Section 6

Current and Potential Future Site and Resource Uses

Local Zoning

The Site is characterized by a broad mix of commercial, public recreational, light industrial, and residential land uses. Just north of CLC Well No. 18 and extending between North Solano Drive and North Walnut Street, a large portion of this area is served by various recreational facilities such as soccer fields, baseball and basketball facilities, and skate boarding designated areas. Residential neighborhoods are present west of North Solano Drive, east of North Walnut Street, north of East Hadley Avenue, and south of East Griggs Avenue. The rest of the area along East Hadley Avenue and East Griggs Avenue between North Solano Drive and just east of North Walnut Street, light industrial/commercial, activities are visible, along with the DACTD maintenance facility located on Griggs Avenue and the CLC fleet facility located on Hadley Avenue. Other commercial and light industrial properties can be found along the major roadways in the vicinity of the Site, including East Lohman Avenue, North Solano Drive, and East Spruce Avenue (refer to **Figure 2-1** for the layout of the streets).

Development in the area of the Site has resulted in changes in land uses since the 1950s. The current landuse activities and associated zoning are not expected to change in the near future. The community however, within the city limits continues to grow, and the demands on the ground water resource are expected to continue increasing. Ground water is the primary source of potable water for the area, and most, if not all municipal, industrial, and private wells are screened in the LHZ.

Section 7

Summary of Site Risks

Under the NCP, 40 CFR § 300.430, the role of the baseline risk assessment is to address the risk associated with a site in the absence of any remedial action or control, including institutional controls. The baseline assessment is essentially an evaluation of the no-action alterative. (See 55 Fed. Reg. 8666, 8710-8711 (March 8, 1990)). The baseline risk assessment also 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 2006 Baseline Human Health Risk Assessment (BHHRA) for the Site and included in the November

2006 Remedial Investigation Report (Section 7 of the RI Report). The BHHRA includes both a Baseline Human Health Risk Assessment and a discussion on the Ecological Risk Assessment Checklist performed for the Site.

A four-step process is utilized for assessing Site-related human health risks in the BHHRA:
(1) Identification of Chemicals of Potential Concern (COPCs) – identifies those contaminants that are carried forward through the BHHRA process based on frequency of detection (FOD) and a comparative analysis to EPA human health risk-based screening levels or other appropriate levels (i.e., MCLs);
(2) Exposure Assessment – estimates the magnitude of actual and/or potential human exposures, the frequency and duration of these exposures, and the pathways (e.g,, ingesting contaminated well water) by which humans are potentially exposed;
(3) Toxicity Assessment – determines the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure (dose) and severity of adverse effects (response), and;
(4) Risk Characterization (including the uncertainty analysis) – summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of Site-related risks. With the completion of this four-step risk assessment process, those exposure pathways and chemicals of concern (COCs) found to pose actual or potential threats to human health at the Site are identified for remedial action.

Identification of Chemicals of Potential Concern

The EPA used a two-step screening process to select COPCs in soil vapor and ground water for the BHHRA. The process evaluated the frequency of detection (FOD) and compared Site data to EPA human health risk-based screening levels or other levels (i.e., MCLs). First, those constituents detected at a frequency of five (5) percent or less in soil vapor or ground water were considered for elimination from the BHHRA. Second, for each constituent carried forward to the second step of the screening process, the maximum detected concentration was compared to its human health risk-based screening level or other screening level for soil vapor and ground water, as identified below:

Soil Vapor − EPA draft generic screening levels for deep soil vapor concentrations for indoor air vapor intrusion, based on a residential scenario, a target excess lifetime cancer risk (ELCR) of 1x10-5, and a non-cancer hazard index (HI) of 1.

Ground Water – The federal MCL, if one is available (EPA, 2002b). For those chemicals without MCLs, the EPA Region 6 MSSL for tap water based on a residential scenario, a target ELCR of 1x10-6, and a non-cancer HI of 1.

It is noted that those constituents considered for elimination in the first step were also compared to the screening levels. With the exception of cis-1,3-dichloropropene, all chemicals with a frequency of detection of 5 percent or less resulted in concentrations less than the screening levels. Cis-1,3-dichloropropene was detected in only 1 of 79 ground water samples, and was detected at a concentration only slightly higher than its screening level (0.41 µg/L versus 0.40 µg/L).

Data Used in the Screening Process

Soil vapor − Soil vapor samples collected in November 2005 were used in completing the BHHRA. Soil vapor data were collected from the immediate vicinity of three areas: (1) eight residences (adjacent to an area of release and area of higher PCE concentrations); (2) the PAL Boxing Facility; and (3) the Meerscheidt Recreation Center. The samples were collected from shallow depths ranging between 3 to 10 ft bgs. A summary of soil vapor analytical data is provided in Appendix A, Table A1-2.1 through Table A1-2.3.

Ground Water − Potential current exposure points were identified in ground water at locations where municipal supply wells or reservoirs distribute water directly to users (e.g., the Upper Griggs Reservoir, one private well [LRG-3191], and CLC wells that are not blended or are currently off-line). Potential future ground water exposure points were identified in the Mesilla Basin under the scenario where additional CLC wells installed in the future or existing CLC wells become impacted with COPCs from ground water migration.

The ground water data were grouped for the BHHRA based on the current use (i.e., water that is distributed to city residents) and potential future use (i.e., ground water in the Mesilla Basin) as follows:

- Municipal supply wells and reservoir currently distributing potable water to city residents—this data group includes the Upper Griggs Reservoir and CLC wells (excluding five CLC wells blended in the Upper Griggs Reservoir and CLC wells 18 and 19).
- One private well—this data group includes the data collected from private well LRG-3191. The well is currently used for irrigation purposes only, and is not the source of drinking water at the residence, although the resident may consume water from the well on an infrequent

basis.

- CLC wells blended in the Upper Griggs Reservoir —this data group includes the data collected from the five CLC wells (CLC wells 10, 21, 29, 32, and 60) providing water to the Upper Griggs Reservoir (the detailed CLC blending plan is provided in Appendix A4). The data collected from the Upper Griggs Reservoir are a better representation of concentrations at exposure points than are the five wells.

- CLC wells 18 and 19—this data group includes the data collected from two CLC wells previously used as part of the public water supply. CLC wells 18 and 19 have not been used since 1996 and 2005, respectively and, therefore, there are no current exposures to these wells.

- Monitoring wells—this data group includes the ground water data collected during the RI from 24 monitoring wells. The specific data used were the most recent available, i.e., from the December 2005 sampling event. In the future, one or more of the following scenarios may occur: (1) the CLC may install additional wells in the Mesilla Basin in areas that are impacted by chemicals above MCLs, (2) the CLC may discontinue their ground water blending program and chemical concentrations in CLC wells may exceed MCLs, or (3) ground water in the Mesilla Basin will likely continue to migrate and impact currently-used CLC wells at levels above MCLs. Therefore, future concentrations in CLC wells may be at levels above MCLs and pose an unacceptable risk.

COC Selection Process

The COC for the Site is PCE. The EPA identified COPCs that were present at concentrations that either exceeded EPA's risk-based screening levels or exceeded MCLs and carried them forward for detailed analysis in the BHHRA. PCE was identified as a COPC for indoor air (from vapor intrusion) based on the estimated lifetime cancer risk (ELCR) calculated from soil vapor samples collected outside of seven residential properties and outside of the PAL Boxing Facility, all of which are located above the current ground water plume. For ground water, EPA identified PCE and Benzene detections at concentrations exceeding the MCL of 5 µg/L for each chemical, and Methyl Tertiary Butyl Ether (MTBE), which was detected at concentrations exceeding the EPA Region 6 MSSL.[1]

[1] [There is no regulation regarding MTBE under the Safe Drinking Water Act, so it has no MCL; however, EPA has responded to requests for guidance by reviewing and updating an advisory for MTBE in December 1997. This Drinking Water Advisory: Consumer Acceptability and Health Effects Analysis provides guidance to communities that may become

Maximum detected concentrations of benzene, MTBE, and PCE at current exposure points (Upper Griggs Reservoir, CLC wells currently on-line and not blended, and one private well) are less than MCLs. However, future concentrations of these three COPCs at exposure points may exceed MCLs if the current blending program fails to maintain concentrations in the Upper Griggs Reservoir at concentration levels that are below MCLs, if additional wells are installed in the GWP Site plume within the Mesilla Basin, or if online wells become impacted via ground water plume migration. If MCLs are exceeded, unacceptable risks may be posed by the water supply. Therefore, the selected remedy must address these concerns, either through treatment, monitoring, or institutional controls for the Site.
In addition, reporting limits (RLs) were compared to screening levels for analytes that were not detected in any samples in a given data group. The reporting limits for TCE in soil vapor slightly exceeded screening levels (10 ppbv versus 4.1 ppbv) at most locations. Additionally, reporting limits for 6 VOCs in ground water exceed screening levels. Those chemicals became identified as COPCs and were carried forward. Quantitative analysis of COPCs for specific exposure pathways were performed in the subsequent section of the BHHRA for these chemicals.

In a baseline risk assessment, the EPA uses a concentration for each COPC to calculate the risk. This concentration, called the exposure point concentration, is a statistically-derived number based on all of the sampling data collected for a Superfund Site. Generally, the 95 percent upper confidence limit (UCL) on the arithmetic mean concentration for a chemical is used as the exposure point concentration. The 95 percent upper confidence limit on the arithmetic mean is defined as a value that, when calculated repeatedly for randomly drawn subsets of Site data, equals or exceeds the true mean 95 percent of the time.

The summary of the COPCs and the medium-specific exposure point concentrations is included in Appendix A, Tables A1-A9.

Uranium was detected above the MCL in seven CLC wells; however, elevated concentrations of uranium are naturally occurring in the area ground water. The EPA's CERCLA authority does

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exposed to drinking water contaminated with MTBE. The advisory recommends control levels that prevent adverse taste and odor (*i.e.* 20 to 40 parts per billion). EPA believes managing water supplies to avoid the unpleasant taste and odor effects at levels in this range would also provide protection against other potential adverse health effects with a large margin of safety.]

not directly apply to naturally occurring contamination such as the uranium contamination found at the Site. Accordingly, the Selected Remedy does not address naturally occurring uranium contamination in the Site ground water. The CLC, however, is currently taking actions to ensure that it continues to meet Safe Drinking Water Act standards wherever uranium exceeds the standards. It is EPA's expectation that the CLC's actions to address uranium in the water supply will be coordinated with the remedial action for PCE if uranium reaches unacceptable levels within the plume boundaries.

Exposure Assessment

In the exposure assessment part of the BHHRA, a detailed evaluation was completed for each potential exposure scenario at the Site. This evaluation included identification and characterization of contaminant sources and release mechanisms, transport media, exposure points, exposure routes, and human receptors. Human receptors identified and assessed as part of the potential exposure scenarios included current and future on-Site adult and child residents, current and future on-Site workers at the PAL Boxing Facility, and current and future adolescent recreational users of the on-Site PAL Boxing Facility. For these exposure scenarios, future land use was assumed to remain the same as present land use.

Potential Effects on Human Health

The BHHRA assessed whether Site-related contaminants pose a current or future risk to human health if no remedial actions are performed. A large part of the BHHRA is the determination as to whether a complete exposure pathway exists. In a BHHRA, exposure pathways are means by which hazardous substances move through the environment from a source to a point of contact with human receptors. A complete exposure pathway must have four parts: (1) a source of contamination, (2) a mechanism for transport of a substance from the source to the air, surface water, groundwater and/or soil, (3) a point where human receptors come in contact with contaminated air, surface water, groundwater or soil, and (4) a route of entry into the body. Routes of entry can be eating or drinking contaminated materials, (ingestion) breathing contaminated air, (inhalation) or absorbing contaminants through the skin (dermal contact). Risks can be assessed when an exposure pathway is complete.

If any part of an exposure pathway is absent, the pathway is said to be incomplete and no exposure or risk is possible. In some cases, although a pathway is complete, the likelihood that significant exposure will occur is very small. Risk assessments include a "pathways analysis" to identify those pathways that are complete and most likely to produce significant exposure.

The pathway analysis at the Site determined that two complete exposure pathways exist for PCE, the contaminant of concern (COC) at the Site. A complete exposure pathway exists for PCE in subsurface soil vapor, and in ground water as a drinking water supply. The inhalation exposure pathway results from soil vapor (by way of indoor vapor intrusion) at residential properties or recreational facilities. Under certain conditions and concentrations, PCE in soil can volatilize and migrate into building structures. The complete pathway for ingestion is by way of consuming PCE-affected ground water. PCE in vapor phase within the unsaturated zone can volatilize and potentially migrate into building structures.

The risk assessment determined that PCE in the proximity of the PAL Boxing Facility and 7 residential properties located northeast of the intersection of East Hadley Avenue and North Walnut Street exceeded screening values and warranted further evaluation to determine if this complete pathway resulted in an unacceptable risk. Some measured risk levels associated with some of the residential properties and the PAL facility exceed EPA's $1x10^{-6}$ point of departure goal, however, EPA has determined further action is unwarranted at either the residential properties or recreational facilities. This determination is based in part, on calculated risk levels at these locations that are within the acceptable risk range. The determination is also based on the conservative nature of the method used for evaluating indoor vapor intrusion, the analytical difficulties in taking air measurements, and the possible presence of contributions of contamination from "background" sources, including ambient (outdoor) air sources[2]. Finally, the risk found at these 7 properties and at the PAL facility is within the 1×10^{-4} to 1×10^{-6} risk range that is acceptable for carcinogens under the NCP when the types of factors identified in this paragraph are present.

In the other complete exposure pathway that EPA identified at the Site, PCE in ground water is pumped from municipal water supply wells (and potentially from domestic wells), where PCE is distributed to Site residents and businesses where it may be ingested as tap water; however, as explained in the next paragraph, the City of Las Cruces has taken management measures to ensure that consumers are protected.

[2] "OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)." (2002) EPA/530/D-02/004 (Although this is "draft" guidance, EPA recommends using it at CERCLA Sites (*see* 67 Fed. Reg. 71169, 71171. 71172)).

It is important to note that the CLC is continuing to maintain its ability to provide safe, potable water supply. The CLC has either discontinued use of the PCE affected wells, or, blends the one remaining on-line well affected with PCE with ground water from unaffected wells to meet Drinking Water Standards (known as Maximum Contaminant Levels (MCLs)) established under the Safe Drinking Water Act (SDWA).

Potential Receptors Considered in the Screening Levels

Adult and child residents, industrial workers, and adolescent recreational users were identified as current and future receptors near the Site. These receptors were considered when identifying the appropriate screening levels for Site data. Future land uses and activities are expected to remain the same as currently present.

Agency for Toxic Substances and Disease Registry (ATSDR), Public Health Assessment

The ATSDR was established by Congress in 1980 under CERCLA, and is required to conduct Public Health Assessments (PHA) at each Site listed on the NPL. The ATSDR also conducts PHAs when petitioned by concerned individuals living near a Superfund Site. A public health assessment includes a preliminary assessment of the potential threats that individual Sites pose to human health. The public health assessment is required to be completed "to the maximum extent practicable" before completion of the RI/FS. ATSDR's public health assessments are intended to help public health and regulatory officials (e.g., EPA) determine if actions should be taken to reduce exposure to hazardous substances and to recommend whether additional information on human exposure and associated risk is needed. EPA considers the information obtained in the public health assessment and the results of the BHHRA when evaluating the potential health threats posed by a Site.

On February 25, 2005, the ATSDR released its Public Health Assessment for the Site, wherein it evaluated the potential indoor air impacts from residential use of evaporative coolers and use of the municipal water supply for irrigating residential gardens. ATSDR'S findings indicated that use of evaporative coolers posed an insignificant risk to residents when water supply concentrations are equal to the drinking water standard (MCL) for PCE. In addition, ATSDR indicated that PCE does not bio-accumulate in plants and therefore associated health risks are not significant. Since ATSDR uses an approach similar to the approach that EPA uses in evaluating risk, and since ATSDR found no risk associated with plants grown in Site ground water or with evaporative coolers that use Site ground water, EPA did not reevaluate these risks in the BHHRA.

The human health conceptual Site model (CSM) presents potential chemical sources, release mechanisms, receptors (current and future), and exposure routes. The risk assessment CSM is provided in Table A1-1. The table identifies which receptors and exposure pathways are quantified in the BHHRA.

Exposure Pathways Quantified in the BHHRA

The following exposure pathways were evaluated to estimate potential risks for the indicated receptors:

- Current/Future Resident (adult and child) – Inhalation of indoor air at each individual home.
- Current/Future Industrial Worker – Inhalation of indoor air at the PAL Boxing Facility.
- Current/Future Recreational user (adolescent) – Inhalation of indoor air at the PAL Boxing Facility.

The maximum detected concentration of the COC for each exposure point was used as the exposure point concentration (EPC) under a reasonable maximum exposure (RME) scenario. If the potential risks associated with an RME scenario exceeded acceptable risk levels, a central tendency (CT) scenario was quantified using the arithmetic mean concentration of the COC as the EPC.

Potential future unacceptable exposures to ground water concentrations above MCLs (from the Mesilla Basin) were not quantified in this BHHRA, primarily because the MCLs are ARARs for public drinking water supply systems. As stated in EPA policy presented in *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, "For ground water actions, MCLs and non-zero MCLGs will generally be used to gauge whether remedial action is warranted."

Exposure Point Concentrations

Exposure point concentrations are used in the intake calculations. Using the Johnson and Ettinger model, EPA calculated the indoor air concentrations of PCE resulting from soil vapor intrusion. Maximum detected concentrations of PCE in soil vapor were used when quantifying RME scenarios, while the arithmetic mean concentration of PCE in soil vapor was used when quantifying the CT scenarios. EPA evaluated potential indoor air exposures to PCE by adult and child residents at the seven residences, and by industrial workers and adolescent recreational users at the PAL Boxing Facility.

Exposure Factors

Standard default exposure factors presented in EPA guidance were used for adult/child residents and industrial workers, while a combination of exposure factors based on EPA guidance and best professional judgment was used for adolescent recreational users. For the CT exposure scenario, the same set of exposure factors as the RME exposure scenario were used (i.e., only the EPC was different).

Toxicity Assessment

Site contaminants were assessed for carcinogenicity and for non-carcinogenic systemic toxicity. The incremental upper bound lifetime cancer risk, presented in this ROD as the "estimated lifetime cancer risk" or "ELCR," represents the additional Site-related probability that an individual will develop cancer over a lifetime because of exposure to a certain chemical (i.e., this ELCR is in addition to the general nationwide lifetime risk of cancer which is about one in three).

