

## Section 1

# Introduction

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The purpose of the Superfund program is to address threats to human health or the environment resulting from releases or potential releases of hazardous substances from abandoned or uncontrolled hazardous waste sites. The Superfund program is defined under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), passed in 1980. This Act gave the Federal government, for the first time, authority to take direct action or force the responsible party to respond to emergencies involving uncontrolled releases of hazardous substances.

The Act also required the Federal government to develop longer-term solutions for the nation's most serious hazardous waste problems. CERCLA gave authority to the President who, in turn, delegated primary responsibility to the United States Environmental Protection Agency (EPA) for managing activities under the Superfund program. The activities under the Superfund program include:

- Identifying sites where releases of hazardous substances had already occurred or might occur and pose a serious threat to human health, welfare, or the environment.
- Taking appropriate action to remedy such releases.
- Ensuring that parties responsible for the releases pay for the cleanup actions. This payment could be either the initial funding of cleanup actions or the repayment of Federal funds spent on response actions.

On October 17, 1986, Congress passed amendments to CERCLA, called the Superfund Amendments and Reauthorization Act (SARA). SARA made several important changes and additions to the Superfund Program that strengthened and expanded the cleanup program. SARA included a freestanding statute, Title III. This statute increased community awareness and access to information regarding the presence of extremely hazardous chemicals in their community.

A comprehensive regulation known as the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) contains the guidelines and procedures for implementing the Superfund program. From the beginning of the Superfund process, EPA makes every effort to identify the parties responsible for the hazard and encourage them to respond. If efforts to ensure responsible party response do not lead to prompt action, EPA may act using Trust Fund monies.

Superfund cleanups must be tailored to the specific needs of each site or hazardous substance release. EPA may respond with enforcement or Trust Fund-financed removal actions or remedial actions, collectively known as “response actions.”

Enforcement actions to obtain voluntary settlement, or if necessary, to compel Potentially Responsible Parties (PRPs), may be taken to implement removal or remedial actions. Once the PRP has agreed to take response actions at a site, the enforcement program ensures that the studies or cleanup activities are performed correctly and in accordance with the order or decree, the statute, the NCP, and relevant guidance.

The Superfund program is triggered by a “release” or a “substantial threat of a release” of hazardous substances into the environment. A “release” is defined in CERCLA as any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing of hazardous substances into the environment. The definition of a release includes the abandonment or discarding of barrels, containers, or other closed receptacles containing a hazardous substance, pollutant, or contaminant. The release must involve either:

- A hazardous substance, as defined in the Superfund statute, or;
- A pollutant or contaminant that may present an imminent or substantial danger to the public health or welfare.

EPA’s list of the most serious releases in the United States is called the National Priorities List (NPL). At or before the time a site is listed on the NPL, the lead agency or PRP begins a Remedial Investigation/Feasibility Study (RI/FS). During an RI/FS, information is gathered to support an informed decision regarding which remedy is most appropriate for a site or operable unit.

Remedial actions at NPL sites are designed to provide permanent solutions to mitigate risk to human health and the environment from the release of hazardous substances to the maximum extent practicable. CERCLA, commonly known as Superfund, authorizes EPA to conduct remedial activity or to enter into site-specific agreements to allow other agencies and/or groups or parties to conduct remedial activity. The remedial process includes steps to develop, design, and conduct a remedial action. Remedial actions are long-term actions that stop or substantially reduce a release or threatened release.

The remedial process is made up of the following six phases:

- Remedial Investigation (RI)

- Feasibility Study (FS)
- Selection of Remedy
- Remedial Design (RD)
- Remedial Action (RA)
- Operation and Maintenance (O&M)

The RI is an assessment of the nature and extent of site-related contamination and the associated health and environmental risk associated with the site-related contaminants. The RI is much more detailed and comprehensive than initial site inspection activities, which may be performed prior to the site being added to the NPL, and is designed to provide information needed to develop and evaluate cleanup alternatives. The RI determines the existence and nature of any actual threat that could be posed to human health or the environment, and defines the extent of the threat posed to human health or the environment by the contamination found at a site.

In general, the RI consists of the following actions:

- Determining the nature and extent of the contamination at the site or operable unit.
- Assessing risks to human health and the environment from this contamination.
- Conducting treatability tests to evaluate the potential performance and cost of the treatment technologies being considered for addressing these risks.

In characterizing the site, the lead agency (EPA) or the PRP identifies source of contamination, potential routes of migration, current and potential human and environmental receptors. A baseline risk assessment conducted during the RI estimates what risks the site poses now and would pose in the future if no cleanup action were taken. Thus, it provides the basis for taking action and identifies contaminants and the exposure pathways that need to be addressed by the remedial action.

Treatability studies are bench, pilot, or full-scale tests of particular technologies on samples of actual site wastes (EPA, 1999). Such studies are not always necessary, and are more commonly used at sites where innovative technology will be employed, or at sites where site-specific analysis is needed to determine which technologies are more suitable for addressing a particular waste.

The FS provides for the development and analysis of a range of cleanup alternatives for the site. This process begins with the formulation of viable alternatives, which involves defining Remedial Action Objectives (RAOs), general response actions, volumes or areas of media to be addressed, and

applicable technologies. Generally, following a preliminary screening of alternatives, a reasonable number of appropriate alternatives undergo a detailed analysis using the nine evaluation criteria in the NCP. The detailed analysis profiles individual alternatives against the criteria and compares them with each other to gauge their relative performance. Each alternative that makes it to this stage of the analysis, with the exception of the required “No Action” alternative, is expected to be protective of human health and the environment and compliant with Applicable or Relevant and Appropriate Requirements (ARARs) (unless a waiver is justified), which are both requirements under CERCLA (EPA, 1999).

In the Superfund regulations (the NCP), EPA established a national goal and a series of expectations to reflect the principal requirements of Section 121 of the CERCLA statute and to help focus the RI/FS on appropriate waste management options. EPA also developed nine criteria for evaluating remedial alternatives to ensure that all important considerations are factored into remedy selection decisions. The nine criteria analysis comprises two main steps: an individual evaluation of each alternative with respect to each criterion; and a comparison of options to determine the relative performance of the alternatives and identify major trade-offs among them (i.e., relative advantages and disadvantages).

The Superfund remedy selection process links the analysis of site cleanup alternatives conducted in a RI/FS with the documentation of the selected remedy in a Record of Decision (ROD). Section 121 established five principal requirements for the selection of remedies. Remedies must: 1) protect human health and the environment; 2) comply with ARARs unless a waiver is justified; 3) be cost-effective; 4) utilize permanent solutions and alternative treatment technologies to the maximum extent practicable; and 5) satisfy a preference for treatment as a principal element, or provide an explanation in the ROD as to why this preference was not met.

EPA selects its preferred alternative, and releases to the public a Proposed Plan documenting why EPA believes that the preferred alternative is capable of remediating the site. Once the public has had its opportunity to review and comment, EPA documents its selected remedy in the ROD.

This report presents the results of the FS conducted pursuant to CERCLA, as amended by SARA, 42 United States Code (USC), Section 9601 et. Seq., and the NCP, 40 Code of Federal Regulations (CFR), Part 300, at the Griggs and Walnut Avenue Ground Water Plume (GWP) Superfund Site in Las Cruces, Doña Ana County, New Mexico (EPA ID NM0002271286). This report was prepared based on information obtained from the RI Report and the risks identified in the Baseline Human Health Risk Assessment (BHHRA) and Ecological Risk Assessment (CH2M HILL, 2006a). EPA

performed this study in cooperation with the New Mexico Environment Department (NMED), the City of Las Cruces (CLC), and Doña Ana County (DAC).

