RECORD OF DECISION AMENDMENT

for Groundwater and Vapor Intrusion

CTS Printex, Inc. Superfund Site

Mountain View, California

U.S. Environmental Protection Agency Region 9

San Francisco, California

September 2011

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PART 1 – DECLARATION

1 Site Name and Location

This document amends the June 28, 1991 Record of Decision (1991 ROD), and addresses groundwater contamination and the vapor intrusion pathway at the CTS Printex Superfund Site (Site) located in Mountain View, California. The U.S. Environmental Protection Agency (EPA) Site Identification Number for the Site is CAD009212838.

2 Statement of Basis and Purpose

This amendment to the 1991 ROD (ROD Amendment) presents the selected remedy for groundwater contamination and the vapor intrusion pathway for the Site, in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. §§9601-9675 (CERCLA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Part 300 (NCP). The decisions set forth in this ROD Amendment are based on information contained in the Administrative Record for the Site.

EPA is the lead agency for this Site, having assumed that role from the California Regional Water Quality Control Board, San Francisco Bay Region (Regional Water Board) in 2006. The Water Board is currently the support agency. The State of California, acting through the Regional Water Board, concurs with the selected groundwater remedy and vapor intrusion remedy.

3 Assessment of the Site

The original response action for groundwater – an extraction system with discharge to sewer, selected in the 1991 ROD – successfully removed much of the contaminant mass at the Site, and was discontinued in 1996. An area with residual contaminant mass has, however, persisted in groundwater at the Site, and contaminant concentrations in groundwater remain above cleanup standards. EPA has also determined that there are potential health risks associated with long-term exposure to trichloroethene (TCE) and other Site chemicals of concern through the vapor intrusion pathway in existing and future buildings overlying that shallow groundwater contamination.

The response actions selected in this ROD Amendment are necessary to protect public health from actual or threatened releases of hazardous substances into the environment. Therefore, an amendment to the 1991 ROD is necessary.

4 Description of the Selected Remedy

The main components of the original 1991 groundwater remedy included:

- Groundwater pumping from extraction wells.
- Disposal of the contaminated groundwater to the sanitary sewer for treatment at the City of Mountain View's wastewater treatment plant.
- Groundwater monitoring.

The revised groundwater remedy replaces the original remedy (groundwater extraction and discharge) with:

- Enhanced anaerobic bioremediation for the area with residual contaminant mass near Monitoring Well 17W;
- Monitored Natural Attenuation (MNA);
- Institutional controls (ICs) to prevent the use of the contaminated groundwater at the Site and any interference with the remedial systems; and
- Monitoring.

In the event that MNA does not prove effective at reducing groundwater contamination to the cleanup levels, the selected remedy includes a contingency. If necessary, the contingency remedy – EAB treatment in areas of the Site north of Plymouth Street – will be invoked through an Explanation of Significant Differences decision document.

There are no principal threat wastes, i.e. highly toxic source materials (as defined in the NCP §300.430(a)(1)(iii)(A)), remaining at the Site. This action will address the dissolved groundwater plume which would only present a low level risk in the event of exposure.

The vapor intrusion remedy selected in this ROD Amendment addresses the potential long-term exposure risks from TCE and other chemicals of concern through the vapor intrusion pathway at the Site, which was not addressed in the 1991 ROD. At that time, less was understood about vapor intrusion, or the migration of volatile chemicals from the subsurface into overlying buildings. EPA's objective for the vapor intrusion remedy is to protect the health of current and future occupants, including workers and residents, of buildings overlying the Site's shallow subsurface contamination.

EPA's selected remedy to address the vapor intrusion pathway and ensure protection of the human health of building occupants at the Site consists of the following:

- For Existing Buildings
    - South of Plymouth Street
        - Passive Sub-slab Ventilation with Vapor Barrier, and ICs (already implemented) and Monitoring. The ICs will consist of:
            - Environmental Restriction Covenant (already recorded).
    - North of Plymouth Street Area
        - No engineering control; ICs only. The ICs consist of:
            - Planning, permitting, and building requirements to install appropriate engineering controls in future construction
- For New Construction/Future Buildings
    - Vapor Barrier with Passive Sub-slab/Sub-membrane Ventilation, Monitoring, ICs (with ability to convert to Active Ventilation) and Monitoring. The ICs consist of:
        - Permitting and building requirements to install appropriate engineering controls.
        - Environmental Restriction Covenant

- Where lines of evidence collected at the time of new construction indicate that there is no potential for vapor intrusion resulting in indoor air concentrations above indoor air cleanup levels;
    - Upon confirmation and with EPA approval, no further action required.

5 Statutory Determinations

The selected remedies for groundwater and vapor intrusion, and if necessary, the contingency remedy, are protective of human health and the environment, comply with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, are cost-effective, and utilize permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. For the groundwater remedy, the application of enhanced anaerobic bioremediation to the area with residual contaminant mass satisfies the statutory preference for treatment as a principal element of the remedy which permanently and significantly reduces the toxicity, mobility, or volume of hazardous substances. The vapor intrusion remedy does not involve active treatment and therefore does not satisfy the statutory preference for treatment as a principal element of the remedy. Unlike typical remedies to address contamination, remedies for vapor intrusion are designed to prevent exposure to the contaminants, but not necessarily designed to reduce toxicity, mobility, and volume through treatment.

The remedies selected in this ROD Amendment will result in attainment of remedial action objectives and cleanup levels such that the affected properties will be available for unlimited use and unrestricted exposure. However, because the remedies will take more than five years to attain those goals, a policy review will continue to be conducted a minimum of every five years to ensure that the Site groundwater and vapor intrusion remedies are, or will be, protective of human health and the environment.

6 ROD Data Certification Checklist

The following information is included in Part 2 (Decision Summary) of this ROD Amendment. Additional information can be found in the Administrative Record file for the Site.

- Chemicals of concern and their respective concentrations in groundwater (Table 1 in Section 8) and in indoor air and sub-slab soil gas (Section 7).
- Baseline risk represented by the chemicals of concern (Section 7).
- Cleanup levels established for chemicals of concern and the basis for these levels (Section 8).
- Source materials were addressed in 1991 ROD, thus no principal threat waste remains at the Site (Section 11).
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and this ROD Amendment (Section 6).
- Potential land and groundwater use that will be available at the Site as a result of the Selected Remedy (Section 12).

- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 9.1 and Section 9.2).
- Key factors that led to selecting the remedy (i.e., describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 12.1, Section 12.2, and Section 14).

7 Authorizing Signature

This ROD Amendment documents the selected remedies for groundwater and the vapor intrusion pathway at the CTS Printex Site. EPA selected these remedies with the concurrence of the State of California, acting through the San Francisco Bay Regional Water Quality Control Board. The Director of the Superfund Division has delegated to the undersigned the authority to approve and sign this ROD Amendment.

Lynn Suer for Kathleen Salyer 9/30/11

Kathleen Salyer Date
Assistant Director
California Site Cleanup Branch, Superfund Division
U.S. Environmental Protection Agency Region 9

PART 2 – DECISION SUMMARY

This Decision Summary provides a description of the site-specific factors, supplemental investigations, remedial alternatives evaluated, and analysis of those options that led to the selection of the groundwater remedy and the vapor intrusion remedy for the CTS Printex Superfund Site (referred to as the "Site"). This Decision Summary also summarizes the groundwater and vapor intrusion remedies that EPA has selected and explains how each remedy fulfills the statutory and regulatory requirements.

1 Site Name, Location, and Brief Description

This document is an amendment to the 1991 Record of Decision (1991 ROD) for the Site, located in Mountain View, California (**Figure 1.** Site Location Map). The EPA Site Identification Number is CAD009212838.

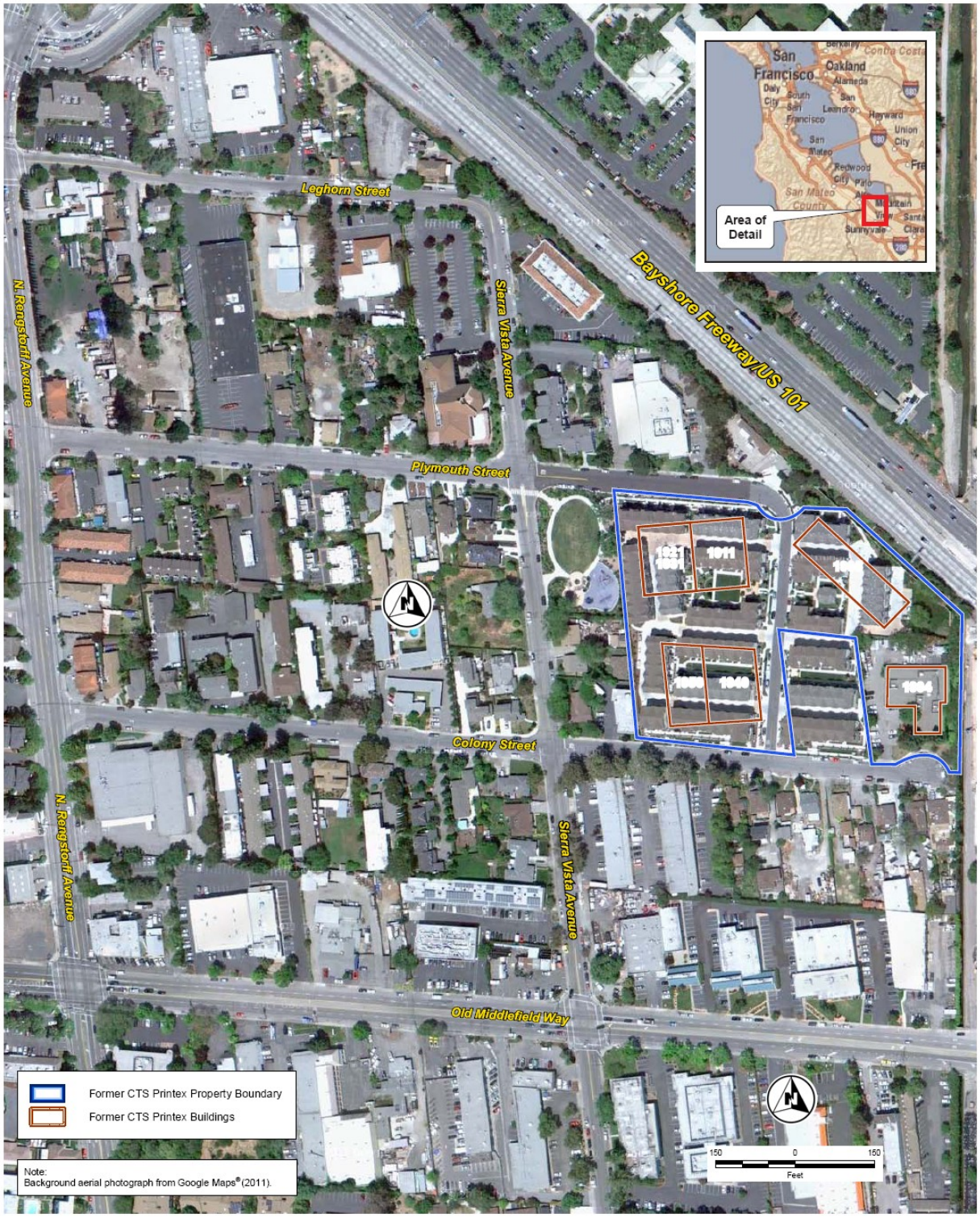
The former CTS Printex facility was located on property bounded by Colony Street on the South, Plymouth Street on the north, Sierra Vista Avenue on the west, and U.S. Highway 101 (Bayshore Freeway) on the east. The Site boundaries are defined by the extent of the underlying groundwater contamination. The land use includes commercial/light industrial and residential.

EPA is the lead agency for this Site, having assumed that role from the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board) in 2006. The Water Board is currently the State support agency.

2 Site History and Enforcement Activities

CTS Printex, and its corporate predecessor, operated a printed circuit board manufacturing facility on a portion of the Site between 1970 and 1985. Those operations involved use of various VOCs, including trichloroethene (TCE), which impacted soils and groundwater on and off the property. In 1985, prior to shutting down operations at the facility, CTS Printex initiated a site investigation, in cooperation with the Water Board and other state and local agencies. When the investigation revealed soil and groundwater contamination, the Water Board pursued enforcement actions, requiring the potentially responsible parties to address the contamination.

Over the next several years, the Water Board issued a number of Cleanup and Abatement Orders (CAOs) regarding the Site, culminating in 1990 with CAO 90-14, which required continued operation and maintenance of the already-operational groundwater extraction system. EPA placed the Site on the National Priorities List (NPL) in 1990, and then issued the 1991 ROD selecting the groundwater remedy, which included continued operation of groundwater extraction and sewer discharge until achievement of cleanup levels. Pursuant to a cooperative agreement with EPA, the Water Board continued the role of lead agency for enforcement of Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. §§9601-9675 (CERCLA).



CTS Printex Superfund Site
Mountain View, California

FIGURE 1
CTS Printex Site Location

After nearly a decade of operation, the groundwater extraction system was shut down in 1996, based on the Water Board's determination that the system was no longer effective. Between 1987 and 1996, the system successfully removed approximately 100 pounds of TCE from 106 million gallons of groundwater and reduced the lateral extent of the TCE groundwater plume in the two shallowest groundwater aquifer zones, referred to as the "A and B zones." By 1996, however, the rate of TCE removal had dropped significantly. No CERCLA decision document was prepared at that time.

The second five-year review report for the Site was issued in 2005 and recommended that a ROD Amendment be prepared to include institutional controls prohibiting the use of contaminated shallow groundwater and to evaluate the potential vapor intrusion pathway. In 2006, EPA assumed the role of lead regulatory, and the Water Board is now the support agency. Annual groundwater monitoring continues at the Site.

3 Community Participation

The Supplemental Remedial Investigation and Feasibility Study reports for groundwater and vapor intrusion were made available to the public on May 29, 2011. On June 2, 2011, EPA issued the Proposed Plan and announced the availability of the Supplemental Remedial Investigation and Feasibility reports and Administrative Record file for review at the information repositories at the Mountain View Public Library and the EPA Superfund Records Center in San Francisco. Electronic copies of the documents were also made available on EPA Region 9's website: www.epa.gov/region9/ctsprintex. Copies of the Proposed Plan were e-mailed and delivered door-to-door to residents, property owners, and other interested parties. Also, a notice was published in the Mountain View Voice newspaper on June 3, 2011; the notice summarized the Proposed Plan and announced the public meeting and public comment period.

A 30-day public comment period began on June 3, 2011. In response to a request for additional time, the public comment period was extended to July 8, 2011. EPA held a public meeting on June 15, 2011, at the Mountain View City Hall, and approximately 12 people attended.

Comments made at the June 15th public meeting and written comments received during the public comment period are included in the Administrative Record file. EPA's summary of responses to those comments is included in Part 3 (Responsiveness Summary) of this ROD Amendment.

EPA has complied with the community involvement requirements set forth in CERCLA Section 117 and NCP Section 300.435(c)(2)(ii) in the process of preparing this ROD Amendment.

