UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION 6

RECORD OF DECISION

BANDERA ROAD GROUDWATER PLUME SUPERFUND SITE
TXN000606565

LEON VALLEY, BEXAR COUNTY, TEXAS

SEPTEMBER 30, 2013

693096

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ABBREVIATIONS AND ACRONYMS

µg/L	Microgram per liter
ABS	Absorption fraction
ADD	Average daily dose
AMSL	Above mean sea level
AOI	Area of Investigation
ARAR	Applicable or Relevant and Appropriate Requirement
AT	Averaging Time
ATSDR	Agency for Toxic Substances and Disease Registry
AuB	Austin Silty Clay
AuC	Austin Silty Clay
BAF	Bioavailability factor
Beacon	Beacon Environmental Services Inc.
bgs	Below ground surface
BrD	Brackett Soils
BTOC	Below Top Of well Casing
BW	Body Weight
CAG	Community Advisory Group
CDC	Centers for Disease Control and Prevention
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFM	Cubic feet per minute
CI	Community Involvement
CIP	Community Involvement Plan
CLP	Contract Laboratory Program
cm^2	Square centimeters
COC	Chemical of concern
COPC	Chemical of potential concern
CR	Contact Rate
CSF	Chemical Slope Factor
CSIA	Compound-specific isotope analysis
CSM	Conceptual site model
CVOC	chlorinated volatile organic compounds
cy	Cubic yard
DCE	Dichlochloroethene
DHC	*Dehalococcoides*
DNA	Deoxyribonucleic Acid
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DQA	Data quality assessment
DQO	Data quality objectives
DSHS	Department of State Health Services
E^2	E^2, Inc.
EA	EA Engineering, Science, and Technology, Inc.
EAA	Edwards Aquifer Authority
ED	Exposure Duration

EF	Exposure Frequency
ELCR	Excess lifetime carcinogenic risk
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
FS	Feasibility Study
FSP	Field Sampling Plan
GAC	Granulated activated charcoal
gpd	Gallons per day
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	Hazard index
HQ	Hazard quotient
HsB	Houston Black Clay
HSP	Health and Safety Plan
HtA	Houston Black Clay, terrace
IDW	Investigation derived waste
IRIS	Integrated Risk Information System
LADD	Lifetime average daily dose
LOAEL	Lowest-observed-adverse-effect level
LMS	Linearized multistage
LvB	Lewisville Silty Clay
m^3/hour	Cubic meter(s) per hour
m^3/kg	Cubic meter(s) per kilogram
MCL	Maximum Contaminant Level
MDL	Method detection limit
mg/cm^2	Milligram per square centimeter
mg/day	Milligrams per day
mg/kg	Milligram(s) per kilogram
mg/kg-day	Milligrams of chemical per kilogram body weight per day
mg/m^3	Milligrams per cubic meter
mm	Millimeter
MNA	Monitored Natural Attenuation
mph	miles per hour
MRL	Minimal risk levels
MSSL	Medium-Specific Screening Levels
MTBE	methyl-tertiary butyl ether
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAEL	No-observed-adverse-effect level
NPL	National Priority List
NSDWS	National Secondary Drinking Water Standards
OEHHA	Office of Environmental Health Hazard Assessment
OSWER	Office of Solid Waste and Emergency Response
PCE	Tetrachloroethene
PCL	Protection Concentration Levels
ppmv	Parts per million vapor
PPRTV	Provisional Peer Reviewed Toxicity Value

QA	Quality Assurance
QAPP	Quality Assurance Project Plan
RAC	Remedial Action Contract
RAGS	Risk Assessment Guidance for Superfund
RAS	RAS Integrated Subsurface Evaluation
RfC	Reference concentration
RfD	Reference dose
RI	Remedial Investigation
RME	Reasonable maximum exposure
ROD	Record of Decision
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
scfm	standard cubic feet per minute
SF	Slope factor
SIM	Single ion monitoring
Site	Bandera Road Ground Water Plume Superfund Site
SAWS	San Antonio Water System
SMP	Site Management Plan
SOP	Standard Operating Procedure
SOW	Statement of Work
SSP	Savings Square Partners, Ltd
SVE	Soil Vapor Extraction
SVOC	Semi-volatile organic compounds
TASC	Technical Assistance Services for Communities
TCE	Trichloroethene
TCEQ	Texas Commission on Environmental Quality
Terracon	Terracon Consultants, Inc.
TPH	Total petroleum hydrocarbons
TxDOT	Texas Department of Transportation
UCL	Upper confidence limit
USACE	U. S. Army Corps of Engineers
USCS	Unified Soil Classification System
USDA	United States Department of Agriculture
VC	Vinyl Chloride
VF	Volatilization factor
VOC	Volatile organic compound
Willowstick	Willowstick Technologies, LLC

PART 1: THE DECLARATION

1.0 SITE NAME AND LOCATION

The Bandera Road Ground Water Plume Superfund Site (hereinafter “the Site”) is located in Leon Valley, Bexar County, Texas (see Figure 1 – Site Location Map). The National Superfund Database Identification Number is TXN000606565. The Site was finalized on the National Priorities List (NPL) on April 6, 2007 (10078 – 10084/Federal Register/Vol. 72, No. 44). This Site has not been separated into separate operable units and all areas and media within the Site are addressed in this Record of Decision (ROD).

2.0 STATEMENT OF BASIS AND PURPOSE

This decision document presents the “Selected Remedy” for the Bandera Road Ground Water Plume Superfund Site in Leon Valley, Bexar County, Texas. The Selected Remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), 42 United States Code §9601 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, as amended.

This decision is based on the Administrative Record for the Site, which has been developed in accordance with Section 133(k) of CERCLA, 42 U.S.C. § 9613(k). This Administrative Record file is available for review at the Leon Valley Public Library in Leon Valley, Texas; and at the Texas Commission on Environmental Quality (TCEQ) Central File Room in Austin, Texas; and at the United States Environmental Protection Agency (EPA, Region 6) Records Center in Dallas, Texas. The Administrative Record upon which the selection of the Remedial Action is based.

The State of Texas concurred with the Selected Remedy.

3.0 ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

4.0 DESCRIPTION OF THE SELECTED REMEDY

This ROD sets forth the selected remedy to address ground water contamination and volatile contamination present in indoor air, subsurface soils, and vadose zone bedrock resulting from previous releases of hazardous substances (i.e., primarily tetrachloroethene (PCE) and its degradation products) at the Site. This ROD addresses identified site risks and no additional RODs are planned for the Site. The general sequence of remedy implementation will be to address contamination present in indoor air, subsurface soils, vadose zone bedrock, and then ground water at the identified source areas. Impacted groundwater contamination downgradient of the source areas may be treated prior to completion of subsurface soil and vadose zone bedrock remedies in identified Site source areas. The plugging and abandoning of improperly constructed or deteriorating wells which can act as contaminant migration pathways can occur throughout remedy implementation.

Performance standards for groundwater contamination are Federal drinking water standards. Health based cleanup criteria for indoor air contamination were calculated for the commercial-industrial exposure scenario based on the lesser of 1 in 100,000 (1×10^{-5}) increased cancer risk incidence or non-cancer hazard index of 1. Generally, a hazard index greater than 1 indicates the potential for adverse non-cancer effects. The general strategy for assessment of performance and closure of soil vapor extraction (SVE) systems in the subsurface soils and vadose zone bedrock is outlined in EPA's "Development of Recommendations and Methods to Support Assessment of Soil Venting Performance and Closure" (EPA/600/R-01/070, September 2001).

The Selected Remedy for the Site integrates various alternatives for contaminated surface and subsurface soils, vadose zone bedrock, ground water and indoor air. The total estimated present worth cost of the selected remedy is $9,429,000. The components of the selected remedy are described in detail in Section 19.0 (Selected Remedy) of this ROD. The major components of the remedy are:

- Membrane/sealant with vapor vent to address indoor air contamination present in the office space of a former dryer cleaner.
- Soil vapor extraction at AOI 1 and AOI 2 to address volatile contamination present in subsurface soils and in the vadose zone bedrock (i.e., the bedrock material between the subsurface soil and water table).
- *In situ* bioremediation to address ground water contamination.
- Institutional Controls (ICs) in the form of administrative and/or legal instruments that place restrictions on the use or development of land and/or ground water within a defined area. ICs include restrictive covenants, deed notices, ordinances, zoning restrictions, building and excavation permits, easements, well drilling prohibitions, or a combination thereof.
- Engineering controls such as fencing or signage used to minimize access to contaminated areas or areas that may pose a physical hazard. Plugging and well abandonment are considered engineering controls.
- Indoor air, soil gas, and ground water monitoring will be conducted to evaluate the protectiveness of the Selected Remedy and to evaluate trends over time. The monitoring data will also allow decisions to be made in the future regarding indoor air impacts, ground water impacts and evaluation of risks to human health, the need for additional monitoring, whether to continue maintaining ICs, and whether any additional actions are needed to protect human health and the environment.

5.0 STATUTORY DETERMINATIONS

The Selected Remedy satisfies the statutory requirements of CERCLA § 121, 42 USC § 9621. The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternate treatment or resource recovery technologies to the maximum extent practicable. The remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment). Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted pursuant to 40 CFR § 300.430(f)(4)(ii) within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

6.0 DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record file for this Site.

- Chemicals of concern and their respective concentrations (see Section 12).
- Baseline risk represented by the chemicals of concern (see Section 14).
- Cleanup levels established for chemicals of concern and the basis for these levels (see Section 15).
- How source materials constituting principal threats are addressed (see Section 19).
- Current and reasonably anticipated land use assumptions and current and potential future beneficial uses of ground water used in the baseline risk assessment and ROD (see Section13).
- Potential land and ground water use that will be available at the Site as a result of the Selected Remedy (see Section 19.4).
- 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 (see Section 19.3).
- Key factors that led to the 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 (see Section 20).

7.0 AUTHORIZING SIGNATURE

This ROD documents the selected remedy for the contaminated vapor, soil, and ground water at the Bandera Road Ground Water Plume Superfund Site. This remedy was selected by the EPA with the concurrence of the TCEQ (Appendix F). The Director of the Superfund Division (EPA, Region 6) has been delegated the authority to approve and sign this ROD.

By: ______________________ Date: 9/30/13

Carl E. Edlund, P.E.
Director
Superfund Division

CONCURRENCE PAGE FOR RECORD OF DECISION
BANDERA ROAD GROUND WATER PLUME SUPERFUND SITE

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FOR

Pamela Phillips, Deputy Director
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9/30/13
Date

PART 2: THE DECISION SUMMARY

This Decision Summary provides a description of the Site-specific factors and analyses that led to the Selected Remedy for the Site. It includes background information about the Site, the nature and extent of contamination found at the Site, the assessment of human health and environmental risks posed by the contamination found at the Site, and the identification and evaluation of remedial action alternatives for the Site.

8.0 SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The Bandera Road Ground Water Plume Site is situated in Bexar County, in the City of Leon Valley. The City of Leon Valley is an enclave on the northwest side of the City of San Antonio, Texas (see Figure 2). The Site is centered in a commercial/industrial area with residential homes nearby. Two City of Leon Valley public water supply wells are within one mile of the center of the Site. The San Antonio Water System (SAWS) Wurzbach/Evers Road public water supply wells are approximately 1.1 miles from the center of the Site.

The Site was placed on the Superfund National Priorities List (NPL) in 2007. The National Superfund electronic database identification number for the Site is TXN000606565.
The EPA is the lead agency for the Site. The TCEQ is the support agency. The source of cleanup monies for the Site is the Superfund.

The Site includes releases and sources from at least two facilities. During the course of the investigation, EPA identified five Areas of Investigation (AOI), which are depicted on Figure 3:

- **AOI 1 –** Includes the area in the vicinity of the Savings Square Shopping Center (located at 6709 Bandera Road) that formerly contained a dry cleaning facility. The Rainbow Cleaners and Premium Cleaners operated from approximately 1991 to 2002. There are no operating dry cleaners within AOI 1. This AOI includes Source Area 1.
- **AOI 2 –** Includes the area in the vicinity of an active dry cleaning facility (located at 6600 Bandera Road) and an automotive repair facility. This AOI includes Source Area 2.
- **AOI 3 –** Includes the area in the vicinity of Uhl's Storage (located at 6200 Grissom Road) that is the location of former Culver Air Field, which operated in the 1940's. There are several industrial businesses in the vicinity of AOI 3 (e.g., machine shop, automotive repair shop, etc.).
- **AOI 4 –** Includes the area in the vicinity of Kwik Wash (located at 7007 Bandera Road) that is the location of a former dry cleaning facility and an active laundry facility. The dry cleaners operated from approximately 1983 to 1987. There are no operating dry cleaners within AOI 4.
- **AOI 5 –** Includes the area in the vicinity of the former Kwik-n-Neat facility (located at 7128 Bandera Road) that is the location of a former dry cleaning facility. The dry cleaners operated from approximately 1987 to 2002. There are no operating dry cleaners within AOI 5.

Henceforth, these AOIs will not include reference to location or facility name. These five AOIs were considered a single Operable Unit for the purpose of conducting the EPA's Remedial Investigation/Feasibility Study (RI/FS). Although EPA has identified these five AOIs during the course of the investigation, additional areas may be identified, investigated and/or monitored as appropriate. For example, at the Former Pride Cleaners located at 6535 Bandera Road, trace levels of tetrachloroethene (PCE) were identified in May 2012 in a 35-foot shallow alluvium monitoring well (MW4-6536, PCE estimated at 1.3 µg/L) and in a 180-foot Austin Chalk monitoring well (MW2-6535, PCE estimated at 5.3 µg/L). These wells were installed in February 2012.

9.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

This section of the ROD provides the history of the Site and a brief discussion of the EPA's and State's removal, and enforcement activities.

9.1 History of Site Activities

The Site was identified as a result of assessment activities conducted by the TCEQ Voluntary Clean-up Program. The investigation identified the presence of PCE and trichloroethene (TCE) at concentrations above the EPA Maximum Contaminant Level (MCL) in Edwards Aquifer wells. EPA has designated the Edwards Aquifer as the sole-source drinking water aquifer for central Texas. Additional details for AOIs 1 and 2, with confirmed source areas, are provided below.

9.1.1 Site History for AOI 1

Dry cleaners operated in AOI 1 from approximately 1991 to 2002. On 6 October 1997, the Leon Valley Fire Department responded to an incident at the dry cleaning facility within AOI 1 (Leon Valley Fire Department, 1997). According to the incident report, cleaning solvent was spilled at the dry cleaners and had leaked under the party wall separating the dry cleaners from the occupied commercial space on the opposite side of the wall. The spill was reported to be less than 100 pounds, which is the reportable quantity.

After the dry cleaning facility closed, Phase I and Phase II Environmental Site Assessments were conducted during a property transfer. As part of the investigation, several soil samples were collected from beneath the building slab. Also, soil samples were collected in the vicinity of the building perimeter. PCE was detected in both soil and ground water samples. Upon discovery of impacted ground water, the property undertook actions to identify potential sources of ground water contamination, identified affected wells, and installed and maintained carbon filters on affected private wells.

The monitoring well presently designated USGS-42 was installed in the alley way adjacent to the building into the Austin Chalk formation to evaluate contaminant migration to the first water bearing zone. Site activities were subsequently turned over to the TCEQ. PCE detections as high as 78.7 µg/L in well DW-30, which was a private Edwards Aquifer well located approximately a tenth of a mile from the former dry cleaner, initiated the hazard ranking process and eventually NPL status of the Site. This well has been plugged and abandoned by EPA.

9.1.2 Site History for AOI 2

A dry cleaner presently operates in AOI 2. According to a Remedial Investigation Report (RMT/Jones & Neuse, Inc. 1995), the dry cleaning facility used petroleum and chlorinated solvents in the dry-cleaning process. The detection of target compounds in the shallow soils under the facility building suggests that the dry cleaning equipment was the source of the contamination. The actual process by which the dry-cleaning chemicals migrated to the subsurface may have been through piping joints whose cement had been compromised by the dry cleaning solvents. Soil, ground water, and soil gas samples were collected in the vicinity of the AOI 2. Both soil and soil gas samples contained PCE. A temporary ground water monitoring well that was screened from 18 to 25-feet below ground surface (bgs) did not contain chlorinated solvents in the perched ground water. As a result of the investigation, the impacted material was capped in place (RMT/Jones & Neuse, Inc. 1995a).

9.2 History of Federal and State Investigations and Removal Actions

The TCEQ and the Agency for Toxic Substances and Disease Registry (ATSDR) conducted investigation activities prior to the EPA RI/FS investigation efforts.

9.2.1 TCEQ Investigations

Site characterization activities date back to 2004. Previous investigations by the TCEQ and the EPA are as follows:

- Site Screening Investigation (TCEQ 2004)
- Preliminary Assessment / Site Inspection (TCEQ 2006)
- Hazard Ranking System Package (TCEQ 2006a)

In 2004, the TCEQ conducted a Site Screening Investigation (TCEQ 2004) for the dry cleaner at AOI 1. The investigation included collecting soil samples, conducting a water well survey, sampling water wells, and an investigation of potential sources. The assessment identified six water wells with PCE and/or TCE concentrations greater than the EPA MCL. Three of these wells were completed in the Edwards Aquifer formation, two were completed in the Buda Limestone formation, and the well completion depth of the sixth well is unknown. Subsequently, the TCEQ installed granular activated carbon (GAC) water filtration systems on five private wells with concentrations greater than the MCL; the sixth location was only used for irrigation, so a water filtration system was not installed.

In 2006, a Preliminary Assessment/Site Inspection (TCEQ 2006) was conducted. Additional ground water samples were collected. However, the source of the ground water contamination was not identified. The TCEQ also collected additional information for the preparation of the

Hazardous Ranking System Documentation Record (TCEQ 2006a). Based upon the scoring results from the Hazardous Ranking System, the Site was proposed to EPA's National Priorities List (NPL).

9.2.2 ATSDR Public Health Assessment and Health Consultation

The Agency for Toxic Substances and Disease Registry (ATSDR) conducted a Public Health Assessment for the Site in 2007 (ATSDR, 2007). The ATSDR was supported by the Texas Department of State Health Services (DSHS). After a review of the data collected by TCEQ was conducted, the ATSDR concluded the following.

> Exposures to PCE and/or TCE in water wells pose an 'indeterminate public health hazard', but 'estimated exposure doses are well below levels that have been shown to cause adverse health effects in humans.' Water wells with contaminant concentrations greater than the EPA MCL that are used for domestic use are equipped with filtration systems to prevent a public health hazard. As long as these systems are maintained, contaminants in the water wells do not pose an apparent public health hazard.

In response to a request from EPA, the ATSDR evaluated public health implications associated with indoor air sampling data collected by EPA in January 2009. The ATSDR was again supported by the DSHS. After a review of the data was conducted, ATSDR provided a "Letter Health Consultation" dated 4 March 2009 (ATSDR, 2009). ATSDR concluded the following:

> Based on available information, the reported concentrations of PCE within the building space of the former dry cleaners exceed health-based screening levels. After reviewing available toxicological information, we would not expect reported concentrations to result in observable adverse non-cancer health effects. Because there is a low increased risk for cancer associated with the reported concentrations, we have categorized this area of the building as posing a public health hazard. The other occupied spaces that were evaluated pose no apparent public health hazard.

9.2.3 EPA Removal Action

The EPA conducted a removal action which extended municipal water lines to residents whose source of drinking water (i.e., private water wells) were found to contain concentrations of PCE and TCE above the Safe Drinking Water MCL of 5.0 parts per billion. Water from these wells was being treated with activated carbon units. The field activities required to connect the six identified locations to the public water supply lines began in the spring of 2007 and were completed in February 2008.

9.3 History of CERCLA Enforcement Activities

In response to ATSDR's indoor air determination, the EPA issued a Field Consent Order to the property owner of the Savings Square Shopping Center. The Field Consent Order directed the property owner to abate the conditions posing an indoor air public health hazard. The building owner took the following actions:

- Installation of vent systems on the exterior wall of the former dry cleaner and at a nearby building.
- Sealing of utility access ports at the former dry cleaner.
- Removal of sheetrock and sealing the floor in office space adjoining the former dry cleaner.

The EPA has issued General Notice Letters to the owner of the former dry cleaner (AOI 1) and the owner of the current dry cleaner (AOI 2).

10.0 COMMUNITY PARTICIPATION

This section of the ROD describes the EPA's community involvement and participation activities. The EPA has been actively engaged in dialogue and collaboration with the affected community and has strived to advocate and strengthen early and meaningful community participation during EPA's remedial and removal activities at the Site. These community participation activities during the remedy selection process meet the public participation requirements in CERCLA 300.430(f)(3) and the NCP.

10.1 Community Involvement Plan

The Community Involvement Plan (CIP) for the Site was amended in February 1, 2011. The CIP is central to Superfund community involvement. It specifies the outreach activities that the EPA will undertake to address community concerns and expectations. The CIP includes background information on the community, community issues and concerns, community involvement activities, a communication strategy, and official contact list, and local media contacts.

10.2 Reasonably Anticipated Future Land Use and Potential Beneficial Uses of Ground Water

In an effort to identify the reasonably anticipated land and ground water uses, a reuse assessment was conducted in 2010. The Reuse Assessment report (E^2 2010) was funded by the EPA Superfund Redevelopment Initiative which was founded to help communities return Superfund sites to productive use. Anticipated future uses of the site area included: residential, commercial, industrial, and a combination of these uses.

In respect to potential beneficial uses of ground water, the Site overlays three different karst and fractured dominated water bearing units: the Austin Chalk, the Buda Limestone, and the Edwards Aquifer. Ground water contaminant migration at the Site is dependent on the interaction between the three water bearing zones. The Austin Chalk lies below the Anacacho Limestone and is the uppermost water-bearing unit. Although the Austin Chalk is not a primary drinking water source in the area, it is used to water lawns and gardens. Prior to the identification of PCE contamination in the Austin Chalk formation at concentrations exceeding the MCL, PCE impacted ground water from the Austin Chalk formation was being used for drinking water by a local resident. The State considers the Austin Chalk a potential drinking water resource and the EPA has determined that the Austin Chalk ground water exceeds EPA Maximum Contaminant Levels (MCLs) for chlorinated solvents. The Eagle Ford Group is a confining, non-water bearing unit below the Austin Chalk. The Buda Limestone is considered the second water bearing unit and is considered a potential domestic water supply source by the State. The Del Rio Clay separates the Buda Limestone from the underlying Edwards Aquifer, and forms the confining unit between the two. The Edwards Aquifer is prolific, yields high quantity and quality ground water, and is the primary drinking water aquifer for the City of Leon Valley and San Antonio.

10.3 Community Meetings and Fact Sheets

The EPA and TCEQ have conducted community meetings during the course of the Superfund activities and have provided public notices of these meetings in order to encourage the community's participation. The majority of these meetings have been held with the Bandera Road Community Advisory Group (CAG). The Bandera Road CAG was formed in 2007 to provide input to EPA on issues regarding the Site's investigation and cleanup. CAG members are residents of Leon Valley, members of other local government agencies (i.e., Northside Independent School District, San Antonio Water System, Edwards Aquifer Authority, etc.) who have an avid interest in the protection of public health and the environment. The Bandera Road CAG meets quarterly, meetings are advertised, and are open to the public.

In addition to EPA's participation in community meetings, additional assistance has been provided to the community through EPA's Technical Assistance Services for Communities (TASC) program. The TASC program provides technical assistance through an independent, outside technical expert. The TASC technical expert has developed with the CAG several newsletters to educate the community on the following:

- The status of the EPA's investigation;
- Exposure to hazardous waste and potential health effects;
- Scientific, engineering, human and public health, or economic concepts related to the cleanup of hazardous waste;
- Cleanup technologies and their effectiveness;
- The cleanup process and how to become involved in the process.

As of July 2012, eight TASC newsletters have been provided to the community. Newsletters were provided approximately every six months.

The Proposed Plan community meeting was held at the Leon Valley Community Center on July 21, 2011. The Proposed Plan presented the EPA's rationale for the preferred remedy for the Site. A public comment period for the Proposed Plan was held from July 18 to October 15, 2011. Public notice of the community meeting and public comment period were published in the San Antonio Express News on July 18, 2011. Additionally, a fact sheet announcing the comment period and meeting was mailed to the contacts included on the Site's mailing list. At the community meeting, representatives from the EPA provided a presentation on the Proposed Plan and answered questions about EPA's preferred alternative for the Site. Representatives from the TCEQ and Texas Department of State Health Services were also present at the meeting. Oral and written comments were accepted at the meeting and a court reporter transcribed the discussions held during the meeting. This transcript is included in the Administrative Record file for the Site. The EPA's responses to the comments received during the public comment period are included in the Responsiveness Summary of this ROD.

10.4 Information Repositories

The EPA established a local information repository to provide the public a location near their community to review and copy background and current information about the Site. The Remedial Investigation (RI) Report, the Feasibility Study (FS), the Proposed Plan, and other relevant documentation used by the EPA in choosing the Selected Remedy described in this ROD are available at the Site's local repository and the Federal/State repositories located at:

Leon Valley Public Library
6425 Evers Road
Leon Valley, TX 78238
(210) 684-0720

U.S. Environmental Protection Agency (Region 6)
1445 Ross Avenue, Suite 700
Dallas, TX 75202-2733
(800) 533-3508

Texas Commission on Environmental Quality
Records Management Center, Central File Room
Technical Park Center Bldg. E, 1st Floor, Room 1003
12100 Park 35 Circle
Austin, TX 78753
(512) 239-2900 and (800) 633-9363

11.0 SCOPE AND ROLE OF RESPONSE ACTION

The NCP, 40 CFR Section 300.5, defines an operable unit as a discrete action that comprises an incremental step toward comprehensively addressing a site's contamination problems. The cleanup of a site may be divided into two or more operable units, depending on the complexity of the problems associated with the site. The EPA and TCEQ have chosen to address the Site as a whole without division into operable units. The selected remedy addresses all contaminated environmental media at the Site with the primary objectives of preventing human exposure to contaminants, preventing or minimizing further migration of contaminants, and to return ground waters to their expected beneficial uses wherever practicable (aquifer restoration). The remedial action objectives are described in more detail in Section 15.

12.0 SITE CHARACTERISTICS

12.1 Physical Site Characterization

The Site is located within the City of Leon Valley, which is an enclave on the northwest side of San Antonio, Texas (Figure 2). During the course of the investigation EPA identified five AOIs, which are depicted on Figure 3:

- **AOI 1 –** Includes the area in the vicinity of a shopping center with commercial buildings B1 and B2 (Figure 4). Building B3 is a commercial structure located to the east. Buildings BA and BB are to the south and are public use buildings, which is similar to a commercial setting. An apartment complex is located to the north. Residential areas are to the north and west. The remainder of this AOI is considered commercial/industrial.
- **AOI 2 –** Includes the area in the vicinity of an active dry cleaning facility and automotive repair facility (Figure 4). Public use buildings are located to the southeast and residences are located to the south and southwest. The remainder of this AOI is considered commercial/industrial.
- **AOI 3 –** Includes a commercial/industrial area with residences to the east and south.
- **AOI 4 –** Includes a commercial/industrial area with residences to the east.
- **AOI 5 –** Includes a commercial/industrial area with residences to the west.

A City of Leon Valley zoning map depicts the zoning designations for the area (Figure 5). Bandera and Grissom Roads transect the Site and are major features.

12.2 Cultural and Historical Features

This section provides a brief description of the Site’s cultural and historical features. The primary source of information was the Leon Valley Historical Society (Historical Society of Leon Valley 2007).

12.2.1 National Register of Historic Places

On 10 August 2005, the Huebner-Onion Homestead and Stagecoach Stop were listed on the National Register of Historic Places. It was included in the Texas Historical Commission statewide Heritage Trail in 2006 and received Texas Landmark status in 2007. A historical marker was erected in May of 2008 to commemorate the homestead’s history.
The homestead is located off Bandera Road, north of the intersection of Bandera Road and El Verde Road. Established in 1862 by Joseph Huebner, the homestead served primarily as a stagecoach stop for travelers in the San Antonio area. Due to the rough terrain and formidable water crossings in the area, travelers commonly utilized the location as a recuperation point during travel. The Site includes a two story limestone homestead, a detached limestone

cookhouse, and a stacked stone barn. Additional structures were present at the Site, but have been removed over the years. The homestead was later occupied by Judge John Onion, who is thought to be buried on the property. Historically, the land surrounding the Huebner-Onion Homestead was utilized as rangeland for cattle ranches and associated homesteads.

Currently, the Leon Valley Historical Society has undertaken renovation activities to restore the integrity of the structures at the Site. Ultimate plans for the homestead include using the main limestone homestead as a museum, with surrounding areas to be used as nature paths, bird watching trails, and outdoor education areas.

12.3 Surface Water Hydrology

Surface water features include ditches and streams. Aerial photographs and reconnaissance have identified Huebner Creek as a main surface-water feature in the subject area. Huebner Creek is an intermittent creek that flows from the north to the south through the Site. Storm water is present during high rain events; otherwise, it is a dry creek bed. Floodplains are depicted on Figure 6 in conjunction with surface topography. Huebner Creek's 100 year floodplain encompasses approximately a 1,000 foot around channel around the creek, including residential locations on the southeast portion of El Verde Road and Jeff Loop. Because the Site is mostly commercial/industrial, surface water is channeled into storm drains, which eventually flows into Huebner Creek.

12.4 Geology

The Site is located in the West Gulf Coastal Plain physiographic province, which stretches along a significant portion of southeastern Texas and is characterized by marine sedimentary deposits that have been uplifted and tilted seaward towards the Gulf of Mexico.

12.4.1 Lithology

Underlying approximately 5 to 60 feet of variable thickness surface soils, caliche, and Quaternary alluvium is a series of sedimentary rock layers deposited during the Cretaceous (Table 1). The sequence observed at the Site is described below, listed in order of increasing depth, and displayed on Figures 7 through 11.

Anacacho Limestone (Kac)

The Anacacho Limestone is a pale yellow, bioclastic and argillaceous limestone with clay and marl interbeds that underlies the alluvium. The Anacacho Limestone, observed through well cuttings, contains fossils, minor lenses of silt and sand, hematite, and glauconite. Thickness of this unit at the Site ranges from 25 to 40 feet, estimated from field borehole logs (EA 2011a). The Anacacho Limestone had low primary porosity and currently has high secondary porosity, with low permeability.

Austin Chalk Limestone (Kau)

The Austin Chalk Limestone consists of microgranular chalk and limestone. Within the Austin Chalk Limestone there are three zones with different physical characteristics; the lowermost beds are hard, thinly-bedded limestone, the middle section is a soft, massive, chalky limestone, and the uppermost beds are chalky limestone with argillaceous layers. Field borehole logs (EA 2011a) indicate the Austin Chalk Limestone is approximately 125 to 140 feet thick at the Site. With low effective primary porosity and fracture secondary porosity, the Austin Chalk Limestone has low permeability.

Eagle Ford Group (Kef)

The Eagle Ford Group underlying the Site consists of very dark gray, massive, calcareous, sandy shale with interbedded argillaceous limestone. Some observed well cuttings had a petroliferous odor. At the Site, the thickness of the Eagle Ford Group is approximately 25 to 50 feet, estimated based on field borehole logs (EA 2011a). Effective porosity and permeability are low at this location.

Buda Limestone (Kbu)

The Buda Limestone is a light gray to pale yellow, fine-grained, dense, microgranular limestone. Well cuttings revealed trace amounts of pyrite and hematite, in addition to trace fractures filled with calcite. The Buda Limestone is typically 50 feet thick as observed in field borehole logs (EA 2011a).

Del Rio Clay (Kdr)

The Del Rio Clay consists of yellow tinted, dark gray, very slightly laminated, calcareous clay. Pyrite and gypsum have been reported to be scattered throughout the formation, but were not noted in field borehole logs (EA 2011a). Field borehole logs indicate that the thickness of the unit varies between 50 and 60 feet at the Site.

Georgetown Formation (Kgt)

The Georgetown Formation is a pale yellow and light gray, slightly sandy and silty, marly limestone. Underlying the Site, the Georgetown Formation contains pyrite, trace glauconite, and calcite filled fractures and fossils. The thickness of the Georgetown Formation in the subsurface underlying the Site is approximately 25 feet.

Edwards Group (Ked)

In Bexar County, the Edwards Group is comprised of the Kainer and Person Formations. The Person Formation ranges in thickness from approximately 170 to 204 feet in Bexar County. The Kainer Formation ranges in thickness from approximately 260 to 310 feet in Bexar County. The Person Formation is a pale yellow to gray, silty, fossiliferous, microgranular limestone with chert and hematite nodules and trace fossils. The Kainer Formation is a combination of fossiliferous mudstones and wackestones that grade upward into dolomitic mudstones with evaporites, and terminate in a shallow marine grainstone.

Glen Rose Formation (Kgr)

The Glen Rose Formation is the upper member of the Trinity Group, described as yellowish tan, thinly bedded, alternating layers of limestone and marl. The Glen Rose Formation is approximately 350 to 500 feet thick.

12.4.2 Structure

Regionally, the Site falls within a tensional structural system known as the Balcones Fault Zone. The Balcones Fault Zone consists of a series of en echelon and normal faults that trend east – west to northeast - southwest, with the downward side of the faults toward the Gulf Coast to the southeast. Fractures within this system can either enhance ground water flow by creating conduits through rocks with limited porosity and permeability or inhibit ground water flow by juxtaposing rocks of significantly different permeability. This type of discontinuous heterogeneity is common in the Edwards Group and exerts a major control on the direction of ground water flow, discussed in greater detail in the following section.

The presentation of regional hydrogeologic sections can be found in the *Texas Waster Development Board Report 296 – Carbonate Geology of the Edwards Aquifer in the San Antonio Area, Texas* (U.S. Geological Survey, November 1986). Information presented in Report 296 was used to prepare Figure 13 (Location of Regional Hydrogeologic Sections) and Figure 14 (Location of Regional Hydrogeologic Section D – D’). These figures illustrate the geologic complexities of the area. The third well from the left presented on Figure 14 is identified as well AY-68-35-310. This well is also present in the lower left corner of Figure 15 (Location of Local Water Wells Identified in the U.S. Geologic Survey Well Inventory (February 2007)). Figure 15 shows that Well AY-68-35-310 is located just south of the Grist Mill Street/Huebner Road intersection and is about 3000 feet west-southwest of the approximate center of the Site near the Grissom Road/Bandera Road intersection.

Three possible faults have been identified within the Site; their locations are displayed on Figure 12. Fault identification was completed through interpretations of (1) the fracture trace analysis study (EPA 2008), (2) the field borehole logs (EA 2011a), and (3) the geophysical investigation (Willowstick Technologies, LLC. 2010). Given the complex nature of the Balcones Fault Zone and the tendency for numerous faults and fractures to make up a fault zone, there are undoubtedly numerous preferential flow paths via minor faults or fracture zones present that have not been identified. However, the identification of additional features is not supported by the available data.

12.5 Hydrology

The discussion of hydrogeology of the Site requires the evaluation of regional aquifers, ground water flow, and hydraulic gradients.

12.5.1 Aquifers

The Site overlies three different karst and fracture permeability dominated limestone hydrogeologic units: the Austin Chalk Aquifer, the Buda Limestone, and the Edwards Group Aquifer. Contaminant migration at the Site is predicated on the interaction between the three aquifers, further discussed below.

Aquifer 1 –Austin Chalk

The Austin Chalk Aquifer is the upper-most aquifer. It supplies good to poor quality water for domestic and stock use. Yields of 500 gallons per minute (gpm) or more have been reported from several wells, which may have been a result of drilling into subsurface caverns. Large yields from the Austin Chalk thought to be a result of hydraulic communication (e.g., faults, secondary porosity) between the formation and the underlying Edwards Aquifer and other associated limestones.

Based on cross-sections from the Edwards Aquifer Authority and subsurface geologic interpretations (Figures 7 through 11) made from field borehole logs (EA 2011a), faults appear to be present near the Site and may contribute to the hydraulic communication between the aquifers. Figure 7 presents the locations of four cross sections: A-A’, B-B’, C-C’, and D-D’.

Cross-section A-A’ includes borehole log information from seven wells beginning with well DW-408 to the north and ending with well DW-412 to the southeast. Cross-section A-A’ covers a horizontal distance of approximately 2200 feet and is presented in Figure 8. No significant vertical displacements along cross-section A-A’ were interpreted based on the field borehole logs.

Cross-section B-B’ includes borehole log information from six wells beginning with well DW-409 to the west and ending with DW417 to the east. Cross-section B-B’ covers a horizontal distance of approximately 1450 feet and is presented in Figure 9. Between wells USGS 58 and DW-405 a vertical displacement fault was interpreted with the upthrown side of the fault present to the east of the fault line.

Cross-section C-C’ includes borehole log information from four wells beginning with well DW-407 to the west and ending at DW-404 to the east. Cross-section C-C’ covers a horizontal distance of approximately 1100 feet and is presented in Figure 10. No significant vertical displacements along cross-section C-C’ were interpreted based on the field borehole logs.

Cross-section D’D’ includes borehole log information from nine wells beginning with well DW-410 to the north and ending with well USGS-51 to the southwest. Cross-section D-D’ covers a horizontal distance of approximately 3550 feet and is presented in Figure 11. Between wells DW-405 to the north and DW- 407 to the southwest a vertical displacement fault was interpreted with the upthrown side of the fault to the south of the fault line. Between wells DW-407 to the north and DW-37 to the southwest was interpreted with the downthrown side of the fault to the south of the fault line. A third vertical displacement fault was interpreted between well DW-37 to the north and well USGS-51 to the southwest with the downthrown side of the fault to the south of the fault line.

Aquifer 2 – Buda Limestone

Confined by the Eagle Ford Group and the Del Rio Clay, the Buda Limestone has secondary porosity, fracture permeability, and the ability to produce limited amounts of ground water. It is not documented as a large producing aquifer and is commonly excluded from the discussion of aquifers in this region due to its limited production; however, locally it yields sufficient water for domestic use in a few wells. Consideration of the Buda Limestone as a hydrogeologic unit is due to the formation's ability to hold water and its proximity between the Austin Chalk Aquifer and the Edwards Aquifer.

Aquifer 3 – Edwards Aquifer

The main drinking water aquifer for Leon Valley and the greater San Antonio area is the Edwards Aquifer, which serves over a million people in south-central Texas. The EPA has designated the Edwards Aquifer a Sole Source Aquifer, as per the Code of Federal Regulations 40 CFR 5834. Two City of Leon Valley Public Water Supply wells, the San Antonio Water System Wurzbach/Evers Road public water supply wells, and a several private wells reside within 1.5 miles of the center of the contaminated ground water plume.

The Edwards Aquifer consists of the Georgetown Formation and the Edwards Group, with an approximate total thickness of 330 to 540 feet. Upper confining units are the Eagle Ford Shale, Buda Limestone, and Del Rio Clay, with a combined thickness under the Site of 125 to 160 feet. The lower confining unit of the Edwards Aquifer is the Upper Glen Rose Formation of the Trinity Group. The Glen Rose Formation generally has low permeability, but yields small quantities of water from distinct lateral zones. The seven members of the Person and the Kainer Formations, together with the overlying Georgetown Formation, compose the eight informal hydrogeologic subdivisions of the Edwards Aquifer (Table 1). The uppermost hydrogeologic member, the Georgetown Formation, has negligible porosity/low permeability and acts more like a confining layer.

The Edwards Aquifer has been divided into eight hydrogeologic subdivisions (Stein and Ozuna 1995), subdivision I is the Georgetown Formation, subdivisions II through IV are layers of the Person Formation, and subdivisions V through VIII are the layers of the Kainer Formation (Table 1). The subdivisions divide layers by porosity and permeability.

Recharge to the Edwards Aquifer occurs to a small extent by direct infiltration of precipitation on the outcrop. To a greater extent, recharge occurs by discharge from the streams that cross the outcrop in the Balcones Fault Zone and by underflow from Medina County (located to the west of Bexar County). The amount of recharge by direct infiltration of precipitation on the outcrop is negligible in comparison to the amount of recharge from other sources. Nonetheless, the response of well hydrographs to precipitation events is virtually one-to-one, and with little lag time in many wells (Figure 16).

12.5.2 Ground Water Flow

Ground water flow in karst aquifers will generally be through secondary porosity (e.g., dissolution features, faults, and fractures) that may or may not be interconnected within a well network. Primary porosity (e.g., intergranular pore spaces developed during formation) within limestones of this region is extremely limited to non-existent. Because of the complexity associated with flow through secondary porosity, detailed characterization of flow in karst aquifers generally is very difficult. As a result, characterization of ground water flow is best accomplished through the use of multiple investigation techniques in a weight of evidence approach.

Evidence revealing the complex nature of ground water flow in this karst environment includes falling head tests that were conducted on some of the wells at the Site. Some of the Austin Chalk wells (e.g, DW-404 and DW-415), when injected with water, took a relatively small amount of water (i.e., 49 and 91 gallons) and exhibited a slow recovery (about 10% of the initial head change within 4 hours for DW-404). This is an indication that the wells probably did not intercept significant fractures. Other Austin Chalk wells (e.g., DW-408, DW-414, and USGS-42) responded differently to the falling head test, in that the wells took 231, 216, and 175 gallons of water. The water level in DW-408 recovered completely within less than an hour. It is clear from this that these wells are hydraulically connected to the one or more of the local fractures, possibly intercepting minor faults and/or karst dissolution conduits. This is consistent with other observations in the wells (e.g., the sound of water flowing within the well and the anomalously low water level).

12.5.3 Horizontal Hydraulic Gradients

Ground water contours illustrating horizontal hydraulic gradient in the Austin Chalk for September 2010 is provided in Figure 17. The contouring was based on ground water levels, subsurface stratigraphic interpretations, and distribution of ground water contaminants. Water levels were not evaluated relative to faulting/inferred fault locations. Hydraulic heads in monitoring wells are very inconsistent as is expected in karst aquifers. The degree to which a potentiometric surface map can be meaningful and constructed with a high level of certainty in karst aquifers is limited, thus extensive fault analysis was not conducted. Continuous hydrographs from transducers indicate that some fractures encountered respond virtually immediately to rainfall and karst flow which is not governed by seepage through porous media. It should be noted that there are several ways that these data could be contoured, and best professional judgment was employed to generate the maps using the available data. It is likely that other, possibly localized, flow paths exist that could not be discerned using the tools available for this investigation. Because of this, these ground water contours should be used with caution and should not be considered definitive.

The horizontal hydraulic gradient within the Austin Chalk Aquifer appears to be controlled by the structure contours of the Austin Chalk and Eagle Ford contact. Evaluation of the bottom of the Austin Chalk Formation depths (Figure 18) reveals similarity between the structure of the formations and the interpreted ground water elevations. Note the general northern flow of ground water in the Source Area 1 wells. However, dye tracer testing conducted at well USGS-42 demonstrated a ground water flow direction to the south-southwest. The Source Area 2 wells showed a general south-southwest ground water flow direction.

Some localized anomalous features exist regarding ground water levels in the Austin Chalk at the Site. The water level in well DW-412 (Figure 17) is considerably higher (40 ft or more) than the other Austin Chalk wells. This result is likely due to the storm drains located next to the well and/or its proximity to Huebner Creek. The water level is only a few feet below land surface, and it has little to no temporal variation; therefore, it is likely that normal ground water flow paths are not hydraulically connected with this well.

Conversely, the water level in Austin Chalk well DW-414 is anomalously low compared to the other wells in the investigation area (Figure 17). The water level in this well is similar to those within the Buda Limestone. The reason for this is not clear, but there appears to be a subsurface low within the bottom of the Austin Chalk Formation (Figure 18). The change in elevation of the bottom of the Austin Chalk Formation could be related to a fault plane transmitting ground water across the Eagle Ford Group from the Austin Chalk to the Buda Limestone.

The horizontal hydraulic gradient in the Edwards Aquifer within the vicinity of the Site appears to be generally from the west-northwest toward the southeast (Figure 19). The Edwards Aquifer is confined in this area. This contour map was generated using only a few wells over a large area, so the contours are more general than those in the Austin Chalk (Figure 17).

12.5.4 Vertical Gradients and Temporal Water Levels

The vertical hydraulic gradient between the Austin Chalk, Buda Limestone, and Edwards Aquifers is generally downward within the investigation area. Continuous water levels were collected by installing transducers in selected wells from April 2009 through July 2010. The water levels measured from September 1, 2010 through October 13, 2010 are presented in Figure 20. The results indicate that water levels in the Austin Chalk wells (except for DW-414) are consistently higher than those in the Buda Limestone and Edwards Aquifers.

The response of water levels in Austin Chalk wells to precipitation events is variable among different groups of wells. Generally the Source Area 1 Austin Chalk wells (Figure 21), have a response to rain events that is very different than the Source Area 2 Austin Chalk wells (Figure 22). Austin Chalk well DW-411 responds to rain events in the same manner as the Source Area 1 Austin Chalk wells (Figure 21). While, the remaining Austin Chalk wells between the source areas respond to rain events in the same manner as the Source Area 2 wells. The similarities in hydrologic response are an indication of a hydrologic connection amongst wells, but no hydrologic connection between the two areas. The hydrologic connections indicated by transducer data correspond to the Austin Chalk Aquifer ground water flow paths discussed previously.

12.5.5 Depth to Ground Water

Depth to ground water is an important factor in the connection between contaminant sources and ground water. Based on water level data from May 21 – 22, 2010, depth to water in the Austin Chalk ranged from approximately 6 feet (DW-412) to approximately 88 feet (DW-417) below ground surface (bgs). Depth to ground water in DW-408 (approximately 86 feet) was similar to that of DW-417, and depth to ground water in DW-414 was approximately 80 feet bgs. The average depth to water at the Site was approximately 63 feet bgs.

12.5.6 Soils

Site specific soil information was obtained from the Soil Survey, Bexar County Texas, produced by the United States Department of Agriculture (USDA) Soil Conservation Service, in cooperation with the Texas Agricultural Experiment Station (USDA 1962). The Site is situated within the Lewisville-Houston Black soil association, generally described as deep, calcareous clayey soils in old alluvium. Soil types encountered at the Site included:

- Houston Black Clay (HsB)
- Austin Silty Clay (AuB) and (AuC)
- Brackett Soils (BrD)
- Houston Black Clay, terrace (HtA)
- Lewisville Silty Clay (LvB)

Houston Black Clay series soils consist of clayey soils that are deep, dark gray to black, and calcareous. These soils have slow to rapid surface drainage and slow to no internal drainage. Runoff can be observed during continuous precipitation events following soil saturation. Natural fertility is high for the soil series, but water erosion can be a hazard. Within the Site two types of Houston Black Clays can be found. HsB soils occur as long, smooth, gentle slopes, roughly one to three percent in grade, and are the dominant soils surrounding the Site. HsB soils can be observed in the vicinity of USGS-42 (Figure 4). Water runoff is a major hazard for this soil type, due to the increased slope and slow water infiltration. HtA soil is the other Houston Black Clay soil that occurs in the area. With zero to one percent slopes, the HtA soils occur as broad outwash plains and terraces, commonly paralleling major streams. These soils commonly contain a water-bearing gravel layer, near their base.

Austin series soils are described as clayey soils that are moderately deep, moderately dark colored (but lighter than the Houston Black Clay series soils), very strongly calcareous, moderately productive, and susceptible to water erosion. These soils are found at higher elevations and are typically gentle rolling hills. These soils developed from weathered chalk or chalky marl, forming under grass. AuB soils range in slope from one to three percent and occupy low, broad ridge-tops. AuC soils range in slope from three to five percent and typically have higher clay content than the other Austin series soils.

Brackett series soils are described as shallow, light colored soils with low fertility that are susceptible to water erosion and high in lime content. These soils typically form over soft limestone interbedded with hard limestone, resulting in a characteristic stair-step appearance. BrD soils typically have five to eight percent slopes, but can have slopes up to twelve percent and occur at higher elevations within the typical rolling hills.

Lewisville series soils are moderately deep, dark colored, highly productive, and highly susceptible to water erosion without terracing or vegetative cover. Forming as nearly level alluvial soils, these soils can commonly be found along the San Antonio River, Medina River, and their many tributaries. Permeability is slow to moderate, resulting in slow to moderate surface drainage. Lewisville series soils have a moderate capacity to hold water resulting in moderate internal drainage. LvB soils typically have one to three percent slopes and occupy long, narrow, sloping areas that separate terraces from upland soils.

12.6 Ground Water, Soil, Vapor Sampling and Additional Investigative Activities

As discussed in Section 9.1 (History of Site Activities), previous TCEQ investigations identified the presence of PCE and TCE at concentrations above the EPA MCLs in private Edwards Aquifer wells. When the Site was listed on the NPL in 2007, no contaminant source areas had been identified. The initial Superfund site activities included the San Antonio office of the U.S. Geologic Survey (USGS) conducting a water well record search followed up by visual inspections of the area to identify water wells. Efforts were also taken to determine that status of wells which were identified in historical records but were no longer present at the ground surface and for which no plug and abandonment records were found (SAIC 2009).

Wells identified in the USGS water well survey were sampled, primary for volatile organic compounds. After several rounds of well sampling, sampling at the most of the wells with no or only trace levels of contaminants (i.e., low level estimated PCE concentrations reported by laboratory generally in the 0.2 – 0.3 µg/L range) was discontinued. Water well sampling has continued at wells determined to be impacted and wells located near impacted wells. In additional, routine sampling of the two Leon Valley municipal water wells has continued to ensure these wells are not adversely impacted. Fourteen (14) additional monitoring wells were installed and sampled by the EPA in the Austin Chalk, Buda Limestone, and the Edwards Aquifer.

Due to elevated levels of PCE detected in the Austin Chalk monitoring well USGS-42 (as high as 11,700 µg/L) (Figure 23) and a documented release of PCE within the location of the former dry cleaner within the Savings Square Shopping Center (Leon Valley Fire Department 1997), passive soil gas sampling was conducted in November 2008 (Beacon 2008). Thirty-eight passive soil gas samplers were installed in the subsurface (i.e., in contact with native soils) on a 25 foot grid around the former dry cleaning location and an adjacent structure to the east. Passive soil gas samplers were left in place for a week, retrieved, and sent for analyses. The analyses reported the mass collected on the sampler from the vapor-phase emanating from a source. The vapor-phase is merely a fractional trace of the source, so, as a matter of convenience, the units used in reporting detection limits from passive soil-gas surveys (e.g., nanograms – 1 billionth of a gram) are smaller than those employed from source-compound concentrations. The measured concentration does not represent a volume of contamination such as a part per million or microgram per liter, but the concentration of a compound adsorbed on the passive soil gas sampler. The passive soil gas results were presented on figures showing the sample locations and corresponding PCE detections (Figure 24). The primary compounds detected were PCE (19,202 nanograms), TCE (2,484 nanograms) (Figure 25), and cis-1,2-TCE (23,230 nanograms) (Figure 26). These results of the soil gas survey were used to inform subsequent soil and active soil gas sampling.

Due to elevated levels of PCE detected in Austin Chalk monitoring well DW-404 (as high as

1,740 µg/L) (Figure 23) and documented PCE soil and soil gas detections (RMT/Jones & Neuse, Inc. 1995), passive soil gas sampling was conducted to the south and east of the active dry cleaner (Figure 4) in October 2009 (Beacon 2009). Twenty-five passive soil gas samplers were installed on a 12.5 meter grid. Passive soil gas samplers were left in place for two weeks, retrieved, and sent for analyses. The analyses reported the mass collected on the sampler from the vapor-phase (e.g., nanograms) emanating from a source (Figure 27). The primary compounds detected were PCE (3692 nanograms), TCE (593 nanograms), cis-1,2-TCE (27,884 nanograms), and vinyl chloride (939 nanograms). With the exception of PCE, the locations of the maximum detections all correspond to the approximate location of the former Luckey water supply well (SAIC 2009). The maximum PCE detection was located just off an existing concrete pad which was used to store 50 gallon drums which contained PCE (Figure 28). These results were used to inform subsequent passive soil gas, soil and active soil gas sampling.

In October 2009, passive soil gas sampling was conducted along the centerline between Poss and El Verde Roads (AOI 3) (Figure 3). Thirteen passive soil gas samplers were installed approximately every 50 meters (Figure 29). Passive soil gas samplers were left in place for two weeks, retrieved, and sent for analyses. No volatile organic compounds were detected (Beacon 2009).

In 2010, passive soil gas sample events occurred in May and in July (Beacon 2010). In May, fifteen additional passive soil gas samplers were installed in an approximate 10-meter grid pattern around the AOI 2 area with the highest previous passive soil gas PCE detection. Passive soil gas samplers were left in place for two weeks, retrieved, and sent for analyses. In July, an additional eight more passive soil gas samplers were installed in an approximate 10-meter grid pattern to the northwest of the May 2010 passive soil gas sampling locations (Figure 30). The primary compound detected was PCE (23,130 nanograms).

In May 2010, passive soil gas sampling occurred in AOI 3 around a current Leon Valley Storage building (Beacon 2010). This building served as an aircraft hanger building in the 1940's as part of the former Culver Air Field. Fourteen passive soil gas samplers were installed approximately every 20 meters around the building (Figure 29). The passive soil gas samplers were left in place for two weeks, retrieved, and sent for analyses. The results of were presented on figures showing the sample locations and corresponding detections (Figure 31). The primary compound detected in the soil gas samples was methylene chloride (165 nanograms). No PCE, TCE, Cis-1,2-DCE, or VC were detected in the passive soil gas samples.

Exterior to the Leon Valley Storage building was the previous Edwards Aquifer well (DW-37) which had a maximum PCE detection of 60.4 µg/L. DW-37 was plugged and abandoned by EPA (Figure 23) in April 2009. No methylene chloride was detected in the eight (8) DW-37 water well sampling events conducted from November 2005 through February 2009 (EA 2011a). In February 2012, an Austin Chalk monitoring well (MW3-6200) was installed at the Leon Valley Storage facility by a contractor for Savings Square Partner's Ltd. (SSP). This well was installed to a depth of 195 feet below ground surface (Figure 32). This well was sampled by the EPA in March and May 2012. PCE concentrations of 2.0 µg/L and 6.3 µg/L were detected. A summary of detected compounds from EPA's sampling of monitoring well MW3-2012 are provided in Table 4.

In November 2010, passive soil gas sampling occurred in AOI 4 (Figure 3). A former dry cleaner operated in the shopping center from 1983 to 1987. There are no operating dry cleaners within AOI 4. Six (6) passive soil gas samplers were installed at shopping center. The passive soil gas samplers were left in place for two weeks, retrieved, and sent for analyses. Two of the passive soil gas samplers located near the current Kwik Wash laundry facility had PCE detections of 117 nanograms and 330 nanograms . An additional eight (8) passive soil gas samplers were installed around the Kwik Wash laundry facility in January 2011 (Figure 33). The passive soil gas samplers were left in place for 13 days, retrieved, and sent for analyses. Four (4) of the passive soil gas samplers had PCE detections from 27 to 298 nanograms (Beacon 2011). PCE concentrations were low in comparison to previous soil gas sampling events in AOI 1 and AOI 2. It is unlikely that the impacts to ground water in the vicinity of AOI 1 or AOI 2 are related to the detections at this location (EA 2011a).

In March 2012, an Austin Chalk monitoring well (MW5-7007) was installed adjacent to Kwik Wash Laundry by a SSP contractor (Figure 34). This well was installed to a depth of 230 feet below ground surface. This well was sampled by the EPA in May 2012. PCE was detected at an estimated concentration of 0.76 µg/L. No other volatile organic compounds were detected.

In November 2010, passive soil gas sampling occurred in AOI 5 (Figure 3). A former dry cleaner (Kwik-n-Neat) operated at this location from approximately 1987 to 2002. There are no operating dry cleaners within AOI 5. Seven (7) passive soil gas samples were installed, left in place for two weeks, retrieved, and sent for analyses (Figure 35). No PCE, TCE, Cis-1,2-DCE, or VC were detected in the samples (Beacon 2011).

12.6.1 In situ Bioremediation Pilot Study Activities

In order to evaluate the ability of *in situ* bioremediation to achieve MCLs in the Austin Chalk, an *in situ* bioremediation pilot study was conducted in the Austin Chalk at Source Area 2. On January 11, 2011, 40.8 kilograms of Regenesis 3-D Microemulsion HRC Advance (3DMe™) (Food Grade) was mixed with well water and injected into the Austin Chalk monitoring well DW-404. Enhanced anaerobic bioremediation using 3DMe™ adds hydrogen (an electron donor) to ground water in order to increase the number and activity of anaerobic microbes that naturally degrade contaminants (i.e., PCE) to ethane, ethene and other innocuous end products. The EPA has been conducting monitoring of well DW-404 for the following parameters:

- PCE and its degradation products (i.e., TCE, cis-1,2 DCE, vinyl chloride);
- Biodegradation products methane, ethane, and ethene; and
- Measuring counts of bacteria capable of reductive dechlorination of PCE to ethene using bio-trap samplers.