To protect human health, EPA has set the acceptable additional risk range for carcinogens at Superfund Sites from 1 in 10,000 to 1 in 1,000,000 (expressed as 1×10^{-4} to 1×10^{-6}). A risk of 1 in 1,000,000 (1×10^{-6}) means that one person out of one million people could be expected to develop cancer as a result of a lifetime exposure to the Site contaminants. Where the aggregate risk from contaminants of concern (COCs) based on existing ARARs exceeds $1\text{x}10^{-4}$, or where remediation goals are not determined by ARARs, EPA uses the $1\text{x}10^{-6}$ as a point of departure for establishing preliminary remediation goals. This means that a cumulative risk level of $1\text{x}10^{-6}$ is used as the starting point (or initial "protectiveness" goal) for determining the most appropriate risk level that alternatives should be designed to attain. Factors related to exposure, uncertainty and technical limitations may justify modification of initial cleanup levels that are based on the $1\text{x}10^{-6}$ risk level.

For non-carcinogenic toxic chemicals, the toxicity assessment is based on the use of reference doses (RfDs) whenever available. A reference dose is the concentration of a chemical known to cause health problems. The estimated potential Site-related intake of a compound is compared to the RfDs in the form of a ratio, referred to as the hazard quotient (HQ). If the HQ is less than 1, no adverse health effects are expected from potential exposure. When environmental contamination involves exposure to a variety or mixture of compounds, a hazard index (HI) is used to assess the potential adverse effects for this mixture of compounds. The HI represents a sum of the hazard quotients calculated for each individual compound. HI values that approach or exceed 1 generally represent an unacceptable health risk that requires remediation.

The current EPA carcinogenic classification for benzene is A (human carcinogen). The EPA however, has no current carcinogenic classification for MTBE. The International Agency for Research on Cancer (IARC) classification for PCE is 2A (probably carcinogenic to humans). The oral non-cancer toxicity values for benzene are based on effects on the blood and immune system, while the oral non-cancer toxicity values for PCE are based on liver toxicity. The inhalation non-cancer toxicity values for benzene are also based on effects on the blood, while the oral non-cancer toxicity values for MTBE and PCE are based on liver and kidney toxicity.

Risk Characterization

EPA's target range (i.e., acceptable risk range) for excess lifetime carcinogenic risk associated with CERCLA Sites and specified in the NCP (40 Code of Federal Regulations [CFR] 300.430) is 1-in-10,000 (1×10^{-4}) to 1-in-1,000,000 (1×10^{-6}) in the human population. Therefore, the risk associated with Site-related exposures should not exceed this target range.

The estimated ELCRs associated with an RME scenario exceeded an ELCR of 1×10^{-6} at the seven residential properties; therefore, a CT scenario was quantified for these locations. The following potential risks were calculated:

Current/Future Resident (Adult and Child)

The following inhalation exposures were estimated from samples collected in the residential neighborhood northeast of East Hadley Avenue and North Walnut Street.

- **Property A** – Inhalation exposures to PCE at Property A were estimated. An ELCR of $3x10^{-5}$ and HIs of 0.03 and 0.06 were calculated for adult and child residents, respectively. PCE exceeded an individual ELCR of $2x10^{-6}$; therefore, a CT scenario was quantified. An ELCR of $8.8x10^{-6}$ was calculated for the CT scenario.

- **Property B** – Inhalation exposures to PCE at Property B were estimated. An ELCR of $4x10^{-5}$ and HIs of 0.03 and 0.07 were calculated for adult and child residents, respectively.

PCE exceeded an individual ELCR of $1x10^{-5}$; therefore, a CT scenario was quantified. An ELCR of $1.3x10^{-5}$ was calculated for the CT scenario.

- **Property C –** Inhalation exposures to PCE at Property C were estimated. An ELCR of $3x10^{-5}$ and HIs of 0.02 and 0.05 were calculated for adult and child residents, respectively. PCE exceeded an individual ELCR of $9x10^{-6}$; therefore, a CT scenario was quantified. An ELCR of $1.8x10^{-5}$ was calculated for the CT scenario.

- **Property D –** Inhalation exposures to PCE at Property D were estimated. An ELCR of $1x10^{-5}$ and HIs of 0.01 and 0.03 were calculated for adult and child residents, respectively. PCE exceeded an individual ELCR of $9x10^{-6}$; therefore, a CT scenario was quantified. An ELCR of $1.2x10^{-5}$ was calculated for the CT scenario.

- **Property E –** Inhalation exposures to PCE at Property E were estimated. An ELCR of $2x10^{-5}$ and HIs of 0.02 and 0.05 were calculated for adult and child residents, respectively. PCE exceeded an individual ELCR of $1x10^{-5}$; therefore, a CT scenario was quantified. An ELCR of $9.4x10^{-6}$ was calculated for the CT scenario.

- **Property F –** Inhalation exposures to PCE at Property F were estimated. An ELCR of $1x10^{-5}$ and HIs of 0.01 and 0.02 were calculated for adult and child residents, respectively. PCE exceeded an individual ELCR of $1x10^{-5}$; therefore, a CT scenario was quantified. An ELCR of $1.6x10^{-5}$ was calculated for the CT scenario.

- **Property G –** Inhalation exposures to PCE at Property G were estimated. An ELCR of $2x10^{-5}$ and HIs of 0.02 and 0.04 were calculated for adult and child residents, respectively. PCE exceeded an individual ELCR of $2x10^{-5}$; therefore, a CT scenario was quantified. An ELCR of $9.7x10^{-6}$ was calculated for the CT scenario.

Current/Future Adult Industrial Worker

Inhalation exposures to PCE at the PAL Boxing Facility were estimated. An ELCR of $7x10^{-7}$ and an HI of 0.02 were calculated.

- **Current/Future Recreational User (Adolescent)**

  Inhalation exposures to PCE at the PAL Boxing Facility were estimated. An ELCR of $4x10^{-8}$ and a HI of 0.02 were calculated.

It is important to note that the calculated risk scenario relied upon conservative exposure assumptions, and was based on uncertainty factors inherent in the use of the Johnson-Ettinger screening level model. The Johnson-Ettinger Model (JEM) was developed for use as a screening level model and, consequently, is based on a number of simplifying assumptions regarding contaminant distribution and occurrence, subsurface characteristics, transport mechanisms, and building construction. As a result, the risk calculated for the Site tend to overestimate the risk by an order of magnitude or more . For these reasons, the Site specific risk values of 1×10^{-5} to 4×10^{-5} which exceeds the point of departure of 1×10^{-6} were considered acceptable for the vapor intrusion exposure pathway. The JEM assumptions are typical of most simplified models of subsurface contaminant transport with the addition of a few assumptions regarding vapor flux into buildings.

Under the JEM, the contaminants are assumed to be homogeneously distributed at the source. Vapor from the source is also assumed to diffuse directly upward (one-dimensional transport) through uncontaminated soil to the base of a building foundation, where convection carries the vapor through cracks and openings in the foundation into the building. Under JEM, both diffusive and convective transport processes are assumed to be at steady state. Under the JEM, neither sorption nor biodegradation is accounted for in the transport of vapor from source to the base of the building. All of these assumptions under the JEM cause it to overestimate risk, and, in light of this, EPA believes that the estimated $4x10^{-5}$ risk, which is within EPA's acceptable risk range, is protective for the Site.

In summary, estimated ELCRs at the seven residential properties and the PAL Boxing Facility were within EPA's acceptable risk range (1×10^{-4} to 1×10^{-6}). Estimated non-cancer HIs were also below the EPA's target HI level (less than or equal to one). Therefore, current and future exposures to indoor air concentrations from vapor intrusion are within acceptable levels. Current risks associated with the municipal water supply are within acceptable levels due to the well management and blending activities implemented by the municipality. However, in the future, benzene, MTBE, and PCE concentrations at drinking water exposure points may exceed

MCLs if a management program is discontinued, if additional wells are installed in the Mesilla Basin, or if additional on-line wells become impacted via ground water plume migration.

Uranium Detections in Ground Water

Elevated concentrations of uranium are naturally occurring in the area. The CLC is addressing the elevated uranium concentrations in the drinking water supply as part of compliance with the SDWA and therefore risks associated with uranium in drinking water are not addressed in this BHHRA. If the uranium concentrations exceed MCLs at the distribution point, unacceptable risks may be posed by the water supply. EPA's CERCLA remediation authority generally does not directly apply to naturally occurring contamination such as the uranium contamination found at the Site. Accordingly, the selected remedy does not address naturally occurring uranium contamination in the Site ground water. It is EPA's intent that the CLC's actions to address uranium in the water supply will be coordinated with remedial actions that address PCE contamination.

Future Ground Water User at Wells above MCLs

In the future, one or more of the following scenarios may occur, resulting in unacceptable concentrations in potable wells above MCLs:

- The CLC may install additional wells in the Mesilla Basin in areas that are impacted by chemicals above MCLs.
- Private landowners may install wells in the Mesilla Basin in areas that are impacted by chemicals above MCLs.
- The blending program that is currently in place to meet the MCLs could experience a malfunction.
- Ground water in the Mesilla Basin will continue to migrate and impact additional potable wells not currently impacted.

If any of the above scenarios were to occur, PCE concentrations in the wells described may exceed the MCL and therefore pose an unacceptable risk. Under the NCP at 40 CFR § 300.430(e)(2)(i), the lead agency at a Superfund Site (in this case EPA) develops remediation goals that establish acceptable exposure concentration levels that are protective of human health and the environment considering, among other things, MCLs for ground water contamination (where the corresponding Maximum Contaminant Level Goal (MCLG) is zero). Since the

MCLG for PCE is zero, EPA has selected the MCL as the remediation goal.

Uncertainty Assessment

The following discussion presents the major uncertainties associated with this BHHRA.

Data Issues

Reporting Limits (RLs) for some analytes in soil vapor and ground water samples exceeded their respective screening levels**.** The RL (10 ppbv) of TCE in soil vapor exceeded its screening level of 4.1 ppbv. However, in accordance with the Quality Assurance Protection Plan (QAPP), ten (10) percent of these field soil vapor samples were collected in Summa canisters and sent to an off-Site laboratory for confirmation analysis by EPA Method TO-15. Although EPA Method TO-15 however can achieve lower RL (0.1 ppbv), there was consistency between the field screening method applied for the soil vapor samples and the fixed laboratory results. Therefore, use of a field screening method for identifying soil vapor concentrations is not expected to contribute a significant level of uncertainty to the BHHRA.

Indoor Air Exposure Point Concentrations (EPCs)

Initially, maximum detected concentrations of PCE in soil vapor were used to model the EPCs in indoor air. However, this approach assumes that an individual is exposed daily to these concentrations and that the maximum concentration is present uniformly underneath the building. Therefore, the modeled indoor air EPCs, which are based on attenuation factors from the Johnson and Ettinger model are expected to be overestimated. The Johnson and Ettinger model conservatively estimates the risks posed to PCE in indoor air through the soil vapor intrusion pathway. Use of the arithmetic mean PCE concentrations in soil vapor (for the Central Tendency scenario) to model the EPCs in indoor air more likely represent the lifetime average concentrations in indoor air.

PCE Toxicity Value

At the current time, the cancer toxicity values to be used for evaluating potential exposure to PCE are under review. In the absence of relevant toxicity values in IRIS or an NCEA Preliminary Peer-Reviewed Toxicity Value (PPRTV)—the first two tiers of human health toxicity values in the EPA Superfund hierarchy—EPA supports use of the California EPA Air Toxic Hot Spots Program inhalation unit risk factor of 5.9×10^{-6} $(\mu g/m^3)^{-1}$ in the Superfund Program and relies upon it until an EPA-promulgated toxicity value becomes available. In general, California EPA develops its toxicity values in a manner that is quite similar to the EPA IRIS program, in that many of the same databases and considerations are used. California EPA assessment used information from some of the same sources that EPA typically considers in the IRIS program, including the most recent relevant studies known to exist, and California EPA considered this information in a manner similar to the EPA IRIS program. California EPA uses similar assumptions in deriving their screening values, except for the use of slightly more stringent toxicity values. Presently, there are no Federal screening values for evaluating indoor vapor intrusion. Therefore, EPA Regions frequently consider the values proposed by California EPA.

Applicability of Soil Vapor Data

Potential exposures and risks associated with the vapor intrusion pathway were evaluated using shallow soil vapor sampling data collected during November 2005, which were then modeled using the Johnson & Ettinger model. Using the November 2005 data set, the excess lifetime cancer risk associated with potential exposure to PCE in indoor air was estimated to be from one to four in 100,000 in the residential area (i.e. 1×10^{-5} to 4×10^{-5}). Because of the uncertainty inherent in the use of the Johnson-Ettinger screening level model, the risk calculated using conservative exposure assumptions tend to overestimate the risk by an order of magnitude or more. Therefore the Site specific risk values of 1×10^{-5} to 4×10^{-5} which exceeds the point of departure of 1×10^{-6} were considered acceptable for the vapor intrusion exposure pathway. The Johnson-Ettinger Model (JEM) was developed for use as a screening level model and, consequently, is based on a number of simplifying assumptions regarding contaminant distribution and occurrence, subsurface characteristics, transport mechanisms, and building construction. The JEM assumptions are typical of most simplified models of subsurface contaminant transport with the addition of a few assumptions regarding vapor flux into buildings.

Under the JEM, the contaminants are assumed to be homogeneously distributed at the source. Under the JEM, vapor from the source is assumed to diffuse directly upward (one-dimensional transport) through uncontaminated soil to the base of a building foundation, where convection carries the vapor through cracks and openings in the foundation into the building. Under JEM, both diffusive and convective transport processes are assumed to be at steady state. Under the JEM, neither sorption nor biodegradation is accounted for in the transport of vapor from source to the base of the building. All of these assumptions under the JEM cause it to overestimate risk, and, in light of this EPA is confident that the estimated 4×10^{-5} risk, which is within EPA's acceptable risk range, is protective for the site.

There are two issues to consider when using this estimation of risk for decision-making related to further action associated with shallow soil vapor. First is the question of seasonal variation – are the data collected in November 2005 representative of conditions throughout the year? The second is the question of using one set of data to estimate risk, as opposed to two or more events. An additional factor to consider when weighing the relative importance of either one of these issues is the conservative nature of the Johnson & Ettinger model, which is thought, in general, to over-estimate risk.

1. **Seasonal Variability**

   The data set used to estimate risk was collected in November when ambient temperatures were relatively mild for the Las Cruces area (temperatures during the sampling event historically are in the high 50s to low 60s (degrees F). In the summer, temperatures are generally in the mid to high 90s. Higher summer temperatures might contribute to some warming of surface soils within the top 2 feet, but is less likely to influence significantly temperatures in slightly deeper soils, where the November data was collected. In addition, barometric pressures are relatively uniform throughout the year in this area, so that there is no significant seasonal "pumping" effect affecting soil vapor flux.

   The vapor intrusion pathway is more significantly affected by advective transport of soil vapor from the subsurface to indoor air. This advective transport is driven by differences in pressure between indoors and the subsurface, resulting from indoor/outdoor temperature differences (the "stack effect") and turbulence induced by the operation of heating, ventilating, and air conditioning (HVAC) systems. Some guidance suggests that there is significant seasonal variability in indoor air concentrations with higher concentrations under winter conditions where the stack effect is presumably greater. However, modeling of air infiltration and radon entry into residences suggests that the stack effect will have little seasonal impact for houses with slab or crawl-space construction, as is found in Las Cruces. The stack effect would be a more important driving force for vapor entry into structures with basements under "hard" winter-time conditions, and not for slab-on-grade construction in more temperate climates such as that observed in Las Cruces.

2. Use of one sampling event to estimate risk

The November 2005 sampling event was actually the second time shallow soil vapor samples have been collected in the residential area of the Site. The first was in 2002, when EPA collected over 600 soil vapor samples at the Site, including the residential area. The data between the 2002 and 2005 sampling events are not directly comparable, having been collected through different methods and for a different purpose (Site characterization vs. evaluation of risk to indoor air). With that caveat, it may be helpful to note the overall similarity or variation in concentrations detected in the residential area in 2002 and 2005.

For example, PCE was detected in August 2002 at about 736 and 1,108 ppbv at depths of 10 feet below ground surface (bgs) in residential street sample locations R9002 and R9004, located >50 feet from any residence, in the middle of the street). In November 2005, PCE was detected at concentrations ranging from 240 to 644 ppbv at depths of 10 feet bgs in the front yards of lots facing this same cul-de-sac.

Overall, the average PCE concentration detected in soil vapor at all depths during the 2005 sampling event is, in general, somewhat lower than the average concentration detected at all depths during the 2002 sampling event. It is unlikely this difference is due to the effects of seasonal variability (based on the discussion presented in the previous section). The apparent reduction in PCE concentrations could be the result of the attenuation of PCE in the soil vapor, the variation in depths sampled (the 2002 data was collected from 10 feet bgs or more, the 2005 data was collected from 10 feet bgs or less), the locations sampled (the street vs. the yards), and/or the different method of collection. The sampling conducted in 2005 was designed for the estimation of risk and is more suitable for evaluation of vapor intrusion pathways because the samples were located near structures.

Note, both PCE and TCE were analyzed in 2002 and 2005. In 2005, TCE was not detected in any samples. In 2002, TCE was detected in only 3 out of 32 locations sampled in the residential area. The maximum detection of TCE in the residential area was 15 ppbv at 30 feet bgs at location R9002.

Conservative Nature of the Johnson & Ettinger Model

Potential indoor air concentrations were estimated from soil vapor using the Johnson and Ettinger model. The assumptions used in the Johnson and Ettinger model were conservative, providing an overstatement of the potential risks associated with inhalation of indoor air. The modeling is conservative principally because of the use of assumptions that calculate a high rate of soil vapor flow into indoor spaces. The key assumptions were that soils underlying the foundations were highly porous, that the houses were very "leaky," but that the outside air exchange rate was very low. This produces a situation unlikely to be present in the real world, because leaky houses also would have high outside air exchange rates. The conservative nature of these assumptions was confirmed by comparing the modeled soil vapor flow rate with the range of values that have been reported in the literature. The modeled rates used for this Site were at the high end of the range of literature values.

Also, the soil vapor concentrations used for the assessment of vapor intrusion risks were developed from laboratory analyses that were based on atmospheric pressure at sea level. This would provide soil vapor concentrations for use in modeling and risk assessment that would be slightly higher compared with soil vapor concentrations under Site-specific conditions (Site-specific conditions being 3,896 feet above MSL). Use of analytical data calculated on a sea-level basis therefore results in slightly higher estimates of indoor air concentrations and risks than would be anticipated under Site-specific conditions.

In summary, current and future exposures to indoor air concentrations from vapor intrusion are within target risk levels for Superfund. Because of the uncertainty inherent in the use of the Johnson-Ettinger screening level model, the risk calculated using conservative exposure assumptions tend to overestimate the risk by an order of magnitude or more. Therefore the site specific risk values of 1×10^{-5} to 4×10^{-5} which exceeds the point of departure of 1×10^{-6} were considered acceptable for the vapor intrusion exposure pathway. The Johnson-Ettinger Model (JEM) was developed for use as a screening level model and, consequently, is based on a number of simplifying assumptions regarding contaminant distribution and occurrence, subsurface characteristics, transport mechanisms, and building construction. The JEM assumptions are typical of most simplified models of subsurface contaminant transport with the addition of a few assumptions regarding vapor flux into buildings.