The EPA presumptive remedy guidance entitled, *Presumptive Response Strategies and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites* (EPA, 1996) was used as the starting point for developing alternatives for detailed analysis. Since the guidance document was released in October 1996, more recent technical advances have been made. Therefore, more recent widely accepted technologies and design variations on presumptive remedy technologies were also considered. Also used in the development of this report was EPA's *Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA* (EPA, 1988).

## 1.1 Purpose

The national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste (40 CFR 300.430(a)(1)(i)).

EPA considers the following expectations while developing appropriate remedial alternatives (40 CFR 300.430(a)(1)(iii)(A-F)):

- EPA expects to use treatment to address the principal threats posed by a site, wherever practicable.
- EPA expects to use engineering controls, such as containment, for waste that poses a relative low long-term threat or where treatment is impracticable.
- EPA expects to use a combination of methods, as appropriate, to achieve protection of human health and the environment.
- EPA expects to use institutional controls, such as water use and deed restrictions, to supplement engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous substances, pollutants or contaminants.
- EPA expects to consider using innovative technology when such technology offers the potential for comparable or superior treatment performance or implementability, fewer or lesser adverse impacts than other available approaches, or lower costs for similar levels of performance than demonstrated technologies.

- 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.

To provide for the development of appropriate response actions, the FS establishes RAOs, defines specific Preliminary Remediation Goals (PRGs) to meet the RAOs, and provides detailed analysis of appropriate remedial alternatives described under the presumptive remedy approach.

## 1.2 Report Organization

This report is divided into five primary sections. These five sections are identified and described below.

**Section 1.0 Introduction** – This section presents an overview of available background information, including a description and history of the site, site geologic and hydrogeologic conditions, the nature and extent of contamination, discussion of fate and transport of site contaminants, and a summary of human health and ecological risks.

**Section 2.0 Applicability and Review of Remedy Technologies** – This section provides a discussion of the applicability and review of the presumptive remedy approach, beginning with a presentation of the development of the RAOs, a description of the ARARs associated with the site, a description of the PRGs selected to meet the RAOs, and the corresponding volumes of material required to be remediated at the site based on the documented nature and extent. This discussion is followed by the identification of applicable presumptive remedy technologies, along with selected more recent widely-accepted technologies or design variations of presumptive technologies, developed since the presumptive remedy guidance was released in 1996.

**Section 3.0 Development of Alternatives** – This section assembles the remaining remedial technologies into remedial alternatives that achieve some or all of the remedial action goals, and provide a range of levels of remediation and a corresponding range of costs.

**Section 4.0 Detailed Analysis of Alternatives** – This section provides a detailed analysis of the remedial alternatives. Each alternative is evaluated based on its overall protection of human health and the environment, compliance with ARARs, long-term effectiveness, reduction of toxicity, mobility or volume (TMV), short-term effectiveness, implementability, and cost.

**Section 5.0 References** – This section identifies reference documentation used during preparation of this FS Report.

## 1.3 Site Background

This section provides a summary of the information available for the site. The information presented includes a description of the site and its history, geologic and hydrogeologic conditions, general ground water chemistry, nature and extent of contamination, the fate and transport of contamination and a summary of risks at the site, provided in more detail in the RI Report (**CH2M HILL, 2006a**).

### 1.3.1 Site Description

The GWP site contains soil vapor and ground water contaminated with perchloroethylene (PCE, also known as tetrachloroethene or tetrachloroethylene). PCE, a volatile organic compound (VOC), is a solvent used in the United States since the 1930's for dry cleaning and parts-cleaning operations. There is some evidence that PCE may have the potential to cause cancer after long-term exposure (**EPA, 1995**).

Under the Safe Drinking Water Act (SDWA), EPA sets Maximum Contaminant Levels (MCLs) for drinking water using the National Primary Drinking Water Regulations and Standards for regulating contaminants. These values are intended to protect the health of people drinking water from public systems over their lifetime. All public water systems (either publicly- or privately-owned) that serve at least 25 people or 15 service connections for at least 60 days per year must abide by these regulations. The MCL for PCE is equal to 5 parts per billion (ppb) or micrograms per liter ( $\mu\text{g/L}$ ); this level has been in effect since 1993.

Under the NCP, maximum contaminant level goals (MCLGs) that are set at levels above zero and established under the SDWA shall be attained by remedial actions for current and potential sources of drinking water, where the MCLGs are relevant and appropriate under the circumstances of the release. If a MCLG is determined not to be relevant and appropriate, the corresponding MCL shall be attained where relevant and appropriate to the circumstances of the release. Where the MCLG for a contaminant has been set at a level of zero, the MCL promulgated for that contaminant under the SDWA shall be attained by remedial actions for current or potential sources of drinking water where the MCL is relevant and appropriate under the circumstances of the release.

The GWP site contamination is located in the subsurface generally between East Griggs Avenue and East Hadley Avenue in Las Cruces, Doña Ana County, New Mexico, extending east to beyond Interstate 25 (I-25), and west to beyond North Solano Avenue. This is an area dominated by recreational, light industrial/commercial, and residential land uses. The geographic coordinates at this location are approximately 32° 18' 56.0" north latitude and 106° 45' 36.0" west longitude. **Figure 1-1** shows the location of the site within the CLC, along with the locations of affected and unaffected

municipal and private supply wells located in the area, and an outline of the estimated extent of PCE detections associated with the GWP site.

The ground water contaminated with PCE at the GWP site occurs within an aquifer used by the CLC for public drinking water supply and irrigation. This aquifer, the Mesilla Bolson Aquifer, extends below the entire length of the Mesilla Valley. At the GWP site, ground water occurs 100 feet (ft) or more below ground surface (bgs). Along with municipal water supply wells, a limited number of private wells also tap into this aquifer; of those private wells that are still in use, the owners of these wells use them primarily for irrigation. Five of these wells are located within one-half mile of the known boundary of PCE-affected ground water associated with the GWP site (JSAI, 2005, NMOSE, 2000, and NMOSE, 2005). None of the private wells are located within the GWP plume boundary or downgradient of the plume boundary within one-half mile of the site.

Four municipal drinking water supply wells (CLC Well Nos. 18, 19, 21, and 27) are affected by the PCE known to be associated with the GWP site (Figure 1-1). NMED first identified the PCE contamination associated with the GWP site beginning in 1993, in CLC Well Nos. 21 and 27. NMED detected PCE in CLC Well No. 19 in 1994 and in CLC Well No. 18 in 1995. CLC Well No. 18 is located northwest of the intersection of East Griggs Avenue and North Walnut Street, between East Griggs and Hadley Avenue (on the north side of the Doña Ana County Transportation Department [DACTD] maintenance facility). CLC Well No. 19 is located along the west side of I-25 at the east end of East Griggs Avenue. CLC Well No. 21 is located along the west side of I-25 at the east end of Craig Avenue. CLC Well No. 27 is located near the southeast corner of the East Griggs Avenue and North Walnut Street intersection. Of these wells, only CLC Well No. 21 remains in service. PCE concentrations at this well have been detected near (both above and below) the MCL of 5 µg/L. The CLC manages Well No. 21's usage under a blending program approved by the NMED Drinking Water Bureau (DWB) (NMED, 2002).

The CLC designed the blending program to mix affected water with unaffected water in the Upper Griggs Reservoir to reduce PCE concentrations to levels below the MCL before the water reaches the distribution system (NMED, 2002). The Upper Griggs Reservoir is an above-ground water supply storage tank located along I-25 at the east end of East Griggs Avenue (Figure 1-1). The CLC monitors the concentration of PCE in the Upper Griggs Reservoir to ensure compliance below the MCL. Periodic sampling performed in 2005 (from January 2005 through December 2005) revealed PCE concentrations at the Upper Griggs Reservoir ranged from not detected to 3.2 µg/L (with an average concentration of about 1.7 µg/L).