Table 2 presents monitoring well DW-404 sampling results for volatile organic compounds (i.e., PCE, TCE, cis-1,2-Dichloroethene) for samples collected from June 2010 to May 2012. Since the addition of the 3DMe™ into monitoring well DW-404 in January 2011, there has been a 99.7% reduction in PCE concentrations. The most recent sampling event, the concentrations for PCE and TCE were not detected with a reporting limit of 5µg/L (i.e., the MCL for PCE and TCE). The May 2012 sampling results for cis-1,2-Dichloroethene were estimated at 1.1 µg/L.

The MCL for cis-1,2-Dichloroethene is 70 µg/L.

Biodegradation products (i.e., methane, ethane, and ethene) have also been measured. A baseline sample was collected in June 2010 followed by samples in February 2011, July 2011, January 2012, and May 2012 (Table 3). Methane concentrations greater than 1,000 µg/L are indicative of conditions conducive for reductive dechlorination of chlorinated solvents (i.e., PCE, TCE). The baseline methane concentration in DW-404 from June 2010 was 0.45 µg/L. Since the application of 3DMe™, methane concentrations have been measured at concentrations as high as 7,720 µg/L (January 2012) and most recently in May 2012 at 5,870 µg/L.

As part of the effort to evaluate the potential for *in situ* biodegradation of chlorinated solvents, the EPA collected water samples for bacteria analysis from monitoring wells (including DW-404) in April 2009. Specifically, the bacteria count for Dehalococcides ssp. (DHC) was determined by Microbial Insights, Inc. The DHC bacteria have been found to be capable of fully dechlorinating PCE to ethene. The April 2009 result for DW-404 found that the DHC counts were less than 0.5 cells/mL. When DHC counts are less than 10 cells/mL, this suggests that complete reductive dechlorination of PCE and TCE to ethene is unlikely to occur under existing conditions. As part of the ongoing *in situ* bioremediation pilot study, the EPA placed bio-trap samplers in monitoring well DW-404 in February 2011 after the addition of 3DMe™. Bio-trap samplers are a passive sampler tool used to collect microbes over time. In January 2012, a bio-trap sampler was removed from monitoring well DW-404 and sent to Microbial Insights for analysis. The January 2012 analysis found a DHC count of 26,900,000 cells/mL (Microbial Insights, 2012). A DHC concentration of 10,000 cells/mL is used to identify sites where reductive dechlorination will yield a generally useful biodegradation rate.

Based on the results outlined above, the application of 3DMe™ has been found to create conditions in monitoring well DW-404 conducive to the reductive dechlorination of PCE to ethene. Based on the results of the May 2012 sampling, MCLs for tetrachloroethene, trichloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene, and vinyl chloride have been achieved in DW-404.

12.6.2 Additional Investigation Activities Conducted by Pilgrim Cleaners and Savings Square Partners, Ltd.

In response to EPA's proposed plan, requests were made by Pilgrims Cleaners and the Savings Square Partners, Ltd. to conduct investigative activities to provide additional information which might better inform the remedy selection. The following is a summary of the investigative activities conducted by Pilgrim Cleaners and Savings Square Partners, Ltd.

12.6.2.1 Pilgrim Cleaners Investigative Activities

In the fall of 2011, Pilgrim Cleaner retained Terracon Consultants, Inc. (Terracon) to collect on-site soil data and upper-most ground water data at the Pilgrim Cleaners property located at 6600 Bandera Road. The work consisted of collecting soil samples from two locations (i.e., TB-1, TB-2) using hollow-stem auger techniques to depths of approximately 35 feet. Soil boring TB-1 was advanced near the southeast corner of a concrete pad that was used to store drums of spent tetrachloroethene (PCE). Soil boring TB-2 was advanced adjacent to a former Edwards Aquifer water supply well referred to as the Luckey well. No plugging records were found for the Luckey well (SAIC 2009). Documentation of this well can be found in the Hazard Ranking System Documentation Record (TCEQ 2006a), Reference 42. Specifically, Reference 42 contains information identifying the well as the Leon Valley Water Supply Company well (State Well No. AY 68 36.101). The well was public water supply well for 30 houses drilled in 1943 and could produce 300 gallons per minute. This well had a total depth of 340 feet with a steel casing to 300 feet. This well is also identified on a 1957 plat map for the Jeff Luckey subdivision as part of the "Water Co" (SAIC 2009).

Upon completion, soil borings TB-1 and TB-2 were completed as ground water monitoring wells TMW-1 and TMW-2. After installation, ground water did not accumulate in monitor well TMW-1. Ground water accumulated in monitoring well TMW-2 immediately after installation. Monitoring well TMW-2 was developed by removing ground water with a peristaltic pump until ground water appeared relatively clear and free of sediment. Ground water samples were collected from monitoring well TMW-2 using low flow sampling techniques.

On January 11, 2012, EPA sampled TMW-1 and TMW-2. Monitoring well TMW-1 had accumulated approximately one foot of water. A bailer was used to collect a water sample. Monitoring well TMW-2 had approximately 12 feet of water and was sampled using the low-flow sampling technique. TMW-1 and TMW-2 were most recently sampled in May 2012. The primary compound detected in TMW-1 was PCE with concentrations of 130 µg/L and 94 µg/L in January 2012 and May 2012, respectively. For TMW-2, the primary compounds detected were PCE, TCE, and cis-1,2-DCE. PCE had the highest concentrations of 640 µg/L and 730 µg/L in January 2012 and May 2012, respectively. A summary of the sampling results for monitoring wells TMW-1 and TMW-2 are presented in Table 5.

12.6.2.2 Savings Square Partners, Ltd. Activities

Additional investigation activities were undertaken by Savings Square Partners, Ltd (the current property owner), in the vicinity of the former dry cleaning operations at the Savings Square Shopping Center located at 6709 Bandera Road, in Leon Valley, Texas. These activities included further evaluation of monitoring well USGS-42, a vadose zone bedrock soil vapor extraction test, and soil sampling beneath the foundation slab. The SSP also installed Austin Chalk monitoring wells at two former dry cleaners in the area and at a former air field. These activities are documented in the Supplemental Remedial Investigation Area of Investigation 1 (Weston Solutions, Inc. August 2012).

12.6.2.2.1 Further Evaluation of Well USGS-42

Further evaluation of well USGS-42 occurred in January 2012. Approximately 150 gallons of water were removed from well USGS-42 after the collection of a baseline sample. The volume of water removed closely correlated to the well volume at the achieved drawdown (about 88 feet of drawdown), and indicated little recharge during the drawdown process. After 1.5 hours, the well had recharged approximately 0.31 feet (or approximately 0.51 gallons). After 26 hours, the well had recharged approximately 4.87 feet (or approximately 7.9 gallons). The water level was monitored for a 17-day period. For the first 13 days, the average recharge rate was approximately 4.73 gallons per day and recovered 35.32 feet to approximately 40% of the pre-test level. Between 27 and 30 January 2012, the average recharge rate increased to 29.16 gallons per day and 10.68 gallons per day during which the well recovery attained 102 percent of the pre-test static level. This increased rate of recharge is attributed to the 3.13 inches of sustained rainfall in the area during 23 to 24 January. This finding is analogous to the information presented on Figure 16 in which a jump in water levels occurs in area wells in response to rain events.

The greater than seven-fold sudden increase in water level recovery rate into the well that occurred on 26 to 27 January 2012 was likely in response to the January rainfall events. However, the low rate of recovery exhibited in the saturated section of the well (below 77.65 feet below the top of the well casing (BTOC) suggest that the sudden water level rise may have been caused by infiltration from more permeable vadose zone units (above 77.65 feet BTOC) exposed between the casing (set to approximately 50 feet below ground surface) and pre-test static water level.

PCE was reported to be present at a concentration of 7,400 μg/L in the baseline (pre-test) sample. In the sample collected the second day of the test after purging the well, PCE was detected at a concentration of approximately 4,400 μg/L. PCE was detected at a concentration of 6,740 μg/L at the end of the test period (January 31, 2012). The most recent sampling of USGS-42 conducted on May 7, 2012, detected PCE at an estimated concentration of 4,100 μg/L.

12.6.2.2.2 Vadose Zone Bedrock Soil Vapor Extraction Test

In October 2010, soil vapor extraction (SVE) testing was conducted at five ground water monitoring wells and two shallow vapor-monitoring wells by the EPA to evaluate the potential for application at the Site. In this pilot test, SVE was evaluated for soil from 0 to 10-feet below ground surface as well as the underlying karsts bedrock. The test duration at each location ranged from 40 minutes to 4.5 hours (EA 2011). Based on this testing, VOCs can be removed from the shallow overlying clay/caliche soil matrix and Austin Chalk. However for shallow SVE wells, there is the potential for short-circuiting (i.e., air from the surface rather than the vadose zone). The primary factor in implementing SVE in the Austin Chalk will be the location of wells in proximity to the source.

The purpose of the testing conducted in 2012 by the SSP was to gather longer-term (several days) soil vapor extraction (SVE) data in the vadose zone bedrock, in order to further assess the applicability of SVE as a full scale remedial measure. The planned work was also intended to further evaluate whether there was a source of PCE in the vadose zone bedrock that warranted separate remediation. Two wells (SVE Well 1 and SVE Well 2) were installed in the alley way adjacent to the former dry cleaner on the SSP property within the vadose zone bedrock (Figure 36). Wells SVE-1 and SVE-2 were completed to depths of approximately 50 feet. Well USGS-42 was used as an observation well and was also subject to a short term flow rate test. SVE testing on well SVE-1 was performed for 71 hours. Field monitoring of the extracted vapors was performed along with documentation of test conditions. A vacuum of up to 150 inches of water was applied to the test well. As part of the testing, nine vapor samples were collected for laboratory analysis. The maximum flow achieved from extraction well SVE-1 was 8.4 standard cubic feet per minute (scfm). The concentration of PCE in the extracted vapor was initially around 2,700 milligrams per cubic meter (mg/m^3) (~ 400 parts per million vapor [ppmv]), which was similar to the concentration reported in the October 2010 SVE test (2,303 mg/m^3). During the 2012 SVE tests, after approximately 24 hours, the concentrations began to drop significantly and, by the end of the test, the PCE concentration in the extracted vapors was 170 mg/m^3 (~ 25 ppmv).

It is important to note that the vapor concentrations in USGS-42 increased during the 71 hour pilot test contrary to the results observed for SVE-1 and SB103 (as shown in Table 3-8 of the Supplemental Remedial Investigation Report – Weston Solutions, Inc. 2012). Previous work at USGS-42 identified a critical fracture located between 70 and 80 feet below ground surface. The increase vapor concentration detected in USGS-42 indicates that the vacuum induced in USGS-42 was extracting higher concentrations from a critical fracture. These critical fractures may contain a significant mass of contamination. During the pilot tests conducted by EA, vacuum influence was observed at large distances from the extraction well (over 200 feet), indicating that subsurface vapor flow is fracture dominated.

A short-term test was performed on USGS-42 to assess the maximum flow rate that could be achieved. Based on this testing, at 60 inches-water induced a flow rate of 18.9 standard cubic feet per minute (scfm) could be achieved.

12.6.2.2.3 Soil Sampling Beneath the Foundation Slab

The objective of this task was to gather additional information regarding to the level and extent of PCE impact to the soil near the former dry cleaner location in order to further evaluate remediation methods: excavation or SVE. Soil borings were completed at seven locations within Building 1 (see Figure 37) and six locations along the southeastern outside edge of Building 1. A PCE concentration of 200 milligrams per kilogram (mg/kg) was reported for the sample CA-1 @ 0-2 collected in the apparent source area at a depth of 0 to 2 feet (Figure 37). This sample was collected within approximately four feet of the location where the highest soil vapor concentrations of PCE were reported to be present. A sample collected from this same location was reported to contain only 0.07 mg/kg of PCE at a depth of 2 to 4 feet. A summary of the detected compounds are presented in Table 6. Addition source delineation sampling of nine soil borings within Building 1 and one soil boring just outside Building 1 (designated AI-1 thru AI-10) took place in May 2012 (Figure 38). A summary of the detected compounds are presented in Table 7.

12.6.2.2.4 Additional Monitoring Well Installation and Sampling

In addition to installing Austin Chalk monitoring wells at the Former Air field and Kwik Wash Cleaners, the SSP also installed two monitoring wells adjacent to the former Pride Cleaners previous located at 6535 Bandera Road - a shallow alluvial 35-foot deep monitoring well (MW4-

6535) and a 180-foot deep Austin Chalk well (MW2-6535). Figure 39 shows the locations of these new wells. These wells were sampled by the EPA on May 7, 2012. A summary of the detected compounds are presented in Table 8. PCE was detected in the shallow alluvial well at an estimated concentration of 1.3 µg/L, and in the Austin Chalk well at an estimated concentration of 5.3 µg/L.

12.6.3 Edwards Aquifer Authority Historical Wells Search Initiative

In late 2011, the Edwards Aquifer Authority (EAA) identified well locations from old right-of-way maps and historical photos. EAA then procured a surveying contractor to identify potential locations and a surface geophysics contractor to search for buried well casings. The geophysics contractor searched for wells at six sites in the contaminated ground water area. Using surface geophysical methods, the contractor found indications of buried wells at the Savings Square Shopping Center and two nearby businesses. The search did not confirm several other expected well locations. The results were provided in a report provided by Round Rock Geophysics, LLC. – The Use of Ground Penetrating Radar (GPR), EM-61, and Magnetic Gradient Methods to Locate Wells in Leon Valley, San Antonio, Texas (Round Rock Geophysics, LLC, 2012).

These old wells, if not properly plugged and abandoned, can act as migration pathways for contaminated ground water. As part of next steps, EAA will coordinate with EPA, landowners and utility companies and perform excavations to expose well casings. EAA will discuss well plugging costs with EPA to define funding mechanisms. In addition, the Texas Department of Transportation (TxDOT), completed a records search for information on historical wells in the Grissom Road and Bandera Road rights-of-way. TxDOT's records indicate that three wells were plugged during the expansion of Bandera Road in the early 1970s.

12.6.4 Additional EPA Investigation Activities

The EPA collected additional ground water samples in January 2012 and May 2012. Additional soil, soil gas, sub-slab vapor, and indoor air samples were collected in May 2012. Ground water samples were collected from the two Leon Valley municipal water wells, three shallow 35-foot monitoring wells, eleven Austin Chalk wells, and two Buda wells. Within AOI 1, three indoor air samples (with one duplicate sample) and one background air sample were collected. Within AOI 2, eight soil samples, five soil gas samples, one indoor air, two sub-slab vapor (with one duplicate sub-slab sample), and two vapor samples (with one duplicate sample) were collected from two shallow ground water monitoring wells. All samples collected were analyzed for volatile organic compounds.

In regards to the Leon Valley municipal water wells, no volatile organic compounds were detected. Two of the three shallow 35-foot monitoring wells (TMW-1, TMW-2) are located on the Pilgrims Cleaners property. The third 35-foot monitoring well is located at the former Pride Cleaners. A summary of sampling results for the 35-foot monitoring wells are provided in Tables 5 and 8.

The sampling results for eleven Austin Chalk wells, two Buda Limestone wells, and two

Edwards Aquifer wells are presented in Table 9. It is important to note that when the sample from the Buda well DW-413 was collected in May 2012, it was mistakenly mislabeled as being collected from the adjacent Austin Chalk monitoring well DW-407. The EPA laboratory reports do not reflect this mislabeling mistake. However, EA's field activity report (EA 2012) does provide documentation of this mislabeling error.

Soil samples were collected from 8 locations (Figure 40) in AOI 2 and analyzed for volatile organic compounds. Trace levels of toluene (less than 1 µg/kg) were detected at each location. PCE was detected at two locations at concentrations of 18 µg/kg and 3.2 µg/kg. The soil sampling results are summarized in Table 10.

Indoor samples were collected from four locations (including one duplicate) and background air sample. The three of the indoor air samples and background air sample were collected in AOI 1. The other indoor air sample was collected in AOI 2. Indoor air and background air samples results are summarized in Table 11.

The five soil gas samples were collected in AOI 2 in the property behind the automotive repair facility adjacent to the active dry cleaner. The highest concentration of PCE was detected in sample VI-224-SGA (5,890 $\mu g/m^3$). The highest concentration of TCE (171 $\mu g/m^3$) was detected in sample VI-206-SGA. Sample VI-222-SGA had the highest detected benzene (129 $\mu g/m^3$), ethylbenzene (101 $\mu g/m^3$), meta-/para-Xylene (27.4 $\mu g/m^3$), and ortho-Xylene (12.6 $\mu g/m^3$) concentrations. The sample locations are provided on Figure 40. The soil gas sampling results are provided in Table 12.

The two sub-slab vapor samples (with one duplicate sub-slab sample) were collected beneath the active dry cleaner in AOI 2. The two shallow well vapor samples (with one duplicate sample) were collected from ground water monitoring wells (TMW-1 and TMW-2) located behind the active dry cleaner. PCE and its degradation products (i.e., TCE, cis-1,2-Dichloroethene, Vinyl Chloride) were detected in the sub-slab and well vapor samples. PCE was detected in sub-slab sample VI-216 at an estimated concentration of 34,600 $\mu g/m^3$ and in well vapor sample TMW-2 SGA at a concentration of 72,800 $\mu g/m^3$. The sub-slab and well vapor sample results are summarized in Table 13.

12.7 Migration Pathways

The nature and extent of contamination is combined with source identification and physical characteristic information to evaluate migration pathways. Although several migration pathways are discussed in the following sections, the following are primary for this Site:

- Leaching to Ground Water
- Soil and Ground Water to Soil Gas
- Soil Vapor to Air
- Vapor Intrusion
- Ground Water Flow

12.8 Area of Investigation 1

AOI 1 includes the area in the vicinity of a former dry cleaning facility that contains Source Area 1.

12.8.1 AOI 1 – Nature and Extent of Contamination

The Conceptual Site Model for Source Area 1 is presented in Figure 41. PCE was released inside Building B1 during dry cleaning operations (Figure 4). Based on the cumulative results to date of soil samples collected beneath the building foundation, the area where PCE impacted soil is present beneath the foundation comprises an area of approximately 15 by 20 feet (Weston 2012).

Surface (0 to 2-feet bgs) and subsurface soil (2 to 10-feet bgs) samples were collected from base material and soil in the vicinity of the building. Generally, soils are located under a 2-6 inch layer of concrete or asphalt, with base material extending 1 to 2-feet bgs. The base material consisted of limestone clasts, in a crushed chalk and clay matrix. Generally, subsurface soils were composed of organic clay and caliche to the Anacacho Limestone, which was encountered at approximately 10-feet bgs.

The maximum PCE concentration in soil was 200 mg/kg (location CA-1, 0-2 feet), which is greater than the EPA regional cancer screening level for industrial soil of 110 mg/kg (Table 6). The maximum subsurface soil PCE concentration for depths greater than 2 feet was 72.4 mg/kg (location CA-3, 2-4 feet). Location CA-3 is also beneath the building slab. The highest PCE soil concentration outside the building footprint was detected at location SB-204 (near the vicinity of the spill location). Location SB-204 had PCE concentrations of 9.26 mg/kg (from 1-3 feet) and 43.5 mg/kg (from 2 – 5 feet).

Soil samples collected in Source Area 1 confirm that PCE was released to soil and is a continuing source for migration, although concentrations decreased with distance from the original spill area inside the building. As shown on Figure 37, the only soil sample with PCE concentrations exceeding the EPA industrial soil risk screening level was at location CA-1 in the near vicinity of the suspected PCE spill location. PCE concentrations in other soil samples were below the industrial soil risk screening level, suggesting a limited lateral extent of affected soil.

Active sub-slab soil gas samples collected from beneath the slab indicate that significant source material remains (Table 15 and Figure 42). This is evidence by sub-slab soil gas sample VI-101-CSA that had a concentration of PCE of 25,000,000 $\mu g/m^3$, which is near the original spill area. Because of the concentrations and migration potential (e.g., leaching to ground water and vapor intrusion), the source area material is considered Principal Threat Waste. As discussed in the Supplemental Remedial Investigation Report (Weston 2012), there are soils beneath Building 1 that are acting as a source of PCE vapors to the indoor air within Building 1, the overburden soil, and vadose zone bedrock. In addition, it appears that PCE and PCE degradation products from this soil are leached by infiltrating water that also enters USGS-42, and the vapors are migrating into the vadose zone bedrock.

Soil gas sample concentrations decrease with distance from the original spill area, as observed in sub-slab soil gas sample VI-111-CSA, which had a concentration of 180 $\mu g/m^3$ (Figure 42). However, soil gas concentrations in the vicinity of Building B1 and nearby buildings indicate that PCE vapors have migrated significantly in the vadose zone soil. This observation is supported by the qualitative passive soil gas sample results, which are depicted in Figure 42. Soil gas vapor ports were installed so that they were open to the construction base and underlying soil, which was typically 1 to 2-feet below ground surface.

Although the discussion has focused on PCE, media have been impacted by the dechlorination daughter products TCE, DCE and VC (Tables 6, 7, 9, 11, 14, 15, and 16). An inspection of the sub-slab soil gas results are presented on Figure 43, which indicate attenuation of PCE to TCE, DCE, and VC from beneath Building B1 in the vadose zone. There is less attenuation beneath Building B2 and Building B3. The attenuation beneath Building B1 may be attributed to a water leak beneath the building, which was suggested by water saturation observed in soil borings and confirmed anecdotally by the buildings occupants. The water leak may have facilitated leaching of the chlorinated solvent to ground water, which is discussed further below.

12.8.2 AOI – Migration Pathways

Chlorinated Solvents may migrate via the following migration pathways:

- **Leaching to Ground Water –** As water percolates from the surface, through vadose zone soil, to the underlying ground water, it can carry dissolved phase constituents. Additionally, source material in contact with ground water can leach directly to ground water. Transport will occur through secondary porosity such as preferred flow paths through fractures, faults, and dissolution features, as well as through man-made flow paths such as well bores. This pathway could include non-aqueous phase liquids or dissolved phase organic compounds.

  During a soil vapor extraction pilot test on USGS-42, PCE soil gas concentrations from the open-hole interval (i.e., approximately 40 to 80 feet below ground surface [top of the water table]) were estimated at 2,000,000 $\mu g/m^3$. This PCE concentration is only an order of magnitude less than those beneath the slab of the building, which is the original spill area. This indicates the potential presence of product in the vadose zone bedrock (i.e., Austin Chalk), which likely migrated via fractures, faults, or dissolution features.

  Soil and Ground Water to Soil Gas – VOCs in soil and ground water can migrate to soil gas via volatilization. Transport in the vadose zone soil or rock is primarily through preferential pathways. The soil to soil gas migration pathway is evident in the source area, where PCE was detected in shallow and deep soil gas sampling ports (Figure 42). Ground water samples indicate the presence of chlorinated solvents, which will volatilize to soil gas at the Henry's Law Constant. Soil gas samples collected some distance from the source are likely from volatilization from ground water rather than from the source area vadose zone; this is evident in sub-slab soil gas samples collected from the residence in AOI 1, which are discussed in the vapor intrusion evaluation below. In addition, dense vapor transport from source material may be impacting the vadose zone.

- **Soil Vapor to Air –** VOCs in soil can migrate from the soil to ambient air, where it can then be transported in the atmosphere. This is considered a minor migration pathway because most of the impacted source area is covered by buildings, paved parking lots, etc.

- **Vapor Intrusion –** VOCs in soil or ground water that emanate to soil gas can be trapped beneath a building slab. Subsequently, these VOCs can migrate to indoor air via preferential pathways (e.g., utility conduits). The vapor intrusion pathway is evaluated further below.

12.8.3 AOI 1 – Vapor Intrusion

Vapor intrusion from soil gas to indoor air was a significant migration pathway for AOI 1 (Figure 4).

Building B1

The default attenuation factor for sub-slab soil gas to indoor air is 0.1 (EPA 2002). However, the site-specific attenuation factors varied based on location. This was observed by comparing sub-slab concentration from VI-101-CSA of 25,000,000 $\mu g/m^3$ to the associated indoor air concentration of 2,400 $\mu g/m^3$ at VI-101-CIA (Figure 44); this corresponds to an attenuation factor of 0.0001. However, because Building B1 has a centralized HVAC system, the indoor air mixes throughout the building, which would have biased the VI-101 attenuation factor low. Indoor air mixing led to a high biased attenuation factor (approximately 3) at location VI-109, with a sub-slab concentration of 29 $\mu g/m^3$ and an indoor air concentration of 84 $\mu g/m^3$. Because the attenuation factors are subject to high and low bias due indoor air mixing, the default attenuation factor for sub-slab soil gas to indoor air (EPA 2002) will be used for the Site.

The maximum PCE indoor air concentration was 2,400 $\mu g/m^3$ at VI-101-CIA in Building B1, is two orders of magnitude greater than the EPA Industrial Air RSL of 47 $\mu g/m^3$ (Table 15). Based on this information, the building owners installed two sub-slab depressurization ports, removed some potentially impacted building materials, and sealed some of the conduits for vapor intrusion (e.g., concrete seams, sewer drain, etc.). The most recent indoor air concentration was collected in May 2012 from location VI-102-CIA (Figure 45). The PCE concentration in this sample was 336 $\mu g/m^3$ (Table 11), which is one order of magnitude greater than the EPA Industrial Air RSL of 47 $\mu g/m^3$. Indoor air concentrations indicate that vapor intrusion, while being significantly reduced by activities within the building mentioned above, is still a complete migration pathway. Note that the indoor air concentrations in the first occupied space (i.e., B1-S1) are greater than those in the rest of the building (Figure 44), due to proximity to source material directly beneath the slab or from VOCs emitting from the concrete itself and/or other building materials. The concrete sample collected near indoor air sample VI-101-CIA had a PCE concentration of 1.67 mg/kg (Table 14). Because the concrete and/or other building materials are impacted with PCE, they are considered a source of contamination.

Building B2

Sub-slab and indoor air samples are presented for Building B2 on Figure 46. The maximum PCE indoor air concentration in Building B2 was 0.86 μg/m^3. However, the background concentration VI-BKG-01, which was collected during the same sampling event, had a concentration of 1.6 μg/m^3. Because the PCE indoor air concentration was consistent with background ambient air, vapor intrusion is not considered a significant migration pathway for this building.

Building B3

Sub-slab and indoor air samples are presented for Building B3 on Figure 47. This figure indicates that the sub-slab soil gas to indoor air is a complete migration pathway. In 2009, two sub-slab depressurization ports were installed on the north side of Building 3 near an underground utility pathway and near an exterior building crack. The maximum PCE indoor air concentration of 43.5 μg/m^3 was collected in June 2010. This concentration is less than the EPA Industrial Air RSL for PCE of 47 μg/m^3 (Table 15). The most recent indoor air sample was collected in Building 3 in May 2012 (Figure 45). PCE was detected at a concentration of 21 μg/m^3 (Table 11). Indoor air concentrations indicate that vapor intrusion is still a complete migration pathway for Building B3. It should be noted that Building B3 is an operative veterinary clinic and may have alternative sources of vapors in indoor air.

Buildings BA and BB

Sub-slab and indoor air samples are presented for Buildings BA and BB on Figures 48 and 49. The maximum PCE concentrations were 0.42 μg/m^3 and 0.59 μg/m^3 respectively. These concentrations are less than the EPA PCE Industrial Air RSL of 47 μg/m^3 (Table 15) and consistent with the background ambient air sample of 0.17 μg/m^3. Because crawl-space and sub-slab soil gas concentrations were low and consistent with background ambient air, vapor intrusion is not considered a significant migration pathway for these buildings.

Apartments

In October 2010, sub-slab and indoor air results for the apartment buildings to the north of Source Area 1 were collected. The sample locations are presented on Figure 50. The maximum sub-slab soil gas PCE concentration was 171 μg/m^3, which indicates that VOCs from a subsurface source are migrating to the near surface soil. Given that Source Area 1 is in the vicinity of Building B1 (Figure 4), it is likely that these VOCs are from impacted ground water. The maximum PCE concentration in indoor air was 7.41 μg/m^3, which was less than the EPA PCE Residential Air RSL of 9.4 μg/m^3. The indoor air detected PCE concentration was consistent with the background ambient air sample BKG-AIR #1, which was collected at the same time and had a concentration of 7.54 μg/m^3. The most recent indoor air sampling occurred in May 2012. An indoor air and background air sample were collected (Figure 45). The indoor air sample had a laboratory qualified (“B” qualified – compound detected in blank sample at a concentration less than 10X the sample detection) PCE detection of 2.2 µg/m^3. The background sample collected on the east end of the apartment complex had a PCE detection of 0.47 µg/m^3.

Residence

Sub-slab results for the residence (sample VI-201-SGA) are presented on Figure 50. The maximum sub-slab soil gas PCE concentration was 12.5 µg/m^3, which indicates that VOCs from a subsurface source are migrating to near surface soil. Given the distance between this residence and Source Area 1 (Figure 4), it is likely that that these VOCs are from impacted ground water migrating some distance from the source.

No indoor air samples were collected from this location due to construction activities. However, if the default attenuation factor of 0.1 is used to estimate the potential indoor air concentration, then the potential indoor air PCE concentration would be 1.25 µg/m^3, which is less than the EPA PCE Residential Air RSL of 9.4 µg/m^3. The background ambient air concentrations was 3.67 µg/m^3 in a nearby sample (sample BKG-AIR #1). Although sub-slab soil gas concentrations were detected, vapor intrusion is not considered a significant migration pathway for residences in this area.

12.9 Area of Investigation 2

AOI 2 includes the area in the vicinity of an active dry cleaning facility that contains Source Area 2 (Figure 4).

12.9.1 Nature and Extent of Contamination

The CSM for Source Area 2 is presented in Figure 51. PCE was released at a dry cleaning facility. The approximate extent of soil and vadose impacts can be ascertained in Figures 35, 52, and 48.

Surface (0 to 2-feet bgs) and subsurface soil (2 to 10-feet bgs) samples were collected from base material and soil in the vicinity of the building. Generally, soils are located under a 2-6 inch layer of concrete or asphalt, with base material extending 1 to 2-feet bgs. The base material consisted of limestone clasts, in a crushed chalk and clay matrix. Generally, subsurface soils were composed of organic clay and caliche to the Anacacho Limestone, which was encountered at approximately 10-feet bgs. The maximum PCE concentration in surface soil was 0.14 mg/kg, which is less than the EPA Industrial Soil RSL of 110 mg/kg (Tables 10 and 14). The maximum subsurface soil PCE concentration was 0.094 mg/kg, which was also less the EPA Industrial Soil RSL. Soil samples collected in Source Area 2 confirm that PCE was released to soil. These soil samples were collected adjacent to a secondary containment area with drums of PCE, exterior to the dry cleaner building, and on the adjoining automotive repair facility property (Figures 35 and 52).

Active sub-slab soil gas samples collected from in this source area found significant PCE contamination (Tables 12, 13, and 15) (Figures 35 and 48). This is evidenced by the PCE detections in the soil gas samples collected at locations VI-206-SGA (132,000 µg/m^3), Terracon-2-SGA (73,000 µg/m^3), VI-216-CSA (46,000µg/m^3), Terracon-1-SGA (30,000 µg/m^3), VI-215-CSA (19,000 µg/m^3) and VI-207-SGA (8,290 µg/m^3). The location of soil gas sample Terracon-2-SGA is adjacent to the location of the former "Luckey" water supply well. The most recent sampling conducted in May 2012 detected elevated PCE concentrations in wells TMW-1 (94 µg/L) and TMW-2 (730 µg/L). These wells are located in the back parking lot of the active dry cleaners. Because the soil gas concentrations near the active dry cleaning facility indicate potential source material and the migration potential is significant (e.g., leaching to ground water), the source area material is considered Principal Threat Waste.

Surface water in the vicinity of VI-206-SGA was observed flowing towards VI-207-SGA and DW-404 during a high rain event; a storm drain is located in the parking lot to the southeast of DW-404 (Figure 40). This surface water transport is considered a localized migration pathway. In addition, infiltration of surface water in the impacted area may be leaching PCE through the vadose zone to the underlying Austin Chalk ground water.

Although the discussion has focused on PCE, media have been impacted by daughter products (e.g., trichloroethene, cis-1,2-Dichlororethene) via degradation of the PCE (Tables 5, 12, 13, 15).

12.9.2 AOI 2 - Migration Pathways

Chlorinated Solvents may migrate via the following migration pathways:

- **Leaching to Ground Water –** As water percolates from the surface, through vadose zone soil, to the underlying ground water, it can carry dissolved phase constituents. Additionally, contaminated material in contact with ground water can leach directly to ground water. Transport will occur through secondary porosity, preferred flow paths such as fractures, faults, and dissolution features, as well as through man-made flow paths such as well bores. This pathway could include non-aqueous phase liquids or dissolved phase organic compounds. Leaching to ground water is evident in AOI 2 where PCE was detected in the shallow ground water monitoring wells (TMW-1, TMW-2) located in the back parking lot of Pilgrim Cleaners. These wells contained elevated levels of PCE in the soil gas (73,000 and 30,000 µg/m^3) and PCE in the ground water (730 and 94 µg/L).

- **Soil and Ground Water to Soil Gas –** VOCs in soil and ground water can migrate to soil gas via volatilization. Transport in the vadose zone soil or rock is primarily through preferential pathways. The soil to soil gas migration pathway is evident in the source area, where PCE was detected in active and passive soil gas samples (Figure 40 and 53). Ground water samples indicate the presence of chlorinated solvents, which will volatilize to soil gas at the Henry's Law Constant.

  During a soil vapor extraction pilot test on DW-404, PCE soil gas concentrations from the open-hole interval (i.e., approximately 40 to 65-feet bgs [top of the water table]) were estimated at 2,500 µg/m^3. This PCE concentration is consistent with the active soil gas samples in the vicinity of this well (Figures 35 and 48). This indicates the potential presence of vadose zone contamination in bedrock (i.e., Austin Chalk), which likely migrated via fractures, faults, or dissolution features.

- **Soil Vapor to Air –** VOCs in soil can migrate from the soil to ambient air, where it can then be transported in the atmosphere. This is considered a minor migration pathway because most of the impacted source area is covered by buildings, paved parking lots, etc.

- **Surface Water Transport** – Although, surface water transport is not a significant migration pathway for most AOIs, it is considered a complete migration pathway for this AOI. However, surface water migration is negated to some degree because high rain events are infrequent and dense vegetation near the active dry cleaners inhibits surface water transport.

- **Vapor Intrusion** – VOCs in soil or ground water that emanate to soil gas can be trapped beneath a building slab. Subsequently, these VOCs can migrate to indoor air via preferential pathways (e.g., utility conduits). The vapor intrusion pathway is evaluated further below.

12.9.3 AOI 2 – Vapor Intrusion

Vapor intrusion from soil gas to indoor air was identified as a potential migration pathway for the commercial building in AOI 2 (Figure 4). One sub-slab (VI-208-SGA), one indoor air (VI-2010CIA), one active soil gas (VI-209-SGA), and one background air sample are presented for the commercial building on Figure 40. These figures indicate that sub-slab soil gas to indoor air is a potential migration pathway. The sub-slab sample collected beneath a back concrete patio had a PCE concentration of 119 µg/m^3 while soil gas sample collected adjacent to a paved parking lot had a PCE concentration of 3,620 µg/m^3. The PCE indoor air concentration was 3.47µg/m^3, which is less than the EPA Industrial Air RSL of 47µg/m^3 (Table 15). Because the background ambient air sample was 0.41 µg/m^3, there is the potential that the indoor air concentrations are a result of vapor intrusion. Therefore, vapor intrusion is considered a potential migration pathway.

12.10 Areas of Investigation 3 Through 5

AOIs 3 through 5 included additional investigation areas depicted on Figure 3, and are presented below. These additional areas were investigated to identify potential chlorinated solvent source areas, which may be contributing to the Austin Chalk ground water impacts.

12.10.1 AOI 3 – Passive Soil Gas

Thirteen passive soil gas samples were collected along a transect between Grissom and El Verde Roads in AOI 3 (Figures 3 and 24). In addition, fourteen passive soil gas samples were placed around a former air hanger. The main compound detected in the passive soil gas samplers was methylene chloride (165 nanograms) (Figure 31). Methylene chloride is not a Site contaminant of concern and was not detected at concentrations that pose adverse risk to human health or the environment. No PCE, TCE, DCE, or VC was detected in the passive soil gas samples (Beacon 2009 and 2010). No indoor air, surface and subsurface soils, and vadose zone remediation activities were identified for this area. Wells in this area may be plugged and abandoned.

12.10.2 AOI 4 – Passive Soil Gas

Passive soil gas samples were collected in the vicinity of a former dry cleaner facility in AOI 4 (Figures 3 and 28). PCE was detected in passive soil gas samples collected in the vicinity of the former dry cleaning building. Please note that there are no direct health-based screening levels for passive soil gas sampling results. The PCE concentrations were low (i.e., 27 to 298 nanograms) in comparison to passive soil gas sampling results at other locations (AOI 1 – 19,020 nanograms, AOI 2 – 23,130 nanograms). No remediation activities were identified for this area.

12.10.3 AOI 5 – Passive Soil Gas

Seven passive soil gas samples were collected in the vicinity of a former dry cleaner facility in AOI 5 (Figures 3 and 30). No primary COCs (i.e., PCE, TCE, DCE, or VC) were detected in the samples (Beacon 2011). Although there were other low-level organics detected (e.g., 2-methylnaphthalene), this area is not considered a potential source area for chlorinated solvent impacts to the Austin Chalk Aquifer. No remediation activities were identified for this area.

12.11 Ground Water

Ground water is evaluated as specific source areas and plumes due to the complexity of ground water flow under the Site and interconnectedness of subsurface features with ground water flow. Ground water samples were collected from wells open to the Austin Chalk, the Buda Limestone, both the Austin Chalk and the Buda Limestone, the Edwards Group, and wells open to unknown intervals.

Results from ground water sampling have allowed for division of the Site into areas based on water bearing zone, distribution of primary COCs (i.e., PCE, TCE, DCE, and VC), water well location, well construction detail (if known), etc. (Figure 23):

- Austin Chalk is the upper most water bearing unit:
  - — Source Area 1 - Northern Plume: These wells are associated with AOI 1 and are located north of Bandera Road;

  - — Source Area 2 - Southern Plume: These wells are associated with AOI 2 and are located south of Bandera Road;
  - — Middle of Plumes – Unimpacted: These wells are either unimpacted or have low-level impacts and are located between AOIs 1 and 2 (i.e., between the Northern and Southern Plumes);
  - — Northern – Unimpacted: These wells are either unimpacted or have low-level impacts and are located north of AOI 1 (i.e., the Northern Plume);
  - — Southern – Unimpacted: This well is unimpacted and located south of AOI 2 (i.e., the Southern Plume).

- Buda Limestone is the middle water bearing unit:

  - — Two Buda Limestone wells have low level impacts; one is located near Source Area 1 (DW-416) and the second is located near Source Area 2 (DW-413). One Austin Chalk/Buda Limestone well (DW-36) is impacted.

- Edwards Aquifer is the deep water bearing unit and is designated by the EPA as a sole-source aquifer for the area:

  - — Edwards Aquifer - These wells are currently being used as public water supply wells and private water wells in the area. The two Leon Valley municipal water wells have been routinely sampled 41 times over the past few years by EPA and TCEQ. Estimated trace levels of PCE between 0.14 µg/L and 0.24 µg/L has been detected three times in one well and five times in the other well since sampling began. The Federal Safe Drinking Water standard for PCE is 5.0 µg/L.
  - — Edwards Aquifer - Plugged and Abandoned: These wells were plugged and abandoned because samples from these wells contained PCE and/or TCE at concentrations above the Federal Drinking Water Standards and were acting as conduits for contaminant migration from the Austin Chalk to the Edwards Aquifer. Edward Aquifer wells (either existing or installed by EPA) are located near the wells which were plugged and abandoned. Sampling of these wells did not identify PCE contamination above MCLs (Figure 23).

- Unknown Aquifer – Construction details regarding these wells is unknown:

  - — Unknown Aquifer – Background: Groundwater analytical data collected from designated “Background” wells may suggest background values or very low concentrations in the water bearing zones on a regional scale. Unknown Aquifer–Impacted: These wells are considered to be impacted by Site contaminants.

Ground water data summaries are provided primarily in Table 16. Ground water data summaries from the recent sampling are provided in Tables 2, 3, 4, 5, 8,and 9. Vertical distribution of PCE concentrations from initial sampling events for select wells is illustrated in cross section on Figures 49 through 57; cross-section locations are depicted on Figure 7.

Section 12.11.1 Source Area 1 Ground Water

Protection of water bearing units such as the Austin Chalk and Buda Limestone is important. The Texas Water Code, Section 26.401 states, "… in order to safeguard present and future ground water supplies, usable and potentially usable ground water must be protected and maintained," In addition, the Texas Water Code states, "… a goal of the state is that existing quality of ground water not be degraded."

Austin Chalk ground water is considered a potential drinking water source by TCEQ. Of the three Austin Chalk wells within Source Area 1 (i.e., USGS-42, DW-408, and DW-415), all three wells had concentrations greater than the EPA Tap Water Regional Screening Level (RSL) of 9.7 µg/L and the EPA MCL of 5 µg/L (Table 16 and Figure 23), which are levels protective of drinking water sources. Additional chlorinated solvent MCL exceedances are provided on Table 16.

The maximum dissolved-phase concentration in USGS-42 (i.e., 11,700 µg/L) is above the generally-accepted threshold of 1 to 10 percent aqueous solubility, which is considered to be an indicator of dense non-aqueous phase liquid (DNAPL) within ground water. PCE has a solubility of 206,000 µg/L in water (EPA 2010) so the lower threshold for the potential presence of DNAPL is 2,060 µg/L. Well USGS-42 had a maximum PCE concentration of 11,700 µg/L, so this well is close to a source or point of release. Soil and soil gas sampling has demonstrated that there is a source beneath the building and in the vadose zone bedrock near USGS-42. The ground water concentrations within well USGS-42 demonstrate a complete migration pathway from the source beneath the Building B1 and the Austin Chalk ground water.

The proximity of DW-408 and DW-415 to USGS-42 and the direction of ground water flow to the northwest (Figures 14 and 53) provide evidence that ground water impacts in Source Area 1 ground water are associated with the source area near USGS-42. The impacts to wells DW-408 and DW-415 were the result of transport of dissolved constituents through the vadose zone from the Source Area 1 and/or from transport within the Austin Chalk ground water. PCE concentrations from the initial ground water sampling event indicate that PCE impacts were higher near the top of the water column (Figure 54), adding to the weight of evidence that the PCE spill that occurred within Source Area 1 is impacting ground water in wells DW-408 and DW-415.

Ground water impacts at Source Area 1 appear contained within the Austin Chalk and have not been detected in the Buda Limestone, as indicated by the lack of detections in the nearby Buda Limestone well DW-416 (Figure 58). Existing and EPA installed Edwards Aquifer wells in this area (i.e., DW-410, DW-406, and USGS-58) were sampled and determined to not be impacted, indicating that there is not a complete migration pathway at these well locations to these lower water bearing zones. However, please note that nearby Edwards Aquifer well DW-30, which was plugged and abandoned by the EPA, had a maximum PCE concentration of 78.7 µg/L. Figure 59 presents the role of abandoned wells in migration of contaminants from upper water bearing zones (i.e., Austin Chalk) to the lower water bearing zones (i.e., Edwards Aquifer).

The plugging of DW-30 does not guarantee that PCE no longer migrates to deeper aquifers especially since information exists that there were other water wells in the area for which there are no plugging records. In addition, as discussed in Section 12.5.2 (Ground Water Flow), ground water flow in karst aquifers will generally be through secondary porosity (e.g., dissolution features, faults, and fractures) that may or may not be interconnected within a well network. Because of the complexity associated with flow through secondary porosity, detailed characterization of flow in karst aquifers is very difficult. Figure 60 presents a schematic of a fractured media site with DNAPL contamination.

Section 12.11.2 Source Area 2 Ground Water

Austin Chalk ground water is considered a potential drinking water source by TCEQ. There are four Austin Chalk wells (i.e., DW-404, DW-412, DW-414, and DW-407) and one Austin Chalk / Buda Limestone well (i.e., DW-36) within Source Area 2 (Figure 23). In addition to the Austin Chalk wells, there are also two shallow 35-foot alluvium wells (TMW-1, TMW-2) (Figure 53). With the exclusion of DW-412, these wells had concentrations greater than the EPA Tap Water RSL of 9.7 µg/L and the EPA MCL of 5 µg/L (Table 16) which are levels protective of drinking water sources. Additional chlorinated solvent MCL exceedances are provided in Tables 2, 5 and 9. The Austin Chalk / Buda Limestone well DW-36 provides a conduit (i.e., complete migration pathway) for contaminant migration from the Austin Chalk to the Buda Limestone Aquifers.

The maximum dissolved-phase concentration in DW-404 (i.e., 1,740 µg/L) does not suggest DNAPL at Source Area 2; however, this supposition is based on a single well (DW-404) that is not located at the point-of-release. Soil gas sampling indicates that there is source material near the active dry cleaning facility (Figures 35 and 48). The ground water concentrations within well DW-404 demonstrate a complete migration pathway from the vadose zone source near the active dry cleaning facility and the Austin Chalk ground water. Additional evidence includes PCE concentrations from the initial ground water sampling event that demonstrate PCE impacts were higher near the top of the water column (Figure 56), adding to the weight of evidence that ground water impacts are due to a nearby vadose zone source.

The proximity of wells DW-414, DW-407, and DW-36 and the direction of ground water flow to the west and south (Figure 17) provide evidence that ground water impacts in Source Area 2 ground water are associated with the source area near DW-404. The former well (i.e., Luckey Well) located beneath the back parking lot of the active dry cleaners may also be acting as a conduit for contaminant transport. No well plugging records were found for the Luckey Well (SAIC 2009). The impacts to these wells are the result of transport of dissolved constituents through Austin Chalk ground water (Figure 59). Maximum PCE concentrations are relatively uniform throughout the water column in DW-414 and DW-407 (Figure 56), that would indicate that the primary transport mechanism is ground water and that there is not DNAPL in the vicinity of these downgradient wells. PCE concentrations in these nearby wells are not indicative of proximity to DNAPL.

Ground water impacts at Source Area 2 are not contained within the Austin Chalk Aquifer. Austin Chalk / Buda Limestone well DW-36 is acting as a conduit (i.e., complete migration pathway) for contaminant migration from the Austin Chalk to the Buda Limestone Aquifer. Existing Edwards Aquifer wells in this area (i.e., DW-406, USGS-51, DW-402, and USGS-60) are not considered impacted, indicating that there is not a complete migration pathway at these well locations to the Edwards Aquifer. Note that the PCE detected in Edwards Aquifer well DW-31 was collected in the historic dataset that was incorporated into this RI Report; however, subsequent sampling events in 2008, 2009, and 2010 indicated that PCE was detected in concentrations similar to those found in background wells (Figure 23). Plugged wells DW-37, DW-43, and DW-44 contained PCE, which indicates impacts to the Buda Limestone and Edwards Aquifer in the area. An ongoing effort to locate and evaluate historical wells in the area is necessary to further abate migration to the Edwards Aquifer. As discussed in Section 12.5.2 (Ground Water Flow), ground water flow in karst aquifers will generally be through secondary porosity (e.g., dissolution features, faults, and fractures) that may or may not be interconnected within a well network. Because of the complexity associated with flow through secondary porosity, detailed characterization of flow in karst aquifers is very difficult.

12.11.3 Compound Specific Isotope Analysis (CSIA) Results

Ground water samples collected during the June 2009 and June 2010 sampling events were evaluated with CSIA. The CSIA evaluation was performed to assess attribution and biodegradation of chlorinated solvents. Biodegradation induces a shift of the residual compound to less negative values of $\delta^{13}C$ (i.e., enrichment of $\delta^{13}C$ and depletion of $\delta^{12}C$). Therefore, the most negative values measured for the organic contaminant in ground water can be the best estimate of the original values of source area $\delta^{13}C$ ($\delta^{13}C_{source}$). Wells in the source area are expected to produce water with the highest concentrations. Because biodegradation enriches (e.g., less negative) $\delta^{13}C$ values, source area wells may be assumed to represent the least degraded material. Based on this premise, well DW-404, with the most negative value of -26.4‰ for PCE in 2009 (Figure 61), implies that it is near a source (i.e., Source Area 2). Similarly, Source Area 1 was implied by CSIA near USGS-42, with values of -24.1‰ and -23.5‰ for PCE, in 2009 and 2010 respectively, representing the baseline for this source. Well USGS-42 had the highest detected PCE concentration (i.e., 11,700 µg/L), but well DW-404 had a more negative $\delta^{13}C$ value. This indicates that either a more recent release has taken place near DW-404 and/or less degradation is occurring near DW-404. Furthermore, the disparity between USGS-42 and DW-404 $\delta^{13}C$ values indicates separate source areas.

Figure 61 provides CSIA results that indicate that the contamination in wells DW-404, DW-407, DW-36 and DW-47 may originate from a different source than USGS-42. The process of degradation results in higher (less negative) values of $\delta^{13}C$, so the PCE at USGS-42 with a $\delta^{13}C$ of -23.5‰ is not consistent with the PCE $\delta^{13}C$ values observed in wells DW-404, DW-407, DW-414, and DW-36. However, the $\delta^{13}C$ values in wells DW-407, DW-47, and DW-36 are all higher (less negative) than the $\delta^{13}C$ values from DW-404. Given these results, the impacts to wells DW-407, DW-36, and DW-47 are attributed to the second source area near DW-404. Similarly, because the $\delta^{13}C$ values in wells DW-408 and DW-415 are higher (less negative) than the $\delta^{13}C$ values from USGS-42, the impacts to wells DW-408 and DW-415 are thought to be related to the source area near USGS-42. This CSIA evaluation is another line of evidence to demonstrate that there are the two source areas impacting separate Austin Chalk ground water plumes.

12.11.4 Dye Tracer Testing

A dye tracer test was conducted by EAA in August 2010 (EAA 2010). Dye was injected in USGS-42 but was not detected in DW-408 or DW-415 (Figure 62). If these wells were hydraulically connected via fracture flow (i.e., secondary porosity), it is likely that dye would have been detected in these wells, as they are less than 300-feet from USGS-42. The dye that was injected into USGS-42 was identified in the charcoal bags deployed in DW-409, but not in the water samples.

The concentrations of dye in the bags were J-flagged, which indicates that the dye was present below the detection limit and could not be accurately quantified, so the dye transport from USGS-42 to DW-409 was minimal at observed water level conditions. However, PCE has not been detected in DW-409, although contaminant migration would likely occur in the same flow-paths. Therefore, the potential hydraulic communication between USGS-42 and DW-409 should be considered tentative.

Dye injected into DW-414 was visually observed in well DW-36, located down gradient (EAA 2010). This detection was confirmed in the water samples. DW-414 is a fast-flowing well and/or intercepts local secondary porosity features as evidenced by the falling head test and water observed in a well vidorehole. Based on its location on (or near) an identified fault, the tracer test results, and the hydraulic connection established through testing, it appears that well DW-414 is an important location with regard to ground water flow and contaminant transport at the Site.

Dye was not detected in any of the remaining wells, including the Edwards Aquifer wells. This does not rule out a connection between the aquifers at the Site. Although no dye was detected in these wells, the lack of detections may be more indicative of a very limited monitoring system, insufficient monitoring period (i.e., 6 weeks), or slow ground water velocities rather than the absence of dye. Additional monitoring or injections and a longer study period would be necessary to adequately investigate potential connections between the Austin Chalk and Edwards aquifers.

12.11.5 Impacted Edwards Aquifer Well

Well DW-31 is open to the Edwards Aquifer and has had MCL exceedances for toluene and bis(2-ethylhexyl)phthalate (Table 16). The geophysical well log for DW-31 (EA 2011a) indicates that bottom of the well casing is approximately 312 feet below ground surface (bgs) and a total well depth is approximately 344 feet bgs. Toluene was detected at a concentration of 1,220 µg/L in January 2008 in passive diffusion bags set at 170 and 210-feet bgs; the MCL for toluene is 1,000 µg/L. Toluene was also detected in January 2008 in passive diffusion bags at concentrations of 656 µg/L at 245 feet bgs, 8.0 µg/L at 285 feet bgs, 24.7 µg/L at 320 feet bgs, 23.3 µg/L at 320 feet bgs, and 19.4 µg/L at 340 feet bgs. However, on five subsequent events, tap water samples collected from the well were non-detect for toluene. For the tap water sampling events, the well pump was set at 280 feet below ground surface. Similarly, bis(2-ethylhexyl)phthalate was detected at a concentration of 7.1 µg/L in a sample collected in November 2007; the EPA MCL for bis(2-ethylhexyl)phthalate is 6 µg/L. In April 2008, bis(2-

ethylhexyl)phthalate was non-detect. The origin of these detections are unknown. Well DW-31 will be properly plugged and abandoned to prevent contaminant transport to the Edwards Aquifer.

12.11.6 Plugged and Abandoned Wells

Five wells open to the Edwards Aquifer were plugged and abandoned in 2009. PCE was found in the Edwards Aquifer wells DW-30, DW-43, DW-44, DW-37, and USGS-44, the highest concentration of which was 148 µg/L. Existing and installed Edwards Aquifer wells in the area were sampled and determined to not be impacted by PCE. Chlorinated solvent MCL exceedances are provided on Table 16. Video logging that was conducted and/or chemical concentration data indicated contaminant migration from the Austin Chalk Aquifer to the Edwards Aquifer via compromised casings in these wells. Due to this contaminant transport pathway, these wells were plugged and abandoned to prevent further contamination of the Edwards Aquifer via borehole leakage (Figure 59).

12.11.7 Unknown Aquifer Impacted

Many of the wells sampled at the Site are of unknown construction (Figure 23). Therefore, these wells were not used to formulate the CSM. Well DW-47 had an exceedance of the PCE MCL, with a concentration of 6.8 µg/L (Table 6). The wells of unknown construction that are impacted by Site contaminants should eventually be plugged and abandoned so that they are not potential contaminant transport pathways to the Edwards Aquifer. Prior to plugging, the Edwards Aquifer Authority requires a licensed driller or pump installer to measure the depth and check the well to ensure that there are no obstructions within the well that may interfere with plugging operations. The Edwards Aquifer Authority also requires a geophysical log of the Edwards Aquifer well from bottom to top before plugging operations begin. The geophysical log shall include a natural gamma log and caliper log.

12.11.8 Unknown Aquifer – Background Wells

Many of the wells sampled at the Site are of unknown construction (Figure 23). Therefore, these wells were not used to formulate the conceptual site model. There are a group of wells to the north of the Site, with unknown construction, that are not considered to be impacted by Site ground water. These wells provide an indication of regional water quality. The maximum reported PCE concentration of these wells is 0.29 µg/L, which does not exceed the EPA MCL of 5 µg/L. These regional PCE concentrations are consistent with those detected infrequently in the two municipal supply wells for the City of Leon Valley. The maximum PCE concentration detected in USGS-18 and USGS-50 was 0.24 µg/L, which is consistent with the regional background PCE concentrations. Communication between the Austin Chalk and Edwards Aquifer is possible (i.e., mainly through joints, faults, and/or dissolution features) and therefore communication between the Austin Chalk and Edwards Aquifer is considered a potential migration pathway.

12.12 Conceptual Site Model

The Conceptual Site Model (CSM) presents a holistic view of the Site to provide a foundation for the remedial alternative evaluation and to support remedy selection. It incorporates the Site's surface features, potential source areas, nature and extent of contamination, contaminant migration pathways, and ancillary information as appropriate. In respect to human health exposure, Figure 63 presents the potentially complete exposure pathways for various potential receptors. The Site is a combination of sources and releases from at least two facilities. EPA identified five AOIs, which are identified on Figure 3. The CSM for the five AOIs are presented below.

12.12.1 AOI 1 – Source Area 1

Source Area 1 within AOI 1 was contaminated from a release of PCE at a former dry cleaning facility. Soil and soil gas sampling results indicate the presence of source material in the soil beneath a building and in the vadose zone bedrock above the Austin Chalk aquifer. Because the soil gas concentrations beneath the slab indicate source and the migration has been demonstrated (e.g., leaching to ground water and vapor intrusion), the source area material is considered Principal Threat Waste (Section 18). Migration in the vadose zone bedrock is primarily via fractures and may have been facilitated by a suspected water leak beneath the building. Once contamination reaches the Austin Chalk ground water, it is transported via secondary porosity (i.e., joints, faults, and solution features). Pore space diffusion is also present, although at a much slower rate.

