UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6

RECORD OF DECISION

GRANTS CHLORINATED SOLVENTS PLUME SITE
Grants, New Mexico

CERCLIS ID # NM007271768

June 30, 2006

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Abbreviations and Acronyms

1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
ARAR	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
BHHRA	Baseline Human Health Risk Assessment
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
°C	Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
CFR	Code of Federal Regulations
cis-1,2-DCE	cis-1,2-dichloroethene
COC	contaminant/chemical of concern
COPC	chemical of potential concern
CSM	conceptual site model
DNAPL	dense non-aqueous phase liquid
DOT	U.S. Department of Transportation
ELCR	Excess Lifetime Cancer Risk
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERD	enhanced reductive dechlorination; Enhanced Reduction Bio-barrier
ERH	electrical resistive heating
ESD	Explanation of Significant Differences
°F	degrees Fahrenheit
FI	Facility Investigation
FS	Feasibility Study
ft	feet
GAC	granular activated carbon
GCSP	Grants Chlorinated Solvents Plume
gpm	gallons per minute
HHMSSL	Human Health Medium-Specific Screening Level (EPA Region 6)
HI	hazard index
HQ	hazard quotient

IRIS	Integrated Risk Information System (EPA)
ISCO	in-situ chemical oxidation (ISCO
MCL	maximum contaminant level
MG	million gallons
µg/L	micrograms per liter
µg/kg	micrograms per kilogram
µg/m^3	micrograms per cubic meters
mg/kg	milligrams per kilogram
mg/kg-day	milligrams per kilogram per day
MNA	monitored natural attenuation
msl	mean sea level
MST&T	Mountain States Telephone and Telegraph Company
MTBE	methyl tert-butyl ether
NCEA	National Center for Environmental Assessment
NCP	National Contingency Plan
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMED-PSTB	New Mexico Environment Department-Petroleum Storage Tank Bureau
NMED-SOS	New Mexico Environment Department-Superfund Oversight Section
NPL	National Priorities List
NRRB	National Remedy Review Board
O&M	operations and maintenance
OSE	New Mexico Office of the State Engineer
PA	Preliminary Assessment
PCE	tetrachloroethene
ppb	parts per billion
PRB	permeable reactive barrier
PRG	Preliminary Remediation Goal
PRP	Potential Responsible Party
PSH	phase-separated hydrocarbon
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RfC	reference concentration
RfD	reference dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	Record of Decision
ROI	radius of influence
SARA	Superfund Amendments and Reauthorization Act

SF	slope factor (cancer)
SI	Sampling Inspection or Site Investigation
SOD	soil oxidant demand
SSL	soil screening level
SVE	soil vapor extraction
TAG	Technical Assistance Grant
TCE	trichloroethene
TMV	toxicity, mobility, and volume
trans-1,2-DCE	trans-1,2-dichloroethene
UCL	upper confidence level
USGS	U.S. Geological Survey
UST	underground storage tank
VC	vinyl chloride
VOC	volatile organic compound
WQCC	Water Quality Control Commission (New Mexico)
yd^3	cubic yard
ZVI	zero-valent iron

Part 1.
The Declaration

Part 1: The Declaration

1.0 Site Name and Location

The Grants Chlorinated Solvents Plume (GCSP) Site is located in Grants, New Mexico (Cibola County). The National Superfund Database Identification Number is NM007271768.

2.0 Statement of Basis and Purpose

This decision document presents the "Selected Remedy" for the Grants Chlorinated Solvents Plume Site (hereinafter "the Site or GCSP Site"). The Selected Remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), 42 United States Code §9601 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, as amended.

This decision is based on the Administrative Record for the Site, which has been developed in accordance with Section 113(k) of CERCLA, 42 United States Code §9613(k). This Administrative Record file is available for review at the University of New Mexico, Grants Campus, Grants, New Mexico, the New Mexico Environment Department (NMED) offices in Santa Fe, New Mexico, and at the U.S. Environmental Protection Agency (EPA Region 6) Records Center in Dallas, Texas. The Administrative Record Index (Appendix A) identifies each of the items comprising the Administrative Record upon which the selection of the Remedial Action is based. The State of New Mexico (NMED) concurs with the Selected Remedy.

3.0 Assessment of the Site

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

4.0 Description of the Selected Remedy

The EPA will address the site contamination as one operable unit. The site-specific media have been divided in to five categories to address the chlorinated solvents contamination in indoor air, soil, and ground water.

