Mann High School Auditorium  
160 Fairforest Way  
Greenville, SC

DHEC will hold a meeting to explain the Proposed Plan, and all of the alternatives presented in the Feasibility Study. After the Proposed Plan presentation, DHEC will respond to your questions. Oral and written comments will be accepted at the meeting.

#### ☐ PUBLIC COMMENT PERIOD: April 9, 2013 through May 9, 2013

DHEC will accept written comments on the Proposed Plan during the public comment period. Submit your written comments to:

Angie Jones, Project Manager  
DHEC-L&WM  
2600 Bull St.  
Columbia, SC 29201  
Email: [jonesar@dhec.sc.gov](mailto:jonesar@dhec.sc.gov)

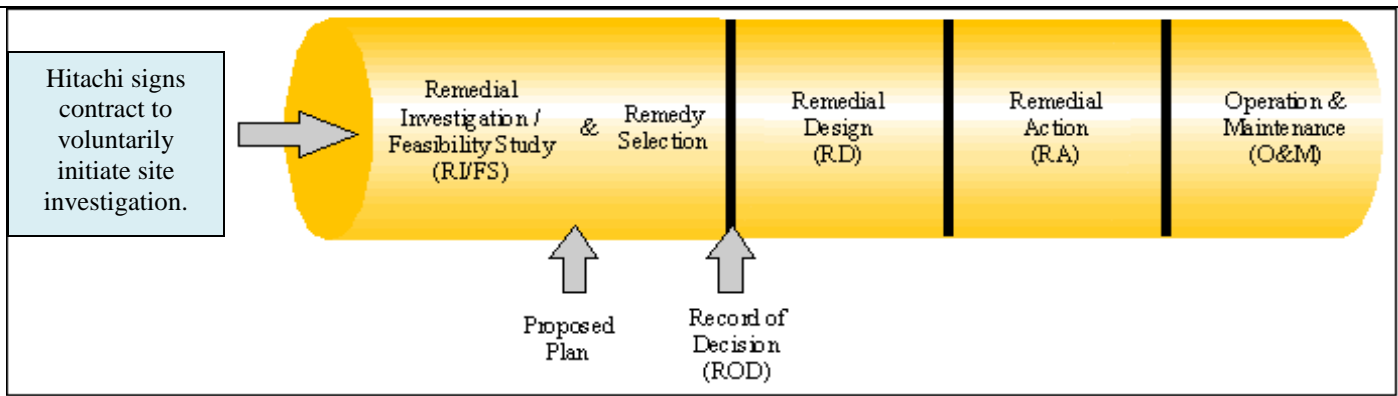
#### ☐ FOR MORE INFORMATION:

**Call:** Angie Jones, Project Manager, 803-896-4076

**See:** DHEC's website at:  
<http://www.dhec.sc.gov/environment/lwm/publicnotice.htm>

**View:** The Administrative Record at the following locations:

- Greenville County Public Library—Augusta Road Branch  
100 Lydia Street, Greenville, SC  
Hours: Monday--Thursday: 9:00am – 9:00pm  
Friday – Saturday: 9:00am – 6:00pm
- DHEC's Bureau of Land & Waste Management  
8911 Farrow Road - Columbia, SC  
Contact: Freedom of Information Office: (803) 898-3817  
Hours: Monday - Friday: 8:30a.m. - 5:00p.m.



## **SITE HISTORY**

The former Hitachi facility is located at 575 Mauldin Road in Greenville, SC and occupies 53.5 acres bounded by Interstate 85 to the north, Parkins Mill Road to the west, Mauldin Road and Wenwood Drive to the south, and an industrial facility to the east (Figure 1). Western Carolina Regional Sewer Authority (WCRSA), now known as Renewable Water (ReWa), operated three permitted grit disposal trenches at the facility from 1978 to 1985. The trenches were located in the area of the current wastewater treatment plant. WCRSA removed waste and closed out the trenches prior to selling the property. TCE was reported in trace amounts in three soil samples collected from the trench area during closure of the trenches. Three groundwater monitoring wells (MW-1, MW-2, and MW-3) were installed in December 1990 and January 1991 by WCRSA as part of the trench closure (Figure 2).

Hitachi purchased the property from WCRSA and began construction of a color picture tube manufacturing facility in 1990. Hitachi's operations began at the facility in 1991 and continued until December 2006. The facility was subsequently vacated by Hitachi in May 2008 and sold to Weston Commercial in November 2008. The eastern portion of the facility is now being leased to Span Packaging Services, a provider of packaging materials for the personal care and pharmaceutical industries, and the central portion is leased to Confluence Watersports, a manufacturer of recreational canoes and kayaks.