Although the Austin Chalk is not a primary drinking water source, it is used to water lawns and gardens. The State considers the Austin Chalk a potential drinking water resource and EPA has determined that the Austin Chalk ground water exceeds EPA MCLs for chlorinated solvents (Tables 9 and 16). The human health vapor intrusion to indoor air exposure pathway has been confirmed in a few occupied structures.

12.12.2 AOI 2 – Source Area 2

Source Area 2 within AOI 2 was contaminated from a release of PCE at an active dry cleaning facility. Migration in the vadose zone bedrock is primarily via fractures, although a former Edwards Aquifer well located behind the dry cleaning facility may be acting as a conduit for contaminant migration to deeper formations. Because the soil gas concentrations near the active dry cleaning facility indicate potential source material and the migration potential is significant (e.g., leaching to ground water), the source area material is considered Principal Threat Waste (Section 18). Once contamination reaches the Austin Chalk ground water, it is transported via secondary porosity (i.e., joints, faults, and solution features). Pore space diffusion is also present, although at a much slower rate. Site related contaminants may be migrating to deeper water bearing zones (i.e., Buda Limestone or Edwards Aquifer) through poorly constructed or improperly plugged and abandoned wells. Edwards Aquifer wells DW-43, DW-44, DW-37 located along Grissom Road (Figure 23) were impacted with PCE and have been plugged and abandoned.

Although the Austin Chalk is not a primary drinking water source, it is used to water lawns and gardens. The State considers the Austin Chalk a potential drinking water resource and EPA has determined that the Austin Chalk ground water exceeds EPA MCLs for chlorinated solvents (Tables 9 and 16). The vapor intrusion to indoor air exposure pathway is a potential migration pathway.

12.12.3 AOI 3

There were low-level organics detected (e.g., methylene chloride) in passive soil gas samples; however, these samples did not identify a potential source area for chlorinated solvent impacts to the Austin Chalk Aquifer. No PCE, TCE, DCE, or VC were detected in AOI 3 passive soil gas samples.

12.12.4 AOI 4

PCE was detected in passive soil gas samples collected in the vicinity of the former dry cleaning building (Figure 33). PCE concentrations were rather low in comparison to previous passive soil gas sampling events in other locations. An Austin Chalk well installed adjacent to the former dry cleaning building (MW5-7007) detected PCE at an estimated concentration of 0.76 µg/L, which is less than the PCE MCL of 5.0 µg/L (Table 9). It is unlikely that the impacts to ground water (e.g., Austin Chalk) in the vicinity of AOI 1 or AOI 2 are related to the impacts at this location.

12.12.5 AOI 5

There were low-level organics detected (e.g., 2-methylnaphthalene) in passive soil gas samples; however, these samples did not identify a potential source area for chlorinated solvent impacts to the Austin Chalk Aquifer. No primary COCs (i.e., PCE, TCE, DCE, VC) were detected. This area is not considered a potential source area for chlorinated solvent impacts to the Austin Chalk aquifer.

12.12.6 Additional Considerations

EPA MCLs have been exceeded for four wells that are not in the Source Area 1 and 2 Remedial Investigation data-groups. Well DW-31 is open to the Edwards Aquifer and had MCL exceedances for toluene and bis(2-ethylhexyl)phthalate; the origin of these exceedances are unknown, but have not been reproducible to date. Well DW-47 with a PCE detection of 6.8 µg/L, had an exceedance of the PCE MCL (5.0 µg/L); it is of unknown construction and should eventually be plugged and abandoned so that it is not a potential contaminant transport pathway to the Edwards Aquifer. Recently installed Austin Chalk wells MW3-6200 and MW2-6535 had PCE exceedences of 6.3 µg/L and 5.3 µg/L (Figure 58). A shallow 35-foot alluvium well (MW4-65635) located adjacent to MW4-6536 had an estimated PCE detection of 1.3 µg/L. Additional monitoring of MW2-6535 is anticipated. Other historical wells in the area should be evaluated and plugged or repaired if these wells are found to be potential pathways for migration into the Edwards Aquifer.

13.0 CURRENT AND POTENTIAL FUTURE LAND AND WATER USES

This section of the ROD discusses the current and reasonably anticipated future land uses, and current and potential ground water uses at the Site.

13.1 Demographics

The Site is located in Leon Valley, Texas, which was incorporated in the 1960s, covers three and one half square miles. According to the 2000 Census (US Census Bureau 2000), the total population of Leon Valley was 9,239 in 2000. This equates to a population density of approximately 2,640 people per square mile. The 2000 Census reported that approximately 13.5 percent of the population was over the age of 65, which is above the Texas state average of 9.9 percent (US Census Bureau 2000). Approximately 26.1 percent of the population was under the age of 20. There were 3,576 housing units in the city and the average household size was 2.56 people per house.

Among the population, a total of 78.07 percent identified themselves as White, 2.77 percent identified themselves as Black or African-American, 0.67 percent identified themselves as Native American, 1.95 percent identified themselves as Asian, 0.15 identified themselves as Pacific Islander, 13.19 percent identified themselves as Other Races, and 3.19 percent identified themselves as Two or More Races. Of the local population, 44.65 percent identified themselves as Hispanic or Latino.

According to the 2000 Census data, the median family income in Leon Valley was $56,543, which was above the U.S. median family income of $50,046 (US Census Bureau 2000). Based on the reported 1999 income data, the Census Bureau estimates 8.1 percent of the population in Leon Valley were living below the poverty level. According to the Texas Department of Commerce (2010), the unemployment rate was 7.1 percent.

Limited by the surrounding City of San Antonio, the City of Leon Valley has projected the population to reach 10,713 residents by 2015 and to reach 11,259 residents by 2020 (Leon Valley 2009).

13.2 Current and Potential Future Land Uses

Currently land surrounding the Site includes a variety of residential, industrial, and retail uses. A City of Leon Valley Zoning and Subdivisions map depicts the zoning designations for the Site (Figure 5). The majority of the land surrounding the Site is currently zoned as commercial and retail, a small portion is zoned as residential and light industrial, and even fewer areas are zoned as government. Detailed information can be found in the Reuse Assessment Report (E^2 2010) and the Leon Valley Texas 2009 Comprehensive Master Plan (Leon Valley 2009).

The Leon Valley Texas 2009 Comprehensive Master Plan is a guide to the future plans of the city and serves as a framework for revising the community's planning directions. The city's vision for the future focuses on protecting the ground water supply from contamination and/or future industrial activities, integrating green infrastructure into current and future projects, and promoting sustainability through city initiatives.

EPA conducted a site visit and discussed potential future land use opportunities with stakeholders. On April 22, 2010, a Bandera Road Community Advisory Group (CAG) meeting was held to present a draft version of the Reuse Assessment Report to the City of Leon Valley residents, source area site owners, the Bandera Road CAG, the Texas Department of Transportation (TxDOT), Bexar County residents, and Halff Associates. Feedback from these stakeholders was included in the final Reuse Planning Report (E^2 2010). Information from the CAG meeting, the final Reuse Planning Report, and the Leon Valley 2009 Comprehensive Master Plan informed the reasonably anticipated future uses of the Site.

Future development plans in the area are focused on green infrastructure, which is a framework for integrating nature and the environment into city and regional planning. The City of Leon Valley would like to ensure municipal water quality protection from the existing ground water plume at Bandera Road and any possible future contaminants. Ultimately, reasonably anticipated future land uses in the area surrounding the Site and the Site itself will include commercial, retail, residential, and light industrial uses.

13.3 Current and Potential Future Ground Water Uses

The Site overlays three different karst and fractured dominated water bearing units: the Austin Chalk, the Buda Limestone, and the Edwards Aquifer (Figure 59). The Austin Chalk is the uppermost water bearing unit and is not currently used as a primary drinking water source in the area. A local resident did use a PCE impacted well open to the Austin Chalk as their source of drinking water. This residence was initially provided water filtration and was later connected to the local public water supply by the EPA. This resident currently uses water from the well to water their lawn. The State considers the Austin Chalk a potential drinking water resource and the EPA has determined that the Austin Chalk ground water exceeds EPA MCLs for chlorinated solvents. The Buda limestone is considered the second water bearing unit and is considered a potential domestic water supply by the State. The Edwards Aquifer is prolific, yields high quantity and quality water, and is the primary drinking water aquifer for the City of Leon Valley and San Antonio. Leon Valley municipal water wells are completed in the Edwards Aquifer and supply water to residents of Leon Valley.

14.0 SUMMARY OF SITE RISKS

The baseline risk assessment estimates what risks the Site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessment for this Site. It is important to note that since the baseline risk assessment was completed in July 2011 as part of the Site's Remedial Investigation Report (EPA

2011), the EPA issued new toxicity information for two of the Site's chemicals of concern - TCE and PCE. A discussion of the new toxicity information and its impact on the baseline risk assessment is discussed in Section 14.3 (Toxicity Assessment). A discussion of the ecological exposure pathway evaluation is also provided.

The human health risk assessment followed a four step process: 1) identification of the chemicals, which, given the specifics of the Site were of significant concern; 2) exposure assessment, which identified actual or potential exposure pathways, characterized the potentially exposed populations, and determined the extent of possible exposure; 3) effects assessment, which considered the types and magnitude of adverse effects associated with exposure to hazardous substances; and, 4) risk characterization and uncertainty analysis, which integrated the three earlier steps to summarize the potential and actual risks posed by hazardous substances at the Site, including carcinogenic and non-carcinogenic risks and a discussion of the uncertainty in the risk estimates.

During the course of the investigation, EPA identified five AOIs, which are depicted on Figure 3. Source areas and ground water impacts from releases from at least two facilities were identified in AOIs 1 and 2. Three additional AOIs (i.e., AOIs 3 through 5) were subject to passive soil gas screening in an effort to identify additional potential source areas. Austin Chalk wells were also installed in AOI 3 and 4, and at another former dry cleaner location in an effort to identify additional source areas; however, source areas associated with these AOIs have not been identified. Because passive soil gas data is considered screening level data and does not meet data quality assessment guidelines for estimating risks, the human health risk assessment (HHRA) did not evaluate the passive soil gas data from AOIs 3 through 5. The HHRA did evaluate potential human health risks for exposure to vapors and impacted soils in AOIs 1 and 2. Exposure to impacted ground water was also evaluated in the HHRA.

14.1 Identification of Chemicals of Concern

Chemicals that were detected in soil, ambient air, and ground water were considered Chemicals of Concern (COCs) for this Site. PCE and its dechlorination daughter products TCE, DCE, and VC have been selected as the primary COCs because these chemicals are the most prevalent (in terms of screening level exceedance and magnitude) and by-in-large are co-located with other organic COCs. PCE is a manmade chlorinated solvent and is used as an industrial degreaser, spot remover, and in dry cleaning. Chronic (long-term) PCE exposure can cause damage to the liver, the kidneys and central nervous system. It may also lead to increased risk for cancer. Other chemicals that exceed risks screening levels may be elevated due to petroleum hydrocarbon sources in the area (e.g., former gas stations).

A summary of number of surface soil (includes concrete sample), subsurface soil, surface water, ground water, and ambient air samples evaluated as part of the HHRA (EPA 2011) is provided in Table 17. A summary of the occurrence of chemicals detected in soil, air, and ground water evaluated as part of the HHRA are provided in Tables 14, 15 and 16. A summary of the samples collected after completion of the HHRA are presented in Tables 2 through 13. The data collected after the HHRA were compared to previously collected data. The chemicals detected and associated concentrations were similar to what was previously detected.

The concentrations in the medium (e.g., subsurface soil) that a receptor may be exposed to are called the exposure point concentrations (EPCs). EPCs were calculated for COCs in the media sampled: surface soil (0 to 2-feet bgs), subsurface soils (2 to 10-feet bgs), ground water, and indoor or ambient air. Data collected after the completion of the Remedial Investigation were not used to calculate EPCs. The methods used to calculate EPCs are detailed in the ProUCL 4.0 User Guide (Singh, Singh, and Maichle 2007). EPCs were also estimated for outdoor air using standard media transfer equations (i.e., from chemicals in soil released to air as volatile chemicals). Finally, values for estimating dermal exposure to COCs in ground water were calculated using equations and methodology presented in RAGS Part E (EPA 2004).

A 95 percent upper confidence limit on the arithmetic mean (95% UCL) was calculated using ProUCL 4.0 Statistical Software. The lower of the 95% UCL and the maximum concentration was used as the EPC. Statistical estimates for data sets with a few number of samples (i.e., less than 4) lack statistical power and cannot be confidently estimated. The maximum detected concentration was therefore used as the EPC for these data sets. Similarly, an EPC estimated from a data set with a large percentage of nondetect results may be biased, thereby skewing the 95% UCL estimation because of the large percentage of nondetect concentrations in the data set. To eliminate this potential bias, the maximum detected concentration was used as the EPC.

Because indoor air concentrations are only representative of a small occupied space, the maximum concentration from each indoor air sampling location was selected as the EPC. The only exception to this protocol was for location VI-101 (see Figure 44), which had vapor mitigation work conducted during the RI. Therefore, the maximum and latest sample prior to completion of the HHRA (i.e., collected in June 2010) were evaluated in the risk assessment. Indoor air samples collected after completion of the HHRA in May 2012 were also evaluated and will be discussed.

Based on the HHRA, human health exposure areas with potential unacceptable risks include the Austin Chalk northern and southern plumes and indoor air within AOI 1 (Buildings B1 and B3). EPA defines human health COCs as those chemicals that meet any of the following criteria:

- Pose a human health excess lifetime cancer risk greater than 1 cancer case in 1,000,000 individuals (1E-06)
- Non-carcinogenic hazard index (HI) greater than (>) 1
- Concentrations greater than chemical-specific ARARs (e.g., drinking water MCLs)

Tables 18 - 22 present the chemicals of concern (COCs) and exposure point concentrations for COCs detected in ground water and indoor air (i.e., the concentration that will be used to estimate the exposure and risk from each COC). These tables include the range of concentrations detected for each COC, as well as the frequency of detection (i.e.., the number of times the chemical was detected in the samples collected), the exposure point concentration (EPC), and how the EPC was derived. Data collected after completion of the Remedial Investigation Report are not reflected in Tables 18 – 22.

Table 18 (Austin Chalk Source Area 1 - Northern Plume) shows that tetrachloroethene (PCE), trichloroethene (TCE), and cis-1,2-Dichloroethene (cis-1,2-DCE) were detected in 100% of the data validated samples (i.e., 72 samples). Vinyl chloride was detected in 35 of 74 samples and 1,1-Dichloroethene was detected in 28 of 74 samples. Benzene was detected in 27 of 74 samples. The 95% UCL on the arithmetic mean was used as the exposure point concentrations for these chemicals. For methylene chloride, due to the limited number of detections (3 of 74), the maximum concentration was used as the default exposure point concentration.

Table 19 (Austin Chalk Source Area 2- Southern Plume) shows that PCE and TCE were detected in over 92% of the data validated samples (i.e., 59 out of 63 for PCE and 65 out of 70 for TCE). Chloroform was detected in 10 of 71 samples. The 95% UCL on the arithmetic mean was used as the exposure point concentrations for these chemicals. The remaining chemicals (bromoform, bromodichloromethane, dibromochloromethane and vinyl chloride) were detected once or twice out of 71 samples. The maximum concentration was used as the exposure point concentration for these chemicals.

Ground water analytes that posed a calculated risk to human health but did not exceed EPA MCLs were not evaluated further. Benzene detected in the Austin Chalk Northern Plume posed a chemical-specific cancer risk equal to 1×10^{-6} but did not exceed the EPA MCL (see Table 16). Because it was detected at levels considered safe for drinking water, benzene was not considered further as a COC for ground water. Several analytes in the Austin Chalk Southern Plume posed a chemical-specific cancer risk greater than one in a million but were infrequently detected and did not exceed the EPA MCLs (see Table 16); because bromodichloromethane, bromoform, carbon tetrachloride, chloroform and dibromochloromethane were detected at levels considered safe for drinking water, they were not considered further as COCs for ground water.

Methylene chloride was detected in 3 out of 74 samples from the Austin Chalk Northern Plume. It is important to note that methylene chloride was also detected in a blank sample and is a common laboratory contaminant. The calculated chemical-specific cancer risk for methylene chloride is 2×10^{-7} which is outside EPA's cancer risk management range. The calculated non-cancer hazard index for methylene chloride is 0.0016. For hazard indexes a "threshold level" (measured usually as a hazard index less than 1) exists below which non-cancer health effects are no longer predicted. For the reasons listed above, methylene chloride was not considered further as a COC.

Table 20 (Edwards Aquifer and Unknown Aquifer) shows that bis(2-ethylhexyl)phthalate and toluene were detected in an existing Edward Aquifer well. These analytes were detected in Edwards Aquifer Well DW-31, which is identified for plugging and abandonment. Bis(2-ethylhexyl)phthalate was detected in one of ten samples and is a common laboratory contaminant. The calculated chemical-specific cancer risk for bis(2-ethylhexyl)phthalate for ingestion is 3.5×10^{-7} which is outside EPA's cancer risk management range. The calculated non-cancer hazard index for bis(2-ethylhexyl)phthalate is 0.0035. Bis(2-ethylhexyl)phthalate will not be considered further as a COC. Tetrachloroethene was detected in Well DW-47. Because the well construction details for this well are not known, Well DW-47 is identified as an "Unknown Aquifer" well. Well DW-47 is also identified for plugging and abandonment.

Table 21 (Edwards Aquifer Plugged and Abandoned Wells) present the exposure point concentrations for tetrachloroethene, trichloroethene, cis-1,2-Dichloroethane, and toluene (i.e., chemicals of concern) in addition to the frequency of detection and concentration range (i.e., minimum and maximum concentrations). Although the Edwards Aquifer wells where these contaminants were detected have been plugged and abandoned, the values are presented to demonstrate that contamination present in the overlying water bearing formation did impact the Edwards Aquifer. EPA installed two Edwards Aquifer wells near areas were wells were plugged and abandoned. These wells were sampled and found not to be impacted.

Table 22 (Indoor Air Exposure Pathway) identifies seven chlorinated compounds (tetrachloroethene, trichloroethene, 1,2-dichloroethane, vinyl chloride, bromodichloromethane, 1,1,2,2-tetrachloroethane, and 1,4-Dichlorobenzene) as COCs. Because indoor air concentrations are only representative of a small occupied space, the maximum concentration from each sampling location was selected as the exposure point concentration. The only exception to this protocol was for location VI-101, which had a remediation system installed during the RI. Therefore, the maximum and the latest sample (i.e., collected in June 2010) were evaluated during the HHRA.

14.2 Exposure Assessment

An exposure assessment identifies potential human receptors that could be exposed to site-related chemicals as well as the routes, magnitude, frequency, and duration of the potential exposures. A more detailed discussion of the exposure assessment can be found in Section 6.4 of the Site's Remedial Investigation Report (EA 2011a). The principal objective of this evaluation is to identify RME, which is the maximum exposure reasonably expected to occur at a site (EPA 1989). The assessment begins with a description of the exposure setting and land use. Potential human receptors and complete exposure pathways are then discussed. Pathways evaluated for ground water exposure included ingestion, dermal contact (i.e., hand washing, cleaning), and inhalation for a resident (i.e., adult and child) and commercial/industrial worker. Pathways evaluated for surface (0 – 2 feet below ground surface) and subsurface soil (2 to 10 feet below ground surface) also included ingestion, dermal contact, and inhalation for a resident, commercial/industrial worker, and recreational or trespasser scenarios. The pathway evaluated for vapor intrusion was inhalation for a resident and commercial/industrial worker. A summary of the exposure areas and exposure scenarios are provided in Table 23. The human health conceptual site model (see Figure 63) presents the potentially complete exposure pathways for potential receptors.

The potential future land use of a property is always subject to uncertainty and is largely dictated by stakeholder involvement. Alternate land use for future development is biased toward evaluating an unrestricted reuse scenario (i.e., residential) so that exposure areas can be evaluated in the absence of restrictions on land use (EPA 1989). If an exposure area does not require any restrictions on land use, then any land use with less exposure (e.g., commercial /industrial, recreational, etc.) would be acceptable. The current and potential future reuse of the Site was evaluated in the Reuse Assessment (E^2 2010).

Private and municipal water wells in the vicinity of the Site are being used for domestic use (i.e., residential) and commercial/industrial uses. There are no restrictions on ground water use for domestic purposes. Therefore, residential (i.e., unrestricted reuse) and commercial/industrial exposure was evaluated for ground water (Table 23).

Soil samples were collected from Source Area 1 within AOI 1 and Source Area 2 within AOI 2. The current land use of both source areas and the surrounding property is predominantly commercial/industrial; however, there are some residences nearby. In addition, trespassers occasionally transgress the property. Finally, future reuse may include intrusive activities associated with development. Therefore, residential (i.e., unrestricted reuse), commercial/industrial, recreational/trespasser, and construction worker exposure scenarios were evaluated (Table 23).

Indoor air samples were collected from occupied structures within AOI 1 and AOI 2. The current land use of both AOIs and the surrounding property is predominantly commercial/industrial; however, there are some residences nearby. Therefore, indoor air samples were evaluated for both residential (i.e., unrestricted reuse) and commercial/industrial exposure (Table 23).

Major assumptions about exposure frequency, duration, and other exposure factors that were included in the exposure assessment (e.g., exposure frequency (days/year), exposure duration (years), and body surface area (cm^2) for dermal exposure) are presented in Table 24 (Human Exposure Parameters).

14.3 Toxicity Assessment

Once the exposure point concentrations (EPCs) are determined for the COCs and the completed exposure pathways are established for the current and potential receptors, toxicity factors are applied to predict human health risks from exposure to contaminated media. The toxicity assessment for the human health risk assessment included identification of toxicity values used to characterize non-cancer health effects and cancer risks, respectively.

Excess lifetime cancer risks were determined for each exposure pathway by multiplying a daily intake level with the chemical specific cancer potency factor. Cancer potency factors have been developed by the EPA from epidemiological or animal studies to reflect a conservative "upper bound" of the risk posed by potentially carcinogenic compounds. That is, the true risk is unlikely to be greater than the risk predicted. The resulting risk estimates are expressed in scientific notation as a probability (e.g., 1×10^{-6} for 1 in 1,000,000) and indicate (using this example), that an average individual is not likely to have greater than a one in a million chance of developing cancer over 70 years as a result of site-related exposure (as defined) to the compound at the stated concentration. All risks estimated represent an "excess lifetime cancer risks" – or the additional cancer risk on top of that which we face from other causes such as cigarette smoke or exposure to ultraviolet radiation from the sun. The chance of an individual developing cancer from all other (non-site related) causes has been estimated to be as high as one in three. The EPA's generally accepted risk range for Site related exposure is 10^{-4} to 10^{-6}. Current EPA practice considers carcinogenic risks to be additive when assessing exposure to a mixture of hazardous substances. A summary of the cancer toxicity data relevant to the COCs for oral/dermal and inhalation exposure pathways are presented in Tables 25 and 26.

Table 25 provides a cancer toxicity data summary for the oral/dermal exposure pathway for tetrachloroethene, trichloroethene, and vinyl chloride. Of these chemicals, tetrachloroethene is characterized as likely to be carcinogenic to humans. Trichloroethene and vinyl chloride are characterized as carcinogenic to humans.

Table 26 provides a cancer toxicity data summary for the inhalation exposure pathway. Trichloroethene and vinyl chloride are characterized as being carcinogenic to humans. Tetrachloroethene and 1,1,2,2-Tetrachloroethene are characterized as likely to be carcinogenic to humans. 1,2-Dichloroethene is characterized as a probable human carcinogen based on sufficient evidence of carcinogenicity in animals.

In assessing the potential for adverse effects other than cancer, a hazard quotient (HQ) is calculated by dividing the daily intake level by the reference dose (RfD) or other suitable benchmark. Reference doses have been developed by the EPA which represents a level to which an individual may be exposed that is not expected to result in any deleterious effect. RfDs are derived from epidemiological or animal studies and incorporate uncertainty factors to help ensure that adverse health effects will not occur. A HQ < 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all the chemicals of concern that affect the same target organ (e.g., liver) within or across those media to which the same individual may reasonably be exposed. A HI < 1 indicates that toxic non-carcinogenic effects are unlikely. A summary of the noncarcinogenic toxicity data relevant to the COCs for oral/dermal and inhalation exposure pathways are presented in Tables 27 and 28.

Table 27 provides a non-cancer toxicity data summary for the oral/dermal exposure pathway for 1,1-dichloroethene, cis-1,2-dichloroethene, tetrachloroethene, vinyl chloride and toluene. The available toxicity data for tetrachloroethene and vinyl chloride indicate that they primarily affect the liver.

Table 28 provides a non-cancer data summary for the inhalation exposure pathway for 1,2-dichloroethane, 1,4-dichlorobenzene, tetrachloroethene, vinyl chloride and toluene. The inhalation reference concentration (RfC) for these chemicals is based on chronic toxicity studies with the exception of RfC for 1,4-dichlorobenzene which is based on a sub-chronic study.

14.4 Risk Characterization

The final step in the human health risk assessment (HHRA) is the characterization of the potential risks associated with exposure to chemicals detected at a site. Information presented in the exposure and toxicity assessments is integrated in this section to characterize risks to commercial/ industrial workers, adult/child residents, construction workers, and adult/child recreational/trespassers that may be exposed to chemicals at the Site. Theoretical noncancer hazards and lifetime-excess cancer risks are characterized and discussed below.

The HHRA was performed on human health exposure scenarios that estimated the reasonable maximum exposure (RME). The RME is estimated for individual exposure pathways and then summed across multiple pathways as appropriate. The intent of the RME is to develop a conservative (i.e., safe) estimate of exposure. Under RME conditions, the calculated risks are not likely to be exceeded by any member of the exposed population because of the health-protective exposure assumptions used. The RME does not measure the actual health effects that hazardous substances may have on people. Conservative safety margins are built into the HHRA to ensure protection of the public. Therefore, people will not necessarily be affected even if they are exposed to chemicals at higher doses than those estimated in the HHRA. Vulnerable receptors (i.e., children) are carefully considered to make sure all members of the public will be protected.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Risk = CDI x SF

Where: risk = a unitless probability (e.g., 2×10^5) of an individual developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
SF = slope factor, expressed as $(\text{mg/kg-day})^{-1}$.

These risks are probabilities that usually are expressed in scientific notation (e.g., $1\text{x}10^{-6}$). An excess lifetime cancer risk of $1\text{x}10^{-6}$ indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an “excess lifetime cancer risk” because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three. EPA’s generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6}.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ < 1 indicates that a receptor’s dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemicals of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI < 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI > 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

where

CDI = Chronic daily intake
RfD = reference dose

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

A summary of the calculated reasonable maximum exposure carcinogenic risks and non-carcinogenic hazards for each exposure area and exposure scenario are presented in Table 29 (Ground Water Exposure), Table 30 (Soil Exposure), and Table 31 (Indoor Air Exposure). These calculations were conducted as part of the HHRA which was completed as part of the Remedial Investigation Report (EPA 2011) in July 2011.

In regards to ground water exposures (Table 29), the Austin Chalk Northern and Southern Plume areas exceeded EPA's accepted cancer risk range of 10^{-4} to 10^{-6} and had hazard index values greater than one. The media group – Edwards Aquifer Plugged and Abandoned, also exceed EPA's accepted cancer risk range and had a HI of 1.5. However, wells which make up this group were plugged and abandoned by EPA because they were acting as conduits for contaminant migration from the Austin Chalk to the Edwards aquifer. The Edwards Aquifer media group had a HI of 1.3. However, the vast majority (i.e., 78%) of the HI is attributed to ingestion of naturally occurring minerals (i.e., iron, manganese, and zinc) in the ground water. Similarly, the media group – Unknown Aquifer Impacted, had an HI of 1.4 of which 80% of the HI is attributed to the ingestion of iron and manganese in the ground water.

In regards to Source Area 1 and Source Area 2 exposures (Table 30) for surface soils (i.e., 0 – 2 feet below ground surface) and subsurface soils (i.e., 2 to 10 feet below ground surface), no calculated cancer risks exceeded EPA's accepted risk range and no calculated hazard indexes exceeded one.

In regards to indoor air exposures (Table 31) for Building B1 (a commercial building), six of the ten indoor samples exceeded EPA's accepted cancer risk range for a commercial/industrial exposure scenario. Only one sample (VI-101-Max) which was collected at a location where subsequent action was taken to address vapor intrusion exceeded a HI of 1 for a commercial/ industrial exposure scenario. For the indoor samples from Building B2 (a commercial building), no calculated cancer exposures exceeded EPA's accepted risk range and no calculated hazard indexes exceeded one for either the commercial/industrial worker or resident. For Building B3 (a commercial building), one indoor air sample exceeded EPA's accepted cancer risk range and had a hazard index of 1.3. However, the cancer risk and hazard index values were for a residential exposure (adult and child combined). For the Apartment building, no calculated cancer exposures exceeded EPA's accepted risk range. The two apartment indoor samples both had a hazard index of 1.3. However, 92% of the hazard index (i.e., 1.2) is attributed to the chemical 1,2,4-Trimethylbenzene which is not a Site COC. 1,2,4-Trimethylbenzene is a compound used as a gasoline additive, a solvent, a paint and lacquer thinner, in making dyes, and in producing prescription drugs. For the indoor samples from Buildings BA, BB, and the AOI 2 Commercial Building; no calculated cancer exposures exceeded EPA's accepted risk range and no calculated hazard indexes exceeded one.

Since the baseline risk assessment was completed as part of the Site's Remedial Investigation Report (EPA 2011) in July 2011, the EPA issued new toxicity information for two of the Site's chemicals of concern - TCE and PCE. The new toxicity information for TCE and PCE was released on September 28, 2011, and on February 10, 2012, respectively (Appendix C and D). This new toxicity information was derived from an intensive literature review of toxicity studies. As a result of these reviews, EPA lowered the carcinogenic values previously used as screening levels for TCE (i.e., TCE is now considered a more potent carcinogen). For PCE, the EPA's new toxicity factors consider that PCE is now slightly less toxic from a carcinogenic perspective, but more toxic for non-carcinogenic effects than previously used toxicity factors (which were based on California EPA guidance). Using the revised PCE and TCE toxicity values, the cancer risks and non-cancer hazard indexes were recalculated. A summary of the calculated reasonable maximum exposure carcinogenic risks and non-carcinogenic hazards for select exposure areas and exposure scenarios are presented in Table 32 (Ground Water Exposure), Table 33 (Soil Exposure), and Table 34 (Indoor Air Exposure).

Table 32 presents a summary of the estimated cancer risks and hazard indexes using the revised PCE and TCE toxicity values for the Austin Chalk Northern and Southern Plume areas. The revised cancer risk estimates for the residential exposure scenario exceeded EPA's accepted cancer risk range (i.e., $1x10^{-4}$ to$1x10^{-6}$) for both the Northern (i.e., $5.2x10^{-3}$) and Southern (i.e., $8.4x10^{-4}$) plume areas. For the commercial/industrial exposure scenario, the estimated cancer risk exceeded EPA's accepted cancer risk range for the Northern Plume area (i.e., $3.2x10^{-4}$). The estimated non-cancer hazard indexes the residential scenario each exceeded 1 for the Northern (i.e., HI = 790) and Southern (i.e., HI = 27) plume areas. For the commercial-industrial exposure scenario, the estimated non-cancer also exceeded 1 for the Northern (i.e., HI = 63) and Southern (i.e., HI = 2.2) plume areas.

In regards to Source Area 1 and Source Area 2 soil exposures (Table 33), no calculated cancer risks exceeded EPA's accepted risk range and no calculated hazard indexes exceeded one.

In regards to indoor air exposures (Table 34) for Building B1 (a commercial building), revised cancer and non-cancer risks were calculated for samples with the highest concentrations of PCE (i.e., VI-101-Max, VI-102, and VI-110). None of the revised cancer risk estimates exceeded EPA's accepted cancer risk range for a commercial/industrial exposure scenario. However, the revised non-cancer hazard indexes each exceeded 1 for the commercial/industrial exposure scenario.

In regards to indoor air exposures (Table 34) for Building B3 (a commercial building), the cancer risk and hazard index were calculated for sample VI-118 which had the highest concentration of PCE for this location. The calculated cancer risk (i.e., $2.7x10^{-5}$) was within EPA's accepted cancer risk range for a commercial-industrial exposure scenario. The calculated HI was less than one for a commercial-industrial exposure scenario.

In regards to indoor air exposures (Table 34) for the Apartments, the estimated cancer risk and hazard index were calculated for sample VI-212 which had the highest indoor air concentrations for this location. The calculated cancer risk (i.e., $5.3x10^{-5}$) was within EPA's accepted cancer risk range for a residential (adult and child combined) exposure scenario. The calculated HI (i.e., 1.5) was greater than one for the residential exposure scenario. However, 80% of the hazard index (i.e., 1.2) is attributed to 1,2,4-Trimethylbenzene which is not a site COC. 1,2,4-Trimethylbenzene is a compound used as a gasoline additive, a solvent, a paint and lacquer thinner, in making dyes, and in producing prescription drugs.

In regards to indoor air exposures (Table 34) for the AOI 2 Commercial Building, the estimated cancer risk and hazard index were calculated for sample VI-210 which was the only indoor sample for this location. The calculated cancer risk was within EPA's accepted cancer risk range for a commercial-industrial worker and for residential exposure. The calculated HI was less than one for a commercial-industrial worker and for residential exposure.

In May 2012, the EPA collected additional indoor samples from Building B1, Building B3, the apartments, and from the AOI 2 Active Dry Cleaner. Table 35 provides a reasonable maximum exposure summary of these locations.

In regards to indoor air exposures (Table 35) for Building B1, the calculated cancer risk (i.e., 1.2×10^{-5}) was within EPA's accepted cancer risk range for the commercial-industrial exposure. The calculated HI (i.e., 3.1) was greater than one for the commercial-industrial exposure. Inhalation of PCE at a measured concentration of 336 µg/m^3 and TCE at a measured concentration of 9.42 µg/m^3 accounted for 96% (i.e., 3.0) of the hazard index.

In regards to indoor air exposures (Table 35) for Building B3, the calculated cancer risk (i.e., 1.6×10^{-5}) was within EPA's accepted cancer risk range for the commercial-industrial exposure. The calculated HI (i.e., 1.8) was greater than one for the commercial-industrial exposure. Inhalation of TCE at a measure concentration of 12.2 µg/m^3 accounted for 78% (i.e., 1.4) of the hazard index. For the apartments, the calculated cancer risk (i.e., 1.0×10^{-3}) exceeded EPA's accepted cancer risk range for residential exposure. Inhalation of 1,4-Dichlorobenzene at a measured concentration of 221 µg/m^3 in the apartment building's rental office accounted for 99% (i.e., 9.9×10^{-4}) of the estimated cancer risk. The chemical is not site related. 1,4-Dichlorobenzene is used primarily as a space deodorant in products such as room deodorizers and toilet deodorant blocks and as a fumigant for moth control. The calculated hazard index was less than one.

In regards to indoor air exposures (Table 35) for the Active Dry Cleaner, the calculated cancer risk (2.0×10^{-4}) exceeded EPA's accepted cancer risk range for commercial-industrial exposure. The calculated hazard index (i.e., 69) was greater than one for commercial-industrial exposure. Inhalation of TCE at a measure concentration of 586 µg/m^3 accounted for 95% (i.e., 1.9×10^{-4}) of the indoor air cancer risk and 96% (i.e., 66) of the hazard index. When evaluating the indoor air concentrations of TCE versus tetrachloroethene (PCE), the indoor concentration of TCE (586 µg/m^3) is 246 times greater than that of PCE (2.38 µg/m^3). For sub-slab sampling location VI-215, the concentration of PCE (19,500 µg/m^3) is 170 times greater than that of TCE (115 µg/m^3). At sub-slab location VI-216, the concentration of PCE (45,200 µg/m^3) is 31 times greater than that of TCE (1,460 µg/m^3). If vapor intrusion was the primary source of TCE vapor within the building, one would expect correspondingly higher concentrations of PCE within the building based on the sub-slab concentrations. This is not the case. The primary source of TCE may be from a source within the building.

A summary of the revised calculated non-cancer hazard indexes and cancer risks for exposure to the Austin Chalk, Buda Limestone and Edwards Aquifer ground water and indoor air exposure for Buildings B1, Building B3, and the AOI 2 Active Dry Cleaner are presented in Table 36. Commercial-industrial and residential exposure scenarios were evaluated. The non-cancer hazard indexes did not exceed 1 and the increased incidence of cancer estimates were not greater than the generally accepted carcinogenic risk range of $1x10^{-4}$ to $1x10^{-6}$ for following ground water areas: Austin Chalk Northern Unimpacted, Austin Chalk Middle Unimpacted, Austin Chalk Southern Unimpacted, Buda Limestone, and Unknown Aquifer Background. The revised risks estimates for the Austin Chalk Northern and Austin Chalk Southern Plume were discussed previously. The Edwards Aquifer has an estimated non-cancer hazard index of 1.3 for the residential exposure scenario. Please note that 77% (i.e., 1.01 of 1.3) of this hazard index is attributed to the ingestion of three naturally occurring minerals: iron, manganese and zinc. Information for the Edwards Aquifer Plugged and Abandoned wells is also presented and shows that ground water from these wells presented a hazard index of 3.5 for the residential exposure scenario. The Unknown Aquifer impacted represents former private water wells located along El Verde Road and had a calculated hazard index of 1.8 for the residential exposure scenario. These wells were located on properties obtained by the Bexar County Flood Control District for a flood control project. These Unknown Aquifer impacted wells will be plugged and abandoned. Indoor air exposures for Building B1, Building B3, and the AOI 2 Active Dry Cleaner were discussed previously.

14.5 Key Uncertainties in Risk Assessment

Exposure scenarios were identified based on observed land use and activity that may occur at the Site. To the degree that actual land use and activity patterns are not represented by those assumed, uncertainties are introduced. It is unlikely that residential exposure will occur for commercial/industrial portions of the Site. Despite their unlikelihood, alternative land uses were evaluate in the HHRA so that health risk estimates generated could be considered applicable for an unrestricted land use. For example, a structure where elevated PCE vapor concentrations were identified in the soil gas is currently being used as a commercial building. This structure was previously used as a residence. It is possible the land use at this location could revert back to that of a residence. Because of this, risks were calculated for both commercial-industrial workers as well as for residents.

Standard EPA methodologies were used for the risk characterization step. Using these methods, the risks from exposure to multiple carcinogens were added to estimate the total cancer risk associated with exposures. The underlying assumption with this approach is that the risks from carcinogens with different target organs are additive. This assumption contributes to the uncertainty in the risk assessment and may result in underestimated or overestimated risks, depending on whether there are synergistic or antagonistic interactions between the site chemicals. Because information on such interactions is generally not available, possible interactions were not evaluated in the HHRA.

14.6 Ecological Exposure Pathway Evaluation

An ecological exposure pathway evaluation was conducted for the Site. The purpose of the pathway evaluation was to evaluate whether there are complete and significant exposure pathways linking ecological receptors to contaminants at the Site. PCE releases at dry cleaning facilities have impacted commercial structures/properties, nearby soil, the underlying vadose zone, and underlying ground water.

Impacted areas are located in highly commercial/industrial areas that present poor habitats for ecological receptors. Most of the release areas are either covered by buildings, parking lots, or caps. Only small areas (e.g., 500 square feet) near the location of the original releases have uncovered soil. Although surface soil is available to most ecological receptors, impacted soil areas are too small for significant ecological exposure. Subsurface soil is inaccessible to plants, wildlife, or other ecological receptors due to intrusive development and limited receptor exposure to subsurface soils. Therefore exposure to surface and subsurface soil for ecological receptors is considered a negligible pathway.

The ground water plume is approximately 1 mile by ½ mile and the area above the impacted ground water is commercial/industrial or residential. The average depth to impacted ground water generally varies between 65 and 110 feet below ground surface. The elevation of the center line of Huebner Creek is approximately 11.5 below the elevation of monitoring well DW-404 (SAIC, 2009). The measured water level in DW-404 when a survey was conducted was 64.2 feet below the top of the well casing. When the survey was conducted, the base of Huebner Creek was approximately 53 above the depth of impacted ground water in monitoring well DW-404. Thus, impacted ground water was not contributing to Huebner Creek.

There are no potentially complete exposure pathways by which ecological receptors could come in direct contact with ground water. Although, it is conceivable that contaminants in ground water could volatilize from the ground water plume where they could be inhaled by wildlife, this pathway is considered a negligible pathway because: the depth to ground water is at generally 65 feet below ground surface, there is poor habitat quality over the plume, and volatile organic compounds would substantially dilute in ambient air. Based on this evaluation, exposure to ground water is considered a negligible pathway.

Because the releases occurred in highly commercial-industrial areas, there are no complete and significant exposure pathways identified for ecological receptors. In addition, as part of the ecological assessment process, the TCEQ’s Tier 1 Exclusion Criteria Checklist described in the Texas Risk Reduction Program (30 TAC §350) was used. The evaluation (dated May 17, 2011), indicated that no further action is necessary to protect ecological receptors at the site.

14.7 Risk Assessment Conclusion and Basis for Response Action

Table 36 provides a summary of the calculated excess cancer risks above 1×10^{-4} and non-cancer hazards greater than one for the commercial-industrial worker and residential (adult and child combined) exposure to Site impacted ground water or exposed to Site impacted indoor air.

14.7.1 The Austin Chalk Northern Plume

Table 37 provides a risk characterization summary of the estimated non-cancer risk for the commercial/industrial worker exposed to contaminated ground water in the Austin Chalk Northern Plume. The Risk Assessment Guidance for Superfund states that, generally, a hazard index (HI) greater than 1 indicates the potential for adverse non-cancer effects. The estimated HI for all chemicals of potential concern detected in the Austin Chalk Northern Plume totaled 63. Approximately 99% (i.e., 62.3) of this HI is attributed to exposure to three COCs: TCE (HI = 32.5), PCE (HI = 18.4), and cis-1,2-dichloroethene (HI = 11.4). The estimated HI of 62.3 for the commercial/industrial worker exposure scenario indicates that the potential for adverse non-cancer effects could occur from exposure to contaminated ground water in the Austin Chalk Northern Plume.

Table 38 provides a risk characterization summary of the estimated cancer risk for the commercial/industrial worker exposed to contaminated ground water in the Austin Chalk Northern Plume. The estimated increased cancer risk to all chemicals of potential concern detected in the Austin Chalk Northern Plume totaled $3.2\text{x}10^{-4}$. This risk level indicates that if no cleanup action is taken, an individual would have an increased probability of 3.2 in 10,000 of developing cancer as a result of exposure to site-related COCs. The COC contributing the most to this risk is TCE. Essentially 100% of the increased cancer risk is attributed to three COCs: TCE (i.e., $2.34\text{x}10^{-4}$), PCE (i.e., $8.2\text{x}10^{-6}$), and vinyl chloride ($4.3\text{x}10^{-6}$).

Table 39 provides a risk characterization summary of the estimated non-cancer risk for the resident (adult and child combined) exposed to contaminated ground water in the Austin Chalk Northern Plume. The estimated HI for all chemicals of potential concern detected in the Austin Chalk Northern Plume totaled 790. Essentially 100% of this HI is attributed to exposure to three COCs: TCE (HI = 486), PCE (HI = 231), and cis-1,2-dichloroethene (HI = 76). The estimated HI of 793 for the resident (adult and child combined) exposure scenario indicates that the potential for adverse non-cancer effects could occur from exposure to contaminated ground water in the Austin Chalk Northern Plume.

Table 40 provides a risk characterization summary of the estimated cancer risk for the resident (adult and child combined) exposed to contaminated ground water in the Austin Chalk Northern Plume. The estimated increased cancer risk to all chemicals of potential concern detected in the Austin Chalk Northern Plume totaled $5.2\text{x}10^{-3}$. This risk level indicates that if no cleanup action is taken, an individual would have an increased probability of 5.2 in 1,000 of developing cancer as a result of exposure to site-related COCs. The COC contributing the most to this risk is TCE. Essentially 100% of the increased cancer risk is attributed to three COCs: TCE (i.e., $4.24\text{x}10^{-3}$), PCE (i.e., $8.3\text{x}10^{-4}$), and vinyl chloride ($1.06\text{x}10^{-4}$).

14.7.2 The Austin Chalk Southern Plume

Table 41 provides a risk characterization summary of the estimated non-cancer risk for the commercial/industrial worker exposed to contaminated ground water in the Austin Chalk Southern Plume. The estimated HI for all chemicals of potential concern detected in the Austin Chalk Southern Plume totaled 2.2. Approximately 96% (i.e., 2.12) of this HI is attributed to exposure to three COCs: PCE (HI = 1.53), TCE (HI = 0.444), and cis-1,2-dichloroethene (HI = 0.145). The estimated HI of 2.12 for the commercial/industrial worker exposure scenario indicates that the potential for adverse non-cancer effects could occur from exposure to contaminated ground water in the Austin Chalk Southern Plume.

Table 42 provides a risk characterization summary of the estimated cancer risk for the commercial/industrial worker exposed to contaminated ground water in the Austin Chalk Southern Plume. The estimated increased cancer risk to all chemicals of potential concern detected in the Austin Chalk Southern Plume totaled 4.6×10^{-5} (Table 36). This risk level indicates that if no cleanup action is taken, an individual would have an increased probability of 4.6 in 100,000 of developing cancer as a result of exposure to site-related COCs. Approximately 22% of the increased cancer risk is attributed to three site COCs: PCE (i.e., 6.65×10^{-6}), TCE (i.e., 3.15×10^{-6}), and vinyl chloride (4.12×10^{-7}). The majority of the estimated cancer risks are attributed to two chemicals: dibromochloromethane and bromodichloromethane. Dibromochloromethane was detected at a frequency of 2 out of 70 samples collected from the Austin Chalk Source Area 2 - Southern Plume (Table 19) and accounts for 39% (i.e., 4.6×10^{-5}) of the total estimated cancer risk. Bromodichloromethane was detected at a frequency of 2 out of 71 samples collected from the Austin Chalk Source Area 2 - Southern Plume (Table 19) and accounts for 32% (i.e., 4.6×10^{-5}) of the total estimated cancer risk. These two chemicals are referred to as trihalomethanes and are formed as a by-product predominantly when chlorine is used to disinfect water for drinking.

Table 43 provides a risk characterization summary of the estimated non-cancer risk for the resident (adult and child combined) exposed to contaminated ground water in the Austin Chalk Southern Plume. The estimated HI for all chemicals of potential concern detected in the Austin Chalk Southern Plume totaled 27 (Table 32). Approximately 96% of this HI is attributed to exposure to three COCs: PCE (HI = 18.6), TCE (HI = 6.46), and cis-1,2-dichloroethene (HI = 0.958). The estimated HI of 26 for the resident (adult and child combined) exposure scenario indicates that the potential for adverse non-cancer effects could occur from exposure to contaminated ground water in the Austin Chalk Southern Plume.

Table 44 provides a risk characterization summary of the estimated cancer risk for the resident (adult and child combined) exposed to contaminated ground water in the Austin Chalk Southern Plume. The estimated increased cancer risk to all chemicals of potential concern detected in the Austin Chalk Southern Plume totaled 8.4×10^{-4} (Table 36). This risk level indicates that if no cleanup action is taken, an individual would have an increased probability of 8.4 in 100,000 of developing cancer as a result of exposure to site-related COCs. Approximately 16% of the increased cancer risk is attributed to three site COCs: PCE (i.e., 6.7×10^{-5}), TCE (i.e., 5.69×10^{-5}), and vinyl chloride (9.99×10^{-6}). The majority of the estimated cancer risks are attributed to two chemicals: dibromochloromethane and bromodichloromethane. Dibromochloromethane was detected at a frequency of 2 out of 70 samples collected from the Austin Chalk Soucre Area 2 - Southern Plume (Table 19) and accounts for 39% (i.e., 4.6×10^{-5}) of the total estimated cancer risk. Bromodichloromethane was detected at a frequency of 2 out of 71 samples collected from the Austin Chalk Source Area 2 - Southern Plume (Table 19) and accounts for 32% (i.e., 4.6×10^{-5}) of the total estimated cancer risk. These two chemicals are referred to as trihalomethanes and are formed as a by-product predominantly when chlorine is used to disinfect water for drinking.

14.7.3 Building B1 – Indoor Air

Building B1is a commercial building with calculated HI > 1 for the commercial-industrial worker exposure scenario. The calculated hazard index for the most recent indoor air sampling from May 2012 is 3.1. Inhalation of PCE and TCE with corresponding HIs of 1.9 and 1.1 accounted for 97% of the non-cancer hazard index.

Table 45 provides a risk characterization summary of the estimated non-cancer risk for the commercial/industrial worker from the inhalation route of exposure. An estimated HI of 3.1 (Table 36) was calculated for all chemicals of potential concern detected in the indoor air sample collected in May 2012 (VI-102). Approximately 97% (HI = 3.0) is attributed to the exposure to two COCs: PCE (HI = 1.9) and TCE (HI = 1.1). The estimated HI of 3.0 for the commercial/ industrial worker exposure scenario indicates that the potential for adverse non-cancer effects could occur from exposure to two site-related COCs.

Table 46 provides a risk characterization summary of the estimated cancer risk for the commercial-industrial worker from the inhalation route of exposure. The estimated cancer risk of $1.2x10^{-5}$ (Table 36) was calculated for all chemicals of potential concern detected in the May 2012 indoor air sample (VI-102). Approximately 92% ($1.1x10^{-5}$) of the cancer risk is attributed to the exposure to three site-specific COCs: PCE ($7.2x10^{-6}$), TCE ($3.1x10^{-6}$), and vinyl chloride ($4.3x10^{-7}$). A cancer risk level of $1.1x10^{-5}$ indicates that a commercial-industrial worker would have an increased probability of 1.1 in 100,000 of developing cancer as a result of exposure to three site-related COCs.

Table 47 provides a risk characterization summary of the estimated non-cancer risk for a resident (adult and child combined) from the inhalation route of exposure. An estimated HI of 13 (Table 36) was calculated for all chemicals of potential concern detected in the indoor air sample collected in May 2012 (VI-102). Approximately 98% (HI = 12.7) is attributed to the exposure to two COCs: PCE (HI = 8.2) and TCE (HI = 4.5). The estimated HI of 12.7 for a residential exposure scenario indicates that the potential for adverse non-cancer effects could occur from exposure to two site-related COCs.

Table 48 provides a risk characterization summary of the estimated cancer risk for a resident (adult and child combined) from the inhalation route of exposure. The estimated cancer risk of $7.3x10^{-5}$ (Table 36) was calculated for all chemicals of potential concern detected in the May 2012 indoor air sample (VI-102). Approximately 89% ($6.5x10^{-5}$) of the cancer risk is attributed to the exposure to three site-specific COCs: PCE ($3.6x10^{-5}$), TCE ($2.2x10^{-5}$), and vinyl chloride ($7.4x10^{-6}$). A cancer risk level of $6.5x10^{-5}$ indicates that a resident would have an increased probability of 6.5 in 100,000 of developing cancer as a result of exposure to three site-related COCs.

14.7.4 Building B3 – Indoor Air

The calculated hazard index for the commercial-industrial worker in Building B3 (a commercial building) for the most recent indoor air sampling from May 2012 is 1.8 (Table 36). Inhalation of TCE and PCE with corresponding hazard indexes of 1.4 and 0.12 accounted for 84% of the non-cancer hazard index. Please note that previous indoor air sampling conducted in June 2010 (Table 34) resulted in a hazard index of 0.52 for the commercial/industrial worker.

Table 49 provides a risk characterization summary of the estimated non-cancer risk for the commercial/industrial worker from the inhalation route of exposure. An estimated HI of 1.8 (Table 36) was calculated for all chemicals of potential concern detected in the indoor air sample collected in May 2012 (VI-118). Approximately 84% (HI = 1.52) is attributed to the exposure to two COCs: TCE (HI = 1.4) and PCE (HI = 0.12). The estimated HI of 1.52 for the commercial/ industrial worker exposure scenario indicates that the potential for adverse non-cancer effects could occur from exposure to two site-related COCs.

Table 50 provides a risk characterization summary of the estimated cancer risk for the commercial-industrial worker from the inhalation route of exposure. The estimated cancer risk of 1.6×10^{-5} (Table 36) was calculated for all chemicals of potential concern detected in the May 2012 indoor air sample (VI-118). Approximately 28% (4.45×10^{-6}) of the cancer risk is attributed to the exposure to two site-specific COCs: TCE (4.0×10^{-6}) and PCE (4.5×10^{-7}). A cancer risk level of 4.45×10^{-6} indicates that a commercial-industrial worker would have an increased probability of 4.45 in 1,000,000 of developing cancer as a result of exposure to two site-related COCs. The chemical 1,4-Dichlorobenzene with an estimated cancer risks of 9.9×10^{-6} attributed 62% of the calculated indoor air cancer risks. 1,4-Dichlorobenzene is used primarily as a space deodorant in products such as room deodorizers and toilet deodorant blocks and as a fumigant for moth control.

Table 51 provides a risk characterization summary of the estimated non-cancer risk for a resident (adult and child combined) from the inhalation route of exposure. An estimated HI of 7.4 (Table 36) was calculated for all chemicals of potential concern detected in the indoor air sample collected in May 2012 (VI-118). Approximately 85% (HI = 6.3) is attributed to the exposure to two COCs: TCE (HI = 5.8) and PCE (HI = 0.5). The estimated HI of 6.3 for a residential exposure scenario indicates that the potential for adverse non-cancer effects could occur from exposure to two site-related COCs.

Table 52 provides a risk characterization summary of the estimated cancer risk for a resident (adult and child combined) from the inhalation route of exposure. The estimated cancer risk of 9.0×10^{-5} (Table 36) was calculated for all chemicals of potential concern detected in the May 2012 indoor air sample (VI-118). Approximately 30% (2.72×10^{-5}) of the cancer risk is attributed to the exposure to two site-specific COCs: TCE (2.5×10^{-5}) and PCE (2.2×10^{-6}). A cancer risk level of 2.72×10^{-5} indicates that a resident would have an increased probability of 2.72 in 100,000 of developing cancer as a result of exposure to two site-related COCs. The chemical 1,4-Dichlorobenzene with an estimated cancer risks of 5.0×10^{-5} attributed 56% of the calculated indoor air cancer risks. 1,4-Dichlorobenzene is used primarily as a space deodorant in products such as room deodorizers and toilet deodorant blocks and as a fumigant for moth control.

14.7.5 AOI Active Dry Cleaner – Indoor Air

The AOI 2 Active Dry Cleaner building had a HI > 1 and cancer risk > 1×10^{-4} for the commercial-industrial worker exposure scenario. The calculated hazard index for the May 2012 indoor air sampling is 69. Inhalation of TCE with an HI of 66 accounted for 96% of the non-cancer index. The calculated cancer risk for the May 2012 indoor air sampling is $2.0x10^{-4}$. Inhalation of TCE with a cancer risk of $1.9x10^{-4}$ accounted for 95% of the cancer risk. It is important to note that the PCE/TCE ratios for the indoor air verses sub-slab vapor collected concurrently varied significantly (as discussed in Section 14.4). This variation indicates that while there are significant measured concentrations of PCE and TCE present in the sub-slab vapor (see Table 13), only TCE was detected at significant concentration within the building. This indicates that there may be a significant source of TCE within the building. Tables 53 and 54 provide a summary of the non-cancer and cancer risks from the indoor exposure to TCE and PCE.

15.0 REMEDIAL ACTION OBJECTIVES

The Remedial Action Objectives that the selected remedy is expected to accomplishment for the Site are:

- Prevent exposure to COCs associated with the Site in ground water and indoor air above cleanup levels.
- Prevent or minimize further migration of COCs associated with the Site in surface soil, subsurface soil, vadose zone bedrock, and ground water above cleanup levels.
- Return ground water to their expected beneficial uses wherever practicable (aquifer restoration).