The five categories are:

- Indoor Air – Ambient air within residential structures.
- Source Areas – two source areas exist at the GCSP site and are targeted for cleanup. The larger Holiday Cleaners source area includes roughly the entire property, an area approximately 150 ft by 100 ft in size. The depth interval requiring treatment extends from the land surface to approximately 80 ft below ground surface (bgs). The abandoned dry cleaner facility source area is approximately 30 ft by 80 ft. The depth interval requiring treatment extends from the land surface to approximately 35 ft bgs.
- Shallow Plume Core and Hot Spot – The shallow ground water plume core is defined as the portion of the plume with PCE and/or TCE concentrations exceeding 5,000 μg/L (micrograms per litre), which is a value 1,000 times the ground water final cleanup goal for PCE and TCE. Similarly, the shallow ground water hot spot is defined as the portion of the plume on Jefferson Avenue between First Street and Geis Street, which is offset from the primary plume core axis, where PCE and/ or TCE concentrations also exceed 5,000 μg/L.
- Shallow Ground Water Plume Periphery – The shallow ground water plume periphery is defined as the portion of the shallow PCE ground water plume (as identified during the Remedial Investigation [RI]) beyond the plume core where PCE concentrations still exceed the Maximum Contaminant Level (MCL) within the upper 20 ft of the subsurface

but are less than 5,000 µg/L. This includes an area extending approximately 1,500 ft downgradient of the Holiday Cleaners source area, over a width of approximately 500 to 600 ft.

- Deeper Ground Water Plume – Deeper ground water is defined as all ground water below 20 ft bgs with contamination above the MCL, based on sampling conducted during the RI.

The components of the Selected Remedy are described in detail in Section 19 of this ROD. Briefly, the major components of the Selected Remedy are:

1. Indoor Air: Vapor Mitigation

   The EPA will install vapor intrusion mitigation systems at 14 residences that are located directly above the ground water plume where concentrations of trichloroethene (TCE) or tetrachloroethene (PCE) in ground water exceed 1,000 µg/L and other locations where indoor air concentrations exceed a one in 100,000 ($1x10^{-5}$) risk level.

   Indoor air monitoring will be conducted prior to and following construction and at least once every 5 years until ARARs are met to ensure remedy protectiveness.

2. Source Area: Thermal Treatment

   Thermal treatment will be implemented at the source areas through heater probes/electrode vapor extraction wells with the central onsite treatment facility located at the Holiday Cleaners source area property.

   Site-specific bench- and/or pilot–scale testing will be performed prior to Remedial Design (RD).

   Performance monitoring will be conducted during the implementation of this remedy.

3. Shallow Plume Core and Hot Spot: In-Situ Chemical Oxidation (ISCO) with Follow-On Enhanced Reductive Dechlorination (ERD)

The EPA will be flexible in applying this technology based on data gathered during the Predesign Field Investigation. Based on the data collected, the EPA may choose to implement ISCO with Follow-On ERD or only the ERD component.

Site-specific bench- and/or pilot–scale testing will be performed prior to RD.

ISCO applications (potassium or sodium permanganate) are followed by ERD (vegetable oil) applications in permanent wells installed within the ground water plume.

Performance monitoring will be conducted throughout the active treatment period.

4. Shallow Ground Water Plume Periphery: ERD Bio-Barrier

ERD involves injecting carbon amendments (vegetable oil) into the aquifer periodically to support the growth of in-situ bacteria capable of treating the chlorinated solvents.

Site-specific bench- and/or pilot–scale testing will be performed prior to RD.

The amendments will be delivered through approximately 100 permanent injection wells once every 15 months over a 20-year period.

A total of approximately 2,400 feet (ft) of bio-barrier wall will be installed with multiple transects spaced approximately 200 ft apart.

Performance monitoring will be conducted throughout the active treatment period.

5. Deeper Ground Water Plume: ERD Bio-Barrier

ERD involves injecting carbon amendments (vegetable oil) into the aquifer periodically to support the growth of in-situ bacteria capable of treating the chlorinated solvents.

Site-specific bench- and/or pilot–scale testing will be performed prior to RD.

ERD amendments will be delivered through approximately 50 permanent injection wells once every 15 months over a 20-year period.

A total of approximately 1,000 ft of bio-barrier wall will be installed to a depth of approximately 60 ft bgs and approximately 250 ft of bio-barrier will be installed to a depth of approximately 80 ft bgs.

Performance monitoring will be conducted throughout the active treatment period.

The complete vertical extent of contamination is not fully defined at this time. Further characterization will be conducted during the Preliminary Field Investigation and the remedy will be implemented such that the entire vertical extent is addressed. The remedy will be re-evaluated during the design phase if new information regarding the vertical and horizontal extent of the plume is determined.

The Selected Remedy will address the principal threat wastes, Dense Nonaqueous Phase Liquids (DNAPL) and chlorinated solvents in ground water and soil such that the Site is made safe for residential use. The EPA will implement the Selected Remedy in a phased manner in the order listed above.