4 Scope and Role of Response Action

This ROD Amendment selects two remedies: a revised groundwater remedy and a new vapor intrusion remedy. The purpose of the selected groundwater response action is to address the remaining groundwater contamination and to achieve groundwater cleanup levels, i.e., drinking water standards.

The purpose of the selected response actions for the vapor intrusion pathway is to minimize or eliminate human exposure to vapor intrusion associated with the remaining groundwater contamination.

5 Site Characteristics

In the Site vicinity, groundwater generally flows to the northwest towards San Francisco Bay. Groundwater contamination at the Site is generally found in two distinct shallow water-bearing zones: the A zone and the B zone. The A zone is approximately 10 to 20 feet below ground surface (bgs), and the B zone is approximately 30 to 40 feet bgs. Shallow groundwater is currently not used for drinking water or other beneficial uses.

The 1991 ROD identified the following Site contaminants of concern (COCs): TCE; 1,1-dichloroethane (1,1-DCA); 1,1-dichloroethene (1,1-DCE); 1,2-dichloroethane (1,2-DCA); trans-1,2-dichloroethene (trans-1,2-DCE); tetrachloroethylene (PCE); toluene; 1,1,1-trichloroethane (1,1,1-TCA); methylene chloride; chloroform; and benzene. For many of these COCs cleanup levels have been met, therefore, the COCs identified in the 1991 ROD have been revised (Table 1) to reflect over 20 years of monitoring data. TCE is the primary COC at the Site and the maximum concentration detected in 2010 is 79 µg/l.

Table 1. Cleanup Levels for Chemicals of Concern in Groundwater
CTS Superfund Site, Mountain View, California

Chemical	Maximum Concentration Detected in 2010 (µg/L)	Cleanup Level (µg/L)
TCE	79	5
cis-1,2-DCE[1]	340	6
trans-1,2-DCE	11	10
1,1-DCE	33	6
1,1-DCA	31	5
Vinyl Chloride[1]	0.25	0.5

Notes: [1] Chemicals added as COCs by this ROD Amendment.

VOCs currently at concentrations above their respective Site cleanup levels, known as maximum contaminant levels (MCLs), are TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and 1,1-DCA. Due to its potential to be formed by the degradation of TCE or 1,2-DCE, vinyl chloride is also considered a chemical of potential concern in shallow groundwater at the Site. EPA is adding two COCs: cis-1,2-DCE since it is the main transformation/breakdown product of TCE; and vinyl chloride due to its potential to form from degradation of TCE or cis-1,2-DCE. **Figure 2** shows the estimated current (2010) extent of the shallow TCE groundwater plume.

Figure 2. Extent of the TCE Plume in Shallow Groundwater

5.1 Supplemental Remedial Investigation

Scope of the Supplemental Remedial Investigation

EPA conducted supplemental groundwater and vapor intrusion investigations at the Site in 2010 to gather the information necessary to evaluate remedial alternatives for groundwater and vapor intrusion. All data used to define residual contamination in shallow groundwater and to evaluate the potential vapor intrusion pathway at the Site were described in the *Supplemental Remedial Investigation Report, CTS Printex Superfund Site, May 2011*. Collectively, these data were used to assess potential health risks from Site contamination.

Findings of the Supplemental Remedial Investigation

***Groundwater*:** EPA found no current complete exposure pathway that could threaten human health or the environment. Groundwater VOC concentrations are generally decreasing and for most parts of the Site the contaminant plume has decreased in size. However, groundwater VOC concentrations remain above cleanup levels defined in the 1991 ROD. In addition, Monitoring Well 17W, located downgradient of the former source area, has elevated VOC concentrations exceeding groundwater cleanup levels relative to other portions of the Site. This mass of

residual VOC contamination is situated in an area where the A and B zones appear to connect at depths of 15 to 30 feet bgs. It is likely this residual mass will continue to contribute contaminants to the A and B zones.

The biological transformation or degradation process primarily responsible for the formation of cis-1,2-DCE and vinyl chloride from TCE is referred to as reductive dechlorination. For the more highly chlorinated ethenes, such as TCE, reductive dechlorination degradation occurs more rapidly than the biological transformations of less chlorinated ethenes (cis-1,2-DCE and vinyl chloride). The presence of cis-1,2-DCE in the shallow groundwater at the Site indicates that biological transformation by reductive dechlorination is occurring. Oxidation-reduction potential (ORP) measurements collected during the Supplemental Remedial Investigation indicate conditions suitable for the biochemical reactions associated with reductive dechlorination. Although the low concentrations of vinyl chloride may suggest that degradation from 1,2-DCE to vinyl chloride is limited at some areas of the Site, vinyl chloride biological transformation also occurs under aerobic conditions. The variation of dissolved oxygen concentrations and ORP measurements in groundwater at the Site suggest that vinyl chloride may be subject to aerobic biodegradation.

Groundwater monitoring data suggests natural attenuation is occurring, that is, physical, chemical, and/or biological processes are reducing the mass, toxicity, mobility, volume, and concentration of contaminants in shallow groundwater. EPA evaluated two separate lines of evidence (trends in TCE and 1,2-DCE concentration levels and predictive modeling[1]) to indicate that MNA in low concentration portions of the plume would be successful in attaining groundwater remediation objectives (See Appendices A,B and C). Although there is some uncertainty demonstrated by fluctuating concentrations in the monitoring data, most likely due to matrix effects within the subsurface, COC concentrations throughout the plume initially increased following groundwater extraction followed by a general decline from 1997 to 2010 suggesting initial sorption followed by volatilization and biotic transformations. The subsurface hydrogeology is complex and COC concentrations at the Site have generally shown periods of unpredictability demonstrated by concentration fluctuations from year-to-year since the system was turned off in 1996.

For example, at monitoring well 23W located in the A-zone water bearing unit at the leading edge of the plume, the TCE concentration initially increased from 8.6 to 30 µg/l, after pumping ended in 1996, then dropped in December 1997 to 5.2 µg/l. The median TCE concentration since 1997 is 6 µg/l, just above the cleanup level of 5 ug/l. TCE concentrations are stable based on the Mann-Kendall Trend Test Analysis (Level of Significance = 0.05). The median concentration of 1,2-DCE (total of both cis and trans isomers) is 13.5 µg/l and concentrations are stable i.e., no significant trend, based on the Mann-Kendall Trend Test.

At the leading edge of the plume in the B-zone, the median TCE concentration over the same 12-year monitoring period at monitoring well 22W is 5.5 µg/l which is also just above the cleanup level for TCE of 5 ug/l. However, TCE concentrations appear to be trending upward based on

[1] *See* also *Final Focused Feasibility Study, Part II: Groundwater*, Appendices A, B, F, and G (May 2011).

the Mann-Kendall Trend Test Analysis. Conversely, the median 1,2-DCE concentration is 4.2 µg/l, which is below the cleanup level of 6 µg/l for cis-1,2-DCE. In addition, 1,2-DCE concentrations are trending downward (Mann-Kendall Trend Test, LOS = 0.05).

Over the same time period, monitoring well 33W located in the A-zone water bearing unit at the leading edge of the plume, the TCE concentration has varied between 2.6 and 6.6 µg/l after pumping ended in 1996. The median TCE concentration is 5.5 µg/l, just above the cleanup level of 5 ug/l. TCE concentrations are stable based on the Mann-Kendall Trend Test Analysis (Level of Significance = 0.05). The median concentration of 1,2-DCE (total of both cis and trans isomers) is 3.2 µg/l and concentrations are stable based on the Mann-Kendall Trend Test.

Also in the A-zone, monitoring well 20W, the TCE concentration has fluctuated between 1.9 and 46 µg/l since 1997. The median TCE concentration is 20.5 µg/l and the TCE concentrations are stable based on the Mann-Kendall Trend Test Analysis (Level of Significance = 0.05). The median concentration of 1,2-DCE (total of both cis and trans isomers) is 11 µg/l and concentrations appear to be trending upward based on the Mann-Kendall Trend Test.

Thus, for areas downgradient of the residual contaminant mass around monitoring well 17W, natural attenuation alone has been able to maintain the concentrations of TCE and 1,2-DCE in monitoring wells 23W (A-zone) and 22W (B-zone) near or below the cleanup levels. Modeling estimates project that by removing the residual contaminant mass around monitoring well 17W will enable natural attenuation to effectively reduce COC concentrations in the downgradient wells, which include monitoring wells 20W, 22W, and 23W.

Groundwater data from monitoring W11 located upgradient of well 17W show median TCE and 1,2-DCE concentrations of 17.6 and 25.5 µg/l, respectively, and these concentrations have been stable since the original remedy was discontinued in 1996.

More importantly, groundwater data from samples taken at temporary wells in 2010 indicate that the contaminant plume has not migrated beyond the current groundwater monitoring network at the Site. EPA concludes that based on the Site data the plume is stable and suggests natural attenuation is occurring outside the area of residual mass.

Key findings from the Supplemental Remedial Investigation updated the Site Conceptual Model as follows: (a) the shallow groundwater plume is stable; (b) while the shallow groundwater (A and B zones) has low VOC concentrations, several chemicals have concentrations above their applicable cleanup levels; (c) the primary VOC contaminants in the shallow groundwater are TCE and cis-1,2-DCE; (d) an area of residual contaminant mass is located near well 17W at depths of 15 to 30 feet bgs (see **Figure 3**) and at maximum concentrations of 79 µg/L for TCE and 340 µg/L for 1,2-DCE, respectively; and (e) natural attenuation processes are occurring, essentially reducing the concentrations of TCE, cis-1,2-DCE and vinyl chloride.

***Vapor Intrusion Pathway*:** The Supplemental Remedial Investigation results support the following conclusions with respect to the vapor intrusion pathway.

Indoor air concentrations were below the screening criteria for indoor air or were similar to outdoor (ambient) air levels. The indoor air screening criteria used was the EPA Regional Screening Levels (RSLs) for Residential and Commercial/Industrial Indoor Air Quality of 1 microgram per cubic meter ($\mu g/m^3$) and 6 $\mu g/m^3$, respectively, for TCE, along with the appropriate RSLs for other VOCs detected in shallow groundwater and/or identified in the 1991 ROD. Sub-slab soil vapor concentrations for two buildings on Plymouth Street (1914 and 1924), however, were elevated, such that any future building at those locations – buildings with different foundation structures or air circulation systems – could potentially accumulate indoor air concentrations exceeding the screening criteria for TCE. As these buildings are located downgradient of the former CTS Printex facility and former source area, volatilization from the dispersed shallow VOC groundwater contamination is the likely source of the vapor concentrations in the sub-slab areas of these buildings.

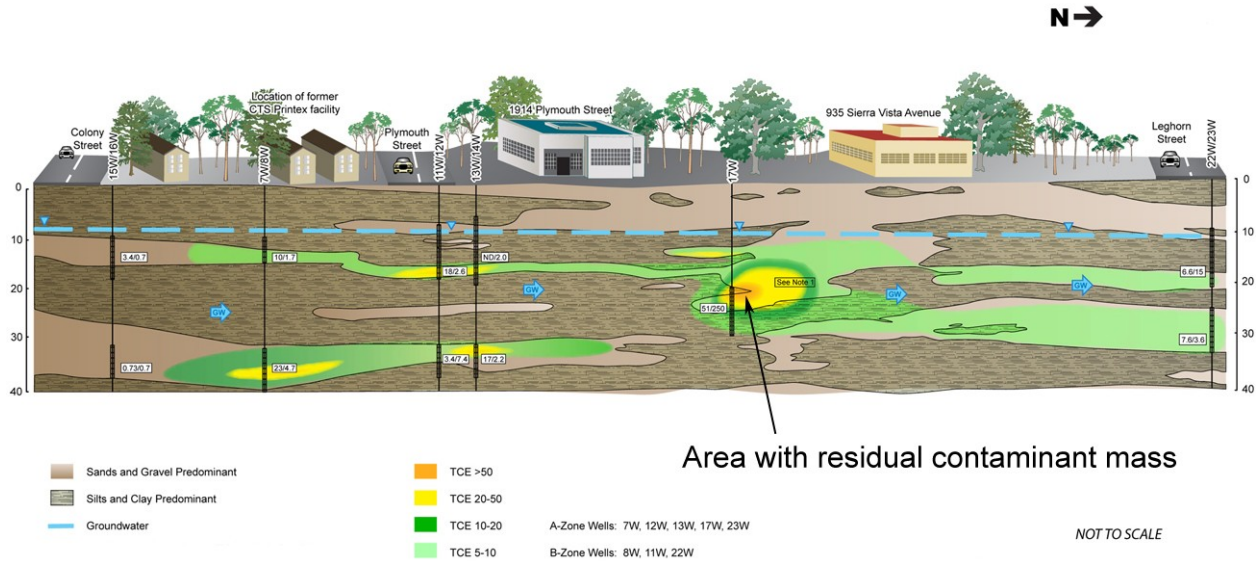


Figure 3. Location of Residual Contaminant Mass in Vicinity of Well 17W

Volatile contaminants found in shallow soils and groundwater may migrate upward through the soil as a vapor and enter into buildings through cracks in floors, plumbing/piping conduits or utility corridors. TCE found in shallow A zone groundwater is the primary source for vapor intrusion at the Site, generally defined by the area where TCE concentrations in shallow groundwater are greater than 5 micrograms per liter (µg/L), or parts per billion (ppb). Indoor air concentrations for all COCs were also below the screening criteria for commercial buildings even when the indoor air ventilation systems were not operating.

5.2 Focused Feasibility Studies for Groundwater and the Vapor Intrusion Pathway

Based on the findings of the Supplemental Remedial Investigation, the Focused Feasibility Studies for Vapor Intrusion and Groundwater (Parts 1 and 2) evaluated a range of remedial alternatives that can be used to mitigate potential vapor intrusion into existing and future buildings and clean up the contaminated groundwater.

6. Current and Potential Future Land and Resource Uses

The current land use at the Site is commercial/light industrial and residential. Based on discussions with the City of Mountain View, the reasonably anticipated future land use will remain as commercial/light industrial and residential.

Groundwater at the Site is not currently used for drinking water. Use of the groundwater beneath the former CTS Printex facility is restricted pursuant to a recorded land use covenant, and all of the groundwater in the area is subject to well standards under Santa Clara Valley Water District (SCVWD) Ordinance 90-1, which requires all wells to be sealed from the surface to 50 feet bgs at minmum.

Although groundwater at the Site is not currently used for drinking water or other beneficial uses, the Water Board has designated drinking water as a potential beneficial use for the Santa Clara Valley Basin, as documented in the San Francisco Bay Basin, Water Quality Control Plan (Basin Plan). Based on this designated beneficial use, groundwater at the Site must be cleaned up to drinking water standards which are the health protective MCLs. The CTS Printex Site is not located in an environmentally sensitive area.

7 Summary of Site Risks

This section presents a brief summary of Site risks for groundwater and vapor intrusion and the bases for taking the response actions to address the groundwater and vapor intrusion pathways at the CTS Printex Site.