The following cleanup levels provide numerical criteria that can be used to measure the progress in meeting the ground water remedial action objectives for the cleanup:

• Tetrachloroethene	5	µg/L	(MCL)
• Trichloroethene	5	µg/L	(MCL)
• 1,1-Dichloroethene	7	µg/L	(MCL)
• Cis-1,2-Dichloroethene	70	µg/L	(MCL)
• Vinyl Chloride	2	µg/L	(MCL)
• Toluene	1000	µg/L	(MCL)

MCL - Maximum Contaminant Level in drinking water under the Federal Drinking Water Act

Table 55 provides a summary of MCL exceedances in ground water. Ground water data collected after completion of the Remedial Investigation Report (EPA, 2011) are not reflected in Table 55. Tables 4, 5, 8, 9 include MCL exceedances in ground water collected after the completion of the Remedial Investigation Report.

Human health cleanup levels for indoor air are based on a cancer risk of $1x10^{-5}$ or non-cancer hazard index of 1 (Table 56) for a commercial/industrial worker. The $1x10^{-5}$ cancer risk was chosen for individual contaminants so that when these cancer risks were added for multiple contaminants, they would not exceed a $1x10^{-4}$ increased incidence of cancer risk. When both cancer and non-cancer values are available, the lowest value was selected. These indoor air cleanup levels were calculated using methodologies presented in the human health risk assessment. The following cleanup levels provide numerical criteria that can be used to measure the progress in meeting the indoor air remedial action objectives for the cleanup:

Tetrachloroethene	175.0	$\mu g/m^3$	(Non-cancer hazard index of 1)
1,1,2,2-Tetrachloroethane	2.1	$\mu g/m^3$	(Cancer risk of $1x10^{-5}$)
Trichloroethene	8.8	$\mu g/m^3$	(Non-cancer hazard index of 1)
1,2-Dichloroethane	4.7	$\mu g/m^3$	(Cancer risk of $1x10^{-5}$)
Vinyl Chloride	28.0	$\mu g/m^3$	(Cancer risk of $1x10^{-5}$)

16.0 DESCRIPTION OF ALTERNATIVES

Remedial alternatives for the Site were developed to address the remedial action objectives and remedial goals for the Site. Remedial alternatives were developed for surface and subsurface soils, vadose zone bedrock, ground water, and indoor air.

- S-1 No Further Action
- S-2 Limited Action: Institutional Controls (ICs), engineering controls, indoor air and soil gas monitoring
- S-3 Excavation and off-site disposal
- S-4 Soil Vapor Extraction

Vadose Zone Bedrock

- B-1 No Further Action
- B-2 Limited Action: Soil gas monitoring, ICs, engineering controls
- B-3 Soil Vapor Extraction
- B-4 *In situ* Desorption

Ground Water

- GW-1 No Further Action
- GW-2 Limited Action: monitoring, ICs, engineering controls
- GW-3 Municipal Water Supply (if new impacted wells are identified)
- GW-4 *In situ* Bioremediation
- GW-5 Pump and Treat

Indoor Air

- VI-1 No Further Action
- VI-2 Limited Action: ICs, engineering controls
- VI-3 Positive Pressure System
- VI-4 Membrane/Sealant with Vapor Vent
- VI-5 Sub-slab Depressurization System

16.1 Common Elements

Many of the alternatives include limited actions. Limited actions utilize institutional controls (ICs), engineering controls, and/or long-term monitoring. ICs are administrative and/or legal instruments that place restrictions on the use or development of land and/or ground water within a defined area. These legal and administrative tools are used to maintain protection of public health and/or the environment, and to protect the integrity of a remedy by limiting land or resource use. IC instruments include restrictive covenants, deed notices, ordinances, zoning restrictions, building and excavation permits, easement, well drilling prohibitions, or a combination thereof. Because some alternatives may include leaving material above EPA Cleanup Levels, ICs (e.g. zoning ordinances) will need to be included, not just for the Limited Action alternative.

Engineering controls are instruments such as fencing or signage that are used to minimize access to contaminated areas or areas that may pose a physical hazard. ICs and engineering controls can be used in all stages of the remedial process to accomplish various remedial objectives, and will be implemented in a series to provide overlapping assurances of protection against contamination.

16.2 No Action Alternatives

Alternative S-1/B-1/GW-1/VI-1:

No Further Action
Estimated Capital Costs: $0
Estimated Annual O&M Cost: $0
Estimated Present Worth Costs: $0
Estimated Construction Timeframe: NA
Estimated Time Until Action Complete: NA

As required by the NCP (40 CFR § 300.430 [e] [6]), the alternatives must include the No Further Action alternative. This is to be used as the baseline alternative against which the effectiveness of all other remedial alternatives are judged. Under No Further Action, no remedial actions will be conducted at the Site. All contaminants will remain in place and will be subject to environmental influences. Furthermore, no action will be taken to prevent unauthorized access or development at the Site. No deed notices to inform interested parties regarding the site conditions will be implemented.

16.3 Surface and Subsurface Soil Remedial Alternatives

Alternative S-2: Limited Action

Source Area 1
Estimated Capital Costs: $33,000
Estimated Annual O&M Cost: $0

Estimated Annual Long Term Monitoring: $3,000
Estimated Present Worth Costs: $70,000

Source Area 2
Estimated Capital Costs: $33,000
Estimated Annual O&M Cost: $0
Estimated Annual Long Term Monitoring: $3,000
Estimated Present Worth Costs: $70,000

Estimated Time Until Action Complete: Not applicable - no field construction performed.

The limited action alternative for the surface and subsurface soil consists of indoor air monitoring, soil gas sampling, and a combination of institutional and engineering controls (e.g., deed notices).

Alternative S-3: Excavation and Off-site Disposal

Source Area 1
Estimated Capital Costs: $1,631,000
Estimated Annual O&M Cost: $9,000
Estimated Annual Long Term Monitoring: $4,000
Estimated Present Worth Costs: $1,793,000
Estimated Construction Timeframe: 4 months
Estimated Time Until Action Complete: 4 months

Source Area 2
Estimated Capital Costs: $638,000
Estimated Annual O&M Cost: $3,000
Estimated Annual Long Term Monitoring: $4,000
Estimated Present Worth Costs: $725,000
Estimated Construction Timeframe: 2 months
Estimated Time Until Action Complete: 2 months

Alternative S-3 is the excavation and removal of contaminated surface and subsurface soils. The removed soil can be transported for off-site disposal. Estimates of principal threat waste at Source Areas 1 and 2 are subject to uncertainty. However, for the purpose of the cost estimate, it was assumed that Source Area 1 was approximately 50-feet square and 10-feet deep; Source Area 2 was assumed to be approximately 25-feet by 50-feet and 10-feet deep.

Excavation at Source Area 1 where contaminated material is present beneath the retail building would require shutting down businesses and demolishing parts of the building that overlie the source area. Disposal requirements will depend on whether the excavated material is classified as a hazardous waste, in which case land disposal restrictions (LDRs) may apply. If the material is considered hazardous waste, it may require treatment prior to disposal. Because the two source areas contain chlorinated solvents that are considered principal threat wastes, it was assumed that the material requiring excavation may require treatment prior to disposal. The cost of incineration significantly exceeds the cost of disposal at the nearest landfill. The cost of excavation and off-site disposal is presented in the cost estimate for this alternative.

Alternative S-4: Soil Vapor Extraction (SVE)

Source Area 1

Estimated Capital Costs: $824,000
Estimated Annual O&M Cost: $66,000
Estimated Annual Long Term Monitoring: $4,000
Estimated Present Worth Costs: $1,039,000
Estimated Construction Timeframe: 4 months
Estimated Time Until Action Complete: 3.5 years

Source Area 2

Estimated Capital Costs: $237,000
Estimated Annual O&M Cost: $62,000
Estimated Annual Long Term Monitoring: $4,000
Estimated Present Worth Costs: $452,000
Estimated Construction Timeframe: 4 months
Estimated Time Until Action Complete: 3 years

Alternative S-4 utilizes SVE. SVE is a physical means of removing or reducing concentrations of volatile compounds. This technology targets the adsorbed, vapor and free (NAPL) phases of the volatile contaminant present in the unsaturated (vadose) portion of the subsurface.

The SVE process involves applying a vacuum to contaminated soils to 10 feet below ground surface in the unsaturated zone in order to induce air flow in the subsurface. The volatile fraction of contaminants stuck to soil particles evaporates and are swept away to extraction wells. Those contaminants that have already volatilized, or 'weathered', are also carried to extraction wells. If volatile NAPL is floating or pooled on the ground water table, it is also carried away in a way similar to a fan blowing past a pool of gasoline. Soil gas collected by the induced vacuum will be treated with granulated activated carbon.

To address the contamination at Source Area 1, it was estimated that 12 horizontal SVE wells will be drilled underneath the existing building (B1) to remove primary source material. Additional vertical wells or existing soil gas ports between Building B1 and B3 may be utilized to extract source material. Additionally, contaminated soils outside the building footprint will need to be excavated to install the horizontal wells. This material will taken offsite for disposal. Vertical SVE wells will be employed to address the contamination at Source Area 2. An estimated thirteen vertical SVE wells will be drilled to a depth of 10 feet to remove primary source material in the surface and subsurface soils.

Institutional controls to prevent access or use of areas that present unacceptable risk to human health during the construction and operation of the SVE system are included. In addition, institutional controls may also impose restrictions on the development of residential dwellings, and the unauthorized drilling, excavating, digging, trenching, or any other activities that might otherwise compromise the remedy. Long term monitoring costs included the collection and analysis of soil gas samples.

16.4 Vadose Zone Bedrock Remedial Alternatives

Alternative B-2: Limited Action

Source Area 1

Estimated Capital Costs: $33,000
Estimated Annual O&M Cost: $0
Estimated Annual Long Term Monitoring: $4,000
Estimated Present Worth Costs: $83,000
Estimated Construction Timeframe: 0
Estimated Time Until Action Complete: NA

Source Area 2

Estimated Capital Costs: $33,000
Estimated Annual O&M Cost: $0
Estimated Annual Long Term Monitoring: $4,000
Estimated Present Worth Costs: $83,000
Estimated Construction Timeframe: 0
Estimated Time Until Action Complete: NA

The limited action alternative for the vadose zone bedrock consists of soil gas monitoring in the buildings and surrounding areas on-site and a combination of institutional and engineering controls (e.g., deed notices) to prevent access or use of areas that present unacceptable risk to human health due to contamination in the vadose zone bedrock.

Alternative B-3: Soil Vapor Extraction

Source Area 1

Estimated Capital Costs: $1,073,000
Estimated Annual O&M Cost: $80,000
Estimated Annual Long Term Monitoring: $30,000
Estimated Present Worth Costs: $1,487,000
Estimated Construction Timeframe: 3 months
Estimated Time Until Action Complete: 4 years

Source Area 2

Estimated Capital Costs: $1,061,000
Estimated Annual O&M Cost: $70,000
Estimated Annual Long Term Monitoring: $30,000
Estimated Present Worth Costs: $1,441,000
Estimated Construction Timeframe: 3 months

Estimated Time Until Action Complete: 4 years
Alternative B-3 utilizes SVE wells that will remove volatile COCs from the vadose zone bedrock by inducing a vacuum. Soil gas collected by the vacuum will be treated with appropriate granular activated carbon vessels. In addition to addressing vadose zone bedrock RAOs, this combined technology alternative will address the ground water RAO for preventing further degradation of ground water quality by removing the primary source material. To address the contamination at Source Area 1 and Source Area 2, vertical SVE wells would be employed and their associated piping. The treatment depth is the depth to the water table. Institutional controls to prevent access or use of areas that present unacceptable risk to human health during the construction and operation of the SVE system are included. Long term monitoring includes the collection and analysis of soil gas samples.

Alternative B-4: *In situ* Desorption

Source Area 1
Estimated Capital Costs: $7,436,000
Estimated Annual O&M Cost: $0
Estimated Annual Long Term Monitoring: $194,000
Estimated Present Worth Costs: $8,093,000
Estimated Construction Timeframe: 6 months
Estimated Time Until Action Complete: 6 months

Source Area 2
Estimated Capital Costs: $5,683,000
Estimated Annual O&M Cost: $0
Estimated Annual Long Term Monitoring: $194,000
Estimated Present Worth Costs: $6,340,000
Estimated Construction Timeframe: 6 months
Estimated Time Until Action Complete: 6 months

Alternative B-4 involves heating the vadose zone bedrock in place. Thermal conductive heating is the heating method represented in the cost estimate. The vaporized organics can be collected and treated. The estimated target area for Source Area 1 is 150 feet by 50 feet. The estimated target area for Source Area 2 is 90 feet by 60 feet. The treatment depth is the depth to the water table.

The wells will be installed with a vapor cover to ensure that the heated vapors do not escape through the surface and are captured via the SVE wells. Collected vapors will pass through a condenser, where it will be treated with granular activated carbon.

16.5 Ground Water Remedial Alternatives

Alternative GW-2: Limited Action

Austin Chalk Northern Plume
Estimated Capital Costs: $181,000
Estimated Annual O&M Cost: $0
Estimated Annual Long Term Monitoring: $11,000
Estimated Present Worth Costs: $317,000
Estimated Construction Timeframe: 0
Estimated Time Until Action Complete: NA

Austin Chalk Southern Plume
Estimated Capital Costs: $181,000
Estimated Annual O&M Cost: $0
Estimated Annual Long Term Monitoring: $11,000
Estimated Present Worth Costs: $317,000
Estimated Construction Timeframe: 0
Estimated Time Until Action Complete: NA

The limited action alternative for ground water consists of ground water monitoring for VOCs and a combination of institutional and engineering controls to prevent ground water use that presents an unacceptable risk to human health. Institutional controls (e.g., local ordinance) to limit future use of ground water or prevent drilling wells would be placed to prevent unacceptable risk from exposure to receptors. In addition, a series of engineering controls could be employed to eliminate access to existing impacted ground water wells (e.g., well plugging and abandonment) and thus eliminating the potential contaminant migration pathway to the Edwards Aquifer. Ground water monitoring would be conducted yearly in a select set of wells to evaluate migration of contaminants.

Alternative GW-3: Municipal Water Supply

Austin Chalk Northern Plume
Estimated Capital Costs: $309,000
Estimated Annual O&M Cost: $0
Estimated Annual Long Term Monitoring: $11,000
Estimated Present Worth Costs: $445,000
Estimated Construction Timeframe: 2 months
Estimated Time Until Action Complete: 2 months

Austin Chalk Southern Plume
Estimated Capital Costs: $309,000
Estimated Annual O&M Cost: $0
Estimated Annual Long Term Monitoring: $11,000
Estimated Present Worth Costs: $445,000
Estimated Construction Timeframe: 2 months
Estimated Time Until Action Complete: 2 months

If additional impacted private water wells (i.e., MCLs are exceeded in water samples) are identified, the purpose of Alternative GW-3 is to provide these residents with a source of water to ensure that they do not need to use contaminated ground water. Residences with impacted water wells in contaminated regions or in the path of contaminated ground water flow will be connected to the municipal water supply. Because connection to the municipal supply does not include a ground water remediation component, it may require a Technical Impracticability Waiver to be a stand-alone remedy.

The cost estimate assumes that up to 12 residences within Source Area 1 and 2 will need to be connected to the municipal water supply. Please note that there are no known residences which require connections to the municipal water supply. As noted previously, the EPA did provide connections to residents who were obtaining their drinking water from private wells and that the water from these wells contained contamination above the MCLs. This remedy contingency was included as part of EPA's remedy evaluation to address the possibility that additional residences are identified using well water containing contamination above the MCLs.

Institutional and engineering controls to restrict the use of ground water at residences in impacted areas will be required to prevent unacceptable risk from exposure to ground water. Long-term monitoring to evaluate plume migration is provided. The monthly costs for water usage will be the responsibility of the resident at a rate set by the municipal water supplier.

Alternative GW-4: *In situ* Bioremediation

Austin Chalk Northern Plume

Estimated Capital Costs: $2,011,000
Estimated Annual O&M Cost: $0
Estimated Annual Long Term Monitoring: $25,000
Estimated Present Worth Costs: $2,321,000
Estimated Construction Timeframe: 20 months
Estimated Time Until Action Complete: 4 - 6 years

Austin Chalk Southern Plume

Estimated Capital Costs: $2,142,000
Estimated Annual O&M Cost: $0
Estimated Annual Long Term Monitoring: $25,000
Estimated Present Worth Costs: $2,452,000
Estimated Construction Timeframe: 20 months
Estimated Time Until Action Complete: 4- 6 years

Alternative GW-4 includes injecting amendments (e.g., 3DMe™) into the Austin Chalk Aquifer that promote the biodegradation of chlorinated solvents. An enhancement to this alternative may include bioaugmentation, where microorganisms that de-grade chlorinated solvents are injected into the aquifer in addition to the amendments. This alternative may be coupled with the municipal water supply alternative to protect human health during the implementation of the remedy.

This alternative's cost estimate includes the installation of 12 injection wells for each of the two source areas. The treatment areas include and extend downgradient of the injection areas because the amendment migrates downgradient via fractures and channels in the formation. The injection area of Source Area 1 was assumed to be 500 feet by 300 feet. The injection area of Source Area 2 was assumed to be 600 feet by 300 feet.

Two injection events were assumed. It was assumed that the second event would follow approximately 18 months after the first one. Additional injection events may be required, but were not estimated. Institutional and engineering controls to restrict the use of ground water in impacted areas will be required to prevent unacceptable risk from exposure to ground water.

Alternative GW-5: Pump and Treat
Development
<u>Austin Chalk Northern Plume</u>
Estimated Capital Costs: $1,897,000
Estimated Annual O&M Cost: $403,000
Estimated Annual Long Term Monitoring: $23,000
Estimated Present Worth Costs: $7,183,000
Estimated Construction Timeframe: 3 months
Estimated Time Until Action Complete: 5-10 years

<u>Austin Chalk Southern Plume</u>
Estimated Capital Costs: $1,888,000
Estimated Annual O&M Cost: $425,000
Estimated Annual Long Term Monitoring: $23,000
Estimated Present Worth Costs: $7,447,000
Estimated Construction Timeframe: 3 months
Estimated Time Until Action Complete: 5-10 years

Alternative GW-5 will employ several extraction wells to remove contaminated ground water from the VOC plume. This extracted water will then be treated (e.g., air stripper) to remove VOCs and may be reinjected or discharged. Following the air stripper, water will pass through a liquid granular activated carbon vessel before being discharged. The effluent air from the air stripper will be treated in a vapor phase granular activated carbon vessel.

This alternative may be coupled with the municipal water supply alternative to protect human health during the implementation of the remedy. A combination of institutional and engineering controls would be necessary to prevent ground water use that presents an unacceptable risk to human health and protect the integrity of the remedy.

16.5 Indoor Air Remedial Alternatives (Building B1)

Alternative VI-2: Limited Action

Estimated Capital Costs: $34,000
Estimated Annual O&M Cost: $0

Estimated Annual Long Term Monitoring: $4,000
Estimated Present Worth Costs: $84,000
Estimated Construction Timeframe: 0
Estimated Time Until Action Complete: 30 years

The limited action alternative for vapor intrusion consists of indoor air monitoring for chlorinated solvents and a combination of institutional and engineering controls to prevent access or use of the areas that present an unacceptable risk to human health.

Alternative VI-3: Positive Pressure System
Estimated Capital Costs: $162,000
Estimated Annual O&M Cost: $3,000
Estimated Annual Long Term Monitoring: $4,000
Estimated Present Worth Costs: $249,000
Estimated Construction Timeframe: 1 week
Estimated Time Until Action Complete: 30 years

Alternative VI-3 attempts to reduce the concentrations of VOC vapors in indoor air for Building B1 by retrofitting or installing a system that brings in more outside air and pressurizes the building. Typical systems are modified HVAC systems. Alternatively, positive pressure can be achieved by introducing outside air into the building using a fan or blower. The goal is to create enough back pressure to prevent soil gas from entering the building. The system will run continuously to prevent intrusion. Periodic air sampling that will be necessary to confirm the efficacy of this alternative.

Alternative VI-4: Membrane/Sealant with Vapor Vent

Estimated Capital Costs: $150,000
Estimated Annual O&M Cost: $3,000
Estimated Annual Long Term Monitoring: $4,000
Estimated Present Worth Costs: $237,000
Estimated Construction Timeframe: 2 weeks
Estimated Time Until Action Complete: 30 years

The purpose of Alternative VI-4 is to address vapor intrusion into the existing building within Source Area 1 and divert vapor emissions from contaminated concrete floor within the office space with the use of a protective barrier. With this alternative, a chemically impermeable gel inserted between two chemically resistant woven fibers will be applied over the concrete foundation of the structure within the immediate vicinity of the contaminant source area. The removal of carpeting and demolition of interior walls is required in order to create a single continuous coat over the concrete foundation. A single continuous coat is necessary to prevent any perforations between the edges of the seals. The protective barrier will prevent VOCs from penetrating through the cracks within the concrete foundation. An additional layer of concrete will be laid above the sealant to protect against potential breakage of the membrane. Passive vapor vents will be installed underneath the membrane to redirect the vapors away from the building. The ventilation exit will be routed above the roof line in order to prevent inhalation to pedestrians. Periodic indoor air sampling collected will be necessary to confirm the efficacy of this alternative.

Alternative VI-5: Sub-Slab Depressurization System
Estimated Capital Costs: $105,000
Estimated Annual O&M Cost: $1,000
Estimated Annual Long Term Monitoring: $6,000
Estimated Present Worth Costs: $191,000
Estimated Construction Timeframe: 2 weeks
Estimated Time Until Action Complete: 30 years

Alternative VI-5 utilizes a sub-slab de-pressurization system within the existing structure adjacent to the source area. This system will depressurize the area underneath the concrete foundation and redirect the VOCs to an exhaust vent located above the roof line. As discussed in Section 9.3 (History of CERCLA Enforcement Actions), vent systems with in-line fans were previously installed on the exterior wall of Building B1. This vent system may be incorporated into the sub-slab depressurization system. Depressurization is expected to reduce contaminant migration into occupied spaces within the building. Once the system is in place, routine maintenance will be required to ensure the system is continuously running. Occasional inspection of the piping will be required to prevent direct intrusion into the building. Periodic air sampling will be necessary to confirm the efficacy of this alternative. Additionally routine maintenance of the depressurization system and a five year replacement of the extraction fans will be required.

17.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

Nine criteria are used to evaluate the different remedial alternatives individually and against each other in order to select a remedy. The nine evaluation criteria are (1) overall protection of human health and the environment; (2) compliance with Applicable or Relevant and Appropriate Requirements (ARARs); (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility, or volume of contaminants through treatment; (5) short-term effectiveness; (6) implementability; (7) costs; (8) State/support agency acceptance; and (9) community acceptance. This section of the ROD profiles the relative performance of each alternative against the nine criteria, noting how it compares to the other options under consideration. The nine criteria are discussed below.

17.1 Overall Protection of Human Health and the Environment

This criterion address 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. The following is a discussion for each alternative:

Surface and Subsurface Soil Alternatives

S-1 No Action Alternative
There is no reduction of risk with this alternative. The surface and subsurface soils would continue to act as source of contamination to indoor air and groundwater.

S-2 Limited Action Alternative
Monitoring which would provide an indication of contaminant migration. Institutional controls would not address vapor intrusion risk unless access to indoor areas is limited. Contaminant migration to ground water would not be addressed.

S-3 Excavation and Off-site Disposal
There will be no unacceptable risk to human health from the surface and subsurface soil once it has been excavated and hauled off-site for either disposal or incineration.

S-4 Soil Vapor Extraction
There will be no unacceptable risk to human health or the environment once SVE is complete. However, institutional controls and engineering controls will be required to prevent human health exposure and protect the integrity of the remedy during the operation of the SVE system.

Alternatives S-3 and S-4 both provide for overall protection of human health and the environment by reducing the mass of contamination. Alternative S-2 does limit access to contamination but is less protective than alternatives S-3 and S-4. Alternative S-1 does not provide for protection of human health and the environment.

Vadose Zone and Bedrock Alternatives

B-1 No Action Alternative
There is no reduction of risk with this alternative. The bedrock vadose zone would continue to act a source of contaminants to indoor air and groundwater.

B-2 Limited Action Alternative
Monitoring which would provide an indication of contaminant migration. Institutional controls would not address vapor intrusion risk unless access to indoor areas is limited. Contaminant migration to ground water would not be addressed.

B-3 Soil Vapor Extraction
There will be no unacceptable risk to human health or the environment once SVE is complete. However, institutional controls and engineering controls will be required to prevent human health exposure and protect the integrity of the remedy during the operation of the SVE system.

B-4 *In situ* Thermal Desorption
There will be no unacceptable risk to human health or the environment once the *in situ* thermal desorption remedy has been completed. However, institutional controls and engineering controls will be required to prevent human health exposure and protect the integrity of the remedy during the installation and operation of the *in situ* thermal

desorption system.

Alternatives B-3 and B-4 both provide for overall protection of human health and the environment by reducing the mass of contamination. Alternative B-2 is less protective than alternatives B-3 and B-4. Alternative B-1 does not provide for protection of human health and the environment.

Ground Water Alternatives

GW-1 No Action Alternative

There is no reduction of risk with this alternative. The ground water would continue to pose unacceptable risk to receptors identified in the risk assessment.

GW-2 Limited Action Alternative

There is some reduction of risk with this alternative by limiting exposure by institutional controls and plugging and abandoning wells. Monitoring will provide an indication of contaminant migration.

GW-3 Municipal Water Supply

There will be no unacceptable risk with this alternative for residents connected to a municipal water supply. Institutional controls and the plugging and abandoning of wells would be required to prevent human health exposure to contaminated ground water.

GW-4 In situ Bioremediation

There will be no unacceptable risk to human health after the remedy is complete. However, institutional controls and the plugging and abandoning of wells will be required during the implementation of the remedy to prevent human health exposure.

GW-5 Pump and Treat

There will be no unacceptable risk to human health after the remedy is complete. However, institutional controls and the plugging and abandoning of wells will be required during the implementation of the remedy to prevent human health exposure.

With the exception of Alternative GW-1, the ground water alternatives provide for overall protection of human health and the environment. Alternatives GW-4 and GW-5 reduce contamination in the ground water thereby reducing potential impacts to the underlying Edwards Aquifer - a sole source aquifer which provides drinking water for the area. Alternative GW-3 provides drinking water to residents with contaminated wells but does not protect the source of the drinking water by reducing contamination. Alternative GW-2 provides protection to human health by limiting access to contaminated ground water but does reduce the contamination in the ground water. Alternative GW-1 does not provide for protection of human health and the environment.

Vapor Intrusion Alternatives

VI-1 No Action Alternative
There is no reduction of risk with the alternative. Vapor intrusion would continue to pose unacceptable risk to receptors identified in the risk assessment.

VI-2 Limited Action Alternative
There is some reduction of risk with this alternative via institutional controls to prevent access or use of areas that present an unacceptable risk to human health. Intrusion of contaminant vapors into building will continue. Monitoring will provide an indication of indoor contaminant concentrations.

VI-3 Positive Pressure System Alternative
There will be no unacceptable risk to human health after the remedy is constructed and operational. System will need to continue to operate to be protective of human health as long as the source of contaminant vapors remains. Vapor emissions from contaminated concrete floor within the building will continue.

VI-4 Membrane/Sealant with Vapor Vent Alternative
There will be no unacceptable risk to human health after the remedy is constructed.

VI-5 Sub-Slab Depressurization System Alternative
There will be no unacceptable risk to human health after the remedy is constructed and operational. System will need to continue to operate to be protective of human health as long as the source of contaminant vapors remains. Vapor emissions from contaminated concrete floor within the building will continue.

Alternative VI-3 provides for overall protection of human health and the environment by eliminating the vapor intrusion into Building B1 from the contaminated concrete floor and the source of contaminant vapors beneath the concrete flooring. Alternatives VI-3 and VI-5 are protective of human health as long as the operation of air moving equipment (e.g., in-line fans) continues. Alternative VI-2 relies on limiting human health exposure to indoor air by preventing access or use of the areas that present an unacceptable risk to human health. Alternative VI-1 does not provide for protection of human health.

17.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Section 121(d) of CERCLA, 42 U.S.C. § 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA section 121(d)(4), 42 U.S.C. § 9621(d)(4). A list of site ARARs for all the remedial alternatives evaluated during the Feasibility Study (EA 2011b) are provided in Table 57. The following is a discussion for each alternative:

Surface and Subsurface Soil Alternatives

S-1 No Action Alternative
Federal Safe Drinking Water Act Primary Drinking Water standards may not be met because COCs can continue to migrate to ground water (i.e., drinking water source) resulting in an exceedence of the MCLs. Continued migration of contaminants to ground water would also prevent restoration of ground water interfering with present and potential uses.

S-2 Limited Action Alternative
Federal Safe Drinking Water Act Primary Drinking Water standards may not be met because COCs can migrate to ground water (i.e., drinking water source) resulting in an exceedence of the MCLs. Continued migration of contaminants to ground water would also prevent restoration of ground water interfering with present and potential uses.

S-3 Excavation and Off-site Disposal
This alternative will meet ARARs by removing contaminated soil from the Site. Off-site transportation and disposal ARARs must be met.

S-4 Soil Vapor Extraction
This alternative will meet chemical-specific ARARs by removing COCs. The SVE treatment facility must comply with air quality action-specific ARARs that address air emissions.

Alternatives S-3 and S-4 will comply with ARARs. Alternatives S-1 and S-2 do not address contaminated source material which can continue to leach into ground water. Clean Water Act standards will not be met and ground water restoration will be impaired.

Vadose Zone and Bedrock Alternatives

B-1 No Action Alternative
Federal Safe Drinking Water Act Primary Drinking Water standards may not be met because COCs can continue to migrate to ground water (i.e., drinking water source) resulting in an exceedence of the MCLs. Continued migration of contaminants to ground water would also prevent restoration of ground water interfering with present and potential uses.

B-2 Limited Action Alternative
Federal Safe Drinking Water Act Primary Drinking Water standards may not be met because COCs can migrate to ground water (i.e., drinking water source) resulting in an exceedence of the MCLs. Continued migration of contaminants to ground water would also prevent restoration of ground water interfering with present and potential uses.

B-3 Soil Vapor Extraction
This alternative will meet chemical-specific ARARs by removing COCs. The SVE treatment facility must comply with air quality action-specific ARARs that address air emissions.

B-4 *In situ* Thermal Desorption

This alternative will meet chemical-specific ARARs by removing COCs. The extracted vapor treatment facility must comply with air quality action-specific ARARs that address air emissions.

Alternatives B-3 and SB4 will comply with ARARs. Alternatives B-1 and B-2 do not address contaminated source material which can continue to leach into ground water. Alternatives B-1 and B-2 will not attain Clean Water Act standards and ground water restoration will be impaired.

Ground Water Alternatives

GW-1 No Action Alternative

Federal Safe Drinking Water Act Primary Drinking Water standards will not be met because COCs exist above MCLs. Ground water contamination may prevent restoration of resources present and potential uses.

GW-2 Limited Action Alternative

Federal Safe Drinking Water Act Primary Drinking Water standards will not be met because COCs exist above MCLs. Ground water contamination may prevent restoration of resources present and potential uses.

GW-3 Municipal Water Supply

Federal Safe Drinking Water Act Primary Drinking Water standards will not be met because COCs exist above MCLs. Ground water contamination may prevent restoration of resources present and potential uses.

GW-4 In situ Bioremediation

This alternative will meet chemical-specific ARARs by reducing contaminant concentrations to levels below MCLs. The *in situ* bioremediation must comply with the action-specific ARARs associated with water restoration and remediation activities (i.e., Edwards Aquifer Protection Program).

GW-5 Pump and Treat

This alternative will meet chemical-specific ARARs by removing COCs. It must also comply with ARARs associated with remedial activities, air discharge (if from an air stripper), ground water restoration, and water discharge.

Alternatives GW-4 and GW-5 will meet ARARs by reducing/removing contamination in the ground water. Alternatives GW-1, GW-2, and GW-3 do not address ground water contamination and will not meet the MCLs.

Vapor Intrusion Alternatives

VI-1 No Action Alternative

There is no chemical-, action-, or location-specific ARAR for the No Action Alternative for vapor intrusion. The indoor air cleanup criteria are based on reducing the indoor air contaminant concentrations to levels that result in not exceeding a hazard index of 1 or having a contaminant-specific increased incidence of cancer of greater $1x10^{-5}$ (Table 56).

VI-2 Limited Action Alternative
There is no chemical-, action-, or location-specific ARAR for the Limited Action Alternative for vapor intrusion. The indoor air cleanup criteria are based on reducing the indoor air contaminant concentrations to levels that result in not exceeding a hazard index of 1 or having a contaminant-specific increased incidence of cancer of greater $1x10^{-5}$ (Table 56).

VI-3 Positive Pressure System Alternative
There is no chemical-, action-, or location-specific ARAR for the Positive Pressure System Alternative for vapor intrusion. The indoor air cleanup criteria are based on reducing the indoor air contaminant concentrations to levels that result in not exceeding a hazard index of 1 or having a contaminant-specific increased incidence of cancer of greater $1x10^{-5}$ (Table 56).

VI-4 Membrane/Sealant with Vapor Vent Alternative
This alternative which diverts vapor from within the building must comply with action-specific ARARs ensuring that emissions do not exceed acceptable concentrations.

VI-5 Sub-Slab Depressurization System Alternative
This alternative which diverts vapors from beneath the slab must comply with action-specific ARARs ensuring that emission do not exceed acceptable concentrations.

There is no chemical-, action-, or location-specific ARAR for alternatives VI-1, VI-2, or VI-3. Alternatives VI-4 and VI-5 must comply with action-specific ARARs ensuring that emissions do not exceed acceptable concentrations.

17.3 Long-term Effectiveness and Permanence

The criterion refers to the expected residual risk and the ability to maintain reliable protection of human health over time, once cleanup levels have been met. The following is a discussion for each alternative:

Surface and Subsurface Soil Alternatives

S-1 No Action Alternative
This alternative will not provide long-term effectiveness or permanence, offers no controls. The COCs can migrate into indoor air and ground water.

S-2 Limited Action Alternative
Institutional or engineering controls rely on humans following access restrictions into perpetuity. The COCs can migrate into indoor air and ground water.

S-3 Excavation and Off-site Disposal

This alternative is effective and permanent because contaminated material will be removed from the site.

S-4 Soil Vapor Extraction
This alternative is considered marginally effective. The SVE system may not be able to remove the source material under the slab of the building. The VOCs removed are considered permanent.

Alternative S-3 that utilizes excavation and off-site disposal is the most effective long-term because the impacted material is removed from the Site. Alternative S-4 that utilizes soil vapor extraction is not as effective long-term because although, the soil gas from the impacted material is removed and treated, the soil gas from the slab or just beneath the slab of the building may not be removable by soil vapor extraction. The limited action alternative (S-2), which utilizes institutional controls to limit exposure, is more protective than the no action alternative (S-1).

Vadose Zone and Bedrock Alternatives

B-1 No Action Alternative
This alternative will not provide long-term effectiveness or permanence, offers no controls. The COCs can migrate into indoor air and ground water.

B-2 Limited Action Alternative
Institutional or engineering controls rely on humans following access restrictions into perpetuity. The COCs can migrate into indoor air and ground water.

B-3 Soil Vapor Extraction
This alternative will provide effectiveness and permanence. The SVE system will remove contaminants in fractures (i.e., secondary porosity), but will not be as effective for contaminants in primary porosity (e.g., pore and vugs). Diffusion from primary porosity will continue to occur at a reduced rate. Because the SVE system removes volatile organic contaminants it is considered permanent.

B-4 *In situ* Thermal Desorption
This alternative will provide effectiveness and permanence. The *in situ* thermal desorption system adds energy (i.e., heat) to the subsurface and will remove contaminants in fractures (i.e., secondary porosity), but will not be as effective for contaminants in primary porosity (e.g., pore and vugs). Diffusion from primary porosity will continue to occur at a reduced rate. Because the *in situ* thermal desorption system removes volatile organic contaminants it is considered permanent.

Alternative B-4 that utilizes *in situ* thermal desorption is the most effective long-term because the bedrock is heated in order to increase production of soil vapor containing COCs for extraction. Alternative B-3 that utilizes soil vapor extraction is second in effectiveness in the long-term because the existing soil gas is extracted and treated. The limited action alternative (B-2), which utilizes institutional controls to limit exposure, is more protective than the no action alternative (B-1).

Ground Water Alternatives

GW-1 No Action Alternative
This alternative will not provide long-term effectiveness or permanence. This alternative offers no controls. The COCs remain in the ground water and migrate.

GW-2 Limited Action Alternative
Institutional or engineering controls rely on persons following access restrictions perpetually. Plugging and abandoning wells is considered effective and permanent.

GW-3 Municipal Water Supply
This alternative will provide long-term effectiveness and permanence. It does limit exposure to ground water. It does not remediate ground water.

GW-4 *In situ* Bioremediation
This alternative will provide long-term effectiveness and permanence once remediation is complete. It is considered a permanent remedy since bioremediation of chlorinated solvents is considered permanent.

GW-5 Pump and Treat
This alternative will provide long-term effectiveness and permanence once remediation is complete. It is considered a permanent remedy since COCs are removed from the ground water.

Alternative GW-3 which utilizes connection to the municipal supply alternative is more effective than the limited action alternative (GW-2) because it eliminates exposure to contaminated ground water. The pump and treat system alternative (GW-5) is considered more effective than the *in situ* bioremediation alternative (GW-4) because the phase transfer mechanisms associated with pump and treat are more predictable and reliable than creating optimal ground water conditions suitable for *in situ* bioremediation. The limited action alternative (GW-2), which utilizes institutional and engineering controls to limit exposure, is more effective than the no action alternative (GW-1).

Vapor Intrusion Alternatives

VI-1 No Action Alternative
This alternative will not provide long-term effectiveness or permanence. This alternative offers no controls. The COCs remain continue to migrate into the indoor air.

VI-2 Limited Action Alternative
Institutional controls rely on persons following access restrictions perpetually. Restricting access and use of buildings via institutional controls are considered marginally effective.

VI-3 Positive Pressure System Alternative
This alternative will adequately control vapor intrusion when the system is functioning

correctly. Any system downtime will result in vapor intrusion. Additionally, the magnitude of residual risk remains the same before and after implementation because COCs still exists in the concrete flooring and beneath the building.

VI-4 Membrane/Sealant with Vapor Vent Alternative
This alternative will provide effectiveness and permanence. This alternative will adequately control vapor intrusion from the concrete flooring and beneath the building. It is effective in reducing exposure, but may require repair periodically.

VI-5 Sub-Slab Depressurization System Alternative
This alternative relies on air flow in the sub-slab which is limited, therefore it is not considered effective. Since the remedy relies on phase transfer from soil gas to outdoor air, the remedy is considered permanent.

Alternative VI-4 that utilizes a membrane/sealant with vapor vents is the most effective long-term especially in addressing vapor emission emanating from the concrete slab within the office space of the former dry cleaner where a PCE release occurred. This alternative will prevent vapor intrusion and redirect vapors away from the building via passive vapor vents without the concern of mechanical failure or power outages that may debilitate other systems.

Alternative VI-5 that utilizes sub-slab de-pressurization is almost as effective long-term because it redirects vapors that would normally enter into the building from beneath the concrete foundation to vents on the roof via extraction fans. However, sub-slab communication is essential, which is not proven to be effective at Building B1. This alternative will not address vapors emitting from the concrete slab.

The effectiveness of the positive pressure system (Alternative VI-3) is contingent on the building's air exchange rate (e.g., opening doors), vapor intrusion to indoor air, and system balancing, which can be troublesome in large buildings with multiple occupied spaces.

The limited action alternative (VI-2), which utilizes institutional and engineering controls to limit exposure, is more protective than the no action alternative (VI-1).

17.4 Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment

This criterion refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. The following is a discussion for each alternative:

Surface and Subsurface Soil Alternatives

S-1 No Action Alternative
No reduction of mobility, toxicity, or volume through treatment.

S-2 Limited Action Alternative
No reduction of mobility, toxicity, or volume through treatment.

S-3 Excavation and Off-site Disposal
Excavation alone will not destroy any contaminants. However, if the excavated soil is taken to off-site incinerator, the organic fraction of the excavated soil will be destroyed. Removal of material will eliminate the potential for mobilization. Unless all COC impacted soil is excavated, residual soil contamination will remain.

S-4 Soil Vapor Extraction
VOCs in the soil gas extracted for the surface and subsurface soils will be captured at the SVE treatment facility. Contaminant toxicity will not be reduced. Mobility and volume are reduced as COCs are removed from soil. Residuals will likely remain after SVE.

Alternative S-3 that utilizes excavation and off-site disposal has a reduction in the contaminated volume because the impacted soils are removed from the site; mobility is also reduced. If this alternative is executed with incineration instead of disposal, it also provides a reduction in toxicity of the impacted soils by incinerating the organic matter. Alternative S-4 that utilizes soil vapor extraction reduces the volume and mobility, but not the toxicity of the contaminants. Alternative S-3 does not reduce the volume of impacted soils as much as the excavation alternative does (S-3). Alternative S-1 and S-2 do not include treatment.

Vadose Zone and Bedrock Alternatives

B-1 No Action Alternative
No reduction of mobility, toxicity, or volume through treatment.

B-2 Limited Action Alternative
No reduction of mobility, toxicity, or volume through treatment.

B-3 Soil Vapor Extraction
COCs in the soil gas extracted for the vadose zone bedrock will be captured at the SVE treatment facility. Contaminant toxicity will not be reduced. Mobility and volume are reduced as COCs are removed from vadose zone bedrock. Residuals will likely remain after SVE.

B-4 *In situ* Thermal Desorption
COCs in the soil gas extracted for the vadose zone bedrock will be captured at the SVE treatment facility. Contaminant toxicity will not be reduced. Mobility of the COCs will increase by heating the vadose zone and will increase the amount of COCs captured by the SVE system. The volume of COCs will be reduced as COCs are removed from vadose zone bedrock. Residuals will likely remain.

Alternatives B-3 and B-4 utilize soil vapor extraction remove COCs from the sub-surface. However, alternative B-4 should remove more mass as the mobility of the COCs will increase when heated. Neither of alternatives B-3 or B-4 reduces the toxicity of the COCs. Alternatives B-1 and B-2 do not include treatment.

Ground Water Alternatives

GW-1 No Action Alternative
No reduction of mobility, toxicity, or volume through treatment.

GW-2 Limited Action Alternative
No reduction of mobility, toxicity, or volume through treatment.

GW-3 Municipal Water Supply
No reduction of mobility, toxicity, or volume through treatment.

GW-4 *In situ* Bioremediation
Contaminated ground water will be treated. The amount will depend on efficacy of the system and duration of operation. A field pilot test conducted at Site monitoring well DW-404 reduced PCE concentrations 99.7%. The alternative does not affect the mobility of the contaminants. This remedy will reduce the volume of contaminated ground water. Complete bioremediation will result in innocuous products (i.e., methane, ethane, ethene).

GW-5 Pump and Treat
Contaminated ground water will be extracted and treated at the surface. Mobility is reduced because migration is reduced. The remedy will reduce the volume of contaminated ground water. Residuals will remain when the system is stopped.

Alternative GW-5 reduces the volume and mobility of contaminated ground water by treatment. It is rated higher because it will remove more contaminants than the *in situ* bioremediation alternative. The *in situ* bioremediation alternative (GW-4) will reduce the volume and toxicity of the COCs if complete dechlorination is achieved as was done at DW-404 during the *in situ* bioremediation pilot study. The municipal water supply alternative (GW-3) is ranked lower than the *in situ* bioremediation and the pump and treat system alternatives because it does not reduce volume, toxicity, or mobility. Alternatives GW-1, GW-2, and GW-3 do not reduced the toxicity, mobility, or volume of contaminants.

Vapor Intrusion Alternatives

VI-1 No Action Alternative
No reduction of mobility, toxicity, or volume through treatment.

VI-2 Limited Action Alternative
No reduction of mobility, toxicity, or volume through treatment.

VI-3 Positive Pressure System Alternative
Alternative does not address toxicity or volume. Alternative will prevent mobility by preventing soil gas from entering the building. No contaminant treatment occurs.

VI-4 Membrane/Sealant with Vapor Vent Alternative
Alternative does not address toxicity or volume. Alternative will prevent soil gas from entering the building. Membrane/sealant will also prevent impacted concrete emissions from entering indoor air. No contaminant treatment occurs.

VI-5 Sub-Slab Depressurization System Alternative
Alternative does not address toxicity. Alternative will reduce mobility by preventing soil gas from entering the building.

Alternative VI-4 that utilizes a membrane/sealant with vapor vents is the only alternative that addresses emissions from impacted concrete within Building BI. The sub-slab depressurization system (VI-5) reduces mobility of the COCs by removing soil gas from underneath the concrete foundation of the building. Alternative VI-3 utilizes a positive pressure system reduce the mobility of the contaminant by preventing sub-slab vapors from entering the building, but does not reduce the toxicity or volume. The limited action and no action alternatives do not reduce mobility, volume, or toxicity.

17.5 Short-term Effectiveness

This criterion addresses the period of time needed to implement the remedy and any adverse impacts that may be poised to workers, the community, and the environment during implementation. The following is a discussion for each alternative:

Surface and Subsurface Soil Alternatives

S-1 No Action Alternative
No action taken.

S-2 Limited Action Alternative
No field construction performed.

S-3 Excavation and Off-site Disposal
Alternative increases short-term risks to community during construction activities and transport of equipment and materials. Alternative involves transporting large volumes of contaminated soils on public roads. Workers can be potentially exposed during excavation and waste handling activities. Implementation time 2 – 4 months.

S-4 Soil Vapor Extraction
Alternative increases short-term risks to the community during construction activities and transport of equipment and materials. Alternative may include transporting some contaminated soils on public roads. Workers can be potentially exposed during construction and SVE operations. Implementation time 3 – 3.5 years.

The excavation and off-site disposal and soil vapor extraction alternatives offer increased short-term risk to the community, workers, and the environment because of the construction activities performed. Additionally, both of these alternatives will involve transporting hazardous material off-site on public roads. Because the excavation and off-site disposal/off-site incineration alternative is more intrusive and would likely result in more contact with impacted material, the soil vapor extraction alternative is ranked higher. The No Action alternative would not offer any additional short-term risk to the community, workers or the environment other than what is already occurring. The limited action alternative would not provide any additional short-term risk either because institutional controls do not involve any field activity, such as construction.

Vadose Zone and Bedrock Alternatives

B-1 No Action Alternative
No action taken.

B-2 Limited Action Alternative
No field construction performed.

B-3 Soil Vapor Extraction
Alternative increases short-term risks to the community during construction activities and transport of equipment and materials. Alternative may include transporting some contaminated soils on public roads. Workers can be potentially exposed during construction and SVE operations. Implementation time is approximately 4 years.

B-4 *In situ* Thermal Desorption
Alternative increases short-term risks to the community during construction activities and transport of equipment and materials. Alternative may include transporting some contaminated soils on public roads. Heating the vadose zone bedrock is energy intensive. Implementation time is approximately 1 year.

The soil vapor extraction and *in situ* thermal desorption alternatives pose a short-term risk to the community, workers, and the environment due to the construction activities that take place. The *in situ* thermal desorption alternative poses a greater short-term risk than the soil vapor extraction because it contains a heating component that increases the level of caution workers must take. The soil vapor extraction alternative is ranked higher than the *in situ* thermal desorption alternative. The No Action alternative would not offer any additional short-term risk to the community, workers or the environment other than what is already occurring. The limited action alternative would not provide any additional short-term risk either because institutional controls do not involve any field activity, such as construction.

Ground Water Alternatives

GW-1 No Action Alternative
No action taken.

GW-2 Limited Action Alternative
No field construction performed.

GW-3 Municipal Water Supply

Alternative increases short-term risks to the community during construction activities and transport of equipment and materials to site. Implementation time is approximately 2 months.

GW-4 *In situ* Bioremediation

Alternative increases short-term risks to the community during construction activities and transport of equipment and materials to site. This alternative may involve transporting small volumes of contaminated material on public roads. Alternative poses risks to workers during construction and injection activities. Risks can be minimized by implementing controls. Implementation time is approximately 4 - 6 years.

GW-5 Pump and Treat

Alternative increases short-term risks to the community during construction activities and transport of equipment and materials to the site. This alternative may involve transporting small volumes of contaminated material on public roads. Emissions from a pump and treat system will increase exposure to COCs. These can be mitigated through standard construction practices and permitting. Implementation time is 5 – 10 years.

The pump and treat system alternative is ranked slightly lower than the *in situ* bioremediation because increased potential exposure to emissions from the pump and treat system. The municipal water supply has a construction component, but is considered routine and does not include exposure to impacted material. The No Action alternative would not offer any additional short-term risk to the community, workers, or the environment. The limited action alternative would not provide any additional short-term risk because institutional controls do not involve any field activity, such as construction.

Vapor Intrusion Alternatives

VI-1 No Action Alternative

No action taken.

VI-2 Limited Action Alternative

No field construction performed.

VI-3 Positive Pressure System Alternative

Alternative increases short-term risks to the community during the installation of the HVAC system and transport of equipment and materials to the Site. Implementation time is one week.

VI-4 Membrane/Sealant with Vapor Vent Alternative

Alternative increases short-term risks to the community during the construction activities involved with installing the membrane sealant and passive vapor vents and transport of equipment and materials to the Site. Implementation time is approximately 2 weeks.

VI-5 Sub-Slab Depressurization System Alternative

Alternative increases short-term risks to the community during the construction activities involved with installing the sub-slab depressurization system and transport of equipment and materials to the Site. Implementation time is approximately 2 weeks.

The positive pressure system alternative is ranked higher than the remaining alternatives because it involves routine construction activities associated with installation of the HVAC system. The membrane/sealant with vapor vents and sub-slab depressurization alternatives are ranked after the positive pressure system alternative and are weighted equally because both involve some form of demolition of the building's floor, take a longer time for installation, and may include some exposure to COCs. The no action alternative would not offer any additional short-term risk to the community, workers, or the environment other than what is already occurring. The limited action alternative would not provide any additional short-term risk either because institutional controls do not involve any field activity, such as construction.

17.6 Implementability

The criterion considers the technical and administrative feasibility of a remedy such as relative availability of goods and services and coordination with other governmental entities. The following is a discussion for each alternative:

Surface and Subsurface Soil Alternatives

S-1 No Action Alternative
Not applicable.

S-2 Limited Action Alternative
Institutional controls may be difficult to implement because they often require consent by the landowner. This is particularly difficult for landowners that are not potentially responsible parties.

S-3 Excavation and Off-site Disposal
Excavation and off-site disposal/incineration is technically feasible. This alternative would require shutting down businesses and demolishing parts of the building that overlie the source area. Equipment and specialists are available for implementation of is alternative. Ability to obtain approvals and coordinate with other agencies assumed to be possible.

S-4 Soil Vapor Extraction
SVE treatment is technically feasible, but the placement of horizontal wells underneath the building at Source Area 1 may prove difficult with respect to utilities. Equipment and specialists are available for implementation of this alternative. Ability to obtain approvals and coordinate with other agencies assumed to be possible.

The no action alternative would be the easiest to implement. The limited action alternative would follow because it relies on institutional and engineering controls, which are easier to implement than an intrusive remedy. The soil vapor extraction alternative is ranked next because it involves usage of horizontal wells to treat the contamination underneath the building at Source Area 1. Installation of horizontal wells may prove difficult with respect to utilities. Vertical SVE wells will be installed at Source Area 2 and are easier to install than horizontal wells. The excavation and off-site disposal alternative is ranked last because it requires shutting down businesses and demolishing parts of the building at Source Area 1 to remove the contaminated soil underneath, making it harder to implement. However, the technical feasibility of removing contaminant mass by excavation is higher than by using horizontal soil vapor extraction wells under the building foundation.

Vadose Zone and Bedrock Alternatives

B-1 No Action Alternative
Not applicable.

B-2 Limited Action Alternative
Institutional controls may be difficult to implement because they often require consent by the landowner. This is particularly difficult for landowners that are not potentially responsible parties.

B-3 Soil Vapor Extraction
SVE treatment is technically feasible, but the placement of SVE wells is complicated in highly developed areas. Equipment and specialists are available for implementation of is alternative. Ability to obtain approvals and coordinate with other agencies assumed to be possible.

B-4 *In situ* Thermal Desorption
In situ thermal treatment is technically feasible, but the placement of SVE wells is complicated in highly developed areas. Equipment and specialists are available for implementation of is alternative, but may be more difficult to obtain than for Alternative B-3. Ability to obtain approvals and coordinate with other agencies assumed to be possible.

The no action alternative would be the easiest to implement. The limited action alternative would follow because it relies on institutional controls, which are easier to implement than an intrusive remedy. The soil vapor extraction and *in situ* thermal desorption alternatives are harder to implement than the no action and limited action alternatives, but the *in situ* thermal desorption alternative will be more difficult to implement because the system to heat the rock is more complicated.

Ground Water Alternatives

GW-1 No Action Alternative
Not applicable.

GW-2 Limited Action Alternative
Institutional controls may be difficult to implement because they often require consent by

the landowner. This is particularly difficult for landowners that are not potentially responsible parties. City ordinances may be employed as institutional controls.

GW-3 Municipal Water Supply
Connecting residences to a municipal water line is technically feasible as main water lines already exist.

GW-4 *In situ* Bioremediation
Remedy is technically feasible. However, transport of reagent, as with groundwater, will occur through secondary porosity such as preferred flow paths through fractures, faults, and dissolution features. Equipment and specialists are available for implementation of is alternative. Ability to obtain approvals and coordinate with other agencies assumed to be possible.

GW-5 Pump and Treat
Remedy is technically feasible. Transport of groundwater will occur through secondary porosity such as preferred flow paths through fractures, faults, and dissolution features. Equipment and specialists are available for implementation of is alternative. Ability to obtain approvals and coordinate with other agencies assumed to be possible.

The no action alternative would be the easiest to implement. The limited action alternative would follow because it relies on institutional and engineering controls, which are easier to implement than an intrusive remedy. The municipal water supply is considered easy to implement because it relies on standard construction techniques. However, this alternative can be difficult depending on the distance required to transport water. The *in situ* bioremediation alternative is weighted higher than the pump and treat alternative; although both rely on installation of numerous wells, the pump and treat system is more complicated to implement so is ranked last.

Vapor Intrusion Alternatives

VI-1 No Action Alternative
Not applicable.

VI-2 Limited Action Alternative
Institutional and engineering controls are implementable in Building B1.

VI-3 Positive Pressure System Alternative
Installing this alternative is technical feasible. Equipment and specialists are available for implementation of is alternative. Ability to obtain approvals and coordinate with other agencies assumed to be possible.

VI-4 Membrane/Sealant with Vapor Vent Alternative
Installing this alternative is technical feasible. Equipment and specialists are available for implementation of is alternative. Ability to obtain approvals and coordinate with other agencies assumed to be possible.

VI-5 Sub-Slab Depressurization System Alternative

> Installing this alternative is technical feasible. Equipment and specialists are available for implementation of is alternative. Ability to obtain approvals and coordinate with other agencies assumed to be possible.

The no action alternative would be the easiest to implement. The limited action alternative would follow because it relies on institutional and engineering controls, which are easier to implement than an intrusive remedy. The positive pressure system would be easier to implement than the other alternatives because it relies on standard construction techniques. The sub-slab depressurization is ranked higher than the membrane/sealant with vapor vents because the sub-slab depressurization alternative does not require demolition of major portions (i.e., interior walls) of the building to implement.

17.7 Costs

This criterion includes estimated capital and operation and maintenance costs as well as present worth costs. Present worth is the total cost of an alternative over time in terms of today's dollar value. Costs estimates are expected to be accurate within a range of +50 to -30 percent. The estimated present worth costs for the surface and subsurface soil, vadose zone bedrock, ground water, and indoor air alternatives are provided below:

Indoor Air – Building B1

VI-1	No Further Action	$0
VI-2	Limited Action	$84,000
VI-3	Positive Pressure System	$249,000
VI-4	Membrane/Sealant with Vapor Vent	$237,000
VI-5	Sub-Slab Depressurization System	$191,000

Surface and Subsurface Soil		Source Area 1	Source Area 2
S-1	No Further Action	$0	$0
S-2	Limited Action	$70,000	$70,000
S-3	Excavation and Offsite Disposal	$1,793,000	$725,000
S-4	Soil Vapor Extraction	$1,039,000	$452,000

Vadose Zone Bedrock		Source Area 1	Source Area 2
B-1	No Further Action	$0	$0
B-2	Limited Action	$83,000	$83,000
B-3	Soil Vapor Extraction	$1,487,000	$1,441,000
B-4	*In Situ* Desorption	$8,093,000	$6,340,000

Ground Water		Austin Chalk Northern Plume	Austin Chalk Southern Plume
GW-1	No Further Action	$0	$0
GW-2	Limited Action	$317,000	$317,000
GW-3	Municipal Water Supply	$445,000	$445,000
GW-4	*In situ* Bioremediation	$2,321,000	$2,452,000
GW-5	Pump and Treat	$7,183,000	$7,447,000

17.8 State/Support Agency Acceptance

The Texas Commission on Environmental Quality concurred with EPA's remedy preference.