Samples from one additional municipal supply well (CLC Well No. 24) contain low concentrations of PCE. In December 2005, EPA measured the PCE concentration in this well at 0.68 µg/L. CLC Well No. 24 is located about one mile south of CLC Well Nos. 18, 19, 21, and 27 (**Figure 1-1**). Three unaffected municipal supply wells (CLC Well Nos. 20, 26, and 61) are located between CLC Well No. 24 and CLC Well Nos. 18, 19, 21, and 27. This fact, combined with information about field-measured ground water flow gradients discussed later in this report, indicates that the contamination at CLC Well No. 24 is unrelated to the contamination at the four GWP site-affected municipal supply wells.

PCE has also been detected in the past at low concentrations (below the MCL) in one private well (LRG-3191, located southwest and outside of the GWP plume) and one public school irrigation well (LRG-1457, located south and outside of the GWP plume, near CLC Well No. 24). The resident reports that well LRG-3191 is used primarily for residential yard watering. Recent samples at this well show no detections of PCE. Lynn Middle School used well LRG-1457 previously to provide irrigation at the school, but this well is no longer in service because of mechanical problems.

### 1.3.2 Site History

PCE was formally added to the list of contaminants to be monitored in drinking water supplies under the SDWA in 1993. In a sampling event performed by the NMED DWB prior to the SDWA requirement, in 1991, PCE was not detected in CLC wells. NMED DWB performed the first sampling event under the new requirements in August 1993. In this sampling event, the first detections of PCE were recorded (at CLC Well Nos. 21 and 27). Concentrations of PCE in these wells at this time were below the MCL of 5 µg/L.

PCE was first detected in CLC Well No. 18 by the NMED DWB in January 1995, at a concentration that exceeded the MCL of 5 µg/L. In a re-sample collected the following month, the concentration was below the MCL, although it was again above the MCL in a sample collected in January 1996. PCE was first detected in CLC Well No. 19 in February 1994, at a concentration below the MCL. PCE was first detected in CLC Well No. 24 in June 2000, also below the MCL.

Over time, the concentrations detected in CLC Well No. 18 have varied widely, ranging from at or near the MCL of 5 µg/L to over 45 µg/L. Limited operation of CLC Well No. 18 and its well construction could have affected PCE concentrations in the samples collected. No specific information is currently available to evaluate the cause of the variable PCE concentration in CLC Well No. 18. The concentrations in the other affected wells have increased slightly over time, but

have stayed near or below the MCL. **Figure 1-2** illustrates the locations of the CLC municipal supply wells near the site and the detections of PCE in each well from August 1993 through June 2006.

Since the initial detections of PCE, CLC and NMED have monitored PCE concentrations in the municipal supply wells as part of compliance monitoring required under the SDWA. The CLC has provided drinking water that meets MCLs by removing from service wells that exceed the MCL, or by diluting contaminated ground water to concentrations below the MCL through the blending program approved by the NMED DWB. As noted above, of the four affected GWP wells, only CLC Well No. 21 is still in service. The CLC manages this well's usage under the NMED-approved blending program, which includes more frequent monitoring (up to bi-weekly, depending on production and detected concentrations). CLC Well No. 24 is also still in service, but PCE concentrations in this well have remained below the MCL, as documented by the monitoring performed by the CLC and NMED.

Environmental investigations performed at the site since the contamination was first discovered show PCE has been detected at the GWP site in ground water at depths of up to 635 feet (ft) below ground surface (bgs) (an approximate elevation of 3,500 ft above mean sea level [MSL]) and in soil vapor in the unsaturated zone above the affected ground water (from ground surface to the water table, which occurs at about 100 to 200 ft bgs (an approximate elevation of 3850 ft MSL). The GWP site was added to EPA's NPL on June 14, 2001 (66 Federal Register 32235 [June 14, 2001]) based on data collected by NMED between 1993 and 2001. These data included analytical results from the sampling of soil vapor and ground water.

At the time the site was added to the NPL in June 2001, EPA initiated the RI/FS. The first RI field mobilization was performed by EPA with support from NMED during April 2002 through February 2003. This mobilization included the collection of over 600 soil vapor samples, the installation of 7 deep soil vapor monitor points (SVMPs), the installation of 8 multi-level ground water monitor wells, and the collection of over 200 ground water samples from new and existing monitor wells. EPA summarized the results and conclusions from this mobilization in a report entitled *The Identification of PCE Release Areas* (also referred to as the IDRA Report) (EPA, 2003).

Based on the areas of contamination described in the IDRA Report, EPA determined where PCE was released at the ground surface. The IDRA Report concluded that the PCE was released to the surface soil and migrated to ground water over time. Three areas, where higher relative concentrations of PCE occurred in the soil vapor were identified as source areas. These three areas are located as follows:

1. Near the intersection of East Hadley Avenue and North Walnut Street (along the former airport runway and the former arroyo parallel to and south of the former airport runway).
2. At the DACTD maintenance facility on East Griggs Avenue.
3. At the former National Guard Armory on East Hadley Avenue.

In January 2004, a comprehensive ground water sampling event was performed to evaluate potential changes in the ground water plume. In this event, EPA collected samples from all GWP site monitor wells. This sampling event is described in a Technical Memorandum entitled *Results of the January 2004 Ground Water Sampling Event* (**CH2M HILL, 2004**).

Based on the results of the first mobilization for the RI (April 2002-February 2003) and the results of samples collected in January 2004, EPA identified several data needs necessary for completing the RI/FS.

On April 20, 2005, EPA signed a Settlement Agreement with the CLC and DAC to address completion of the RI/FS for the GWP site (**EPA, 2005**). The CLC and DAC formed a local consortium called the Joint Superfund Project (JSP) to facilitate their participation in the agreement. EPA then formed a Technical Work Group with the NMED and the JSP to provide a forum for stakeholders to participate in the completion of the RI/FS and provide input related to stakeholder needs. The GWP Technical Work Group provided input into the final data needs during a meeting on July 21, 2005, in Las Cruces and in subsequent conference calls, and provided review and comment on work plans prepared to direct the work efforts of EPA's consultant during the second field mobilization. The overall objectives for the second field mobilization were to provide data sufficient to refine further the description of the nature and extent of contamination at the GWP site, and to collect data sufficient to perform the BHHRA and evaluate remedial alternatives.

EPA performed the second mobilization field tasks with field sampling support from NMED during October through December 2005. These field tasks included installation of two additional monitor wells, installation of one additional deep SVMP, collection of additional shallow subsurface soil vapor samples, and collection of ground water samples in new and existing monitor wells. The JSP provided computer simulation of flow and transport of PCE in the ground water to refine the conceptual site model and to support the evaluation of remedial alternatives (see **Section 1.3.7**).

A chronology of significant events related to the GWP site is presented in **Table 1-1** of the RI Report (**CH2M HILL, 2006a**).

### 1.3.3 Geologic and Hydrogeologic Conditions

This section summarizes information on the site-specific geologic and hydrogeologic conditions. A detailed description of geologic and hydrogeologic conditions at the site is available in the RI Report (CH2M HILL, 2006).

#### 1.3.3.1 Site Geology

A stratigraphic model was developed for the site based on data obtained from geophysical logging and visual inspection of sediment cuttings obtained during RI drilling activities. The GWP site stratigraphy observed during the monitor well drilling is consistent with the regional stratigraphy documented in published literature for the Rio Grande Alluvium and the Santa Fe Group. Alternating beds of gravels, sands, silts, and clays occur across the vicinity of the site. Many beds can be correlated across most of the area.