In 1996, TCE was identified in a groundwater sample, leading to subsequent investigations. These investigations determined that both soil and groundwater at the facility were contaminated with TCE. As a result, Hitachi, as the owner and operator of the facility, and the Department entered into Voluntary Cleanup Contract 97-5303-RP in December 1997.

## **SITE CHARACTERISTICS**

Hitachi has performed various response activities under DHEC's oversight, including a Remedial Investigation (RI) to determine the sources, nature, and extent of contamination; a Risk Assessment; a Feasibility Study (FS) to evaluate cleanup alternatives; and interim cleanup measures such as soil excavation, thermal treatment, soil vapor extraction, and groundwater recovery.

Investigations have determined that the former TCE Tank Area, including the TCE tank, in-ground sumps, and the TCE reclamation unit area, is the primary source of contamination. Although there was a concrete containment area and sumps, TCE seeped through the floor to the underlying soil. Various Volatile Organic Compounds (VOCs), including TCE and its daughter (breakdown) products, primarily dichloroethenes and vinyl chloride, have impacted soil, groundwater, and, to a lesser extent, surface water, sediment, and air. The sampling results for various media are summarized below.

- **Surface Soil** - Surface soils are not a concern at the Hitachi Site as the area of the TCE tank is paved and the release occurred in the subsurface.
- **Subsurface Soils** - Subsurface soils are impacted in the former TCE Tank Area and the area north of the former Target Treatment Zone (TTZ) (Figure 3), which encompass approximately 600 square feet and 1,900 square feet, respectively. A maximum concentration of 10,000 ug/kg (micrograms per kilogram or parts per billion) TCE was reported in a sample collected at 42 feet below ground surface (bgs) in the former TCE Tank Area. In the area north of the former TTZ, a maximum concentration of 770 ug/kg was reported at 17.5 feet bgs.
- **Groundwater** - Groundwater impact has been identified in the saprolite and bedrock. The "source area" treatment area has been defined as the area including and immediately surrounding the former TTZ. TCE concentrations in this area have exceeded 200,000 micrograms per liter (ug/L). The "plume area" is defined as other locations where TCE and its daughter products exceed their respective Maximum Contaminant Levels (MCLs) established for drinking water under the Safe Drinking Water Act. The plume area encompasses approximately 16 acres, much of which extends off the former Hitachi property (Figure 4).
- **Indoor Air** - Four indoor air sampling events have been completed. The most recent data indicate a slightly elevated concentration of TCE, however, it does not warrant remedial measures.
- **Surface Water** - TCE and cis-1,2-DCE have only been detected sporadically in Reedy River surface water samples, but not in any significant concentrations or consistent pattern.

No Site-related VOCs were detected in any of the surface water samples collected in Wenwood Creek.

- **Sediment** - Stream sediment sampling was conducted at locations in the Reedy River and Wenwood Creek. No VOCs were detected in the sediment samples collected in Wenwood Creek. Two of the eight sediment samples collected in the Reedy River contained VOCs, however, the concentrations do not warrant remedial measures.

- **Ecological Risks** - There were no contaminants of concern in the surface water, soil, and sediment with respect to ecological receptors that required further evaluation.

It is DHEC's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect public health and the environment from actual or threatened releases of hazardous substances into the environment.

## **SCOPE AND ROLE OF THE ACTION**

Hitachi has previously conducted the following cleanup activities: excavated contaminated soils and operated an SVE system in the Tank Area, conducted In-Situ Thermal Desorption to address high levels of contamination in the Thermal Treatment Zone, and operated an interim groundwater extraction and treatment system (ongoing). The proposed action in this plan will be the final cleanup action for the Site. The remedial action objectives for this proposed action include preventing exposure to contaminated subsurface soils, groundwater and air; preventing the migration of contaminants from soil to groundwater and surface water; and restoring groundwater to beneficial use through the use of treatment technologies. The proposed response actions will permanently reduce the toxicity, mobility, and volume of contamination at the Site.