Current exposures to the municipal water supply are within acceptable levels as long as CLC maintains compliance with drinking water standards. As the most widespread contaminant at the GWP Site in both soil vapor and ground water, found in both monitoring wells and municipal supply wells, PCE is considered the primary COC for the GWP Site because a potential for future unacceptable exposure exists.

Ecological Considerations

The process for an ecological risk assessment, according to EPA Superfund guidance, begins with preparing an ecology checklist. Next, consideration is given to whether exposure pathways are complete. If they are, then one would proceed to performing a screening ecological risk assessment. If exposure pathways for ecological receptors are determined to be incomplete, then the ecological risk assessment process can be exited. For the GWP Site, an ecology checklist was prepared for the GWP Site, as required for all Superfund sites. Information regarding the ecological condition of the Site as well as aerial photographs of the Site was collected during Site visits and the field investigation. The Site can be described as a moderately developed area, with limited ecological habitat. Some disturbed and undeveloped lots exist within the vicinity of East Griggs Avenue and North Walnut Street, but are vegetated mostly with invader species of shrubs. Except for small isolated areas of remnant desert scrub/shrub habitat, the majority of the vegetation is in the form of ornamental landscaping, and turf maintained at recreational soccer/baseball fields.

The few undeveloped lots near the Site demonstrate the presence of desert scrub species including invader shallow rooted non-native vegetation, commonly found on highly disturbed desert landscape. Given the land use of this urban environment (i.e., the last 30 years), this Site does not appear to be critical habitat because of the urban setting. PCE is not detected in soil until depths of about 10 ft. bgs were reached, so 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, and therefore does not affect flora or fauna. 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.

Section 8

Remedial Action Objectives

The Remedial Action Objectives (RAOs) and Remediation Goals are based on current uses and on potential future uses of ground water and on exposure scenarios that are consistent with these uses. Generally, drinking water standards (federal MCLs, non-zero MCLGs, or more stringent state ground water standards) are ARARs and are incorporated into remediation goals for Site ground water determined to be a current or potential future source of drinking water (40 CFR §300.430(e)(2)(i)(B and C)). Since the MCLG for PCE is zero under the provisions of the NCP, the MCL of 5 µg/L for PCE is the ARAR for the Site and has been selected as the remediation goal for ground water.

The RAOs for ground water at this Site were established in accordance with the *Presumptive Response Strategy and Ex Situ Treatment Technologies for Contaminated Ground water at CERCLA Sites*, and are provided as follows:

- Prevent human exposure to contaminated ground water above the MCL (5 µg/L) for PCE.
- Maintain capture of the PCE-contaminated ground water plume above the MCL (5 µg/L) for PCE.
- Restore ground water to its beneficial use as a drinking water supply with PCE concentrations no greater than the MCL (5 µg/L).

PCE was identified as the COC for ground water based on a comparison between ground water concentrations and MCLs in monitoring wells. Concentrations of PCE were measured below the MCLs at current ground water exposure points, primarily as a result of the blending program enacted by the CLC to meet drinking water regulations. Nonetheless, 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.

Remediation Goals

The target contaminant defined for ground water at the Site is PCE. The New Mexico Water Quality Control Commission Regulations (20.6.2.3103 of the New Mexico Administrative Code [NMAC]) include ground water standards for PCE based on human health (0.02 mg/L). The MCL for PCE established under the SDWA is lower (0.005 mg/L) and therefore the MCL will be used as the Remediation Goal.

PCE degradation products (TCE, cis-1,2 DCE, trans-1,2, DCE) have been detected within the PCE plume boundary but no remediation goal was established because their concentrations remain below their respective MCLs and because the aquifer conditions were evaluated and determined to be non conducive toward natural attenuation of PCE. Therefore, it is difficult to determine if these degradation products are in fact, degrading from the PCE releases, or are from other off-Site related releases. Nonetheless, these other chlorinated solvents are within the plume and will therefore, be treated with PCE and the selected treatment process. These PCE degradation products will also continue to be monitored and treated to ensure compliance with their respective MCLs.

Benzene has also been detected in Site monitoring wells above its MCL of 5 µg/L, although it has not been detected in samples from municipal supply wells. A Remediation Goal will not be established for benzene at the Site because benzene is addressed under the New Mexico Petroleum Storage Tank regulations (NMAC 20.5). It will be monitored as part of the Long Term Monitoring (LTM) program however, to primarily ensure other source areas are not uncontrolled, as well as to reduce concentrations within the plume. Annual evaluations of ground water data collected at the Site will monitor water quality trends.

EPA's CERCLA remediation authority generally does not directly apply to naturally occurring contamination such as the uranium contamination found at the Site. Accordingly, the selected remedy does not address naturally occurring uranium contamination in the Site ground water. The CLC is working with the New Mexico Drinking Water Bureau to address uranium and has taken steps to ensure that it continues to meet Safe Drinking Water Act standards when, or if uranium detection in municipal water supply wells exceed its MCLs.

Section 9

Description of Alternatives

The remedial alternatives were developed to meet the RAOs and Remediation Goals in consideration of Site conditions, ARARs, and the technology options appropriate for the Site. Five alternatives were developed for final consideration at the Site. The five alternatives are defined as follows:

- Alternative 1: No Action
- Alternative 2: Ground Water Extraction with Blending
- Alternative 3: Ground Water Extraction with Treatment
- Alternative 4: Enhanced Ground Water Extraction with Treatment
- Alternative 5: In-Well Air Stripping in Higher Concentration Areas of the Ground Water Plume

Common Elements

Remedial components common to all or most of the remedial alternatives evaluated, including the selected remedy, include Institutional Controls (ICs), long-term ground water monitoring (LTM) for PCE as well as for other contaminants, and technical support (*e.g.,* model refinement). LTM also will include sampling for other VOCs (including halgoenated VOCs), (*e.g.,* benzene, MTBE, PCE daughter products such as TCE, 1,2 cis-and 1,2 trans-DCE, and vinyl chloride). Common elements are described in the sections below:

A. Institutional Controls

One of the elements that is common to all of the action remedial alternatives evaluated including the selected remedy is institutional controls. ICs are non-engineered instruments such as administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use; are generally to be used in conjunction with, rather than in lieu of, engineering measures such as waste treatment or containment; can be used during all stages of the cleanup process to accomplish various cleanup-related objectives; and, should be "layered" *(i.e.*, use multiple ICs) or implemented in a series to provide overlapping assurances of protection from contamination. The Site remedy will incorporate the following controls to compliment the overall remedy for the Site:

1. Future private well drilling at the Site will be temporarily restricted, and no well drilling will be allowed until the Site remedial action meets the RAOs or, without the

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prior written consent and approval of the JSP, in coordination with the State Engineer's Office for the State of New Mexico.

The BHHRA indicated that human ingestion of the PCE contaminated ground water above the MCLs at the Site would pose a risk to human health. Therefore, this prohibition to private well drilling will support the remedy and help prevent human exposure.

2. For purposes of preventing comingling of contaminants at the Site, the JSP has agreed that it will communicate with other local departments, state agencies, and authorities, to develop a process under which these other departments, agencies, and authorities will notify the JSP whenever a release occurs that may affect the Site ground water or the remediation efforts under this ROD. Under this process, JSP has agreed that it will notify these departments, agencies and authorities when it becomes aware of such a release. In addition, the process will encourage the exchange of information and data related to ground water quality.

B. Long-Term Monitoring Program

Another common element of all the action remedial alternatives that were evaluated including the selected remedy is Long Term Monitoring. To confirm that remediation goals are met, LTM is required. This LTM will measure the progress of the remedy. The remedial monitoring program will be fully developed during the RD for purposes of refining the monitoring locations and will include an exit strategy for discontinuing or modifying the program once the remedial action objectives have been met. While the objectives of the monitoring program will continue, the sampling locations may need to change over time, depending upon the data trends, plume control, and other associated factors.

CLC Wells will continue to be monitored, and if PCE concentrations increase in areas within the plume boundaries, (*e.g.,*if concentrations of PCE increase in monitoring wells, such as GWMW06, or if PCE is detected in CLC Well No. 10,) further investigation may be necessary.

At GWMW15, PCE currently exceeds the MCL in the upper portion of the LHZ. GWMW15 is presently the furthest down-gradient well at the Site and the one sample collected during the 2005 sampling event at the nested well detected 18 µg/L of PCE. The extent of the PCE detections in this eastern area of the plume has not been defined to concentrations below the MCL.

Therefore three new nested monitoring well locations are called for in this ROD. A nested monitoring well should be considered at the eastern portion of the plume consisting of three individual wells installed within the same borehole. During the Site investigation this location was identified as a location that could assist in refining the plume delineation. The suggested screened intervals are approximately 290 to 305 feet bgs, 460 to 475 feet bgs, and 580 to 595 feet bgs to correlate with the known contaminated zones of the aquifer (the screened intervals should be finalized during RD). Another nested monitoring well location could be located either south of the currently defined plume boundaries at a location consistent with the JSP fate and transport model prediction of future flow patterns toward the south, or, at a location near CLC Well 10 and GWMW06 depending upon which location the remedial design determines to be most appropriate for meeting the RAOs. Three locations for the suggested nested monitoring wells for purposes of implementing LTM are shown on **Figure 9-1**.

With the addition of the three nested monitoring wells (a total of 9 new sample locations), to be used along with existing monitoring wells, the LTM program should be sufficient to evaluate the effectiveness of the remedy. The suggested monitoring wells recommended for routine sampling are listed in **Table 9-1**.

During LTM, monitoring wells will be sampled for VOCs (including halogenated VOCs) to address PCE as well as other VOCs detected at the Site. These other detected VOCs include benzene and MTBE, both identified in the BHHRA contaminants of potential concern (COPCs) in ground water. Benzene has been detected in seven Site monitoring wells at concentration levels that exceed its corresponding MCL. MTBE is detected above its corresponding MSSL in one monitoring 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 that are below the MSSL. PCE is the contaminant of concern for the Site. PCE is the most widespread contaminant, in both soil vapor and ground water at the Site and has been detected in both monitoring wells and municipal supply wells. However, these other detected contaminants identified above (benzene and MTBE) are also important to monitor during LTM to keep them under control or as part of the treatment process.

The LTM program will include sampling for the compounds that result from PCE degradation in the environment including TCE, 1,2 cis - and 1,2 trans-DCE and vinyl chloride, although bio-degradation of PCE does not appear to be occurring at the Site in appreciable rates. These other

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compounds are included in the standard VOC parameter list.

For costing purposes, it was estimated that the monitoring wells in the LTM program will be sampled annually during the first five years and biannually in subsequent years. The frequency of monitoring and the list of included analytes will be refined during the RD. Five year review reports that are consistent with the EPA guidance will be required during the project duration.

Approximately ten (10) piezometer wells will most likely be necessary to adequately measure water levels. The piezometer wells will also be used to help determine the extent of the treatment zone for the extraction wells. The exact number and locations of the piezometers will be determined during the RD.

C. Annual Reviews and Reporting

Each alternative evaluated including the selected remedy, included annual reporting requirements. Annual reports will include a review of remedy performance to date, and recommend adjustments that should be made in the remedy to meet remediation goals and remedial action objectives. Each annual review will include a discussion of remedy performance based on the results of the monitoring data collected during the previous year(s). Each annual report should include recommendations associated with pumping rates, any necessary changes in pumping locations, or new approaches for data collection procedures. Each annual report should also include sufficient information an analysis of the Site conditions to potentially update and improve the Site ground water model based on data collected to date. Data collected and summarized in the annual report will include:

1. Measurement of water levels sufficient to support that the plume is being captured by the extraction wells and sufficient to document the predictive capabilities of the ground water model.
2. Monitoring of the ground water concentrations of PCE and the products of its environmental degradation (including TCE, MTBE, benzene, and the analytes on the VOC list determined during remedy design, and sufficient to document remedy progress and the predictive capabilities of the ground water model).
3. Monitoring of contaminant concentrations sufficient to document that the remedy continues to protect public health and the environment.

D. Uranium Treatment

EPA's CERCLA remediation authority generally does not directly apply to naturally occurring contamination such as uranium concentrations found at the Site. Accordingly, the selected remedy does not directly address naturally occurring uranium contamination at the Site ground water. The CLC however, has taken steps to ensure that ground water continues to meet Safe Drinking Water Act Standards for uranium. The CLC is undertaking actions in coordination with the New Mexico Drinking Water Bureau. The cost for treatment of uranium is not included in the FS cost estimates or the ROD cost estimates because uranium removal within the plume boundaries is not anticipated and the additional treatment for uranium is not part of the CERCLA action for this Site.

E. Technical Support

Each remedial alternative includes a line item for technical support. This component includes the continual technical evaluation of the selected remedy, as the remedy is being implemented. This component includes without limitation, evaluation of system parameters, review of field and analytical data, and system optimization. This support will provide real-time evaluation of the selected remedy with the purpose of optimizing the operation and effectiveness of the selected remedy and monitoring program. Technical support includes routine review of the Site conditions, changes in water levels, well pumping rates, and water usage.

Description of Alternatives Evaluated

In the following paragraphs, the ROD describes the various remedial alternatives that were evaluated prior to selection of the final remedy for this ROD. The Selected Remedy is Alternative 4: Enhanced Ground Water Extraction with Treatment and is described in further detail in Section 12 of the ROD.

Alternative 1: No Action

As part of its responsibilities under the NCP, the EPA must examine what would happen should no further response action be taken at the Site. The evaluation of the “No Action” alternative serves as a baseline for comparing the other remedial alternatives. Under this no action alternative, the water supply system would function with no modifications. Treatment is the preferred remedy for contaminated ground water under CERCLA and the NCP; however, under the no action alternative the PCE in ground water extracted by municipal wells would not be treated. The ground water at the GWP Site would continue to exceed the MCLs such that the RAOs for ground water would not be met. Under the no action alternative, the PCE in the ground water plume would be allowed to attenuate naturally by dilution and dispersion but this would take so long that other municipal water supply wells that are not contaminated would become contaminated, to the detriment of the public water supply and it its beneficial use. Specifically, as predicted by the ground water modeling performed by the JSP, if no hydraulic containment is provided, the PCE plume would eventually contaminate CLC Well No. 26 and migrate past toward CLC Well No. 24.

Alternative 2: Ground Water Extraction with Blending

The CLC has managed the PCE concentration in the drinking water by blending the water from those supply wells within the PCE contaminated area with the water from those wells in areas that are not impacted with PCE above the MCL. The blending program has been an effective short term alternative in preventing exposure to PCE at concentrations that exceed the MCL and in continuing to provide water supply under the current demand. In addition, the municipal wells pump the contaminated plume, creating a cone of depression, thereby providing a measure of interim plume containment. Alternative 2 relies on the blending approach, but would add a controlled hydraulic plume containment. Under Alternative 2, the containment would be accomplished by pumping the ground water flow from the contaminated plume towards the above ground reservoir where it would be blended, prior to distribution into the public water supply. Pumped water would be blended with water from wells that have not been affected by PCE. Costs associated with this alternative however, did not consider the potential need for building a new blending facility, should capacity at the current reservoir tank be exceeded, and if additional modeling results indicate an increase in pumping is necessary for purposes of plume containment. For this alternative, CLC Well Nos. 18 and 27 would be used to provide hydraulic containment of the plume to prevent expansion, pumped to levels that do not exceed the MCL and then blended, prior to distribution. Modeling results show that plume containment can be achieved using existing municipal supply wells CLC Well Nos. 18 and 27. The CLC Well Nos. 18 and 27 would be pumped at a long term average of 380 and 520 gpm, respectively. The modeling scenario assumed that neighboring CLC Wells 20, 24, and 26 would continue to pump and that CLC Wells 19, 21, and 38 would be turned off. Based on the total mass of PCE removed in one year, assuming the long-term average pumping rates and the December 2005 PCE analytical data for each well, the water pumped from these wells would have to be blended with more than 6.1 million gallons per day (MGD) of PCE-free water to achieve concentrations below the MCL. Blending would be expected to take place at the Upper Griggs Reservoir. Revisions to the blending program would require approval from EPA and the NMED DWB and become state and federally enforceable. Alternative 2 provides no active engineering remediation treatment system. Since treatment is preferred under CERCLA and the NCP, Alternative 2 is disfavored on this basis.

Alternative 3: Ground Water Extraction with Treatment

Under this alternative to contain the PCE contaminated ground water plume, CLC municipal supply well Nos. 18 and 27 would be pumped at increased flow rates (compared to their current flow rate), while remaining within their current design capacity. In order to capture the plume, the modeling scenario for this alternative assumed that neighboring CLC Well Nos. 19, 20, 21, 24, 26, and 38 would be turned off. In addition, the extracted ground water from CLC Well Nos. 18 and 27 would be treated until PCE concentrations are below the MCL prior to distribution to the municipal supply system; moreover, since it would be treated, the extracted water will not require blending to meet the MCL. Pumping at higher flow rates, followed by treatment to meet the MCL would reduce the time of remediation, but pumping at higher flow rates could exceed the capacity of the present wells, and consequently, the current wells would have to be replaced. The JSP model estimates that 21 years of active extraction and treatment would be necessary to remove all concentrations of PCE that exceed the MCL from the ground water.

The estimated long-term average flow rates for CLC Wells 18 and 27 are estimated to be 460 and 620 gpm, respectively. It is expected that these wells will operate 95 percent of the time at their design capacity. Under Alternative 3, extracted ground water would be conveyed to a central treatment facility location for treatment to meet the PCE MCL before it is distributed to consumers. The cost associated with Alternative 3 includes building the central treatment facility. The treatment facility would likely be located near municipal supply well CLC Well No. 27. The potential treatment technologies considered for the extracted ground water were as follows:

> *Air Stripping*: A low-profile tray air stripper system could be used to lower the PCE to below the MCL in the extracted ground water in a continuous flow system. In an air stripper system, mineral buildup or “scaling” can occur over time, thereby reducing the efficiency of a system and requiring de-scaling treatment Some remedies include pre-treatment, to help reduce the scaling from occurring. Therefore, the cost tables include an estimate for both pretreatment as well as air stripping without prior treatment.
>
> Las Cruces is an attainment area under the Clean Air Act. During any air stripping treatment, there is a possibility the air-stripping process could require emission controls

to prevent any violations to the National Ambient Air Quality Standards. In accordance with the OSWER Directive 9355.0-28 "Control of Air Emissions from Superfund Air Strippers at Superfund Groundwater Sites" (**EPA, 1989**), preliminary calculations of air emission rates associated with air stripping of PCE were prepared. These preliminary calculations indicate it is unlikely that air emission controls will be required for the GWP Site. The alternatives that include air stripping include an estimate of the costs associated with air monitoring to confirm emissions are in compliance.

Under Alternative 3, once ground water has been treated, ground water will be conveyed to the municipal supply system for use as potable water. In addition to air-stripping, other treatment options that were considered include the following:

GAC: A continuous flow granular activated charcoal (GAC) filtering system could be used to remove contaminants from the extracted ground water. Carbon filter change-outs would be required with this option and would be performed by the vendor. The spent carbon would be returned to the vendor for regeneration or disposal and the treated ground water would be conveyed to the municipal supply system for use as potable water.