The Rio Grande alluvium is present across the western portion of the GWP site. Within the site area, this alluvium is composed primarily of sand and gravel deposits, with some interbedded clays and silts. The base of the unit consists of a thick sand and gravel deposit that is present at depths of between 80 and 120 ft bgs (at approximate elevations between 3,860 and 3,880 ft MSL). This unit was easily recognizable in site monitor wells GWMW03, GWMW04, GWMW06, and GWMW07 and appears to pinch out towards the eastern end of the GWP site. Where present at the GWP site, the Rio Grande alluvium is approximately 80 to 120 ft thick, and only the lower 10 to 15 ft is saturated. The water table occurs within the Rio Grande Alluvium beneath the western portion of the site.

The Santa Fe Group sediments are present at the GWP site beneath the Rio Grande alluvium west of monitor well GWMW03 and at the surface east of GWMW03. Along the eastern portion of the GWP site, the upper part of the Santa Fe Group consists of mostly interbedded sand and gravel deposits. Thinner beds of finer grained deposits are also present. These surficial deposits are between 150 and 260 ft thick and are present down to an approximate depth of 3,850 ft mean sea level (MSL) in elevation. This upper portion of the Santa Fe Group is unsaturated.

A thick layer composed of fine sand with varying percentages of silt and clay is present below the upper portion of the Santa Fe Group deposits and the base of the Rio Grande alluvium. The thickness of this layer is between 50 and 115 ft, is continuous across the site, but thins towards the east. The water table occurs within this unit beneath the eastern portion of the site. At its base, the unit becomes interbedded with silt and clay deposits. These interbedded clay and silt deposits are not present beneath the far eastern portion of the GWP site at monitor well GWMW15.

Below these layers, the Santa Fe Group is composed primarily of fine to coarse sand units ranging in thickness from 10 to 130 ft. These units are commonly separated with thin, interbedded finer grained units. These finer-grained beds are more numerous in the western portion of the GWP site, with the beds pinching out towards the east. Some gravel beds are present at lower depths. The base of the Santa Fe Group was not encountered in any of the boreholes drilled at the GWP site, down to an elevation of 3,325 ft MSL.

A detailed description of the site geology including geologic cross sections of the site is provided in the RI Report (**CH2M HILL, 2006a**).

### 1.3.3.2 Site Hydrogeology

At the GWP site, the unsaturated zone is underlain by an alluvial aquifer composed of unconsolidated sediments. The aquifer can be subdivided into two general hydrologic zones, an Upper Hydrologic Zone (UHZ) and a Lower Hydrologic Zone (LHZ). The boundaries between the zones were established from observed water levels and geophysical changes observed with depth. Pumping data from the City's wells, compared with water level responses in monitor wells, indicate a hydraulic connection between the UHZ and LHZ.

The water levels in the UHZ are typically 4.5 to 12.5 ft higher than the water levels in the LHZ (**CH2M HILL, 2006**). At the site, the saturated zone extends from the water table, which occurs at elevations between 3,860 and 3,825 ft MSL, down to below an elevation of approximately 3,325 ft MSL, which was the deepest depth drilled. The lower boundary of the aquifer at the GWP site is most likely igneous bedrock, which occurs at a depth not attained during drilling of any of the site monitor wells.

A brief description of the unsaturated and hydrologic zones is provided below (all bgs depths are relative to an approximate surface elevation of 4,100 ft MSL).

- **Unsaturated Zone** - The unsaturated zone overlying the aquifer at the site extends from the ground surface to the water table, which occurs at elevations between 3,860 and 3,835 ft MSL. Its thickness ranges from about 80 ft in the western part of the site to over 200 ft in the east. This zone is typically a permeable layer of sediment through which water infiltrates to the aquifer. Air and other vapors can migrate in horizontal and vertical directions in the unsaturated zone through physical processes such as diffusion. The lithology of the unsaturated zone varies from fine sand with silt and clay to coarse sand and gravel. Sediment exposed at the land surface and in the shallow subsurface is mostly fine to coarse sand. Small lenses of clay and silt exist, but are predominantly present at depth in the eastern portion of the site.

- **Upper Hydraulic Zone** – The UHZ is partially saturated. Ground water in this zone occurs under unconfined or water-table conditions. The UHZ is composed of the lower portions of the Rio Grande Alluvium and the upper portion of the Santa Fe Group. It represents the uppermost portion of the aquifer and is over 100 ft thick along the western portion of the GWP site. Representative thicknesses of the UHZ in the eastern part of the site range from 20 ft at GWMW09 to 50 ft at GWMW15. The UHZ extends from the water table down to an elevation of 3,810 ft MSL at GWMW09 (where the UHZ is thinnest) and to an elevation of 3,750 ft MSL at GWMW07 (where the UHZ is thickest) In general, this zone is wedge shaped. The zone is thicker in the western portions of the GWP site, but becomes thinner towards the east.

Along the western portion of the GWP site, the upper portion of this zone is composed of a gravel and coarse sand layer that marks the base of the Rio Grande Alluvium. Below this layer, and along the eastern portion of the GWP site, this zone is composed of fine sand that contains varying percentages of silt and clay.

- **Lower Hydraulic Zone** –Most of the LHZ is composed of fine to coarse sand with some fine gravel. The boundary between LHZ and the UHZ is marked by interfingering layers of sand with clay and silt, clay and silt that are present across most of the site. These finer-grained sediment layers appear to pinch out east of monitor wells GWMW09 and GWMW10 and comprise the “upper portion” of the LHZ. The upper portion of the LHZ is considered the portion of the aquifer from an elevation of 3,675 ft MSL up to the base of the UHZ, which occurs between elevations of 3,750 ft MSL and 3,810 ft MSL. The lower part of the upper portion of the LHZ contains sediments composed of fine to coarse sand.

The lower portion of the LHZ is considered the portion of the aquifer below an elevation of 3,675 ft MSL. The lower portion of the LHZ is primarily composed of fine to coarse sand sediments. Interfingered within the zone are thin (10 to 20 ft) layers of fine sand, silt, and clay. These fine-grained lenticular beds are more prevalent in the western portion of the site. Layers containing coarse sand and gravel were noted in the deeper intervals logged during monitor well construction. These coarse sand and gravel layers comprise the “lower portion” of the LHZ. While the total thickness of the LHZ is unknown, it does extend from the base of the UHZ to at least 800 ft bgs at an elevation of 3,300 ft MSL. The bottom of the LHZ was not encountered in any of the boreholes drilled at the GWP site. This zone is the primary ground water production interval for the CLC municipal supply wells in the study area.

The LHZ is divided into upper and lower portions based on lithologic differences that occur in areas of the site west of monitor wells GWMW09 and GWMW10. In addition, PCE is present to a greater extent within the upper portion of the LHZ and water level responses to peak periods of pumping and water level trends within the upper and lower portions of the LHZ are similar.

Within the LHZ, the water levels in the upper and lower portions are similar in elevation.

Ground water flow in the UHZ is towards the east-southeast in the western portion of the GWP site. The ground water flow becomes more eastward near monitor wells GWMW03 and MW-SF6. This easterly flow direction continues across the eastern portion of the GWP site, flowing towards the CLC's municipal supply wells in the area of I-25. This easterly flow direction is also consistent with previous flow directions observed at the site since December 2002 (EPA, 2003, and CH2M HILL, 2004). The ground water flow direction indicates that the UHZ is affected by pumping at the CLC's municipal supply wells, especially in areas east of monitor well GWMW03.

Ground water flow in the upper portion of the LHZ is towards the northeast across the entire GWP site. Ground water flow in the lower portion of the LHZ is toward the east in the western portion of the site, but changes direction near the DACTD maintenance facility. Near the DACTD maintenance facility, the ground water flow direction shifts to the northeast. The CLC supply wells are screened across most of the LHZ. The flow patterns indicate that ground water flow in the LHZ at the GWP site is affected by pumping at the CLC municipal supply wells (CH2M HILL, 2006a). A detailed description of site hydrogeologic conditions is provided in the RI Report (CH2M HILL, 2006a).