17.9 Community Acceptance

During the public comment period (July 18, 2011 through August 16, 2011) for the Proposed Plan, fourteen verbal comments and two written comments were received. The verbal comments were received during the Community Meeting held on July 21, 2011, and are included in the Responsiveness Summary with EPA's written responses. Verbal comments included questions on EPA's proposed remedial approach, previous investigative techniques and sampling results, municipal well sampling frequency and results, and the presence of geologic barriers to contaminant transport into the Edwards Aquifer. Two written comments were received from the Edwards Aquifer Authority (EAA) and Texas Department of State Health Services (DSHS). The Edwards Aquifer Authority in a letter dated August 10, 2012, stated that "EAA staff has reviewed the Proposed Plan and generally agrees with the preferred alternatives" and that "EAA strongly encourages USEPA to aggressively pursue closure of impacted wells, including historical wells that have been covered by development in and around the Savings Square Shopping Center (Source Area 1)." EAA's letter also offered continued technical assistance with well closure activities. The Texas DSHS letter dated August 15, 2011, stated that "DSHS supports EPA's proposed plan because it is protective of human health."

In response to requests received during the public comment period, the EPA did extend the public comment period two times for an additional 60 days. The second public comment period extension ended on October 15, 2011. During this extension of the public comment period, additional written comments were received from the Bandera Road Community Advisory Group, a local citizen, and from legal and technical representatives of the Savings Square Partners, Ltd. and Pilgrim Dry Cleaners.

The Bandera Road Community Advisory Group comments were provided to by a Technical Assistance Services for Community (TASC) contractor. The comments were received by the EPA on August 22, 2011, and included numerous questions regarding EPA's previous investigation, EPA's plans for additional studies including further evaluation of indoor air exposures, and questions regarding components of EPA's preferred alternative. In the conclusion of the TASC's letter it stated: "The remedies selected appear to be appropriate to ensure protectiveness of human health and the environment."

The comment from a local citizen was received by email on October 14, 2011. This email stated: "I have been in attendance at most all of the public meetings you have conducted over the past several years and have followed your efforts to identify the extent of contamination to our drinking water supply (The Edwards Aquifer) by The Leon Valley Ground Water Plume now referred to as The Bandera Road Ground Water Plume … Thank you for all your success identifying the limits of the contamination and efforts to remediate the pollution."

Because the comment period extension ended on a Saturday, the EPA accepted comments provided by the end of the next business day – Monday, October 17, 2011. Two sets of comments were received on October 17, 2011, from the legal and technical representatives of the Savings Square Partners, Ltd. and Pilgrim Dry Cleaners. These comments covered numerous topics including EPA's involvement at the site, questions regarding the ground water classification, previous investigations conducted by EPA and other parties, principal threat waste determination, EPA Remedial Investigation and Feasibility Study, and other potential sources of contamination. In addition to the comments, the letters also included requests to conduct investigative activities to provide additional information which might better inform the remedy selection. Additional investigative activities were performed and are discussed in Section 12.6.2 (Additional Investigation Activities Conducted by Pilgrim Cleaners and Savings Square Partners, Ltd.) of the ROD.

The comments received during the Public Comment period are summarized with EPA's responses in Part 3 of the ROD – the Responsiveness Summary.

18.0 PRINCIPAL THREAT WASTES

The NCP establishes the EPA's expectation that treatment be used to address the principal threats posed by a site wherever practical. The principal threat concept applies to the source materials at a Superfund site that are highly mobile and cannot be reliably controlled in place, or would present a significant risk to human health or the environment should exposure occur. A source material includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to ground water, surface water, or air or act as a source for direct exposure.

In Source Area 1, "There are soils beneath Building [B]1 that are acting as a source of PCE vapors to the indoor air within Building [B]1, the overburden soil, and vadose zone bedrock. In addition, it appears that PCE and PCE degradation products from this soil are leached by infiltrating water that also enters USGS-42, and vapors are migrating into vadose bedrock … An active soil gas survey conducted during the 2010 RI field activities indicated a PCE vapor concentration of 25,000 mg/m^3 at monitoring point VI-111-CSA, located within three feet of boring CA-1 where the highest PCE concentration in soil was detected (200 mg/kg). Although the sample vapor concentrations do not indicate saturated vapor with respect to PCE, they are sufficiently elevated to initiate density-driven migration of PCE vapor downward through the soil overburden and into underlying bedrock fractures of the Austin Chalk" (Weston Solutions, Inc. 2012). The site's highest PCE ground water concentration (i.e., 11,700 µg/L) was detected in the Austin Chalk ground water monitoring well USGS-42 located adjacent to the Savings Square Partners, Ltd. property. This concentration is above the generally-accepted threshold of 1 to 10 percent aqueous solubility, which is considered to be an indicator of dense non-aqueous phase liquid (DNAPL) within ground water. PCE has a solubility of 206,000 µg/L in water so the lower threshold for the potential presence of DNAPL is 2,060 µg/L.

In regards to Source Area 2, previous investigations (RMT/Jones & Neuse, Inc. 1995) revealed that the subsurface soils beneath the dry cleaner building have been impacted by PCE, TCE, and 1,2-dichloroethene. Recent ground water and sampling conducted in May 2012 in the shallow 35-foot monitoring well TMW-2 located in the back parking lot of Source Area 2 found elevated ground water concentrations of PCE (730 µg/L), TCE (55 µg/L) and cis-1,2-Dichloroethene (180 µg/L) (Table 5). Elevated PCE and TCE sub-slab and shallow monitoring vapor concentrations were also detected (Table 13).

PCE and its degradation products in Source Area 1 and 2 are highly mobile and cannot be reliably controlled in place and present a significant risk to human health. The results of soil, soil gas, and ground water sampling support the conceptual site models for Source Areas 1 and 2 that source material is present in soils beneath the former and current dry cleaner and has migrated into the indoor air and vadose zone resulting in continued contamination of the Austin Chalk ground water.

19.0 SELECTED REMEDY

19.1 Summary of the Rationale for the Selected Remedy

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives, and State and public concerns, the EPA has determined that the following alternatives best satisfy the requirements of CERCLA Section 121, 42 U.S.C. § 9621, and provide the best balance of tradeoffs among the remedial alternatives with respect to the NCP's nine evaluation criteria, 40 CFR §300.430(e)(9):

Indoor Air
Alternative VI-4 (Membrane/Sealant with Vapor Vent) for Source Area 1 – Building B1

Surface and Subsurface Soil
Alternative S-4 (Soil Vapor Extraction) for Source Areas 1 and 2

Vadose Zone Bedrock
Alternative B-3 (Soil Vapor Extraction) for Source Areas 1 and 2

Ground Water
Alternative GW-4 (*In situ* Bioremediation) for Austin Chalk Northern Plume and Austin Chalk Southern Plume.

Alternative VI-4 eliminates the inhalation exposure pathway from vapor intrusion and PCE impacted concrete for the commercial-industrial workers within Building B1 by utilizing a membrane/sealant with vapor vents to redirect vapors from within the building without concern of mechanical failure or power outages that may debilitate other systems. The alternative was chosen over the other indoor air alternatives because it addressed inhalation exposure non-cancer and cancer risk and was more implementable than the sub-slab depressurization system.

Alternative S-4 was chosen for Source Area 1 because it removes contamination in the subsurface soil which can impact the indoor air in Building B1 and Building B3. Alternative S-4 will remove COCs and reduce migration of contamination to the vadose zone bedrock and ground water.

The indoor air inhalation risk identified in the AOI 2 Active Dry Cleaner will be addressed by identification and proper management of source(s) of TCE within the Active Dry Cleaner and by removing contamination from the subsurface (Alternative S-4). Alternative S-4 will remove COCs and reduce migration of contamination to the vadose zone bedrock and ground water.

Alternative B-3 was selected for the vadose zone bedrock in Source Areas 1 and 2 to address source materials which are impacting the underlying ground water. Alternative B-3 is also substantially less costly than Alternative B-4 which also addresses source materials. In regards to soil vapor extraction alternatives (S-4 and B-3), the performance will be monitored by VOC analysis of samples of the vapor extracted from the soil. It is anticipated that soil vapor extraction systems will be operated until asymptotic removal levels are obtained: the operational definition of “asymptotic removal rate” refers to the point where declining mass removal rates (by the SVE system) make continued operation of the system ineffective and indicate operations should be terminated. Prior to terminating operations, the system will undergo rebound testing (a series of periodic operation and rest periods) to determine if significant VOCs remain. If significant VOCs remain, an evaluation of the residual VOC vapor concentrations will be conducted to determine if the SVE system should continue to operate or if alternative actions should be evaluated.

The general strategy for assessment of performance and closure of SVE systems will be based on four components considered integral to successful venting application: (1) site characterization, (2) design, (3) performance monitoring, and (4) mass flux to and from ground water. These four components form converging lines of reasoning or a preponderance of evidence regarding performance and closure. Each component is interrelated and requires continuous evaluation during the operation period for the remedy component. The use of converging lines of evidence for evaluating continued operation of an SVE system is outlined in EPA’s “Development of Recommendations and Methods to Support Assessment of Soil Venting Performance and Closure” (EPA/600/R-01/070, September 2001). When the determination concludes that closure of the SVE system is appropriate, an assessment of the potential remaining impacts to indoor air and underlying groundwater will occur. If such impacts result in exceeding either the indoor air or ground water cleanup levels, additional action will be considered.

Alternative GW-4 was selected over other alternatives because it is expected to achieve substantial risk reduction through treatment of contaminants in the ground water, was demonstrated to be capable of fully degrading PCE at the site, and provide measures to prevent exposure to currently impacted ground water, and prevent migration of contaminants by plugging and abandoning impacted wells.

It is important to note that the conceptual model for contaminant migration in the Austin Chalk is based on fracture dominated flow for non-aqueous phase liquids, water, and vapors. Within this framework, the permeability of fractured networks is large while overall the primary porosity and permeability of the chalk is likely very low. The SVE pilot tests indicated communication of the fracture network, which was expected. Therefore, intersection of the fracture network is paramount from the perspective of any remediation approach. The movement of fluids, whether ground water or soil vapors, will be dominated by fracture permeability; it is also true the migration of contaminants in vadose zone or ground water is equally dominated by the fracture and/or karst system.

19.2 Description of the Selected Remedy

The following descriptions are a summary of the remedy components for the surface and subsurface soils, vadose zone bedrock, ground water and indoor air remedies selected in this Record of Decision. In implementing the remedy components, EPA may use a phased approach for remediating site contamination. In a phased response approach, site response activities are implemented in a sequence of steps, or phases, such that information gained from earlier phases is used to refine subsequent investigations, objectives or actions. Implementing investigations and actions in phases can be advantageous for several reasons, including:

- Data from earlier response actions are use to further characterize the site and assess restoration potential;
- Attainable objectives can be set for each response phase;
- Flexibility is provided to adjust the remedy in response to unexpected site conditions;
- Remedy performance is increased, decreasing remediation timeframe and costs, and
- Likely remedy refinements are built into the selected remedy, better defining the potential scope and minimizing the need for additional decision documents.

If significant changes to this remedy occur as a result of additional data or information collected during the Remedial Design or construction process, the EPA will document the changes using a technical memorandum in the Administrative Record, an Explanation of Significant Differences (ESD), or a ROD Amendment, as appropriate and consistent with the applicable regulations. EPA's guidance document - *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (EPA 540-R-98-031, July 1999) will be used to determine the level of documentation required (i.e., technical memorandum, ESD, or ROD Amendment). Section 7 (Documenting Post-ROD Changes: Minor Changes, Explanation of Significant Differences, and ROD Amendments) of the guidance provides information for evaluating post-ROD information, types of post-ROD changes, and documenting post-ROD changes.

19.2.1 Surface and Subsurface Soils

Alternative S-4 utilizes SVE wells that will remove COC mass from the surface and subsurface soil by inducing a vacuum in the wells. Soil gas collected by the induced vacuum will be treated. Treatment options for the collected vapors include Cryogenic Condensation and Compression

(C3 technology), Granulated Activated Carbon (GAC), and thermal oxidation.

To address the contamination at Source Area 1, it was estimated that 12 horizontal SVE wells will be drilled underneath the existing building (B1). Results of the SVE pilot test conducted in October 2010 indicate a radius of influence (ROI) of approximately 10 feet in soil. Therefore, the horizontal wells will be placed in 12 laterals that are 15 feet apart, allowing for some overlap between targeted areas. Figure 64 illustrates an example configuration of the horizontal SVE wells. Vertical SVE wells will be employed to address the contamination at Source Area 2. Twenty-seven SVE wells will be drilled to a depth of 10 feet to address the COC vapors in surface and subsurface soils. Figure 65 illustrates and example configuration of the vertical SVE wells in Source Area 2.

During the Feasibility Study, the target treatment area for Source Area 1 was assumed to be 150 feet by 100 feet. Based on additional sampling conducted after completion of the Feasibility Study, the treatment area for Source Area 1 may be less. The USACE engineering manual, "*Engineering and Design – Soil Vapor Extraction and Bioventing*," identifies a range of pore volumes to achieve clean up levels; 2000 pore volumes were estimated as the total extraction required achieving RAOs. Based on 30% porosity for the clay soils, 2000 pore volumes in the target area will be extracted in about 1.75 years with 100 cubic feet per minute (CFM) blower. Applying a safety factor of 2, the operational time for this system will be 3.5 years.

Similarly, the target treatment area for Source Area 2 was estimated at 175 feet by 75 feet. Assuming a porosity of 30% for the soils, 2000 pore volumes in the target area will be extracted in about 1.5 years with a 100 CFM blower. Applying a safety factor of 2, the operational time for this system will be 3 years.

The soil gas collected in both source areas will be treated with granular activated carbon.

Institutional controls to prevent access or use of areas that present unacceptable risk to human health during the construction and operation of the SVE system are included. In addition, institutional controls may also impose restrictions on the development of residential dwellings, and the unauthorized drilling, excavating, digging, trenching, or any other activities that might otherwise compromise the remedy. Long term monitoring costs include the collection and analysis of soil gas via Summa Canisters.

19.2.2 Vadose Zone Bedrock

Alternative B-3 utilizes SVE wells that will remove COCs from the vadose zone bedrock by inducing a vacuum. Soil gas collected by the vacuum will be treated. Treatment options for the collected vapors include: Cryogenic Condensation and Compression (C3 technology), Granulated Activated Carbon (GAC), and thermal oxidation. In addition to addressing vadose zone bedrock RAOs, this combined technology alternative will address the ground water RAO for preventing further degradation of ground water quality by removing the primary source material.

To address the contamination at Source Area 1, vertical SVE wells would be employed.

Although Figure 66 shows only 6 SVE wells, this alternative includes up to 12 wells and their associated conveyance piping because the direction of vacuum communication in karst is unknown. Similarly, 6 vertical SVE wells are shown in Figure 67 to address the contamination at Source Area 2. However, this alternative includes up to 12 SVE wells and their associated conveyance piping. Figures were prepared prior to the collection of additional data in 2012. The locations of SVE extraction wells will be modified based on additional data.

The blower is sized to accommodate the maximum flow anticipated from six SVE wells. According to the SVE Pilot Test (EA 2011), approximately 80 CFM can be extracted from each well. For this reason, a 500 CFM blower and appropriate GAC vessels to treat the extracted soil gas are included.

Determining the operation time for such an SVE system is difficult, because airflow pathways and formation conditions are unknown. Therefore, the EPA Guideline "*How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites*" was used as a reference to decide the operation time for this alternative. This document suggests that typical operation times are from 6 months to two years under optimal conditions. Applying a safety factor of 2, the operation time for this alternative is expected to be 4 years. Institutional controls to prevent access or use of areas that present unacceptable risk to human health during the construction and operation of the SVE system are included. Long-term monitoring includes the collection and analysis of soil gas samples via Summa Canisters.

19.2.3 Ground Water

Alternative GW-4 includes injecting amendments into the Austin Chalk Aquifer that promote anaerobic metabolic processes of microorganisms that biodegrade chlorinated solvents. These amendments will create reducing conditions in the aquifer and provide a carbon source for the microorganisms. An enhancement to this alternative may include bioaugmentation, where microorganisms that degrade chlorinated solvents are injected into the aquifer in addition to the amendments.

An electron donor, such as 3D Microemulsion^{TM} (3DMe^{TM}), will be injected into the Northern and Southern Austin Chalk Plume. This includes the installation of 12 injection wells for each of the two plume areas. The treatment areas include and extend downgradient of the injection areas because the amendment migrates downgradient via fractures and channels in the formation. Additional impacted wells such as DW-414 may also receive amendments that promote anaerobic metabolic processes of microorganisms that biodegrade chlorinated solvents. The amendment volume required for treatment of the aquifer is a function of the source injection area, aquifer depth, and effective fracture porosity.

The injection area of Source Area 1 was assumed to be 500 feet by 300 feet. The injection area of Source Area 2 was assumed to be 600 feet by 300 feet. The effective porosity in a fractured karst aquifer varies with the age of the rock. The geometric mean of the fracture porosities of Silurian, Mississippian, and Cretaceous rock is 0.033% (Ford 2007). This is the effective porosity used to calculate the required volume of 3DMe^{TM}. Two injection events were assumed. It was assumed that the second event would follow approximately 18 months after the first one.

Additional injection events may be required, but were not estimated. Institutional and engineering controls (e.g., plugging and abandoning impacted wells) to restrict the use of ground water in impacted areas will be required to prevent unacceptable risk from exposure to ground water. Post-injection monitoring will include analyses of VOCs, anions, and TOC to determine the effectiveness of the injection.

19.2.4 Indoor Air

The purpose of Alternative VI-4 is to prevent vapor intrusion into existing building (B1) within Source Area 1 with the use of a protective barrier. With this alternative, a chemically impermeable gel inserted between two chemically resistant woven fibers will be applied over the concrete foundation of the structure within the immediate vicinity of the contaminant source area. The removal of carpeting and demolition of interior walls is required in order to create a single continuous coat over the concrete foundation. A single continuous coat is necessary to prevent any perforations between the edges of the seals. The protective barrier will prevent COCs from penetrating through the cracks within the concrete foundation. An additional layer of concrete will be laid above the sealant to protect against potential breakage of the membrane. Passive vapor vents will be installed underneath the membrane to redirect the vapors away from the building. The ventilation exit will be routed above the roof line in order to prevent inhalation to pedestrians.

It was assumed that a three layer Geo-Seal^{TM} coat would be used over a 5,000 square foot area. The seal will extend beyond the apparent contaminant source area due to the migration of vapors beneath the slab, which can emit indoors. This extension will reduce the risk of VOC vapor migration around the seal. However, it may be necessary to line the entire building to eliminate the potential for vapor intrusion. Periodic indoor air sampling collected with summa canisters will be necessary to confirm the efficacy of this alternative.

To ensure the long-term protection of the protective barrier over time (i.e., with regards to multiple property owners and/or tenants), the EPA will work with the TCEQ and property owner in the implementation and enforcement of appropriate institutional controls.

19.2.5 Institutional Controls

The owners of the Site will be responsible for implementing and maintaining institutional controls. The TCEQ will be responsible for enforcing these controls. The institutional controls that can be implemented and enforced by the TCEQ consist of either a restrictive covenant or a deed notice. The criteria used to establish the use of institutional controls and the type(s) of institutional controls at a site by the State of Texas are defined in 30 TAC § 350.4(47) (Definitions and Acronyms/ Institutional Control) and specified in 30 TAC § 350.111 (Use of Institutional Controls).

19.3 Summary of Estimated Remedy Costs

The cost estimate details are provided in Appendix B (Cost Estimate Details for Selected Remedy). The cost estimate is based on the best available information regarding the anticipated scope of the selected remedy. Changes in the cost elements are likely to occur as a result of changes in the price of materials, qualifying bids for performance of the remedial action, and progress of construction activities. Major changes may be documented in the form of a memorandum in the Administrative Record file, and ESD, or ROD Amendment. The total present worth cost is calculated using a 7% discount rate. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost. The total estimated present worth cost of the selected remedy is $9,429,000.

19.3.1 Surface and Subsurface Soils

19.3.1.1 Source Area 1

The total estimated cost to implement the soil vapor extraction remedy for surface and subsurface soils in Source Area 1 is $1,039,000. The estimated construction time is 4 months. Estimated operation time is 3.5 years. Post remediation monitoring time is 5 years. The total estimated capital cost, operation and maintenance cost, and long term monitoring costs are $824,000, $199,000, and $16,000, respectively. Major components of these costs are presented below:

CONSTRUCTION ACTIVITIES	
Temporary Facilities and Site Maintenance	$4,599
Horizontal SVE Wells	$358,499
SVE Conveyance to Treatment Facility	$56,469
Treatment Facility	$36,378
Electrical System	$27,500
Institutional Controls (ICs)	$33,000
Mobilization and Demobilization (10% of Construction Costs Excluding ICs)	$48,345
System Contingency (25% of Construction Costs Excluding ICs)	$132,948
Project Management (5% of Construction Costs Excluding ICs)	$33,237
Design (8% of Construction Costs Excluding ICs)	$53,179
Construction Management (6% of Construction Costs Excluding ICs)	$39,884
Total Construction Costs (rounded to nearest thousand)	**$824,000**
OPERATION AND MAINTENANCE	
Annual O&M Cost	$66,000
Lifetime O&M (4 Years with 7% discount factor)	**$199,000**
LONG TERM MONITORING	
Annual Long Term Monitoring	$4,000
Lifetime Long Term Monitoring (5 years with 7% discount factor)	**$16,000**
TOTAL COSTS	**$1,039,000**

19.3.1.2 Source Area 2

The total estimated cost to implement the soil vapor extraction remedy for surface and subsurface soils in Source Area 2 is $452,000. The estimated construction time is 4 months. Estimated operation time is 3 years. Post remediation monitoring time is 5 years. The total estimated capital cost, operation and maintenance cost, and long term monitoring costs are $273,000, $163,000, and $16,000, respectively. Major components of these costs are as follows:

CONSTRUCTION ACTIVITIES	
Temporary Facilities and Site Maintenance	$3,114
SVE Wells	$68,776
SVE Conveyance to Treatment Facility	$27,679
Treatment Facility	$36,878
Electrical System	$10,000
Institutional Controls (ICs)	$33,000
Mobilization and Demobilization (10% of Construction Costs Excluding ICs)	$14,645
System Contingency (25% of Construction Costs Excluding ICs)	$40,273
Project Management (5% of Construction Costs Excluding ICs)	$10,068
Design (8% of Construction Costs Excluding ICs)	$16,109
Construction Management (6% of Construction Costs Excluding ICs)	$12,082
Total Construction Costs (rounded to nearest thousand)	**$273,000**
OPERATION AND MAINTENANCE	
Annual O&M Cost	$62,000
Lifetime O&M (4 Years with 7% discount factor)	**$163,000**
LONG TERM MONITORING	
Annual Long Term Monitoring	$4,000
Lifetime Long Term Monitoring (5 years with 7% discount factor)	**$16,000**
TOTAL COSTS	**$452,000**

19.3.2 Vadose Zone Bedrock

19.3.2.1 Source Area 1

The total estimated cost to implement the soil vapor extraction remedy for vadose zone bedrock in Source Area 1 is $1,487,000. The estimated construction time is 3 months. Estimated operation time is 4 years. Post remediation monitoring time is 6 years. The total estimated capital cost, operation and maintenance cost, and long term monitoring costs are $1,073,000, $271,000, and $143,000, respectively. Major components of these costs are as follows:

CONSTRUCTION ACTIVITIES	
Temporary Facilities and Site Maintenance	$2,228
SVE Wells	$366,054
SVE Well Geotechnical Investigation	$28,469
SVE Conveyance to Treatment Facility	$167,049
Treatment Facility	$44,257
Electrical System	$27,500
Institutional Controls (ICs)	$33,000
Mobilization and Demobilization (10% of Construction Costs Excluding ICs)	$63,556
System Contingency (25% of Construction Costs Excluding ICs)	$174,779
Project Management (5% of Construction Costs Excluding ICs)	$43,695
Design (8% of Construction Costs Excluding ICs)	$69,911

Construction Management (6% of Construction Costs Excluding ICs)	$52,434
Total Construction Costs (rounded to nearest thousand)	**$1,073,000**
OPERATION AND MAINTENANCE	
Annual O&M Cost	$80,000
Lifetime O&M (4 Years with 7% discount factor)	**$271,000**
LONG TERM MONITORING	
Annual Long Term Monitoring	$30,000
Lifetime Long Term Monitoring (6 years with 7% discount factor)	**$143,000**
TOTAL COSTS	**$1,487,000**

19.3.2.2 Source Area 2

The total estimated cost to implement the soil vapor extraction remedy for vadose zone bedrock in Source Area 2 is $1,441,000. The estimated construction time is 3 months. Estimated operation time is 4 years. Post remediation monitoring time is 6 years. The total estimated capital cost, operation and maintenance cost, and long term monitoring costs are $1,061,000, $237,000, and $143,000, respectively. Major components of these costs are as follows:

CONSTRUCTION ACTIVITIES	
Temporary Facilities and Site Maintenance	$2,228
SVE Wells	$366,054
SVE Well Geotechnical Investigation	$28,469
SVE Conveyance to Treatment Facility	$165,466
Treatment Facility	$38,771
Electrical System	$27,500
Institutional Controls (ICs)	$33,000
Mobilization and Demobilization (10% of Construction Costs Excluding ICs)	$62,849
System Contingency (25% of Construction Costs Excluding ICs)	$172,835
Project Management (5% of Construction Costs Excluding ICs)	$43,209
Design (8% of Construction Costs Excluding ICs)	$69,134
Construction Management (6% of Construction Costs Excluding ICs)	$51,850
Total Construction Costs (rounded to nearest thousand)	**$1,061,000**
OPERATION AND MAINTENANCE	
Annual O&M Cost	$70,000
Lifetime O&M (4 Years with 7% discount factor)	**$237,000**
LONG TERM MONITORING	
Annual Long Term Monitoring	$30,000
Lifetime Long Term Monitoring (6 years with 7% discount factor)	**$143,000**
TOTAL COSTS	**$1,441,000**

19.3.3 Ground Water

19.3.3.1 Austin Chalk Northern Plume

The total estimated net present value cost to implement the *in situ* bioremediation remedy for Austin Chalk Northern Plume is $2,321,000. The estimated construction time is 20 months. There is no anticipated operation and maintenance time. Post remediation monitoring time is 30 years. The total estimated capital cost and long term monitoring costs are $2,011,000 and $310,000, respectively. Major components of these costs are as follows:

CONSTRUCTION ACTIVITIES	
Temporary Facilities and Site Maintenance	$2,228
In situ Bioremediation Wells	$490,502
Injection Events (Two Events – 18 months apart)	$625,470
Engineering Controls (Plug and Abandon Wells (5))	60,500
Institutional Controls (ICs)	82,500
Mobilization and Demobilization (10% of Construction Costs Excluding ICs)	117,870
System Contingency (25% of Construction Costs Excluding ICs)	$324,142
Project Management (5% of Construction Costs Excluding ICs)	$81,036
Design (8% of Construction Costs Excluding ICs)	$129,657
Construction Management (6% of Construction Costs Excluding ICs)	$97,243
Total Construction Costs (rounded to nearest thousand)	**$2,011,000**
OPERATION AND MAINTENANCE	**NA**
LONG TERM MONITORING	**$310,000**
Annual Long Term Monitoring (includes Plugging and Abandoning Wells)	$25,000
Lifetime Long Term Monitoring (30 years with 7% discount factor)	$310,226
TOTAL COSTS	**$2,321,000**

19.3.3.1 Austin Chalk Southern Plume

The total estimated net present value cost to implement the *in situ* bioremediation remedy for Austin Chalk Northern Plume is $2,452,000. The estimated construction time is 20 months. There is no anticipated operation and maintenance time. Post remediation monitoring time is 30 years. The total estimated capital cost and long term monitoring costs are $2,142,000 and $310,000, respectively. Major components of these costs are as follows:

CONSTRUCTION ACTIVITIES	
Temporary Facilities and Site Maintenance	$2,228
In situ Bioremediation Wells	490,502
Injection Events (Two Events – 18 months apart)	705,446
Engineering Controls (Plug and Abandon Wells (5))	$60,500
Institutional Controls (ICs)	$82,500
Mobilization and Demobilization (10% of Construction Costs Excluding ICs)	$125,868
System Contingency (25% of Construction Costs Excluding ICs)	$346,136
Project Management (5% of Construction Costs Excluding ICs)	$86,534
Design (8% of Construction Costs Excluding ICs)	$138,454
Construction Management (6% of Construction Costs Excluding ICs)	$103,841
Total Construction Costs (rounded to nearest thousand)	**$2,142,000**
OPERATION AND MAINTENANCE	**NA**
LONG-TERM MONITORING	
Annual Long Term Monitoring (includes Plugging and Abandoning Wells)	$25,000
Lifetime Long Term Monitoring (30 years with 7% discount factor)	$310,226
TOTAL COSTS	**$2,452,000**

19.3.4 Indoor Air

The total estimated net present value cost to implement the membrane/sealant with vapor vent remedy in Building B1is $237,000. The estimated construction time is 2 weeks. The operation and maintenance include costs for annual site visits and maintenance for 30 years. Post remediation monitoring time is 30 years. The total estimated capital cost, operation and maintenance, and long term monitoring costs are $150,000, 37,000, and $50,000, respectively. Major components of these costs are as follows:

CONSTRUCTION ACTIVITIES	
Site Preparation	$5,417
Sealant Application	$36,650
Conformation Sampling	$6,400
Site Restoration	$13,191
Institutional Controls (ICs)	$30,000
Mobilization and Demobilization (10% of Construction Costs Excluding ICs)	$9,166
System Contingency (25% of Construction Costs Excluding ICs)	$25,206
Project Management (5% of Construction Costs Excluding ICs)	$6,301
Design (8% of Construction Costs Excluding ICs)	$10,082
Construction Management (6% of Construction Costs Excluding ICs)	$7,562
Total Construction Costs (rounded to nearest thousand)	**$150,000**
OPERATION AND MAINTENANCE	
Annual O&M Cost	$3,000
Lifetime O&M (30 Years with 7% discount factor)	**$37,000**
LONG TERM MONITORING	
Annual Long Term Monitoring	$4,000
Lifetime Long Term Monitoring (30 Years with 7% discount factor)	**$50,000**
TOTAL COSTS	**$237,000**

19.4 Expected Outcomes of Selected Remedy

The expected outcomes of the selected remedy for the Site is expected to accomplish are:

- Prevent exposure to COCs associated with the Site in ground water and indoor air above cleanup levels.
- Prevent or minimize further migration of COCs associated with the Site in surface soil, subsurface soil, vadose zone bedrock, and ground water above cleanup levels.
- Return ground water to their expected beneficial uses wherever practicable (aquifer restoration).

The following cleanup levels provide numerical criteria that can be used to measure the progress in meeting the indoor air remedial action objectives for cleanup:

• Tetrachloroethene	175.0	$\mu g/m^3$	(Non-cancer hazard index of 1)
• 1,1,2,2-Tetrachloroethane	2.1	$\mu g/m^3$	(Cancer risk of $1x10^{-5}$)
• Trichloroethene	8.8	$\mu g/m^3$	(Cancer risk of $1x10^{-5}$)
• 1,2-Dichloroethane	4.7	$\mu g/m^3$	(Cancer risk of $1x10^{-5}$)
• Vinyl Chloride	28.0	$\mu g/m^3$	(Cancer risk of $1x10^{-5}$)

The following cleanup levels provide numerical criteria that can be used to measure the progress in meeting the ground water remedial action objectives for the cleanup:

• Tetrachloroethene	5	µg/L	(MCL)
• Trichloroethene	5	µg/L	(MCL)
• 1,1-Dichloroethene	7	µg/L	(MCL)
• Cis-1,2-Dichloroethene	70	µg/L	(MCL)
• Vinyl Chloride	2	µg/L	(MCL)
• Toluene	1000	µg/L	(MCL)

MCL - Maximum Contaminant Level in drinking water under the Federal Drinking Water Act
Land use at the Site is currently a mix of commercial/industrial and residential. This land use is not expected to change as a result of the remedy. Risk associated with vapor intrusion will be mitigated. The ground water remedy will reduce the current risks to the local ground water which is classified as both Class 1 and Class 2 water resources – current and potential sources for drinking water.

20.0 STATUTORY DETERMINATIONS

Under CERCLA section 121, 42 U.S.C. §9621, the EPA must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (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 treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

20.1 Protection of Human Health and the Environment

The selected remedy for the Building B1 indoor air exposure route will protect human health by the placement of a protective barrier which will prevent contaminated vapor from the impacted concrete and sub-slab vapors from entering the indoor air work space. The vapors captured beneath the protective barrier will be passively vented above the building roof line in order to prevent inhalation to pedestrians.

The selected remedy for surface and subsurface soils will protect human health by removing contaminant mass via SVE which can impact the indoor air in Building B1, Building B3 located adjacent to the Source Area 1 spill location, and the AOI 2 Active Dry Cleaner. SVE will also reduce the mass of contaminant migrating into the vadose zone bedrock and underlying ground water. The selected remedy for the vadose zone bedrock (i.e., SVE) will protect human health by reducing the contaminant mass acting as a source of contamination to the underlying ground water.
The selected remedy for contaminated ground water will protect human health by reducing the mass of contamination via *in situ* bioremediation. The plugging and abandoning wells will

eliminate migration pathways to the underlying Buda limestone and Edwards Aquifer.

20.2 Compliance with Applicable or Relevant and Appropriate Requirements

The NCP §§ 300.430(f)(5)(ii)(B) and (C) require that a ROD describe the Federal and State ARARs that the Selected Remedy will attain or provide justification for any waivers. ARARs include substantive provisions of any promulgated Federal or more stringent State environmental standards, requirements, criteria, or limitations that are determined to be legally ARARs for a CERCLA site or action. 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 a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements are requirements that, while not legally "applicable" to circumstances at a particular CERCLA site, address problems or situations sufficiently similar to those encountered at the site that their use is well-suited. There are three categories of ARARs:

- Chemical-specific ARARs are health- or risk-based numerical values or methodologies used to determine acceptable concentrations of chemicals in a media (e.g., water). When applied to site-specific conditions, the chemical-specific ARAR may result in the development of cleanup standards for a COC.
- Location-specific ARARs are restrictions placed on health-based concentrations of hazardous substances or the conduct of activities because of the special locations, which have important geographical, biological or cultural features. Examples of special locations include wetlands, flood plains, and sensitive ecosystems.
- Action-specific ARARs are technology-based or activity-based requirements or limitations on actions to be taken to handle hazardous wastes. They are triggered by the particular remedial activities selected to accomplish a remedy. For all CERLCA remedies, the remedial action is exempt from having to obtain permits for on-Site activities. However, any substantial requirements of applicable permits, such as discharge limitations, must be met in the remedy.

Where no ARARs exist for a given chemical, action or location, the EPA may consider non-promulgated Federal or State advisories and guidance as To Be Considered criteria (TBC). Although consideration of a TBC is not required, if standards are selected based on TBC, those standards are legally enforceable as performance standards.

This remedial action will comply with all ARARs and does not require that any waivers be invoked. The chemical-specific, location-specific, and action-specific ARARs for the selected remedy are presented in the following sections. In addition, the remedial action will need to comply with Occupational Safety and Health (OSHA) requirements, 29 CFR § 1910.120, for permissible exposure limits and appropriate worker protection or engineering controls, as necessary.

20.2.1 Chemical-Specific ARARs

Medium: Ground Water
Authority: Federal Safe Drinking Water Act, Primary Drinking Water Standards (MCLS)
Citation: 40 CFR 141.61
Description: Establishes health-based standards for public water systems. Primary MCLs have been issued for a number of organic and inorganic compounds in drinking water. MCLs are considered relevant and appropriate if the ground water is currently used, or has the potential to be used, for drinking water.
Applicability: ARAR applies because Austin Chalk, Buda Limestone, and Edwards Aquifer are primary or potential drinking water sources.
Action to Attain Requirement: MCLs will be used as performance standards for measuring the progress of the selected remedy in preventing further migration and restoring the Austin Chalk to its beneficial use as a drinking water supply.

20.2.2 Location-Specific ARARs

Authority: Code of Federal Regulations - Location Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
Citation: 40 CFR 264.18
Description: Portions of new facilities where treatment, storage, or disposal of hazardous waste will be conducted must not be located within 200 feet of a fault displaced in Holocene time, and require that a facility must be designed and maintained to avoid washout if located within a 100-year floodplain.
Applicability: ARAR applies because site contains faults that may be displaced in Holocene time. Additionally, parts of the site are within a 100-year floodplain.
Action to Attain Requirement: No new treatment or hazardous waste storage facilities will be set-up within 200 feet of a fault displaced in Holocene time. Additionally, if a new treatment or hazardous waste storage facility is set within a 100-year floodplain, it will be designed and maintained to avoid washout by a 100-year flood, unless the owner or operator can demonstrate to the Regional Administrator's satisfaction that procedures are in effect which will cause the waste to be removed safely, before flood waters can reach the facility, to a location where wastes will not be vulnerable to flood waters. The remedy does not include the construction of new on-site hazardous waste disposal facility.

Authority: Texas Risk Reduction Program – Ground Water Classification
Citation: 30 TAC § 350.52(1)(A)
Description: Ground water bearing units within ½ mile of public drinking water supply wells are Class 1 ground water resources if they can contribute COCs to the ground water production zone of such water supply well based on chemical properties of the COCs, the hydrology, and the construction of the well. For Class II classification, the ground water bearing unit must meet one of the following two conditions: (A) any ground water-bearing unit which is a ground water production zone for an existing well located with ½ mile of the affected property and which is used to supply ground water for human consumption, agricultural purposes or any purpose which could result in exposure to human or ecological receptors; or (B) any ground water-bearing unit which is capable of producing waters with a naturally occurring total dissolved solids content of

less than 10,000 milligrams per liter and at a sustainable rate greater than 150 gallons per day to a well with a four inch diameter casing or an equivalent sustainable rate in gallons per day to a well with a smaller or larger diameter casing.
Applicability: ARAR applies to the Leon Valley public water supply well (designated within this ROD as USGS-50) which is completed in the Edwards Aquifer is located about 2500 feet southeast of AOI 2/Source Area 2. Based on the COCs (i.e., PCE is a DNAPL), the hydrogeologic setting (i.e., karst formations), and construction of wells (i.e., surface casing and open hole), the Austin Chalk, Buda Limestone, and Edwards Aquifer ground water bearing units are Class 1 ground water resources.

It is pertinent to note that a private water well with well construction open to the Austin Chalk formation was being using as a source of drinking water prior to the PCE contamination being detected in the well. A carbon treatment unit was installed on the well prior to the residence being hooked up to the local public water supply. This well is currently being used to water the property owner’s lawn.

In respect to the Austin Chalk, as discussed in the Hazard Ranking System Documentation Record for the Bandera Road Ground Water Plume (TCEQ, 2006b), the Austin Chalk supplies water for domestic or stock use where yields of 500 gallons per minute or more were reported from several wells. Such yields may result when wells have been drilled into subsurface caverns. Subsurface cavern features were identified in the Austin Chalk monitoring well DW-408. Some of the large yields from the Austin Chalk are believed to be obtained where the formation is in hydraulic communication (e.g., faults, secondary porosity) with the Edwards and associated limestones.

Based on cross-sections from the Edwards Aquifer Authority, minor faults appear to be present within the investigation area (within 2 miles from the center of the contamination plume) and may contribute to the hydraulic communication between the Austin Chalk and the Edwards Aquifer (TECQ, 2006b). Based on review of field borehole logs and geophysical investigation determination (EPA, 2011), and a fracture trace analysis determination (EPA, 2008), faults were identified in the Site area.

Action to Attain Requirement: Since the local COC impacted ground water bearing zones meet the State’s definitions of Class I and Class II ground water resources, MCLs were designated as cleanup levels.

Authority: Texas Risk Reduction Program – Tier 1: Exclusion Criteria Checklist
Citation: **30 TAC** § 350.77(b)
Description: This exclusion criteria checklist is intended to aid the person and the TCEQ in determining whether or not further ecological evaluation is necessary at an affected property where a response action is being pursued under the Texas Risk Reduction Program (TRRP). Exclusion criteria refer to those conditions at an affected property which preclude the need for a formal ecological risk assessment (ERA) because there are incomplete or insignificant ecological exposure pathways due to the nature of the affected property setting and/or the condition of the affected property media.

Applicability: The Tier 1 Exclusion Criteria Checklist utilized regional information (e.g., topographic map), local information such as proximity to a surface water body, field observations regarding habitat or lack thereof, and site-specific data (e.g., soil boring data/groundwater analysis), as a basis of determining that no further action was necessary to protect ecological receptors at the site.
Action to Attain Requirement: Based on the ecological assessment which included the Tier 1 Exclusion Criteria Checklist, no further action is necessary to protect ecological receptors at the site.

Medium: Ground Water
Authority: Texas Department of Licensing and Regulation, Water Well Drillers and Water Well Pump Installers
Citation: 16 TAC § 76.1000-1009
Description: Regulations regarding the installation and abandonment of ground water wells. Licensed drillers/drilling companies are notified via TDLR notices/letters that define designated restricted drilling areas and advise drillers of potential contamination and the contaminated water bearing units. Based on this information the TDLR may prescribe more stringent site-specific drilling procedures, well construction, and well completion specifications. A designated restricted drilling area does not prohibit drilling and there is no "registration" by which to initiate enforcement. The TDLR may learn of drilling in a restricted drilling area via a complaint or after a State of Texas well report has been submitted to the TDLR by the licensed driller. If the well report indicates the well was not constructed and completed in accordance with the TDLR specifications defined for the restricted drilling area, the TDLR may initiate enforcement based on improper well construction and/or completion.
Applicability: ARAR applies to remedial actions which include the installation of ground water wells.
Action to Attain Requirement: Well installation activities will be in compliance with regulation.

Medium: Surface Water
Authority: Texas Administrative Code – Texas Surface Water Quality Standards
Citation: 30 TAC § 307
Description: Establishes surface water limits to ensure public health and enjoyment, propagation and protection of terrestrial and aquatic life, operation of existing industries, and economic development of the state.
Applicability: ARAR applies if remedial actions result in discharge into adjacent surface waters.
Action to Attain Requirement: Sampling will be conducted to ensure water surface water meets criteria prior to discharge.

Authority: Executive Order - Floodplain Management
Citation: Executive Order 11988; 40 CFR 6.302 and Appendix A
Description: Federal agencies are required to evaluate the potential effects of actions they may

take in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain.
Applicability: ARAR applies because parts of the site are within a 100-year floodplain.
Action to Attain Requirement: EPA will evaluate the potential effects of actions that may be taken in the site's 100-year floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain.

20.2.3 Action-Specific ARARs

Medium: Ground Water
Authority: Federal Water Pollution Control Act
Citation: 40 CFR 403.6
Description: Establishes responsibilities of Federal, State, and local government, industry and the public to implement National Pretreatment Standards to control pollutants which pass through or interfere with treatment processes in Publicly Owned Treatment Works (POTWs) or which may contaminate sewage sludge.
Applicability: ARAR applies because extracted ground water may be delivered to POTWs.
Action to Attain Requirement: If extracted ground water (i.e., from well installation and development activities) is taken to POTWs for disposal, the extracted ground water will need to meet the National Pretreatment Standards.

Medium: Ground Water
Authority: Federal Safe Drinking Water Act
Citation: 40 CFR 149, Subpart B
Description: Provides for a federally implemented sole source aquifer program, which prohibits federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area.
Applicability: ARAR applies because the Edwards Aquifer has been designated by the EPA as a Sole Source Aquifer.
Action to Attain Requirement: No federal funds are being expended on projects that may contaminate the sole or principal source of drinking water in the area. Federal funds are being expended on activities to protect the Edwards Aquifer (i.e., plugging and abandoning wells).

Medium: Ground Water
Authority: Texas Water Code - Ground Water Restoration
Citation: Texas Water Code 26.401
Description: "Protection of the environment and public health and welfare requires that ground water be kept reasonably free of contaminants that interfere with present and potential uses of groundwater." Requires ground water quality to be restored, if feasible.
Applicability: ARAR applies because RAO for ground water is to restore through remediation processes.
Action to Attain Requirement: Identified ground water restoration activities include addressing contaminant source areas, treating impacted ground water in place, and plugging and abandoning wells.

Medium: Air
Authority: National Primary and Secondary Air Quality Standards (NAAQS)
Citation: 40 CFR 50.4, 50.6 50.8, 50.9, 50.11, 50.12
Description: NAAQS define levels of air quality to protect the public health or the public welfare from any known or anticipated adverse effects of a federally regulated pollutant. NAAQS for sulfur dioxide, nitrogen dioxide, and carbon monoxide apply to incineration.
Applicability: ARAR may apply if incineration is used during remedial action.
Action to Attain Requirement: Excavation and offsite disposal of contaminated soils may require the soils to be incinerated. If so, air emissions would need to comply with NAAQS.

Medium: Air
Authority: Texas Clean Air Act
Citation: Texas Health and Safety Code 382.021, 382.0216
Description: The policy of this state and the purpose of this chapter are to safeguard the state's air resources from pollution by controlling or abating air pollution and emissions of air contaminants, consistent with the protection of public health, general welfare, and physical property.
Applicability: ARAR applies since remediation includes emissions for SVE operations.
Action to Attain Requirement: Monitor emissions from SVE systems and employ control devices, as necessary.

Medium: Air
Authority: Texas Administrative Code – Air Quality
Citation: 30 TAC § 101.4
Description: No person shall discharge from any source whatsoever one or more air contaminants or combination thereof, in such concentration and of such duration as are or may tend to be injurious to adversely affect human health or welfare, animal life, vegetation, and physical property.
Applicability: ARAR applies since remediation includes emissions for SVE operations.
Action to Attain Requirement: Monitor emissions from SVE systems and employ control devices, as necessary.

Authority: Texas Administrative Code – Air Quality
Citation: 30 TAC § 115
Description: Control of air pollution from volatile organic compounds.
Applicability: ARAR applies since remediation includes emissions from SVE operations.
Action to Attain Requirement: Monitor emissions from SVE systems and employ control devices, as necessary.

Medium: Soil
Authority: Relocation of Soils Containing Chemicals of Concern for Reuse Purposes
Citation: 30 TAC § 350.36

Description: A person must comply with this section when relocating soils for reuse purposes from an affected property (on-site or off-site) which is undergoing or has completed a response action under Remedy Standard A or B and the soils contain COCs in excess of naturally occurring background concentrations.
Applicability: ARAR applies because a possible remedial alternative for soil treatment is excavation and off-site disposal.
Action to Attain Requirement: Soil will be properly characterized and handled appropriately.

Medium: Waste
Authority: Code of Federal Regulations – Criteria for Identifying the Characteristics of Hazardous Waste and for Listing Hazardous Waste
Citation: 40 CFR 261
Description: Provides the criteria for identifying a characteristic or listed waste. Solid waste is a hazardous waste if it exhibits any of the characteristics of ignitability, corrosivity, reactivity, and toxicity or if it is a listed waste.
Applicability: Applicable to off-site disposal of excavated soils.
Action to Attain Requirement: Waste will be properly characterized prior to shipment to an off-site disposal facility.

Medium: Waste
Authority: Code of Federal Regulations – Standards Applicable to Generators of Hazardous Waste
Citation: 40 CFR 262
Description: Provides requirements for preparation of waste manifests, waste packaging, labeling and handling.
Applicability: Applicable to off-site disposal of excavated soil.
Action to Attain Requirement: Waste will be properly characterized, manifested, packaged, labeled and handled for off-site disposal.

Medium: Waste
Authority: Code of Federal Regulations and Texas Administrative Code – Standards Applicable to Transporters of Hazardous Waste
Citation: 40 CFR Part 262, 30 TAC 335.91
Description: Requires that hazardous material to be transported off-site be labeled and placarded according to the regulations and that contractors who transport the hazardous waste provide proper documentation.
Applicability: Applicable to off-site waste disposal.
Action to Attain Requirement: Waste will be properly labeled and placarded according to regulations and transporters will have proper documentation.

Medium: Waste
Authority: Code of Federal Regulations – Land Disposal Restrictions

Citation: 40 CFR 268
Description: Restricts the land disposal of most hazardous waste, and specified specific treatment standards that must be met before this waste can be land disposed.
Applicability: Applicable to off-site waste disposal of excavated soils.
Action to Attain Requirement: Excavated soils taken off-site for disposal will meet land disposal restriction requirements.

Medium: Waste
Authority: Code of Federal Regulations – Procedures for Planning and Implementing Off-site Response Action
Citation: 40 CFR 300.440
Description: Hazardous waste generated from CERCLA cleanups must go to RCRA permitted treatment, storage, and disposal facilities that are in compliance with RCRA and state rules and that do not have releases to the environment.
Applicability: Applicable to off-site waste disposal.
Action to Attain Requirement: EPA will determine if there are relevant releases or relevant violations at a facility prior to initial receipt of CERCLA waste.

Medium: Waste
Authority: Texas Administrative Code – Spill Prevention and Control
Citation: 30 TAC § 327.4
Description: Defines the reportable quantities in the event of a spill or release to environment.
Applicability: ARAR applies to possible releases or spills to the environment during remedial activities.
Action to Attain Requirement: Notification of any spills in excess of defined reportable quantities will be made as required.

Medium: Waste
Authority: Texas Administrative Code – Waste Classification
Citation: 30 TAC § 335.505, 30 TAC § 335.508
Description: Provides procedure for implementation of Texas waste notification system and establishes standards for classification of industrial solid waste managed in Texas, including Class 1, Class 2, and Class 3 wastes.
Applicability: Applicable since waste will be generated during remedial activities.
Action to Attain Requirement: Waste generated by site activities will be properly classified.

Remediation Activity: Technical Requirement
Authority: Texas Administrative Code – Standard for Capping and Plugging of Wells
Citation: 16 TAC § 76.1004
Description: Describes standards for capping and plugging wells that penetrate undesirable water or constituent zones.
Applicability: Applicable for site wells that will be plugged.

Action to Attain Requirement: Wells will be plugged as required.

Medium: Air
Authority: Texas Administrative Code – Permitting by Rule Subchapter A: General Requirements for Air Emissions during Remedial Activities
Citation: 30 TAC § 106
Description: Requires employment of fugitive dust controls and meeting applicable standards for specific contaminants, as appropriate. Confirms compliance via air monitoring during excavation activities. Also applicable to emissions from SVE remediation system. Equipment used to extract, handle, process, condition, reclaim, or destroy contaminants for the purpose of remediation is permitted by rule, provided that all the conditions of this section are satisfied.
Applicability: Applicable for excavation and SVE system operations.
Action to Attain Requirement: Monitor emissions from site activities and employ control devices, as necessary.

Medium: Water
Action: Remediation Activities
Authority: Texas Administrative Code – Permitting by Rule Subchapter X: Waste Processes and Remediation
Citation: 30 TAC § 106.532 (Water and Wastewater Treatment), § 106.533 (Remediation)
Description: Provides conditions under which water and wastewater treatment units are permitted by rule and provides conditions for equipment used to extract, handle, process, condition, reclaim, or destroy contaminants for the purpose of remediation are permitted by rule.
Applicability: Applicable to water treatment and remediation activities (i.e., SVE vapor treatment).
Action to Attain Requirement: Applicable conditions of permitting by rule will be attained for Site remediation activities.

Medium: Air
Authority: Texas Administrative Code – Visible and Particulate Emission Standard
Citation: 30 TAC § 111.145
Description: Requires meeting visible emission standards using fugitive dust controls, such as wetting, and confirm compliance via air monitoring during excavation and well drilling activities.
Applicability: Applicable to excavation and well drilling activities.
Action to Attain Requirement: Contractor shall furnish all the labor, equipment, and means required, and carry out proper and efficient measures whenever and as often as necessary to reduce the dust nuisance to persons, and prevent damage by dust from operations to vehicles, buildings, existing vegetation or any other properties.

Medium: Ground Water
Authority: Texas Administrative Code – Edwards Aquifer Protection Program

Citation: 30 TAC § 213
Description: The purpose of this chapter is to regulate activities having the potential for polluting the Edwards Aquifer and hydrologically connected surface streams in order to protect existing and potential uses of ground water and maintain Texas Surface Water Quality Standards. The activities addressed are those that pose a threat to water quality.
Applicability: Applicable to remedial activities performed on impacted ground water.
Action to Attain Requirement: Will work closely with the State of Texas and Edwards Aquifer Authority for activities regarding impacted ground water (i.e., ground water remedial activities plug and abandon wells).

Medium: Water
Authority: National Pollutant Discharge Elimination System
Citation: 40 CFR 122, 40 CFR 125
Description: Provides conditions that must be incorporated into NPDES permits. Applicable to discharge of storm water from the Site.
Applicability: ARAR applies because water may be discharged from the site during remedial activities.
Action to Attain Requirement: Applicable conditions of NPDES permits will be attained for Site remediation activities.

Medium: Water
Authority: Code of Federal Regulations – Underground Injection Control Program
Citation: 40 CFR 144
Description: Provides minimum requirements for Class 5 injection wells.
Applicability: Applicable to *in situ* bioremediation wells where reagents will by injected below the water table.
Action to Attain Requirement: Comply with requirements for Class 5 wells (i.e., notification, operation and closer requirements).

Medium: Water
Authority: Pre-treatment requirements for discharge to City public owned treatment works (POTW).
Citation: 30 TAC § 315
Description: Requires water discharged to City POTW to meet specific allowable contaminant levels.
Applicability: ARAR applies because extracted ground water treated with an air stripper at the site may be delivered to POTWs.
Action to Attain Requirement: Water discharged to City POTW will meet specific allowable contaminant levels.

Medium: Ground Water
Authority: Texas Administrative Code – Underground Injection Control Program
Citation: 30 TAC § 331

Description: Requires state approval for reinjection of treated ground water and any treatment amendments.
Applicability: Applicable to *in situ* bioremediation wells.
Action to Attain Requirement: Will receive state approval for injection of treatment amendments.

Medium: Ground Water and Soil
Authority: State Regulatory Authority
Citation: TPDES Construction General Permit No. TXR150000
Description: Specifies limitations and monitoring requirements for construction sites that discharge storm water associated with construction activity.
Applicability: Applies because construction activities will be performed during remedial action at site.
Action to Attain Requirement: Substantive provisions will be met through implementation of construction run-off controls.

20.3 Cost Effectiveness

In EPA's judgment, the selected remedies for surface and subsurface soils, vadose zone bedrock, ground water, and indoor air are cost-effective because the remedy's costs are proportional to its overall effectiveness (see 40 CFR 300.430(f)(1)(ii)(D)). This determination was made by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria (i.e., that are protective of human health and the environment and comply with all federal and any more stringent State ARARs, or as appropriate, waive ARARs). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination: (1) long-term effectiveness and permanence; (2) reduction in toxicity, mobility, and volume through treatment; and (3) short-term effectiveness. The overall effectiveness of each alternative then was compared to the alternative's costs to determine cost-effectiveness.

For the surface and subsurface soils alternatives, S-3(Excavation and Off-site Disposal) and S-4 (Soil Vapor Extraction), both alternatives were considered to be protective and ARAR compliant. Alternative S-3 provides greater long-term effectiveness than alternative S-4 while alternative S-4 presents less of short term adverse impacts on the workers and the community. Alternative S-3 does not provide reduction of toxicity, mobility, or volume through treatment unless the excavated soils required treatment prior to land disposal. Alternative S-4 removes volatile contaminants by SVE. The extracted vapor is then run through activated carbon which captures the VOC contaminants. The activated carbon can then be reactivated by utilizing a high temperature process in a controlled environment to destroy all contaminants. During the Proposed Plan public meeting, a local community member ask in respect to Building B1, why can't you just demolish the building and pull out the soils underneath the and remedy the product? Alternate S-3 would require shutting down the businesses and demolishing parts of the building that overlie contaminated soils. In regards to estimated costs for Source Areas 1 and 2, the selected alternative S-4 ($1,491,000) was approximately 60% of the estimated costs of alternative S-3 ($2,518,000).