Chemical/UV Oxidation: A self-contained, skid-mounted unit that combines ozone and hydrogen peroxide could be used to destroy ground water contaminants. Because this is a destruction technology, no air emissions nor waste are produced. After treatment, ground water would be conveyed to the municipal supply system for use as potable water.

The evaluation of Alternative 3 included cost estimates for ground water extraction and treatment including estimates for the verification of the capacity of the extraction well network (and refurbishing where necessary), estimates for the design and installation of conveyance piping and a centralized treatment plant, estimates for treatment equipment, estimates for design and installation of a supervisory control and data acquisition (SCADA) system, and estimates for annual O&M costs for operation of the treatment infrastructure for a period of 21 years.

Alternative 4: Enhanced Ground Water Extraction with Treatment: The Selected Remedy Under This ROD

EPA has selected Alternative 4 as the remedy for the GWP Site under this ROD. Alternative 4 is similar to Alternative 3, but Alternative 4 uses enhanced ground water extraction to reduce the time required to meet remediation goals. Under this Selected Remedy, CLC municipal supply wells Nos. 18 and 27 will maximize their pumping capacity and flow rates, while remaining within their current design capacity. The ground water model was used to help determine the best way to optimize extraction of contaminated water and obtain plume containment. Targeted pumping will be used to extract ground water from CLC wells and will be modified most likely, by screening across the vertical layers of the aquifer that have the highest contaminant concentration. The targeted screen interval for CLC Well Nos. 18 and 27 is 315 to 515 ft bgs. Well modifications can be achieved in a variety of ways, including, but not limited to, placing sections of blank well casing against selected screen intervals to block flow from those layers, and adding perforations to sections of existing blank casing to increase productions from the upper portions of the aquifer. It is estimated that it will take 14 years to meet remediation goals and remedial action objectives under the Selected Remedy, Alternative 4. The Selected Remedy will rely on targeted pumping using a combination of wells, most likely, CLC Well Nos. 18 and 27 along with a new extraction well located along the plume axis northeast of CLC Well No. 27 to achieve the expedited remediation. For planning purposes it is expected that CLC Well No. 18 will be used for the first five years of operation after which CLC Well No. 18 will be replaced with the new extraction well. CLC Well Nos. 19, 20, 21, 24, 26, and 38 are expected to be shut off to assist in the hydraulic control.

Use of existing municipal supply wells (CLC Well Nos.18 and 27) under the Selected Remedy, will assist in minimizing costs, however, it is recognized that the use of different wells or the installation of new wells may be required to obtain the desired plume capture. A schematic drawing of the selected remedy is presented in **Figure 9-2** but it is subject to revision during remedial design, as explained in the preceding sentence. Operation and maintenance (O&M) of the constructed remedy will take approximately 14 years.

Alternative 5: In-Well Air Stripping in Higher Concentration Areas of the Ground Water Plume

This alternative would provide for in-situ treatment of PCE contaminated ground water in the ground water where the highest detections of contaminants have been detected, coupled with pumping to provide hydraulic containment of the plume. The in-situ treatment option that would be used under this alternative is in-well air stripping.

When treating ground water using in-well air stripping, air is injected into the ground water through a pipe within the treatment well using a gas injection line and a compressor. The resulting bubbles will aerate the water, forming an air-lift pumping system and causing ground-water to flow upward in the well. As the bubbles rise through the contaminated ground water, the PCE will transfer from the dissolved to the vapor phase by this air stripping process. The air/water mixture rises until it encounters the dividing device within the inner well, above the contaminated zone. The dividing device is designed and located to maximize volatilization. The water/air mixture is forced out of the upper screen below this divider. The outer casing is under a vacuum, and vapors are drawn upward through the annular space and are collected at the surface for treatment to meet applicable air emissions standards as necessary, prior to discharge to the atmosphere. The ground water, from which some VOCs have been removed, re-enters the contaminated zone. As a result of rising ground-water lifting at the bottom of the well, additional water enters the well at its base. This water is then lifted via aeration. The partially treated water re-entering the aquifer is eventually cycled back through the process as ground water enters the base of the well. This pattern of ground water movement forms a circulation cell around the well, allowing ground-water to undergo sequential treatment cycles until remedial goals have been met. The area affected by this circulation cell, and within which ground water is being treated, is called the radius of influence of the stripping well.

Based on the Site lithology, it is estimated that the radius of influence would be 150 feet. Under Alternative 5, the stripping wells would be new wells spaced approximately every 300 ft. within the area of highest PCE concentrations (i.e., those areas above 20 μg/L PCE). It is expected that the flow rate needed to develop a circulation pattern within the aquifer would be approximately 10 to 50 gallons per minute in each treatment well. Given the heterogeneity of the subsurface, it is expected that ground water intake would be required in two zones (the UHZ and the upper portion of the LHZ). It is estimated that plume containment could be achieved using one new extraction well located along the plume axis north of CLC Well No. 27, pumped at a flow rate of 300 gpm. The extracted water from this well would be treated using an ex-situ treatment technology (GAC).

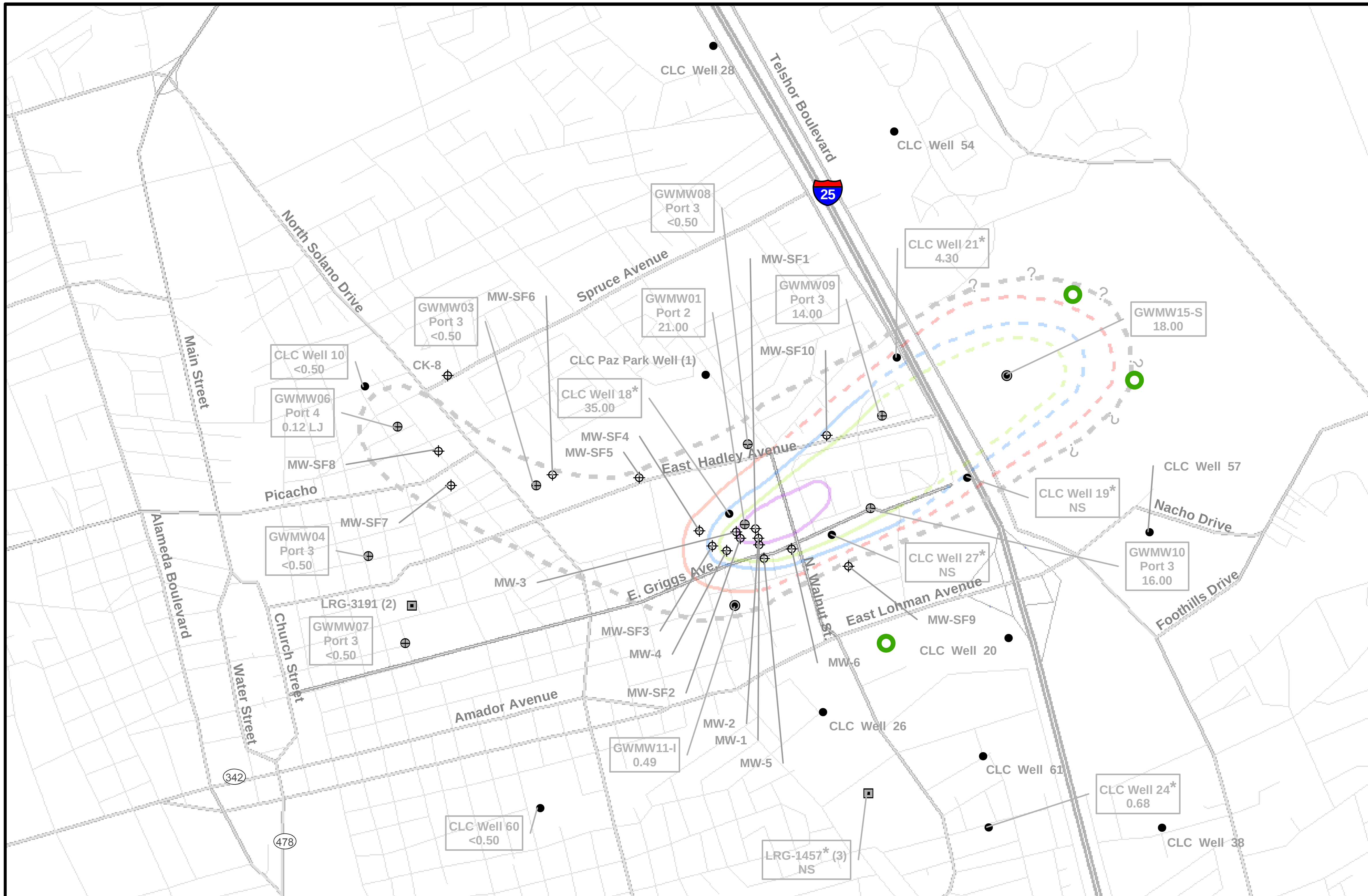
The cost estimate for Alternative 5 was based on the following:

- No free-phase DNAPL is present at the Site.

- A total of 4 new air stripping wells would be installed within the shallow ground water plume (the UHZ).
- 8 new air stripping wells would be installed within the intermediate ground water plume (upper portion of the LHZ).
- One blower would serve 2 in-well air stripping wells. The shallow wells would be co-located with the intermediate wells, so that one blower can serve both wells. Therefore, a total of 8 blower systems would be required (four blowers for the 8 co-located shallow and intermediate zone wells and four blowers for the other 4 intermediate zone wells).
- No off-gas treatment would be required. Air samples would be collected quarterly to verify this assumption.
- One new extraction well would be installed with a screened interval from approximately 250 to 450 bgs.
- Ex-situ treatment would be provided for the ground water extracted from the new extraction well. If water is extracted from other municipal supply wells within the plume for use in the water supply during active remediation, concentrations of contaminants would require monitoring and treatment to below MCLs prior to use.
- Wellhead treatment using a skid-mounted GAC system would be used for treatment of the water extracted from the new extraction well was assumed for cost estimating purposes. The GAC treatment system represents the lowest cost ex-situ treatment option.
- As with the ex-situ air stripping unit, the potential for scaling problems within the wells would exist. Options would include a drip acid treatment system or periodic well cleaning. The costs provided by the vendor include contingencies for these treatment options.
- It is estimated that a minimum of 20 years of annual O&M would be required for the system to achieve MCLs throughout the plume.

Table 9-1
List of Wells Proposed for Ground Water Monitoring
Griggs and Walnut Ground Water Plume
Las Cruces, New Mexico

Monitor Well ID	Monitor Well ID
CK-8	MW-SF10
MW-1	MW-SF11
MW-2	LRG-3191
MW-3	GWMW01 (Ports 01 through 07)
MW-4	GWMW03 (Ports 01 through 07)
MW-5	GWMW06 (Ports 01, 02, 04, 05, 06, 07)
MW-6	GWMW07 (Ports 01 through 67)
MW-SF1	GWMW08 (Ports 01, and 03 through 07)
MW-SF2	GWMW09 (Ports 01 through 08)
MW-SF3	GWMW10 (Ports 01 through 07)
MW-SF5	GWMW11 (3 nested wells)
MW-SF6	GWMW15 (3 nested wells)
MW-SF7	Proposed: GWMW-16 (three nested wells)
MW-SF8	Proposed: GWMW-17 (three nested wells)
MW-SF9	Proposed: GWMW-18 (three nested wells)



Notes:

PCE Concentrations in micrograms per liter (ug/L).

No Data obtained from GWMW06 Port 3. Data for Port 2 was <0.50 and data for Port 4 was 0.12 LJ. Therefore, PCE contamination is assumed to extend past GWMW06.

1. The CLC Paz Park Well is used for irrigation. The other CLC wells illustrated on this map are designated for drinking water supply (not all are used).

2. Samples from LRG-3191 have demonstrated the presence of PCE, but samples collected since August 2002 have been non-detect for PCE

3. LRG-1457 is an irrigation well for the Lynn Middle School. It is not currently in service.

Gas Card Monitor Well and Private Well LRG-7375 have been abandoned and are not shown on figure.

Unit Qualifiers:
J - Estimated
L - Concentration below the reporting limit

Concentration Data Contoured by Hand.

NS - Not Sampled

The municipal supply well concentrations are used for informational purposes only. The PCE concentrations in these wells were not used to prepare the PCE isoconcentration contours shown on this figure.

Upper portion of Lower Zone corresponds to an approximate elevation range of 3675 to 3775 ft MSL.

* Indicates Private and CLC Municipal Supply Wells where PCE is detected.

LEGEND

- ⊕ **Water Table Monitor Well** (screen depths of these wells range from 101 to 204 feet bgs.)
- ● **City of Las Cruces (CLC) Municipal Water Supply Wells** (screen depths of these wells range from 281 to 1,050 feet bgs.)
- ▣ **Private Water Supply Wells** (screen depths of these wells range from 150 to 290 feet bgs, depth of screen information is not available for LRG-1457)
- ⊕ **Multi-Port Monitor Well** (screen depth of these wells range from 90 to 640 feet bgs)
- ◉ **Nested Monitor Well Installed During RI** (screen depths of these wells range from 190 to 590 ft bgs)
- GWMW07 Port 3 <0.50 — Monitor Well ID, Port Number & PCE Concentration
- Estimated Extent of GWP-Related PCE Detections
- ? Indicates Uncertainty of Extent of GWP-Related PCE Detections
- Proposed Location of New Monitoring Well

PCE Concentration Levels (Dashed Where Infered)

- 2.5 ug/L
- 5 ug/L
- 10 ug/L
- 20 ug/L

CH2MHILL

Figure 9-1
Proposed Location of New Ground Water Monitor Wells

Griggs & Walnut Ground Water Plume Site

Las Cruces, New Mexico

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Section 10

Comparative Analysis of Alternatives

Evaluation Criteria

The detailed analysis of alternatives required under 40 CFR § 300.440(e)(9), consists of the analysis and presentation of the relevant information needed to allow decision makers to select a Site remedy. It is not the decision making process itself. During the detailed analysis, each alternative is assessed against each of the nine criteria. The analysis lays out the performance of each alternative in terms of compliance with ARARs, long term effectiveness, and permanence, reduction of toxicity, mobility or volume through treatment, short term effectiveness, implementatbility, and cost. The assessment of overall protection draws on the assessments conducted under other evaluation criteria, especially long term effectiveness and permanence, short term effectiveness and compliance with ARARs, State and community acceptance also are assessed. The analysis criteria are categorized into three groups: threshold criteria, balancing criteria, and modifying criteria. Threshold criteria must be met by a particular alternative for it to be eligible for selection as a remedial action. There is little flexibility in meeting the threshold criteria; a particular alternative either meets the threshold criteria, or that alternative is not considered acceptable. The two threshold criteria are overall protection of human health and the environment, and compliance with ARARs. If ARARs cannot be met, a waiver may be obtained when one of the six exceptions listed in the NCP occur (see 40 CFR 300.430 (f)(1)(ii)(C)(1 to 6)). Unlike the threshold criteria, the five balancing criteria assess the advantages and disadvantages among alternatives. The EPA balances the trade offs, identified in the detailed analysis, among alternatives with respect to long term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, short term effectiveness, implementability, and cost. This initial balancing determines preliminary conclusions as to the maximum extent to which permanent solutions and treatment can be practicable and utilized in a cost effective manner. The two modifying criteria are community and state acceptance. These criteria are evaluated after the public comment closes and are used to modify the recommended alternative, as appropriate.

The nine evaluation criteria objectives are as follows:

Evaluation Criteria For Superfund Remedial Alternatives

Overall Protectiveness of Human Health and the Environment: determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.

Compliance with ARARs: evaluates whether the alternative meets Federal and State environmental statutes, regulations, and other requirements that pertain to the Site, or whether a waiver is justified. Tables 13-1 and Table 13-2 summarize the pertinent ARARs pertaining to the Selected Remedy.

Long-term Effectiveness and Permanence: considers the ability of an alternative to maintain protection of human health and the environment over time.

Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment: evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

Short-term Effectiveness: considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.

Implementability: considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.

Costs: includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to – 30 percent.

State/Support Agency Acceptance: considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.

Community Acceptance: considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

Individual Analysis of Alternatives

See Table 10-1 at the end of this section.

Comparative Analysis

After making the individual criterion assessments for each alternative, the alternatives are compared to each other. This comparative analysis identified the key tradeoffs (relative advantages and disadvantages) among the alternatives with respect to the nine criteria. The purpose of this comparative analysis is to provide decision makers with sufficient information to balance the trade offs associated with the alternatives, select an appropriate remedy for the Site and demonstrate satisfaction of the CERCLA remedy selection requirements.

The NCP makes clear that overall protection of human health and the environment and compliance with ARARs (unless grounds for invoking a waiver is provided) are threshold criteria that must be satisfied by an alternative before it can be selected. Long term effectiveness and permanence; reduction of toxicity, mobility; and cost are primary balancing criteria. State and community acceptance are modifying criteria that may have significant input in the final remedy selection (see 300.430(f)(4)(i) and, to the degree they are available earlier, may affect the development of alternatives and the selection of the Proposed Plan.

Both the JSP and NMED assisted in the development of the remedial alternatives for the Site. Both NMED and the JSP provided technical assistance for both the RI and FS completion. The JSP provided the modeling results for each of the alternatives, except Alternative 5.

Table 10-1 presents the comparative analysis of alternatives under each of the nine criteria. **Table 10-2** presents a summary of the costs associated with each alternative.

Threshold Criteria

To be eligible for selection, an alternative must meet the two threshold criteria described below, or in the case of ARARs, must justify why a waiver is appropriate.

Overall Protection of Human Health and the Environment

Alternative 1 (No Action) is not protective of human health and the environment because elevated levels of contaminants exist in the ground water at concentration levels that exceed the MCLs. The contaminated ground water plume is expanding, according to the JSP ground water model.

The No Action alternative would do nothing to stop the contaminated ground water plume from expanding to the point where it reached additional wells, and contaminated more ground water. Therefore this alternative will not be discussed further in this comparative analysis.

Of the remaining four alternatives, all provide some measure of protection of human health and the environment. All of these four alternatives provide controlled removal of contaminated ground water in order to provide hydraulic containment and to eventually restore the aquifer to beneficial use (the range of remediation time frames is 14 years [Alternative 4, the selected remedy] to 23 years [Alternative 2]) based on preliminary modeling results

Alternative 2 (Ground Water Extraction with Blending), however, relies on blending, which does not constitute treatment. The contaminant remains in the water and is simply diluted. Maintaining a proper blending program is less reliable than the treatment alternatives due to potential fluctuation in concentrations. More frequent monitoring would be required than for other alternatives to ensure the blending ratio is appropriate and concentrations are consistently maintained below the MCL prior to distribution into the municipal drinking water supply.