4.1 Institutional Controls

To protect human health from exposure to the existing ground water contamination while cleanup is ongoing, the EPA and NMED will request the New Mexico Office of the State Engineer (OSE) to issue an order restricting future well drilling within a portion of the aquifer contaminated by the plume until remediation goals (RGs) for the ground water are met. The order will only apply to new requests for water well permits and cannot be enforced against existing water well permit holders. The OSE does not have a vested enforcement authority but has the ability to enforce with a court order. Based on interviews the existing wells are not being used for any purpose. The EPA will work with NMED to issue a health advisory not to consume ground water from the existing wells within the plume area.

4.2 Contingency Remedy

EPA will evaluate the site conditions to determine if monitored natural attenuation (MNA) is a viable remedial alternative after the first Five-Year Review and after source control has been established in the Source Areas and the Shallow Ground Water Plume. If ground water data demonstrates evidence that MNA is occurring such that RAOs will be met in a timely manner, then EPA may consider proposing MNA as the remedial strategy for the Shallow Ground Water Periphery and the Deeper Ground Water Plume. If this alternative is determined to be the most efficient and effective remedy, then EPA with NMED's concurrence will issue an Explanation of Significant Differences (ESD) to document the change in the remedy. MNA is not a component of the Selected Remedy.

MNA is a proven ground water remedy at many sites; however, at this time there is insufficient data to select MNA as a component of the Selected Remedy at the GCSP Site. The EPA will collect the necessary data for MNA evaluation during the pre-design investigation phase. The contingency will be invoked not because of a potential failure of the Selected Remedy but rather as an alternative that would not only achieve final cleanup goals but also provide significant cost savings to the agency.

5.0 Statutory Determinations

The Selected Remedy attains the mandates of CERCLA §121, and the regulatory requirements of the NCP. This remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the Remedial Action, is cost-effective, and utilizes permanent solutions to the maximum extent practicable.

The Selected Remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduce the toxicity, mobility, or volume of hazardous substances through treatment). The concentrations of chlorinated solvents in the ground water at the Site indicate presence of DNAPL, which is considered a principal threat waste. The thermal treatment at the source areas and active treatment in the downgradient areas are expected to remove any DNAPL present and eliminate the threat to the deeper drinking water aquifer.

Ground water restrictions area necessary because the Selected Remedy will initially result in hazardous substances, which are above levels that allow for unlimited use and unrestricted exposure. A statutory review will be conducted within five years after initiation of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. This review will be conducted not less often than every five years after the date of the initiation of the remedial action.

6.0 ROD Data Certification Checklist

The following information is included in the Decision Summary (Part 2) of this ROD, while additional information can be found in the Administrative Record file for this site:

a) Chemicals of concern (COCs) and their respective concentrations (see Section 14.1.1 Identification of Chemicals of Concern);

b) Baseline risk represented by the COCs (see Section 14.1.4 Risk Characterization);

c) Remediation goals (i.e., cleanup goals) established for the COCs and the basis for the goals (see Section 19.5.3 Final Cleanup Levels);

d) How source materials constituting principal threats are addressed (see Section 5.0 Statutory Determinations and Section 18.0 Principal Threat Wastes);

e) Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the Baseline Human Health Risk Assessment and this ROD (see Section 13.1 Current and Potential Future Land Uses, Section 13.2 Current and Potential Future Ground Water Uses, Section 19.5.1 Available Land Uses, and Section 19.5.2 Available Ground Water Uses);

f) Potential land and ground water use that will be available at the site as a result of the Selected Remedy (see Section 13.1 Current and Potential Future Land Uses, Section 13.2 Current and Potential Future Ground Water Uses, Section 19.5.1 Available Land Uses, and Section 19.5.2 Available Ground Water Uses);

g) Estimated capital, lifetime operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected (Section 19.4 Cost Estimate for the Selected Remedy; and Appendix B Cost Estimate for Selected Remedy); and

h) Key factor(s) that led to selecting the remedy (see Section 14.3 Basis for Remedial Action).

7.0 Authorizing Signature

This ROD documents the Selected Remedy for contaminated soil, ground water, and indoor air at the GCSP Superfund Site. The EPA selected this remedy with the concurrence of the NMED (Appendix C – NMED Concurrence with the Selected Remedy). The Director of the Superfund Division (EPA, Region 6) has been delegated the authority to approve and sign this ROD.

By:

for John R. Hepola

Samuel Coleman, P.E., Director
Superfund Division (6SF)

CONCURRENCE PAGE
RECORD OF DECISION FOR
THE GRANTS CHLORINATED SOLVENTS PLUME SUPERFUND SITE

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for Samuel Coleman, P.E. Date
Director, Superfund Division

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Part 2.
The Decision Summary

Part 2: The Decision Summary

This Decision Summary provides a description of the site-specific factors and analyses that led to the selection of the indoor air, soil, and ground water remedies for the site. It includes background information about the site, the nature and extent of contamination found at the site, the assessment of human health and environmental risks posed by the contaminants at the site, and the identification and evaluation of remedial action alternatives for the site.