## **SUMMARY OF SITE RISKS**

As part of the RI/FS, Hitachi conducted a baseline risk assessment to determine the potential current and future risks of contaminants to human health and the environment. The Site property is currently zoned industrial and this zoning extends east of the Site along Interstate 85. The areas west and south of the Site are zoned services where Western Carolina Regional Sewer Authority (aka ReWa) has its wastewater treatment operations. Residential zoned areas are located north and southeast of the Site. Since it is very unlikely that any of this zoning will change in the future, the current and future land use scenarios are the same. With respect to potential receptors, a Construction Worker (Adult), Trespasser/Visitor (Child – 7 to 16 years old), Industrial Worker (Adult), and Resident (Child – 1 to 6 years old chosen as the most sensitive population) were established for the various exposure mediums.

- **Human Health Risks** - None of the constituents in soil present a cancer risk greater than the target of one in one million ( $10^{-6}$ ) or a hazard quotient greater than the target of one (1). The Risk Assessment identified elevated risks for exposure scenarios that include exposure to contaminated groundwater.

## **REMEDIAL ACTION OBJECTIVES**

Remedial action objectives (RAOs) are developed in order to set goals for protecting human health and the environment. The goals should be as specific as possible but should not unduly limit the range of alternatives that can be developed. Accordingly, the following RAOs were developed for the Site:

1. Eliminate future potential exposure to TCE in shallow subsurface soil in the former TCE Tank Area.
2. Prevent the migration (i.e., leaching) of contaminants of concern from TCE-impacted soil to groundwater. DHEC has calculated 88 ug/kg TCE as the appropriate screening level.
3. Prevent exposure of human receptors to groundwater containing contaminants at levels exceeding MCLs.
4. Prevent exposure of human receptors to indoor air containing contaminants exceeding appropriate screening levels for indoor air.
5. Restore groundwater to beneficial use within a reasonable timeframe.
6. Monitor groundwater and soil in a manner that will verify the effectiveness of the remedial actions.
7. Mitigate further migration of the contaminant plume and groundwater discharge to surface water above the Ambient Water Quality Criteria.

The proposed action will reduce the concentration of soil contaminants to levels that are protective of groundwater at drinking water levels. The site-specific target level, or remedial goal, for TCE in subsurface soils is 88 ug/kg.

The remedial goals for groundwater contaminants are based on the MCLs established under the Safe Drinking Water Act. For groundwater, the remedial goals are:

TCE	5 ug/L
cis-1,2-DCE	70 ug/L
Vinyl chloride	2 ug/L

## ***SUMMARY OF REMEDIAL ALTERNATIVES***

Based on information collected during the previous investigations, a Feasibility Study (FS) was conducted to identify, develop, and evaluate cleanup options and remedial alternatives. The FS process used the information on the nature and extent of contamination and associated potential human health risks developed during the Remedial Investigation and associated studies to develop and evaluate potential remedial alternatives and their overall protection of human health and the environment. Both soils and groundwater were considered in the FS analysis. Each remedial alternative evaluated by the Department is described briefly below. Note: A final Remedial Design will be developed prior to implementation. The table below briefly describes the alternatives that were carried through the identification and screening process to the final detailed analysis of alternatives. All alternatives, except the No Action Alternative, will include institutional controls such as restrictions on groundwater use, etc.

<b>SUMMARY OF REMEDIAL ALTERNATIVES</b>		
<b>Medium</b>	<b>Designation</b>	<b>Description</b>
<b>SOIL</b>	S1	No Action
	S2	Mechanical Excavation and Off-Site Disposal
	S4	Soil Vapor Extraction or SVE; vacuum "pulls" contaminated vapors from the subsurface soils to the surface where they are treated
	S8	Mechanical Excavation and Off-Site Disposal with Additional ISCO Vadose Zone Treatment
<b>GROUNDWATER</b>	GW1	No Action.
	GW4A	ISCO Groundwater Treatment in the Source Area with ISCR Plume Treatment
	GW4B	ISCO Groundwater Treatment in the Source Area with ISCO and ISCR Plume Treatment
	GW8	ISCO Groundwater Treatment

### ***Soil Alternatives***

#### **S1: No Action**

The "No Action" alternative is required to be evaluated to establish a baseline for comparison of the other remedial action alternatives. Under this alternative, the existing concrete pad would remain in place, but there would be no active measures to prevent exposure to the soil contamination or leaching to groundwater. No institutional controls or active remediation would be implemented under this alternative. This alternative is used as a baseline for comparison to other remedial action alternatives.

No cost would be associated with this alternative.