Different interpretations of the site hydrogeology have been made, in particular to support the JSP modeling activity (JSAI, 2006a). The interpretation by JSAI divides the saturated zone into six intervals based on elevation to define further the distribution of PCE. The RI Report provides a correlation between the RI interpretation of Upper and Lower Hydrologic Zones and the JSP interpretation, summarized in [Section 1.3.7](#) of this FS Report.

### 1.3.4 Ground Water Quality

General water quality conditions at the GWP site were determined by EPA during the first RI field mobilization in December 2002, the ground water sampling event in January 2004, and the second RI field mobilization in December 2005. EPA also collected samples for analysis of Target Analyte List (TAL) metals from site monitor wells during the January 2004 sampling event. The CLC and NMED also routinely sample municipal water supply wells to evaluate uranium concentrations. [Tables 1-1 through 1-3](#) present selected results from sampling events performed at the site, including general

water chemistry, TAL metals (or inorganics), uranium, and PCE, respectively. A more complete discussion of ground water quality is provided in the RI.

Uranium is the only metal that exceeds its MCL (30 µg/L) in the municipal supply wells. The uranium concentrations detected since May 2004 are provided in **Table 1-3**. CLC attributes the uranium concentrations at these wells to natural aquifer conditions (uranium occurs naturally in some ground water aquifers). The United States Geological Survey (USGS) performed a general assessment of the water quality in portions of New Mexico in 1995 (**USGS, 1997**). This assessment included sampling of ground water in the Mesilla Basin from 12 wells; concentrations of uranium detected in this sampling were between <1.0 µg/L and 102 µg/L. The document indicated that the detection of radionuclides (including uranium) in their samples were the result of natural aquifer conditions (**USGS, 1997**). The CLC also performed an evaluation of the potential sources of uranium in their municipal supply wells. This evaluation concluded that the uranium was naturally occurring (**JSAI, 2006c**). The CLC and NMED continue to monitor the municipal supply wells for uranium and the CLC is currently evaluating options to address uranium exceedances of the MCL in these wells.

### 1.3.5 Nature and Extent of Contamination

This section summarizes the nature and extent of contamination described for the GWP site in the RI report (**CH2M HILL, 2006a**). Data and interpretations of the data from the RI report provide input to the fate and transport of contamination, the potential exposure pathways for risk, and the basis for evaluation and selection of remedial alternatives.

Based on the data interpretations in the RI and the assessment of risk, PCE has been determined to represent the Contaminant of Concern (COC) for the GWP site. PCE is the most widespread contaminant detected in soil vapor and ground water at the GWP site. The following paragraphs provide further detail regarding the contaminants detected at the site in soil vapor and ground water.

#### 1.3.5.1 Soil Vapor

Soil vapor data collected during the first field mobilization (December 2002) indicated that PCE and trichloroethylene (TCE) were present in the soil vapor at the GWP site. PCE was detected in shallow subsurface soil vapor in the residential neighborhood northeast of the intersection of East Hadley Avenue and North Walnut Street above health-based screening levels and additional data collection was warranted. Additional shallow soil vapor data were collected during the second field mobilization (October through December 2005) for purposes of quantifying the potential risk from exposure of PCE to human receptors at these locations via inhalation through indoor vapor intrusion.

A detailed discussion of the soil vapor sampling conducted during the first and second RI mobilizations is provided in the RI Report (**CH2M HILL, 2006a**).

The objective of soil vapor sampling performed during the first RI field mobilization in 2002 was to determine the extent of contamination, and the locations of sources of PCE at the site. The soil vapor analytical results from the first RI mobilization are included in the IDRA Report (**EPA, 2003**). The lateral extent of PCE detected in the soil vapor during the first mobilization is depicted on **Figure 1-3**. The figure illustrates that the concentrations of PCE in the soil vapor are low and widespread. In three locations, however, higher relative concentrations of PCE in the shallow soil vapor are observed:

- In the vicinity of the North Solano Drive/East Hadley Avenue intersection (at sample location SVMP03).
- In the vicinity of the East Hadley Avenue/North Walnut Street intersection (at sample location PA077).
- In the vicinity of the East Griggs Avenue/North Walnut Street intersection (at sample locations SVMP01, DA028, R8005, and R2017).

These areas are the three identified PCE release (or source) areas for the site (see **Figure 1-3**). The PCE source areas were identified as property formerly occupied by the former National Guard Armory (on property currently owned by the CLC), property formerly occupied by the Crawford Municipal Airport (on property currently owned by the CLC), and the DACTD maintenance facility (on property currently owned by DAC). The PCE concentrations in soil vapor decrease laterally away from these three areas.

The vertical extent of PCE detected in soil vapor during the first field mobilization is illustrated in cross-sectional view in **Figures 1-4, 1-5, and 1-6**. The locations of these cross-sections are shown on **Figure 1-3**.

Additional shallow soil vapor sampling was performed during the second RI field mobilization at 5 ft bgs and 10 ft bgs in the residential neighborhood northeast of the intersection of East Hadley Avenue and North Walnut Street, at the Police Athletic League (PAL) Boxing Facility, and at the Meerscheidt Recreation Center. This sampling was performed to support the evaluation of risk to potential residential and recreational receptors posed by vapor intrusion. **Figure 1-7** through **Figure 1-9** present the PCE concentrations detected in the residential neighborhood northeast of the intersection

of East Hadley Avenue and North Walnut Street, at the Meerscheidt Recreation Center, and the PAL Boxing facility, respectively. A detailed discussion of the shallow soil vapor results is provided in the RI Report (CH2M HILL, 2006a).

SVMP16 was installed at the DACTD maintenance facility during the second RI field mobilization to evaluate the relation between PCE in the soil vapor and ground water. Likewise, existing soil vapor monitor points SVMP01, located at the DACTD maintenance facility, and SVMP03, located at the former National Guard Armory (installed during the first RI mobilization), were also sampled during the second RI mobilization for this purpose. **Table 1-4** lists the PCE soil vapor concentrations detected in the SVMPs during the first and second RI mobilizations. A detailed discussion of the installation of SVMP16 and the sampling of SVMP01, SVMP03, and SVMP16 is provided in the RI Report (CH2M HILL, 2006a).

### 1.3.5.2 Ground Water

Ground water contamination at the GWP site is best defined by the distribution of the contaminant PCE. PCE is the most widespread contaminant at the site. The highest PCE concentrations observed in the ground water in January 2004 occurred in the UHZ near CLC Well 18 and multi-port monitor well GWMW01 (at the DACTD maintenance facility). The ground water plume extends from between CLC Well 10 and monitor well GWMW06 towards the east to the area near I-25. PCE exceeded the MCL in two separate locations within the plume. The first area is located in the northwest portion of the plume at monitor wells GWMW06 and MW-SF8, located near the Former National Guard Armory. The second location extends from the DACTD maintenance facility east to monitor wells GWMW10 and MW-SF10. Deeper within the aquifer, and within the LHZ, the horizontal extent of the ground water plume where PCE exceeded the MCL occurred between CLC Well Nos. 18, 19, 21, and 27 (CH2M HILL, 2004).

The horizontal extents of PCE in the UHZ, the upper portion of the LHZ, and the lower portion of the LHZ during December 2005 are provided on **Figure 1-10** through **Figure 1-12**, respectively. The upper and lower portions of the LHZ are presented to show changes in the plume extent with depth at the site. The data from individual wells are presented and contoured to show the distribution of PCE contamination. Each figure is contoured to a PCE concentration of one-half the MCL (2.5 µg/L). The concentrations of samples collected from the CLC municipal supply wells are provided on each figure for reference purposes and are not used to contour the extent of the PCE contamination in ground water. The recent data set indicates that within most areas of the site, the horizontal extent of the PCE plume has not changed significantly since January 2004. The recent data set shows the extent of PCE in ground water slightly farther south of the DACTD maintenance facility. PCE was

also detected east of I-25 at more recently installed monitor wells GWMW15-S (18  $\mu\text{g/L}$ ) and GWMW15-D (0.18  $\mu\text{g/L}$ ), extending the plume footprint potentially east of the Las Cruces Flood Control Dam.