8.0 Site Name, Location, and Description

The GCSP Site is located in the City of Grants, Cibola County, New Mexico (Figure 1). The site is bounded by Second Street to the west; Adams Avenue and Jefferson Avenue to the North; Anderman Street, Washington Avenue, and Mesa View Elementary School property to the east; and Stephens Avenue and the Rio San Jose to the south. The GCSP Site is located in a mixed commercial and residential area.

The approximate area of ground water contamination at the GCSP Site is 20 acres. A site map is provided in Figure 2. The geographic coordinates of the GCSP Site are approximately 35°9′20″N latitude and 107°51′15″W longitude and within Township 11 North, Range 10 West, Section 25 of the U.S. Geological Survey (USGS) Grants Quadrangle 7.5 minute map. The approximate elevation of the Site is 6,420 ft above mean sea level (msl).

The National Superfund Database Identification Number for the Site is NM007271768. The GCSP Site is a fund-lead site, with the EPA being the lead agency for the remedial activities, and NMED the support agency. The Potential Responsible Party (PRP) for the site did not participate in the Remedial Investigation/Feasibility Study (RI/FS).

Dry cleaning operations have been historically performed at multiple facilities within the GCSP Site, although only a single dry cleaning facility, Holiday Cleaners at 715 First Street, is currently active. Dry cleaning has historically been performed at the R&L Laundry (reportedly prior to approximately 1987), at an abandoned facility at 605 First Street just north of Washington Avenue, and at a former Holiday Cleaners location at 313 First Street north of Stephens Avenue. The active Holiday Cleaners has operated at its current location since approximately 1969, and under the current ownership since approximately 1975.

9.0 Site History of Enforcement Activities

This section of the ROD provides the history of the site and a brief discussion of the EPA's and the State's remedial and enforcement activities. The "Proposed Rule" proposing the site to the National Priorities List (NPL) was published in the *Federal Register* on March 8, 2004. The "Final Rule" adding the site to the NPL was published in the *Federal Register* on July 22, 2004.

9.1 History of Site Activities

Chlorinated solvents were first identified in ground water at the GCSP Site in 1993, during a NMED – Petroleum Storage Tank Bureau (NMED-PSTB) investigation of leaking underground storage tank (UST) sites in the vicinity.

Several possible sources for the release of chlorinated solvents to the ground water were identified during the subsequent NMED Preliminary Assessment (PA), the NMED Site Investigation (SI), and the Remedial Investigation (RI). The PA considered all of the UST sites in the vicinity of the ground water plume as potential sources for chlorinated solvents. However, there was no record of the use or storage of chlorinated solvents at any of these sites. Several other sites were identified that are presently using or may have used chlorinated solvents in the past. These include the following locations:

- Holiday Cleaners (715 First Street)
- Former Holiday Cleaners (313 First Street) (currently Audio/Video Hill)
- R&L Laundry (604 First Street)
- Abandoned Dry Cleaning Facility (605 First Street)
- Former Wash 'n Clean World (located in Baties Shopping Center on north side of Stephens Avenue between First Street and Anderman Street)
- Former Mountain States Telephone and Telegraph Company (MST&T) (621 Geis Street) maintenance yard, which is now a private residence and automotive hobby shop
- A work shed located behind a private residence at 700 First Street

Based on interviews conducted by the NMED-Superfund Oversight Section (NMED-SOS), the current and past owners of Holiday Cleaners on 715 First Street have used PCE for a number of years (NMED, 2001). During interviews, the current owner of Holiday Cleaners reported that historically PCE leaked from cleaning equipment onto the building floor, as well as from a storage container maintained in the rear portion of the building. When the container was full, PCE occasionally overflowed onto the ground surface in response to thermal expansion of the PCE fluid. This equipment has been removed from service and upgraded and the PCE storage tank is no longer in use at the Holiday Cleaners.

The RI conducted by EPA identified the Abandoned Dry Cleaners property on First Street as a secondary source of ground water contamination. The remaining suspected locations identified above were not determined to be sources for ground water contamination based on available information.

9.2 History of Federal and State Investigations

9.2.1 Site Investigation Report

Following the discovery of the chlorinated solvent contamination at the GCSP Site, NMED-SOS conducted a series of investigations from September 1998 through August 2000 to identify the sources and characterize the distribution of chlorinated solvents in soil and ground water.

The SI Report (NMED, 2001) is the primary source of background information assembled for the GCSP Site. The SI gathered information regarding the site description and history; identification of potential sources; previous NMED-PSTB investigations; collection of initial soil, soil vapor, and ground water samples; air, soil, and ground water pathway identification; and ground water receptor identification.