The remaining three alternatives use treatment to reduce PCE in the extracted water to concentration levels that are below the MCL prior to distribution to the municipal drinking water supply system. Although monitoring is a requirement for all four of the treatment remedies to confirm the MCL is met, the performance of these alternatives is more certain and predictable than blending.

Alternatives 2 (Ground Water Extraction with Blending), 3 (Ground Water Extraction with Treatment), and 4 (Enhanced Ground Water Extraction with Treatment) are progressively more aggressive in their remediation strategies and the expected time to meet the MCL for PCE in ground water decreases as the extraction effort is increased. Under the selected remedy, Alternative 4, the expected time to meet the MCL/remediation goal is the shortest at 14 years. (The expected duration for the other action alternatives evaluated are 23 years for alternative 2, 21 years for Alternative 3, and 20 years for Alternative 5. Alternative 5 (In-Well Stripping in Higher Concentration Areas of the Ground Water Plume) uses an aggressive in-situ treatment strategy, but does not significantly reduce the remediation time frame (the expected time to achieve the MCL for PCE in ground water under this alternative is still 20 years). It is also the most costly alternative, but not the most efficient alternative.

Alternatives 3 and 4 include three options for treatment (air stripping, GAC, or chemical/UV oxidation). Alternative 5 uses in-situ air stripping in the treatment wells, but includes three options for treatment of water that has been extracted as part of the hydraulic containment effort. Air stripping and GAC transfer contaminants to another medium, presenting a potential risk from residual contamination (i.e., either from air emissions or from the disposal of hazardous waste). Since chemical/UV oxidation is a destructive technology, there is no risk associated with residual contamination.

The selection of the ex-situ treatment technology also involves varying potential risks to workers from the use of chemicals. GAC uses no additional chemicals; therefore the potential risk to the workers from the implementation of this technology is minimal. Air stripping may require the use of scaling pretreatment chemicals and chemical/UV oxidation uses strong oxidants to destroy contaminants. The potential risk to the workers from these two technologies is therefore somewhat higher than if GAC is used.

Compliance with Applicable or Relevant and Appropriate Requirements

Alternatives 2, 3, 4, and 5 (Remedial action will be implemented under each of these "action alternatives") and are each capable of meeting ARARs. All four of these alternatives extract PCE contaminated ground water from the subsurface in a controlled manner, and are expected to restore the aquifer to its beneficial use as a source of municipal water supply. Alternative 2 uses blending of the extracted ground water to meet the MCL before delivery to the municipal water supply and it is possible, that Alternative 2 might not comply with ARARs through the blending process if the PCE concentrations in extracted ground water exceed the dilution capacity of the blending system. Alternatives 3, 4, and 5 use treatment to reduce PCE in extracted ground water to concentration levels that are below the MCL. All four alternatives require monitoring to ensure MCLs are met prior to distribution. Alternative 2 blending could require more frequent monitoring than the other alternatives.

Also, for options under Alternatives 3, 4, and 5 that include air stripping, controls to remove contaminants from the vapor phase may be required, depending on the concentration of contaminants in the emissions and local requirements. Las Cruces is an attainment area under the CAA. In accordance with the OSWER Directive 9355.0-28 "Control of Air Emissions from

Superfund Air Strippers at Superfund Groundwater Sites," preliminary calculations of air emission rates associated with air stripping of PCE were prepared. The preliminary calculations did not predict a need for controlling air emission from air stripping, because of the low to minimal PCE concentrations expected to be emitted, and because of the distance from human receptors.

Balancing Criteria

The five primary balancing criteria are long term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short term effectiveness; implementability; and cost. Under the NCP, balancing in remedy selection shall emphasize long term effectiveness and reduction of toxicity, mobility, or volume through treatment. The balancing shall also consider the preference for treatment as a principal element.

Long-Term Effectiveness and Permanence

Alternatives 2 through 5 are all expected to use extraction (pumping) to reduce the levels of PCE in the aquifer to meet the MCL, and restore the aquifer to its beneficial use. The time to restoration varies depending on the remedy (14 years [Alternative 4] to 23 years [Alternative 2]). For all four action alternatives, the potential for plume expansion is minimized through the use of hydraulic containment. The higher pumping rates under Alternatives 3 and 4 provide higher likelihood of success in maintaining hydraulic containment and should restore the aquifer more quickly. The targeted pumping under Alternative 4 decreases the time period for remediation most efficiently.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 2 (Ground Water Extraction with Blending) provides no reduction of the TMV of the PCE through treatment, as blending does not constitute treatment.

Alternatives 3 (Ground Water Extraction with Treatment), 4 (Enhanced Ground Water Extraction with Treatment; the selected remedy), and 5 (In-Well Stripping in Higher Concentration Areas of the Ground Water Plume) provide overall reduction in TMV of the PCE within contaminated ground water through treatment. Alternative 4 provides the most aggressive reduction of TMV in the contaminated ground water through the use of targeted pumping (estimated to be about 14 years to achieve the MCL for PCE in ground water). Alternative 5 is also aggressive, but the in-situ treatment is less controlled than extraction and ex-situ treatment, and is anticipated to take longer (estimated to be about 20 years to achieve the MCL for PCE in ground water) than the targeted pumping and ex-situ treatment of Alternative 4.

Short-Term Effectiveness

Alternative 2 (Ground Water Extraction with Blending) adds no infrastructure, therefore there are no risks to the community, workers, or the environment during the implementation of this alternative. The immediate risk to human health receptors would be reduced by blending the water supply to meet MCLs. Alternatives 3 (Ground Water Extraction with Treatment), 4 (Enhanced Ground Water Extraction with Treatment; the selected remedy), and 5 (In-Well Stripping in Higher Concentration Areas of the Ground Water Plume) involve the addition of treatment systems, increasing slightly the risk to workers, the community, and the environment, but the additional risks are expected to be low. OSHA training for workers minimizes risks. The use of a non-destructive treatment technology (i.e., air stripping or GAC) for Alternatives 3, 4, and the hydraulic containment portion of Alternative 5 would transfer the contaminants to another medium, potentially posing a risk to human health and the environment from air emissions or a hazardous waste, that would require proper disposal. The use of chemicals associated with the air stripping and chemical/UV oxidation ex-situ treatment technology options for Alternatives 3, 4, and 5 potentially poses a risk to workers.

The installation of a new extraction well in Alternative 4 and new treatment wells in Alternative 5 poses a risk to workers from the exposure to uncontaminated ground water, but the risks are expected to be low since OSHA-trained workers are required.

The model predicts that Alternative 2 will take approximately 23 years to meet RAOs. Alternative 3 is predicted to take 21 years. Alternative 4 (the Selected Remedy) is predicted to reach RAOs faster (14 years) than Alternative 3 by pumping the layers with the highest contamination. Pumping the stratigraphic layers with the highest contamination is expected to result in more rapid mass removal and a shorter time of remediation. Alternative 5 is estimated to reach RAOs in 20 years, based on Site conditions and experience at similar Sites.

Implementability

Alternative 2 (Ground Water Extraction with Blending) relies on existing infrastructure and therefore is the easiest to implement. This alternative includes hydraulic containment, requiring LTM to ensure that the plume is adequately contained. The potential for mechanical failure as well as control failure in the blending process increases the difficulty of Alternative 2.

Alternatives 3 (Ground Water Extraction with Treatment) and 4 (Enhanced Ground Water Extraction with Treatment; the Selected Remedy) propose a central treatment unit and a conveyance system to carry extracted ground water to the central treatment unit. Construction of a conveyance system to the central treatment unit, and the siting of the treatment unit, could impact populated areas, however, the impacts are expected to be low, since the treatment unit should not be significantly large or excessively noisy. Alternative 5 (In-Well Stripping in Higher Concentration Areas of the Ground Water Plume) includes wellhead treatment; construction of this unit could also impact populated areas.

The technologies used for the removal of PCE from the extracted ground water are commonly used and each requires O&M. GAC is the easiest to implement and maintain, followed by air stripping and chemical/UV oxidation. Scaling buildup within wells and conveyance piping due to mineralization can potentially occur at most Sites over time but can be evaluated and mitigated using bench or pilot tests. Scaling buildup within an air stripper system is more likely than scaling buildup within the wells and conveyance piping due to the removal of CO^2 during the treatment process and due to the subsequent change in pH. Chemical/UV oxidation would require a continuous supply of treatment chemicals and ozone production.

The LTM programs for Alternative 3 and 4 are not expected to be significantly different from one another. Alternative 2 and 5 would require more frequent monitoring.

Alternative 4 (Enhanced Ground Water Extraction with Treatment; the selected remedy) involves the installation of one new extraction well, and modification to existing wells, making this alternative more challenging to implement than Alternative 3 (Ground Water Extraction with Treatment), but once the wells are modified, Alternative 4 provides better efficiency than Alternative 3.

Alternative 5 (In-Well Air Stripping in Higher Concentration Areas of the Ground Water Plume) is expected to be the most technically challenging to implement. The addition of deep treatment wells and a new extraction well is required for this alternative, thereby increasing the difficulty of implementation. Alternative 5 also involves the installation of many new mechanical components, increasing the O&M requirements and the potential for failure. It is anticipated that multiple air stripping wells can be operated with a single blower provided piping connects the treatment wells. The Alternative 5 system could be cumbersome to install in populated areas and requires more space to implement than Alternatives 3 and 4. The treatment of the extracted ground water under Alternative 5 will be the similar to Alternatives 3 and 4.

Cost

All costs are summarized on **Table 10-2.** Aside from Alternative 1 (No Action), the lowest costs are associated with Alternative 2 because the existing infrastructure can be used. The cost estimate for Alternative 2 does not consider well failure or the infrastructure costs for conveying clean water from remote areas for blending and does not account for increases in public water supply demand from the general population.

Initially, annual operating costs for Alternatives 3 and 4 are the same due to the use of the same initial pumping rate. After year five, however, Alternative 4 includes replacement of CLC Well No.18 with a new extraction well at a lower pumping rate, reducing the annual costs. Alternative 3 net present worth costs are somewhat higher than Alternative 4 due to the slightly higher O&M costs after year 5 and the longer remediation time, which offsets the higher capital costs in Alternative 4. The highest costs are associated with Alternative 5 due to the large capital costs associated with the installation of the treatment infrastructure. The annual operating costs are also much higher in Alternative 5.

The need for an acid pretreatment system for options that include air stripping significantly affects the overall costs. An acid pretreatment system adds substantial capital and annual operating costs. For both Alternatives 3 and 4, treatment using GAC is the least costly option if it is determined that a pretreatment system would be required for an air stripper. If no pretreatment system is needed, air stripping and GAC costs are very similar. In addition, the destructive chemical/UV oxidation technology is lower in cost than air stripping if pretreatment is needed. For costing purposes, chemical oxidation was assumed rather than UV oxidation. Capital costs for UV oxidation are anticipated to be lower than for chemical oxidation, but annual O&M costs would be higher.

Modifying Criteria

Once all comments are evaluated, state and community acceptance may prompt modifications to the preferred remedy and are thus designated modifying criteria.

Community Acceptance

Although no formal written comments were received from the public, a few questions were asked during the public meeting held on December 7, 2006, (see Responsiveness Summary). In addition, EPA received a letter of concurrence dated January 22, 2007, from the JSP on behalf of the City and County governments in support of the remedy proposed during the comment period.

State and Local Acceptance

(Reference Appendix C for Concurrence Letters)

Table 10-1

Comparative Analysis of Remedial Alternatives

Remedial Alternative	Alternative 1: No Action	Alternative 2: Ground Water Extraction with Blending	Alternative 3: Ground Water Extraction with Treatment	Alternative 4: Enhanced Ground Water Extraction with Treatment	Alternative 5: In-Well Stripping in Higher Concentration Areas of the Ground Water Plume
Threshold Criteria					
Overall Protection of Human Health & the Environment	NO – No action would be performed and RAOs would not be met. Elevated levels of contaminants exist in ground water at concentration levels that exceed the MCLs. This contamination will continue to threaten human health and the environment through plume migration. PCE contamination will probably spread to other municipal supply wells, and to any domestic wells that may be completed in the contaminated aquifer.	YES--Hydraulic containment will prevent migration of the PCE contaminated plume to other wells; however, ground water is not treated to meet MCLs. Instead ground water is diluted by blending with other water to meet MCLs	YES – Hydraulic containment and reduction in contaminant concentrations in the aquifer by pumping and active treatment will meet RAOs, thereby reducing risk to human health and the environment.	YES – Hydraulic containment and reduction in contaminant concentrations in the aquifer by pumping and active treatment will meet RAOs, thereby reducing risk to human health and the environment.	YES – Hydraulic containment and reduction in contaminant concentrations in the aquifer by active treatment will meet RAOs, thereby reducing risk to human health and the environment.
		Removal of contaminants from the ground water restores the aquifer to its beneficial use. The JSP ground water fate and transport model predicts elevated levels of PCE will persist for about 23 years.	Removal of contaminants from the ground water restores the aquifer to its beneficial use. The JSP ground water fate and transport model predicts elevated levels of PCE will persist for about 21 years.	Removal of contaminants from the ground water restores the aquifer to its beneficial use. The JSP ground water fate and transport model predicts elevated levels of PCE will persist for about 14 years.	Removal of contaminants from the ground water restores the aquifer to its beneficial use. Based on JSP ground water fate and transport modeling of other alternatives, it is anticipated with this alternative that elevated levels of PCE will persist for about 20 years.

Remedial Alternative	Alternative 1: No Action	Alternative 2: Ground Water Extraction with Blending	Alternative 3: Ground Water Extraction with Treatment	Alternative 4: Enhanced Ground Water Extraction with Treatment	Alternative 5: In-Well Stripping in Higher Concentration Areas of the Ground Water Plume
Overall Protection of Human Health & the Environment (Cont'd)		Ground water is not treated to meet MCLs. Instead ground water is diluted by blending with other water to meet MCLs which is not as protective as treatment.	Provides protection of human health through treatment of contaminated ground water to below MCLs prior to distribution into the public drinking water supply.	Provides protection of human health through treatment of contaminated ground water to below MCLs prior to distribution into the public drinking water supply.	Provides protection of human health through treatment of contaminated ground water to below MCLs prior to distribution into the public drinking water supply.
		This alternative relies on above-ground (ex-situ) blending which does not constitute treatment. The contaminant remains in the water and is simply diluted	This alternative relies on above-ground (ex-situ) treatment, which will, depending on the technology chosen, either safely transfer the contaminants from ground water to another medium (e.g. air) or destroy the contaminants (e.g. chemical/UV oxidation).	This alternative relies on above-ground (ex-situ) treatment, which will, depending on the technology chosen, either safely transfer the contaminants from ground water to another medium (e.g. air) or destroy the contaminants (e.g. chemical/UV oxidation).	This alternative relies on a combination of in-well treatment using air stripping and above-ground (ex-situ) treatment using Granular Activated Carbon (GAC), both of which safely transfer the contaminants from ground water to another medium (e.g. air).
		Active long-term monitoring in the aquifer and the blending effluent is required to confirm hydraulic containment and compliance with ARARs (e.g. MCLs). Maintaining a proper blending program is less reliable than treatment alternatives due to the potential fluctuation in concentrations. More frequent monitoring may be	Active long-term monitoring in the aquifer and in the treatment effluent is required to confirm hydraulic containment and compliance with ARARs (e.g. MCLs).	Active long-term monitoring in the aquifer and in the treatment effluent is required to confirm hydraulic containment and compliance with ARARs (e.g. MCLs).	Active long-term monitoring in the aquifer and the treatment effluent is required to confirm hydraulic containment and compliance with ARARs (e.g. MCLs).

Remedial Alternative	Alternative 1: No Action	Alternative 2: Ground Water Extraction with Blending	Alternative 3: Ground Water Extraction with Treatment	Alternative 4: Enhanced Ground Water Extraction with Treatment	Alternative 5: In-Well Stripping in Higher Concentration Areas of the Ground Water Plume
Overall Protection of Human Health & the Environment (Cont'd)		required than for other alternatives and to ensure that the blending ratio is appropriate and concentrations are consistently maintained below the MCL prior to distribution into the public drinking water supply.			
		This alternative involves low risk to workers from affected ground water or the blending process during active remedial action and O&M.	This alternative involves low risk to workers from affected ground water or the treatment process during active remedial action and O&M.	This alternative involves low risk to workers from affected ground water or the treatment process during active remedial action and O&M.	This alternative involves low risk to workers from affected ground water or the treatment process during active remedial action and O&M.
Compliance with ARARs	NO - Not compliant. Ground water extraction is not sufficiently controlled or targeted under the No Action alternative so parts of the contaminated ground water plume would remain in the subsurface and continue to expand. The JSP model predicts that this expansion will ultimately reach additional municipal supply wells and contaminate more water. Contamination in the ground water will NOT be removed within a time frame that is reasonable. Moreover, MCLs may not	YES–- Ground water extraction would be controlled and targeted in order to ensure that the contaminated plume does not expand. Contamination in the ground water will be removed within a time frame that is reasonable. Ground water would not be treated to meet MCLs, although treatment is practicable, and preferred under CERCLA. Drinking water would continue to meet MCLs but only after PCE concentrations had been diluted by blending Moreover, MCLs may not	YES – Provides treated drinking water that meets MCLs. Also, provides restoration of the aquifer to its beneficial use as a drinking water supply (within about 21 years). Requires monitoring to ensure MCLs are met prior to distribution to the drinking water supply.	YES – Provides treated drinking water that meets MCLs. Also, provides restoration of the aquifer to its beneficial use as a drinking water supply (within about 14 years). Requires monitoring to ensure MCLs are met prior to distribution to the drinking water supply.	YES – Provides drinking water that meets MCLs. Also, provides restoration of the aquifer to its beneficial use as a drinking water supply (within about 20 years). Requires monitoring to ensure MCLs are met prior to distribution to the drinking water supply.

Remedial Alternative	Alternative 1: No Action	Alternative 2: Ground Water Extraction with Blending	Alternative 3: Ground Water Extraction with Treatment	Alternative 4: Enhanced Ground Water Extraction with Treatment	Alternative 5: In-Well Stripping in Higher Concentration Areas of the Ground Water Plume
Compliance with ARARs (cont'd)	be met if the PCE concentrations in extracted ground water should exceed the dilution capacity of the blending system.	be met if the PCE concentrations in extracted ground water should exceed the dilution capacity of the blending system Provides hydraulic containment of the plume, and restoration of the aquifer to its beneficial use as a drinking water supply (within about 23 years). May require more frequent monitoring than other alternatives to ensure MCLs are met prior to distribution to the drinking water supply.			
Balancing Criteria					
Long-term Effectiveness and Permanence	No action would be performed. Contaminants would remain in the aquifer above MCLs for an indefinite period (estimated to be longer than 30 years). The JSP ground water fate and transport model predicts future plume expansion, with impacts to GWMW Well 11 and CLC Well No. 26.	Removal of contaminants from the ground water through pumping and blending will meet RAOs and restore the aquifer to its beneficial use (within the predicted time frame of about 23 years). The potential for plume expansion is minimized through the use of hydraulic containment.	Removal of contaminants from the ground water through pumping and treatment will meet RAOs and restore the aquifer to its beneficial use (within a predicted timeframe of about 21 years). The potential for plume expansion is minimized through the use of hydraulic containment.	Removal of contaminants from the ground water through enhanced pumping and treatment will meet RAOs and restore the aquifer to its beneficial use (within a predicted timeframe of about 14 years). The potential for plume expansion is minimized through the use of hydraulic containment.	Removal of contaminants from the ground water through treatment will meet RAOs and restore the aquifer to its beneficial use (within a predicted timeframe of about 20 years). The potential for plume expansion is minimized through the use of hydraulic containment.