#### **S2: Mechanical Excavation and Off-Site Disposal**

Alternative S2 involves the physical removal of contaminated shallow subsurface soil in the identified target areas (Figure 3). The concrete pad would be removed to allow access to subsurface soils which would be excavated to a depth of 5 feet bgs in the northeastern portion of the treatment area, grading down to 11 feet bgs in the southwestern portion of the treatment area. The concrete pad and excavated soils would be loaded into trucks or roll-off boxes for transportation and offsite disposal. The excavated area would then be backfilled with suitable material and paved.

The net present value of this alternative is estimated at \$728,800 if the materials must be disposed as hazardous waste and \$378,000 if the materials are non-hazardous.

#### **S4: Soil Vapor Extraction**

Alternative S4 involves removal of TCE mass from the treatment area using SVE. SVE technology targets volatile contaminants (which readily evaporate, such as TCE) present in unsaturated soils. SVE works by inducing a vacuum on the affected soils, causing the contaminated vapors to be "pulled" to the surface where they are treated. It was assumed a carbon filter would be used on the treatment exhaust to minimize emissions. System maintenance and sampling would also be required. The project life is estimated at two years of operation. The cost estimate assumes treatment will be warranted in both the areas to the north and east of the former TTZ.

The net present value of this alternative is estimated at \$199,705.

#### **S8: Mechanical Excavation and Off-Site Disposal with Additional ISCO Vadose Zone Treatment**

Alternative S8 involves the same excavation activities as described in Alternative S2, but also includes the emplacement of permanganate in the vadose zone during the source area groundwater treatment. This treatment will address elevated TCE concentrations that were found at 42 feet bgs. At this depth, direct

human exposure is not a concern; however, isolated intervals of TCE contamination could provide a future source of TCE contamination in groundwater.

The net present value of this alternative is estimated at \$754,943 if the materials must be disposed as hazardous waste and \$404,153 if the materials are non-hazardous.

## ***Groundwater Alternatives***

The nature and extent of contamination, subsurface lithology, Site conditions, and access issues limited the practical alternatives to three in-situ chemical treatment options: Alternative GW4A, Alternative GW4B, and Alternative GW8. These alternatives can reduce TCE groundwater concentrations to below the MCL within a reasonable timeframe, which for this Site is considered to be more than 10 years but within a few decades. It is unlikely that any single technology can achieve MCLs in the immediate future. Alternatives GW4A, GW4B, and GW8 currently present the best potential for depleting source area mass, shrinking the size of the plume, and significantly reducing the overall life of remedial activities. It is anticipated MNA (Monitored Natural Attenuation) will be a component of the remedy once it has been demonstrated the source has been removed, the plume is not migrating, contaminant concentrations are decreasing, and further remedial actions would not provide significant reductions in contaminant mass.

### **GW1: No Action**

The No Action alternative is carried through the screening process, as it serves as a baseline for comparison of the other remedial action alternatives. No active remediation or routine groundwater monitoring would be implemented under this alternative. Existing groundwater contamination would not be addressed through any means other than naturally occurring attenuation processes. There would be no restrictions on groundwater use at the facility and protections against further contaminant migration to offsite properties would not be provided.

No cost would be associated with this alternative.

### **Common Elements Under Alternatives GW4A, GW4B, and GW8**

Alternatives GW4A, GW4B, and GW8 are relatively similar in many ways as they were considered the most promising options to eventually remediate the entire plume. For example, each of the proposed alternatives contains two separate approaches: a source area treatment and a plume barrier treatment. Each source area treatment addresses contamination through direct injection of amendments, while each plume treatment relies on barriers which would intercept mobile TCE dissolved in the groundwater. Each proposed alternative also involves the injection of commercial amendments for the purpose of degrading TCE. The primary differences between these alternatives are (1) the mechanism by

which TCE is degraded, and (2) the relative persistence of the amendment in the subsurface after delivery (for the purpose of achieving adequate distribution and treatment lifetime). Source area treatment by ISCO is common to all three Alternatives. For plume treatment, ISCR is considered in Alternative GW4A, both ISCO and ISCR are considered in Alternative GW4B, and ISCO is considered in Alternative GW8.

- **Source Area Groundwater Treatment**

All three Alternatives (GW4A, GW4B, and GW8) share a common proposal for source area treatment. This is due to the successful emplacement of potassium permanganate during the August 2011 ISCO pilot study. The use of an oxidative technology in the source area restricts the use of competing technologies in that location, including reductive or biological treatments. Furthermore, significant decreases of VOC concentrations were observed as a result of the pilot study, indicating ISCO is a viable option for this area. Under these alternatives, these borings would be arranged in a grid-like pattern as shown in Figure 5.