In addition to the NMED SI Report, the following investigations were completed after the SI Report had been prepared but prior to the initiation of RI field activities:

- Rio San Jose Hyporheic Zone Sampling (EPA, 2002)
- *Allsup's 200 Secondary Investigation Report* (Tetra Tech EM, Inc., 2003)

9.2.2 Rio San Jose Hyporheic Zone Sampling

Concurrent with the planning phase of the RI, EPA and NMED collected water samples from the Rio San Jose. On December 11, 2002, EPA and NMED performed a joint sampling effort of the shallow ground water/surface water interface (hyporheic zone) of the Rio San Jose in the vicinity of the GCSP Site. The hyporheic zone was sampled at seven locations along the Rio San Jose from Second Street on the west to 600 ft east of

Anderman Street on the east. An eighth location was sampled just west of the intersection of Second Street and Monroe Avenue, within a drainage ditch along Second Street, west of the Holiday Cleaners. A ninth location was sampled adjacent to a lint trap at a suspected Former Dry Cleaning Facility approximately 400 ft east of the intersection of First Street and Stephens Avenue.

The results of the laboratory analyses indicated that PCE was not detected in these samples. However, 1,1-Dichloroethane (1,1-DCA) and cis-1,2-dichloroethene (cis-1,2-DCE) were detected in four of the samples and TCE was detected in one of the samples. All detected concentrations were less than their respective federal maximum contaminant levels (MCLs). The chlorinated volatile organic compounds (VOCs) observed in the hyporheic zone first appear at the intersection of the Rio San Jose with First Street. It does not appear that these chlorinated VOC compounds in the hyporheic zone are related to the primary release locations identified during the SI or RI, based on contaminant distribution discussed in Section 5.2. Although the concentrations of chlorinated solvents were below EPA MCLs for each of the analytes, the presence of these compounds indicates that chlorinated solvents are entering the Rio San Jose from another undefined source, potentially near First Street.

9.2.3 Allsup's 200 Secondary Investigation Report

The NMED-PSTB initially investigated five leaking UST sites near the GCSP Site, which were discovered as the result of UST removal and/or upgrade activities. These sites are the Allsup's 200, Atex #71, Tommy's 66, Spencer Automotive, and the Grants School Maintenance Yard.

NMED-PSTB conducted a Secondary Investigation at the Allsup's 200 site to further investigate the confirmed release of petroleum hydrocarbons from this site. Investigations performed at this leaking UST site were independent of the RI activities at the GCSP Site. The NMED-PSTB provided EPA with the results of this Secondary Investigation. The field investigation was completed from May 14 through July 6, 2003.

The Secondary Investigation indicated the following items regarding site hydrogeologic conditions and petroleum hydrocarbon compounds in ground water:

- Ground water was contaminated with dissolved-phase benzene, toluene, ethylbenzene, and xylenes (BTEX).
- Phase-separated hydrocarbon (PSH) is present onsite at the Allsup's 200 site and is confined to the site boundary.
- The dissolved-phase gasoline plume migrates southeast towards Geis Street.
- Methyl tert-butyl ether (MTBE) exists downgradient of Allsup's well MW-11 and the horizontal extent of MTBE has not been defined in the downgradient direction.
- Ground water flow was to the southeast with a gradient of 0.003.
- Anaerobic conditions exist within the plume.

The results of the Secondary Investigation additionally indicated the following regarding chlorinated solvents at the Allsup's 200 site:

- Chlorinated solvents were detected in 11 of the 12 site wells.
- PCE was detected at concentrations ranging from less than 1 microgram per liter (µg/L) to 6,200 µg/L.
- TCE was detected at concentrations ranging from less than 1 µg/L to 5,500 µg/L.
- Cis-1,2-DCE was detected at concentrations ranging from less than 1 µg/L to 3,200 µg/L.
- Trans-1,2-dichloroethene (trans-1,2-DCE) was detected at concentrations ranging from less than 1 µg/L to 380 µg/L.

- 1,1-dichloroethene (1,1-DCE) was detected at concentrations ranging from less than 1 μg/L to 6.2 μg/L.

9.2.4 EPA's Remedial Investigation

Based on the results of the NMED-SOS sampling conducted from 1998 through 2000, the EPA initiated an RI/FS for the GCSP Site to further characterize the nature and extent of contamination and to evaluate remedial alternatives for the site. The RI sampling program was designed based on the data previously obtained at the site and was intended to augment the historic data.

The EPA conducted the RI in phases beginning in October 2003 and ended in April 2005. The RI investigation included the collection and analysis of onsite soil, soil gas, ground water, and vapor intrusion samples from indoor and outdoor locations. Soil, soil vapor, and ground water samples were collected using the direct-push drilling technique. Indoor and outdoor air samples were collected in summa canisters. The RI Report (EPA, 2005a), documents in detail the nature and extent of contamination present at the site.