7.1 Shallow Groundwater

Since the original remedy (groundwater extraction and discharge to sewer) was not able to achieve cleanup levels and restore shallow groundwater to its beneficial use as a potential drinking water source (i.e., COC concentrations are greater than their respective drinking water standard), a modification to the groundwater remedy is necessary to reduce COC concentrations in shallow groundwater to meet the Remedial Action Objectives (RAOs). Since the health protective drinking water standards have not changed for the COCs listed in **Table 1**, the risk assessment presented in the 1991 ROD was not updated as part of this ROD Amendment.

7.2 Vapor Intrusion Pathway

The 1991 ROD identified the potential long-term exposure risk from TCE and other chemicals of concern through the vapor intrusion pathway, but did not develop RAOs for this pathway. In 2005, an Environmental Site Assessment was conducted at the former CTS Printex properties to evaluate whether occupants of the proposed residential redevelopment, as well as construction workers associated with the redevelopment, would be subject to unacceptable exposures to TCE

as a result of vapor intrusion. Soil and soil vapor samples were collected to evaluate potential exposure of future residents and construction workers to TCE through ingestion, dermal contact, and inhalation of dust-borne particulates and outdoor air emissions. In 2006, the properties were sold and redeveloped for residential use. As a precautionary vapor intrusion mitigation measure, vapor barriers and passive sub-slab ventilation systems were installed beneath all the buildings. Indoor air sampling was conducted prior to each building's occupancy and confirmed that subsurface vapor intrusion was not impacting indoor air quality.

As part of the supplemental remedial investigations performed in 2010, EPA conducted indoor and outdoor air sampling for the other four existing buildings (three commercial buildings and one apartment building complex) at the Site, all located north of Plymouth Street. The indoor air results were compared against outdoor "ambient" air concentrations and long-term health-based indoor air screening levels. Indoor air results for both commercial and residential building types did not exceed their respective indoor air screening levels for residential and commercial buildings. No Site COCs were detected in residential buildings. TCE was the only COC detected in indoor air in commercial buildings.

The sub-slab soil vapor TCE concentrations for two of the three commercial buildings sampled were between 2,900 and 8,500 $\mu g/m^3$. These levels indicate a potential for vapors to enter the overlying building at concentrations exceeding indoor air action levels if building type or building foundation conditions change significantly (e.g., penetrations through slab foundation, preferential pathways into the building, or new building construction).

EPA evaluated all data collected to date to assess potential vapor intrusion pathways at the Site and determined that future groundwater and land use conditions may change. Therefore, response actions are needed to ensure that occupants of any future buildings are protected from the potential or anticipated future risk of subsurface groundwater contamination migrating into buildings above indoor air cleanup levels.

Therefore, the selected vapor intrusion remedy identified in this ROD Amendment is necessary to protect the health of building occupants. The potential for vapor intrusion will be further reduced as VOC concentrations in shallow groundwater reach cleanup levels.

7.3 Indoor Air Cleanup Levels for CTS Printex Chemicals of Potential Concern

For the CTS Printex Site, EPA used Regional Risk Screening Levels (RSLs) and Site-specific information as a basis for setting Site-specific action levels and cleanup standards, where appropriate. EPA adopted the RSLs as indoor air cleanup levels for residential and commercial worker exposures.

Table 2 lists the indoor air cleanup levels for residential buildings and commercial buildings at the Site. For this Site, EPA established a TCE indoor air cleanup level of one (1) microgram per cubic meter ($\mu g/m^3$) for residential buildings, and 6 $\mu g/m^3$ for commercial/non-residential buildings. The cleanup levels for TCE in air are risk-based concentrations, set to be protective against carcinogenic risks as well as other health effects associated with long-term exposure to

TCE in residential and nonresidential workplace settings. The TCE indoor air cleanup level is set to correspond to a one-in-one million (1×10^{-6}) excess lifetime cancer risk level.

Table 2. Indoor Air Cleanup Levels for Residential & Commercial Buildings
CTS Printex Superfund Site, Mountain View, California

Chemical[1]	Indoor Air Cleanup Level ($\mu g/m^3$)		Comments
	Residential	Commercial (Non-Residential)	
1,1-DCA	2	8	Based on $1x10^{-6}$ lifetime cancer target risk
1,1-DCE	210	880	Based on non-cancer hazard index of 1
trans-1,2-DCE	63	260	Based on non-cancer hazard index of 1
cis-1,2-DCE	63	260	Not Available. Based on trans-1,2-DCE non-cancer hazard index of 1
TCE	1	6	Based on $1x10^{-6}$ lifetime cancer target risk
Vinyl Chloride*	0.2	3	Based on $1x10^{-6}$ lifetime target cancer risk

Notes: * Detected in shallow groundwater, but not at concentrations above its groundwater cleanup level.

8 Remedial Action Objectives

RAOs are specific goals for protecting human health and the environment. The 1991 ROD established the following RAO:

- Reduce levels of chemicals in groundwater and restore groundwater to its beneficial use as a potential drinking water source.

In the 1991 ROD, no RAOs for the vapor intrusion pathway were identified.

This ROD Amendment establishes two additional RAOs, one for groundwater and one for vapor intrusion:

- Accelerate the reduction of vapor intrusion from Site COCs in shallow groundwater and soil gas to levels that are protective of current and future building occupants, such that the need for a vapor intrusion remedy would be minimized or no longer necessary.
- Protect occupants of commercial and residential buildings at the Site by preventing subsurface Site contamination from migrating into indoor air above cleanup levels for long-term exposure.

9 Description of Remedial Alternatives

Alternatives are presented separately for groundwater cleanup and vapor intrusion control.

9.1 Description of Groundwater Remedial Alternatives

This section summarizes the remedial alternatives developed in the *Final Focused Feasibility Study: Part 2 – Groundwater*.

Common Elements for Groundwater Remedial Alternatives

Institutional controls, or ICs, are non-engineered instruments, such as legal and administrative controls, that help minimize the potential for human exposure to contamination and protect the integrity of an engineered remedy. ICs are intended to affect human activities in such a way as to prevent or reduce exposure to Site contaminants.

All alternatives described in the *Final Focused Feasibility Study* included the following ICs to restrict groundwater use: (1) the existing "environmental restriction" covenant for 1900 – 1950 Cambridge Drive; 841 – 862 Avery Drive; 1900 – 1932 Aberdeen Lane; 851 – 863 Donovan Way; 1900 – 1938 Newbury Drive (also known as Gables End properties, formerly the CTS Printex plant property, known as 1905, 1911, 1921, 1931 Plymouth Street and 1916, 1930, 1940, and 1950 Colony Street), Mountain View, California; and (2) SCVWD Ordinance 90-1 (restricting well drilling). The environmental restrictive covenant was recorded in 2010 and prohibits the following activities: (1) any use of the groundwater below the Gables End properties without prior written approval by EPA; (2) any activities at the Gables End properties that may impact the groundwater or interfere with groundwater monitoring conducted in accordance with remedies described in the ROD (as it may be amended) unless approved in writing by EPA; and (3) any interference with the continued operation and maintenance of the vapor intrusion prevention and monitoring systems, as described in the developer's Risk Management Plan (GeoSyntec, 2006b), and as approved by EPA as part of the Operations, Monitoring and Maintenance Plan (OMMP).

SCVWD Ordinance 90-1 is a well permitting program and requires all wells to be sealed from the surface to 50 feet bgs at minimum. In combination, these ICs prevent the use of the contaminated groundwater at the Site for drinking water. Except for Alternative 1, No Action, all alternatives included groundwater monitoring to evaluate the effectiveness of the alternative.

For each alternative except Alternative 1, No Action, the *Final Focused Feasibility Study* provided estimated timeframes to achieve cleanup levels. The estimated timeframes were based on groundwater monitoring trend analysis and computer model results. These estimates were intended strictly for comparison purposes and not to predict an exact Site cleanup time for any alternative.

Alternatives 2B, 3A, 3B, and 3C would rely on monitored natural attenuation or MNA as part or all of the remedy (Alternative 4) to restore shallow A and B zone groundwater to its future beneficial use as a source of drinking water. Natural attenuation relies on naturally occurring physical, chemical, and/or biological processes that act without treatment to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in shallow groundwater. Two

separate lines of evidence (trends in TCE and 1,2-DCE concentration levels and predictive modeling[2]) were used to indicate that MNA would be successful in attaining groundwater remediation objectives. However, EPA has determined that a contingency measure should be implemented if, after 15 years, MNA cannot be demonstrated to have achieved the cleanup levels for areas of the Site north of Plymouth Street. The contingency measure would require application of the active remediation technology described in each alternative. In addition, an enhanced groundwater monitoring program would be developed as part of MNA to demonstrate that conditions are suitable for the complete biodegradation of TCE and other VOCs and to evaluate the performance of the natural attenuation processes.

Total present worth costs for each alternative were calculated using a discount rate of 7 percent and an annual cost escalation rate of 2 percent in accordance with EPA guidance and are approximate (+50% and – 30%) based on the estimated cleanup time for each alternative.

The alternatives evaluated for groundwater were:

- Alternative 1 – No Action
- Alternative 2A – Groundwater Extraction, and Monitoring (1991 Remedy)
- Alternative 2B – Groundwater Extraction, MNA, and ICs
- Alternative 3A – In-situ Chemical Oxidation (ISCO), MNA, and ICs
- Alternative 3B – Enhanced Anaerobic Bioremediation (EAB), MNA, and ICs
- Alternative 3C – In-situ Chemical Reduction (ISCR), MNA, and ICs
- Alternative 4 – Monitored Natural Attenuation (MNA) and ICs

Alternative 1 – No Action

EPA is required to consider the no-action alternative as a baseline for comparison to the other remedial alternatives. Under this alternative, the existing land use covenant would remain in place, and no active remediation would be implemented.

Alternative 2A – Groundwater Extraction and Monitoring (1991 ROD Remedy)

Approximately nine groundwater extraction wells would be installed throughout the current extent of the plume, consistent with the original remedy, to remove contaminated shallow groundwater until cleanup levels are met. Extracted water would be discharged to the sanitary sewer for subsequent treatment at a wastewater treatment facility. The estimated time to construct this alternative is one year, and the estimated cleanup time frame is 22 years.

The estimated capital cost for Alternative 2A is $855,000, with average annual operation and maintenance (O&M) costs of $256,400. The 22-year total present worth is $4,482,000.

Alternative 2B – Groundwater Extraction, MNA, and ICs

Approximately seven groundwater extraction wells would be installed at select locations, including the area of residual contaminant mass near well 17W, to remove higher VOC

[2] See Appendices A, B, and C. Also, see *Final Focused Feasibility Study, Part II: Groundwater*, Appendices A, B, F, and G (May 2011).

concentrations. MNA would be used in areas of low VOC groundwater concentrations not subject to groundwater extraction. An enhanced groundwater monitoring program would be included as part of MNA to confirm suitable conditions for the complete biodegradation of TCE and other VOCs and to evaluate the performance of the natural attenuation processes. The estimated time to construct this alternative is approximately one year, and the estimated length of time required to achieve cleanup is 22 years.

The estimated capital cost for Alternative 2B is $695,000, with average annual O&M costs of $228,300. The total present worth is $3,976,000.

Alternative 3A – In-situ Chemical Oxidation (ISCO), MNA, and ICs

In-situ chemical oxidation is a treatment process used to convert contaminants such as TCE into water, carbon dioxide, and chloride salts. ISCO would require injection of an oxidant (a chemical that produces a reaction) into shallow groundwater within the area with residual contaminant mass located in the vicinity of monitoring well 17W (see **Figure 3**). To achieve a reasonably uniform delivery of the oxidant, an injection grid layout would be established across the treatment area (approximately 7,000 sq. ft). For the rest of the plume, i.e., outside the area of residual mass, reduction of contaminant concentrations in shallow groundwater would occur by MNA. If, after 15 years, MNA has not reduced COC concentrations to the cleanup levels north of Plymouth Street, then ISCO would be applied to those areas as well.

For the area with active ISCO treatment, the time required to achieve cleanup levels is estimated at less than one year. For other portions of the plume outside the active treatment zone, and under MNA, the estimated time to achieve cleanup levels by natural attenuation is approximately 15 years.

The estimated capital cost for Alternative 3A is $2,365,000, with average annual O&M costs of $68,500. The total present worth is $3,197,000 over the 15-year timeframe.

Alternative 3B – Enhanced Anaerobic Bioremediation, MNA, and ICs (EPA's Selected Alternative)

Enhanced anaerobic bioremediation (EAB) consists of adding a suitable chemical substrate (e.g., lactate, emulsified oils, molasses, ethanol, etc.) and bacteria throughout the shallow groundwater in the area with residual contaminant mass located in the vicinity of well 17W (see **Figure 3**). Under suitable anaerobic (without oxygen) conditions, the VOCs in groundwater will biodegrade to intermediate by-products, and then eventually to nontoxic end products. To distribute the substrate and bacteria throughout the treatment area (approximately 7,000 sq. ft), a flushing or recirculation system is created by extracting groundwater and then re-injecting this groundwater. For the rest of the plume, i.e., outside the area of residual mass, reduction of contaminant concentrations in shallow groundwater would occur by MNA. If, after 15 years, MNA has not reduced COC concentrations to the cleanup levels north of Plymouth Street, then EAB would be applied to those areas as well.

The time required to achieve the MCLs in the area of active EAB remediation is approximately two to four years. For areas using natural attenuation, the estimated time to achieve cleanup levels is approximately 15 years.

Alternative 3B has an estimated capital cost of $859,000, with average annual O&M costs of $72,900. The total present worth is $1,766,000 over the 15-year timeframe.

Alternative 3C – In-situ Chemical Reduction (ISCR), MNA, and ICs

Zero-valent iron, such as cast iron particles, can chemically reduce TCE and the other VOCs to intermediate by-products and eventually to harmless end products. Similar to Alternative 3A, this alternative would involve injecting a solution containing zero-valent iron into shallow groundwater in the area with residual contaminate mass located in the vicinity of well 17W (see **Figure 3**). For the rest of the plume, i.e., outside the area of residual mass, reduction of contaminant concentrations in shallow groundwater would occur by MNA. If, after 15 years, MNA has not reduced COC concentrations to the cleanup levels north of Plymouth Street, then ISCR would be applied to those areas as well.

The estimated time to complete the zero-valent iron injections is less than one year, with the length of time required to achieve cleanup levels in the treated area estimated to be less than four years. For areas using natural attenuation, the estimated time to achieve clean up levels is approximately 15 years.

The estimated capital cost for Alternative 3C is $1,542,000, with average annual O&M costs of $68,500. The total present worth is $2,374,000 over the 15-year timeframe.

Alternative 4: Monitored Natural Attenuation (MNA) and ICs

MNA alone would be used as the remedy to restore shallow A and B zone groundwater to its future beneficial use as a source of drinking water. While annual monitoring to date has indicated cleanup measures implemented at the Site have reduced the footprint of the plume and reduced concentrations of several COCs to below the MCLs, modeling projections, suggest using MNA alone may take 70 to 100 years to achieve cleanup levels[3].