Remedial Alternative	Alternative 1: No Action	Alternative 2: Ground Water Extraction with Blending	Alternative 3: Ground Water Extraction with Treatment	Alternative 4: Enhanced Ground Water Extraction with Treatment	Alternative 5: In-Well Stripping in Higher Concentration Areas of the Ground Water Plume
Long-term Effectiveness and Permanence (cont'd)		Pumping rates set at the minimum long-term average pumping rate is needed to maintain hydraulic containment.	Higher pumping rates than those used under Alternative 2 provides a higher likelihood of success in achieving and maintaining hydraulic containment and restoring the aquifer.	Targeted pumping provides higher likelihood of success in restoring the aquifer in a shorter period compared to Alternative 2 and 3.	Targeted in-situ treatment provides higher likelihood of success in restoring the aquifer compared to Alternatives 2 and 3.
Reduction of Toxicity, Mobility, or Volume (TMV) Through Treatment	No action would be performed and no overall reduction of TMV through treatment would occur.	No overall reduction of TMV in the contaminated ground water through treatment would occur (blending does not constitute treatment).	Provides overall reduction of TMV in the contaminated ground water through treatment.	Provides overall reduction of TMV in the contaminated ground water through treatment.	Provides overall reduction of TMV in the contaminated ground water through treatment.
Short-term Effectiveness	No action would be performed, and ground water would not be treated to meet MCLs, although treatment is practicable and preferred under CERCLA.	Low risk to workers, the community, and the environment in the short-term are expected. Low risk to the community associated with the use of the blended ground water for drinking water as long as pumping rates to control bending to below the MCL are maintained and adequate controls re in place to warn of system failure. There is the potential for failures in the blending process, including but not limited to, mechanical failure of	Low risk to workers, the community, and the environment in the short-term are expected. Minimal risk to the community associated with the use of treated ground water for human consumption as long as adequate controls are in place to warn of system failure. There is minimal potential for failure in the treatment process, including but not limited to, mechanical failure of equipment, control logic failures.	Low risk to workers, the community, and the environment in the short-term are expected. Minimal risk to the community associated with the use of treated ground water for human consumption as long as adequate controls re in place to warn of system failure. There is minimal potential for failure in the treatment process, including but not limited to, mechanical failure of equipment, control logic failures.	Low risk to workers, the community, and the environment in the short-term are expected. Minimal risk to the community associated with the use of the treated ground water for human consumption as long as adequate controls re in place to warn of system failure. There is minimal potential for failures in the treatment process, including but not limited to, mechanical failure of equipment, control logic failures.

Remedial Alternative	Alternative 1: No Action	Alternative 2: Ground Water Extraction with Blending	Alternative 3: Ground Water Extraction with Treatment	Alternative 4: Enhanced Ground Water Extraction with Treatment	Alternative 5: In-Well Stripping in Higher Concentration Areas of the Ground Water Plume
Short-term Effectiveness (cont'd)		equipment, control logic failures, or incorrect blending ratios. Low risk to workers and to the environment from affected ground water are anticipated during production and O&M.	Low risk to workers during construction and maintenance of the ex-situ treatment unit. The use of a non-destructive treatment technology (i.e., air stripping or GAC) transfers the contaminants to another medium, posing a short-term risk to human health and the environment by the production of air emissions or a waste that requires proper handling and disposal. The chemicals used for certain treatment units (i.e., air stripper with pretreatment and chemical/UV oxidation) provide a risk to workers if not properly handled and disposed. Meeting ARARs for emissions and waste handling and OSHA-training for workers minimizes short-term risks to workers.	Low risk to workers during construction and maintenance of the ex-situ treatment unit. The use of a non-destructive treatment technology (i.e., air stripping or GAC) transfers the contaminants to another medium, posing a short-term risk to human health and the environment by the production of air emissions or a waste that requires proper handling and disposal. The chemicals used for certain treatment units (i.e., air stripper with pretreatment and chemical/UV oxidation) provide a risk to workers if not properly handled and disposed. Meeting ARARs for emissions and waste handling and OSHA-training for workers minimizes short-term risks to workers.	Low risk to workers during construction and maintenance of the ex-situ treatment unit. The use of a non-destructive treatment technology (i.e., air stripping or GAC) transfers the contaminants to another medium, posing a short-term risk to human health and the environment by the production of air emissions or a waste that requires proper handling and disposal. The chemicals used for certain treatment units (i.e., air stripper with pretreatment and chemical/UV oxidation) provide a risk to workers if not properly handled and disposed. Meeting ARARs for emissions and waste handling and OSHA-training for workers minimizes short-term risks to workers.
			This alternative requires installation of additional wells (for ground water monitoring) that could pose a low risk to workers during installation. OSHA-training for workers	This alternative requires installation of additional wells (for ground water monitoring) that could pose a low risk to workers during installation. OSHA-training for workers	This alternative requires installation of additional wells (for ground water monitoring) that could pose a low risk to workers during installation. OSHA-training for workers minimizes short-term risks to

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Remedial Alternative	Alternative 1: No Action	Alternative 2: Ground Water Extraction with Blending	Alternative 3: Ground Water Extraction with Treatment	Alternative 4: Enhanced Ground Water Extraction with Treatment	Alternative 5: In-Well Stripping in Higher Concentration Areas of the Ground Water Plume
			minimizes short-term risks to workers.	minimizes short-term risks to workers.	workers.
Implementability	No action to implement.	Easy to implement because the majority of the initial infrastructure is already in place. If the availability of sufficient clean water for blending decreases with increasing PCE concentrations in the extracted water, significant changes to infrastructure or the addition of another treatment technology could become necessary over time. Could likely require more frequent monitoring than other alternatives to ensure MCLs are met prior to distribution to the drinking water supply.	The ground water extraction technologies considered under this alternative are commonly used, and are generally easy to install and maintain. Of the three treatment options considered under this alternative: (1) the air stripper may require pretreatment for scaling (preliminary evaluations indicate the potential for scaling is borderline); (2) GAC treatment requires periodic carbon replacement and disposal; and (3) chemical/UV oxidation requires a continuous source of chemicals.	The ground water extraction technologies considered under this alternative are commonly used, and are generally easy to install and maintain. Of the three treatment options considered under this alternative: (1) the air stripper may require pretreatment for scaling (preliminary evaluations indicate the potential for scaling is borderline); (2) GAC treatment requires periodic carbon replacement and disposal; and (3) chemical/UV oxidation requires a continuous source of chemicals.	The ground water extraction technologies considered under this alternative are commonly used, and are generally easy to install and maintain. The in-well air stripping might result in scaling in wells, and some chemical addition may be required. Additional mechanical equipment and infrastructure associated with this alternative increases O&M costs over the other alternatives.
		Pretreatment is not required.	The potential need for pretreatment to address scaling under air stripping option should be considered in more detail during the RD.	The potential need for pretreatment to address scaling under air stripping option should be considered in more detail during the RD.	The potential need for pretreatment to address scaling associated with in-well air stripping should be considered in more detail during the RD.

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Remedial Alternative	Alternative 1: No Action	Alternative 2: Ground Water Extraction with Blending	Alternative 3: Ground Water Extraction with Treatment	Alternative 4: Enhanced Ground Water Extraction with Treatment	Alternative 5: In-Well Stripping in Higher Concentration Areas of the Ground Water Plume
Implementability (cont'd)		No modifications to existing wells required, other than the addition of piping between CLC Well Nos. 18 and 27, and O&M.	No modifications to existing wells required, other than the addition of piping between CLC Well Nos. 18 and 27, and O&M.	Modifications to the pumping wells and the addition of new extraction wells somewhat increases the difficulty of this alternative.	Installation of in-situ treatment wells and the addition of an extraction well for containment somewhat increases the difficulty of this alternative.
Costs (Present worth)	**None** – requires no additional expenditure.	**$10.2 M**	**$15.6 – $18.4 M** Air stripping without pretreatment: $16.6 MM[2] GAC: $15.6 M Chemical/UV oxidation: $18.4 M.	**$13.3 - $15.4 M** Air stripping without pretreatment: $13.8 MM[2] GAC: $13.3 M Chemical/UV oxidation: $15.4 M.	**In-well air stripping and GAC for ground water extracted to maintain hydraulic containment: $31.9 M.**
- 30% to +50% range:	**None** – requires no additional expenditure.	**$7.1 to 15.2 M**	**$10.9 to $27.6 M** Air stripping without pretreatment: $11.6-$24.9 M GAC: $10.9-23.5 MM Chemical/UV oxidation: $12.9-27.6 M.	**$9.3 to $23.1 M** Air stripping without pretreatment: $9.6-$20.6 MM[2] GAC: $9.3-20.0 M Chemical/UV oxidation: $10.8-23.1 M.	**$22.3 to 47.8 M**

Table 10-2

Alternative Cost Summary

Griggs and Walnut Ground Water Plume

Las Cruces, New Mexico

	Alt 1: No Action	Alt. 2: Ground Water Extraction with Blending[1]	Alt. 3: Ground Water Extraction with Treatment[3]			Alt. 4: Enhanced Ground Water Extraction With Treatment[3]			Alt 5: In-Well Stripping in Higher Concentration Areas of the Ground Water Plume
			Air Stripper	**GAC**	**Chemical/ UV Oxidation**	**Air Stripper**	**GAC**	**Chemical/ UV Oxidation**	
Capital Cost	$ -	$ 1,122,723	$ 3,946,036	$ 4,504,573	$ 5,211,897	$ 5,151,978	$ 5,710,514	$ 6,340,304	$ 18,403,797
Total Year 1 Operations and Maintenance	$ -	$ 552,472	$ 821,029	$ 764,672	$ 986,991	$ 821,029	$ 764,672	$ 986,991	$ 1,051,260
Total Year 2-5 Operations and Maintenance	$ -	$ 464,797	$ 638,635	$ 571,708	$ 649,457	$ 638,635	$ 571,708	$ 649,457	$ 679,255
Total Year 6-30[2] Operations and Maintenance	$ -	$ 260,906	$ 536,818	$ 460,019	$ 547,640	$ 510,090	$ 433,291	$ 520,912	$ 577,438
Five Year Reviews		$ 3,023	$ 40,804	$ 40,804	$ 40,804	$ 40,804	$ 40,804	$ 40,804	$ 40,804
Total Post Closure Cost	$ -	$ 52,977	$ 553,867	$ 553,867	$ 685,776	$ 580,249	$ 580,249	$ 712,158	$ 1,028,741
TOTAL PRESENT WORTH	$ -	**$ 10,152,542**	**$ 16,627,776**	**$ 15,633,464**	**$ 18,407,955**	**$ 13,780,213**	**$ 13,323,493**	**$ 15,407,101**	**$ 31,882,979**
High Range (+50%)	$ -	$ 15,228,813	$ 24,941,665	$ 23,450,197	$ 27,611,932	$ 20,670,320	$ 19,985,239	$ 23,110,651	$ 47,824,468
Low Range (-30%)	$ -	$ 7,106,779	$ 11,639,443	$ 10,943,425	$ 12,885,568	$ 9,646,149	$ 9,326,445	$ 10,784,970	$ 22,318,085
Treatment Cost per Pound PCE	$ -	$ 30,765.28	$ 50,387.20	$ 47,374.13	$ 55,781.68	$ 41,758.22	$ 40,374.22	$ 46,688.18	$ 96,615.09
Remediation Time Frame (years)	unknown PRG not met in 30 years	23	21	21	21	14	14	14	20

Notes:

1. It is assumed that existing equipment can be used to perform blending and no additional capital costs are included. Only O&M costs included are for routine operation and sampling to document effectiveness of blending system.

2. Costs are through year 30, or through the predicted remediation timeframe if less than 30 years. See bottom of table for predicted remediation timeframe.

3. The costs EXCLUDE provision of a pretreatment system for control of scaling in the air stripping and other process equipment. The costs of pretreatment would be significant and could greatly affect the overall net present worth for those

A preliminary evaluation indicates the potential for scaling is borderline under the ex-situ air stripping treatment option. The Ryznar Stability Index (RSI) calculated for $CaCO_3$ scaling potential at GWP is 6.1; RSI less than 6 indicates higher potential for scaling. The Langlier Index (LI) calculated for $CaCO_3$ scaling potential at GWP is 0.9; LI greater than 1 indicates higher potential for scaling. Because the assumptions used in making these calculations can greatly affect the result, a more detailed evaluation of scaling potential must be performed during the RD.

Pretreatment for scaling under the ex-situ air stripping treatment option would increase the costs of Alternatives 3 and 4 by a net present worth value cost of about $5 to $6 MM for the entire period of operation. The cost estimate with acid pretreatment for Alternatives 3 and 4 is as follows:

	Without Acid Pretreatmen	With Acid Pretreatment
Alternative 3-Air stripping	$ 16,627,776	$ 22,879,028
Alternative 4-Air stripping	$ 13,780,213	$ 18,421,834

Section 11

Principal Threat Waste

Principal threat wastes are wastes that cannot be reliably controlled in place, such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds (e.g., concentrations that are several orders of magnitude above levels that allow for unrestricted use and unlimited exposure). The EPA expects that treatment will be the preferred means to address the principal threats posed by a Site; wherever practicable. Low-level threat wastes are those source materials that generally can be reliably contained and that contain contaminant concentrations not greatly above the acceptable levels. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied.

The remedy satisfies the statutory preference of treatment, and reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through hydraulic containment and treatment. The Site however, does not have a principal threat waste on Site. The waste is not a principal threat because the ground water contamination is not a source material such as a Dense Nonaqueous Phase Liquid (DNAPL). The waste is not a low-level threat because it cannot be reliably contained in place.

Section 12

Selected Remedy - Enhanced Ground Water Extraction with Treatment

The selected remedy for the Site is Alternative 4, **Enhanced Ground Water Extraction with Treatment.** This selected remedy calls for treatment of ground water and hydraulic control of the PCE contaminated ground water plume relying upon the existing municipal supply wells to the extent possible. The objective of the remedy is to remove PCE from ground water until concentrations that meet MCLs are attained, to contain the plume through hydraulic containment and treatment in order to keep it from migrating, and to reduce the plume size by targeted ground water pumping in areas within the plume boundaries that have higher PCE concentrations. Under the selected remedy extracted ground water will enter a conveyance system that will transport the ground water to a central plant. The remedy will maximize its use of the existing infrastructure already in place with some retrofitting prior to ground water conveyance for treatment. The treatment plant will be located within the plume boundaries and is expected to take minimal space and be centrally located. Treated water will then be available for delivery into the public water supply.

The selected remedy is intended to address the entire ground water plume Site through treatment. The Site is located within a mixed land-use. Principal threat wastes are wastes that cannot be reliably controlled in place, such as liquids, highly mobile materials (e.g., solvent), and high concentrations of toxic compounds (e.g., concentrations that are several orders of magnitude above levels that allow for unrestricted use and unlimited exposure). The EPA expects that treatment will be the preferred means to address the principal threats posed by a Site, wherever practicable. Low-level threat wastes are those source materials that generally can be reliable contained and that contain contaminant concentrations not greatly above the acceptable levels. The waste is not a principal threat because the ground water contamination is not a source material such as a Dense Nonaqueous Phase Liquid (DNAPL). The waste is not a low-level threat because it cannot be reliably contained in place. The remedy will incorporate treatment and the use of engineering controls for purposes of plume containment. The remedy will also use institutional controls to augment the remedy. The reason for such action is because the contaminant plume affects a primary drinking water supply source. The remedy expectation is to return the ground water to its beneficial use in an expeditious manner.

Major Components of the Selected Remedy:

Under the selected remedy for the GWP Site, water will be pumped from municipal supply wells (CLC Well Nos. 18 and 27, or other wells as appropriate with selection of wells to be determined during remedial design and remedial action). Based on modeling results it is expected that within approximately five years one new extraction well location will be necessary to continue treating and reducing the PCE contaminated ground water in order to reduce concentrations of PCE in the entire ground water plume to concentrations that are below the MCL. The new extraction well would probably be used to replace CLC Well No. 18 after the first five years of operation. This new well would replace CLC Well No. 18 because the fate and transport model predicts that over time, CLC Well No. 18 will draw more clean water than PCE affected water and it also predicts that over time CLC Well No. 18 will extract contaminated ground water less efficiently. PCE plume containment will rely on hydraulic control, and on discontinuing the use of CLC Wells 19, 20, 21, 24, 26, and 38 during remediation. Hydraulic control, treatment, and plume reduction will be further evaluated and refined during remedial design and remedial action to determine the appropriate locations and pumping rates for full-scale operation. The remedy will be supported by the following activities:

Institutional Controls

Long-Term Monitoring Program

Annual Reviews and Reporting

The Remedial Action Objectives (RAOs) are expected to be reached in approximately 14 years.

Summary of the Rationale for the Selected Remedy

Based upon consideration of requirements of CERCLA, and based on consideration of the requirements of the NCP including without limitation a detailed analysis of the remdial action alternatives using the nine NCP criteria [40 CFR § 300.430(e)(9)] that included, among other things, an analysis of public comments, EPA has determined that Alternative 4 (Enhanced Ground Water Extraction with Treatment), is the most appropriate remedy for the GWP Site. The selected remedy provides adequate protection of human health and the environment, complies with ARARs, and is cost-effective. The selected remedy represents the best balance of trade-offs among the nine criteria in the NCP. Several options and treatment technologies were evaluated but the Selected Remedy provides the most efficiency, cost effectiveness, and reliability, through treatment and plume containment in the least amount of time. The remedy provides the necessary treatment to protect human health and the environment and is expected to meet the remedial action objectives and remediation goals.

Alternative 4: Enhanced Ground Water Extraction with Treatment- Selected for the Following Reasons:

- The Selected Remedy provides best overall protection of human health and the environment;
- The Selected Remedy provides treatment by conveying extracted ground water to a central treatment facility to meet the PCE MCL before it is distributed to consumers. The remedy will most likely require modifications to existing CLC supply wells and an additional extraction well. The remedy will also most likely include targeted pumping in the most contaminated areas of the aquifer, based on the results of modeled performance . The model results indicated targeted pumping will provide the most expeditious time frame for reaching the RAOs as compared to performing a more traditional pump and treat remedy.
- While Alternative 5 also provides total PCE destruction, additional infrastructure would have to be installed under Alternative 5, than under the Selected Remedy. In addition, with

Alternative 5, more complexity is involved in obtaining the same remediation goals as the selected remedy. Moreover, Alternative 5 has a higher probability of mechanical failure and higher maintenance costs.