9.2.5 National Remedy Review Board Review

The EPA's National Remedy Review Board (NRRB) reviewed the proposed remedy for the site on March 29, 2006, and provided some recommendations. The NRRB has been set up by the EPA to help control response costs and promote consistency with the NCP and Superfund policy guidance. The NRRB comprises of cross-regional and management-level members who evaluate cleanup actions that exceed cost-based review criteria. A copy of the NRRB's comments and EPA Region 6's response are included in Appendix E.

9.3 History of CERCLA Enforcement Activities

The EPA has conducted PRP searches and has issued 104(e) Information Requests to past owners, operators, and current owners of Holiday Cleaners. The principal PRP for this site is the current owner of Holiday Cleaners.

Information Requests were sent to four PRPs on March 8, 2004 and all four responded. On August 24, 2004, the EPA followed up with another Information Request regarding their financial status. All PRPs have complied with the request for information. At this time the EPA is reviewing the financial viability of the PRPs and has not made a decision on enforcement.

10.0 Community Participation

This section of the ROD describes the EPA's community involvement activities. The EPA has actively sought a dialogue and collaboration with the affected community and has strived to advocate and strengthen early and meaningful community participation during the EPA's remedial activities at the site. These community participation activities during the remedy selection process meet the public participation requirements in CERCLA §121 and the NCP 40 CFR §300.430(f)(3).

10.1 Community Meetings

The EPA and NMED have conducted numerous community meetings during the course of the RI/FS for the site and provided public notices of these meetings to encourage the community's participation. Following is a brief summary of the community meetings held by the EPA.

On October 7, 2003, the EPA conducted the first public meeting in Grants, New Mexico to inform the residents about the Superfund Site and the upcoming RI/FS. Residents also were informed about indoor air sampling activities at some homes located over the plume. Fact sheets with site information also were mailed to residents prior to the meeting.

On December 15, 2004, a second public meeting was held at Grants to inform the public about the progress of the RI. Fact sheets with updated information were mailed and provided during the meeting.

10.2 Public Meeting for the Proposed Plan

A public meeting was held on April 20, 2006, at the Cibola Convention Center, Grants, New Mexico, to present the Proposed Plan (EPA, 2006a) to community members. Representatives from the EPA answered questions about the EPA's preferred alternative for the site. Oral and written comments were accepted at the meeting. A court reporter transcribed the discussions held during the meeting. This transcript is included in the Administrative Record file for the site, which is maintained at the Information Repository located at the University of New Mexico, Grants Campus, NMED's office located in Santa Fe, and the EPA's office located in Dallas, Texas.

The RI (EPA, 2005a), FS Report (EPA, 2006b), Baseline Human Health Risk Assessment (EPA, 2005b), and Proposed Plan (EPA, 2006a) for the site were made available to the public on April 11, 2006. These documents are currently located in the Administrative Record file for the site. The notice of the availability of these documents was published in the *Cibola Beacon* on April 11, 2006. A public comment period was held from April 12, 2006 to May 11, 2006.

10.3 Technical Assistance Grant

Information about the availability of Technical Assistance Grant (TAG) was provided during the public meetings in October 2003 and December 2004. However, no groups came forward to seek the grants.

10.4 Fact Sheets

Numerous fact sheets, both in English and Spanish, have been prepared during the planning and implementation of the RI/FS. These fact sheets were placed at the GCSP Site's repository and distributed to those community members on the mailing list.

10.5 Local Site Repository

The purpose of the local site repository is to provide the public a location near the community to review and copy background and current information about the site.

The repository is located near the GCSP Site at:

University of New Mexico
Grants Campus Library
1500 Third Street
Grants, NM 87020

11.0 Scope and Role of Response Action

The entire site is addressed as one operable unit. The two main objectives for response action at this site are to remove vapor intrusion risk and treat ground water so that COCs are below MCLs and the site is made safe for residential use. The planned Remedial Action is a final action for the site and is expected to successfully achieve the Remedial Action Objectives (RAOs). Through the use of a mix of different treatment technologies, this response will permanently reduce the toxicity, mobility, and volume of those source materials that constitute the principal threat wastes at the Site and restore ground water to meet ARARs. The site-specific media impacted are the following: Indoor Air, Soil, and Ground Water. The EPA has selected a combination of technologies to address the contamination in the various media.

12.0 Site Characteristics

This section of the ROD provides an overview of the site's geology and hydrogeology; the sampling strategy chosen for the site; the conceptual site model (CSM); and the nature and extent of contamination at the site. Detailed information about the site's characteristics can be found in the RI Report (EPA, 2005a).