- **Plume Treatment**

All proposed groundwater alternatives share the planned use of permeable reactive barriers (PRBs) for plume remediation. PRBs are water permeable barriers that are installed across the flow path of a plume of affected groundwater, allowing contaminated groundwater to be treated as it moves through the barrier. Each alternative uses one onsite barrier and one or two offsite barriers. The ISCR barriers will include the emplacement of Zero Valent Iron (ZVI) and the ISCO barriers will include the emplacement of potassium permanganate.

### **GW4A: ISCO Groundwater Treatment in the Source Area with ISCR Plume Treatment**

Alternative GW4A uses three ISCR barriers for plume treatment. An ISCR amendment (solid ZVI) would be used for plume treatment downgradient. Three permeable reactive ZVI barriers would be installed: one onsite along the access road extending to the west and north from the existing ZVI pilot study barrier (Barrier A), one offsite along Mauldin Road (Barrier B), and one near MW-19 close to the river (Barrier C), as shown on Figure 6. ZVI would be injected via high pressure injections.

The net present value of this alternative is estimated at \$7,242,445 if one reinjection event is required, and \$8,102,948 if two reinjection events are required.

### **GW4B: ISCO Groundwater Treatment in the Source Area with ISCO and ISCR Plume Treatment**

Alternative GW4B uses one ISCO barrier and one ISCR barrier for plume treatment (Figure 7). The ISCR barrier is proposed in combination with an ISCO barrier since the natural Site conditions

are reducing in the low-lying areas of the plume (close to the river), and the ISCR barrier will mitigate the potential negative impact of ISCO on the river. The ISCO barrier (Barrier A) would be emplaced using the same materials and methods as the source area treatment. Barrier A would be located onsite near recovery wells RW-2 and RW-3, and would extend to the west and north along the Site access road. The ISCR barrier (Barrier B) would be located offsite near MW-19, sufficiently downgradient from the ISCO barrier. Additional re-injections may be required to maintain the barrier for a sufficient timeframe to treat this portion of the plume. Additional permanganate re-injections would significantly increase the total cost of this Alternative.

The net present value of this alternative is estimated at \$8,439,950 if one reinjection event is required, and \$11,011,485 if two reinjection events are required.

#### **GW8: ISCO Groundwater Treatment**

Alternative GW8 uses two ISCO barriers for plume treatment (Figure 8). The ISCO barriers would be emplaced using the same methods described for Barrier A in Alternative GW4B. The first ISCO barrier (Barrier A) would be the same Barrier A as described in Alternative GW4B. The second ISCO barrier (Barrier B) would be located off-Site near MW-16 and MW-17. The barrier is farther upgradient than the ISCR barrier in GW4B to lessen the likelihood of permanganate discharge to the river. Furthermore, based on the anticipated travel time between the source area and the first barrier and the expected life span of the permanganate, additional re-injections may be required to maintain the barriers for a sufficient timeframe to treat this portion of the plume. Additional permanganate re-injections would result in a significant increase in the total cost for this option.

The net present value of this alternative is estimated at \$9,689,108 if one reinjection event is required, and \$13,238,536 if two reinjection events are required.

## ***EVALUATION OF ALTERNATIVES***

The National Contingency Plan requires the Department use specific criteria to evaluate the different remediation alternatives individually and against each other in order to select a remedy. This section of the Proposed Plan profiles the relative performance of each alternative against the criteria, noting how it compares to the other options under consideration. The criteria are:

1. Overall protection of human health and the environment;
2. Compliance with ARARs;
3. Short-term effectiveness;
4. Long-term effectiveness and permanence;
5. Reduction of toxicity, mobility, or volume through treatment;
6. Implementability;

7. Cost; and
8. Community Response

## ***Comparative Analysis of Soil Alternatives***

A comparative analysis of each subsurface soil alternative was performed. Alternative S1 (No Action) was used as the baseline for comparison to the criteria outlined above.

### **Overall Protection of Human Health and the Environment**

The Risk Assessment concluded the shallow subsurface soil in the former TCE reclamation tank posed no adverse health risks. However, DHEC calculated a site-specific soil screening level for TCE of 88 µg/kg for the Protection of Groundwater. Alternative S1 (No Action) would not be capable of achieving soil RAOs. Alternative S2 (Excavation) would be capable of meeting soil RAOs in shallow soil but would not reduce contamination in deeper soil. Alternatives S4 (SVE) and S8 (Excavation plus ISCO) would be capable of meeting soil RAOs.