The GWP site plume extends laterally west-to-east from near monitor well GWMW06 and CLC Well No. 10 eastward beyond the Las Cruces Flood Control Dam and is approximately 9,500 ft (1.8 miles) in length. Near GWMW06, the PCE detections are limited to the UHZ. The area of PCE extending from the DACTD maintenance facility eastward beyond GWMW15 is approximately 6,000 ft (1.1 mi.) in length. The plume, at its widest point, extends north-to-south from north of CLC Well No. 21 to south of CLC Well No. 19 and is approximately 2,700 ft (0.5 mi) wide (see [Figure 1-10](#)). The plume configuration appears to have been largely shaped by municipal well pumping.

The PCE concentrations in the UHZ (at the water table) still exceed the MCL in two areas (see [Figure 1-10](#)). The first area is located in the vicinity of monitor well GWMW06 in the northwestern part of the plume. This area is located upgradient of and near the former National Guard Armory. The second area where PCE concentrations exceed the MCL extends from near monitor well MW-SF3 (located at the DACTD maintenance facility) to the east toward monitor well MW-SF10. This second area is much larger in aerial extent than the first area.

In the upper and lower portions of the LHZ, PCE concentrations exceed the MCL in the area extending eastward and downgradient from the DACTD maintenance facility (see [Figures 1-11](#) and [1-12](#)). The area of the plume where PCE exceeds the MCL in the lower portion of the LHZ ([Figure 1-12](#)) occurs at the DACTD maintenance facility near monitor well GWMW01. PCE concentrations in the upper portion of the LHZ ([Figure 1-12](#)), above an elevation of 3,675 ft MSL, exceed the MCL in a broad area extending from the eastern portion of the DACTD maintenance facility downgradient to the east of monitor well GWMW15-S. The down-gradient (eastern) lateral extent of PCE in the upper portion of the LHZ is not well defined.

The vertical distribution of PCE at the GWP site from December 2005 is presented in cross-section view on [Figures 1-13](#) through [1-15](#). The locations of these cross-sections in relation to the site are shown on [Figure 1-16](#). In the northwestern part of the plume, the highest detections of PCE occur in the UHZ at GWMW06 port 1 (10  $\mu\text{g/L}$ , see [Figure 1-13](#)). The PCE concentration decreases away from this monitor well location. In the LHZ in this area, the PCE concentrations are low (less than 1  $\mu\text{g/L}$ ) or not detected. This infers that the concentrations observed at GWMW06 are confined to the upper reaches of the aquifer and do not contribute significantly to the rest of the plume. In the eastern area of the plume, between monitor wells GWMW01 and GWMW15, the PCE contamination extends

deep into the aquifer as shown on **Figures 1-13** through **1-15**. The highest PCE concentrations in this area occur at monitor wells GWMW01, GWMW09, GWMW10, and GWMW15. In the area near GWMW01, the contamination extends from the water table down into the lower portion of the LHZ. At GWMW01, PCE was encountered at levels exceeding the MCL in port 6 down to an elevation of 3,515 ft MSL. At monitor wells GWMW09 and GWMW10, PCE concentrations exceeding the MCL extend from the upper portion of the LHZ down to elevations of 3,560 ft MSL at GWMW09 (port 5) and 3,615 ft MSL at GWMW10 (port 4). PCE is not detected above the MCL in the UHZ at these two well locations. At GWMW15, PCE concentrations exceeding the MCL are confined to the upper portion of the LHZ, in well GWMW15-S (at an elevation of 3,785 ft MSL).

The vertical distribution of PCE in the eastern area of the plume is directly influenced by pumping at the nearby CLC municipal supply wells. This is best illustrated near CLC Well No. 18, as evidenced by the PCE detections in port 6 at monitor well GWMW01.

In addition to PCE, uranium, and VOCs benzene, toluene, methyl tertiary butyl ether (MTBE), and PCE degradation products TCE, and 1,2 cis- and 1,2 trans-dichloroethene (DCE) have been detected in the ground water within the footprint of the PCE plume at the site. Of these, only benzene has been detected in site monitor wells above its corresponding MCL (in seven monitor wells), and MTBE is detected above its corresponding EPA Region 6 Media-Specific Screening Level (MSSL) in one monitor well (MTBE does not have an MCL). Benzene is not detected in any municipal supply wells; MTBE is detected in one municipal supply well at concentrations below the MSSL. The benzene, toluene, and MTBE are addressed under the New Mexico Petroleum Storage Tank Regulations (NMAC 20.5). Uranium exceeds its corresponding MCL in seven municipal supply wells. However, elevated concentrations of uranium are naturally occurring, and the CLC is addressing the elevated uranium concentrations in the drinking water supply as part of compliance with the SDWA. As the most widespread contaminant at the GWP site in both soil vapor and ground water, found in both monitor wells and municipal supply wells, PCE is considered the primary COC for the GWP site. Other detected contaminants are also discussed and will continue to be evaluated during implementation of the remedy.

### 1.3.6 Fate and Transport of Contamination

This section summarizes the factors affecting the migration and fate of PCE, the potential routes of migration, the likelihood for natural attenuation of the contamination, and an evaluation of potential routes of exposure. A detailed description of fate and transport of PCE at the GWP site is provided in the RI Report (**CH2M HILL, 2006a**).

### 1.3.6.1 Chemical and Physical Nature of PCE

PCE is a chlorinated VOC commonly used in the dry cleaning industry or as a degreasing agent in metal cleaning operations. It is characterized by relatively high vapor pressure, high Henry's Law constant, and high solubility in water compared to the concentration required to exceed its MCL. The chemical and physical characteristics of PCE are identified in [Table 1-5](#). As a free product, PCE is denser than water, and therefore, will tend to settle to the bottom of the water column. For this reason, the pure phase of this compound is referred to as a dense non-aqueous phase liquid (DNAPL).

The relatively high Henry's Law constant indicates that PCE will tend to partition to the vapor phase from either sorbed (soil) or dissolved (aqueous) phases, provided there is adequate interaction between the two partitioning media (i.e. mixing). PCE is released through volatilization from either contaminated soil or surface water. The rate of loss through volatilization depends on the chemical-specific vapor pressure, the ambient temperature, and the unsaturated zone permeability.

Vapor phase PCE, which has a half-life of about 96 days, is degraded in the atmosphere by reaction with photochemically produced hydroxyl radicals. PCE is also degraded in the atmosphere by reaction with ozone, but the rate of this reaction is too slow to be environmentally important. Direct photolysis is not expected to be significant because PCE only weakly absorbs light in the ultraviolet (UV) spectrum. All of the PCE contamination at the GWP site resides below land surface and therefore cannot be degraded by photolysis.

Volatilization from the ground water to soil vapor and from soil moisture to the atmosphere occurs based upon the relatively high Henry's Law constant (see [Table 1-5](#)). PCE dissolved in water is expected to have moderate mobility in soil because of the relatively low organic carbon partitioning coefficients ( $K_{oc}$ ) (see [Table 1-5](#)). As a result, PCE is not expected to adsorb significantly to solids and sediment in water.