For the vadose zone bedrock alternatives, B-3 (Soil Vapor Extraction) and B-4 (*In situ* Thermal Desorption), both alternatives were considered to be protective and ARAR compliant. Alternative B-4 provides greater long-term effectiveness by potentially removing more contaminant mass than alternative B-3. Alternative B-3 presents less adverse short-term impacts to the contractors implementing the remedy than alternative B-4 which requires energy to heat the vadose zone bedrock. The extracted vapor for alternatives B-3 and B-4 would run through activated carbon to capture the VOC contaminants. The activated carbon could then be reactivated by utilizing a high temperature process in a controlled environment to destroy all contaminants. In regards to the estimated costs for Source Areas 1 and 2, the selected alternative B-3 ($2,928,000) was approximately 20% of the estimated costs of alternative B-4 ($14,433,000).

For the ground water alternatives, GW-4 (*In situ* Bioremediation) and GW-5 (Pump and Treat), both alternatives were considered to be protective and ARAR compliant. Alternative GW-4 provides greater long-term effectiveness by removing more contaminant mass than the can be addressed by the alternative GW-4. Alternative GW-4 presents less adverse short-term impacts to the contractors implementing the remedy than alternative GW-5 which requires operation of ground water treatment system. The *in situ* bioremediation pilot study conducted at monitoring well DW-404 demonstrated that the addition of 3DMe™ has resulted in a 99.7% reduction of PCE concentrations. The most recent sampling event, the concentrations for PCE and TCE were not detected with a reporting limit of 5µg/L (i.e., the MCL for PCE and TCE). The May 2012 sampling results for cis-1,2-Dichloroethene were estimated at 1.1 µg/L. The MCL for cis-1,2-Dichloroethene is 70 µg/L. Above ground treatment of ground water contamination can fully reduce the toxicity and volume through treatment. In regards to the estimated costs for Source Areas 1 and 2, the selected alternative GW-4 ($4,775,000) was approximately 33% of the estimated costs of alternative B-4 ($14,630,000).

For the vapor intrusion alternatives for Building B1, VI-3 (Positive Pressure System), VI-4 (Membrane/Sealant with Vapor Vent), and VI-5 (Sub-slab Depressurization System), these alternatives were considered to be protective and ARAR compliant. Alternative VI-4 ranked highest in providing long-term effectiveness and permanence. Alternatives VI-3 and VI-5 require the long-term operation of a positive pressure system or a sub-slab depressurization system to remain effective. Alternative VI-3 present less short-term construction risks to contractors than alternatives VI-4 and VI-5. The estimated costs of selected alternative VI-4 ($237,000) was 19% more than alternative VI-3 ($191,000) and 5% less than alternative VI-5 ($249,000).

20.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

The selected remedy meets the statutory requirement to utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. The EPA has determined that the selected remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, and cost, while also considering the statutory preference for treatment as a principal element, the bias against off-site land disposal of untreated waste, and state and community acceptance.

The selected remedy for ground water satisfies the criteria for long-term effectiveness and permanence by employing a treatment technology (*in situ* bioremediation) to permanently reduce contaminant concentrations. Plugging and abandoning wells will permanently remove potential contaminant migration pathways to lower water bearing zones (i.e., Buda Limestone and Edwards Aquifer). The use of soil vapor extraction in the surface and subsurface soils and vadose zone bedrock will permanently remove contaminant VOCs which act as a continuing source for vapor intrusion and ground water impacts. The selected remedy presents less short-term risks than other alternatives that involve treatment.

The selected remedy for vapor intrusion (Membrane/Sealant with Vapor Vent) satisfies the criteria for long-term effectiveness and permanence because it eliminates the indoor air exposure for workers in Building B1. The SVE remedy for surface and subsurface soils will also assist in reducing vapor intrusions exposure to Buildings B1, B3 and the Active Dry Cleaner.

20.5 Preference for Treatment as a Principal Element

Principal threat waste consisting of PCE and its degradation products in Source Area 1 and Source Area 2 are highly mobile and cannot be reliably controlled in place. The selected remedy will satisfy the statutory preference for treatment as a principal element through the combination of soil vapor extraction (surface and subsurface soils and vadose zone bedrock) and *in situ* bioremediation of impacted ground water to reduce the mobility, toxicity, and volume of the waste.

20.6 Five-Year Review Requirements

If the selected remedy results in hazardous substances, pollutants, or contaminants remaining at the Site above levels that allow for unlimited use and unrestricted exposure, then CERLCA requires the EPA to conduct a review of the Site remedy every five years to ensure that the remedy is, or will be, protective of human health and the environment. Because the ground water remedy may not result in hazardous substances, pollutants, or contaminants remaining in the ground water above levels that allow for unlimited use and unrestricted exposure, but it may take more than five years to attain remedial action objectives and goals, a policy review may be conducted within five years of construction completion for the Site. The statutory and legal basis for conducting Five-Year Reviews is provided in CERLCA § 121(c), 42 U.S.C. § 9621(c) and NCP § 300.430(f)(5)(iii)(C). The current guidance on Five-Year Reviews is provided in OSWER Directive 9355.7-03B-P, *Comprehensive Five-Year Review Guidance* (June 2001).

21.0 DOCUMENTATION OF SIGNIFICANT CHANGES FROM PREFERRED ALTERNATIVE

The EPA has determined that a significant change to the remedy, as originally identified as a component of the preferred remedial alternative in the Proposed Plan, was necessary and appropriate. The public comment period for the Proposed Plan was from July 18, 2011, through October 15, 2011. The proposed plan identified Alternative S-3 (Excavation and Off-site Disposal) as the preferred alternative for Source Area 2 surface and subsurface soils. Based on a recalculation of cancer and non-cancer risks using the revised PCE and TCE toxicity values, the excavation and offsite disposal of the surface and subsurface soils for Source Area 2 soils was determined to no longer be necessary (Table 33). The revised toxicity calculations for commercial-industrial worker for surface and subsurface soils did not exceed the non-cancer hazard index of 1. The revised increased cancer risk for surface and subsurface soils did not exceed EPA's cancer risk range point of departure of $1x10^{-6}$. Vapor intrusion and leaching to ground water is still a concern. The calculated non-cancer indoor air inhalation risk for the active dry cleaner resulted in a hazard index of 69 for the commercial-industrial worker. The Austin Chalk Southern Plume and in the shallow monitoring wells directly behind the active dry cleaner had PCE, TCE, and cis-1,2-Dichloroethene concentrations which exceeded the MCLs. To address the non-cancer risk and MCL exceedences, alternative S-4 (Soil Vapor Extraction) is selected to address principal threat waste consisting of PCE and its degradation products in Source Area 2 surface and subsurface soils. There are no other significant changes to the remedy identified in the Proposed Plan.

PART 3: RESPONSIVENESS SUMMARY

22.0 RESPONSIVENESS SUMMARY

The Responsiveness Summary summarizes the comments received regarding both the remedial alternative and general concerns about the Site submitted during the public comment period and EPA's responses to these comments. The Administrative Record file includes a transcript of the public meeting held by the EPA on July 21, 2011, to describe the preferred alternative. The questions and answers discussed during this meeting can be found in the meeting transcript included as part of the Administrative Record.

Public Meeting Comments

1. **Comment:** How are you remediating the risk?

   EPA Response: Implementation of the selected remedy identified in this Record of Decision is how EPA will address identified Site risks.

2. **Comment:** For restaurants operating in areas where contamination has been identified, is there something to be concerned about?

   EPA Response: No. For restaurants in areas near to where contamination has been identified, sampling completed nearest the restaurants did not indicate a problem.

   Current and future risk estimates for various exposure scenarios were calculated using conservative assumptions at locations where contamination was detected. Based upon this evaluation, the primary structure where response action will be required to address potential long-term exposure risk to indoor air is the building where a former dry cleaner operated at the Savings Square Shopping Center – Building B1. It is important to note that within this structure, actions have already been taken to reduce indoor air contaminant concentrations. Please note that contaminant concentrations decreased significantly the further you move away from the former dry cleaning location.

Building B3, located directly east of the former dry cleaner location had varying levels of chemicals detected within the building. The estimated cancer and non-cancer risk for the June 2010 indoor air sample (Table 34) was within EPA's generally accepted increased cancer risk range of 10^{-4} to 10^{-6} and the calculated hazard index was less than one for the commercial industrial scenario. A hazard index less than 1 indicates that toxic non-cancer effects are unlikely. The estimated cancer and non-cancer risk for the sample collected in May 2012 (Table 35) for Building B3 was also within EPA's generally accepted increased cancer risk range of 10^{-4} to 10^{-6} however the non-cancer hazard index of 1.8 was above 1. The selected alternative for the subsurface soil and vadose bedrock in the area of Buildings B1 and B3 is soil vapor extraction (SVE). SVE will remove volatile contaminant vapor in the subsurface soil and vadose bedrock thereby reducing the potential migration of the vapors into buildings and contaminant migration to the groundwater.

A sample collected in May 2012 in the Active Dry Cleaner in Area of Interest 2 was evaluated and found to present inhalation risk primary from the chemical TCE. Based on an evaluation of the indoor air and sub-slab air samples, it is suspected that the primary source of TCE is within the building. Efforts will made to locate the TCE within the building in addition to applying SVE to remove volatile contaminant vapor in the subsurface soil and vadose bedrock thereby reducing the potential migration of the vapors into buildings and contaminant migration to the groundwater.

In addition to the actions described above, as part of ongoing work, additional sampling will be conducted to ensure long-term protectiveness of individuals in the area.

3. **Comment:** How deep when you were doing the soil gas survey were you able to collect your samples?

   EPA Response: The depth of collecting soil gas samples for the passive soil gas survey was a minimum of 12 inches or until native soils were reached. The typical depth of soil gas samples was about 1.5 feet below ground surface. For active soil gas sampling, sample depths are generally 5 – 7 feet below ground surface.

4. **Comment:** What are the closest wells to impacted areas?

   EPA Response: For Area of Investigation (AOI) 1, the closest well is designated USGS-

42. It is an Austin Chalk well located approximately 30 feet from the former dry cleaner location. For AOI 2, the closest Austin Chalk well is designated DW-404 which is located approximately 150 feet southwest of the active dry cleaner and automotive repair shop. The property owner for Pilgrim Cleaners recently installed shallow (i.e., 30 foot) borings on the Pilgrim property (designated TB-1, TB-2). These borings were completed as shallow wells. PCE was detected in water samples collected from TB-1 (130 µg/L) and TB-2 (730 µg/L) (see Table 5).

5. **Comment:** Where do you take the soil that been excavated as part of the cleanup?

   EPA Response: The excavated material will need to be properly characterized to ensure its proper management (e.g., storage, transport, treatment, and disposal). The results of the characterization will determine the type of facility where the excavated soil can be taken for disposal.

6. **Comment:** In respect to the building with the former dry cleaner (AOI 1), why can’t you just demolish the building and pull out the soils underneath and remedy the product?

   EPA Response: Other alternatives were determined to be preferred to demolishing parts of the building to address contamination beneath the building.

   The EPA did consider the excavation and off-site disposal as one of the potential alternatives for impacted concrete and surface and subsurface soils (Alternative S-3) at the former dry cleaner location (AOI 1). This alternative would require shutting down businesses and demolishing parts of the building that overlie the contaminated soils. At the former dry cleaning location, the estimated cost of demolishing parts of the building overlying contaminated soils, excavating and disposing the contaminated soils off-site was $1,793,000.

7. **Comment:** In respect to the soil vapor extraction test, how many feet was your influence?

   EPA Response:

   The measured influence of the soil vapor extraction tests varied from around 19 feet to over 200 feet. Significant variability was found within the clay/caliche soil matrix. Within the underlying bedrock, vacuum influence was consistent with fracture dominated flow.

   The results of the soil vapor extraction test are presented in the *Soil Vapor Extraction (SVE) Pilot Test Report* (EA Engineering, March 25, 2011) which is included in the Site’s Administrative Record. The following summary of measured results of the radius of vacuum influence from the SVE Pilot Test:

- Vadose zone soil well SB-103 was screened from approximately 5 to 9 feet below ground surface. The extracted vapor flow ranged from 66 to 70 standard cubic feet per minute (scfm) when applying vacuum up to 54 inches of water column (WC). Vacuum influence ranged from no measurable vacuum at 25 feet (SB-104) to 0.30 inches WC at 29 feet. Vacuum influence of 0.1 inches WC was observed at a distance of 50 feet (SB-105). The range of observed vacuum influence is an indication that there is significant air flow variability within the clay/caliche soil matrix. The calculated PCE concentration in the extracted vapors of 34.4 mg/m^3 indicates that volatile organic compounds (VOCs) can be removed from the soil-matrix.
- Vadose zone soil well SB-204 was screened from approximately 1 to 3 feet below ground surface. The extracted vapor flow ranged from 55 to 76 scfm when applying vacuum up to 54 inches WC. Vacuum influence ranged from no measurable vacuum at 16-feet (SB-201) to 0.20 inches WC at 29-feet (SB-104). This is an indication that there is significant air flow variability within the clay/caliche soil matrix. The calculated PCE concentration in the extracted vapors of 13.0 mg/m^3 indicates that VOCs can be removed from the soil matrix. Given the screened interval for this well is shallow, there was a potential for short-circuiting (i.e., pulling air from the surface rather than the subsurface soils). This was also evidenced by the low PCE concentrations in the extracted vapors from a well that was close to the source area.
- Vacuum applied to vadose zone soil wells SB-103 and SB-204 had little response in Austin Chalk well USGS-42, indicating that SVE at SB-103 and SB-204 in vadose zone soil would have little influence on the underlying bedrock.
- Austin Chalk well USGS-42 is open hole (i.e., no well casing) from 45 feet below ground surface to the top of the water table at approximately 80 feet below ground surface. The vapor flow ranged from 67 to 240 scfm when applying vacuum up to 136 inches WC. Vacuum influence from bedrock to nearby vadose zone soil ranged from no measureable vacuum at 41-feet horizontally (SB-105) to 0.70 inches WC at 19 feet horizontally (SB-204). This is an indication that there is air flow variability between the Austin Chalk and the overlying clay/caliche soil matrix; however, it also demonstrates that there is a complete migration pathway. This migration pathway is demonstrated by the calculated PCE effluent concentration of 2,303 mg/m^3, which indicates potential source material nearby.
- Austin Chalk well DW-408 was open hole from 53 feet to the top of the water table at approximately 100-feet below ground surface at the beginning of the test; the water table rose approximately 10-feet (i.e., 90-feet below ground surface) during the test. The vapor flow ranged from 63 to 86 scfm when applying vacuum up to 109 inches WC. Vacuum influence in bedrock ranged from 0.019 inches WC (USGS-42) at 374-feet to 2.1 inches WC (DW-415) at 222-feet.
- These results are similar to those in other test wells (i.e., DW-415, DW-404, and DW-414). There is good transmission at 200 feet within bedrock (DW-408 and DW-415); vacuum influence at these distances (e.g., greater than 200 feet) are consistent with fracture dominated flow. However, vacuum influence was not observed at distances of 300 feet or more (DW-408, DW-404, and DW-414).

8. **Comment:** Is there something wrong with the water? When we use the dishwasher with ordinary soap, it takes away the luster from aluminum.

   EPA Response: No. The effect you noticed with aluminum (i.e., lost luster) in your dishwasher is not caused by water contamination. Hard-anodized aluminum is prone to discoloration in the dishwasher. Aluminum can react with the minerals in hard water and alkalinity in home dishwasher detergent (these are alkaline to remove fat/oil).

9. **Comment:** Are any domestic wells contaminated?

   EPA Response: Water testing of the domestic wells found that the water is safe to drink. Trace levels of contaminants were infrequently detected in domestic wells. However, the contaminant concentrations were estimated to be less than 5% of the contaminant specific drinking water standards established under the Safe Drinking Water Act.

   The EPA has sampled the Leon Valley domestic water supply wells 40 times since 2007. No site contaminants of concern were detected above the Federal Drinking Water Standards. Trace levels of PCE were estimated by the laboratory in samples collected in June 2009, June 2010, July 2010, April 2011, and October 2011.

   For the 7520 Huebner Road well, three of the forty samples had laboratory estimated PCE concentrations of 0.10 µg/L to 0.17 µg/L. For the 6210 Grass Hill well, five of the forty samples had laboratory estimated PCE concentrations of 0.14 µg/L to 0.24 µg/L. These estimated trace levels of PCE were qualified by the laboratory because the reported concentrations were below the PCE contract required quantitation limit of 0.5 micrograms per liter. Please note that the Federal drinking water standard (i.e., Maximum Contaminant Level – MCL) for PCE is 5.0 micrograms per liter (parts per billion). The MCL is the legal threshold limit on the amount of PCE allowed in drinking water under the Safe Drinking Water Act.

10. **Comment:** So you haven't had to place any treatment systems on the well-head.

    EPA Response: EPA has not placed treatment systems on the municipal water wells. Private water wells which were contaminated with PCE above the MCL were provided individual carbon treatment units to filter the water. EPA subsequently provided connections to the local public water supply for individuals with these impacted wells. When the impacted wells were Edwards Aquifer wells, they were plugged and abandoned by the EPA. The Bexar County Public Works Department has also plugged and abandoned wells along El Verde Road for properties acquired as part of the Huebner Creek Enhanced Conveyance Project.

11. **Comment:** What is EPA's long-term monitoring frequency for the municipal water wells?

EPA Response: The EPA is currently monitoring the municipal water wells four times a year. This sampling frequency may decline over time based on the results of previous sampling.

12. **Comment:** Do you think quarterly testing of the municipal water wells is adequate?

EPA Response: Yes. Based on the results from years of sampling conducted by the EPA, sampling the municipal water wells on a quarterly basis is sufficient.

13. **Comment:** Regarding the PCE levels you do find in the municipal wells, are they staying the same or is it an up-and-down situation?

EPA Response: When detected, the estimated laboratory reported PCE concentrations are generally staying the same.

14. **Comment:** Won't the clay lenses protect the Edwards Aquifer as long as there's not some water well that's been drilled, something that hasn't been abandoned?

EPA Response: The clay lenses do provide some protection to the Edwards Aquifer. However, abandoned wells and the presence of faults in the area can allow contamination present in the Austin Chalk to impact the Edwards Aquifer.

The most impacted water bearing zone at the Site is the Austin Chalk which overlies the Eagle Ford Shale. Based on field borehole logs, there is approximately 25 to 50 feet of Eagle Ford Shale, 50 feet of Buda Limestone, and 50 to 60 feet of Del Rio Clay between the Austin Chalk and the Edwards Aquifer.

John Hoyt of the Edwards Aquifer Authority has stated that the Eagle Ford shale and Del Rio clay are relatively impermeable to fluid migration. In their un-weathered state, are relatively soft, malleable, geologic units that tend to "heal" after faulting; therefore, the small displacement faulting in the area is not likely to create highly transmissive connections to the Edwards Aquifer from overlying units.

Based on cross-sections from the Edwards Aquifer Authority and subsurface geologic interpretations made from field borehole logs, faults appear to be present near the Site and may contribute to the hydraulic communication between aquifers. Contaminated Austin Chalk water has entered the Edwards Aquifer through old improperly completed or deteriorating water wells. PCE identified impacted Edwards Aquifer wells have been plugged and abandoned by the EPA.

In addition to the verbal comments received during the public meeting, the EPA received six sets of written comments. Written comments (with the date they were received) were provided by:

- Karl J. Dreher, General Manager, Edwards Aquifer Authority (August 10, 2011)
- Carrie Bradford, PhD, Toxicologist, Health Assessment and Consultation and Toxicologist, Texas Department of State Health Services (August 15, 2011)
- Skeo Solutions - Technical Assistance Services for Communities Contractor (August 22, 2011)
- Daniel Simmons Bee, Private Citizen (October 14, 2011)
- Phil Bullock, PG, Principal Hydrologist, AMEC Geomatrix on behalf of CNBG Real Estate II, Ltd., and with particular regard to the Pilgrim Dry Cleaner Site (October 17, 2011)
- Erich Birch, Attorney for Savings Square Partners Ltd. (October 17, 2011)

EPA's responses to written comments received during the public comment period are provided below.

Karl J. Dreher, General Manager, Edwards Aquifer Authority (August 10, 2011)

15. **Comment:** The Edwards Aquifer Authority (EAA) appreciates the opportunity to participate in the public process to review the U.S. Environmental Protection Agency's (USEPA) Proposed Plan for the Bandera Road Ground Water Plume Superfund site. EAA staff has reviewed the Proposed Plan and generally agrees with the preferred alternatives to initiate remediation of impacted media. Regarding ground water remedies, EAA strongly encourages USEPA to aggressively pursue closure of impacted water wells, including historic wells that have been covered by development in and around the Savings Square Shopping Center (Source Area 1). EAA has successfully located covered wells with surface geophysical methods and is prepared to continue to provide USEPA technical assistance with its well closure activities in the project area.

    EPA Response: EPA greatly appreciates all the technical support the EAA has provided and continues to provide in addressing Site threats to the Edwards Aquifer. In respect to the closure of improperly completed or deteriorating impacted water wells, the selected remedy specifically includes the plugging and abandonment of these wells. EPA will continue to work with EAA to identify and address (i.e., plug and abandon) improperly completed or deteriorating impacted wells in the Site area.

Carrie Bradford, PhD, Toxicologist, Health Assessment and Consultation and Toxicologist, Texas Department of State Health Services (August 15, 2011)

16. **Comment:** The preferred alternative for the Bandera Road Site is a combination of remedial alternatives, applied as needed throughout the Site:
    - Membrane/Sealant with Vapor Vents to address indoor air contamination,

- Soil Vapor Extraction and Excavation and Off-site Disposal to address surface and subsurface soil contamination,
- Soil Vapor Extraction to address Vadose Zone contamination, and
- *In situ* Bioremediation to address ground water contamination.

The Texas Department of State Health Services supports EPA's proposed plan because it is protective of human health.

EPA Response: Comment noted.

Skeo Solutions, Technical Assistance Services for Communities (TASC) Contractor (August 22, 2011)

Skeo Solutions, on behalf of the Bandera Road Ground Water Plume Site Community Advisory Group, reviewed the Proposed Plan and technical reports (i.e., RI and FS Reports) and summarized these documents in a format easily understood by the general public. Numerous general comments regarding the RI/FS and remedy selection process were provided.

17. **Comment:** The remedies selected appear to be appropriate to ensure protectiveness of human health and the environment. In the July 21, 2011 public meeting held to discuss the Proposed Plan, EPA's remedial project manager (RPM) indicated that long-term monitoring of indoor air quality and long-term of ground water will continue. It is recommended that the RPM clarify in the Site's ROD that these long-term monitoring programs will continue and that the Bandera Road Superfund Site Community Advisory Group (CAG) continue to be briefed on monitoring results. It is also recommended that the RPM include details in the ROD describing how institutional controls will be implemented and enforced to prevent exposure to contaminated ground water and to ensure future uses of affected properties will be compatible with site remedies.

EPA Response: Long term monitoring of indoor air quality and ground water will continue. EPA will also continue to provide briefings to the Bandera Road Superfund Site Community Advisory Group (CAG) of site progress and sampling results. Section 19.2 of the ROD (Description of the Selected Remedy) includes details on how institutional controls will be implemented and enforced.

18. **Comment:** The RI Report indicates that additional areas may be identified and/or investigated as appropriate. What is EPA current opinion as to whether investigation of additional areas are planned or expected?

EPA Response: There are currently no additional areas where investigations are planned or expected.

Additional investigative studies have been conducted by two private parties as discussed in Section 12.6.2 (Additional Investigation Activities Conducted by Pilgrim Cleaners and

Savings Square Partners, Ltd.). These studies included in the installation and sampling of monitoring wells, collection of soil samples beneath the location of the former dry cleaner at AOI, and a three day soil vapor extraction pilot test. The Edwards Aquifer Authority, in coordination with the EPA, has been working to identify historical water wells in area. The EPA also collected additional soil and soil vapor samples in AOI 2 as discussed in Section 12.6.3 (Additional EPA Investigation Activities).

In addition, further delineation of contamination within of areas already identified is anticipated as part of the Site's remedial design. The installation and sampling of additional monitoring wells is also anticipated. The locations of additional monitoring wells may include areas outside the five identified AOIs. As remediation of the Site progresses, if the results of ongoing monitoring indicate the presence of additional source areas, an evaluation will be conducted to determine if further investigation is required.

19. **Comment:** Falling head test is a method for determining permeability, which is a measure of how easily a fluid (water) can flow through a porous medium (the grains of sand in an aquifer). The RI report states that falling head tests were conducted on "five selected wells impacted with chlorinated solvents (DW-404, DW-408, DW-414, DW-415, and USGS-42) in the Austin Chalk." Why were these wells selected for the falling head tests and other wells not selected?

EPA Response: Wells were selected to determine if they would be suitable locations for injections during dye tracer studies. Wells DW-408, DW-415, and USGS-42 are located at Area of Investigation (AOI) 1 in northern plume area. Wells DW-404 is within AOI 2 and DW-414 is within AOI 3 in the southern plume area. Wells USGS-42 and DW-404 are the most contaminated wells.

20. **Comment:** During the remedial investigation, five private wells were plugged and abandoned by EPA. These wells may have been conduits for contaminant movement from the upper Austin Chalk aquifer to the lower Buda Limestone and Edwards Aquifer. How many other private wells are known to exist on the Site and are there any specific plans for plugging and abandoning additional private wells?

EPA Response: The EPA has identified and sampled 49 private water wells in the site area. Of these wells, five (5) wells have already been plugged and abandoned by the EPA. These five wells were determined to be acting as conduits for contaminant transport to the Edwards Aquifer (see Figure 59, Role of Abandoned Well – Ground Water Plume Conceptual Drawing). Properly plugging and abandoning impacted wells eliminates that groundwater contaminant migration pathway.

As part of the Huebner Creek Flood Control project, four residential properties along El Verde Road with private water wells were acquired by Bexar County. Bexar County has plugged and abandoned (P&A) three of these wells and the P&A activities for the forth well is planned. In addition to these four private wells, there are two existing private wells were PCE has been detected at concentrations greater than the laboratory required quantitation limit (i.e., 0.5 micrograms per liter). Water from these wells is not being used as a source of drinking water. The private land owners will be contacted to discuss plugging and abandoning these wells. The EPA is currently working with the Edwards Aquifer Authority to identify abandoned wells in the area.

21. **Comment:** How did the results of passive soil gas surveys influence further site characterization and what additional work was done?

EPA Response: If the results of the passive soil gas survey identified significant VOC contamination, additional site characterization was conducted and included one or more of the following: the placement of additional passive soil gas samplers, the collection of soil samples, and/or the collection of soil gas using dedicated soil gas sampling probes.

Passive soil gas surveys are good tools to identify volatile organic compounds (VOCs) in subsurface soil or ground water. As VOCs migrate from the subsurface to ambient air, they are adsorbed on the passive soil gas samplers, which can then be analyzed via standard analytical methods. This data was used to evaluate the presence or absence of VOCs in subsurface soil in AOIs 1 through 5.

22. **Comment:** The direction and rate of ground water flow near monitoring well USGS-42 seems uncertain. It is reported that data indicated minimal to no inflow or outflow in monitoring well USGS-42. Yet, the dye tracer test conducted by the Edwards Aquifer Authority on August 2010 concluded that, “Results of the tracer tests demonstrated a ground water flow path from well USGS-42 to well DW-409”. Discussion of ground water flow in Section 3.5.2 (Ground Water Flow) of the RI Report indicates that monitoring well USGS-42 took significant quantities of water and the water level recovered rapidly. In Section 3.5.3 (Horizontal Hydraulic Gradients) of the RI Report, it states “general northern flow of ground water.”

EPA Response:

The predominant direction of ground water flow in the Austin Chalk is generally to the north based on the evaluation of water levels in the area around monitoring well USGS-42. However, the direction of flow between USGS-42 and nearby wells can temporarily change based on how quickly the wells respond to water recharge from storm events. Please note that ground water flow in the area is influence by karst features.

In regards to the determination of minimal to no inflow or outflow in monitoring well USGS-42, a RAS - Integrated Subsurface Evaluation, under contract to the Edwards Aquifer Authority, conducted a hydrophysical logging evaluation of USGS-42 between January 5 – 9, 2010. The measured water level at the start of the test was approximately 76.37 feet below the top of the well casing. The fluid electrical conductivity and temperature along the entire water column within the well was initially logged and recorded. The water within the well was subsequently pumped out of the well and replaced with deionized water. A series of fluid electrical conductivity and temperature measurements were collected continuously throughout the water column and compared to previous measurements to determine how quickly and where within the well water column the deionized water was being replaced with formation water. Based on these measurements, the estimated inflow and outflow of water within the water column was in the range of -0.009 gallons per minute (outflow) to 0.006 gallons per minute (inflow). The various depths along the water column where inflow and outflow occurred were also identified. The results of this evaluation are presented in Appendix A-1 – EPA Investigation Reports (USGS-42 Well Logging) of the Remedial Investigation Report.

In regards to the dye tracer tests, results of the tests demonstrated a ground water flow path from well USGS-42 to well DW-409 and from well DW-414 to well DW-36. All four wells are completed in the Austin Chalk Aquifer. Uranine dye was injected into USGS-42 on July 29, 2010 and was detected in charcoal samples from well DW-409. Two charcoal receptors from DW-409 contained trace amounts of dye beginning with the August 9, 2010 sample. Since the dye arrived at well DW-409 sometime during the four days that the charcoal receptor was in the well, the apparent velocity could range from 22 to 35 meters per day. While dye was detected in DW-409, it is important to note that PCE has not been detected in DW-409 above the laboratory detection limit of 0.5 µg/L.

Eosin dye from DW-414 was visible in several samples from well DW-36 starting with a water sample collected on August 12, 2010. Dye arrived sometime between the injection and the first sample collected on August 12, 2010, for an apparent velocity of at least 20 meters per day. Since visible dye was observed, the apparent velocity was most likely faster than the 20 meters per day because there was little or no dilution by ground water. A more refined travel time could not be determined because water samples were not collected immediately following injection. However, the relatively fast ground water velocities are indicative of the karstic nature of the Austin Chalk. The distribution of dyes confirmed the southerly ground water gradient in the Austin Chalk Aquifer (Edwards Aquifer Authority, 2010).

In regards to the falling head test conducted at USGS-42, approximately 216 gallons of water were injected into the well over a period of approximately 45 minutes (about 5 gallons per minute). The initial water level was approximately 73 feet below ground surface. The addition of 216 gallons of water brought the water level up 72 feet to within one foot of ground surface. Within ten minutes of stopping the water injection, the water level dropped approximately 28 feet. Over the next hour, the water level dropped approximately16 more feet. Based on the results of the falling head test at well USGS-42 and wells DW-408 and DW-414 (which behaved similarly), it is clear that these wells are hydraulically connected to one or more local features, possibly intercepting minor faults and/or karst dissolution conduits.

In regards to the measured water levels, pressure transducers were used to collect continuous water level measures over several months. By comparing the water levels between two wells, one can infer the general direction of the flow of water between the wells going from the well with higher water level to the well with a lower water level (i.e., water flows downhill). For the area around USGS-42, the direction of flow was generally to the north based on differences in water levels. However, the inferred direction of flow between two wells can temporarily change based on how quickly the wells respond to recharge from storm events.

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23. **Comment:** The Remedial Investigation Report discussed the potential vapor intrusion into the apartment buildings to the north of Source Area 1. The measured PCE indoor air concentration was about the same as the concentration in the outdoor air. The PCE concentrations for indoor air were 7.41 and 7.34 micrograms per cubic meter ($\mu g/m^3$). The measured outdoor air concentration was 7.54 $\mu g/m^3$. The PCE concentrations in indoor and outdoor air are about 18 times higher than the EPA Residential Air Regional Screening Level of 0.41 $\mu g/m^3$. Is there a reason for these measured concentrations and a remedy to address the indoor air concentrations?

Additional comments were provided regarding residential exposures to background and indoor air.

EPA Response:

The reason why the measured indoor air and outdoor air concentrations were similar is not known. No remedy was selected to address indoor air concentrations in the apartment buildings north of AOI 1. The measured indoor air concentrations in the apartments did not exceed the current cancer or non-cancer screening levels.

EPA's Regional screening levels are used to determine whether levels of contamination detected warrant further investigation or site cleanup, or whether no further investigation or action may be required. It is important to note that EPA's Integrated Risk Information System (IRIS) program posted the final toxicological evaluation for PCE on the IRIS database (http://www.epa.gov/IRIS/subst/0106.htm) on February 10, 2012. The cancer potency estimates declined indicating that PCE is less toxic than previously thought. The non-cancer reference values decreased meaning the non-cancer risks were determined to be greater than previously thought. The final toxicological evaluation supersedes all existing toxicity values provided by other sources, such as the November 2011 Regional Screening Levels (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table).

The following table compares screening levels based on the new EPA IRIS toxicity values to the November 2011 Regional Screening Levels (RSL) for PCE. All screening levels are based on the default exposure factors and assumptions used in the RSL tables.

	Screening Levels Based on New IRIS Values for PCE		Previous PCE Screening Levels	
	Cancer Risk = 10^{-6}	HI = 1	Cancer Risk = 10^{-6}	HI = 1
Soil (mg/kg)				
Residential	22	86	0.55	370
Industrial	110	410	2.6	2,300
Air (µg/m^3)				
Residential	9.4	42	0.41	280
Industrial	47	175	2.1	1,200
Tap Water (µg/L)				
	9.7	35	0.072	84

A baseline risk assessment was conducted using conservative exposure assumptions and the measured indoor air concentrations to determine potential cancer risks. The exposure assumptions include an exposure time of 24 hours/day, exposure frequency of 350 days/year, and exposure duration of 24 years for an adult resident and 6 years for a child resident.

The reason why the measured indoor air and outdoor air concentrations were similar is not known. Please note that previous PCE outdoor air concentrations collected at the same location near the apartment complex was 0.41 µg/m^3. The most recent background outdoor air sample was collected in May 2012. The detected PCE concentration in this sample was 0.48 µg/m^3. It is anticipated that additional indoor and outdoor air monitoring will occur as the cleanup of the Site progresses.

24. **Comment:** It remains unknown if the former dry cleaner facility in AOI 4 is potential source of PCE to the Austin Chalk aquifer. Does EPA have plans to conduct addition investigative work at AOI 4?

EPA Response: An Austin Chalk well was installed earlier this year adjacent to the former dry cleaner in AOI 4 (Figure 34). The results of ground water sampling from this well (MW5-7007) are presented in Table 9. PCE was reported at an estimated concentration of 0.76 µg/L. This concentration is well below the PCE MCL of 5.0 µg/L. There are no plans to conduct additional investigative work at AOI 4.

25. **Comment:** The Remedial Investigation report indicates that PCE may be present as free product in the vicinity of monitoring well USGS-42. Does EPA have any plans for further investigation?

EPA Response: Yes. Further investigation and sampling of this area was conducted earlier this year and is anticipated as part of the remedial design and remedial action including the installation of additional soil vapor extraction wells and Austin Chalk ground water wells.

26. **Comment:** The Remedial Investigation report states that “wells of unknown construction that are impacted by site contaminants should eventually be plugged and abandoned so they are not potential contaminant transport pathways to the Edwards Aquifer.” Is the plugging and abandonment of wells that may transport contaminants to the Edwards Aquifer a high priority?

    EPA Response: Yes. The EPA has already taken action to plug and abandon wells in the site area found to be acting as contaminant migration pathways to the Edwards Aquifer. The EPA is currently working with the Edwards Aquifer Authority to identify additional abandoned and/or improperly plugged Edward Aquifer wells which may be impacted by site contaminants. Once identified, efforts will be pursued to properly plug and abandon these wells.

27. **Comment:** Only AOI 1 and AOI 2 are evaluated for risk to human health. No source areas or ground water impacts have been identified to date of AOIs 3, 4, or 5. The passive soil gas data collected for AOIs 3, 4, and 5 is considered screening level data and the Remedial Investigation report states it is not suitable for use in estimating human health risk. Does EPA agree that human health risk assessments for AOIs 3, 4, and 5 are unnecessary?

    EPA Response: Human health risk assessments were not necessary for AOI 4 and AOI 5. Ground water data from AOI 3 was used in EPA’s human health risk assessment.

    Passive soil gas survey results represent the mass collected from the vapor phase emanating from a source. The vapor phase is a fractional trace of the source. The units used in reporting detection values from passive soil gas surveys (i.e., nanograms (1 x 10^{-9} grams) or 1 billionth of a gram) are smaller than those employed for source-compound concentrations. The concentrations reported in the passive soil gas samplers in AOIs 3, 4, and 5, are not indicative of identified PCE release areas. In addition, passive soil gas data cannot be used to conduct risk assessments. In regards to AOI 3, please note that sampling data from water wells within AOI 3 were included in the risk assessments which evaluated exposure to ground water contamination. In fact, data collected during EPA’s Remedial Investigation from all water well samples was evaluated for risk to human health.

28. **Comment:** Selection of exposure pathways and receptors (people who may be exposed) seems appropriate; with one exception. Given the high levels of PCE measured in outdoor (ambient) air in AOI 1, this exposure pathway may warrant further consideration.

    EPA Response: The data from outdoor (ambient) air samples was evaluated as part of the risk assessment. The risk assessment concluded that based on these air sample concentrations, action under CERCLA is not warranted. Please note that additional air sampling will be conducted as part of the Site’s remedy implementation.

29. **Comment:** The cumulative risks presented in the Remedial Investigation report Table 6-7 did not include all the exposure areas identified in Table 6-6. Why is this?

EPA Response: Table 6-7 (Cumulative Risk Evaluation) included a summary of the calculated risks for Sample Groups (e.g., Austin Chalk – Northern Plume and Southern Plume, Building B1) which had calculated cancer risks greater than 1 in 10,000 (1×10^{-4}).

30. **Comment:** Given the karst nature (i.e., highly dissolvable features with fractures and faults) of the underlying aquifers and uncertainty of ground water flow paths, is further evaluation of indoor air for residences near AOI 1 anticipated?

EPA Response: Additional air sampling will be conducted as part of the Site's remedy implementation and may include further evaluation of indoor air for residences near AOI 1.

31. **Comment:** Homeowners and building occupants within or near AOI 1, where high PCE levels in ambient air and indoor air were detected may wish for further information about their air quality.

EPA Response: Whenever EPA collects indoor and outside (background) air samples, in addition to providing the property owner the laboratory results, the EPA provides additional information. This additional information includes sample result comparisons to EPA's residential and/or commercial regional screening levels for indoor air, a discussion of any compounds that exceeded the screening levels, common household sources of background indoor air contamination for compounds which exceeded screening levels, a discussion of potential cancer risks and non-cancer hazard indexes, and contact information if the property owner has any questions or need additional information.

32. **Comment:** The ground water alternative GW-3 (Municipal Water Supply) estimates that up to 12 residences will need to be connected to the municipal water supply. It is unclear why any affected residences are not already connected to the municipal water supply.

EPA Response: There are currently no known residences in the Site area using water from wells for drinking water that exceed the ground water cleanup criteria. Ground water alternative GW-3 may be implemented if residents are identified who are using impacted private water wells as their source of drinking water.

Daniel Simmons Bee, Private Citizen (October 14, 2011)

33. **Comment:** I have been at most all of the public hearings you have conducted over the past several years and I have followed your efforts to identify the extent of contamination to our drinking water supply (the Edwards Aquifer) the Leon Valley Ground Water

Plume now referred to as the Bandera Road Ground Water Plume.

When I consider what you have had to contend with accomplishing your task, you are to be commended for your insight, knowledge and understanding dealing with the problems created … Thank you for all your success identifying the limits of the contamination and efforts to remediate the pollution.

EPA Response: Comment noted.

Note: Because the public comment period ended on a Saturday (October 15, 2011), comments were accepted through the end of the next business day – Monday, October 17, 2011.

Phil Bullock, PG, Principal Hydrologist, AMEC Geomatrix on behalf of CNBG Real Estate II, Ltd., and with particular regard to the Pilgrim Dry Cleaner Site (October 17, 2011)

34. **Comment:** From our understanding of the chronology of events, the EPA first became involved in the documented ground water contamination from Area of Investigation (AOI) 1 because an identified source for AOI 1 was deemed ineligible for entry into the State of Texas' Dry Cleaner Remediation Program (DCRP).

EPA Response: The Bandera Road Ground Water Plume site was identified through activities conducted by the Texas Commission on Environmental Quality (TCEQ) Voluntary Cleanup Program. The investigation identified the presence of tetrachloroethene (PCE) and trichloroethene (TCE) in concentrations above the Safe Drinking Water Maximum Contaminant Level (MCL) of 5.0 parts per billion (ppb) within the Edwards Aquifer. When EPA first became involved with the Site, the Site consisted of a PCE and TCE contaminated ground water plume originating from unidentified source(s).

When the Site was identified, five private wells were known to contain concentrations of PCE above the MCL, and several of these wells also had TCE above the MCL. Within these five wells, the concentration of PCE ranged from 23 to 82 ppb and the concentration of TCE ranged from 0.530 to 7.53 ppb. Six other private wells had detected concentrations below the MCL. Two City of Leon Valley public water supply wells are within one mile of the center of the contaminated ground water plume. The contaminated wells were completed in the Edwards Aquifer which is typically at a depth of 350 to 400 feet in the area.

35. **Comment:** In the course of the investigation work being performed by the EPA to document the nature and extent of the AOI 1 ground water plume (i.e., the North Plume Area), the EPA believes they identified a second plume (i.e., the South Plume), which they believe is essentially unrelated to the North Plume. From the RI document, the EPA further believes the CNBG property is a confirmed source for the South Plume.

EPA Response: An objective of EPA's investigation was to identify the nature and extent of ground water contamination within the Austin Chalk, Buda Limestone, and Edwards Aquifer formation. As part of this investigation, existing wells were identified, studied to determine their construction details, and sampled. Additional wells were later installed to further define the extent of contamination. Based upon this work, the Austin Chalk formation is the most adversely PCE contaminated water bearing formation. Between the most impacted Austin Chalk wells, there is a line of unimpacted wells from west to east. These wells are DW-409, DW-406, DW-411, and DW-417, which form a defining line for the Northern and Southern Austin Chalk Plumes. The designation of the Northern and Southern Plumes does not exclude the possibility that that the plumes are related.

In regards to the Southern Plume area, the most PCE impacted well was DW-404 which is located approximately 150 feet south of the CNBG property. As part of the remedial design and remedial action, further delineation of the impacted ground water will occur.

36. **Comment:** CNBG Real Estate Ltd. II has always made their mandated fee payments for the Texas Dry Cleaner Remediation Program (DCRP). Is the Pilgrim Cleaners facility located within AOI 2 eligible to participate in the DCRP?

EPA Response: Pilgrim Cleaners is not eligible to participate in the DCRP.

Pursuant to 30 Texas Administrative Code Chapter 337.208 (b)(3)(B)(i) (Dry Cleaner Environmental Response, Unauthorized Payments), the Texas Commission on Environmental Quality may not spend money from the fund for payment of any costs related to corrective action at a dry cleaner facility that has been included by the United States Environmental Protection Agency on the national priorities list.

37. **Comment:** There is a need for current soil and ground water data from the Pilgrim Cleaners property.

EPA Response: The EPA agrees that additional data will need to be collected at AOI 2 (which includes Pilgrim Cleaners) as part of the remedial design and remedial action.

During the EPA investigation, a request was made in May 2009, for access to the Pilgrim Cleaner's property to conduct the following activities:

- The taking of samples, surface and subsurface, including but not limited to soil, soil vapor, sediments, water, and air samples, and other solids or liquids stored or disposed of at the property as may be determined necessary;
- The installation, surveying, testing and maintenance of ground water and vapor monitoring wells;
- Other investigative actions at the property as may be necessary to determine the nature and extent of potential threat to human health and the environment; and

- The taking of such response actions as may be necessary to remediate the threat of releases of hazardous substances from the Site.

No response to EPA's request was provided.

Access was subsequently requested by the EPA and provided to conduct a smaller scope of activities, namely to conduct passive soil gas sampling. The results of the initial round of passive soil gas survey are presented in the BEACON Report No. 2171C dated November 17, 2009 (Beacon, 2009). The sample results identified PCE and its degradation products TCE, cis-1,2-DCE, and vinyl chloride in the soil gas. These detections were primarily identified near the location of the former Luckey water supply well located beneath the back parking lot of Pilgrim Cleaner's (SAIC, 2009). No records have been found regarding the proper plugging and abandonment of this well.

Additional soil, soil gas and groundwater data was collected in 2012 as previously mentioned.

38. **Comment:** The Austin Chalk is characterized in the RI and FS Reports as a Class 1 ground water resource. This seems to be based on the EPA's belief that 1) the Austin Chalk is a likely drinking water resource and/or 2) the ground water zone may be interconnected to the much deeper Edwards Aquifer.

EPA Response: The Austin Chalk was characterized as a Class 1 ground water resource based on the Texas Administrative Code, Title 30, Part 1, Chapter 350, Subchapter C, Rule § 350.52 (Ground Water Resource Classification).

The mission of the Superfund program is to protect human health and the environment, consistent with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), in part by restoring contaminated ground waters to beneficial use. The NCP states that "EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site" (40 CFR § 300.430(a)(1)(iii)(F)). This policy often hinges on the determination of the current or potential use of the ground water aquifer. Class I and Class II ground water resources are considered to be current and potential sources for drinking water. The NCP preamble states:

> *… to the degree that the state or local governments have classified their ground water, EPA will consider these classifications and their applicability to the selection of an appropriate remedy …*

The State of Texas, in the Texas Administrative Code, Title 30, Part 1, Chapter 350, Subchapter C, Rule § 350.52 (Ground Water Resource Classification), identifies conditions required for a ground water resource classification. For a Class I classification, the ground water bearing unit must meet one of three conditions. For the

Bandera Road Site, the ground water meets the following condition:

(1)(A) any ground water-bearing unit within ½ mile of an existing well used to supply drinking water to a public water system as defined in §290.38 of this title (relating to Definitions), as amended, which can contribute COCs to the ground water production zone of such public water supply well based on chemical properties of the COCs, the hydrogeology, and the construction of the well.

The City of Leon Valley's Grass Hill Drive public water supply well, which is completed in the Edwards Aquifer, has reported detections of PCE in ground water and is located within ½ mile (i.e., about 2,400 feet) east-southeast of AOI 2. Based on COCs (i.e., PCE is a DNAPL – dense non-aqueous phase liquid), the hydrogeologic setting (i.e., karst formations, faulting), and construction of wells (i.e., surface casing and open hole completions), the Austin Chalk, Buda Limestone, and Edwards ground water units are Class 1 ground water resources.

For a Class II classification, the ground water bearing unit must meet one of the following two conditions:

(2)(A) any ground water-bearing unit which is a ground water production zone for an existing well located with ½ mile of the affected property and which is used to supply ground water for human consumption, agricultural purposes or any purpose which could result in exposure to human or ecological receptors; or

(2)(B) any ground water-bearing unit which is capable of producing waters with a naturally occurring total dissolved solids content of less than 10,000 milligrams per liter and at a sustainable rate greater than 150 gallons per day to a well with a four inch diameter casing or an equivalent sustainable rate in gallons per day to a well with a smaller or larger diameter casing.

Its is pertinent to note that a local private water well with well construction open to the Austin Chalk formation was being using as a source of drinking water prior to the PCE contamination being detected in the well. A carbon treatment unit was installed on the well prior to the residence being hooked up to the local public water supply. This well is currently being used to water the property owner's lawn.

In respect to the Austin Chalk, as discussed in the Hazard Ranking System Documentation Record for the Bandera Road Ground Water Plume (TCEQ, 2006b), the Austin Chalk supplies water for domestic or stock use where yields of 500 gallons per minute or more were reported from several wells. Such yields may result when wells have been drilled into subsurface caverns. Subsurface cavern features were identified in the Austin Chalk monitoring well DW-408. Some of the large yields from the Austin Chalk are believed to be obtained where the formation is in hydraulic communication (e.g., faults, secondary porosity) with the Edwards and associated limestones.

Based on cross-sections from the Edwards Aquifer Authority, minor faults appear to be present within the investigation area (within 2 miles from the center of the contamination plume) and may contribute to the hydraulic communication between the Austin Chalk and the Edwards Aquifer (TECQ, 2006b). Based on review of field borehole logs and geophysical investigation determination (EPA, 2011), and a fracture trace analysis determination (EPA, 2008), faults were identified in the Site area.

39. **Comment:** The RI and FS characterize the vapor intrusion exposure pathway as being “confirmed” at a commercial building located south of Pilgrim. This conclusion is apparently based on elevated detections of PCE in an indoor air sample that was collected as part of the RI.

EPA Response: The “confirmed” designation of a completed vapor exposure pathway was based on vapor sampling conducted within, outside, and beneath the commercial building located south of Pilgrim Cleaners.

In addition to the indoor air sample collected at the commercial building, soil gas samples were also collected beneath a concrete slab on the back side of the building and in a grassy area a few feet from the parking lot in front of the building. The soil gas sample beneath the concrete slab had a PCE detection of 119 micrograms per cubic meter ($\mu g/m^3$). The soil gas sample near the parking lot in front of the building had a PCE detection of 3,620 $\mu g/m^3$. In indoor sample had PCE detection of 3.47 $\mu g/m^3$. An outside background air sample had a PCE detection of 0.41 $\mu g/m^3$. It is acknowledged that there could have been other potential sources of PCE within the commercial building.

40. **Comment:** Treatment of the Austin Chalk ground water zone as a Class 1 ground water resource fails to appropriately identify applicable or relevant and appropriate requirements (ARARs).

EPA Response: The Austin Chalk was characterized as a Class 1 ground water resource based on the Texas Administrative Code, Title 30, Part 1, Chapter 350, Subchapter C, Rule § 350.52 (Ground Water Resource Classification).

Ground water response actions under CERCLA are governed in part by the following mandate established by Congress in CERCLA 121(d)(2)(A):

… Such remedial action shall require a level or standard of control which at least attains Maximum Contaminant Level Goals established under the Safe Drinking Water Act and water quality criteria established under section 304 and 303 of the Clean Water Act, where such goals or criteria are relevant and appropriate under the circumstances of the release or potential release.

Maximum contaminant level goals (MCLGs), established under the Safe Drinking Water Act, that are set at levels above zero, shall be attained by remedial actions for ground or surface waters that are current or potential sources of drinking water, where the MCLGs are relevant and appropriate under the circumstances of the release based on factors in 300.400(g)(2). If an MCLG is determined not to be relevant and appropriate, the corresponding maximum contaminant level (MCL) shall be attained where relevant and appropriate to the circumstances of the release (see 40 CFR 300.430(e)(2)(i)(B)).

The NCP preamble further clarifies that EPA's policy is that MCLs or MCLGs above zero should generally be the relevant and appropriate requirement for ground water that is or may be used for drinking, and that a waiver is generally needed in situations where a relevant and appropriate MCL or non zero MCLG cannot be attained.
As discussed in the NCP and in various associated guidance, there are in general, five key principles that stem from the overarching expectations for ground water restoration. These are as follows:

- If ground water that is a current or potential source of drinking water is contaminated above protective levels (e.g., for drinking water aquifers, contamination exceeds Federal or State MCLs or non-zero MCLGs), a remedial action under CERCLA should seek to restore that aquifer to beneficial use (e.g., drinking water standards) wherever practicable.
- Ground water contamination should not be allowed to migrate and further contaminate the aquifer or other media (e.g., vapor intrusion into buildings; sediment; surface water; or wetland).
- Technical impracticability waivers and other waivers may be considered, and under appropriate circumstances granted if the statutory criteria are met, when ground water cleanup is impracticable; the waiver decision should be scientifically supported and clearly documented.
- Early actions (such as source removal, plume containment, or provision of an alternative water supply) should be considered as soon as possible. Institutional controls (ICs) related to ground water use or even surface use, may be useful to protect the public in the short-term, as well as in the long-term.
- ICs should not be relied upon as the only response to contaminated ground water or as a justification for not taking action under CERLCA (see 40 CFR § 300.430(a)(iii)(D). To ensure protective remedies, CERCLA response action cleanup levels for contaminated ground water should generally address all pathways of exposure that pose an actual or potential risk to human health and the environment.

41. **Comment:** EPA seems to largely ignore two critical elements that should be integral to the Feasibility Study process: EPA's Comprehensive Ground Water Protection Program (collectively the CGWPP) and its "resource based" considerations when selecting response actions for a site, and the Texas Risk Reduction Program (TRRP).

EPA Response: The EPA did consider the objectives of the CGWPP and the TRRP requirements during the Feasibility Study.

Pursuant to EPA's CGWPP, EPA will pursue the following three-tiered hierarchy of preferred ground water protection objectives:

- Prevention of contamination whenever possible.
- Prevention of contamination based on the relative vulnerability of the resource, and where necessary the ground water's use and value.
- Remediation based on relative use and value of the ground water.

PCE contamination above the MCL has already been detected in the Austin Chalk and underlying Edwards Aquifer – the sole source drinking water aquifer for the area. Actions have been taken (i.e., plugging and abandoning impacted wells) to prevent further migration of contaminants from the Austin Chalk to the Edwards Aquifer through these wells. EPA is continuing its efforts identify additional historical wells which may act as conduits for contaminant transport into the Edwards Aquifer. It is uncertain if all historical wells in the area wells can be identified and addressed.

In addition to abandoned or improperly constructed or deteriorating wells, the geology in the Site area includes karst features and fractures which can provide contaminant migration pathways. Given the inherit complexity of the local geology and the high value of the area's ground water, an EPA objective, as discussed in the FS, is to return ground waters to their expected beneficial uses wherever practicable.

In regards the Texas Risk Reduction Program, the EPA has worked closely with the State of Texas, namely the Texas Commission on Environmental Quality, throughout the investigation and development of the RI and FS reports.

42. **Comment:** Will EPA's designation of the Austin Chalk as a Class 1 ground water resource justify, or even perhaps mandate, the re-opening of other previously closed environmental sites in which the TCEQ designated the Austin Chalk as Class 2?

EPA Response: Classification of ground water is only used to determine the scope of site-specific remedial actions and does not provide regional classification of ground waters.

43. **Comment:** CNBG understands that there will always be a degree of uncertainty in the technical data gathered during the RI/FS process. While CNBG appreciates the reality of the cited technical uncertainties, they do not believe the Superfund process is suppose to accept uncertainties when it comes to the actual identification of a responsible party.

EPA Response: The RI and FS Report, in respect to AOI 2 state that it "Includes the area in the vicinity of Pilgrim Cleaners (located at 6600 Bandera Road) that contains an active dry cleaning facility." Liability questions and concerns fall outside the scope of issues that may be addressed in the public comment period. Therefore, it is not appropriate for EPA to address such liability questions in this Responsiveness Summary.

44. **Comment:** It is CNBG's opinion that, if identified guidance were followed, the Austin Chalk at AOI 2 would be classified by the EPA as a Class 2 ground water.

EPA Response: The Austin Chalk was characterized as a Class 1 ground water resource based on the Texas Administrative Code, Title 30, Part 1, Chapter 350, Subchapter C, Rule § 350.52 (Ground Water Resource Classification).

See EPA Response 38.

45. **Comment:** Section 1.2 (Site Location and Description) of the FS report describes AOI 2 as follows: "Includes the area in the vicinity of Pilgrim Cleaners (located at 6500 Bandera Road) that contains an active dry cleaning facility." This AOI includes Source Area 2 (Figure 1-3). It is not clear why this discussion does not mention all the potential sources within the area.

EPA Response: The description of AOI 2 was meant to provide a general location for the reader. AOI 2 includes the area where site COCs were detected in soils, soil vapor and ground water (e.g., the adjoining transmission repair property, monitoring well DW-404).

46. **Comment:** It is unclear how five physically distant and operationally unrelated "areas" (and all of the individual potential sources within each of these areas), can appropriately be treated as a single Operable Unit throughout completion of both the RI and FS.

Please explain exactly how considering all five of the AOIs (and each of the potential source areas within each of the five AOIs) as a single operational unit throughout the entire RI/FS process appropriately facilitated the EPA's accomplishing the critical source-specific data needs that should be required to move a given "potentially" responsible party (i.e., PRP) to a "confirmed" responsible party designation.

EPA Response: As defined in 40 CFR Section 307.14 (Definitions), operable units "may consist of any set of actions performed over time or any actions that are concurrent but located in different parts of a site. Operable units will not impede implementation of subsequent actions, including final action at the Site."

In regards to PRPs, to date two parties have been noticed by EPA as PRPs for the Site. Liability questions and concerns fall outside of the scope of issues that may be addressed in the public comment period. Therefore, it is not appropriate for EPA to address such liability questions in this Responsiveness Summary.