Alternatives S2 and S8 would require no additional future action for the shallow subsurface soil in the former TCE reclamation tank area. Alternative S2 would leave impacted soil untreated below 11 feet. Excavated material would be replaced with clean material, negating the potential for untreated residuals or a need for post-remedial action monitoring within the limits of the excavation. Alternative S8 would also achieve soil RAOs within a shorter timeframe than Alternative S4.

### **Compliance with ARARs**

In this section, the alternatives are evaluated with regard to their compliance with the following Applicable or Relevant and Appropriate Requirements (ARARs). No location-specific ARARs were identified for soil alternatives.

- Chemical-specific ARARs, including the TCE Soil Screening Level (SSL)
- Action-specific ARARs, including disposal and transportation of hazardous waste, mitigation of run-off during excavation, and air emission control

Assuming no action is taken, the elimination of future potential exposure to TCE in the shallow subsurface soil would not be met. Alternatives S2, S4, and S8 are capable of achieving the Residential TCE remedial goal in this area. Alternatives S2 and S8 would require less time to comply with ARARs than Alternative S4. Alternatives S4 and S8 are also capable of achieving the Protection of Groundwater TCE remedial goal. Alternative S2 is capable of achieving this level in shallow soil, but not in deeper soil.

### Short-Term Effectiveness

Alternative S1 does not involve any action and would not include any short-term impacts. Alternatives S2 and S8 involve the excavation of soil and could increase the potential for exposure pathways to onsite workers. This would be addressed through the development of appropriate health and safety measures, including the use of personal protective equipment (PPE). Alternative S8 also involves the potential exposure to permanganate and hazards associated with high pressure injections into the vadose zone. These would also be addressed through the development of health and safety measures and the use of PPE. Alternative S4 poses no short-term impacts to onsite workers or the community beyond that required for well installation.

### Long-Term Effectiveness and Permanence

Alternative S1, which involves no action be taken, would leave the contaminated soil in place, which may serve as a potential future exposure pathway. A small decrease in TCE concentrations would occur under Alternative S1 due to naturally occurring processes, but this alternative would not achieve subsurface soil RAOs in a reasonable timeframe. Alternatives S4 and S8 would reliably meet the Residential and Protection of Groundwater screening levels for TCE. Alternative S2 would meet these levels in shallow soil but would not affect TCE concentrations at deeper levels.

No long-term or post-remedial action monitoring, operation, or maintenance is required for Alternatives S2 or S8. The backfill material would be clean and would not require replacement. Alternative S4 would involve significant operation, monitoring, maintenance, and replacement requirements. Alternatives S4 and S8 would result in no further treatment of subsurface soils in the former TCE reclamation tank area. Alternative S2 may require further treatment of deeper subsurface soils.

### Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative S1 would provide only limited reduction in toxicity, mobility, or volume of TCE in the shallow subsurface soil in the former TCE reclamation tank area over an extended timeframe and would not eliminate future potential exposure. Alternatives S2, S4, and S8 would address the principal threats. Alternatives S2 and S8 would provide a reduction in volume of onsite contaminated soils through removal and disposal. TCE in the excavated soil would not be destroyed unless treated offsite. Alternative S8 would also treat contaminated soil at deeper intervals through permanganate emplacement. Alternative S4 would provide a reduction in toxicity of onsite contaminated soils through volatilization of TCE from the treatment area and emission to either the atmosphere or carbon filtration unit. All alternatives, except S1 (No Action), provide irreversible reductions in volume or toxicity of onsite contaminated soil.

### Implementability

Alternative S1 can be easily implemented as no action would be taken. The technologies employed in Alternatives S2, S4, and S8 have been shown to be effective at this Site previously. The construction and operation of all alternatives are reliable and there are no significant uncertainties as the treatment area is relatively small and the technologies are well established. Under Alternatives S2 and S8, the limits of the excavation would be restricted by the nearby foundation of the main building and the sloping requirements necessary to maintain the integrity of the foundation.

Equipment and personnel required for all alternatives are readily available. Excavation and transport equipment and personnel, as well as disposal facilities, are available for Alternatives S2 and S8. Permanganate and injection personnel are also available for Alternative S8. SVE blowers and emission control equipment for Alternative S4 are readily available for purchase, but they would require pilot testing, design, and permitting prior to installation.