### 1.3.6.2 Potential Migration Pathways

Following release at the surface or shallow subsurface, migration of contamination within the subsurface occurs via three primary mechanisms: infiltration of water containing dissolved contaminants through the unsaturated zone, migration of vapor-phase contamination through the unsaturated zone, and free-phase DNAPL migration through the unsaturated zone, or in the saturated zone. Each of the three mechanisms mentioned have the potential to transport PCE to ground water. The absence of elevated detections of PCE in ground water and soil indicate that DNAPL is not present at the site. Migration of PCE to ground water is more likely related to infiltration; migration via soil vapor diffusion is also possible.

PCE that is released as dissolved phase product is unlikely to bind tightly to soil, based on its low soil  $K_{oc}$ . PCE in soil will largely be found dissolved either in pore water or as vapor in soil voids. PCE could migrate through soil either by leaching in pore water, or diffusion through air-filled voids between soil particles. Contaminants dissolved in pore water would enter ground water directly.

PCE in soil vapor that diffuses downward to the water table can partition into ground water. However, the contaminant transport between soil vapor and ground water is slow and significantly limited by the liquid diffusion coefficient. Likewise, the reverse condition is also true. The volatilization of PCE from ground water to soil vapor is very slow and is not considered to be a significant transport mechanism for PCE in ground water.

Volatile contaminants that migrate close to building foundations might intrude into the building via advective/convective transport, in a process referred to as vapor intrusion. Indoor spaces can have negative pressures at various times relative to the outdoors and the surrounding soil vapor. The pressure difference can be from operation of heating, ventilating, and air conditioning systems with unbalanced air supplies and inadequate makeup air; use of fireplaces or heaters that vent exhaust gases to the exterior; use of fans in bathrooms or kitchens; the “stack effect” in which higher indoor temperatures slightly decrease the density of air relative to the colder underlying soil, producing a pressure difference; or the pressure exerted by wind on the walls of buildings. The combination of these conditions results in advective flow of soil vapor to indoor spaces through floor cracks, floor-wall seams, utility penetrations, or other conduits into the closed space. In Las Cruces, the stack effect would be somewhat reduced because houses are not closed up as tightly as in other parts of the country (such as the northeastern United States), and slab-on-grade construction reduces transport through the stack effect relative to homes constructed with basements.

### 1.3.6.3 Degradation Pathways

The degradation of PCE is known to occur through biological and physical processes.

Overall, the aquifer at the GWP site appears to exhibit a range of geochemical conditions. Conditions are generally aerobic and therefore not capable of reductive dechlorination of PCE. This can be from a lack of organic carbon, inadequate populations of bacteria necessary for the process to occur, and a significant presence of dissolved oxygen (DO) in the ground water. Further, the extremely low number of detections and lack of daughter products (i.e. TCE, and *cis*-1,2-dichloroethene [*cis*-1,2-DCE]) in ground water indicate that biodegradation is not a significant method of attenuation at the GWP site.

Physical processes such as dilution and volatilization can also attenuate concentrations of PCE at the GWP site. Dilution is probably the most significant attenuation process in deep aquifers or in aquifers without reducing conditions or significant populations of bacteria necessary for biodegradation to take place. Physical processes that comprise natural attenuation of PCE at the GWP site include diffusion, dispersion, sorption, and volatilization. PCE present in the dissolved phase in the ground water is unlikely to bind tightly to soil, based on its low soil  $K_{oc}$ ; therefore, sorptive attenuation processes are likely small at the GWP site.

The PCE concentration trends indicate that the PCE concentrations are decreasing in most portions of the plume. The decreasing concentrations are most likely the result of dispersion and dilution of the PCE in ground water and possibly the decreasing amounts of PCE entering ground water from the release areas. The loss of PCE from ground water through volatilization to soil vapor could be possible in localized areas, but it is not likely to be significant throughout the plume at the GWP site.

#### 1.3.6.4 Potential Exposure Pathways

PCE has been detected in both ground water and soil vapor at the GWP site. Previous reports (**EPA, 2003; ATSDR, 2005**) identified that the following potential exposure pathways may be present at the GWP site:

- Ingestion, dermal contact, or inhalation of PCE from indoor ground water use from CLC municipal supply wells and/or private wells,
- Inhalation of PCE from ground water used in evaporative coolers (i.e. evaporative coolers),
- Inhalation of PCE from soil vapor intrusion into buildings,
- Ingestion of plants irrigated with ground water.

A detailed description of the potential exposure pathways listed above is provided in the RI Report (**CH2M HILL, 2006a**).

#### 1.3.7 Ground Water Modeling Summary

A ground water flow and transport model was developed by the JSP to support the GWP site RI/FS. The model was developed to evaluate the fate and transport of GWP site contamination, to evaluate remedial alternatives for the site, and to assist in refining the conceptual site model. The modeling report entitled *Ground-Water-Flow, Solute-Transport Model for the Griggs and Walnut Superfund Site, Las Cruces, New Mexico*, is provided in **Appendix A**, and information pertinent to this report is summarized below.

Once the flow and transport portions of the model were completed and calibrated, predictive scenarios were run to assist in developing and refining the remedial alternatives identified and described in [Sections 3.0](#) and [Sections 4.0](#). The overall goals of the predictive modeling were to evaluate the following scenarios for use in developing remedial alternatives:

- Examine long-term plume movement without treatment, and predict potential migration of PCE in the ground water to other city wells.
- Achieve plume capture of ground water with PCE concentrations greater than the MCL for PCE of 5 µg/L.
- Achieve clean up of PCE in the ground water to below the MCL within a maximum of 30 years.
- Evaluate the potential of plume cleanup over a shorter time than 30 years while considering maximum use of the current municipal wells where possible.

The ground water model developed by the JSP further refines the site hydrogeologic model. The JSP model divides the site hydrogeology into five model layers. The five model layers are based on the hydrostratigraphic units and lithofacies assemblages presented by Hawley and Kennedy (**Hawley and Kennedy, 2004**). [Table 1-6](#) provides a cross-reference of the UHZ, upper portion of the LHZ, and lower portion of the LHZ as described in the RI report (**CH2M HILL, 2006a**) and [Section 1.3.3](#) to the JSP's ground water model layers and the hydrostratigraphic units and lithofacies assemblages from Hawley and Kennedy. The UHZ is equivalent to the ground water model layer 1. The upper portion of the LHZ is equivalent to the ground water model layer 2 and the uppermost portion of the ground water model layer 3. The lower portion of the LHZ is equivalent to the majority of the ground water model layer 3 and layers 4 and 5.

It should be noted that the ground water model indicates that ground water flow at the site is toward the south-southeast and southeast within the LHZ, which is different from that discussed in [Section 1.3.3.2](#). The ground water modeling report (see [Appendix A](#)) attributes this difference to the lack of water level data north and east of CLC Well 21 and east of I-25, thus resulting in water level data from the current monitor well network not fully delineating the cone-of-depression created by pumping at the CLC wells. The current monitor well network is limited to a narrow west-to-east area from monitor wells GWMW07 and GWMW06, east to GWMW15. Additional data collected from new monitor wells or piezometers installed during the RD or RA may result in a better alignment

between ground water flow depicted based on field measurements and that depicted in the ground water flow model.

The primary limitation of the predictive model is the uncertainty in historic PCE source areas, concentration, and flux into the aquifer (JSAI, 2006a). Because of the uncertainty associated with the predictive model, continued monitoring of ground water concentrations will be necessary to evaluate during RD/RA the predictive results of the modeling.

Modeling assumptions used in evaluating the predictive scenarios are provided in [Appendix A](#). The results of the predictive modeling were incorporated into the development of the remedial alternatives and associated costs presented in [Section 3.0](#) and [Section 4.0](#).