47. **Comment:** Section 1.3 of the FS Report fails to mention earlier studies that were conducted at the CNBG site in the 1990s. Based on our review of the RI data, we do not find any data that supports a conclusion that the Pilgrim Dry Cleaner operations are, in

fact, the source of PCE found in the area of monitoring well DW-404 or throughout the Southern Plume.

EPA Response: Previous studies conducted at the Pilgrim Dry Cleaner facility, subsequent investigations and sampling do indicate that Pilgrim Dry Cleaner operations are a source of PCE contamination in the area.

In regards to Section 1.3, it does include the list four documents prepared by the TCEQ and Agency for Toxic Substances Disease Registry (ATSDR) related to CERCLA activities conducted prior to EPA RI/FS activities. These documents are:

- Site Screening Investigation (TCEQ 2004)
- Preliminary Assessment/Site Inspection (TCEQ 2006)
- Hazard Ranking System Package (TCEQ 2006)
- Public Health Assessment (ATSDR 2007)

The intent of this section was not to provide an extensive list and discussion of historical documents related to the various AOIs for the Site.

In regard to the CNBG information (i.e., earlier studies), the EPA in a June 2, 2008, 104(e) Information Request (question 4) asked CNBG to: "Provide all reports, information or data related to soil, water (ground and surface), or air quality and geology/hydrogeology at and about the facility. Provide copies of all documents containing such data and information as well as documents containing analysis or interpretation of such data."

On May 22, 2009, having received no reply, the EPA sent CNBG a second 104(e) Information Request. In an August 14, 2009 response letter, CNBG stated in response to question 4:

"We do not have any soil, water, and geology records in our possession. Reports related to soil, water and geology are being compiled from records at the Texas Commission on Environmental Quality (TCEQ) by a third party and will be forwarded upon receipt."

On July 22, 2009, the EPA did receive electronic copies of the following documents from Mr. Craig Tribley of STC Environmental Services Inc.:

- Remedial Investigation Report for Pilgrim Enterprises, Inc. Bandera Road (RMT/Jones & Reuse, Inc., June 1995 - Final)
- Corrective Measures Study for Soil Impacted by Dry Cleaning Solvents Pilgrim Enterprises, Inc. 6600 Bandera Road (RMT/Jones & Neuse, Inc., June 1995 – Final)
- Response Action Closure Report 6600 Bandera VCP#073 with a date stamp of October 27, 1997.

This information was reviewed and evaluated along with the information collected as part of EPA's investigation activities at AOI 2. The following is a brief discussion of the AOI 2 information collected by EPA and information from previous investigations conducted at the Pilgrim Cleaners.

In September 21, 2007, a geophysical survey was conducted in the parking lot behind Pilgrim Cleaners. It was suspected that an abandoned well was located in this area based on a review of historical plat maps and interviews completed by the EPA with personnel whom had been employed by the cleaning facility in the past. Additionally, on-site interviews of long term Leon Valley municipal employees (city offices are located directly across the street) verified the suspected location of the former well referred to as the "Luckey" well. Three anomalous metallic detections were identified with the largest matching the suspected well location based on completed interviews and the historical plat maps.

On September 26, 2007, a well drilling crew scraped off the asphalt over the anomalous area just outside the main bay door of the dry cleaning facility. The crew then hand dug the area to a depth of approximately two feet below grade. A 6-inch diameter steel casing was exposed and to a total depth of three feet below grade. The casing had some debris inside which was loosely packed and below was solid grout, which preliminarily indicated the well had been plugged and abandoned.

On October 30, 2007, Vortex Drilling completed air rotary drilling inside the exposed casing to approximately 25 feet below ground surface. The grout appeared to be competent based on small grout chips and very slow progress made by the air rotary bit. No further drilling occurred and Vortex Drilling filled the drilled casing with concrete. The EPA was not able to locate any records which indicate when and if this well was properly plugged and abandoned. When asked about this well, CNGB in their August 2009 104(e) response letter stated that "We have no information on this well and were not aware of its existence until contacted by the EPA in 2007."

The Hazard Ranking System Documentation Record (TCEQ 2006b), Reference 42 (Texas Water Development Board (TWDB) Ground Water Data) includes driller's logs from thirty-four (34) wells located within 2.0 miles of TCEQ DW-43-A Well. Included in these driller's log is well number AY-68-36-101- the Leon Valley Water Supply Co./Jeff Luckey Well. The coordinates for this well correspond with the buried well identified in 2007 behind the Pilgrim Cleaners. According to the driller log, the total depth of the well was 340 and the well was cased from 0 to 300 feet below ground surface.

On January 23 -25, 2009, the EPA installed and Austin Chalk monitoring well (i.e., DW-404) to a depth of 166 feet below grade. This well is located in the Leon Valley municipal parking lot approximately 140 feet south-southwest of the former "Luckey" well. Subsequent sampling of the well DW-404 found elevated PCE detections as high as 1,740 parts per billion.

On October 2009, the EPA conducted a passive soil gas survey on the CNBG property.

The results of the passive soil gas survey are presented in the BEACON Report No. 2171C dated November 17, 2009 (Beacon, 2009). The sample results identified PCE and its degradation products TCE, cis-1,2-DCE, and vinyl chloride in the soil gas. These detections were primarily identified near the location of the former Luckey water supply well located beneath the back parking lot of Pilgrim Cleaner's.

Subsequent soil gas sampling was conducted in April 2010 and included soil gas samples on the adjacent USA Auto Care Center property. PCE detections as high as 23,130 nanograms were detected on the USA Auto Care Center property.

Active soil gas and soil sampling was also conducted in areas were access was provided. Access was precluded beneath the Pilgrim Cleaners building and on an adjacent concrete slab. The highest PCE soil gas concentration of 132,000 µg/m^3 was detected in the soil gas sample closest to the USA Auto Care Center/CNBG buildings (Figure 40). The next closest PCE soil sampling location between the first location and DW-404 had a PCE soil gas detection of 8,290 µg/m^3. Additional soil gas samples were collected near a commercial building and are discussed in response to comment #40.

The following information was taken from the three Pilgrim Cleaner reports from the 1990s.

<u>Remedial Investigation Report for Pilgrim Enterprises, Inc. Bandera Road (RMT/Jones & Reuse, Inc., June 1995 - Final)</u>

- Pilgrim operates a dry cleaning facility and routinely uses petroleum and chlorinated solvents in the dry cleaning process.
- The soil boring investigation revealed that the subsurface soils at the site have been impacted by tetrachloroethene (PCE), trichloroethene (TCE), and 1,2-dichloroethene (total). Only PCE was detected in soil samples in concentrations greater than the Risk Reduction Rules Ground-Water Cross-Media Protection Standard. No target compounds were detected in soil samples in concentrations greater than the soil cleanup standards for residential land use based on air emissions, human ingestion and inhalation.
- Ground water was encountered in two soil borings (B3 and B4) at a depth of approximately 15 feet below ground level (BGL). Ground water was not encountered in soil borings B2, B5, and B8, located closest to borings B3 and B4, which were drilled to a total depth of approximately 20 to 23 feet BGL.
- Ground water grab samples were collected from soil borings B3 and B4 and were submitted to an on-site mobile laboratory for analysis. The sample from B3 had a PCE detection of 27.5 µg/L. The sample from B4 had detections of PCE (57.6 µg/L), TCE (7.9 µg/L), and 1,2-dichloroethene (total – 1.3 µg/L).
- Soil boring B-4 was completed as a monitoring well (MW-1) and sampled. No compounds were detected.
- Source Identification: Shallow soil samples taken from manually augured soil borings located inside the facility building exhibit the highest concentrations of PCE indicating that the source of the compounds impacting the subsurface soils in

borings B4 and B5 is the facility dry-cleaning equipment. The actual process by which the dry cleaning chemicals migrated to the subsurface may have been through piping joints whose cement had been compromised by the dry cleaning solvents.

- Shallow and subsurface soils are impacted by PCE, TCE, and 1,2-DCE (total). The subsurface soils impacted by these constituents are localized under the facility building and in the B4 and B5 area, at depths of approximately 5 to 12 feet below ground level.

<u>Corrective Measures Study for Soil Impacted by Dry Cleaning Solvents Pilgrim Enterprises, Inc. 6600 Bandera Road (RMT/Jones & Neuse, Inc., June 1995 – Final)</u>

The last page of this report identified the following Proposed Remedial Actions:

- The proposed Remedial Actions consists of construction of a cover system to cover all soils identified with constituents at levels above the ground water protection standard. The cover system will consist of a 40 mil HDPE liner covered by six inches of reinforced concrete. At locations where concrete exist the cover system will be dowelled into the existing concrete. All joints will be sealed with non-shrink grout.
- The ground water treatment portions of the remedial actions will consist of a pump and treat system. Wells will be installed at locations to maximize recovery with electric submersible or pneumatic pumps. Withdrawal water will be treated by either air stripping or carbon adsorption or both. Treated water will need to be discharged to a local POTW, the waters of the State, or sent to an appropriate facility for disposal.

<u>Response Action Closure Report, 6600 Bandera, San Antonio, Texas, VCP # 073</u>

Responsive activities at this site were limited to the installation of a cap and cover system which was to prevent migration through direct contact and volatilization. In addition, the cap was designed to eliminate infiltration that will reduce migration to ground water. Under this alternative, the toxicity and volume of contaminants will not be reduced. The cover system should effectively immobilize any residues that remain in the unsaturated zone throughout the site.

Recent ground water sampling conducted at the Pilgrim Cleaners facility detected elevated levels of site contaminants (i.e., PCE, TCE, csi-1,2-DCE) which are discussed in response to the following comment.

48. **Comment:** Section 1.4.1 (Basis of Understanding) of the Feasibility Study Report states “The source identification, nature and extent discussion, and migration pathway analysis were supported by the comparison of data to screening levels.” Based on our review of the RI data, we do not find any data that supports a conclusion that the Pilgrim Dry Cleaner operations are, in fact, the source of PCE found in the area of monitoring well

DW-404 or throughout the Southern Plume. We recommend the EPA not identify Pilgrim as the source of ground water contamination, much less the only source of ground water contamination, unless and until EPA obtains actual on-site data that would support such a claim with an adequate degree of scientific certainty.

EPA Response: Identification of Pilgrim Dry Cleaner Operations as a source of ground water contamination was based on information present in the RI and discussed previously. This identification does not preclude the potential for other sources of PCE contamination.

In regards to additional data from the Pilgrim Dry Cleaner property, CNBG voluntary commissioned the installation and testing of two soil borings on the property last fall. Soil boring TB-1 was located near the southeast corner of a concrete pad used to store drums of spent PCE. Soil boring TB-2 was located adjacent to the former Luckey well. The measured depths of these borings was approximately 30 – 32 feet below ground surface. Water accumulated in TB-2, which was subsequently sampled and found to contain PCE and its degradation products (TCE, cis-1,2-DCE, vinyl chloride). Additional compounds including toluene and xylene were also detected. In January 2012, the EPA collected water samples from TB-2 and TB-1 (in which a small amount of water had accumulated). The following contaminants were detected in these samples along with the associated Federal drinking water standard (Maximum Contaminant Level - MCL):

Contaminant (µg/L)	TB-1	TB-2	MCL
PCE	130	640 D	5.0
TCE	2.6 LJ	54	5.0
Cis-1,2-Dichloroethene	2.4 LJ	130	70.0
Toluene	U	3.3 J	1,000

Note:
Reported concentrations are in µg/L (micrograms per liter).
D – Sample was diluted by laboratory to conduct analysis.
L – Reported concentration is below contract required quantitation limit
J - Laboratory estimated concentration.
U – Not detected.

Table 5 presents a summary of the sample detections from samples collected in January 2012 and May 2012.

49. **Comment:** Section 1.4.1.2 (Source) of the FS Report describes a source material as a "… media that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration to other media or for direct exposure." This section goes on to describe Principal Threat Waste (PTW) as "Source materials that are considered highly toxic or highly mobile and that generally cannot be reliably contained or would present a significant risk to human health or the environment if exposures were

to occur."

With specific regard to Pilgrim, the RI does not present any on-site soil or ground water data that indicates PTWs exist at the site, per the above definitions. When the 1990s release was first discovered, the site conditions would have met the above conditions. Specifically, at that time, it was determined that contaminants in the shallow soil were at concentrations that could leach to ground water. It was also documented that elevated soil gas concentrations were present. However, subsequent to the [state's] VCP [Voluntary Cleanup Program] response action in 1995, all documented source materials/PTWs were mitigated in a manner that was determined by the TCEQ to be fully protective. Specifically, any residual source materials/PTWs were rendered protective (i.e., reliably contained and protected against possible exposure), through the installation of an engineered cap (for the impacted area outdoors) and the maintenance of the building foundation (for the impacted area beneath the building).

EPA Response: Chlorinated solvents, such as those detected at the Bandera Road Superfund site are included in a class of compounds referred to a dense nonaqueous phase liquids (DNALPs). DNAPLs are immiscible fluids with a density greater than water. The potential for significant long-term ground water contamination by DNAPL chemicals is high due to their toxicity, limited solubility (but much higher than drinking water limits), and significant migration potential in soil gas, ground water, and/or as a separate phase liquid.

The prior response actions conducted at Pilgrims, while helpful in preventing direct contact exposure, would not have precluded previous contaminant migration prior to installation of the cap system or ongoing migration of chlorinated solvents in the soil gas and ground water. Ground water sampling conducted in January and May 2012 by the EPA in two shallow borings at the Pilgrim facility detected significant concentrations of chlorinated solvents (i.e., PCE (730 µg/L), TCE (55 µg/L), cis-1,2-DCE (180 µg/L)). A summary of the sample detections from the shallow wells are presented in Table 5.

50. **Comment:** An active response action for soils should not be considered necessary unless and until EPA obtains data that supports the actual need for such.

EPA Response: As discussed in Section 12.6.2 (Additional Investigation Activities Conducted by Pilgrim Cleaners and Savings Square Partners Ltd.) and 12.6.3 (Additional EPA Investigative Activities) of the ROD, additional data has been collected in Source Areas 1 and 2. As discussed in Section 18.0, the soils beneath Building B1 and the Active Dry Cleaner contain wastes which are acting as a source of PCE vapors to the indoor air in Building B1 and a source for sub-slab vapors at the Active Dry Cleaner. PCE and its degradation products from this soil have been identified in ground water samples collected adjacent to each building at elevated concentrations.

In regards to an active response action for soils, the proposed plan identified excavation and off-site disposal of impacted soils as the preferred alternative for AOI 2 surface and subsurface soils. The selected alternative for AOI 2 surface and subsurface soils is SVE. SVE will address contaminant mass present in the subsurface and vadose zone bedrock to reduce vapor intrusion risks and reduce contaminant migration to ground water.

51. **Comment:** Given the nature of the Austin Chalk ground water zone (i.e., low and unreliable yields), the availability of municipal supply water, the presence of the underlying Edwards Aquifer, and the comprehensive manner in which ground water use is controlled in the area (i.e., Edwards Aquifer, San Antonio Water System, City of Leon Valley), it should be considered highly unlikely that the Austin Chalk formation would ever be used for residential drinking water purposes.

The EPA has recommended active remediation of the Austin Chalk to the ground water drinking water standards (i.e., MCLs), which has apparently triggered the position that the soils and vadose zone bedrock also need to be remediated. The "expected" beneficial use of the Austin Chalk is not as a drinking water resource. Instead, at best, the Austin Chalk formation should be considered a "potential" drinking water aquifer.

CNBG believes the appropriate response action at the CNBG property for the Austin Chalk Formation would provide for the use of institutional controls and passive (i.e., natural attenuation), remedies based on a site-specific Class 2 ground water designation.

EPA Response: As discussed in the NCP and in various associated guidance, there are in general, five key principles that stem from the overarching expectations for ground water restoration. These are as follows:

- If ground water that is a current or potential source of drinking water is contaminated above protective levels (e.g., for drinking water aquifers, contamination exceeds Federal or State MCLs or non-zero MCLGs), a remedial action under CERCLA should seek to restore that aquifer to beneficial use (e.g., drinking water standards) wherever practicable.
- Ground water contamination should not be allowed to migrate and further contaminate the aquifer or other media (e.g., vapor intrusion into buildings; sediment; surface water; or wetland).
- Technical impracticability waivers and other waivers may be considered, and under appropriate circumstances granted if the statutory criteria are met, when ground water cleanup is impracticable; the waiver decision should be scientifically supported and clearly documented.
- Early actions (such as source removal, plume containment, or provision of an alternative water supply) should be considered as soon as possible. Institutional controls (ICs) related to ground water use or even surface use, may be useful to protect the public in the short-term, as well as in the long-term.
- ICs should not be relied upon as the only response to contaminated ground water or as a justification for not taking action under CERLCA (see 40 CFR § 300.430(a)(iii)(D). To ensure protective remedies, CERCLA response action cleanup levels for contaminated ground water should generally address all

pathways of exposure that pose an actual or potential risk to human health and the environment.

52. **Comment:** Section 5.3.2. (Compliance with ARARs) of the Feasibility Study makes the statement: "Institutional controls (e.g., restricting land use) are easily violated and engineering controls can be circumvented." CNBG believes the statement to be overly broad and overly simplified. Specifically, while certain ICs may be easily violated or circumvented, others cannot. Accordingly, it is CNBG's opinion that the use of ICs should be carefully considered on an individual basis and not unilaterally discounted or diminished using a broad oversimplified brush.

EPA Response: EPA considers the use of Institutional Controls a significant component of remedial alternatives with the exception of the "No Action" alternative.

53. **Comment:** The Texas Risk Reduction Program (TRRP) is identified as a "to be considered" (TBC) regulation. TRRP should be identified as an Applicable or Relevant and Appropriate Requirement (ARAR). The application of TRRP investigation and remedial action requirements provides for the full protection of human health and the environment. Further, the full use of TRRP will ensure consistency in environmental response actions. In contrast, to not use TRRP would create confusion amongst the regulated community and the general public.

EPA Response: Some provisions of TRRP are ARARs. Other provisions of TRRP are not ARARs because they are administrative, rather than substantive requirements or because they are not more stringent than analogous federal standards. Even if some TRRP provisions are not considered ARARs, they may be appropriate as guidance "To Be Considered" by EPA.

ARARs include substantive provisions of any promulgated Federal or more stringent State environmental standards, requirements, criteria, or limitations that are determined to be legally ARARs for a CERCLA site or action. 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 a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements that, while not legally "applicable" to circumstances at a particular CERCLA site, address problems or situations sufficiently similar to those encountered at the site that their use is well-suited. There are three categories of ARARs:

- Chemical-specific ARARs are health- or risk-based numerical values or methodologies used to determine acceptable concentrations of chemicals in a media (e.g., water). When applied to site-specific conditions, the chemical-specific ARAR may result in the development of cleanup standards for a contaminant of concern (COC).
- Location-specific ARARs are restrictions placed on health-based concentrations

of hazardous substances or the conduct of activities because of the special locations, which have important geographical, biological or cultural features. Examples of special locations include wetlands, flood plains, and sensitive ecosystems.

- Action-specific ARARs are technology-based or activity-based requirements or limitations on actions to be taken to handle hazardous wastes. They are triggered by the particular remedial activities to accomplish a remedy. For all CERCLA remedies, the remedial action is exempt from having to obtain permits for on-site activities. However, any substantial requirements of applicable permits, such as discharge limitations, must be met in the remedy.

Where no ARARs exist for a given chemical, action or location, the EPA may consider non-promulgated Federal or State advisories and guidance as To Be Considered criteria (TBC). Although consideration of a TBC is not required, if standards are selected based on a TBC, those standards are legally enforceable as performance standards.

54. **Comment:** Surface and subsurface soil, or vadose zone bedrock, at Source Area 2 should not be subject to a remedial action because the applicable data does not indicate a cumulative human health cancer risk greater than 10^{-4} or a non-cancer Hazard Index (HI) risk > 1. The response action for the soil/bedrock at the CNBG property is being recommended to prevent future leaching to ground water. However, there is not sufficient evidence that soils/bedrock at CNBG property represent a leaching source. Also, given the ground water classification recommended, the need to actively remediate soil and vadose zone bedrock, would need to be re-evaluated. Unless and until EPA obtains actual on-site soil data that supports a recommendation for active remedial action, no remedial action should be carried forward in the feasibility study for soils or bedrock at the CNBG property.

EPA Response: For Source Area 2, which includes the CNGB property, the risk posed by contaminants identified has been re-evaluated based on the revised toxicity values for PCE and TCE (i.e., site contaminants of concern) published after the completion of the RI/FS reports and the additional data collected since end of the public comment period. The revised risk calculations are discussed in Section 14 (Summary of Site Risks). New information is discussed in Section 12.6.2 (Additional Investigation Activities Conducted by Pilgrim Cleaners and Savings Square Partners, Ltd.) and Section 12.6.3 (Additional EPA Investigation Activities).

Based on the re-evaluation of risk, excavation and off-site disposal of surface and subsurface soils in AOI 2 will not be implemented. However, elevated vapor concentrations beneath and adjacent to the Active Dry Cleaner and the impacted ground water will be addressed. Active remediation of the subsurface soil and vadose zone bedrock using soil vapor extraction will be implemented to remove contaminant mass and prevent future leaching to the underlying ground water.

In regards to ground water classification, please refer to comments 38 and 40.

55. **Comment:** The findings of the indoor air testing at the commercial building should be considered highly suspect, rather than being used to confirm a vapor intrusion pathway.

EPA Response: As discussed in comment 39, it is acknowledged that there could have been other potential sources of PCE within the commercial building. Pursuant to EPA's Vapor Intrusion Guidance (OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Ground water and Soils (Subsurface Vapor Intrusion Guidance), November 2002), shallow soil gas (e.g., sub-slab gas and soil gas measured at 5 feet below the foundation level) is conservatively assumed to intrude into indoor air spaces with an attenuation factor of 0.1. The soil gas sample beneath the concrete slab on the back of the building had a PCE detection of 119 micrograms per cubic meter (µg/m^3). For deep soil gas (e.g., soil gas samples taken at depths greater than 5 feet below the foundation level) an attenuation factor of 0.01 (generally considered reasonably conservative) is used to calculate target concentrations. The soil gas sample near the parking lot in front of the building had a PCE detection of 3,620 µg/m^3. Applying these attenuation factors would result in estimated indoor air concentrations of 11.9 µg/m^3 and 36.2 µg/m^3, respectively. In indoor sample had PCE detection of 3.47 µg/m^3.

56. **Comment:** With specific regard to Source Area 2 (i.e., Pilgrim), we would request that the EPA identify what RI data supports the conclusion that the soil and vadose zone bedrock contain Principal Threat Waste that continues to act as a reservoir for migration of contamination to ground water and indoor air.

EPA Response: See response to comments 47, 48, and 49.

57. **Comment:** The RI data, or the process outlined in the FS, should not have resulted in the FS recommending remediation of soils or bedrock at the CNBG property. Unless and until the EPA obtains on-site data that supports the need for remediation of soils and bedrock at the CNBG property, no such recommendations should be made.

EPA Response: The proposed remedial alternative for site soils at AOI 2 (including CNBG) has been revised based on revised toxicity values for TCE and PCE. Additional information has been collected on the CNBG property identifying PCE, TCE, and cis-1,2-DCE contamination in water samples (see Comments 48 and 49) above MCLs. These contaminants will need to be address to prevent further migration and contamination of the underlying ground water.

58. **Comment:** The EPA considers the "expected" use of the Austin Chalk to be for drinking water supply. In reality, the Austin Chalk, at best, should be considered a "potential" future drinking water source and a Class 2 ground water resource. Accordingly, the use of resource-based (not just risk-based) remediation strategies is entirely appropriate. A resource-based remediation strategy for this water-bearing zone would provide for the appropriate use of institutional controls and passive remediation methodologies (e.g., monitored natural attenuation - MNA), while at the same time allow for a final

remediation goal of MCLs if such a goal is deemed warranted.

EPA Response: Pursuant to CERCLA, ground waters contaminated above protective levels (i.e., MCLs) that are a current or potential source of drinking water should be restored wherever practicable. Institutional controls and monitored natural attenuation were evaluated as potential remedial alternatives to address ground water contamination, but would address the remedial action goal to prevent or minimize further migration of contaminants of concern in the ground water above cleanup levels.

The Austin Chalk ground water in the site area was being used as a source of drinking water until May 2007. Due to the presence of PCE above the MCL, an alternate source of drinking water was provided to the resident who previously used their private well to pump water from the Austin Chalk formation for their source of drinking water.

As discussed in the NCP and in various associated guidance, if ground water that is a current or potential source of drinking water is contaminated above protective levels (e.g., MCLs or non-zero MCLGs), a remedial action under CERCLA should seek to restore that aquifer to beneficial use (e.g., drinking water standards) wherever possible. In addition, ground water contamination should not be allowed to migrate and further contaminate the aquifer or other media (e.g., vapor intrusion into buildings).

In response to the classification of the Austin Chalk aquifer, see Comments 38 and 40. In regards to institutional controls, they should not be relied upon as the only response to contaminated ground water or as a justification for not taking action under CERCLA (see 40 CFR § 300.430(a)(iii)(D)). The potential of monitored natural attenuation as remedial alternative has been evaluated (EA 2010). Conclusions of this evaluation included the following:

- The MNA evaluation was based on the occurrence of chlorinated volatile organic compounds (CVOCs) in fifteen wells that are open to the Austin Chalk, Buda Limestone, and Edwards Aquifer. The data used in this evaluation was primarily from the February 2009, October 2009, and June 2010 sampling events.
- The presence of TCE (presumed to be a daughter product of PCE) and dichloroethene (DCE) is evidence that biodegradation is occurring at the Site, but at a slow rate that may be inadequate to remediate or stop migration of chlorinated volatile organic compounds in ground water. Based on the screening, the data do not support that anaerobic bioremediation is occurring at a rate that will limit plume expansion.
- Plume behavior for nine of the thirteen wells is best described as Type 3 behavior, characterized by inadequate concentrations of native and/or anthropogenic carbon. Type 3 behavior also occurs in ground water that does not contain microbes capable of biodegradation of chlorinated solvents (e.g., PCE, TCE), but this does not appear to be the case for the Site, due to results of the microbial evaluation.
- Although MNA alone may not be viable remedial solution for this Site, it may be a component of a more robust remedial scheme. In addition to the confirmed low-level presence of *Dehalococcoides* bacteria (known to be able to degrade PCE to

> ethene) across the Site, several site conditions are favorable for enhancing the subsurface environment making it conducive to more aggressive bioremediation. Specifically, the temperature, pH, and cation-anion geochemistry are compatible with enhanced reductive dechlorination if an electron donor (i.e., carbon substrate source) can be successfully introduced into the subsurface within the target treatment area. The lack of carbon source is likely the single most contributing factor to low bioattenuation rates; however, this is a reversible condition.

In an effort to assess the potential for enhanced bioremediation, the EPA conducted an *in situ* bioremediation field pilot study. In January 2011, an amendment (i.e., Regenesis 3DMe) was added to EPA monitoring well DW-404. Well DW-404 is located in AOI 2 and contained the second highest PCE concentrations detected at the Site. Well water samples were collected in January 2001, February 2011, March 2011, July 2011, January 2012, and most recently in May 2012. Table 2 presents the PCE, TCE and cis-1,2-DCE sampling results. Since the addition of the 3DMe™ into monitoring well DW-404 in January 2011, there has been a 99.7% reduction in PCE concentrations. The most recent sampling event, the concentrations for PCE and TCE were not detected with a reporting limit of 5µg/L (i.e., the MCL for PCE and TCE). The MCL for cis-1,2-Dichloroethene is 70 µg/L.

In addition to contaminants, other parameters were measured including DHC, methane and nitrate. DHC concentrations greater than 10,000 cells/milliliter are indicative of sites where there is significant biodegradation due to reductive dechlorination. In April 2009, the baseline DHC bacteria count from DW-404 was less than 0.5 cells/milliliter. In January 2012, the DHC bacteria count in well DW-404 was 26,900,000 cells/milliliter. Methane concentrations greater than 1 mg/L are indicative of conditions conducive for reductive dechlorination of chlorinated solvents. Sampling results from January 2012 found methane concentrations greater than 7 mg/L. Guidance states that nitrate concentrations less than 1.0 mg/L are desirable for anaerobic dechlorination of chlorinated hydrocarbons. In May 2012, the nitrate concentration was estimated by the laboratory at a concentration of 0.076 J mg/L (J flagged – estimated concentration).

59. **Comment:** The use of the Green Remediation Evaluation Matrix (GREM) was limited to a comparison of remediation alternatives that involve treatment. We recommend that the GREM scoring also be applied to the remedial alternatives that do not involve treatment, such as the Limited Action Alternative.

EPA Response: The GREM is a simple Excel-based tool for qualitative comparisons of treatment alternatives. The tools compares treatment technologies based on criteria such as the release of pollutants and waste (including air pollutants and green house gases), physical disturbances and disruptions (such as noise and traffic), and resource deletion or gain. The GREM evaluation was evaluated as part of the Short-term Effectiveness evaluation. The GREM evaluation was not used to evaluate the Limited Action and No Action alternatives because they do not involve treatment.

60. **Comment:** Table 3-5 (Technology Screening: Surface and Subsurface Soil) of the Feasibility Report indicates under the General Response Action of the “Limited Action” alternative, that only “some” Remedial Action Objectives (RAOs) can be achieved. The table should specify which RAOs would not be achieved.

EPA Response: The Feasibility Study Report identified the following remedial action objectives:

- Prevent exposure to COCs associated with the Site in surface soil, subsurface soil, ground water, and indoor air above cleanup levels.
- Prevent or minimize further migration of COCs associated with the site in surface soil, subsurface soil, vadose zone bedrock, and ground water above cleanup levels.
- Return ground waters to their expected beneficial uses wherever practicable (aquifer restoration).

The Limited Action alternative for surface and subsurface soils would not prevent exposure to site contaminants of concern (COCs) in indoor air above cleanup levels, would not prevent or minimize further migration of COCs, and would not return ground waters to their expected beneficial uses wherever practicable (aquifer restoration).

61. **Comment:** Table 3-5 of the Feasibility Report, under “Containment” states that an engineered cap is not retained because it “will not address the RAO for preventing contaminant migration.” This conclusion is confusing because, in practice, engineered caps are routinely used for the purpose of preventing migration of contaminants. For instance, engineered caps are a common means of mitigating the vapor intrusion pathway. Caps are also routinely used to prevent chemicals in the soil from leaching to ground water. In fact, as it relates to the 1990s Pilgrim release, the TCEQ has previously, through its VCP approval process, concluded that the engineered cap does prevent contaminant migration. The elimination of a cap because it supposedly fails to meet RAOs of preventing contaminant migration needs further explanation.

EPA Response: As discussed in response to Comment 47, the Pilgrim Cleaner’s Response Action Closure Report noted that the cap was designed to eliminate infiltration that will reduce migration. Unfortunately, the cap has not eliminated contaminant migration to soil vapor or the ground water (see Responses to Comment 47 and 48). COCs for the site are chlorinated solvents (i.e., PCE) which are included in a class of compounds referred to as dense nonaqueous phase liquids (DNAPLs). DNAPLs are immiscible fluids with a density greater than water. The potential for significant long-term ground water contamination by DNALP chemicals is high due to their toxicity, limited solubility (but much higher than drinking water limits), and significant migration potential in soil gas, ground water, and/or as a separate phase liquid.

62. **Comment:** Table 3-6 (Technology Screening: Vadose Zone Bedrock) of the Feasibility Report indicates under the general response action of the "Limited Action" alternative, the general response action "Will not achieve the remedial action objective. The table should specify which RAOs would not be achieved by this method.

    EPA Response: The Limited Action alternative for the vadose zone bedrock would not prevent or minimize further migration of COCs associated with the Site in the vadose zone bedrock.

63. **Comment:** Table 3-7 (Technology Screening: Ground water) of the Feasibility Study under the General Response Action of Limited Action states that the general response action will not achieve the remedial action objective. The table should specify which RAOs would not be achieved by the method.

    EPA Response: The Limited Action alternative for ground water would not prevent or minimize further migration of COCs associated with the Site in ground water above cleanup levels and would not return ground waters to their expected beneficial uses wherever practicable (aquifer restoration).

64. **Comment:** Table 4-1 (Remedial Alternatives for Surface and Subsurface Soil) and Table 4-2 (Remedial Alternative for Vadose Zone Bedrock) indicated the Limited Action Alternatives S-2 and B-2, respectively, do not address the RAO of preventing or minimizing further migration of COCs above cleanup levels. This conclusion, however, was made assuming the Austin Chalk is a Class 1 resource. Proper characterization of the Austin Chalk as a Class 2 ground water resource would permit the management of the affected ground water (e.g., a plume management zone), while the chemicals are restored to MCLs through natural attenuation processes.

    EPA Response: Class 1 and Class 2 ground water resources are considered to be current and potential sources of drinking water. As discussed in the NCP and in various associated guidance, if ground water that is a current or potential source of drinking water is contaminated above protective levels (e.g., MCLs or non-zero MCLs), a remedial action under CERCLA should seek to restore that aquifer to beneficial use (e.g., drinking water standards) wherever practicable. Ground water contamination should not be allowed to migrate and further contaminate the aquifer or other media (e.g., vapor intrusion into buildings; sediment; surface water; or wetland). In response to the potential for natural attenuation processes to attain MCLs, see the response to Comment 58.

65. **Comment:** Table 5-3 (Ground water Alternative Evaluation Summary) (1) Overall Protection of Human Health and the Environment. Under the Limited Action Alternative (GW-2), this Table describes that "*There is some reduction of risk with this alternative by limiting exposure via institutional controls and plugging and abandoning wells.*

Monitoring will provide an indication of contaminant migration." In reality, there are no drinking water supply wells completed in the Austin Chalk and under all active Alternatives, abandoned wells have been plugged. Accordingly, all humans will be connected to a municipal water supply, which is equivalent to, and provides the same degree of protection as, Alternative GW-3 [Municipal Water Supply]. GW-3 states there will be "… no unacceptable risks…"

EPA Response: The EPA and Edwards Aquifer Authority are working to identify all abandoned wells in areas where the ground water is known to be impacted by site contaminants. It is uncertain if all abandoned wells can be identified and properly plugged and abandoned. Even if all abandoned wells were identified and properly plugged and abandoned, the potential for contaminated ground water to impact deeper water bearing zones (i.e., Edwards Aquifer) remains. Based on cross-sections from the Edwards Aquifer Authority and subsurface geologic interpretations made from borehole logs, faults appear to be present near the Site and may contribute to the hydraulic communication between aquifers. Contaminated Austin Chalk water has entered the Edwards Aquifer through old improperly completed or deteriorating water wells.

In regards to alternative GW-3, Table 5-3 states "*There will be no unacceptable risk to human health for the residents that are connected to a municipal water supply. Institutional controls and plugging and abandoning of wells would be required to prevent human health exposure*." As with alternative GW-2 (Limited Action), these alternatives do not seek to restore the aquifer to its beneficial use nor do they seek prevent contaminant migration.

66. **Comment:** CNBG would like the EPA to explain how data for the on-site testing at Pilgrim and the Transmission Repair Property were used to "update" the Conceptual Site Model (CSM) when the CSM presented in the Final RI:

- Does not formally identify the Transmission Repair property as a potential source area.
- Does not identify any data gaps specifically associated with the Transmission Repair property.
- Asserts that uncontained PTW is present on the CNBG property despite soil data to the contrary.

EPA Response: A conceptual site model is a planning tool used by the EPA to support the decision making processes at contaminated land and ground water at Superfund sites. The CSM organizes available information about a site to facilitate the identification of data and information gaps. Once the CSM is established, additionally needed data can be gathered and integrated in the CSM, followed by a revision of the CSM and refinement of decision goals.

At the Bandera Road Site, a Preliminary Conceptual Site Model Technical Memorandum was prepared in October 2007. Existing data was summarized and included information obtained from the Hazard Ranking System Documentation Record (TCEQ 2006b) and ground water data collected from private wells during four TCEQ ground water sampling events (i.e., November 2005, May 2006, November 2006, and April 2007). The technical memorandum also discussed the background, geology and hydrology, nature and extent of contamination, risk assessment, and potential data gaps. A need to evaluate the dimensional distribution of aquifer contamination and to resolve data gaps was discussed. Data gaps included identifying the direction of ground water flow and identification of potential residual source areas.

An Updated Conceptual Site Model was prepared in September 2008. Four main investigation components were conducted to support investigation activities at the Site, including: a video and geophysical logging event, two-semi-annual residential well sampling events, three quarterly Leon Valley municipal water well sampling events, and two permeable diffusion bag water well sampling events. A preliminary monitored natural attenuation screen and fracture trace analysis was also conducted. Recommendations from the Updated Conceptual Site Model included the installation of additional monitoring wells to characterize ground water flow and to conduct passive soil gas sampling to identify potential source areas.

The latest discussion of the Conceptual Site Model is presented in the RI/FS Reports. Figure 5-12 (Tetrachloroethene Investigation at Source Area 2) of the RI Report summarizes the result of soil and soil gas sampling conducted in Source Area 2 (which includes the USA Auto Care Facility) and identifies the location of the PCE impacted monitoring well DW-404. As discussed in the Proposed Plan, further delineation of soil contamination will be conducted during the remedial design. Please note that it is possible that additional sampling may not identify highly contaminated soils for which a specific soil response action (i.e., excavation and off-site disposal) would be required, especially given the recently revised PCE toxicity values.

In regards to the CNBG property, the CSM (as presented in Figure 5-11 of the RI Report) states that PCE was spilled at a dry cleaning facility (RMT/Jones & Neuse, Inc., 1995). To date, only facilities with documented PCE releases have been identified as source areas. Source material is near/beneath the structure and is migrating downward. Recent ground water sampling of the soil boring TB-2 (located about 20 feet behind the back of dry cleaner) adjacent to former Leon Valley Water Supply/Luckey well supports this statement. A former water well [i.e., the Luckey well] may be acting as a conduit for contaminant migration. Passive soil gas sampling conducted in October 2009 (Beacon 2009) identified PCE and its degradation products TCE, cis-1,2-DCE, and vinyl chloride in the soil gas near the location of the former Luckey water supply well. Water infiltration through the impacted alluvium is leaching PCE toward the vadose zone bedrock. Contaminants are then transported primarily via bedrock fractures to the Austin Chalk aquifer. Pore space diffusion is also present, although at a much slower rate. Site related contaminants may be migrating to deeper water bearing zones (i.e., Buda Limestone or Edwards Aquifer) via old water wells.

67. **Comment:** Section 4 of the RI Report (Analytical Data Summary) describes that "historical data were combined with EPA RI field investigation data to form the RI Report dataset, …" Please explain why the historic data associated with TCEQ's 1995 closure of the PCE release at the Pilgrim facility was apparently not considered as part of the RI?

EPA Response: The historical reports were identified and considered in the RI Report. The data within the report was not incorporated into the risk assessment because it did not meet the data quality assessment goals (e.g., represent current conditions at the Site).

The reports which discuss the PCE release at the Pilgrim facility are referenced in Section 1.2.2.2 (Site History for AOI 2) of the RI Report. The RMT/Jones, Inc. Remedial Investigation Report and Response Action Report were identified in Section 10 (References) of the Remedial Investigation Report. Information presented in these documents were reviewed and considered by EPA. As discussed in Section 4.1 of the RI Report, historical data were evaluated to ensure that it met DQA [Data Quality Assessment] goals for incorporation into the RI Report. The following DQA goals were used to evaluate historical data:

- Collected in accordance with generally accepted practices for data collection
- Sample locations documented using definitive identifier
- Demonstrated a chain-of-custody from sample collection through analyses
- Analyzed by an acceptable TCEQ or EPA accredited laboratory
- Validated using EPA data validation rules
- Represent current conditions at the Site

The historical dataset included ground water data collected between November 2005 and April 2007.

68. **Comment:** We would like EPA to explain specifically why the Transmission Repair property was not formally identified as a potential source area?

EPA Response: Figure 5-12 (Tetrachloroethene Investigation at Source Area 2) of the RI Report summarizes the results of soil and soil gas sampling conducted in Source Area 2 and includes the USA Auto Care Facility as property where PCE has been detected in soil gas and soil samples.

69. **Comment:** We would like EPA to explain why, and based on what site-specific data, did the RI go beyond the stated purpose of the RI (i.e., identify potential source areas) and specifically identify Pilgrim as a confirmed "source" area (not just a potential source area), for the documented ground water contamination in the Southern Plume. Please address these questions in the context of EPA's Information Updates dated January 2009 and January 2010 which do not indicate a PTW has been confirmed at the CNBG property.

EPA Response: Please note that the Information Updates were developed through EPA's Technical Support Services for Communities (TASC) program specifically at the request of the Bandera Road Community Advisory Group. These updates are prepared twice a year and provide a general site update for the community. In regards to identifying areas as confirmed source areas, to date only properties where documented PCE releases have occurred in addition to the investigative findings (discussed in numerous previous responses) have been identified as confirmed source areas.

70. **Comment:** We recommend the list of source documents provided be modified to include the site-specific information available to the EPA regarding the 1990s PCE release and conditional closure at the Pilgrim facility.

EPA Response: As noted previously, documents available to EPA regarding the 1990s PCE release were included in Section 10 (References) of the RI Report. These documents will be added to the Site's administrative record.

71. **Comment:** Please explain specifically what soil and ground water sampling and analyses data were used to characterize conditions at and beneath the CNBG property. Please also describe how using these data meets the minimum data quality objectives for characterizing a given site as a "confirmed" source of ground water contamination and for further confirming the presence of PTWs. Also, please explain how any RI data that contradicted a conclusion of on-site PTW (e.g., essentially clean soils), was considered in development of the Conceptual Site Model for the CNBG property.

EPA Response: Soil, soil gas and ground water sample and analysis data used to characterize conditions at the CNBG property were previously discussed. In regards to soil and ground water data used to characterize conditions beneath the CNBG property, the only data available to the EPA was from the aforementioned 1990s reports (provided to EPA on July 22, 2009).

In May 2009, the EPA did request access to conduct remedial investigative activities (see Comment 37) at the CNBG property including the taking of soil samples, soil vapor samples, installing ground water monitoring and vapor monitoring wells, collecting water samples, and air samples. No response to EPA's request was provided. Access was subsequently requested by the EPA to conduct a much smaller scope of activities, namely, to conduct passive soil gas sampling. On August 14, 2009, conditional access was granted for the collection of soil gas samples subject to the owner's restrictions including the following:

- *"The EPA and/or contractor shall not disturb the capped areas at the site (see attached plat showing areas where drilling access is NOT GRANTED)."*

The attached figure identified the building footprint and two tracts of property along the building were access was not granted. As discussed previously, additional data will need to be collected at AOI 2 as part of remedial design and remedial action.

In regards to data quality, the analytical data collected on behalf of the EPA for the Remedial Investigation and Risk Assessment was validated by either the EPA Region Laboratory or EA Engineering. The Data Evaluation Summary Report (EA Engineering, October 2010) summarized analytical data quality and usability as related to the project-specific data quality objectives. The report concluded that the analytical results met the overall objectives for the quantity and quality of data required to support the decision-making process of the investigation. Data without qualifiers and data qualified as estimated are usable for purposes in supporting project objectives. Validated data were also found to be representative and comparable for all samples. Precision and accuracy were acceptable.

In regards to characterizing the given site as a “confirmed” source of ground water contamination and further confirming the presence of PTW, ground water samples collected from monitoring well DW-404 had the second highest PCE concentrations (i.e., 1740 µg/L) found at the Site. Soil gas samples detected PCE and its degradation products in samples collected at the CNBG property and adjacent USA Auto Repair Facility. Passive soil gas sample L-12, which was installed at the approximately location of the former Luckey water supply well, detected PCE (2527 nanograms) and its degradation compounds TCE (593 nanograms), cis-1,2-DCE (27,884 nanograms), and vinyl chloride (690 nanograms). The CMS, as presented in Figure 5-11 of the RI Report, states that PCE was spilled at a dry cleaning facility and that source material near/beneath the structure is migrating downward. Recent shallow ground water samples collected on the CNBG property in January 2012 at the two monitoring points TB-1 and TB-2 found elevated PCE concentrations of 130 µg/L and 640 µg/L. Data for EPA samples collected at TB-1 and TB-2 were validated by the EPA’s Houston laboratory.

Shallow soil samples collected by the EPA outside the footprint of the CNBG structure have not identified PCE concentrations indicative of PTW. As discussed in Section 4.2.1 (Source Identification) of the Remedial investigation Report for Pilgrim Enterprises, Inc. (RMT/Jones & Reuse, Inc., June 1995 – Final), “*Shallow soil samples taken from manually augured soil borings located inside the facility building exhibited the highest soil concentrations of PCE indicating that the source of the compounds impacting the subsurface soils in borings B4 and B5 is the facility dry-cleaning equipment. The actual process by which dry-cleaning chemicals migrated to the subsurface may have been through piping joints whose cement had been compromised by the dry cleaning solvents*.”

Soil gas samples collected beneath the former dry cleaning facility found elevated levels of PCE and its degradation products (Table 13). PCE concentrations as high as 46,200 $\mu g/m^3$ were detected in May 2012.

72. **Comment:** Section 2.2.8 (Passive Soil Gas Surveys) of the RI Report characterizes the use of passive soil gas as a screening tool. However, for other portions of the RI, it appears the EPA has actually used the passive and/or active soil gas data as a means of

"confirming" the presence of PTWs at the CNBG property. Please explain how soil gas data (passive or otherwise) can be used to positively confirm PTW is present.

This Subsection also describes that, based on the results of the soil gas data, "additional characterization was conducted as necessary." Please explain what is meant by the term "… as necessary" and, with specific regard to the CNBG property, please explain what additional characterizations were performed and what the results were.

EPA Response: Passive soil gas sampling was not used to confirm the presence of PTW at the CNBG property. Active soil gas sampling using Summa canisters of the sub-slab of the active dry cleaner (Area of Investigation 2) did find elevated concentrations of PCE (46,000 µg/m^3) (See Figure 53, Soil Vapor and Indoor Air Tetrachloroethene Concentrations).

In regards to additional characterization conducted "as necessary," if the passive soil gas survey found significant VOC contamination, additional site characterization was conducted and included one or more of the following: the placement of additional passive soil gas samples, and/or the collection of soil gas using dedicated soil gas sampling probes. With regards to the CNBG property, the property owner installed two shallow water monitoring ports (TB-1 and TB-2). The sample locations were sampled by the EPA in January 2012. PCE was detected at concentrations of 130 µg/L and 640 µg/L. Additional, sub- slabvapor samples collected in May 2012 detected elevated concentrations of PCE and its degradation products (Table 13).

73. **Comment:** Subsection 3.1 (Surface Features) of the RI Report. It would be useful if this section identified each of the potential source areas that are known or suspected to be located within each area of Investigation. For instance, according to the Update, January 2009, the EPA identified 21 dry cleaning facilities, 26 automobile repair related facilities, and 4 light industrial facilities. Please indicate in which AOI each of these potential source areas is located. A map specifically identifying the location of each potential source area would also be helpful.

EPA Response: Reference 46 (Potential Responsible Party List) of the Hazard Ranking System Documentation Report (TCEQ, 2006b) identifies potential sources of releases within approximately four miles of the center of the contaminant plume. Internet searches were conducted on the following services in the area to identify businesses that are current potential sources: Dry Cleaners, Gasoline, Service Stations, and Automotive. Also, the list includes PRPs from historical activities determined through field surveys that are documented in Reference 23. Reference 46 identifies 21 dry cleaners, 26 automotive related businesses, and four other potential sources. Google maps are included in Reference 46 showing the locations of these businesses.

74. **Comment:** Subsection 3.5.1 (Aquifers) of the RI Report presents a region-wide description of the ground water zones. With specific regard to the Austin Chalk

formation, the discussion suggests the potential for the Austin Chalk to be interconnected with the much deeper Edwards Aquifer due to faulting and/or secondary porosity, etc. In accordance with TRRP, the classification of a ground water zone is determined on a site-specific basis. Accordingly, it may be very important to distinguish the AOI 1 area from the AOI 2 area geographically and/or hydrogeologically if it is believed they are materially different. For instance, if faulting is present in AOI 1 that is believed to create hydraulic communication between the Austin Chalk and the Edwards Aquifer, then it may be appropriate to classify the Austin Chalk as a Class 1 ground water resource in that area. However, if there is no evidence that such faulting is present in the area of the CNBG property (assuming it is a source), then there may be no reason to designate it as a Class 1 ground water resource.

EPA Response: See Comment and EPA Response 38 regarding the classification of the Austin Chalk ground water. AOI 1 and AOI 2 are not believed to be materially different geographically and/or hydrogeographically. In regards to faulting, based on cross-sections from the Edwards Aquifer Authority, minor faults appear to present within the investigation area (within two miles from the center of the contamination plume) with the Edwards and associated limestones (TECQ, 2006b). Based on review of field borehole logs and geophysical investigation determination, and a fracture trace analysis determination (EPA, 2008), faults were identified in the site area. Figure 12 (Fault Locations) of this document presents inferred fault locations in the area of the Site.

75. **Comment:** Subsection 3.5.3 (Horizontal Gradients) of the RI report presents a ground water contour map (Figure 3-8) for the Austin Chalk formation. It describes that the "… contouring was based on ground water levels, subsurface stratigraphic interpretations, and distribution of ground water contaminants …" Please clarify exactly how the stratigraphic interpretations and distribution of ground water contaminants were used in contouring ground water elevation data. Also, please explain how the contours depicted in Figure 3-8 are believed to be representative of the Austin Chalk ground water flow, given the results of the dye tracer studies.

EPA Response: As noted on Figure 3-8 of the RI report, "*Contours are interpretive and should be used with caution*." The primary information used to generate the contours in Figure 3-8 were measured water levels collected on September 7, 2010. Pressure transducers were used to collect continuous (i.e., every five minutes) water level measures over several months. By comparing the water levels between two wells, one can infer the general direction of the flow of water between the wells going from the well with higher water level to the well with a lower water level (i.e., water flows from higher to lower elevations – i.e. downhill). For the area around USGS-42, the direction of flow was generally to the north based on differences in water levels. However, the inferred direction of flow between two wells can change based on how quickly the wells respond to recharge from storm events. Figure 3-11 (Water Levels For All Wells (Feet MSL)), Figure 3-12 (Austin Chalk Aquifer Northern and Middle Wells Water Levels (Feet MSL)), and Figure 3-13 (Austin Chalk and Buda Limestone Aquifer Southern and

Middle Well Water Level (Feet MSL)) of the RI report present the transducer data from September 2010 through October 2010 and show how individual water levels responded to a storm event.

Stratigraphic information (i.e., the base of the Austin Chalk formation) is also presented in Figure 3-8 of the RI report. This information provides some insight into the vertical displacement of the base of the Austin Chalk formation across the area.

Ground water contaminant concentration data may also be used as a general indicator of the direction of ground water flow. Wells with higher contaminant concentrations can generally be considered to be upgradient of wells with lower contaminant concentrations. However, identifying the localized direction of ground water flow can be very difficult in karst formations present at the Site. Based on the results of falling head tests conducted at monitoring wells USGS-42, DW-408, and DW-414, it appears that these wells are hydraulically connected to one or more local features, possibly intercepting minor faults and/or karst dissolution conduits.

In regards to the dye tracer tests, results of the tests demonstrated a ground water flow path from well USGS-42 to well DW-409 and from well DW-414 to well DW-36. All four wells are completed in the Austin Chalk Aquifer. Uranine dye was injected into USGS-42 on July 29, 2010, and was detected in charcoal samples from well DW-409. Two charcoal receptors from DW-409 contained trace amounts of dye beginning with the August 9, 2010 sample. Since the dye arrived at well DW-409 sometime during the four days that the charcoal receptor was in the well, the apparent velocity could range from 22 to 35 meters per day. Eosin dye from DW-414 was visible in several samples from well DW-36 starting with a water sample collected on August 12, 2010. Dye arrived sometime between the injection and the first sample collected on August 12, 2010 for an apparent velocity of at least 20 meters per day. Since visible dye was observed, the apparent velocity was most likely faster than the 20 meters per day because there was little or no dilution by ground water. A more refined travel time could not be determined because water samples were not collected immediately following injection. However, the relatively fast ground water velocities are indicative of the karstic nature of the Austin Chalk. In addition, the distribution of dyes confirmed the southerly ground water gradient in the Austin Chalk Aquifer (Edwards Aquifer Authority, 2010).

76. **Comment:** Subsection 3.5.5 (Depth to Ground Water) of the RI Report states that "*Depth to ground water is an important factor in the connection between contaminant sources and ground water*." Please explain the significance of this statement in the context of the only two "confirmed" sources that have been identified.

EPA Response: The more shallow the ground water the higher the likelihood for contaminants to enter the ground water. In regards to Area of Investigation 1, a water leak beneath Building 1 was suggested by water saturation observed in soil borings and confirmed anecdotally by building occupants. In regards to Area of Investigation 2, shallow ground water has been encountered at depths of 15 to 18 feet below ground surface.

Chlorinated solvents (i.e., PCE, TCE) which have been identified at the two source areas are defined as dense non-aqueous phase liquids (DNALPs). DNALPs are only slightly soluble in water and therefore exists in the subsurface as a separate fluid phase immiscible with water. DNAPLs (which are denser than water) have the ability to migrate to significant depths below the water table where they slowly dissolve into flowing ground water, giving rise to aqueous plumes. A release of DNAPL at the ground surface can therefore lead to long-term contamination of both the unsaturated and saturated zones at the Site.

As water percolates through vadose zone soil to the underlying ground water, it can carry dissolved phase constituents. Additionally, source material in contact with ground water can leach directly to ground water. Transport will occur through secondary porosity such as preferred flow paths through fractures, faults, and dissolution features, as well as through man-made flow paths such was well bores. This pathway could include both non-aqueous phase liquids and dissolved phase constituents.

In regards to Area of Investigation 1, a water leak beneath Building 1 was suggested by water saturation observed in soil borings and confirmed anecdotally by the building occupants. The water leak may have facilitated leaching of chlorinated solvents to ground water. Monitoring well USGS-42, located in the alley way adjacent to Building 1, has had PCE detections as high as 11,700 µg/L.

In regards to Area of Investigation 2, shallow ground water has been encountered at depths of approximately 15 feet below ground surface (RMT/Jones & Neuse, Inc., 1995). On January 9, 2012, water sampling was conducted by the EPA at TB-2 located approximately 20 feet south of the back of the active dry cleaners. TB-2 is also located adjacent to the former Luckey Water Supply well. The measured total depth of TB-2 was approximately 30.69 feet below the top of casing. The measured depth to water was approximately 17.66 feet below the top of casing resulting in 13 feet of water column. PCE and TCE were detected at concentrations of 730 µg/L and 55 µg/L.

77. **Comment:** With specific regard to the environmental issues that have been identified in the subject area (i.e., ground water contamination). It would be more useful if this section included a realistic evaluation about the potential for ground water resources to be used in the future. For instance, this section could highlight the presence of municipal water supply throughout the area, the high degree of regulatory control over ground water use, and the generally unreliable nature of the Austin Chalk formation for sustainable water supply.

EPA Response: There are no known Austin Chalk wells in the Site area that are currently being used as a source of drinking water. In respect to AOI 2, there is a former public water supply well located within the back parking lot of the active dry cleaner.

EPA has not been able to locate documentation that this well has been properly plugged and abandoned such that it would no longer provide a migration pathway for the impacted ground water identified in the Austin Chalk in Area of AOI 2 to the underlying Edwards Aquifer formation.

The municipal water supply gets its water from wells completed in the Edwards Aquifer. Of the two municipal water supply wells located within the City of Leon Valley, one of these wells is located within ½ mile of AOI 2. The Site was listed on the NPL primarily due to the presence of PCE detected in private Edward Aquifer water supply wells at concentrations above the MCL. Work conducted at the Site has found that improperly completed or deteriorated well casing have provided a pathway for contaminated Austin Chalk ground water to impact the Edwards Aquifer. In the oxic conditions found throughout the Edwards aquifer (dissolved oxygen concentrations of a least 1 mg/L (milligram per liter)), anthropogenic contaminants such as PCE will not readily degrade and can persist over long distances (USGS, 2011).

The City of Leon Valley, the TCEQ and EPA would like to ensure municipal water quality protection from the existing ground water contamination at the Bandera Road Site. Ground water contamination identified in the Austin Chalk aquifer should not be allowed to migrate and further contaminate the aquifer or other media. The NCP states that EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site (40 CFR § 300.430(a)(1)(iii)(F)).