- The Selected Remedy maximizes use of the existing infrastructure to the extent possible and thereby reducing costs associated with remedy construction.
- Under the Selected Remedy, existing supply wells CLC Well Nos. 18 and 27 would be modified and a new extraction well installed will maximize hydraulic containment of ground water containing PCE concentrations that exceed the MCL.
- Under the Selected Remedy, CLC Wells Nos. 18 and 27 will be redesigned to extract water from targeted ground water intervals that contain higher PCE concentrations. By targeting these higher PCE concentrations, the Selected Remedy will realize efficiencies that could not be attained by any of the other remedial alternatives, including Alternative 3.
- Unlike Alternatives 1 and 2 the Selected Remedy will treat ground water to reduce the PCE concentrations in extracted ground water to concentration levels that are below the MCL before distribution to the public water supply system. This would reduce the human health risk to residents who obtain their potable water from this municipal supply.
- The Selected Remedy provides the most active hydraulic containment of the PCE plume, both vertically and laterally within the plume boundaries. This means that the Selected Remedy will do the most to prevent plume migration, thereby protecting other wells.
- Under the Selected Remedy, the RAOs will be reached in the shortest period of time, compared to the other remedial alternatives.
- Under the Selected Remedy, LTM would provide data trends on PCE concentrations and would also confirm hydraulic containment of the plume. Treatment of the entire plume permanently reduces TMV of PCE within the aquifer providing protection of human health and the environment.
- The Selected Remedy involves low risk to workers involved in the remedial action or O&M. Neither the treatment process nor exposure to the extracted ground water poses significant risks to workers.

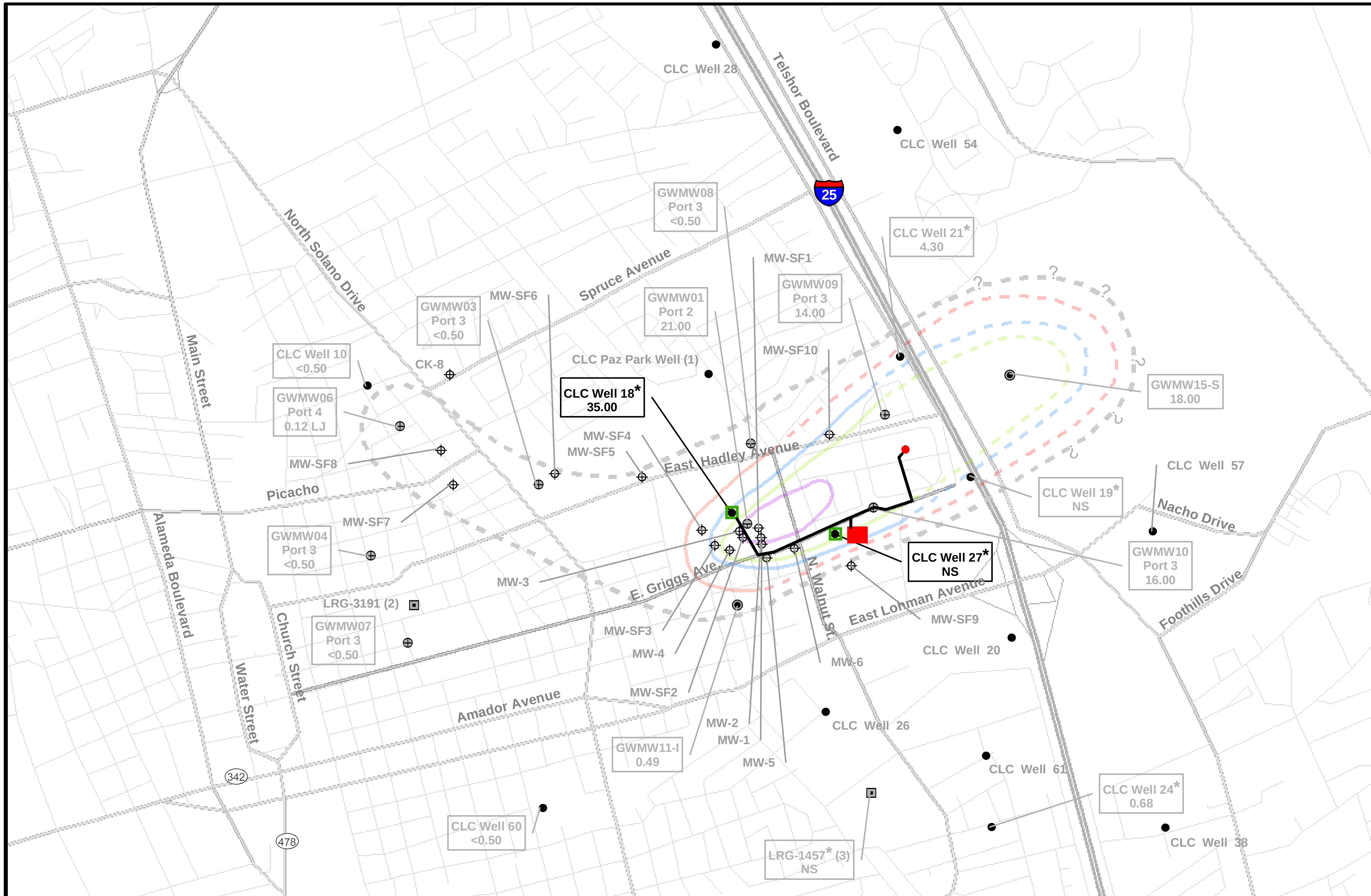
- Operation of the extraction well network under the Selected Remedy would adequately contain and treat the PCE plume to meet the remediation goals, and the remedial action objectives.
- The extraction and treatment of ground water under the Selected Remedy would provide reduction in the TMV of the PCE in the contaminated ground water through treatment. The entire plume would be both hydraulically contained and treated.
- Treatment of the entire plume under the selected remedy increases the likelihood that the RAOs will be permanently met and that the remedy will have long-term success. The aquifer would be restored to its beneficial use as a municipal water supply within about 14 years.
- Air stripping is the preferred option for treating ground water, prior to conveyance into the public water supply. It is expected to be the most cost effective treatment, options will be further refined during remedy design.
- Air stripping, or a combination of air stripping with any other treatment (i.e., GAC) will provide treatment of PCE as well as other contaminants identified within the plume boundaries (such as the COPCs) and will ensure ground water continues to meet the drinking water standards, at or below the MCL.
- Under the Selected Remedy, the removal of the mass of PCE from the ground water would reduce the toxicity and volume of PCE within the aquifer, and plume containment would reduce the contaminant mobility.

Las Cruces is an attainment area under the CAA. In accordance with the OSWER Directive 9355.0-28 “Control of Air Emissions from Superfund Air Strippers at Superfund Groundwater Sites,” preliminary calculations of air emission rates associated with air stripping of PCE were prepared. Air emission estimates are provided in the calculations in Appendix B, of the Feasibility Study and are estimated to be well below National Institute for Occupational Safety and Health (NIOSH) exposure limits as well as permitting thresholds.

Cost

Total Present Worth Estimated Costs:

Capital Cost:	$ 5.2 M
Annual O&M Cost (Year 1):	$ 0.8 M
Annual O&M Cost (Years 2-5):	$ 0.6 M
Annual O&M Cost (Year 6-14):	$ 0.5 M
Total Present Worth Cost:	**$ 13.8 M**



Approximate location of new ground water extraction well.

New Below Grade Piping

Notes:

PCE Concentrations in micrograms per liter (ug/L).

No Data obtained from GWMW06 Port 3. Data for Port 2 was <0.50 and data for Port 4 was 0.12 LJ. Therefore, PCE contamination is assumed to extend past GWMW06.

1. The CLC Paz Park Well is used for irrigation. The other CLC wells illustrated on this map are designated for drinking water supply (not all are used).
2. Samples from LRG-3191 have demonstrated the presence of PCE, but samples collected since August 2002 have been non-detect for PCE
3. LRG-1457 is an irrigation well for the Lynn Middle School. It is not currently in service.

Gas Card Monitor Well and Private Well LRG-7375 have been abandoned and are not shown on figure.

Unit Qualifiers:
J - Estimated
L - Concentration below the reporting limit

Concentration Data Contoured by Hand.

NS - Not Sampled

The municipal supply well concentrations are used for informational purposes only. The PCE concentrations in these wells were not used to prepare the PCE isoconcentration contours shown on this figure.

Upper portion of Lower Zone corresponds to an approximate elevation range of 3675 to 3775 ft MSL.

* Indicates Private and CLC Municipal Supply Wells where PCE is detected.

LEGEND

- **Water Table Monitor Well** (screen depths of these wells range from 101 to 204 feet bgs.)
- **City of Las Cruces (CLC) Municipal Water Supply Wells** (screen depths of these wells range from 281 to 1,050 feet bgs.)
- **Private Water Supply Wells** (screen depths of these wells range from 150 to 290 feet bgs, depth of screen information is not available for LRG-1457)
- **Multi-Port Monitor Well** (screen depth of these wells range from 90 to 640 feet bgs)
- **Nested Monitor Well Installed During RI** (screen depths of these wells range from 190 to 590 ft bgs)
- GWMW07 Port 3 <0.50 — Monitor Well ID, Port Number & PCE Concentration
- Estimated Extent of GWP-Related PCE Detections
- ? — Indicates Uncertainty of Extent of GWP-Related PCE Detections
- Existing municipal supply wells to be used for ground water extraction.
- Central Treatment System

PCE Concentration Levels (Dashed Where Infered)
- 2.5 ug/L
- 5 ug/L
- 10 ug/L
- 20 ug/L

CH2MHILL

Figure 12-1
Alternative 4 Conceptual Layout: Enhanced Ground Water Extraction with Treatment

Griggs & Walnut Ground Water Plume Site

Las Cruces, New Mexico

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Section 13

Statutory Determinations

Applicable or Relevant and Appropriate Requirements (ARARs)

The NCP requires a selected response action to attain ARARs under Federal and State environmental laws 40 CFR 300.430(e)(2)(i)(A). RAOs and remediation goals established for a Site must consider ARARs.

Under CERCLA, a requirement may be either “applicable” or “relevant and appropriate” to a specific response action, but not both. The NCP (40 CFR Section 300.5) defines “applicable” and “relevant and appropriate” requirements as follows:

- **Applicable requirements** are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA Site. Only the state standards that are more stringent than federal requirements may be applicable.

- **Relevant and appropriate requirements** are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that, while not “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA Site, address problems or situations sufficiently similar to those encountered at the CERCLA Site so that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.

Typically, ARARs are compiled in the following three categories:

- Chemical-specific
- Action-specific
- Location-specific

The primary factor that influenced selection of the ARARs for the GWP Site was the elevated contaminant concentration levels of PCE found in CLC municipal water supply wells. **Tables 13-1** and **13-2** present the Federal and State of New Mexico ARARs, respectively. The

ARARs listed on the tables are grouped by type of regulation (i.e., air, water, solid and hazardous waste, transportation).

Chemical-Specific ARARs

Chemical-specific ARARs are usually health- or risk-based numerical values or methodologies used to determine acceptable concentrations of chemicals that may be found in or discharged to the environment, for example, MCLs that establish safe levels in drinking water. The chemical-specific ARARs most pertinent to the GWP Site are the federal SDWA MCLs, the State of New Mexico drinking water standards (NMAC 20.7), and the New Mexico Water Quality Control Commission Regulations (NMAC 20.6.2). These standards are important in establishing remediation goals for ground water.

Action-Specific ARARs

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions or conditions involving specific substances. The action-specific ARARs presented in this document for the GWP Site have been selected based on potential remedial action alternatives. The following potential action-specific requirements may be applicable or relevant and appropriate: (1) design standards affecting the construction of a remedy; (2) performance standards affecting operation of a remedy, specifically, treatment requirements and management of residuals; and (3) discharge standards for a particular process.

The action-specific ARARs most pertinent to the response actions discussed later in this report are the federal and state laws pertaining to the management of solid and hazardous waste, and those pertaining to air emissions, including the New Mexico Air Pollution Control Regulations (NMAC 20.2). 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. Any improvements to the system must comply with all applicable state rules and regulations. Such requirements are usually set by the state, if the state is authorized to administer the federal program.

Location-Specific ARARs

Location-specific ARARs restrict actions or contaminant concentrations in certain environmentally sensitive areas. Examples of areas regulated under various federal laws include floodplains, wetlands, and locations where endangered species or historically significant cultural resources are present.

To-Be-Considered Criteria

To-be-considered (TBC) criteria are nonpromulgated, nonenforceable guidelines, or criteria that may be useful for developing a remedial action or that are necessary for evaluating what is protective to human health and/or the environment. Examples of TBC criteria include EPA drinking water health advisories, reference doses, and cancer slope factors.

Remediation Goals

The target contaminant defined for ground water at the GWP Site is PCE. The New Mexico Water Quality Control Commission Regulations (20.6.2.3103 of the New Mexico Administrative Code [NMAC]) include ground water standards for PCE based on human health (0.02 mg/L). The MCL for PCE established under the SDWA is lower (0.005 mg/L) and therefore the MCL, an ARAR, will be used as the remediation goal for the selected remedy.

Occurrence and Volume of Affected Media with Concentrations of PCE that Exceed Remediation Goals

PCE contamination is observed in ground water in the UHZ, in the upper portion of the LHZ, and in the lower portion of the LHZ, as shown in **Figures 5-2 through 5-7**. The approximate volume of contaminated ground water at the GWP Site was estimated by the JSP as part of the ground water modeling activity. The estimated volume was estimated by the JSP at between 1,928 and 2,892 acre-feet (6.82 to 9.42 billion gallons). The approximate volume of ground water to be remediated, i.e. with PCE concentrations greater than 5 μg/L, was estimated at between 735 and 1,102 acre-feet (2.39 to 3.59 billion gallons).

The total contaminant mass of PCE at the Site was estimated (based on the volume of contaminated ground water provided above) at between 150 and 225 kilograms (between 330 and 496 pounds). The contaminant mass of PCE to be remediated, (i.e. the contaminant mass that could potentially be extracted from ground water with PCE concentrations greater than 5 μg/L), was estimated at between 110 and 160 kilograms (between 242 and 357 pounds).

Federal Applicable or Relevant and Appropriate Requirements for Remedial Action Table 13-1			
Citation	Requirement/Purpose	Applicability	ARAR Category
Control of air emissions from Superfund air strippers at Superfund ground water sites, 1989, OSWER Directive 9355.0-28. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response	The directive establishes guidance on control of air emissions from air strippers used at Superfund sites for groundwater treatment. The joint memorandum from Office Directors, OERR, and Air Quality Planning and Standards, establishes procedures for implementation.	Las Cruces, is in an attainment of the National Air Quality Standards. This directive does not apply to the City, unless it can be demonstrated emissions from the remedy can lead toward non-attainment for one of the standards.	Chemical-specific, TBC
40 CFR 122.26 - EPA Administered Permit Programs: The National Pollutant Discharge Elimination System; Storm Water Discharges	Requires obtaining an NPDES permit for discharge of storm water from specified industrial and construction activities, developing a storm water pollution prevention plan, implementing best management practices to prevent discharge of pollutants to storm water, and monitoring storm water discharges.	Although NPDES permit coverage is not required for on-site discharges of storm water, substantive requirements, including implementing best management practices to prevent discharge of pollutants to storm water, are applicable to construction activities disturbing one acre or more. These requirements may be applicable to construction of a central groundwater treatment plant.	Action-specific
40 CFR 141.61–National Primary Drinking Water Regulations; Maximum Contaminant Levels for Organic Compounds; 40 CFR 141.66–National Primary Drinking Water Regulations; Maximum Contaminant Levels for Radionuclides	Establishes maximum contaminant levels (MCLs) for specific chemicals to protect drinking water quality.	MCLs for contaminants, including PCE degradation products are applicable if the water will be supplied directly to a drinking water distribution system with a specified number of consumers or connections. MCLs are relevant and appropriate if the water could be used for human consumption.	Chemical-specific
Reference Doses (RfDs), EPA Office	Presents non-enforceable toxicity data for specific	”To be considered” criterion used to	Chemical-

Federal Applicable or Relevant and Appropriate Requirements for Remedial Action Table 13-1			
Citation	Requirement/Purpose	Applicability	ARAR Category
of Research and Development	chemicals for use in public health assessments.	assess risk associated with soil and ground water; not an ARAR.	specific TBC
Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on Methyl Tertiary-Butyl Ether (MtBE) (*EPA-822-F-97-009*); EPA Office of Water Risk-Specific Doses (RSDs), EPA Carcinogen Assessment Group and EPA Environmental Criteria and Assessment Office	Presents non-enforceable guidance for drinking water suppliers recommending a level of contamination for MTBE in drinking water to protect consumer acceptance of the water resource and provide a margin of safety from toxic effects. Represents the dose of a chemical in mg per kg of body weight per day associated with a specific risk level (i.e., 10_6). RSDs are determined by dividing the selected risk level by the cancer potency factor (slope factor).	"To be considered" criterion used in setting an acceptable MTBE level in drinking water; not an ARAR. Applicable standard used to assess risk associated with soil and groundwater.	Chemical-specific TBC
Solid and Hazardous Waste Regulations			
40 CFR §§ 261.20, and 261.30, RCRA Waste Analysis Requirements, RCRA, 40 CFR §262.30	RCRA waste analysis requirements found at 40 CFR §§ 261.20 and 261.30, RCRA manifesting requirements found at 40 CFR § 262.20, and RCRA packaging and labeling requirements found at 40 CFR § 262.30 are relevant and appropriate requirements for off-site disposal of contaminated personal protective equipment (PPE) and other contaminated material generated during this removal action.	Because on-site storage of wastes is not expected to exceed ninety (90) days, specific storage requirements found at 40 CFR Part 265 are neither applicable nor relevant nor appropriate. See 40 CFR § 262.34.	Action-specific
40 CFR 268- Land Disposal Restrictions	The land disposal restrictions prohibit land-based disposal of listed and characteristic hazardous wastes that do not meet specified treatment standards.	Applicable to off-site land disposal of listed or characteristic hazardous wastes, and to on-site remedies that include placement of these wastes.	Action-specific
Historical Preservation Regulations			
National Historical Preservation Act 16 USC Section 431-433 - Antiquities Act of 1906 16 U.S.C. Section 470 et seq. 16 USC Section	Establishes procedures for the preservation of scientific, historical, and archaeological data that might be destroyed through alteration of terrain as a result of a federal construction project or federally licensed activity or program. If scientific,	Will be applicable during remedial activities if scientific, historical, and archaeological artifacts are identified during the implementation	Location-specific