### Cost

Alternative S1 does not include a cost estimate as no action would be involved. The total estimated cost for Alternative S2, assuming that the excavated soil and concrete can be disposed of as non-hazardous materials, is \$378,010. If the excavated materials must be disposed of as hazardous waste, the estimated cost is \$728,800. The total cost for Alternative S4 is estimated to be \$199,705. The total estimated cost for Alternative S8 is \$404,153 assuming non-hazardous disposal of excavated materials, or \$754,953 assuming hazardous disposal is necessary. Alternatives S2 and S8 include only capital costs such as construction, disposal, and project oversight. No O&M or monitoring costs are associated with Alternatives S2 and S8. Alternative S4 requires capital, O&M, and monitoring costs.

## *Comparative Analysis of Groundwater Alternatives*

A comparative analysis of each groundwater alternative was performed. Alternative GW1 (No Action) was used as the baseline for comparison to the criteria listed previously.

### Overall Protection of Human Health and the Environment

Alternative GW1 would not meet groundwater RAOs, although some reduction in the toxicity in groundwater would occur due to naturally occurring processes. A significant reduction in TCE and daughter product concentrations would not occur in a reasonable timeframe. Alternatives GW4A, GW4B, and GW8 present the best possibility for achieving groundwater RAOs in a reasonable timeframe. The proposed alternatives are relatively similar in that they each involve the injection of amendments capable of degrading TCE by oxidative or reductive mechanisms and would reduce the toxicity of contaminated groundwater. These

alternatives are considered to be essentially equal in overall protection of human health and the environment.

### **Compliance with ARARs**

In this section, the alternatives are evaluated with regard to their compliance with the following ARARs.

- Chemical-specific ARARs, including the MCLs for TCE and subsequent daughter products
- Action-specific ARARs, including the need for Underground Injection Control (UIC) permits and OSHA standards
- Location-specific ARARs, including the proximity to the wetlands and river located off-Site

Alternative GW1 would not comply with ARARs because it would not attain MCLs in a reasonable timeframe. Alternatives GW4A, GW4B, and GW8 were identified as the most probable alternatives to achieve MCLs in a reasonable timeframe. These alternatives would significantly reduce the remedial timeframe compared to Alternative GW1.

Action-specific potential ARARs include obtaining UIC permits for injection of amendments for Alternatives GW4A, GW4B, and GW8. OSHA standards would also apply to these alternatives.

The only location-specific potential ARAR concerns the protection of the off-Site wetland and Reedy River from the migration of injected amendments. All permanganate treatments have been planned at sufficient distances from the wetlands and river so impact from the permanganate should not be a concern. Surface water quality would be monitored during and after injections.

### **Short-Term Effectiveness**

Alternative GW1 poses no short-term impacts as no action is involved. Alternatives GW4A, GW4B, and GW8 pose a potential dust hazard during implementation from the mixing of ZVI or permanganate in the slurry. The permanganate requires special handling precautions. A Health and Safety Plan would be developed and implemented for each proposed alternative to minimize potential health risks.

The remedial timeframe to achieve groundwater RAOs for the proposed alternatives is uncertain. Alternatives GW4A, GW4B, or GW8 would significantly reduce the timeframe to meet RAOs compared to Alternative GW1.

### **Long-Term Effectiveness and Permanence**

Under Alternative GW1, groundwater would remain untreated. Alternatives GW4A, GW4B, and GW8 should significantly decrease TCE concentrations. The risk posed by residual TCE groundwater contamination following completion of these alternatives would be much lower than under Alternative GW1.

Long-term monitoring would be required for Alternatives GW4A, GW4B, and GW8. As described previously, MNA would eventually be incorporated into each alternative until groundwater MCLs are achieved. All injected amendments would degrade over time and long-term monitoring would include parameters necessary to evaluate the effectiveness of MNA.

Reinjection of amendments is planned at various frequencies for Alternatives GW4A, GW4B, and GW8. All alternatives assume one reinjection of solid potassium permanganate in the source area. More than one reinjection event in the barriers may be warranted based on the expected lifetime of permanganate in the subsurface, the spacing between the barriers, and the uncertainty inherent in the performance of the barriers due to subsurface heterogeneity. For comparison purposes in the FS, two cost scenarios are presented. A best case scenario for ISCO treatment assumes only one reinjection of permanganate in the ISCO barrier locations for Alternatives GW4B and GW8. Due to the high likelihood that a second reinjection will be needed, costs assuming two re-injections have been included as well. In contrast, ZVI is expected to persist for approximately 10–15 years; hence, no re-injections of ZVI are anticipated in Alternatives GW4A and GW4B.