### 1.3.8 Conceptual Site Model

The data collected from the GWP site have been evaluated to understand how PCE releases have affected ground water; for identifying where releases have occurred (sources); for predicting how the contamination behaves in the system (potential migration pathways); and whether the concentrations are increasing over time. These interpretations of PCE at the site comprise the conceptual site model (CSM). The CSM describes the general nature and extent of the plume, and identifies potential exposure pathways for evaluating risks to human health and the environment. The model is an important tool also, in assisting with identifying plausible remedial alternatives. [Figure 1-17](#) depicts the CSM for the site.

EPA has determined that PCE was released at the following locations:

1. Near the intersection of East Hadley Avenue and North Walnut Street (along the former airport runway and the former arroyo parallel to and south of the former airport runway).
2. At the DACTD maintenance facility on East Griggs Avenue.
3. At the former National Guard Armory on East Hadley Avenue.

The use or discharge of PCE at these locations resulted in the release of PCE, which subsequently migrated into the unsaturated zone and to the ground water. A specific method of release or discharge of PCE at these locations is not known. Based on the higher relative concentrations of PCE in soil vapor and ground water, the most significant release(s) of PCE probably occurred at the DACTD maintenance facility.

The primary migration pathways for contamination originating from the likely source areas consists of transport through the unsaturated zone in the vapor phase and in the dissolved phase within water

that is migrating towards the water table. PCE could have migrated in the subsurface via infiltration, soil vapor diffusion, and/or as a DNAPL. The absence of elevated detections of PCE in ground water and soil at any of the locations suggest that DNAPL or residual phase liquids are not present or no longer present. If present, these materials are bound up within the soil matrix of the unsaturated zone with only limited potential to provide low levels of PCE to infiltrating liquids, soil moisture and soil vapor.

The current migration of PCE to ground water is likely the result of induced infiltration and vapor diffusion. It is possible that dissolved PCE occurring in leachate from precipitation or storm water in the former arroyo located north of the DACTD maintenance facility could have migrated to the ground water over a period of many years. Infiltration of precipitation through the unsaturated zone can transport contamination to the ground water, however, the low precipitation in Las Cruces indicates that infiltration of contaminated water could have originated from, or been accelerated by, leaking underground pipes (e.g. sanitary sewers), irrigation within the parks, or unlined discharge structures (sumps etc). Improperly disposed fluids containing PCE, driven by further disposal of everyday fluids or process water, could have enhanced or induced infiltration of PCE into the soil and possibly to the ground water. In a similar manner, irrigation water, infiltrating through areas of PCE contamination, could have enhanced or induced infiltration of PCE into the soil and possibly to the ground water. Localized pumping from CLC municipal supply wells has facilitated transport of PCE horizontally and across the site and vertically into deeper parts of the aquifer.

A detailed description of the CSM is available in **Section 6.0** of the RI report (**CH2M HILL, 2006a**).

### 1.3.9 Summary of Human Health and Ecological Risk Assessment

This section provides a summary of the evaluation of the estimated risk associated with GWP site contaminants. For more detail, the BHHRA and Ecological Screening Checklist for the site are available in the RI Report (**CH2M HILL, 2006a**).

#### 1.3.9.1 Human Health

The risk assessment team performed a BHHRA to assess whether site-related contaminants pose a current risk or future risk to human health if no RA is performed. Potentially complete exposure pathways were determined to be shallow soil vapor (through vapor intrusion to buildings) and ground water (through the water supply distribution system, or through private domestic wells). The assessment of risk is not affected by any remaining ground water data needs described in the conclusions of the RI Report; the higher concentration areas of the PCE plume are sufficiently

defined, and the PCE contamination is completely defined at all potential receptor points within the area surrounding the extent of PCE detections associated with the GWP site.

Potential exposure points for shallow soil vapor intrusion were identified in the neighborhood northeast of the East Hadley Avenue and North Walnut Street intersection, the PAL Boxing Facility, and the Meerscheidt Recreation Center. Samples in the area of the neighborhood and the PAL Boxing Facility exceeded the initial screening of 120 ppb by volume (ppbv). The Meerscheidt Recreation Center samples did not exceed the initial screening level, and this area was dropped from further evaluation. Based on the comparison to initial screening levels, PCE was identified as a Chemical of Potential Concern (COPC) for soil vapor at seven adjacent residences and at the PAL Boxing Facility located above the current ground water plume. EPA identified no COPCs for soil vapor at the Meerscheidt Recreation Center building. The risk assessment team calculated the potential indoor air concentrations of PCE resulting from soil vapor intrusion using the Johnson and Ettinger model as presented in the *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings* (EPA, 2004a), and the results were within EPA's acceptable risk range (one-in-10,000 to one-in-1,000,000;  $10^{-4}$  to  $10^{-6}$ ).

Based on the comparison between ground water concentrations and MCLs and EPA Region 6 MSSSLs, PCE, benzene, and MTBE were identified in the BHHRA as COPCs in ground water. Benzene has been detected in site monitor wells above its corresponding MCL (in seven monitor wells), and MTBE is detected above its corresponding EPA Region 6 MSSSL in one monitor well (MTBE does not have an MCL). Benzene is not detected in any municipal supply wells; MTBE is detected in one municipal supply well at concentrations below the EPA Region 6 MSSSL. As the most widespread contaminant at the GWP site in both soil vapor and ground water, found in both monitor wells and municipal supply wells, PCE is considered the primary COC for the GWP site. Other detected contaminants are also discussed and will continue to be evaluated during implementation of the remedy.

For each COPC, concentrations at current ground water exposure points were measured below the MCLs for potable ground water. However, a potential for future unacceptable exposure above the MCL exists if (1) PCE is not maintained below the MCL in the municipal water supply; (2) if private wells are completed in the plume; or (3) if the ground water plume expands beyond the current site boundary.

Uranium was also detected above the MCL in seven CLC wells; however, elevated concentrations of uranium are thought to be naturally occurring in the ground water. Uranium contributes to the site

risk because the concentrations exceed the MCL in seven CLC wells. The CLC is addressing the elevated uranium concentrations in the drinking water supply as part of compliance with the SDWA.

In conclusion, current and future exposures to indoor air concentrations from vapor intrusion are within acceptable levels. Current exposures to the municipal water supply are within acceptable levels as long as CLC maintains compliance with drinking water standards; however, a potential for future unacceptable exposure exists. As the most widespread contaminant at the GWP site in both soil vapor and ground water, found in both monitor wells and municipal supply wells, PCE is considered the primary COC for the GWP site.

### 1.3.9.2 Ecological Receptors

An ecological checklist was prepared for the GWP site following the format presented by EPA (**EPA, 1997a**). Information regarding the ecological condition of the site as well as aerial photographs of the site was gathered during site visits and during the field investigation. The ecological checklist for the GWP site is provided in the RI Report (**CH2M HILL, 2006a**).

The GWP site is not considered critical habitat because of the urban development that has occurred over the last 30 years. Soil vapor detections begin at least 10 ft bgs and it is unlikely that a complete exposure pathway exists for biota (flora or fauna, particularly burrowing organisms) to the VOCs. Additionally, the contaminated ground water does not discharge to surface water. Ground water does not discharge naturally to the surface at the GWP site and the contaminants are too deep for biota exposure, therefore, it can be concluded that no complete ecological exposure pathways exist.

### 1.3.10 Principle and Low-Level Threat Waste

The national goal of the remedy selection process is to “select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste” (40 CFR 300.430(a)(1)(i)). While protection of human health and the environment can be achieved through a variety of methods, this goal reflects CERCLA’s emphasis on achieving protection through the aggressive but realistic use of treatment. Remedies that rely on engineering and institutional control as major components, in addition to being less permanent than treatment remedies, may place constraints on the productive re-use of land.

Although remedy selection decisions are site-specific determinations based on analyses of remedial alternatives using the nine evaluation criteria, these expectations help to focus the RI/FS on appropriate waste management options (**EPA, 1997b**).