Federal Applicable or Relevant and Appropriate Requirements for Remedial Action Table 13-1			
Citation	Requirement/Purpose	Applicability	ARAR Category
470aa-470ll – Archaeological Resources Protection Act of 1979 36 CFR Part 65 – National Historic Landmarks Program 36 CFR Part 800 –Protection of Historic Properties 40 CFR 6.301 (c) - Landmarks, Historical, and Archaeological Sites (Historic, prehistoric and archeological data)	historical, and archaeological artifacts are discovered at the site, work in the area of the site affected by such discovery will be halted pending the completion of any data recovery and preservation activities required pursuant to the act and its implementing regulations.	of the remedy.	
Flood Plain Regulations			
Flood Control Act of 1944 16 U.S.C. Section 460	Provides the public with knowledge of flood hazards and promotes prudent use and management of flood plains.	Applicable if the site is located on a designated flood plain.	Location-specific

New Mexico Applicable or Relevant and Appropriate Requirements for Remedial Action Table 13-2			
Citation	Requirement/Purpose	Applicability	ARAR Category
20.7 NMAC - New Mexico Regulations for Public Drinking Water Systems	Provides the state primary drinking water regulations based on MCLs for public water systems.	These requirements are applicable. When the MCLGs are zero, groundwater will be treated to meet MCLs. The MCLs PCE is 5 ppb.	Chemical-specific
20.6.2 NMAC – New Mexico Regulations for protection of ground water quality	20.6.2.3101 and 3103 provides concentration standards for ground water of 10,000 mg/L Total Dissolved Solids concentration or less 206.2.4101 and 4103 provide abatement standards and requirements for vadose zone and ground water.	These requirements are applicable. NMWQCC regulations will apply where PCE or its degradation products where the NMWQCC regulated concentration is lower than Federal MCL. Abatement requirements apply where vadose zone and ground water concentrations exceed applicable NMWQCC standards.	Chemical and Action specific
20.2 NMAC New Mexico Air Quality Regulation	20.2.73 Notice of Intent to discharge 20.2.78 Emission Standards for Hazardous Pollutants	These requirements may be applicable depending on treatment technologies used and emission discharge rates.	Chemical - specific
Hazardous Waste Management	RCRA waste analysis requirements found at 20.4.1.300 NMAC (40 CFR §§ 261.20 and 261.30), RCRA manifesting requirements found at 20.4.1.300 NMAC (40 CFR § 262.20), and RCRA packaging and labeling requirements also found at 20.4.1.300 NMAC (40 CFR § 262.30) are relevant and appropriate requirements for off-site disposal of contaminated personal protective equipment (PPE) and other contaminated material generated during this remedial action.	Applies to actions involving treatment, storage, and disposal of hazardous waste. Incorporates Federal Hazardous Waste Regulations by reference, with specified exceptions. Because on-site storage of wastes is not expected to exceed ninety (90) days, specific storage requirements found at NMAC 20.4.1.600 (40 CFR Part 265) are neither applicable nor relevant nor appropriate. See NMAC 20.4.1.600 (40 CFR § 262.34).	Action-specific
New Mexico Cultural Properties Act (NMSA 1978)	Requires the identification of cultural resources, assessment of impact on those resources that may be caused by the proposed remedy, and consultation with the State Historic Preservation Officer.	This requirement may become applicable if cultural resources are identified during remedial activities.	Location-specific
New Mexico	The purpose of the New Mexico Prehistoric and Historic Sites	This requirement may become applicable if	Location-

Prehistoric and Historic Sites Preservation Act 18-8 et seq. (NMSA 1989)	Preservation Act is the acquisition, stabilization, restoration or protection of significant prehistoric and historic sites by the state of New Mexico and corporations.	prehistoric or historic sites are identified during and affected by remedial activities.	specific

References

Agency for Toxic Substances and Disease Registry (ATSDR), 1997. Toxicological Profile for Tetrachloroethylene. September 1997.

Agency for Toxic Substances and Disease Registry (ATSDR), 2005. *Public Health Assessment for Griggs & Walnut Ground Water Plume (a/k/a Griggs & Walnut Ground Water Site) Las Cruces, Dona Ana County, New Mexico*. EPA Facility ID: NM0002271286. February 25, 2005.

CH2M HILL, 2002a. *Technical Activities Work Plan, Remedial Investigation/Feasibility Study, Griggs and Walnut Avenue Groundwater Plume Site, Las Cruces, Doña Ana County, New Mexico*. Version 1.3. March 2002.

CH2M HILL, 2002b. *Field Sampling Plan, Remedial Investigation/Feasibility Study, Griggs and Walnut Avenue Groundwater Plume*. Version 1.1. March 2002.

CH2M HILL, 2002c. *Quality Assurance Project Plan, Remedial Investigation/Feasibility Study, Griggs and Walnut Avenue Groundwater Plume*. Version 1.1. March 2002.

CH2M HILL, 2002d. *Site Management Plan, Remedial Investigation/Feasibility Study, Griggs and Walnut Avenue Groundwater Plume*. Version 1.1. March 2002.

CH2M HILL, 2002e. *Source Investigation, RI/FS Technical Activities Work Plan Addendum No. 1, Griggs and Walnut Avenue PCE Groundwater Plume*. March 29, 2003.

CH2M HILL, 2004. *Technical Memorandum - Results of the January 2004 Ground Water Sampling Event, Griggs and Walnut Ground Water Plume Superfund Site*. Response Action Contract Work Assignment No. 961-RICO-06HZ. June 2, 2004.

CH2M HILL, 2005a. *Field Sampling Plan, Remedial Investigation/Feasibility Study, Griggs and Walnut Ground Water Plume Site*. Version 2.0. September 2005.

CH2M HILL, 2005a. *Technical Activities Work Plan, Remedial Investigation/Feasibility Study, Griggs and Walnut Ground Water Plume Site*. Version 2.0. August 2005.

CH2M HILL, 2005b. *Field Sampling Plan, Remedial Investigation/Feasibility Study, Griggs and Walnut Ground Water Plume Site*. Version 2.0. September 2005.

CH2M HILL, 2005b. *Quality Assurance Project Plan, Remedial Investigation/Feasibility Study, Griggs and Walnut Ground Water Plume Site*. Remedial Action Contract Work Assignment 061-RICO-06HZ. Version 2.0. September 2005.

CH2M HILL, 2005c. *Quality Assurance Project Plan, Remedial Investigation/Feasibility Study, Griggs and Walnut Ground Water Plume Site*. Remedial Action Contract Work Assignment 061-RICO-06HZ. Version 2.0. September 2005.

CH2M HILL, 2005d. *Site Management Plan, Remedial Investigation/Feasibility Study, Griggs and Walnut Ground Water Plume Site*. Remedial Action Contract Work Assignment 061-RICO-06HZ. Version 2.0. October 2005.

CH2M HILL, 2006a. *Remedial Investigation Report, Version 1.2, Griggs and Walnut Ground Water Plume Superfund Site, Las Cruces, New Mexico*. November 2006.

CH2M HILL, 2006b. *Technical Memorandum –Uranium and PCE Treatment – Phase 1 Evaluation of Treatment Technologies*. Prepared for the City of Las Cruces, Utility Division by CH2M HILL. June 2006

City of Las Cruces (CLC), 2002. *Report to Consumers on the Quality of Water - 2002.* 2002.

Cohen, Robert and James Mercer, 1993. *DNAPL Site Evaluation.* C. K. Smoley, 1993.

Frenzel, Peter F., 1992. *Simulation of Ground-Water Flow in the Mesilla Basin, Dona Ana County, New Mexico, and El Paso County, Texas, Supplement to Open File Report 88-305.* U. S. Geological Survey Water Resources Investigations Report 91-4155. 1992.

Frenzel, Peter F., et al., 1990. *Geohydrology and Simulation of Ground-Water Flow in the Mesilla Basin, Dona Ana County, New Mexico, and El Paso, Texas.* U. S. Geological Survey Open-File Report 88-305. January 1, 1990.

Hawley, J. W., and Kennedy, J. F., 2004. *Creation of a Digital Hydrogeologic Framework Model of the Mesilla Basin and Southern Jornada Del Muerto Basin.*

New Mexico Water Resources Research Institute Technical Completion Report No. 332, 105 p. plus CD.

Hawley, J.W., and Kennedy, J.F., 2004, Creation of a digital hydrogeologic framework model of the Mesilla Basin and southern Jornada del Muerto Basin: N. M. Water Resources Research Institute, NMSU; prepared for Lower Rio Grande Water Users Organization;Technical Completion Report—Account No. 01-4-23987b

John Shomaker and Associates, Inc. (JSAI), 2005. Letter from Steven T. Finch/John Shomaker and Associates to Dan Sanantonio/City of Las Cruces Joint Superfund Project Manager, regarding private well survey for Griggs and Walnut Joint Superfund Project, Las Cruces, New Mexico. October 25, 2005.

John Shomaker and Associates, Inc. (JSAI), 2006a. *Ground-Water Flow and Solute-Transport Model for the Griggs and Walnut Superfund Site, Las Cruces, New Mexico*. Prepared for the Griggs and Walnut Joint Superfund Project (City of Las Cruces and Doña Ana County), November 2006.

John Shomaker and Associates, Inc. (JSAI), 2006a. *Ground-Water Flow and Solute-Transport Model for the Griggs and Walnut Superfund Site, Las Cruces, New Mexico*. Prepared for the Griggs and Walnut Joint Superfund Project (City of Las Cruces and Doña Ana County), April 7, 2006.

John Shomaker and Associates, Inc. (JSAI), 2006b. Letter from Steve Finch/JSAI to Dan Santantonio/City of Las Cruces, regarding “Source of naturally occurring uranium in the Mesilla Basin within the City of Las Cruces area”. July 5, 2006.

John Shomaker and Associates, Inc. (JSAI), 2006b. Letter from Steve Finch/JSAI to Dan Santantonio/City of Las Cruces, regarding “EPA Requested Model Runs Using the Griggs and Walnut Ground-Water-Flow and Solute-Transport Model and Preliminary Results”. May 5, 2006.

John Shomaker and Associates, Inc. (JSAI), 2006c. Letter from Steve Finch/JSAI to Dan Santantonio/City of Las Cruces, regarding “Source of naturally occurring uranium in the Mesilla Basin within the City of Las Cruces area”. July 5, 2006.

Johnson, P. 2002. *Identification of Critical Parameters for the Johnson and Ettinger (1991) Vapor Intrusion Model*. API Technical Bulletin #17. May 2002

Johnson, P.C., and R. A. Ettinger, 1991. *Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors Into Buildings*. Environ. Sci. Technol. 25: 1445-1452.

King, W. E., et al., 1971. *Hydrogeologic Report 1, Geology and Ground-Water Resources of Central and Western Dona Ana County, New Mexico.* New Mexico State Bureau of Mines and Mineral Resources, New Mexico Institute of Mining Technology. 1971.

Malm, N. R., 2003. *Climate Guide Las Cruces, 1892-2000* Agricultural Experiment Station, Research Report 749 College of Agriculture and Home Economics, New Mexico State University

Massachusetts Department of Environmental Protection (MADEP). 2002. *Indoor Air Sampling and Evaluation Guide*. WSC Policy # 02-430. Office of Research and Standards, 1 Winter Street, Boston, MA. April 2002.

National Research Council (NRC), 2000. *Natural Attenuation for Groundwater Remediation*. National Academy Pres, 274 ppg, 2000.

New Mexico Environment Department (NMED), 2002. Letter from NMED to the City of Las Cruces Regarding "Blending Plan for Well #21". September 24, 2002.

New Mexico Environment Department (NMED), 2002a. Letter from NMED to the City of Las Cruces Regarding "Blending Plan for Well #21". September 24, 2002.

New Mexico Environment Department (NMED), 2002b. Memorandum from Maura Hanning/Manager, Superfund Oversight Section, Ground Water Quality Bureau, NMED, to LaDonna Walker, Site Assessment Manager, Response and Prevention Branch, USEPA Region 6, regarding Pre-CERCLIS Screen of North Main Ground Water, Las Cruces, NM, CERCLA/SARA Investigation Recommended. December 17, 2002.

New Mexico Office of the State Engineer (NMOSE), 2000. *Lower Rio Grande Basin Hydrographic* Survey Report, Northern Mesilla Valley Section, Volumes I-IV. June 2000.

New Mexico Office of the State Engineers (NMOSE), 2005. Internet Water Administration Technical Engineering Resource System (iWATERS) Database. http://www.ose.state.nm.us/waters_db_index.html.

Office of Environmental Health Hazard Assessment (OEHHA), 2002. *Air Toxics Hot Spots Program Risk Assessment Guidelines*. November 2002. http://www.oehha.ca.gov/air/hot_spots/pdf/TSDNov2002.pdf

Sherman, M.H., 1992 Simplified Modeling for Infiltration and Radon Entry, In *Proceedings, Thermal Performance of the Exterior Envelopes of Buildings Conference V* (addendum), Atlanta, GA:ASHRAE, 1992. LBL-31305. http://epb.lbl.gov/Publications/pub_index.html

Texas Commission on Environmental Quality (TCEQ), 2005. TRPP: Toxicity and Chemical/Physical Properties. March, 2005.

U. S. Environmental Protection Agency (EPA), 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERLCA.* EPA/600/R-98/128. September 1998. http://www.epa.gov/OUST/oswermna/mna_epas.htm

U. S. Environmental Protection Agency (EPA), 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA. Interim Final.* EPA/540/G-89/004. OSWER Directive 9355.3-01. October 1988.

U. S. Environmental Protection Agency (EPA), 1989. *Control of Air Emissions from Superfund Air Strippers at Superfund Groundwater Sites.* OSWER Directive 9355.0-28. June 1989.

U. S. Environmental Protection Agency (EPA), 1991. *A Guide to Principal Threat and Low Level Threat Wastes.* Quick Reference Fact Sheet. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington D.C., October 1991.

U. S. Environmental Protection Agency (EPA), 1992. *CERCLA/SUPERFUND Orientation Manual. Office of Solid Waste and Emergency Response (OSWER).* EPA/542/R-92/005. October 1992.

U. S. Environmental Protection Agency (EPA), 1995. *National Primary Drinking Water Regulations Contaminant-Specific Fact Sheet on Perchloroethylene*. Office of Water. EPA 811-F-95-004-T. October 1995.

U. S. Environmental Protection Agency (EPA), 1996. *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Groundwater at CERCLA Sites*. EPA 540/R-96/023. OSWER Directive 9283.1-12. October 1996.

U. S. Environmental Protection Agency (EPA), 1997a. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*. EPA 540-R-97-006, Interim Final. June 1997.

U. S. Environmental Protection Agency (EPA), 1997b. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments.* EPA 540-R-97-006, Interim Final. June 1997.

U. S. Environmental Protection Agency (EPA), 1997b. *Rules of Thumb for Superfund Remedy Selection*. EPA 540-R-97-013. August 1997.

U. S. Environmental Protection Agency (EPA), 1999. *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents.* EPA 540-R-98-031. July 1999.

U. S. Environmental Protection Agency (EPA), 2000a. Data Quality Objectives Process for *Hazardous Waste Site Investigations, EPA QA/G-4HW, Final*. EPA/600/R-00/007. January 2000.

U. S. Environmental Protection Agency (EPA), 2000b. *HRS Documentation Record, Griggs and Walnut Ground Water Plume Site, Las Cruces, Dona Ana County, New Mexico, CERCLIS ID No. NM0002271286*. Prepared for EPA by Roy F. Weston. November, 2000.

U. S. Environmental Protection Agency (EPA), 2002. *Draft: Institutional Controls: A Guide to Implementing, Monitoring, and Enforcing Institutional Controls at Superfund, Brownfields, Federal Facility, UST and RCRA Corrective Action Cleanups*. December 2002.

U. S. Environmental Protection Agency (EPA), 2004. *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings*. February 22, 2004.

U. S. Environmental Protection Agency (EPA), 2004a. *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings*. February 22, 2004.

U. S. Environmental Protection Agency (EPA), 2004b. *Strategy to Ensure Institutional Control Implementation at Superfund Sites*. OSWER Directive 9355.0-106. September 2004.

U. S. Environmental Protection Agency (EPA, 2000a). *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*. EPA 540-R-00-002, OSWER 9355.0-75. July 2000.

U. S. Environmental Protection Agency (EPA, 2000b). *Institutional Controls: A Site Manager's Guide to Identifying, Evaluating, and Selecting Institutional Controls and Superfund and RCRA Corrective Action Cleanups*. EPA 540-F-00-005. OSWER Directive 9355.0-74FS-P. September 2000.

U. S. Geological Survey (USGS), 1955. Tortugas Mountain, New Mexico Quadrangle (7.5-minute Series topographic quadrangle map).

U. S. Geological Survey (USGS), 1978. Las Cruces, New Mexico Quadrangle (7.5-minute Series topographic quadrangle map).

U. S. Geological Survey (USGS), 1997. *Water-Quality Assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas – Ground-Water Quality in the Rio Grande Flood Plain, Cochiti Lake, New Mexico, to El Paso, Texas, 1995.* Water-Resources Investigations Report 96-4249.

U.S. Environmental Protection Agency (EPA), 1991. *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions.* Office of Solid Waste and Emergency Response. OSWER Directive 9355.0-30. April 22.

U.S. Environmental Protection Agency (EPA), 1997a. *Health Effects Assessment Summary Tables FY-1997 Update.* Solid Waste and Emergency Response.

U.S. Environmental Protection Agency (EPA), 2002a. Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Ground Water and

Soils (Subsurface Vapor Intrusion Guidance). Federal Register, Vol. 67, No. 230: 71169–72.

U.S. Environmental Protection Agency (EPA), 2002b. National Primary Drinking Water Standards. USEPA 816-F-02-013.

U.S. Environmental Protection Agency (EPA), 2003. *Identification of PCE Release Areas in the Vicinity of the Griggs and Walnut Ground Water Plume Report*. November 2003.

U.S. Environmental Protection Agency (EPA), 2003a. *Identification of PCE Release Areas in the Vicinity of the Griggs and Walnut Ground Water Plume Report* Version 1.1. November 2003.

U.S. Environmental Protection Agency (EPA), 2003b. Memorandum from Elizabeth Southerland to Dr. Marcia Bailey. Office of Solid Waste and Emergency Response. OSWER No. 9285.7-75. June 12, 2003.

U.S. Environmental Protection Agency (EPA), 2005. Settlement Agreement for Funding of EPA's Remedial Investigation/Feasibility Study, and Letter from EPA to the City of Las Cruces and Doña Ana County regarding the "Involvement of the City of Las Cruces and Doña Ana County in the RI/FS Process". Signed April 20, 2005.

U.S. Environmental Protection Agency (EPA), 2005a. Settlement Agreement for Funding of EPA's Remedial Investigation/Feasibility Study, and Letter from EPA to the City of Las Cruces and Doña Ana County regarding the "Involvement of the City of Las Cruces and Doña Ana County in the RI/FS Process". Signed April 20, 2005.

U.S. Environmental Protection Agency (EPA), 2005b. *Human Health Medium-Specific Screening Levels.* [Online]. Available: <http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm>

U.S. Environmental Protection Agency (EPA), 2006. *Integrated Risk Information System*.