Alternative 4 has no capital costs since all monitoring wells are in place. The estimated average annual O&M costs are $33,800. The total present worth is $661,000, based on a 30-year time frame.

9.2 Description of Vapor Intrusion Remedial Alternatives

This section summarizes the remedial alternatives developed in the *Final Focused Feasibility Study: Part 1 – Vapor Intrusion Pathway*.

[3] *See Final Focused Feasibility Study, Part II: Groundwater*, Appendix A (May 2011).

Common Elements for Vapor Intrusion Remedial Alternatives

Each alternative, with the exception of the no-action alternative, includes ICs and monitoring. Alternatives 3 and 4 also include an appropriate engineering control. The engineering control is the physical, operating portion of the remedy that, in this case, prevents vapors from entering an overlying building or prevents vapors from accumulating indoors at concentrations exceeding indoor air cleanup levels for long-term exposure.

As described above, ICs are non-engineered remedy components, and are included in each of the remedial alternatives for vapor intrusion, except the no-action alternative. ICs are a necessary element of this remedy and will accomplish the following goals: (1) ensure maintenance and monitoring of the engineering controls that will prevent levels of indoor contaminants associated with the vapor intrusion pathway from reaching EPA's indoor air action; (2) ensure that the appropriate engineering controls are installed as part of any new development at the Site; (3) provide information to building owners and occupants regarding the vapor intrusion remedy for each building; and (4) provide information to EPA and the Responsible Parties regarding new construction and changes of property ownership at the Site. The ICs that would be used for the Site are the following: City of Mountain View planning and building permit reviews, recorded covenants, and informational outreach. Each of these ICs can be used in combination and would be monitored for effectiveness.

An IC Implementation and Assurance Plan (ICIAP) describing monitoring activities, schedules, and task responsibilities will be prepared for the Site. Applicable ICs for each property would be included in an Operation, Maintenance, and Monitoring Plan for future (new) construction.

Building permit reviews would be conducted by the City of Mountain View – in line with the similar program recently adopted for the MEW Superfund site in Mountain View – to notify EPA and the Responsible Parties regarding new building construction at the Site. EPA will work with the City of Mountain View to formalize its planning, permitting, and tracking procedures for the Site. These procedures will include EPA approval of plans to ensure a vapor intrusion control system is part of new building construction, if warranted.

Additionally, informational tracking services may be employed to provide information regarding activities at the CTS Printex Site that could impact the vapor intrusion remedy.

Recorded environmental restriction covenants are "proprietary" ICs. An example of a recorded covenant is the covenant for the former CTS Printex facility property; that covenant prohibits all uses of the groundwater and any interference with the established vapor intrusion control system that were incorporated into the residential development. Covenants only need to be negotiated once for each property, because once recorded, they "run with the land" and are binding and permanent on subsequent property owners, unless terminated in accordance with the terms of the covenant. If mitigation is necessary, recorded covenants would be effective in informing future property owners of vapor intrusion issues and remedial requirements. Future restrictive covenants would be negotiated between property owners and the CTS Printex responsible parties, designating EPA as a third party beneficiary.

Present worth costs are calculated based on a 15 year timeframe, reflecting EPA's estimate of how long it will take to achieve cleanup levels for groundwater.

Cost estimates for Alternative 3 are based on a 7,000 square-foot commercial building. Alternative 4 costs are based on a residential building of 5,000 square feet and a commercial building of 7,000 square feet.

The alternatives evaluated for the vapor intrusion pathway were:

- Alternative 1 – No Action
- Alternative 2 – Monitoring and ICs
- Alternative 3 – Mechanical Indoor Air Ventilation and ICs
- Alternative 4 – Vapor Barrier, Sub-Slab/Sub-Membrane Passive Ventilation (with Ability to Convert to Active), Monitoring, and ICs

Alternative 1 – No Action

EPA is required to consider the no-action alternative as a baseline for comparison to other alternatives. This alternative does not include engineering controls, ICs, or monitoring for vapor intrusion.

Alternative 2 – Monitoring and Institutional Controls (ICs)

This alternative would apply to existing buildings and properties located north of Plymouth Street. The following ICs would be implemented: planning and building permit reviews, and informational outreach for all properties overlying subsurface groundwater contamination at the Site.

Building permit reviews would be conducted by the City of Mountain View (a similar program was recently adopted for the MEW Superfund site) to notify EPA and the responsible parties regarding new building construction or major building modifications at the Site. Additionally, informational tracking services may be employed to monitor and provide information regarding activities at the CTS Printex Site that could impact the vapor intrusion remedy.

There are no capital costs for this alternative, however, the annual cost of monitoring and building permit reviews is estimated between $5,000 and $15,000. If an evaluation of new construction is required, one-time monitoring costs are estimated to be $12,000. The total present worth cost for Alternative 2 is $105,000 over a 15-year timeframe.

Alternative 3 – Mechanical Indoor Air Ventilation and ICs

Mechanical indoor air ventilation systems (i.e., HVAC systems) in commercial buildings can prevent vapor intrusion and achieve indoor air quality similar to outdoor air by (1) creating a slightly higher pressure inside the building, and (2) increasing the air exchange rate to reduce indoor VOC concentrations. This alternative is only applicable to future non-residential/commercial buildings because the mechanical ventilation systems of residential buildings cannot be consistently managed and operated.

At the time of new development or new building construction, data collection activities for lines of evidence, i.e., groundwater monitoring, soil gas samples, confirmatory indoor air samples, etc., may be necessary to evaluate the potential for vapor intrusion.

Initial capital costs to install an HVAC system for a new commercial building are not included since HVAC systems are required by law and building code. However, incremental costs for an enhanced HVAC system were estimated for a 7,000 square-foot future commercial building, comparable to existing commercial building sizes at the Site. The incremental capital cost for a ventilation system for a 7,000-square-foot commercial building is estimated to be $4,000. Annual costs are estimated to be $13,300. The total present worth cost for Alternative 3 is $150,000 over a 15-year timeframe.

Alternative 4 – Vapor Barrier, Sub-Slab/Sub-Membrane Passive/Potentially Active Ventilation, Monitoring, and ICs

This alternative consists of a vapor barrier and a passive, sub-slab ventilation system that could be converted to an active ventilation system. A passive sub-slab ventilation system relies on slight pressure differences to force contaminant vapors to flow away from the building enclosure rather than allowing them to enter from beneath the building foundation. The passive sub-slab ventilation system would consist of: (1) a gravel and/or sand layer with perforated pipe for vapor collection, (2) solid piping in vertical risers that vent to the atmosphere; and (3) a wind-driven turbine located on top of each riser to generate a slight negative pressure at the vapor collection area. This alternative requires installation of a vapor barrier to prevent soil vapors from entering through the building foundation. Post-construction indoor air monitoring would be conducted prior to building occupancy, and periodic inspections would be made to verify the integrity and effectiveness of the alternative's components.

A recorded environmental restrictive covenant would be required to prohibit interference with the operation and maintenance of the vapor intrusion control system and would be effective in informing future property owners of vapor intrusion issues and remedial requirements.

At the time of new development or new building construction, data collection activities for lines of evidence, i.e., groundwater monitoring, soil gas samples, confirmatory indoor air samples, etc., may be necessary to evaluate the potential for vapor intrusion.

Future Residential Building: Capital costs for a future 5,000 square-foot residential building are estimated to be $75,000. Annual costs are estimated to average $2,600. The total present worth cost of Alternative 4 for a new residential structure is $105,000 over a 15-year timeframe.

Future Commercial Buildings: Capital costs for a future 7,000-square-foot commercial building are estimated to be $105,000. Annual costs are estimated to average $2,600. The present worth cost of Alternative 4 for a new commercial building is $134,000 over a 15-year timeframe.

10 Comparative Analysis of Alternatives

This section presents a comparative analysis of alternatives with respect to EPA's nine evaluation criteria listed in 40 C.F.R. § 300.430. A separate comparative analysis is provided for ground water alternatives and vapor intrusion alternatives.

10.1 Evaluation of Groundwater Alternatives

Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

All of the alternatives, except the no-action alternative, protect human health and the environment, by eliminating, reducing, or controlling risks posed by the Site through treatment, engineering controls, and institutional controls.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Section 121(d) of CERCLA requires that remedial actions at Superfund sites must attain (or the decision document must justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations, which are collectively referred to as "applicable or relevant and appropriate requirements," or "ARARs."

ARARs can be chemical-specific, action-specific, or location-specific. For example, the MCL, or drinking water standard, for TCE (5 µg/L) is a chemical-specific ARAR. All alternatives, with the exception of Alternative 1, will reduce COC concentrations below the MCL cleanup levels and would meet their respective ARARs. However, modeling projections suggest that Alternative 4, MNA, may take up to 70 years to meet cleanup levels.

Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risks and the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup levels have been met.

Each alternative provides long-term protectiveness. Contaminant removal achieved by Alternatives 2A, 2B, 3A, 3B, and 3C would achieve groundwater cleanup levels in less than 30 years; and, for Alternative 4 in 70 years. The original remedy, groundwater extraction (Alternative 2A), did not achieve groundwater cleanup levels. Therefore, both groundwater extraction alternatives 2A and 2B are less effective than Alternatives 3A, 3B, and 3C. Alternatives 3A, 3B, and 3C actively remediate groundwater in the area with residual contamination to permanently remove the COCs with comparable effectiveness and permanence to achieve cleanup levels in a reasonable timeframe.

The effectiveness of any of these alternatives would need to be evaluated as part of regular five-year reviews, as long as groundwater contaminants would remain on-site at concentrations above cleanup levels.

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

The "reduction of toxicity, mobility, or volume through treatment" criterion requires consideration of the anticipated performance of the treatment technologies that may be part of a remedy.

Alternatives 3A, 3B, and 3C would eventually transform the chemical contaminants, through treatment, to nontoxic end products effectively reducing the mobility, volume, and toxicity of groundwater contamination. Alternatives 2A and 2B would involve off-site treatment of extracted groundwater. Alternative 4 does not include treatment as a component of the remedy and, therefore, does not reduce the toxicity, mobility or volume through treatment at this Site.

Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the alternative and any adverse impacts that may affect workers, the community, or the environment during the construction and operation of the alternative until cleanup levels are achieved.

All alternatives can be implemented in a way that protects the community and workers and could be constructed in less than one year. Alternative 3A may pose potential risk to workers due to the use of chemical oxidants used for ISCO. Another aspect of short-term effectiveness is the amount of time required to achieve the remediation goals. Alternatives 2A and 2B would require approximately 20+ years to achieve the cleanup, while Alternative 4 would require up to 70 years. Alternatives 3B and 3C would require an estimated 15 years to achieve cleanup and best satisfy this criterion.

Implementability

Implementability addresses the technical and administrative feasibility of an alternative, from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Alternatives 2A, 2B, 3A, 3B, and 3C employ relatively straightforward remediation technologies which vary with regard to implementability. Because a residential complex was developed over the former source area of the Site, installing new extraction wells in this location under Alternative 2A would be difficult to implement. For Alternatives 2B, 3A, 3B, and 3C, the proposed system components are located in accessible areas. Although implementable, Alternatives 2A, 2B, 3A, 3B, and 3C would require access agreements with private property owners for installation, operation, and monitoring of the remedial system. Materials and services to install, operate, and monitor the components of the alternatives are locally available.

Cost

EPA compares each alternative based on "present worth" cost, which is a measure of the total project cost over the time frame required to achieve the cleanup goals. The estimated present worth costs for the alternatives, not including the no-action alternative, range from $661,000 for Alternative 4 to $4.4 million for Alternative 2A (see Table 3). Alternative 3B has the lowest cost among alternatives with active remediation (Alternatives 2A, 2B, 3A, 3B, and 3C). For Alternative 4, the uncertainty in the time frame to achieve cleanup levels could increase the estimated present worth cost.

Table 3. Summary of Present Worth Costs – Groundwater Alternatives
CTS Printex Superfund Site, Mountain View, California

Alternative	Present Worth (U.S. 2010 $)			
	Capital	Annual O&M	Periodic	Total
Alternative 1 – No Action	$0	$0	$0	$0
Alternative 2A – Groundwater Extraction, Monitoring, and ICs	$855,000	$3,539,000	$88,000	$4,482,000
Alternative 2B – Groundwater Extraction, MNA, and ICs	$695,000	$3,024,000	$77,000	$3,976,000
Alternative 3A – ISCO, MNA, and ICs	$2,365,000	$763,000	$69,000	$3,197,000
Alternative 3B – EAB, MNA, and ICs	$859,000	$824,000	$83,000	$1,766,000
Alternative 3C – ISCR, MNA, and ICs	$1,542,000	$763,000	$69,000	$2,374,000
Alternative 4 – MNA and ICs	$0	$585,000	$76,000	$661,000

State Acceptance

In email correspondence dated September 19, 2011, the State of California through the Regional Water Board, concurred with EPA's selected remedy to address the contaminated, shallow groundwater at the Site.

Community Acceptance

During the public comment period, the community expressed a range of opinions on the proposed alternatives. EPA received oral comments from members of the public who attended the June 2011 public meeting, and the entire transcript of the public comments is included in the Administrative Record file for the Site. EPA also received written comments from the community, including residents, property owners, and the Responsible Parties. All of the comments, along with EPA's responses to them, are presented in Part 3, Responsiveness Summary, of this ROD Amendment.

Most community members expressed their support for Alternative 3B, though several questioned the need for a contingency remedy.

10.2 Evaluation of Vapor Intrusion Alternatives

Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

Alternative 1, No Action, would not eliminate, reduce or control risk through any engineering or management controls and would not be protective of human health as long as any potential long-term exposure risk from vapor intrusion exists. Alternative 2 is protective of human health as long as the required ICs are monitored for effectiveness and additional data are generated at the time of new development. Alternatives 3 and 4 are both protective as long as the vapor intrusion control system is properly installed, designed, operated, and maintained.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Section 121(d) of CERCLA requires that remedial actions at Superfund sites must attain (or the decision document must justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations, which are collectively referred to as "applicable or relevant and appropriate requirements," or "ARARs."

When implemented along with appropriate ICs, Alternatives 2, 3, and 4 would meet their respective Federal and State ARARs. Alternative 1 would not meet ARARs.

Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence assesses the expected residual risk, the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup levels have been met, and the adequacy and reliability of controls.

Each alternative, except the no-action alternative, provides some degree of long-term protection. Alternatives 3 and 4 provide long-term effectiveness in preventing the entry of VOCs into a building at levels exceeding cleanup levels for long-term exposure. However, the long-term effectiveness and permanence of Alternative 3 would be dependent on a recorded agreement with building owners and operators to use, maintain, and monitor each buildings ventilation system as a vapor intrusion control system to meet RAOs, thus making Alternative 3 more complex and difficult to implement than the other alternatives. Alternative 4 has been demonstrated at other sites to be effective in controlling vapor intrusion in new buildings and is therefore ranked highest.