While all action alternatives are expected to be very effective in the short-term, the long-term effectiveness varies significantly among the alternatives. The longevity of ZVI is greater than permanganate. Therefore, Alternative GW4A (all ZVI barriers) is expected to remain active and effective for a longer period of time than Alternatives GW4B and GW8. The shorter lifetime of the ISCO barriers would be problematic if full plume treatment did not occur while the barriers were active.

### **Reduction of Toxicity, Mobility, or Volume Through Treatment**

Alternative GW1 provides no reduction in toxicity, mobility, or volume of contaminated groundwater. Alternatives GW4A, GW4B, and GW8 would address the principal threat of TCE in groundwater and provide a reduction in the toxicity of groundwater through degradation of TCE. The oxidative approach used in all proposed alternatives would oxidize the contaminants to non-hazardous end products. Reductive approaches used in Alternatives GW4A and GW4B deplete plume mass through conversion of TCE to ethene. Each alternative contains a component to treat source and plume groundwater contamination. The source area treatment is intended to decrease TCE flux from the source. The plume barrier treatment is intended to shrink the size of the plume.



## Implementability

Alternative GW1 requires no action be implemented. Alternatives GW4A, GW4B, and GW8 face similar potential implementation difficulties. Each alternative requires numerous bedrock and saprolite injection wells and would require appropriate drilling and injection techniques. The methods for drilling subsurface injection are very similar among all proposed action alternatives. All of the proposed alternatives can be readily implemented. Personnel and equipment are available for the drilling and delivery of the amendments. Each of the proposed alternatives would require UIC permits prior to implementation.

## Cost

Alternative GW1 does not include a cost estimate as no action would be involved. Assuming one reinjection in areas treated by permanganate, the total groundwater remedial costs are estimated to be \$7,242,445 for Alternative GW4A, \$8,439,950 for Alternative GW4B, and \$9,689,108 for Alternative GW8. Due to the high likelihood that additional permanganate re-injections will be necessary, costs assuming two reinjection events have been included as well. If two reinjection events are required in areas treated by permanganate, the estimated costs increase to \$8,102,948 for Alternative GW4A, \$11,011,485 for Alternative GW4B, and \$13,238,536 for Alternative GW8.

## Community Response

Community acceptance of the preferred remedy will be evaluated after the public comment period ends. Public comments will be summarized and responses provided in the Responsiveness Summary Section of the Record of Decision document that will present the Department's final alternative selection. The Department may choose to modify the preferred alternative or select another based on public comments or new information.

## ***SUMMARY OF THE DEPARTMENT'S PREFERRED ALTERNATIVE***

The Department has identified a combination of alternatives to address both the soil and groundwater contamination at the Site.

**Soil:** The Department's preferred soil remedial alternative, Alternative S4, consists of the installation of an SVE system in the areas to the east and north of the former TTZ. The final details and specifications of the SVE system will be determined during the design process. An estimated \$199,705 would be required to implement this treatment technology. Alternative S4 was selected over other alternatives because it is expected to achieve substantial and long-term risk reduction, prevent further migration of contaminants from soil to groundwater, and is cost effective.

**Groundwater:** The Department's preferred groundwater remedial alternative, Alternative GW4A, involves In-Situ Chemical Oxidation (ISCO) treatment of source area groundwater and In-Situ Chemical Reduction (ISCR) treatment in the plume area. The ISCO treatment will include the injection of potassium permanganate to oxidize contaminants and render them harmless, while the ISCR treatment will include the construction of three permeable reactive ZVI barriers to degrade TCE.

The net present value of this alternative is estimated at \$7,242,445 if one reinjection event is required, and \$8,102,948 if two reinjection events are required.

Based on information currently available, the Department believes the Preferred Alternative meets the mandatory threshold criteria (Criteria 1 and 2) and provides the best balance of trade-offs among the other alternatives. The Department expects the Preferred Remedy to satisfy the following statutory requirements: 1) be protective of human health and the environment; 2) comply with applicable or relevant and appropriate requirements; 3) be cost-effective; 4) utilize permanent solutions to the maximum extent practicable; and 5) satisfy the preference for treatment as a principle element of the remedy.

## **Community Participation**

The Department will evaluate comments from the public before selecting a final alternative. A comment period has been established to allow the public an opportunity to submit written comments to the Department. The community is also invited to a public meeting where the Department will discuss the Feasibility Study results, present the preferred alternative, and accept comments on the remedial alternatives. The dates for the public comment period, the date, location, and time of the public meeting, and the locations of the Administrative Record files, are provided on the first page of this Proposed Plan.