12.1 Overview of the Site

The City of Grants is located in north-central Cibola County, New Mexico. Cibola County borders Arizona and is slightly north of the north-south centerline of the state of New Mexico. The City of Grants can be found on the “Grants” USGS 7.5-Minute Topographic Quadrangle, primarily in Section 25, Township 11 North, Range 10 West and Section 30, Township 11 North, Range 9 West. The City of Grants is at an elevation of approximately 6,420 ft above msl.

The topography surrounding Grants, New Mexico is composed of mesas extending hundreds to approximately 1,000 ft above broad valleys and dissected by steep canyons. The highest point in the region is Mount Taylor, approximately 15 miles to the northeast, at an elevation of 11,301 ft. Black Mesa rises just northwest of the City of Grants to an elevation of approximately 7,200 ft. West Grants Ridge, Grants Ridge, and East Grants Ridge rise north and northeast of Grants to elevations between 7,200 ft and 7,500 ft. Horace Mesa, at an elevation of approximately 7,800 ft, rises east of the City of Grants.

The Rio San Jose and its tributaries comprise the main drainage system in the area. The Rio San Jose flows through the City of Grants, and is sourced from Bluewater Creek to the west. Bluewater Creek is dammed by Bluewater Dam, forming Bluewater Lake, approximately 20 miles west of the City of Grants. The Rio San Jose discharges to the Rio Puerco approximately 50 miles to the east of Grants.

The climate in the Grants area is semiarid and characterized by low precipitation, cool and dry winters, warm summers, and low relative humidity. During the period of record from 1953 to 2004, the mean January and July temperatures were 30.2 and 71.6 degrees Fahrenheit (°F), respectively (NMED, 2001). The mean annual total precipitation was 10.38 inches for the period of record from 1953 to 2004 (NMED, 2001). The greatest amount of precipitation occurs during the summer and early fall with approximately 58 percent of the annual average precipitation occurring during the months of July, August, September, and October. The mean annual snowfall was 13.59 inches for the period of record from 1953 to 2004 (NMED, 2001). Snowfall occurs between the months of October and April, and is greatest during December.

12.2 Site Geology

Shallow lithology beneath the GCSP Site was characterized during Phase 1 of the RI by direct-push sampling. A direct-push drilling rig was used to advance a total of 85 borings throughout the site, and each boring was lithologically characterized in the field. These borings were advanced to a maximum depth of approximately 16 ft bgs. At each of these borings, the shallow subsurface was predominately clay and silt, with thin, laterally-continuous sand and silty sand layers. A 6-inch to 1-ft thick sand and silty sand layer was identified continuously from the Holiday Cleaners to at least the intersection of Washington Avenue and Anderman Street at a depth gradually increasing from approximately 8 ft bgs to approximately 16 ft bgs.

Additional lithologic characterization was performed during the Phase 2 direct-push sampling event. Lithologic information was collected to a maximum depth of approximately 40 ft bgs at three locations during this investigation. Lithologic data also were collected during the drilling of six monitoring wells by NMED (GMW-1 through GMW-6). The drilling log for GMW-1 indicates fine- to medium-grained sand with some gravel at a depth between 43 and 50 ft bgs, the greatest depth lithologically characterized at the site.

12.3 Site Hydrogeology

Ground water is present within the shallow clay and silt alluvium at a depth of approximately 5 to 6 ft bgs at the GCSP Site. The ground water table is somewhat deeper (6 to 8 ft bgs) within the southeastern portion of the site. Ground water elevations have been monitored on several occasions at the site. Figure 3 shows the ground water elevation contour map from February 2004.

Ground water elevations varied by approximately 1 ft over the 5-year period 1999-2004, but ground water flow directions remained consistent. In the northeast portion of the site, near the Holiday Cleaners, ground water flows toward the southeast, turning slightly more southward near Geis Street. In the western portion of the site, near the Atex #71 gasoline station, ground water flows approximately due east, but quickly turns toward the southeast to the east of the intersection of First Street and Washington Avenue. The ground water gradient varies between approximately 0.004 and 0.006 (southeastward) near the Tommy's 66 gasoline station to between approximately 0.002 and 0.003 (southeastward) near the Holiday Cleaners.

12.4 Sampling Strategy

The sampling strategy for the site addressed these key issues to determine the nature and extent of contamination at the site:

- Determine the presence of hazardous substances in soil, ground water and indoor air.
- Identify additional source(s) of hazardous substances to soil and ground water, if present.
- Fully define the horizontal and vertical extent of hazardous substances in soil and water-bearing strata underlying suspected source areas and the margins of the plume.
- Fully characterize the Site stratigraphy and hydrogeology, and evaluate temporal variations in ground water flow and contaminant concentrations.
- Evaluate indoor air quality in buildings located over or in close proximity to the ground water contaminant plume.