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

Reduction of toxicity, mobility, or volume through treatment analyzes the anticipated performance of the treatment technologies that may be included as part of a remedy. None of the vapor intrusion remedial alternatives meet this requirement.

Unlike typical remedial alternatives to address contamination, alternatives for vapor intrusion are not necessarily designed to reduce the toxicity, mobility, or volume through treatment of the Site contaminants, but rather are designed to prevent exposure to these contaminants. The groundwater remedy selected in this ROD Amendment addresses the source of subsurface contamination and reduces the toxicity, mobility and volume of that contamination through treatment. Treatment of the Site contaminants causing vapor intrusion will be accomplished by directly addressing the subsurface shallow groundwater contamination in accordance with the selected groundwater remedy identified below in Section 12.1.

Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the alternative and any adverse impacts that may affect workers, the community, or the environment during the construction and operation of the alternative until cleanup levels are achieved.

Alternative 2 involves no construction or field work, and, therefore, protection of workers' health is not an issue for this alternative. Alternatives 3 and 4 could be implemented in a short time frame (less than one year) and would be protective of worker's health during construction as long as standard construction procedures are implemented.

Implementability

Implementability addresses the technical and administrative feasibility of an alternative from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

For existing buildings, Alternative 2 is easily implementable. Alternatives 3 and 4 are implementable for new commercial buildings by incorporating each system's requirements into the design, construction, and operation of the new building. Alternative 3 could be difficult to implement and require consent and cooperation of the property owner to ensure the mechanical indoor air ventilation system is properly operated. Alternative 4 is easily implementable and feasible for new residential or commercial buildings. With regard to ICs, recording of agreements for each building requiring remedial action may be cumbersome but is feasible. Formalization of City of Mountain View procedures to incorporate remedy requirements for new construction is feasible, as it will essentially duplicate a set of procedures being developed for the MEW Site.

Cost

A comparison of relative costs for the alternatives is presented below for future residential and commercial buildings over a 15-year time frame. This comparison is based on the present worth costs summarized in **Table 4**.

Residential – The estimated present worth cost for a 5,000 square foot building under Alternative 4 is $105,000.

Commercial – Alternatives 3 and 4 have comparable costs for a 7,000 square foot non-residential building of $150,000 and $134,000, respectively.

Table 4. Summary of Present Worth Costs – Vapor Intrusion Alternatives[1]
CTS Printex Superfund Site, Mountain View, California

Alternative	Present Worth (U.S. 2010 $)[2]		
	Capital	Annual O&M	Total
Alternative 1 – No Action	$0	$0	$0
Alternative 2 – Institutional Controls	$0	$105,000	$105,000
Alternative 3 – Mechanical Indoor Air Ventilation and Institutional Controls	$4,000	$146,000	$150,000
Alternative 4 – Vapor Barrier, Sub-slab/Sub-membrane Passive Ventilation, and Institutional Controls	$105,000	$29,000	$134,000

[1] Costs for a new, 7,000 square foot, commercial building.
[2] Present worth based on 15 years (estimated time for groundwater clean-up selected remedy).

State Acceptance

In email correspondence dated September 19, 2011, the State of California through the Regional Water Board, concurred with EPA's selected remedy to address the potential vapor intrusion pathway at the Site.

Community Acceptance

During the public comment period, the community expressed a range of opinions on the proposed alternatives. EPA received oral comments from members of the public who attended the June 2011 public meeting and the entire transcript of the public comments is included in the Administrative Record file for the Site. EPA also received written comments from the community, including residents, property owners, and the Responsible Parties. All of the comments, along with EPA's responses to them, are presented in Part 3, Responsiveness Summary, of this ROD Amendment.

While most community members concurred with EPA's preferred vapor intrusion remedy, some stakeholders expressed an opinion that a vapor intrusion remedy was not necessary. Monitoring frequency and level of monitoring will be addressed during implementation of the remedy and part of remedial design.

11 Principal Threat Waste

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever possible. Highly toxic or highly mobile source materials that would present a significant risk to human health are generally classified as "principal threat wastes", and were addressed in the 1991 ROD, thus no principal threat waste remains at the CTS Printex Superfund Site.

12 Selected Remedy

EPA's selected remedy for groundwater is described in Section 12.1. The selected remedy for the vapor intrusion pathway uses a classification system for existing buildings and a tiered approach for future buildings as described in Section 12.2.

12.1 Groundwater

Based on information currently available, EPA believes the selected remedy for groundwater meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. As discussed further in Section 14, EPA expects the selected groundwater remedy to satisfy the following statutory requirements of CERCLA §121(b): (1) be protective of human health and the environment; (2) comply with ARARs (or justify a waiver); (3) be cost-effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element.

EPA's selected remedy is Alternative 3B: Enhanced Anaerobic Bioremediation (EAB), MNA, ICs, and Monitoring.

The revised remedy replaces the original remedy (groundwater extraction and discharge) with:

- Enhanced anaerobic bioremediation for the area with residual contaminant mass near Well 17W;
- Monitored Natural Attenuation (MNA);
- Institutional controls (ICs) to prevent the use of the contaminated groundwater at the Site and any interference with the remedial systems; and
- Monitoring.

Alternative 3B was selected because this alternative would protect human health and the environment and meet ARARs by relying on achieving suitable conditions within the treatment zone to biodegrade the VOCs in shallow groundwater to cleanup levels; the groundwater is estimated to reach cleanup levels within 15 years. Implementation of this remedy can be achieved despite the developed nature of the Site. In addition, the selected remedy described in **Table 5**:

- Achieves the cleanup goals in a reasonable time frame (approximately 15 years) and at less cost than other remedial alternatives using treatment;
- Eliminates the potential for vapor intrusion in a shorter period of time; and
- Combines active remediation with monitored natural attenuation.

Table. 5 EPA's Selected Remedy – Enhanced Anaerobic Bioremediation (EAB) with MNA

CTS Printex Superfund Site, Mountain View, California

Alternative Description:			
• Enhanced anaerobic bioremediation (EAB) would be performed to treat the area of residual chlorinated aliphatic hydrocarbon mass in the vicinity of well 17W. Monitored natural attenuation (MNA) would be applied to achieve groundwater clean-up in the other portions of the plume. Components[4] of the EAB are described below.			
• Injection of an organic substrate of sufficient mass to achieve anaerobic conditions in the treatment zone will be performed at selected points distributed throughout the treatment zone. Injection of the organic substrate would occur throughout the A and B zones, beginning at the water table (depth of 10 feet bgs) and continuing to 40 feet bgs.			
• Besides the organic substrate, a microbial amendment(s) for bioaugmentation would also be included with the organic substrate injected into the A- and B-Zones. The organic substrate with bioaugmentation will result in the complete biological transformation of the CAHs to ethene.			
• Shallow groundwater recirculation (i.e., flushing) systems would be established in each of the A- and B-Zones by installing injection and extraction wells appropriately screened for each zone. Each zone's recirculation system would include an extraction well, ability to augment the extracted groundwater with substrate or amendments, and reinjection by gravity flow at the injection wells. Organic substrate, bioaugmentation, and other amendments would be added to the water being re-injected, as needed. The flushing action of the recirculation system will enhance the distribution of the injected substrate and microbial amendments throughout the treatment zone.			
• A treatability study would be performed as part of the remedial system design to evaluate and select the actual organic substrate, appropriate nutrients, bioaugmentation requirements, and other design criteria.			
Site Characteristics:			**Comments:**
• Maximum TCE concentration	79	µg/L	Well 17W (2010 sampling event)
• Maximum cis-1,2-DCE concentration	340	µg/L	Well 17W (2010 sampling event)
• Maximum 1,1-DCA	31	µg/L	Well 17W (2010 sampling event)
• Effective porosity	30	%	Assumed
• EAB treatment area	7,700	square feet	See Figure 2
• EAB treatment depth (A and B zones)	30	feet	From top of water table (10 ft bgs) to 40 ft bgs
• EAB treatment volume (void volume)	1,950,000	liters	Calculated
Conceptual Design Components and Assumptions			
Enhance Anaerobic Bioremediation			
• Amendment, consisting of organic substrate will be delivered through injection points, with injection zone targeted from depths between 10 and 40 feet bgs.			

[4] Assumptions subject to change during Remedial Design

Table. 5 EPA's Selected Remedy – Enhanced Anaerobic Bioremediation (EAB) with MNA

CTS Printex Superfund Site, Mountain View, California

Alternative Description:	
• Separate re-circulating (i.e., flushing) systems established within A-Zone and B-Zone. The injection and extraction wells will be screened to target a specific zone, either the A- or B-Zone.	
• The re-circulation system will consist of pairs of injection wells (a pair being a well screened in the A-Zone and another well screened in the B-Zone) and 1 pair of extraction wells.	
• A laboratory bench-scale test treatability test would be performed to ascertain the necessary amendment contents and dosage.	
• Additional sampling and analysis would be performed to evaluate EAB effectiveness for the area being treated. Frequency sampling/analyses would be described in Compliance/General Monitoring	
Cleanup Goals:	
Chemical	***Cleanup Level (µg/l)***
TCE	**5**
cis-1,2-DCE	**6**
trans-1,2-DCE	**10**
1,1-DCE	**6**
1,1-DCA	**5**
Vinyl Chloride	**0.5**

The ultimate objective for the groundwater remedial action is to restore contaminated shallow groundwater to its beneficial uses as a future source of drinking water. MNA will be used in part to achieve this objective. Performance of the remedy will be monitored and EPA will evaluate the effectiveness of the selected remedy during the Five-Year-Review process.

EPA has determined that MNA is an appropriate component of the groundwater remedy for the Site based on the following factors:

- Groundwater contaminants at the Site can be effectively remediated by natural attenuation processes as suggested by a shrinking, well-defined plume boundary;
- The contaminant plume is generally stable, with the exception of fluctuating TCE and/or 1,2-DCE concentrations in wells 22W and 20W, areas downgradient from the area of residual mass near Well 17W. EPA expects the COC concentrations in these wells to decrease within the first ten to fifteen years after treatment of the residual mass near Well 17W;
- The ICs already in place will prevent any potential impacts to human health or ecological receptors;
- Groundwater is not currently used as a drinking water resource and is not expected to be used over the time period that the remedy will remain in effect, nor will groundwater

contamination exert a long-term detrimental impact on available water supplies or other environmental resources;
- MNA will be used in conjunction with active remediation and the estimated timeframe to achieve clean levels is reasonable and publically acceptable; and,
- EAB will be implemented to control the remaining residual contaminant mass near Well 17W.

Actual performance of the remedy will include a long-term monitoring program that will continue until remediation objectives have been achieved. The current monitoring program will be enhanced to include increased monitoring frequency, additional geochemical and physiochemical analyses, and the installation of an additional monitoring well downgradient from the EAB treatment zone to assess continued plume stability (i.e., to ensure that the plume is not migrating or has low potential for migration), and expected decreases in COC concentrations consistent with existing monitoring data and predictive analysis.

Although EPA expects MNA to be effective in restoring the aquifer outside of the residual contaminant area, there is some uncertainty associated with ability of MNA to achieve clean up levels after active remediation is completed. A contingency remedy is therefore appropriate here. First, the primary remedy will be implemented and given time to achieve the Remedial Action Objectives. As noted, EPA expects the EAB/MNA remedy to be effective, as demonstrated by monitoring data, within fifteen years of this ROD Amendment. However, if, at the fifteen year mark, these data instead demonstrate the following, EPA will implement the contingency remedy:

- Significant increase in levels of parent contaminants, indicating that other sources may be present;[5]
- Concentration levels of parent contaminants and/or daughter products differ significantly from current concentration trends and modeling predictions; and
- Contaminant plume for parent contaminants and daughter products increase significantly in areal or vertical extent and/or volume from that predicted by modeling estimates.

In that circumstance, EPA will issue an Explanation of Significant Differences decision document and implement EAB for those areas of the Site north of Plymouth Street.

The following ICs have already been implemented to restrict groundwater use: (1) an environmental restriction covenant for 1900 – 1950 Cambridge Drive; 841 – 862 Avery Drive; 1900 – 1932 Aberdeen Lane; 851 – 863 Donovan Way; 1900 – 1938 Newbury Drive (formerly known as 1905, 1911, 1921, 1931 Plymouth Street and 1916, 1930, 1940, and 1950 Colony Street), Mountain View, California; and (2) SCVWD Ordinance 90-1. The restrictive covenant: (1) prevents use of the groundwater below the Gables End properties to be used for any purpose without prior written approval by EPA; and (2) prohibits activities at the Gables End properties that may impact the groundwater or interfere with groundwater monitoring conducted in accordance with remedies described in the ROD (as it may be amended) unless approved in

[5] Level of Significance = 0.05.

writing by EPA. SCVWD Ordinance 90-1 is a well permitting and well construction standard program and requires all wells within the Site boundary to be sealed from the surface to 50 feet bgs at minimum. In combination, these ICs prevent the use of the contaminated groundwater at the Site for drinking water and will remain in place until cleanup levels have been achieved.

The current land use at the Site will not be affected by the selected remedy.

Summary of the Estimated Groundwater Remedy Costs

The total present worth of the selected remedy is $1,766,000 over the 15-year timeframe. The estimated capital cost is $859,000, with average annual O&M costs of $72,900. A detailed summary of the cost estimate for the selected remedy is described in Appendix D. The estimated capital cost of the contingency measure will add $118,000 to the remedy[6].

12.2 Vapor Intrusion

EPA's selected remedy will apply to buildings requiring response actions, as described herein.

The selected remedy for existing buildings located south of Plymouth Street is the installation of a Passive Sub-slab Ventilation with Vapor Barrier, ICs and Monitoring. Installation of the ventilation system and vapor barrier, and recording of an Environmental Restriction Covenant were completed in 2010. The selected remedy for existing buildings located north of Plymouth Street is the implementation of ICs consisting of: planning, permitting, and building requirements to install appropriate engineering controls in future construction. For all future buildings, EPA's selected engineered remedy is the installation of a vapor barrier and passive sub-slab ventilation system (with the ability of convert to active), monitoring, and ICs.

Based on information currently available, EPA believes the selected remedy for the vapor intrusion pathway meets the threshold criteria and provide the best balance of tradeoffs among the alternatives with respect to the balancing and modifying criteria. As discussed further in Section 14, EPA expects the selected remedy to satisfy the following statutory requirements of CERCLA §121(b): (1) be protective of human health and the environment; (2) comply with ARARs; and (3) be cost-effective. The vapor intrusion remedy does not involve active treatment and therefore does not satisfy the statutory preference for treatment as a principal element of the remedy.