In respect to the Austin Chalk, as discussed in the Hazard Ranking System Documentation Record for the Bandera Road Ground Water Plume (TCEQ, 2006b), the Austin Chalk supplies water for domestic or stock use where yields of 500 gallons per minute or more were reported from several wells. Such yields may result when wells have been drilled into subsurface caverns. Subsurface cavern features were identified in the Austin Chalk monitoring well DW-408. Some of the large yields from the Austin Chalk are believed to be obtained where the formation is in hydraulic communication (e.g., faults, secondary porosity) with the Edwards and associated limestones.

78. **Comment**: The introductory paragraph of Section 4 (Analytical Data Summary) of the Remedial Investigation Report describes that only historic data that met the EPA's data quality assessment goals are included. Please identify which historic data was eliminated and please specify why. For instance, the historic soil and ground water data obtained at the Pilgrim site in regard to the 1990s release and regulatory conditional closure was apparently not considered by the EPA.

EPA Response: Historical data such as the Pilgrims Cleaners 1990s release was considered in the development of the conceptual site model. However, only data which met the data quality assessment goals were used in estimating potential risks to human health and the environment and for making remedial decisions. The following data quality assessment goals were used to evaluate historical data:

- Collected in accordance with generally accepted practice for data collection
- Sample locations documented using definitive identifier
- Demonstrated a chain-of-custody from sample collection through analysis
- Analyzed by an acceptable TCEQ or EPA accredited laboratory
- Validated using EPA data validation rules
- Represent current conditions at the Site

Based on the above criteria, only data collected after November 2005 were used in estimating potential risks to human health and environment and for making remedial decisions. Historical ground water data were collected between November 2005 and April 2007. Data collected during the November 2005 sampling event were documented in the Hazardous Ranking System (TCEQ, 2006b). These data and subsequent data were collected under the TCEQ QAPP (TCEQ 2003). These samples were submitted with chain-of-custody documentation to approved laboratories for analysis. Data were validated in accordance with National Functional Guidelines and were considered acceptable for inclusion in the RI Report.

79. **Comment**: Subsection 5.3.3 (CSIA Results) presents the results of the Compound Specific Isotope Analysis (CSIA). The CSIA appears to be one of the key lines of evidence the EPA has used to conclude there are at least two different release sources, and for determining that the second release source is near DW-404. While not specifically stated in the RI, the EPA's *Technology News and Trends Newsletter*, dated February 2010, states that the CSIA study was performed in accordance with the EPA's *Guide for Assessing Biodegradation and Source Identification of Organic Ground Water Contaminants Using CSIA.*

As described in the RI, the area of DW-404 has been identified as a different source area because it had a lower C^{13} to C^{12} ratio, as compared to the known Source Area 1 well USGS-42. The RI does not, however, explain why then, if this is the basis for determining different release areas, the areas of well DW-415 and DW-407 were not also identified as yet additional release areas. According to Figure 5-23 of the RI, DW-414 had the lowest isotope ratio of all wells tested in June 2010 (i.e., -27.76) and the ratio for DW-407 was essentially the same as DW-404 (i.e., -26.40 versus -26.23).

CNBG is concerned that the CSIA data interpretations, and resulting conclusions, have been overly simplified. The fact is, CSIA is highly interpretive. While the RI adequately describes the general theory behind the analysis – comparing C^{13}/C^{12} ratios from different monitoring well locations, with the expectation that ground water closest to source areas will exhibit the most negative ratios due to less degradation. However, in this simplified form, there is no discussion about the variety of factors that can significantly impact (i.e., limit) and complicate the usefulness of isotopic comparisons. For instance, the RI fails to mention the effects of natural heterogeneity in biodegradation within the aquifer. According to the EPA guidance cited, the rate and extent of biodegradation may be heterogeneously distributed within an aquifer, which may confuse the interpretation of the isotopic ratios. The RI has clearly documented that the aquifer conditions throughout the Site are extremely complex. Given this, please explain in what manner did the EPA's CSIA attempt to quantify and account for possible natural biodegradation heterogeneity in the aquifer?

CNBG's point here is simply that the CSIA methodology is an extremely interpretative technique for trying to establish source areas with a reasonable degree of scientific certainty. Depending on the complexity of a given site, the technique may have numerous limiting factors. Accordingly, all reasonably plausible scenarios should be considered and, if determined potentially applicable, they should be evaluated and accounted for in the assessment. Accordingly, to the extent that certain limiting factors may be applicable to the Bandera Road Ground water Plume Superfund site, the RI should thoroughly discuss them and justify their elimination, as appropriate. For example, CNBG understands that petroleum hydrocarbon constituents have been detected in the immediate area of Source Area 1 while no petroleum hydrocarbons have been detected in the area of DW-404. How was this fact accounted for and how did it impact the CSIA findings? More generally, please explain how the EPA determined what degradation rates would be expected at the various locations throughout the plume, in consideration of the differing regimes that would have been experienced over both time and space? Also, please explain how the EPA's study, which was performed over a very large and very complex area, only utilized two sampling events of a maximum of 8 wells, when the EPA's guidance recommends a minimum of 12 to 20 wells be used? The guidance further states the following:

> "*The fewer the number of wells that are analyzed in the study, the higher the risk of mis-interpretations. In such cases, the comprehensive interpretation of many different lines of evidence becomes more important*."

EPA Response: While the detections limits required to conduct CSIA have decreased over time, when the CSIA analysis was conducted, sample preparation techniques for CSIA analysis required chlorinated solvents to be in the low parts per billion ($\sim 20\ ppb$) concentration ranges. When the CSIA was conducted, all existing wells with chlorinated solvents concentrations at or above 20 ppb were utilized (i.e., sampled).

A quantitative measure of the site-specific analytical uncertainty has not been determined due to the low number of CSIA samples (EA, 2010). Nevertheless, the CSIA data were used in a weight-of-evidence approach with other data to demonstrate a likely contaminant transport scenario; the scenario presented below is considered the most likely, but certainly not the only plausible contaminant transport scenario.

Biodegradation induces a shift of the residual compound to less negative values of $\delta^{13}C$ (i.e., enrichment of $\delta^{13}C$ and depletion of $\delta^{12}C$). Therefore, the most negative values measured for the organic contaminant in ground water can be the best estimate of the original values of source areas $\delta^{13}C$ ($\delta^{13}C_{source}$). Wells in the source area are expected to produce water with the highest concentrations. Because biodegradation enriches (e.g., less negative) $\delta^{13}C$ values, source area wells may be assumed to represent the least degraded material. Based on this premise, well DW-404, with the most negative value of

-26.4‰ for PCE in 2009 (Figure 61), implies that it is near a source (i.e., Source Area 2). Because a source area was confirmed near USGS-42, the values of -24.1‰ and -23.5‰ for PCE, in 2009 and 2010 respectively, represent the baseline for this source. Based on only CSIA data, the disparity between USGS-42 and DW-404 $\delta^{13}C$ values may represent two source areas, or may represent different $\delta^{13}C$ values in the source PCE over time, a phenomenon that is known to occur and represents another forensic use of CSIA. However, the presence of a second source area has been confirmed near DW-404, based on the collaborating evidence of soil vapor sampling, passive soil gas sampling, soil sampling, and shallow well sampling at the recently installed TB-1 and TB-2 locations.

In order to determine if a site has multiple source areas, the extent of fractionation must be greater than the total analytical uncertainty. In addition, the observed difference in the values of $\delta^{13}C$ must exceed the variability (spatial and temporal) introduced by different sources of contamination. Typically, the total analytical uncertainty is ± 0.5‰ (EPA 2008a). Therefore, the observed fractionation limit is set at > 1‰ at a minimum. To ensure reliable interpretation, EPA recommends that >2‰ be used as a criterion for positive identification of degradation to minimize erroneous interpretation. There is a qualitative indication of biodegradation or transformation along a flow path in ground water when the values of $\delta^{13}C$ in the down gradient wells are enriched (less negative) by 2‰ compared to values of $\delta^{13}C$ in the up gradient well.

The wells USGS-42 and DW-404 have higher $\delta^{13}C$ values for PCE than surrounding wells, with the exception of DW-414, suggesting that the contaminants are degraded as they move away from the source areas. Although DW-414 has a higher $\delta^{13}C$ value that the nearby DW-404 (-26.4 compared to -27.8), the difference is within the 2‰ criterion for positive identification.

The $\delta^{13}C$ values for wells indicate that the contamination in wells DW-404, DW-407, DW-414, DW-36, and DW-47 may originate from a different source than USGS-42. The process of degradation results in higher (less negative) values of $\delta^{13}C$, so the PCE at USGS-42 with a $\delta^{13}C$ value of -23.5‰ is not consistent with the PCE $\delta^{13}C$ values observed in wells DW-404, DW-407, DW-414, and DW-36. However, the $\delta^{13}C$ values in wells DW-407, DW-414, and DW-36 are all higher (less negative) than the $\delta^{13}C$ values from DW-404. Given these results, it is possible that the impacts to wells DW-407, DW-36, and DW-47 are from a source near DW-404 or are from another yet undiscovered source.

It is likely that the impacts to DW-408, with a $\delta^{13}C$ of -20.3‰ in 2009 and -21.1‰ in 2010, are attributable to the source near USGS-42, with a $\delta^{13}C$ of -23.5‰ in 2009 and -24.1‰ in 2010. It is also apparent that DW-408 exhibits evidence of degradation with difference in PCE $\delta^{13}C$ values of approximately 3‰, which exceeds the 2‰ threshold recommended by EPA (EPA 2008a).

In respect to the statement that no petroleum hydrocarbons have been detected in the area of DW-404, please note that samples collected from well DW-31, located about 400 feet southwest of DW-404, had toluene detections of 1220 µg/L in passive diffusion bag samples collected at depths of 170 and 210 feet below ground surface in January 2008.

80. **Comment**: Subsection 5.5.4 (Chlorinated Solvent Ratios) presents an analysis of chlorinated solvent ratios as another line of evidence to support a conclusion that there are at least two different release sources. The analysis begins with an assumption that the two areas have comparable hydrogeologic settings. This assumption is not further explained or justified. The discussion goes on to describe how differing degradation rates are observed even between different depths within a single well, and between wells with different hydraulic connection to the aquifer. Please explain how the EPA was able to evaluate the solvent ratio data in context of different degradation regimes over both time and space?

EPA Response: The chemical analysis of ground water samples was used to determine the type, concentration, and distribution of contaminants and daughter products. Using the maximum concentrations detected, there is some indication of PCE degradation to TCE and DCE, with the vast majority of contamination being present as PCE. Contaminant ratios provide a means to evaluate data between wells and even within single wells, given the datasets.

Erich Birch, Attorney for Savings Square Partners Ltd. (October 17, 2011).

81. **Comment:** When the Site was originally proposed for listing as a Superfund site there were great fears regarding the potential threat to a unique sole-source aquifer and the unknowns regarding the causes and extent of contamination. Now seven years later, these fears have proved to be unfounded. Extensive investigation activities have been conducted by EPA over the past years and today the extent and levels of contamination in the Edwards Aquifer appear largely unchanged from the situation as it existed in 2004, although EPA has obviously connected some residents onto a public water supply and plugged wells that could provide a pathway to the Edwards Aquifer.

EPA Response: The Site was originally proposed for listing as a Superfund site based on the investigation of 33 private wells. Out of the 33 wells in the investigation, analytical results indicated that 11 wells met the criteria for an observed release of PCE and/or TCE. Six of the 11 private wells with an observed release also have concentrations exceeding health based levels (i.e., Maximum Contaminant Levels) (TCEQ, 2006b).

Based on EPA's investigation, PCE was found in the Edwards Aquifer wells DW-30, DW-43, DW-44, DW-37, and USGS-44, the highest concentration of which was 148 µg/L. Video logging that was conducted and/or chemical concentration data indicated that contaminant migration from the Austin Chalk Aquifer to the Edwards Aquifer via compromised casings in these wells. Due to this contaminant transport pathway, these wells were plugged and abandoned to prevent further contamination of the Edwards Aquifer via borehole leakage (EPA, 2011).

Because improperly completed or deteriorating impacted wells have been shown to provide contaminant migration pathways from the overlying impacted Austin Chalk Aquifer into the Edwards Aquifer in the area, the selected remedy specifically includes the plugging and abandonment of wells. The EPA will continue to work with the Edwards Aquifer Authority and other parties to identify and address (i.e., plug and abandon) improperly completed, deteriorating, impacted and/or abandoned wells in the site area. Although best efforts will be used to locate these wells, it is uncertain as to whether all improperly completed, deteriorating, or abandoned wells can be located and thus properly plugged.

82. **Comment:** Savings Square Partners, Ltd (SSP) comments on the Proposed Plan can be summarized as follows: EPA's justifications for spending over $10 million in remediation costs are based on incomplete data and erroneous assumptions. In particular:

- It fails to consider that the SSP site is not a threat to the Edwards Aquifer water supply because: (a) the Austin Chalk is not in communication with the Edwards Aquifer in the SSP site area, (b) all of the wells but one that have Edwards Aquifer contamination are tied solely to Source Area 2, and not SSP, (c) the sole well in the Edwards Aquifer that could possibly have been tied to the SSP site has been plugged, and (d) the sole well in the Edwards Aquifer possibly tied to the SSP site is far away from any public water supply well.

EPA Response: In regards to the comment that EPA's proposed plan was based on incomplete data, the objective of EPA's Remedial Investigation/Feasibility Study (RI/FS) is not the unobtainable goal of removing all uncertainty, but rather to gather information sufficient to support an informed risk management decision regarding which remedy appears to be most appropriate for a given site.

In regards to the Edwards Aquifer, as discussed previously, the solvent (i.e., PCE, TCE) impacted Austin Chalk ground water has already impacted the underlying Edwards Aquifer. It remains uncertain as to whether all improperly completed, deteriorating, or abandoned wells have been located and thus properly plugged. In regards to the SSP property, the Edwards Aquifer Authority (EAA) recently identified the potential locations of historical wells in the area using old right-of-way maps/historical photographs. The EAA obtained access to properties and marked potential well locations using a surveying contractor. The EAA then procured a surface geophysics contractor who applied ground penetrating radar, EM-61 technology, and magnetic gradient technology to search for buried well casings at the potential well locations. Using these technologies, an abandoned well was located within the SSP parking lot.

In addition to historical wells, based on cross-sections from the EAA, minor faults appear to be present within the investigation area (within 2 miles from the center of the contamination plume) and may contribute to the hydraulic communication between the Austin Chalk and the Edwards Aquifer (TCEQ, 2006b). Based on review of field borehole logs and geophysical investigation determination (EPA, 2011), and a fracture trace analysis determination (EPA, 2008), faults were identified in the site area.

83. **Comment:** The materials in the soil, subsurface soils and vadose zone bedrock at SSP do not fall within the definition of a principal threat waste.

EPA Response: EPA disagrees. In addition, SSP's own contractor (Weston Soloutions, Inc.) in their report to EPA stated "*There are soils beneath Building 1 that are acting as a source of PCE vapors to indoor air within Building 1, the overburden soil, and vadose zone bedrock. … The soils beneath the Building 1 slab appear to represent the primary source of PCE within AOI 1 and should be addressed by active remediation*."

Section 4.1.2 (Source) of the Feasibility Study Report defines Principal Threat Waste as source materials that are considered highly toxic or highly mobile and that generally cannot be reliably contained or would present a significant risk to human health or the environment if exposure were to occur. Source material is a media that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration to other media or for direct exposure (EPA 1991).

Chlorinated solvents, such as those detected at the SSP property are included in a class of compounds referred to a dense nonaqueous phase liquids (DNALPs). DNAPLs are immiscible fluids with a density greater than water. The potential for significant long-term ground water contamination by DNAPL chemicals is high due to their toxicity, limited solubility (but much higher than drinking water limits), and significant migration potential in soil gas, ground water, and/or as a separate phase liquid.

Indoor air sampling at the former dry cleaner location within the SSP property has detected chlorinated solvents at concentrations adverse to human health. Sampling of the ground water at the SSP property has detected the highest concentrations of chlorinated solvents found at the Site. The most recent sampling conducted in May 2012 found PCE concentrations of 336 $\mu g/m^3$ in the indoor air and 4100 µg/L in the underlying ground water.

The Supplemental Remedial Investigation Report (SRI) Area of Investigation 1 (Weston Solutions, Inc., August 2012) prepared for the SSP and provided to the EPA for consideration made the following conclusion and recommendation in regards to soils beneath Building 1:

"*There are soils beneath Building 1 that are acting as a source of PCE vapors to the indoor air within Building 1, the overburden soil, and vadose zone bedrock. In addition, it appears that PCE and PCE degradations products from this soil are leached by infiltrating water that enters well USGS-42, and the vapors are migrating into the vadose bedrock. Based on the sampling that has been performed, the extent of apparent 'source area soil' appears to be an area of approximately 15 feet by 20 feet to depths of up to approximately 6 feet below the building slab in some areas… The soils beneath the Building 1 slab appear to represent the primary source of PCE within AOI 1 and should be addressed by active remediation*".

In regards to the vadose zone bedrock beneath Building 1, the SRI report made the following conclusion and recommendation:

> "*The results of a three-day SVE test on the vadose zone bedrock, which showed a significant decline in the PCE concentrations of the extracted vapors over relatively short test period, does not support the presence of a significant 'source' of PCE in this zone (upper 50 feet). The source of the vapors found in the vadose zone bedrock is most likely the PCE in the overburden soil … As a point of reference, PCE vapor is almost six times as heavy as air and would tend to migrate downward from the overburden soil into the underlying fractured bedrock. The significant decline in the concentration of PCE in the extracted vapors, along with the low flow rates obtained from the test well (and other wells), even with high applied vacuum (150 inches-water), indicates that application of a full-scale SVE remediation system within the vadose zone bedrock is not necessary and would not be technically practicable. It is proposed that the vadose zone bedrock be monitored on completion of the removal activities … to address the affected soil. In the event that the concentrations of vapors in the vadose zone bedrock do not decline as would be expected, additional remedial measures will be evaluated and implemented. One potential option is to perform another short-term SVE event on the vadose zone bedrock, followed by monitoring.*"

The SVE tests conducted in 2010 and 2012 demonstrated that SVE can be used to remove PCE and its degradation products from the vadose zone soil. The 2010 SVE testing, conducted from January 17 – 19, 2012, consisted of a series of shorter duration tests (i.e., approximately 4 hours) at individual vapor extraction wells at the SSP and other locations. The 2012 SVE testing consisted of three short-term (i.e., 10 to 15 minute test) at three locations and a 71 hour test at the SSP property.

For the 71 hour test, vapor was extracted from a newly installed SVE well (SVE-1). SVE-1 is located along the exterior wall of the former dry cleaner. SVE-1 and SVE-2 wells were drilled to a total depth of 50 feet. The clay and clayey silt soil overburden and the upper weathered portion of the bedrock were drilled using hollow-stem augers until auger refusal occurred at depths of 20 and 25 feet. An air-rotary rig was used to drill into the bedrock to 30 feet, approximately 5 to 10 feet into bedrock, at which 4-inch diameter steel casing was set and grouted in place and allowed to cure approximately 24 hours. Air-rotary drilling was then used to drill to a total depth of 50 feet.

The average extracted total organic vapor (TOV) concentration during the first 8 hours of the test was 153 parts per million (ppm). Thereafter, TOV concentrations averaged 860 ppm (peak value of 1,718 ppm) until 31 hours into the test when they exhibited a sharply decreasing trend. During the final 19 hours of the test TOV detections averaged 94 ppm. As noted in the SRI report, PCE and its degradation products, TCE, and cis-1,2-DCE, were the only volatile organic compounds detected in the samples. PCE concentrations during the first 20 hours of the test ranged from 2,300 to 2,700 mg/m^3, or approximately 340 to 400 ppmv. At 36 hours into the test, PCE concentrations had decreased to 1,800 mg/m^3 or approximately 265 ppmv. PCE vapor concentrations decreased to 170 mg/m^3 or 25 ppmv by the end of the test.

In addition to the 2012 SVE test, a water well recovery test was conducted at monitoring well USGS-42, located in the alley way adjacent to the former dry cleaner. On January 12, 2012, approximately 150 gallons of ground water was purged from USGS-42. After approximately 1.5 hours the well recharged only 0.31 feet (approximately 0.51 gallons). After 26 hours, the total well recharge was 4.78 feet (approximately 7.9 gallons). During the 13-day post-drawdown period ending on 25 January 2012, the water level in well USGS-42 had recovered 35.32 feet, approximately 40 percent of the pre-test static level. During this period, the average recharge rate was 4.73 gallons per day. Between 27 and 30 January 2012, the average recharge rate increased to 29.16 and 10.68 gallons per day during which the well recovery attained 102 percent of the pre-test static level. This increased rate of recharge is attributed to the 3.13 inches of sustained rainfall that occurred in the area during 23 and 24 January.

The greater than seven-fold sudden increase in water level recovery rate into the well that occurred sometime on 26 to 27 January 2012 was likely in response to the 23 to 24 January rainfall events. However, the extremely low rate of recovery exhibited in the saturated section of the well (below 77.65 feet below top of casing) suggests that the sudden water level rise may have been caused by percolation and trickle fill from more permeable vadose zone units (above 77.65 feet below top of casing) exposed between the casing and the pre-test static water level. Well USGS-42 is cased to approximately 50 feet below ground surface.

Water samples were collected from USGS-42 prior to purging the well (12 January), the day after purging the well (13 January), and at the end of the test (31 January). PCE was detected at concentrations of 7,410 µg/L (estimated – high bias), 4,600 µg/L (estimated – high bias), and 6,740 µg/L, respectively. The last sample was collected after completion of the SVE testing (19 January 2012). As stated above, the sudden water level rise within the well which occurred sometime on 26 to 27 January may have been caused by percolation and trickle fill from the more permeable vadose zone units (between 50 and 77.65 feet below the top of casing). If this is the case, significant mass of contaminants may remain in the vadose zone given the ongoing elevated PCE concentrations detected in USGS-42.

84. **Comment:** The Austin Chalk ground water at SSP is not a Class 1 unit.

EPA Response: EPA disagrees. The State of Texas, in the Texas Administrative Code, Title 30, Part 1, Chapter 350, Subchapter C, Rule § 350.52 (Ground Water Resource Classification), identifies conditions required for a ground water resource classification. For a Class I classification, the ground water bearing unit must meet one of three conditions. For the Bandera Road Site, the ground water meets the following Class 1 condition:

(1)(A) any ground water-bearing unit within ½ mile of an existing well used to supply drinking water to a public water system as defined in §290.38 of this title (relating to Definitions), as amended, which can contribute COCs to the ground water production

zone of such public water supply well based on chemical properties of the COCs, the hydrogeology, and the construction of the well.
The Bandera Road Ground Water Plume map, Figure 3 (Ground Water Plume Map) in the Hazard Ranking System Documentation Record (TCEQ 2006b), is based on 11 wells which met the criteria for an observed release of PCE and/or TCE. The SSP property is the location of the highest PCE ground water detection every recorded for the Site (i.e., 11,700 µg/L) and is located within the designated ground water plume boundary.

For a Class II classification, the ground water bearing unit must meet one of the following two conditions:

(2)(A) any ground water-bearing unit which is a ground water production zone for an existing well located with ½ mile of the affected property and which is used to supply ground water for human consumption, agricultural purposes or any purpose which could result in exposure to human or ecological receptors; or

(2)(B) any ground water-bearing unit which is capable of producing waters with a naturally occurring total dissolved solids content of less than 10,000 milligrams per liter and at a sustainable rate greater than 150 gallons per day to a well with a four inch diameter casing or an equivalent sustainable rate in gallons per day to a well with a smaller or larger diameter casing.

An existing private water well is currently being used by a local citizen for within ½ mile of the SSP property.

Class I and Class II ground water resources are considered to be current and potential sources for drinking water. The NCP states that “EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.”

85. **Comment:** Contamination in the Austin Chalk ground water at SSP is not a potential threat to water supply wells in the Edwards Aquifer.

EPA Response: EPA disagrees. As discussed previously, solvent (i.e., PCE, TCE) impacted Austin Chalk ground water has already impacted the underlying Edwards Aquifer in the area of the SSP property. It remains uncertain as to whether all improperly completed, deteriorating, or abandoned wells have been located and thus properly plugged. In regards to the SSP property, the Edwards Aquifer Authority (EAA) recently identified the potential locations of historical wells in the area using old right-of-way maps/historical photographs. The EAA obtained access to properties and marked potential well locations using a surveying contractor. The EAA then procured a surface geophysics contractor who applied ground penetrating radar, EM-61 technology, and magnetic gradient technology to search for buried well casings at the potential well locations. Using these technologies, an abandoned well was located within the SSP parking lot.

In addition to historical wells, based on cross-sections from the EAA, minor faults appear to be present within the investigation area (within 2 miles from the center of the contamination plume) and may contribute to the hydraulic communication between the Austin Chalk and the Edwards Aquifer (TCEQ, 2006b). Based on review of field borehole logs and geophysical investigation determination (EPA, 2011), and a fracture trace analysis determination (EPA, 2008), faults were identified in the Site area.
From April 2007 through May 2012, the Leon Valley municipal water wells located at 7520 Huebner Road (designated USGS-18) and 6210 Grass Hill Road (designated USGS-50), have each been sampled 41 times by contractors for the EPA and the TCEQ. These wells along with the San Antonio Water System Evers Road/Wurbach Road well field provide drinking water for thousands of Leon Valley and San Antonio businesses and residents in the area. In January 2010, the Leon Valley public water supply wells provided 2,213 active services and pumped an average of 948,000 gallons per day. The following table list PCE detections in the Leon Valley public water supply wells:

Sampling Date	Leon Valley Municipal Public Water Supply Wells		
	7520 Huebner Road – USGS-18 (µg/L)	6210 Grass Hill - USGS-50 (µg/L)	
		Original Sample	Duplicate Sample
06/10/2009	0.18 J	0.14 J	0.19 J
06/07/2010	0.10 LJ	0.18 LJ	0.19 LJ
07/12/2010	0.17 LJ	0.24 LJ	0.24 LJ
04/13/2011	U	0.21 LJ	0.20 LJ
10/17/2011	U	U	0.23 LJ
05/07/2012	U	U	U

Notes:

J	Estimated value
L	Reported concentration below the Contract Required Quantitation Limit
U	Compound was not detected at or above the sample detection limit (0.5 µg/L)

In the U.S. Geologic Survey's fact sheet, *Assessing the Vulnerability of Public-Supply Well to Contamination: Edwards Aquifer Near San Antonio* (U.S. Department of the Interior/U.S. Geologic Survey, 2011), the vulnerability of the San Antonio Water System's Evers Road/Wurzbach Road well field to contamination was assessed. This Edwards Aquifer well field is located approximately 1.1 miles from the SSP property and provides drinking water for thousands of people in San Antonio and Leon Valley. Typically, this well field yields 20-21 millions of gallons per day. Samples collected by USGS personnel in 2004 and 2005 from a public-supply well in the selected well field contained some constituents of concern for drinking water quality, including the volatile organic compound PCE. These constituents were detected in untreated water at concentrations much less than established drinking-water standards. Most of the constituents of concern detected in the selected well field are anthropogenic (introduced by human activity). For example, PCE is a man-made chemical that is commonly used as a solvent in industrial and commercial facilities and at dry cleaners.
Overall, the study findings point to four primary factors that affect the movement and fate of contaminants and the vulnerability of the public-supply well field in San Antonio,

Texas: (1) ground water age (how long ago water entered, or recharged the aquifer), (2) fast pathways for flow of ground water through features formed or enlarged by dissolution of bedrock, (3) recharge characteristics of the aquifer, and (4) natural geochemical processes within the aquifer.

Ground water age refers to the elapsed time since water entered the aquifer at the water table. Because water in an aquifer typically flows downward and laterally over time, it is expected that the youngest water will be found near the water table and older water will be found at greater depths. Ground water age can be estimated by measuring concentrations of tracers (i.e., tritium and its decay product, helium-3). Sampling results from the USGS assessment indicate that ground water in the well field and about 1.5 miles upgradient is generally young, recently recharged water (<1 to 41 years old) throughout most of the thickness of the aquifer. Unlike most aquifer settings, water age does not increase with depth near the well field.

To better understand the blend of water of different ages produced by the public water supply well, a computer model simulation of ground water flow and transport was used to estimate the travel time (or age) of water particles entering the public-supply well. Modeled findings show that the simulated ages of particles reaching the well range from less than one day to 342 years, with a mean age of four years. Insight into well vulnerability can be gained from considering both the longest and shortest travel times to the well. Less than one percent of the water entering the well is 50 or more years old; water in this age range recharged the aquifer before the use of manmade chemicals became prevalent. Such a small percentage of old water offers little potential for dilution of young water containing contaminants from human activities, should changes in land use degrade the quality of water recharging the aquifer in the future.

A more immediate vulnerability is indicated by the shortest travel times to the well. Almost half of the water reaching the public-supply well is less than 2 years old. Such a large percentage of very young water indicates that contaminants entering the aquifer may be transported rapidly to the well and there is limited time for chemical reactions to occur that may attenuate contaminants.

In regards to fast pathways for flow of ground water through features formed or enlarged by dissolution of bedrock, rapid flow of water through dissolution-enlarged pathways was evidenced by fluctuations in ground water chemistry that can be correlated to individual precipitation events. With rain, concentrations of PCE increased (at the selected well field), likely because of accelerated movement of water from an upgradient source to the well (U.S. Department of the Interior/U.S. Geologic Survey, 2011).

Analysis of water samples collected from shallow, intermediate, and deep zones of the Edwards aquifer at public water supply well W4 in the well field and from nearby monitoring wells revealed that water in the vicinity of the selected well field is notably well mixed throughout the sampled thickness of the Edwards aquifer, showing little of the chemical variation with depth that is common in other aquifers. Contaminants were found at all depths, and they did not enter the well through a specific horizon. The well-mixed of the Edwards aquifer is caused by the recharge characteristics of the area combined with the fast flow paths through karst features (i.e., dissolution-enlarged faults, fractures).

Geochemical conditions, such as the oxygen content of ground water, control whether specific contaminants are attenuated or mobilized once they enter the ground water system. In the oxic conditions found throughout the Edwards aquifer (dissolved oxygen concentrations of at least 1 milligram per liter), anthropogenic contaminants such as PCE will not degrade and can persist over long distances.

86. **Comment:** Generally the risk assessment standards are based on unreasonably maximum exposure scenarios and are unnecessarily and unreasonably conservative.

EPA Response: EPA disagrees. Standard risk assessment protocol was used in developing the risk assessment. Since the baseline risk assessment was completed as part of the Site's Remedial Investigation in July 2012, the EPA issued new toxicity information for two of the Site's chemicals of concern – PCE and TCE. The new toxicity information was used to recalculate Site risks. Further discussion of risk assessment can be found in Section 14 (Summary of Site Risks).

87. **Comment**: The indoor air remediation standards are unreasonable because they are based on:

- Overly conservative PCE toxicity values derived from the State of California EPA.
- Samples collected prior to indoor air response activities that have already significantly reduced indoor air concentrations.
- Inapplicable risk standards.

EPA Response: EPA disagrees. Since the baseline risk assessment was completed as part of the Site's Remedial Investigation in July 2012, the EPA issued new toxicity information for two of the Site's chemicals of concern – PCE and TCE. The new toxicity information was used to recalculate Site risks. Further discussion of risk assessment can be found in Section 14 (Summary of Site Risks).

In regards to indoor air concentrations, samples collected throughout EPA's Remedial Investigation, including samples collected in May 2012, were evaluated individually. The risk posed by inhalation of impacted indoor air in Building B1 has come down. However, additional reduction of indoor air COC concentrations is still required.

88. **Comment**: The investigation of other potential sites has not been completed, and other sites may be primary or contributing sources to the Edwards Aquifer contamination.

EPA Response: Additional studies at other potential sites have been completed and are discussed below.

The SSP recently installed one shallow alluvium well and three Austin Chalk monitoring wells at locations consider potential source areas based on prior activities which occurred at these areas. The EPA worked with Craig Tribley (SSP technical representative) in contacting the property owners to request access to install ground water monitoring wells. Access was granted at three of the four locations discussed below:

Former Pride Cleaners located at 6535 Bandera Road

No prior EPA investigative activities occurred at this location. Access to install ground water monitoring wells was requested and granted by the property owner. Two monitoring wells were installed at this location – an Austin Chalk monitoring well (i.e., MW2-6535) and shallow alluvium well (MW4-6535). The total depths of MW2-6535 and MW4-6535 are 180 feet below ground surface and 35 feet below ground surface, respectively. These monitor wells were sampled by the SSP technical representative on March 1, 2012, and by the EPA on May 7, 2012. The results of these sampling events are summarized below:

Compound Detected (µg/L)	**MW2 (Austin Chalk Well)**		**MW4 (Alluvium/Shallow Well)**	
	March 1, 2012 (SSP)	**May 7, 2012 (EPA)**	**March 1, 2012 (SSP)**	**May 7, 2012 (EPA)**
Tetrachloroetyhene (PCE)	2.26 B	5.3 J	0.586 J B	1.3 J
Cis-1,2-Dichloroethene	U	1.3 J	U	U
Carbon disulfide	U	U	0.367 J	U
Benzene	U	U	0.0976 J	U
Chloroform	U	U	0. 3 J	U
Methylcyclohexane	U	U	1.74	U

Notes:

B	The compound was found in the blank and sample
U	Compound was not detected at or above the sample detection limit.
J	Estimated value

Former Air Field located at 6200 Grissom Road

This area was investigated as part of Area of Investigation (AOI) 3 (see Figure 3). The former air field was the location of an impacted Edwards Aquifer well designated DW-37. The maximum PCE concentration in this well was 60.4 µg/L (see Figure 23). Well DW-37 was plugged and abandoned by the EPA in April of 2009 (State of Texas Well Plugging Permit No. C103-114).

As part of the AOI 3, fourteen (14) passive soil gas samples were placed around the former air hanger located adjacent to well DW-37 in addition to seven (7) passive soil gas samples on the backside of the property along the transect between Grissom and El Verde Roads (see Figure 29). No primary contaminants of concern (i.e., PCE, TCE, cis-1,2-DCE, or vinyl chloride) were detected in the passive soil gas samples.

Access to install an Austin Chalk ground water monitoring well was requested and granted by the property owner. The monitoring well was installed by the SSP and was designated MW3-6200. The total depth of MW3-6200 is 195 feet below ground surface. This monitor well was sampled by the SSP technical representative and the EPA on March 1, 2012, and by the EPA on May 7, 2012. The results of these sampling events are summarized below:

Compound Detected (µg/L)	**MW3-6200**		
	March 1, 2012 (EPA)	**March 1, 2012 (SSP)**	**May 7, 2012 (EPA)**
cis-1,2-Dichloroethene	0.26 LJ	U	U
Trichloroethene	0.17 LJ	U	0.23 J
Tetrachloroethane (PCE)	2.00	2.26 B	6.3
Methylene chloride	U	U	U
Carbon tetrachloride	U	U	0.10 J

Notes: µg/L micrograms/Liter (parts per billion)

L	Reported concentration is below the Contract Required Quantitation Limit
J	Estimated value
B	The compound was found in the blank and sample
U	Compound was not detected at or above the sample detection limit.

Kwik Wash Cleaners located at 7007 Bandera Road

This area was investigated as part of Area of Investigation 4 (see Figure 3). This area includes the area in the vicinity of Kwik Wash that is the location of a former dry cleaning facility and an active laundry facility. The dry cleaners operated from approximately 1983 to 1987. There are no operating cleaners within AOI 4. Passive soil gas samples were collected in the vicinity of a former dry cleaner building. The passive soil gas sampling results are the mass collected from the vapor phase emanating from a source. Because this sampling method can report detections at very low concentrations (i.e., nanaograms), it is good screening method to determine if previous spills had taken place. The samples were analyzed for volatile organic compounds. Ten locations around the building were sampled. Five locations found PCE concentrations from 27 nanograms to 330 nanograms (see Figure 33). These PCE concentrations were rather low in comparison to previous soil gas sampling events in other locations.

In 2012, access to install an Austin Chalk ground water monitoring well was requested and granted by the property owner. The monitoring well was installed by the SSP and was designated MW5-7007. This Austin Chalk monitor well was sampled by the EPA on May 7, 2012. Tetrachloroethene was detected at an estimated concentration of 0.76 µg/L. No other compounds were detected.

Former Kwik-n-Neat Cleaners located at 7128 Bandera Road

Access was requested but not granted to install an Austin Chalk ground water monitoring well. Previous passive soil gas sampling was conducted by the EPA at this location in

October 2010. Seven passive soil gas samplers were install around the building foundation. These samplers were left in place for two weeks, removed, and sent for analysis. The passive soil gas sampling results are the mass collected from the vapor phase emanating from a source. Because this sampling method can report detections at very low concentrations (i.e., nanaograms), it is good screening method to determine if previous spills had taken place. The samples were analyzed for volatile organic compounds. Of primary interest to the EPA were chlorinated solvents (i.e., tetrachloroethene, trichloroethene, cis-1,2- Dichloroethene, and vinyl chloride). No chlorinated solvents were detected.

89. **Comment**: The Edwards Aquifer plume appears stable and unchanged in the seven years since the EPA investigation started and there is no threat to the water supply from PCE in overlying zones at SSP, and therefore institutional controls are the most appropriate alternative.

EPA Response: In response to the assertion that there is no threat to the water supply from PCE in the overlying zones at SSP, see EPA Response 85. As discussed in the NCP and in various associated guidance, institutional controls should not be relied upon as the only response to contaminated ground water or as a justification for not taking action under CERCLA (see 40 CFR § 300.430(a)(iii)(D).

90. **Comment**: EPA's justification for the preferred alternatives in the Proposed Plan are inadequate, fail to appropriately consider all of the CERCLA evaluation criteria, conflict with the rankings of the remedial alternatives in the Feasibility Study, and are not supported by the information developed during the RI/FS. In particular:

- The proposed remediation for indoor air (at EPA's projected cost of more than \$300,000) does not take into account a far less expensive remedy that would be equally effective. Using the currently available data, SSP has considered the appropriate technologies for remediation of the SSP site. Using an appropriate analysis of all relevant EPA evaluation criteria as further described in additional comments, SSP believes the preferred remedial alternative for Source Area 1 would include:

    - Building material removal and potential sub-slab depressurization for the indoor air;
    - Institutional controls;
    - Potential remediation of contaminated soil below the Building B1 foundation (subject to further evaluation based on the results of SSP's proposed additional investigation); and
    - Determining if any remaining wells exist in or near SSP that might provide a pathway to the Edwards Aquifer, and plugging those wells.
    -

EPA Response: In regards to building material removal and potential sub-slab depressurization, the EPA is not opposed to these actions. However, to date, these actions alone have not been shown to be able reduce indoor concentrations below the indoor air target remediation goals.

In regards to institutional controls, absent of restricting access to the building, how can institutional controls be used to reduce exposure to indoor air concentrations?

In regards to potential remediation of contaminated soil below the Building B1 foundation, the EPA did consider this action as one of the potential alternatives.

In regards to the comment of determining if any remaining wells exist in or near the SSP that might provide a pathway to the Edwards Aquifer, and plugging those wells, the Proposed Plan identified this action as part of the identified preferred remedial alternative.

91. **Comment**: The proposed identification of soil vapor extraction as the preferred alternative for surface and subsurface soil (at EPA's projected cost of more than $1,500,000) is incorrect because it: (a) wrongfully considered the source materials to be a principal threat waste, (b) erroneously eliminated a less costly and equally protective alternative, (c) failed to consider that site related contaminants have not been shown to be migrating from soils at the SSP site to the Edwards Aquifer, and (4) did not take into account the wide use of institutional controls as an increasing prevalent remedy component at superfund sites.

EPA Response: In response to principal threat waste comment, see EPA Response 83.

For a discussion of the selected remedy, see Section 19 (Selected Remedy).

In regards to the migration of contaminants from soils at the SSP site, see EPA Response 83.

In regards to the use of institutional controls, EPA considers the use of institutional controls a significant component of remedial alternatives with the exception of the "No Action" alternative.

92. **Comment**: The proposed identification of soil vapor extraction as the preferred alternative for vadose zone bedrock (at EPA projected cost of more than $1,500,000) is incorrect because it: (a) wrongfully considered materials in the bedrock to be a principal threat waste, (b) was not justified by any vadose zone bedrock samples, (c) failed to consider that site related contaminants have not been shown to be migrating from the vadose zone bedrock at SSP to the Edwards Aquifer, and (d) did not take into account the wide use of institutional controls as an increasing prevalent remedy component at superfund sites.

EPA Response: EPA disagrees.

The SVE tests conducted in 2010 and 2012 and testing at monitoring well USGS-42 has demonstrated that significant quantities of PCE and its degradation products are present in the vadose zone beneath the SSP property, PCE and its degradation products are leaching into infiltrating water that is entering the Austin Chalk ground water, and that SVE can be used to remove PCE and its degradation products from the vadose zone soil. The results of the 71-hour SVE tests conducted in 2012 indicate that an SVE unit may not need to operate as long as estimated in the feasibility study (i.e., 4 years), thus resulting in significant costs savings. In respect to institutional controls, institutional controls would not prevent the migration of contaminants present in the vadose zone from impacting the underlying ground water or prevent vapor intrusion into overlying buildings.

93. **Comment**: The proposed identification of *in situ* bioremediation (at EPA's project cost of more than $2,300,000) as the preferred remedial alternative for the Austin Chalk ground water is incorrect because it: (a) failed to recognize that the Austin Chalk is not used nor is it likely to be used for drinking water purposes, (b) failed to consider that site related contaminants are not migrating from the Austin Chalk at SSP to deeper water bearing zones, (c) did not take into account the wide use of institutional controls as an increasingly prevalent remedy component at superfund sites, (d) did not recognize the technical impracticability of *in situ* bioremediation to ever achieve drinking water levels (MCLs) in the Austin Chalk ground water, and (e) failed to consider that, for these reasons, *in situ* bioremediation is a technology that has not been successfully implemented at other similar sites in the Austin Chalk.

EPA Response: EPA disagrees.

The Austin Chalk ground water in the site area was being used as a source of drinking water until May 2007. Due to the presence of PCE above the MCL, an alternate source of drinking water was provided to the resident who previously used their private well to pump water from the Austin Chalk formation for their source of drinking water.

As discussed in the NCP and in various associated guidance, if ground water that is a current or potential source of drinking water is contaminated above protective levels (e.g., MCLs or non-zero MCLGs), a remedial action under CERCLA should seek to restore that aquifer to beneficial use (e.g., drinking water standards) wherever possible. In addition, ground water contamination should not be allowed to migrate and further contaminate the aquifer or other media (e.g., vapor intrusion into buildings).

In regards to the comment that site related contaminants are not migrating from the Austin Chalk at SSP to deeper water bearing zones, see EPA Response 85.

In regards to the use of institutional controls, EPA considers the use of institutional controls a significant component of remedial alternatives with the exception of the "No

Action" alternative. The use of institutional controls was identified as a component of EPA's preferred alternative.

In regards to the technical impracticability of the *in situ* bioremediation technology to achieve MCLs in the Austin Chalk and the comment that *in situ* bioremediation has not been successfully implemented at other similar sites in the Austin Chalk, as part of EPA's remedial investigation activities, a *in situ* bioremediation pilot study was conducted in the Austin Chalk at Source Area 2.

On January 11, 2011, 40.8 kilograms of Regenesis 3-D Microemulsion HRC Advance (3DMe™) (Food Grade) was mixed with well water and injected into monitoring well DW-404. Enhanced anaerobic bioremediation using 3DMe™ adds hydrogen (an electron donor) to ground water in order to increase the number and activity of anaerobic microbes that naturally degrade contaminants (i.e., PCE) to ethane, ethene and other innocuous end products. The EPA has been conducting monitoring of well DW-404 for the following parameters:

- PCE and its degradation products (i.e., TCE, cis-1,2 DCE, vinyl chloride);
- Biodegradation products methane, ethane, and ethene; and
- Measuring counts of bacteria capable of reductive declorination of PCE to ethene using bio-trap samplers.

The following table presents monitoring well DW-404 sampling results for PCE and two of its degradation products for samples collected from January 2011 to May 2012.

Monitoring DW-404 Sample Results

Target Compound	***January 2011 (µg/L)***	***February 2011 (µg/L)***	***March 2011 (µg/L)***	***July 2011 (µg/L)***	***January 2012 (µg/L)***	***May 2012 (µg/L)***
PCE	1,570	428	259	61	21	5.0 U
Trichloroethene	37.9	U	U	U	2.7 J	5.0 U
cis-1,2-Dichloroethene	49.4	U	52.5	1100	18	1.1 J

Note

U	Not detected (reporting limit 25 µg/L)
J	Estimated value

Since the addition of the 3DMe™ into monitoring well DW-404 in January 2011, there has been a 99.7% reduction in PCE concentrations. The most recent sampling event, the concentrations for PCE and TCE were not detected with a reporting limit of 5µg/L (i.e., the MCL for PCE and TCE). The MCL for cis-1,2-Dichloroethene is 70 µg/L.

Biodegradation products (i.e., methane, ethane, and ethene) have also been measured. A baseline sample was collected in June 2010 followed by samples in January 2011, July 2011, January 2012, and May 2012 (see following table).

Biodegradation Products	***June 2010 (µg/L)***	***January 2011 (µg/L)***	***July 2011 (µg/L)***	***January 2012 (µg/L)***	***May 2012 (µg/L)***
Methane	0.45	1.1	681	7,720	5,870
Ethane	0.65	3.41	0.97 J	0.32 U	0.32 U
Ethene	1.3	6.17	4.19	24.3	5.38

Note

U	Not detected
J	Estimated value

Methane concentrations greater than 1,000 µg/L are indicative of conditions conducive for reductive dechlorination of chlorinated solvents (i.e., PCE, TCE).

As part of the effort to evaluate the potential for *in situ* biodegradation of chlorinated solvents, the EPA collected water samples for bacteria analysis from monitoring wells (including DW-404) in April 2009. Specifically, the bacteria count for Dehalococcides ssp. (DHC) was determined by Microbial Insights, Inc. The DHC bacteria have been found to be capable of fully dechlorinating PCE to ethene. The April 2009 result for DW-404 found that the DHC counts were less than 0.5 cells/mL. When DHC counts are less than 10 cells/mL, this suggests that complete reductive dechlorination of PCE and TCE to ethene is unlikely to occur under existing conditions.

As part of the ongoing *in situ* bioremediation pilot study, the EPA placed bio-trap samplers in monitoring well DW-404 in February 2011 after the addition of 3DMe™. Bio-trap samplers are a passive sampler tool used to collect microbes over time. In January 2012, a bio-trap sampler was removed from monitoring well DW-404 and sent to Microbial Insights for analysis. The January 2012 analysis found a DHC count of 26,900,000 cells/mL. A DHC concentration of 10,000 cells/mL is used to identify sites where reductive dechlorination will yield a generally useful biodegradation rate.

Based on the results outlined above, the application of 3DMe™ has been found to create conditions in monitoring well DW-404 conducive to the reductive dechlorination of PCE to ethene. Based on the results of the May 2012 sampling, MCLs have been achieved.

94. **Comment**: The Proposed Plan fails to consider or even note past PCE contamination in the Edwards Aquifer near the SSP vicinity prior to the operation of a dry cleaning operation on the SSP property. This could very well mean that the only Edwards well contaminated near the SSP Site (which was plugged) could have been contaminated by a completely different source and that the SSP Site is and continues to be a limited site that does not impact the Edwards Aquifer. Similarly the Proposed Plan does not mention the band of wells located across northern Bexar County, again prior to the operation of dry cleaners at SSP.

EPA Response: The EPA did consider historical data for the area. The single page with the image of partial chromatograph dated 3/17/83 with George B. Ozuna’s U.S. Geological Survey business card was provided to the EPA by Craig Tribley. The image had hand written notes identifying three peaks on the chromatograph and designated that the analysis was from a sample collected from a well designated Huebner # AY-68-28-702. This well designation corresponds to the Leon Valley municipal water supply well located at 7520 Huebner Road. One peak was identified as tetrachloroethylene (i.e,, PCE) with a concentration of 0.2 parts per billion. No supporting documentation was provided.

Historical data were evaluated to ensure that it met data quality assessment goals for incorporation into the Remedial Investigation Report. The following data quality assessment goals were used to evaluate historical data:

- Collected in accordance with generally accepted practices for data collection
- Sample locations documented using definitive identifier
- Demonstrated a chain-of-custody from sample collection through analyses
- Analyzed by an acceptable TCEQ or EPA accredited laboratory
- Validated using EPA data validation rules
- Represent current conditions at the Site

The historical data was considered by the EPA but was not incorporated in the site's Remedial Investigation Report, specifically the site's risk assessment because it did not meet the data quality assessment goals.

In regards to the band of wells located across northern Bexar County, these wells are outside the scope of EPA's Bandera Road Ground Water Plume investigation. However, these wells do draw a parallel with the findings of U.S. Geological Survey's National Water-Quality Assessment (NAWQA) Program studies. Among the major findings are that VOCs were detected in most aquifers throughout the Nation, and were not limited to a few specific aquifers or regions. VOCs were not detected, however, in many of the nearly 3,500 sampled wells; for example, about 80 percent had no detections above a threshold of 0.2 part per billion. The most frequently detected VOCs were chloroform, the solvents PCE and TCE, and the gasoline oxygenate MTBE. The occurrence of VOCs commonly corresponded to percentage of urban land use within a one-half kilometer radius of sampled wells. VOC detections generally were higher in shallow ground water underlying urban areas than in shallow ground water underlying other land-use areas.

Chlorinated solvents (i.e., PCE, TCE) have physical properties that allow them to be transported to, and be persistent in, ground water. In general, these solvents have relatively high densities, which allow them to penetrate the water table, and a high solubility, which allows them to move readily with ground water. The half-lives of solvents in ground water generally are longer than those of other commonly used VOCs, like gasoline hydrocarbons. This means that solvents can persist for relatively long periods of time in certain aquifers.

Protecting and managing ground water are critical. Nearly one-half of the Nation's population depends on ground water for drinking and other household uses, and it is an important natural resource that supports many of the Nation's industrial, agricultural, and commercial activities.

95. **Comment**: SSP again urges EPA to consider remanding this site back to the State of Texas for remediation under the Texas Dry Cleaner Program.

EPA Response: Pursuant to 30 Texas Administrative Code Chapter 337.208 (b)(3)(B)(i) (Dry Cleaner Environmental Response, Unauthorized Payments), the Texas Commission on Environmental Quality may not spend money from the fund for payment of any costs related to corrective action at a dry cleaner facility that has been included by the United States Environmental Protection Agency on the national priorities list.

23.0 REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. “Public Health Assessment for Bandera Road Ground Water Plume Leon Valley.” 28 September.

ATSDR. 2009. Letter Health Consultation. 4 March

Beacon. 2008. Beacon Environmental Services, Inc. (Beacon). Passive Soil Gas Survey. Bandera Road Ground Water Plume Superfund Site. 3 December.

Beacon. 2009. Passive Soil Gas Survey. Bandera Road Ground Water Plume Superfund Site. 17 November.

Beacon. 2010. Passive Soil Gas Survey. Bandera Road Ground Water Plume Superfund Site. 30 August.

Beacon. 2011. Passive Soil Gas Survey. Bandera Road Ground Water Plume Superfund Site. February.

City of Leon Valley. 2009. 2009 Comprehensive Master Plan. 20 January.

City of Leon Valley Fire Department. 1997. Incident Report. 6 October.

EA Engineering Science and Technology, Inc. (EA). 2010. Monitored Natural Attenuation Screening. August

EA. 2011. Soil Vapor Extraction Pilot Test Report. Bandera Road Ground Water Plume Superfund Site. March

EA. 2011a. Remedial Investigation Report. Bandera Road Ground Water Plume Superfund Site. Leon Valley, Bexar County, Texas. July.

EA. 2011b. Feasibility Study Report. Bandera Road Ground Water Plume Superfund Site. Leon Valley, Bexar County, Texas. July

EA. 2012. Field Activity Report. Bandera Road Ground Water Plume Superfund Site. Leon Valley, Bexar County, Texas. October.

E^2, Inc. (E^2). 2010. Final Reuse Assessment Report. June.

Edwards Aquifer Authority (EAA). 2010. Tracer Testing at the Bandera Road Ground Water Plume Superfund Site.

Historical Society of Leon Valley. 2007. Home Page of Leon Valley Historical Society. Accessed February 2011. http://www.e2sq.com/lvhs/home.htm

Microbial Insights. 2012. Bandera Road Ground Water Plume Site Laboratory Report. January.

RMT/Jones & Neuse, Inc. 1995. Remedial Investigation Report. June.

RMT/Jones & Neuse, Inc. 1995a. Corrective Measures Study. June.

Round Rock Geophysics, LLC. 2012. The Use of Ground Penetrating Radar (GPR), EM-61 and Magnetic Gradient Methods to Locate Wells in Leon Valley, San Antonio, Texas. February

SAIC. 2009. San Antonio International Corporation . Final Summary Report. Bandera Road Ground Water Plume Investigation, Leon Valley, Texas. June.

Singh, A., Singh, A.K., and R.W. Maichle. 2007. ProUCL Version 4.0, User Guide. On-line address: http://www.epa.gov/nerlesd1/tsc/images/proucl3apr04.pdf.

Stein, G., William, and George B. Ozuna. 1995. Geologic Framework and Hydrogeologic Characteristics of the Edwards Aquifer Recharge Zone, Bexar County, Texas.

Texas Commission on Environmental Quality (TCEQ). 2003. Quality Assurance Project Plan. Texas Commission on Environmental Quality – Preliminary Assessment/Site Inspection Program. November.

TCEQ. 2004. Site Screening Investigation. Bandera Road Ground Water Plume. Leon Valley/San Antonio, Bexar County, Texas. July.

TCEQ. 2006. Preliminary Assessment / Site Inspection. Bandera Road Ground Water Plume. Leon Valley/San Antonio, Bexar County, Texas. July.

TCEQ. 2006a. Hazard Ranking System. Documentation Record. Bandera Road Ground Water Plume. Leon Valley/San Antonio, Bexar County, Texas. September.

Texas Water Development Board. 1986. Report 296. Carbonate Geology and Hydrology of the Edwards Aquifer in San Antonio Area, Texas. November

U.S. Census Bureau. 2000. Profile of General Demographic Characteristics: 2000. Accessed February 2011http://factfinder.census.gov/servlet/QTTable?_bm=y&-geo_id=16000US4842388&-qr_name=DEC_2000_SF1_U_DP1&-ds_name=DEC_2000_SF1_U&-_lang=en&-_sse=on

U.S. Department of Agriculture/ Texas Agricultural Experiment Station. 1962. Soil Survey, Bexar County Texas. March.

U.S. Department of the Interior/U.S. Geologic Survey. 2011. Assessing the Vulnerability of Public-Supply Wells to Contamination: Edwards Aquifer Near San Antonio, Texas. Fact Sheet 2011-3142. November.

EPA. 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. Office of Emergency and Remedial Response (OERR). EPA/540/1-89/002. December.

EPA. 1991. A Guide to Principal Threat and Low-level Threat Waste. OSWER Directive 9380.3-06FS. November

EPA. 2002. Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Ground water and Soils (Subsurface Vapor Intrusion Guidance). November.

EPA. 2004. "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)." Final. EPA/540/R/99/005. Office of Superfund Remediation and Technology Innovation. July.

EPA. 2008. Fracture Trace Analysis Report of Bandera Road Ground Water Plume Site. City of Leon Valley, Texas. Environmental Sciences Division. Las Vegas, NV. TS-PIC-20806003S. September.

EPA. 2008a. A Guide for Assessing Biodegradation and Source Identification of Organic Ground Water Contaminants using Compound Specific Isotope Analysis (CSIA). EPA 600/R-08/148. Available on-line at: www.epa.gov/ada. December

EPA. 2009. Summary of Key Existing EPA CERCLA Policies for Ground Water Restoration, Office of Solid Waste and Emergency Response, OSWER Directive 9283.1-33. June.

EPA. 2010. Regional Screening Levels for Chemical Contaminants at Superfund Sites. Available On-line at: http://www.epa.gov/region09/superfund/prg/. April.

EPA. 2011. Remedial Investigation Report – Revision 01. July.

Weston Solutions, Inc. 2012. Supplement Remedial Investigation Report Area of Interest 1. Bandera Road Ground Water Plume Site. Leon Valley. Bexar County. Texas. August.

Willowstick Technologies, LLC. 2010. AquaTrack Geophysical Investigation. Bandera Road Ground Water Plume Superfund Site. 27 January.