Existing Buildings

To determine the appropriate level of action that would be required, EPA has classified existing properties overlying the current extent of the groundwater plume into Areas (see **Figure 4** and **Table 6**) using a multiple-lines-of-evidence approach from all data generated to date. Existing buildings located in Areas B and E have demonstrated through multiple lines of evidence that there is no potential or anticipated future risk for vapor intrusion impacting indoor air quality. Existing residential buildings, located in Area A, have an engineered remedy in place (i.e., vapor barrier with sub-slab passive ventilation system) and currently have indoor air concentrations

[6] See Appendix G for a description of the contingency remedy including detailed capital cost estimate

below EPA's cleanup level. Unless demonstrated otherwise, continued monitoring and maintenance of that engineering control is required to ensure that indoor air concentrations remain below the indoor air cleanup levels.

Figure 4. Area Classification for Vapor Intrusion

Table 6. Vapor Intrusion Response Actions for Areas of the CTS Printex Superfund Site[1,2]

Area(s)	Description	Response Action
A	Residential buildings with vapor intrusion control system installed. Confirmatory indoor air concentrations below indoor air cleanup levels.	Ensure continued maintenance and monitoring of passive sub-slab ventilation system with vapor barrier. Ensure continued inspection and maintenance under Operation, Monitoring, and Maintenance Plan. Monitor and maintain proprietary IC (Environmental Restriction Covenant).

Table 6. Vapor Intrusion Response Actions for Areas of the CTS Printex Superfund Site[1,2]

Area(s)	Description	Response Action
C, D	Commercial buildings with current indoor air concentrations below indoor air action levels. No current risk for vapor intrusion. However, buildings have not demonstrated through multiple lines of evidence that there is no potential or anticipated future risk for vapor intrusion at the property exceeding indoor air action levels.	No engineered remedy required. Implement governmental ICs to track new construction/development.
F	Undeveloped Parking Area. Property overlying plume has not demonstrated through multiple lines of evidence that there is no potential or anticipated future risk for vapor intrusion impacting indoor air quality if new buildings are constructed.	Implement governmental ICs to track new construction/development.

[1] Areas overlying shallow groundwater contamination.

[2] Area B removed since no response action was necessary.

To ensure EPA receives sufficient notice of any changes in land use or new construction, ICs are required for Areas C, D, and F (see **Figure 4**).

An IC Implementation and Assurance Plan (ICIAP) describing monitoring activities, schedules, and task responsibilities will be prepared for the Site. Building permit reviews would be conducted by the City of Mountain View (a similar program was recently adopted for the MEW Superfund site) to notify EPA and the responsible parties regarding new building construction or major building modifications at the Site. Additionally, informational tracking services may be employed to monitor and provide information regarding activities at the CTS Printex Site that could impact the vapor intrusion remedy.

In addition, a covenant and environmental restriction is in place for 1900 – 1950 Cambridge Drive; 841 – 862 Avery Drive; 1900 – 1932 Aberdeen Lane; 851 – 863 Donovan Way; 1900 – 1938 Newbury Drive (formerly known as 1905, 1911, 1921, 1931 Plymouth Street and 1916, 1930, 1940, and 1950 Colony Street), Mountain View, California to prevent interference with the operation and maintenance of all elements of the vapor intrusion prevention and monitoring systems described in the RMP (GeoSyntec, 2006b) in accordance with an EPA-approved Operations, Monitoring and Maintenance Plan (OMMP); and that the RWQCB and/or any persons acting pursuant to RWQCB orders shall have reasonable access to specified portions of the Gables End site for the purposes of inspection, surveillance, maintenance, or monitoring.

Future Buildings/New Construction

To determine the appropriate tier, multiple lines of evidence (e.g., groundwater, soil gas, etc.) will be collected and evaluated at the time of development or new construction and submitted to EPA for review. Once a building has been assigned a tier by EPA, the selected action for a building of that tier would be implemented, including engineering and institutional controls. In the absence of sufficient data, EPA will assign the building to Tier 1. Where multiple lines of evidence indicate that there is no longer the potential for vapor intrusion above indoor air cleanup levels, the proposed building would be categorized as Tier 2. For new buildings, the description of tiers and the corresponding response actions are shown in **Table 7**.

Table 7. Vapor Intrusion Response Action for Future Buildings/New Construction[1]

Tier	Description	Response Action
1	Future (new) building(s) on properties where lines of evidence indicate that there is the potential for vapor intrusion into the new building above indoor air cleanup levels[7].	• Implement Sub-slab/Sub-membrane Passive Ventilation with Vapor Barrier. • Perform confirmation indoor air sampling after construction to verify remedial action is effective. • Implement proprietary ICs.
2	Future (new) building(s) on properties where lines of evidence indicate there is no potential for vapor intrusion into the new building above indoor air cleanup levels.	Perform indoor air sampling after building is constructed to confirm that there is no potential risk and cleanup levels are met. Upon confirmation with EPA approval, then no action is required.

[1] Areas overlying shallow groundwater contamination at time of development.

Selection of Remedy for the Vapor Intrusion Pathway

EPA's selected remedy to address the vapor intrusion pathway and ensure protection of the human health of building occupants at the Site consists of the following and is also summarized in **Table 8**:

- For Existing Buildings
  - South of Plymouth Street
    - Passive Sub-slab Ventilation with Vapor Barrier, and ICs (already implemented) and Monitoring. The ICs will consist of:
      - Environmental Restriction Covenant (already recorded).
  - North of Plymouth Street Area
    - No engineering control; ICs only. The ICs consist of:

[7] See Table 2,Section 7.3

- Planning, permitting, and building requirements to install appropriate engineering controls in future construction

- For New Construction/Future Buildings
  - Vapor Barrier with Passive Sub-slab/Sub-membrane Ventilation, Monitoring, ICs (with ability to convert to Active Ventilation) and Monitoring. The ICs consist of:
  - Permitting and building requirements to install appropriate engineering controls.
  - Environmental Restriction Covenant
  - Where lines of evidence collected at the time of new construction indicate that there is no potential for vapor intrusion resulting in indoor air concentrations above indoor air cleanup levels described in **Table 2**.
    - Upon confirmation and with EPA approval, no further action required.

Table 8. EPA's Selected Remedy – Vapor Intrusion Pathway

Building Scenario	**Selected Remedy**
Existing Buildings (Commercial and Residential)	
Area A	Passive Sub-slab Ventilation with Vapor Barrier, and ICs (already implemented) and Monitoring. The ICs will consist of: • Environmental Restriction Covenant (already recorded)
Area C, D, and F[8]	No engineering control; ICs only. The ICs consist of: • Planning, permitting, and building requirements to install appropriate engineering controls in future construction.
New Buildings/New Construction (Commercial and Residential)	
Tier 1	Vapor Barrier with Passive Sub-slab/Sub-membrane Ventilation, Monitoring, ICs (with ability to convert to Active Ventilation) and Monitoring. The ICs consist of: • Permitting and building requirements to install appropriate engineering controls. • Environmental Restriction Covenant.
Tier 2	No remedy required

[8] Area F comprises a parking lot, which overlies the current extent of the contaminant plume. There is no existing building on Area F.

	Indoor Air Cleanup Level (µg/m^3)	
Chemical[1]	**Residential**	**Commercial (Non-Residential)**
1,1-DCA	2	8
1,1-DCE	210	880
trans-1,2-DCE	63	260
cis-1,2-DCE	63	260
TCE	1	6
Vinyl Chloride*	0.2	3

Notes: * Detected in shallow groundwater, but not at concentrations above its cleanup level.

An IC Implementation and Assurance Plan (ICIAP) describing monitoring activities, schedules, and task responsibilities will be prepared for the Site. Building permit reviews will be conducted by the City of Mountain View (a similar program was recently adopted for the MEW Superfund site) to notify EPA and the responsible parties regarding new building construction or major building modifications at the Site. Additionally, informational tracking services may be employed to monitor and provide information regarding activities at the CTS Printex Site that could impact the vapor intrusion remedy. A recorded environmental restrictive covenant would be required to prohibit interference with the operation and maintenance of the vapor intrusion control system and would be effective in informing future property owners of vapor intrusion issues and remedial requirements.

The covenant and environmental restriction will remain in place for 1900 – 1950 Cambridge Drive; 841 – 862 Avery Drive; 1900 – 1932 Aberdeen Lane; 851 – 863 Donovan Way; 1900 – 1938 Newbury Drive (formerly known as 1905, 1911, 1921, 1931 Plymouth Street and 1916, 1930, 1940, and 1950 Colony Street), Mountain View, California, that prohibits interference with the operation and maintenance of all elements of the vapor intrusion prevention and monitoring systems described in the RMP (GeoSyntec, 2006b) in accordance with an EPA-approved Operations, Monitoring and Maintenance Plan (OMMP); and that the RWQCB and/or any persons acting pursuant to RWQCB orders shall have reasonable access to specified portions of the Gables End site for the purposes of inspection, surveillance, maintenance, or monitoring.

At the time of new development or new building construction, data collection activities for lines of evidence to evaluate the potential for vapor intrusion may consist of groundwater monitoring, soil gas samples, and confirmatory indoor air samples.

Summary of the Estimated Vapor Intrusion Remedy Costs

The 15-year present worth costs of the selected remedy vary by application and if engineering controls are needed for future residential and/or non-residential buildings. Capital costs for a future 5,000 square-foot residential building are estimated to be $75,000. Annual costs are

estimated to average $2,600. The total present worth cost of the selected remedy is $105,000 for a 5,000 square-foot residential building over a 15-year timeframe. For future non-residential/commercial buildings: Capital costs for a future 7,000-square-foot commercial building are estimated to be $105,000. Annual costs are estimated to average $2,600. The present worth cost of the remedy for a new commercial building is $134,000 over a 15-year timeframe. A detailed summary of the cost estimate for the selected remedy is provided in Appendix E.

13 Applicable or Relevant and Appropriate Requirements (ARARs)

Section 121(d) of CERCLA requires that remedial actions at Superfund sites achieve (or justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate. This section selects the ARARs with regard to this Site's groundwater and vapor intrusion remedy.

"Applicable requirements" are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address the circumstance at a CERCLA Site. An applicable federal requirement is an ARAR. An applicable state requirement is an ARAR only if it is more stringent than federal ARARs.

If the requirement is not legally applicable, then the requirement is evaluated to determine whether it is relevant and appropriate. "Relevant and appropriate requirements" are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable, address situations or problems similar to the circumstances of the proposed response action and are well suited to the conditions of the site. A requirement must be determined to be both relevant and appropriate in order to be considered an ARAR.

An ARAR may be either "applicable" or "relevant and appropriate," but cannot be both. Identification of ARARs must be done on a site-specific basis and involve a two-part analysis: first, a determination whether a given requirement is applicable; then, if it is not applicable, a determination whether it is nevertheless both relevant and appropriate. When a determination is made that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable. If there is not a specific federal or state ARAR for a particular remedial action, then other criteria or guidelines may be identified as "to be considered" (TBC) criteria. Where EPA determines that TBC criteria are necessary to ensure the protection of human health and the environment, they become mandatory elements of the remedy, equivalent to ARARs.

ARARs fall into three categories: chemical-specific, location-specific, and action-specific requirements. Chemical-specific ARARs are health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. Location-specific ARARs set restrictions on certain types of activities based on characteristics of

the site locale. Action-specific ARARs govern particular activities or technologies involved in a remedy and aim to control discrete actions.

13.1 Groundwater ARARs

Chemical-specific ARARs

Safe Drinking Water Act Regulations, 40 C.F.R. §§ 141.24 and 141.61; California Safe Drinking Water Regulations, 22 California Code of Regulations § 64444: The Safe Drinking Water Act (SDWA) regulations, 40 C.F.R. Part 141, establish national primary drinking water standards, referred to as maximum contaminant level goals (MCLGs) and maximum contaminant levels (MCLs), to protect the quality of water in public water systems. The NCP requires that remedial actions for both surface water and groundwater attain any "relevant and appropriate" MCLGs with values *above* zero. 40 C.F.R. § 300.430(e)(2)(i)(B). When the MCLGs are set *at* zero, which is generally the case for a chemical considered to be a carcinogen, the MCL for that contaminant becomes the chemical-specific ARAR instead, where relevant and appropriate. 40 C.F.R. § 300.430(e)(2)(i)(C).

MCLs (and MCLGs) are relevant and appropriate for remedies that involve water which may be used for drinking. Pursuant to the San Francisco Bay Basin, Water Quality Control Plan (Basin Plan), discussed further below, California has established drinking water as a beneficial use of the Site groundwater. Therefore, MCLs are relevant and appropriate to the selected groundwater remedy.

California drinking water standards, under the SDWA, establish primary MCLs for public water systems. If a California drinking water MCL is more stringent than a federal MCL for a specific COC, then the more stringent MCLs was chosen as the potential ARAR. The remedial action objectives based on the MCLs for COCs at the Site are listed in **Table 1**. SDWA also requires monitoring to determine compliance with the MCLs.

State Water Resources Control Board, Resolution No. 68-16: Resolution 68-16, also known as the Anti-degradation Policy, requires that high quality waters of the State be maintained or restored, to the maximum extent practicable. Any action that would degrade water quality will be allowed only if the following conditions are met: the action is "consistent with the maximum benefit to the people of the State," does not unreasonably affect present and anticipated beneficial uses, and does not result in water quality less than that prescribed in the policies of the Water Board and the State Water Resources Control Board. Where degradation is allowed, the discharge must meet best practicable treatment or control, which must prevent pollution or nuisance and result in the highest water quality consistent with maximum benefit to the people of the State. Resolution 68-16 is applicable to the selected remedy, which is designed to restore groundwater quality at the Site.

State Water Resources Control Board, Resolution No. 92-49, III-G: Section III-G of this resolution requires cleanup and abatement of the effects of discharges in a manner that promotes attainment of either background water quality or the best water quality which is reasonable. This resolution has the objective of maintaining high-quality waters of the State. Any cleanup level that is less stringent than background must consistent with the maximum benefit to the people of

California, not unreasonable affect anticipated use of the water, and not result in water quality less than that prescribed in Water Quality Control Plans and policies of the State and Regional Water Boards. SWRCB Resolution No. 92-49, Section III-G, is relevant and appropriate. For purposes of this remedy, selection of the MCLs satisfies these requirements.

San Francisco Bay Basin, Water Quality Control Plan (Basin Plan), Chapters 2 and 3: The State of California established water quality objectives for the protection of groundwater (and surface water) under the Porter-Cologne Water Quality Control Act. Specifically, the Water Board's Basin Plan (last amended on December 31, 2010) established in Chapter 2, Section 2.2.2, that the beneficial uses of the groundwater basins within the Site boundaries include drinking water, and established in Chapter 3, Section 3.4, water quality objectives for groundwater. The substantive provisions of the Basin Plan, Sections 2.2.2 and 3.4, are applicable to the selected remedy.

Location-specific ARARs

None identified

Action-specific ARARs

Underground Injection Control, Safe Drinking Water Act, 42 U.S.C. § 300f-300j, 40 C.F.R. §§ 144.82, 144.83, 146.10: Parts 144 through 148 of 40 C.F.R. regulate underground injection and are designed to protect groundwater from contamination by subsurface emplacement of fluids. The substantive provisions of Sections 144.82, 144.83, and 146.10 apply to this remedy because treatment substrate will be injected into the groundwater.

Wells for injection of treatment chemicals are designated Class V wells. *See* 40 C.F.R. § 146.5. Section 144.82 prohibits the movement of fluid containing any contaminant into an underground source of drinking water if it would cause a violation of primary drinking water standards under 40 C.F.R. Part 141, or other health-based standards, or may otherwise adversely affect the health of persons. Section 144.83 specifies inventory requirements for the operation of injection wells. Section 146.10 contains well plugging and abandonment requirements. Injection well closure must prevent emplaced fluid movement.

13.2 Vapor Intrusion Pathway ARARs

Chemical-Specific ARARs

There are no chemical-specific ARARs for the vapor intrusion remedy.

Location-Specific ARARs

There are no location-specific ARARs for the vapor intrusion remedy.

Action-Specific ARARs

Air Emissions, Bay Area Air Quality Management District (BAAQMD) Regulation 8, Rules 47 and 40: BAAQMD Regulation 8, Rule 47 addresses emission control requirements for organic compound emissions from air stripping and soil vapor extraction systems. This Rule

may be relevant and appropriate for emissions of VOCs from Active Sub-slab Depressurization systems or Sub-membrane Depressurization systems. Rule 47 requires a control device reducing emissions by at least 90 percent by weight for those operations that emit benzene, vinyl chloride, PCE, methylene chloride and/or TCE. BAAQMD Regulation § 8-47-301. Section 8-47-301 does not apply if the operation emits no more than one of the following compounds: benzene, vinyl chloride, TCE, PCE, or methylene chloride, and if benzene emissions do not exceed 0.05 pounds per day, vinyl chloride emissions do not exceed 0.2 pounds per day, or TCE, PCE, or methylene chloride emissions do not exceed 0.5 pounds per day. BAAQMD Regulation § 8-47-109. Rule 47 is therefore an ARAR for systems that emit more than the designated amount of benzene, vinyl chloride, TCE, PCE or methylene chloride. Additionally, Section 8-47-301 does not apply to operations with total emissions of less than one pound per day of benzene, vinyl chloride, PCE, methylene chloride, and/or TCE, unless those emissions subsequently rise to over 1 pound per day. BAAQMD Regulation § 8-47-113.

Based on the subsurface concentrations and anticipated flow rates of these systems, it is not anticipated that any of the threshold emissions levels will be exceeded. This must be demonstrated during the design for each Active Sub-slab Depressurization and Sub-membrane Depressurization system. If the levels are exceeded, the substantive provisions of these rules will be relevant and appropriate.

BAAQMD Regulation 8, Rule 40 is potentially relevant and appropriate to activities during the construction phase of the selected remedy. Where more than 8 cubic yards of contaminated soil are removed for construction of a remedial system beneath buildings at the Site, and where the soil has organic content above 50 parts per million by weight (ppmw), Section 8-40-304 would require that inactive storage piles be appropriately covered. Thus, these requirements are ARARs where more than 8 cubic yards of contaminated soil are removed for remedy construction.

To be Considereds (TBCs)

Where there is not a regulatory standard for exposure to a chemical at a site, EPA may also set site-specific, risk-based cleanup levels that apply specifically to the contaminants and exposures at the site. The site-specific risk analysis can be based on multiple considerations, including chemical-specific ARARs and criteria found in "to be considered" guidance.

EPA Regional Screening Levels (RSLs): For this Site, EPA is using RSLs and site-specific information to determine appropriate risk-based indoor air cleanup levels. The indoor air RSLs for TCE are 1 µg/m³ for residential occupancy and 6 µg/m³ for commercial worker/non-residential occupancy. EPA derived these TCE indoor air cleanup levels using health-based screening level for long-term exposure to TCE. The CTS Printex indoor air cleanup levels are listed in Table 2.

14 Statutory Determinations

Under CERCLA Section 121 and the National Contingency Plan (NCP), EPA must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ, as a principal element, treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes. The following sections discuss how the selected groundwater and vapor intrusion remedies meet these statutory requirements and preferences.

Once implemented, the groundwater and vapor intrusion remedies will protect human health of building occupants at the Site from actual or threatened releases of Site-related hazardous substances into the environment via ingestion of groundwater or the vapor intrusion pathway. Groundwater and indoor air cleanup levels have been established that are protective of public health and can be achieved over time upon implementation of the remedies. Both the groundwater and vapor intrusion remedies and, if necessary, the groundwater contingency remedy, will meet all applicable and relevant and appropriate requirements. Land use at the Site is expected to remain commercial/light industrial and residential, and not change as a result of the revised groundwater remedy and selected vapor intrusion remedy.

14.1 Groundwater Remedy

Protection of Human Health and the Environment

The selected groundwater remedy, Alternative 3B, will protect human health and the environment through in situ treatment and monitored natural attenuation. The groundwater remedy is expected to achieve the remedial action objective of returning the contaminated groundwater to drinking water quality. Until this goal is achieved, or the contingency remedy is implemented, the established institutional controls – consisting of a recorded land use covenant and well permitting and installation standard requirements – will remain in place to ensure that there are no exposure pathways to contaminated groundwater at the Site. The implementation of the selected remedy will not pose unacceptable short-term risks.

Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy will comply with all ARARs identified for the Site, as described in Section 13.1, above. The MCLs for TCE and the other COCs are relevant and appropriate because the State of California has designated the groundwater at the Site to have a beneficial use as a drinking water source. The selected remedy is expected to achieve all ARARs within 15 years.

Cost-Effectiveness

In EPA's judgment, the Selected Remedy is cost-effective and best meets the balancing criteria used in the detailed analysis of alternatives: Long term effectiveness and permanence; Reduction in toxicity, mobility, and volume through treatment; and Short-term effectiveness. In making this determination, the following definition was used: "A remedy shall be cost effective if its costs are proportional to its overall effectiveness." (NCP §300.430(f)(1)(ii)(D)). The other remedial alternatives are more expensive, with limited benefit in risk reduction or require an unnecessary longer time frame to clean up the contaminated groundwater. The long-term

groundwater monitoring component of the selected remedy is necessary to comply with ARARs by enabling a future determination that MCLs have been achieved. The estimated present worth cost of the selected remedy is $1.7 million[9]; if necessary, the estimated capital costs of implementing the contingency remedy will add $118,000 to that total[10].

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

EPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site. The reductions in the concentrations of the COCs achieved by this revision to the remedy are expected to be permanent and the remedy uses proven technologies used on other groundwater cleanups in the greater South Bay region. While the monitored natural attenuation component of the selected remedy is not a technology in itself, combining monitored natural attenuation with active treatment of the residual contaminant mass will meet the remediation objectives and offers the best balance of tradeoffs for the Site.

Preference for Treatment as a Principal Element

The selected groundwater remedy includes active treatment by enhanced anaerobic bioremediation for the portion of the Site with the residual contaminant mass exceeding cleanup levels. Although monitored natural attenuation as applied to the other portions of the Site does not include active treatment, the principal element of the remedy is active treatment of the residual contaminant mass. Furthermore, the original remedy, which included treatment as a principal element, already reduced the extent of contaminated groundwater and reduced the contaminant concentrations at the Site. Therefore, choosing a remedy with active treatment for the area with residual contaminant mass and no active treatment in areas with lower contaminant concentrations is an appropriate remedy for this Site. If necessary, the contingency remedy, enhanced anaerobic bioremediation, will be implemented for those portions of Site north of Plymouth Street where MNA proves ineffective at achieving groundwater cleanup levels.

Five-Year Review Requirements

NCP §300.430(f)(4)(ii) requires a five-year review if the remedial action results in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. TCE concentrations, as well as concentrations for several other COCs, in the shallow groundwater are still above levels that allow for unlimited use and unrestricted exposure, and so a policy Five-Year Review requirement triggered by construction completion of the original remedial action will remain in place for the Site. Three Five-Year Reviews have been completed for the Site since the 1991 ROD was signed – in 1999, 2005, and 2010. The next Five-Year Review will be completed in 2015.

[9] A detailed summary of the cost estimate for the selected groundwater remedy is provided in Appendix D.

[10] A detailed summary of the capital cost estimate for the contingency remedy is provided in Appendix F

14.2 Vapor Intrusion Remedy

Protection of Human Health and the Environment

The selected vapor intrusion remedy will protect human health and the environment by using a combination of engineering controls and ICs. Engineering controls to mitigate vapor intrusion were installed for the existing residential development south of Plymouth Street. ICs are in place to maintain the integrity and functionality of the installed engineering controls, as well as provide notification to EPA of future construction at the Site that could result in potential impact to indoor air by the vapor intrusion pathway. For future buildings, north of Plymouth Street, EPA's review and approval of new construction and implementation of engineering controls, if warranted, for the new construction, will keep the indoor air concentrations below cleanup levels.

ICs will be used for this remedy to protect human health by (1) ensuring the ongoing implementation of the remedy; (2) providing notice to owners and occupants of buildings overlying the shallow subsurface contamination about the remedy; and (3) providing notice to EPA and the Responsible Parties of changes in occupancy or construction. Using multiple lines of evidence, EPA has established vapor intrusion remedy requirements for new construction at the Site. Implementation of the vapor intrusion remedy will not pose any unacceptable short-term risks.

Compliance with Applicable or Relevant and Appropriate Requirements

The selected vapor intrusion remedy will comply with all ARARs described in Section 13.2 of this ROD Amendment.

Cost-Effectiveness

40 C.F.R. § 300.430(f)(ii)(D) requires EPA to determine the cost-effectiveness of the selected remedy by evaluating the cost of an alternative relative to its overall effectiveness. Effectiveness is defined by three of the criteria used in the detailed analysis of alternatives: long-term effectiveness, short-term effectiveness, and reduction of toxicity, mobility and volume through treatment. The overall effectiveness is then compared to cost to ensure that the selected remedy is cost-effective.
The estimated present worth cost for the selected remedy for new construction ranges from $105,000 to $134,000 depending on building type and size and whether multiple lines of evidence indicate that mitigation for the vapor intrusion pathway is warranted at the building location. As the indoor air quality of existing buildings is not impacted by vapor intrusion, the estimated present worth cost for the vapor intrusion remedy for existing buildings is associated with establishing the necessary ICs for informing property owners and establishing the ICs so that EPA is notified of future construction at the Site.

The selected remedy for future construction – a sub-slab/sub-membrane ventilation system – achieves the greatest degree of overall effectiveness and health protectiveness relative to cost. This remedy has a high ranking on long-term effectiveness and low present worth costs for the assumed building size than the active indoor air ventilation system alternative. Therefore, the vapor intrusion remedy is cost effective.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

EPA has determined that the selected vapor intrusion remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site. Treatment of the contaminants causing vapor intrusion will be accomplished by directly addressing the subsurface shallow groundwater contamination in accordance with the selected groundwater remedy. EPA has determined that the selected vapor intrusion remedy best meets the five balancing criteria (long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, short-term effectiveness, implementability, and cost), while also considering State and community acceptance.

The selected remedy satisfies the long-term effectiveness criterion for new construction by using multiple lines of evidence to determine what level of vapor intrusion mitigation is necessary to prevent the entry of Site chemicals of concern into the new construction (new building or modification of existing building) at levels exceeding indoor air cleanup levels for long-term exposure. The institutional controls selected will ensure that the remedy continues to be implemented appropriately at each property with respect to new construction at the Site.

Preference for Treatment as a Principal Element

Treatment of the contaminants causing vapor intrusion is accomplished by remediating shallow groundwater contamination conducted in accordance with the selected groundwater remedy identified in this ROD Amendment.

The selected vapor intrusion remedy does not specifically satisfy the statutory preference for treatment as a principal element of the remedy. Unlike typical remedies to address contamination, remedies for vapor intrusion are not necessarily designed to reduce the toxicity, mobility, and volume through treatment of the Site contaminants, but rather to prevent exposure to these contaminants.

Five-Year Review Requirements

The vapor intrusion remedy will result in hazardous substances remaining onsite above levels that allow for unlimited use and unrestricted exposure. Therefore, EPA will conduct a review of the vapor intrusion remedy at least once every five years as part of the review of the overall Site-wide remedy. The review will assess whether the vapor intrusion remedy continues to provide adequate protection of human health and the environment. If it is determined that the vapor intrusion remedy is no longer protective of human health and the environment, then modifications to the remedy will be evaluated and implemented as necessary.

15 Documentation of Significant Changes

EPA issued its *Proposed Plan to Amend 1991 Cleanup Plan* for the CTS Printex Superfund Site on June 2, 2011. The *Proposed Plan* identified EPA's preferred alternative for a revised groundwater remedy and the preferred alternatives for the vapor intrusion remedy. No significant changes were made to the Proposed Plan. During the public comment period, EPA received comments that prompted only minor changes to the groundwater and vapor intrusion

remedies, as described in Section 12. These changes mainly pertain to the implementation details of the selected remedies and will be addressed as part of the remedial design for the selected remedies.

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PART 3 – RESPONSIVENESS SUMMARY

Responsiveness Summary
EPA Responses to Public Comments on EPA's June 2011 Proposed Plan for the Groundwater and Vapor Intrusion Pathway
CTS Printex Superfund Site
Mountain View, CA

PUBLIC COMMENT	EPA RESPONSE	COMMENT BY
1 [T]his alternative [Alternative 3B] should be modified to clarify where a contingent remedy would be applied and where it would not be warranted. 2 Alternative 3B should be modified to clarify that the contingent remedy would not be necessary in the area south of Plymouth Street and that MNA is the appropriate groundwater remedy for this area.	Having considered public comment and based on additional technical review, EPA has determined that a contingency remedy for groundwater is in fact warranted. EPA expects that EAB in the area of residual contaminant mass and MNA will reduce contaminant levels and, with time, meet cleanup levels. However, due to the complexity of the subsurface environment and variable concentration trends at select monitoring wells located north of Plymouth Street, EPA has selected EAB as a contingency measure in these areas that, if necessary, would be invoked through an ESD. In addition, ICs are in place to prevent groundwater use and exposure. EPA will evaluate the effectiveness of the remedy as part of its Five Year Review process.	Nancy T. Bice, Geosyntec, Consultant to Regis Homes.
3 Under the City of Mountain View's Community Development Department procedures for the MEW area (copy attached [to letter]), if an applicant proposes modifications to the building slab or foundation, any penetrations must be properly sealed. We believe this approach to be health protective without the automatic requirement to retrofit the existing building with a new sub-slab vapor control system, or to seek EPA approval.	EPA agrees that requirements to be incorporated into the City of Mountain View permitting and building procedures similar to those adopted for the MEW area would be sufficient to address slab or foundation modifications at the CTS Printex Site. . As described in Sections 9.2 and 12.2 of the ROD, these procedures are part of the selected remedy for vapor intrusion.	Perry Palmer, Mountain View Commercial Owners
4 We suggest the following modification to the text on pages 7 and 8:	The implementation work plan for vapor intrusion mitigation will include EPA's review and assignment of an appropriate tier (see Table 7 of the ROD Amendment) for new construction. EPA will	Perry Palmer

PUBLIC COMMENT	EPA RESPONSE	COMMENT BY
These procedures will include EPA approval of plans to ensure a vapor intrusion control system is part of new building construction. ***Notice shall be provided to EPA of*** *any modification of an existing building's slab or foundation.* ***Such modifications shall be properly sealed.*** =+IA testing to ensure action levels are not exceeded. EPA of course always has the opportunity to require a retrofit of an existing building with a sub-slab vapor system where representative indoor air sample results exceed EPA standards.	establish construction details, a monitoring plan, and/or other requirements for vapor intrusion mitigation based on the multiple lines of evidence and the assigned tier. EPA will include the suggested modification as part of the Notification Requirements component of the Institutional Controls Implementation and Assurance Plan (ICIAP), which will be developed as part of the remedial design phase.	
5 Costs: We believe there is an inadvertent error in the Capital Cost for Alternative 2, Table 3. As written on Page 8. Alternative 2 (Monitoring and ICs), EPA is requiring the installation of vapor intrusion control systems for existing buildings where building slabs or foundations are modified. However, the capital cost for this requirement is not included in the table, which significantly understates the cost of the alternative. Installation constraints posed by an existing building, will likely cause the system to be active rather than passive, in order to be effective. As a result, the cost of an active system should equal or exceed the $105,000 cost of a passive, system, and as such, should be included in the cost	EPA is not requiring vapor control systems for modifications of building slabs for existing buildings at the Site. For existing buildings at Areas C and D, as well as the parking lot (Area F) in Figure 4, Alternative 2 includes the requirement for monitoring to establish multiple lines of evidence to evaluate the potential for vapor intrusion at the time of new development and new construction. Based on the generated multiple lines of evidence, an appropriate tier (see Table 7) will be assigned to the new construction that may or may not include the need to implement EPA's Selected Remedy. If vapor intrusion mitigation is needed (i.e., Tier 1 in Table 9), the selected remedy – Passive Sub-slab Ventilation with Vapor Barrier – will be implemented. As the need for engineering controls cannot be determined yet for future construction, the costs identified for Alternative 2 are appropriate relative to the scope of the alternative. If mitigation is necessary,	Perry Palmer

PUBLIC COMMENT	EPA RESPONSE	COMMENT BY
analysis for Alterative 2.	costs as identified in Appendix B for an assumed building size and associated vapor intrusion mitigation would be applicable.	
6 This section [Section 5.1, Vapor Intrusion] describes results from sub-slab samples collected in two buildings and states the following: "Sub-slab soil vapor concentrations between 2,900 and 8,500 ug/m^3 were found in the subsurface, and these levels exceed EPA's sub-slab regional screening levels of 61 ug/m^3." EPA calculated the screening level for trichloroethene (TCE) of 61 ug/m^3. Using this 'screening level' is not applicable for this Site: • EPA's Remedial Investigation (RI) report for the Site states that "recent studies have shown that applying this default attenuation factor [of 0.1] is extremely conservative based on different attenuation factors observed in several case studies." • EPA's concurrent sub-slab and indoor air sample data allow calculation of a site-specific attenuation factor. For each building where sub-slab and indoor air samples were collected (see Table 4-2, of the RI), attenuation factors can be calculated as follows [the tabulation provided in the letter, while not copied herein, listed attenuation factors of 0.0008 to 0.00019 for 1924	Response actions for the existing buildings at 1914 and 1924 Plymouth Street were based on indoor air concentrations. The need for future vapor intrusion mitigation at these two properties for new construction will be based on multiple lines of evidence collected at the time of new construction. Sub-slab samples provided another line of evidence to show the potential for vapor intrusion into the overlying areas. As identified in Table 8 of the ROD Amendment, the existing buildings in Areas C and D require no engineering remedy for the vapor intrusion pathway. For new construction, the selected remedy is Passive Sub-slab Ventilation with Vapor Barrier. If necessary, EPA may evaluate multiple lines of evidence collected at the time of development.	Elie H. Haddad, Haley & Aldrich, Inc., Consultant to CTS Corporation

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Plymouth Street and 0.00011 to 0.00019 for 1914 Plymouth Street]: • The table [attenuation factors listed] above uses the June 2010 sub-slab and indoor air samples. The RI indicates that the June sub-slab samples are reliable (when collecting sub-slab samples in March 2010, EPA observed leakage into the sub-slab soil gas). • The calculations above show attenuation factors ranging from 0.00008 to 0.00019. These attenuation factors are well within EPA's Vapor Intrusion Database Preliminary Evaluation of Attenuation Factors, which shows that sub-slab attenuation factors in the database have a range of over four orders of magnitude, with a median value of about 0.005 and an interquartile range of about an order of magnitude around the median. • By applying the most conservative site-specific attenuation factors calculated above (0.00019) to the proposed action level for TCE, the calculated soil gas screening level for TCE in the sub-slab samples is 31,000 $\mu g/m^3$. Since the sub-slab soil gas samples are substantially lower than the calculated screening levels above, Building C and D require no further		

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action for the vapor intrusion pathway.		
7 Section 3.0 of the Proposed Plan lists the chemicals of concern (COCs) identified in the 1991 Record of Decision (ROD), but then states that of these COCs, only TCE, 1,1,-DCE, cis-1,2-DCE, trans-1,2-DCE, and 1,1-DCA are measured above the maximum contaminant level (MCL). Cleanup measures implemented at the Site have reduced the footprint of the plume and reduced concentrations of several COCs to below the MCLs. Therefore, it would be appropriate for the (ROD) to update the COCs to list only those COCs currently above MCLs, and to add vinyl chloride (although currently below MCLs) as byproduct of the degradation of TCE.	The COCs identified in the 1991 Record of Decision have been revised (see Table 1) to reflect over 20 years of monitoring data. The revised list includes only those COCs currently above MCLs, as well as vinyl chloride, which, although currently below MCLs, is a byproduct of the degradation of TCE and may therefore be increasing in the groundwater as TCE degrades.	Elie H. Haddad
8 The Proposed Plan includes a contingency to apply enhanced anaerobic bioremediation in low concentration areas where the preferred remedy is monitored natural attenuation (MNA). Studies have been conducted by researchers showing that at low VOC concentrations, such as those found in the areas at the site where MNA is proposed, adding more electron donors to the subsurface will not accelerate the degradation rate.	See Response to Comment 1, above.	Elie H. Haddad

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9 In Section 7.2, the Proposed Plan states that "[r]estricted covenants would be negotiated between the property owners and the CTS Printex responsible parties, designating EPA as a third party beneficiary." First, it is very difficult for the responsible parties to negotiate a restricted covenant on a property they do not own. Second, an existing ROD for the nearby MEW site, recently issued by EPA, does not include restrictive covenants as an institutional control; rather, it includes recorded agreements if a mitigation measure is necessary. Third, additional covenants (or recorded agreements) are not necessary at the Site because none of the properties have shown the potential for vapor intrusion above levels of concern [see also Comment 6 above].	An environmental restriction covenant would only be required on a property if EPA classifies new development as Tier 1 which would require installation of a vapor barrier and passive sub-slab ventilation system (see Table 8 of the ROD Amendment). The covenant would mainly address the operation, maintenance, and monitoring of the vapor barrier and sub-slab ventilation system. EPA only proposes pursuing this option if the circumstances demonstrate the need. As noted in the comment itself, the MEW Site constitutes a helpful model in some respects, but ultimately presents different facts and circumstances – and needs a different remedy – from this Site.	Elie H. Haddad
10 Page 8, Alternative 2, 2nd paragraph. The statement "[t]hese procedures will include EPA approval of plans to ensure a vapor intrusion control system is part of […] where an existing building's slab or foundation is modified" is unduly restrictive and not practical. For example, a vapor intrusion control system would not be needed if the slab is modified to retrofit a restroom, or install a conduit. Such as system may not be needed if the building slab is	See Response to Comment 3, above.	Elie H. Haddad

PUBLIC COMMENT	EPA RESPONSE	COMMENT BY
expanded.		
11 The allowable levels of TCE in residential indoor air are not defined accurately. In 5.1 the results of the indoor and outdoor air sampling both commercial and residential buildings is given as not exceeding acceptable limits of 1.2 micrograms/cubic meter. The acceptable limit for TCE in residential spaces is 1.0 microgram/cubic meter with an active proposal to reduce the allowable level to 0.7 micrograms/cubic meter. Were the sampling results less than 1.0 micrograms/cubic meter? Were they less than 0.7 micrograms/cubic meter?	The indoor air action level used in the vapor intrusion Focused Feasibility Study was 1.2 micrograms per cubic meter (1.2 $\mu g/m^3$) for residential buildings and 6.1 $\mu g/m^3$ for commercial buildings. Indoor air concentrations for TCE on March 5, 2010 and March 11, 2010 at 1914 Plymouth Street (light industrial/commercial building) were 1.1 $\mu g/m^3$, and below the 6.1 ug/m^3 action level for a commercial building. A subsequent indoor air sampling event for this building in June 2010 had TCE concentrations below 1 $\mu g/m^3$, ranging from 0.41 to 0.94 $\mu g/m^3$ at 1914 Plymouth Street and non-detect (<0.27 $\mu g/m^3$) to 0.67 $\mu g/m^3$ at 1924 Plymouth Street (ITSI, 2011. *Final Supplemental Remedial Investigations, CTS Printex Superfund Site, Mountain View, California*. May). For simplicity in the text of the Proposed Plan, these action levels were rounded down to the nearest whole number – that is, from 1.2 to 1 $\mu g/m^3$ for residential buildings and from 6.1 to 6 $\mu g/m^3$ for commercial buildings.	Bob Moss
12 Table 1 shows the indoor action level for TCE in commercial building to be 6 micrograms/cubic meter. The correct value should be 4 micrograms/cubic meter, apparently the Water Board allows 4.1 micrograms/cubic meter, not 6 micrograms/cubic meter which is excessive.	The actions levels (now cleanup levels) for indoor air are correct for this ROD Amendment. They are based on EPA's site-specific calculation of the risk levels that will be protective of human health, assuming long-term exposure to indoor air concentrations.	Bob Moss
13 While Alternative 4, vapor barrier, sub-slab	Details regarding implementation of the vapor intrusion	Bob Moss

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	membrane and institutional controls (ICs) has many good features, it lacks definition and requirements for ongoing indoor air sampling and mechanisms for taking corrective action, such as converting a passive sub-slab ventilation system into an active system, nor does it define frequency and desired location of ongoing indoor air sampling in either the commercial or residential spaces. Frequency and minimum sampling period should be stated. The proposed response action for new commercial and residential buildings in Table 5 omits ongoing monitoring. That should be added.	mitigation for a Tier 1 building will be established during the remedial design phase of the remedy. Development of an implementation plan and a monitoring plan will be part of the remedial design process and will include details regarding monitoring requirements and implementation details. In addition, for new construction that is classified as Tier 1, a building-specific addendum to the implementation and monitoring plans will be prepared and subject to EPA's approval before the new construction will be allowed. This added step will make it possible for EPA to ensure the appropriate implementation and monitoring of vapor intrusion mitigation at new construction.	
14	Based on all of these factors, Alternative 3B should be modified to clarify that the contingent remedy would not be necessary in the area south of Plymouth Street and that MNA is the appropriate groundwater remedy for this area.	See Response to Comment 1, above.	Bob Moss
15	You've made some projections about this preferred method of [groundwater] remediation. Is that based on direct experience with that compound [TCE]? If you have tried this before, can you give me a feel for how many other times you've tried this method and what are the projections based upon? What was the chemistry behind what breaks it [TCE] up?	Two EPA-approved models (BIOCHLOR and REMChlor) were used to estimate the time frame for groundwater remediation. BIOCHLOR was used to model the time frame for monitored natural attenuation to achieve cleanup in areas where applied, with REMChlor used to check the BIOCHLOR time estimates and also to model the time frame for groundwater extraction to achieve cleanup. Reductive dechlorination is the chemical process responsible for	Mike Chin

PUBLIC COMMENT	EPA RESPONSE	COMMENT BY
	the transformation of TCE to harmless end products by enhanced anaerobic bioremediation. Reductive dechlorination occurs under reducing conditions similar to sulfate reduction, and results in the chlorine atoms on the chlorinated ethene, such as TCE, being replaced with hydrogen atoms. Complete reductive dechlorination of TCE results in the formation of ethene and chloride salts. This technology has been used for remediation of TCE-contaminated groundwater at other locations within Region 9 and at other sites in the United States.	
16 I thought you were at least requiring one indoor air sample after construction.	With respect to new construction, the remedy will require indoor air sampling subsequent to installation of a vapor barrier and passive sub-slab ventilation system. The sampling will be used to determine whether the passive system is sufficient to meet indoor air cleanup levels. A monitoring plan will be developed during remedial design to ensure protectiveness of the remedy.	Lenny Siegel
17 I would recommend some subsequent monitoring based upon the potential, say, for earthquakes creating cracks or someone drilling a hole in the floor.	EPA will consider other factors, such as earthquakes, that could affect the integrity of the building slab during development of the implementation and monitoring plans as part of remedial design. Also see the response to Comment 18, below.	Lenny Siegel
18 What – have you thought about monitoring if – if the indoor air monitoring shows exceedance of the action level, and you have to go active, put a fan on the system? Do you have a plan for ongoing operation maintenance, monitoring for an active system? If it goes active, do you have a contingency for how you would [monitor].	EPA will continue to confirm the effectiveness of the vapor intrusion systems; the selected remedy for vapor intrusion will include requirements for operating, maintenance, and monitoring plans. These plans may include details regarding monitoring frequency, and contingency requirements to be followed if indoor air monitoring shows that a COC concentration exceeds the indoor air cleanup level. EPA will continue to compare indoor	Lenny Siegel

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	air results to concurrent outdoor air results when sampling a building and take into account outdoor (background) ambient air levels.	
19 When you're using bioremediation, typically, over time the effectiveness drops off. So how do you monitor the effectiveness of the biological species system that you're using, and then what do you do?	The remedial design process will include an evaluation as to whether bioaugmentation is needed to ensure a sufficient population of the microorganisms responsible for TCE and 1,2-DCE degradation. The groundwater monitoring plan developed during the remedial design may include an assessment of the population and activity of the microorganisms responsible for the reductive dechlorination of TCE and other chlorinated ethenes.	Bob Moss
20 Would you consider bio-augmentation as they have in the other pilots?	See Response to Comment 19, above.	Lenny Siegel
21 What kind of circulation rates are you talking about?	Specific details regarding the circulation rate, chemical addition, bioaugmentation, and the arrangement of the extraction and injection wells for the recirculation system will be determined as part of the remedial design.	Alan Chin
22 CTS is the responsible party for the cost of this?	In connection with the 1991 ROD, EPA entered into enforceable agreements with two parties: CTS Printex and ADN Corporation/Nearon Enterprises (the former owner of the property on which CTS Printex operated). EPA will be pursuing a new enforceable agreement for implementation of this ROD Amendment and recovery of EPA costs. The final agreement will be available to the public.	Robert Nansen