12.5 Conceptual Site Model

The CSM is presented in flow chart form in Figure 4 and in pictorial form in Figure 5. These figures describe the primary contaminant sources, the primary release mechanisms, secondary sources, secondary release mechanisms, and migration pathways. The primary sources at the GCSP Site are the Holiday Cleaners at the corner of First Street and Monroe Avenue and the Abandoned Dry Cleaning Facility on First Street north of Washington Avenue. Contaminant release mechanisms, secondary sources, and migration pathways are essentially the same for both sources. A potential source that cannot be ruled out based on the data collected during the RI is a work shed near the intersection of First Street and Jefferson Avenue. Additional characterization of the work shed location will be performed during a preliminary design field investigation.

The primary release mechanisms at the active Holiday Cleaners facility were routine spills, releases into a system of interior trenches, disposal of water decanted from a solvent/water separator and discharged to the sanitary sewer, and overflowing of a former PCE storage tank due to thermal expansion. The primary release mechanisms at the Abandoned Dry

Cleaning Facility are less certain, since interviews were not conducted with the facility owner. Similar release mechanisms as at the Holiday Cleaners are likely. Releases of PCE by these mechanisms caused PCE to accumulate in surface soils, migrate into the subsurface as DNAPL, and potentially flow through the sanitary sewer line. Soil, residual DNAPL, and the sanitary sewer line are thus secondary sources of PCE. Secondary release mechanisms include surface runoff, volatilization of PCE from soil and ground water, leaching of PCE from soil and/or DNAPL during infiltration, dissolution of DNAPL in ground water, and leakage of the sanitary sewer line. Once released into the environment at the GCSP Site, PCE (and its degradation products) migrate within the shallow subsurface soils, soil vapor, and ground water.

Release mechanisms at the Former Holiday Cleaners were likely similar to those at the active Holiday Cleaners. PCE or other chlorinated VOCs, or products containing significant quantities of these compounds, may have been stored at the work shed near the intersection of First Street and Jefferson Avenue. Soil samples collected near the work shed indicate that chlorinated VOCs may have been released to soil, potentially from periodic and/or routine spills.

12.6 Nature and Extent of Soil Contamination

This section of the ROD describes the nature and extent of soil contamination found at various suspected source locations. PCE and TCE are the primary COCs identified in subsurface soil at the site. Figure 6 shows the sampling locations used during the RI.

12.6.1 Soil Contamination at Holiday Cleaners

Soil samples were collected from depths of 2 ft, 5 ft, and 10 ft bgs at locations surrounding the Holiday Cleaners. PCE was detected to the maximum depth of exploration (10 ft bgs) at several locations surrounding the Holiday Cleaners, and at a maximum concentration of 36 milligrams per kilogram (mg/kg) (nearly 70 times the EPA Region 6 Human Health

Medium-Specific Screening Level [HHMSSL] of 0.55 mg/kg for residential soil) near the southeast corner of the building. PCE also was detected at concentrations up to 21 mg/kg in soil samples collected near the Holiday Cleaners southeastern property boundary. At the Holiday Cleaners, TCE and other PCE degradation products were detected in soils primarily near the southeastern property boundary, although TCE was detected just above the EPA Region 6 HHMSSL (0.043 mg/kg) near the southeastern corner of the building.

12.6.2 Soil Contamination at Abandoned Dry Cleaners

PCE was detected in soil to the maximum depth of exploration (10 ft bgs) at locations adjacent to and downgradient of the Abandoned Dry Cleaning Facility located on First Street just north of Washington Avenue. PCE was detected at over 16 times the EPA Region 6 HHMSSL near the east wall of the building (DP-13 at 2 ft bgs) and at over three times the HHMSSL near the south wall (DP-12 at 5 ft bgs) of the building. PCE also was detected at the far southeastern extent of the Abandoned Dry Cleaning Facility property. TCE and other PCE degradation products were not identified in soil surrounding the facility.

12.6.3 Soil Contamination at R&L Laundry

PCE was detected in two soil sampling locations in the alley behind the R&L Laundry, which does not currently conduct dry cleaning, although it has in the past. PCE was detected in soil below the EPA Region 6 SSL at a concentration of 0.082 mg/kg at the northeastern building corner. PCE was detected at twice the EPA Region 6 SSL near the building back door. PCE also was detected below the EPA Region 6 SSL at a location in front of the building. TCE and other PCE degradation products were not detected in soil surrounding the R&L Laundry.

12.6.4 Soil Contamination at Former Holiday Cleaners

PCE was detected in a single soil sample collected from 2 ft bgs in the alley behind the Former Holiday Cleaners location on First Street north of Stephens Avenue. PCE was detected in soil below the EPA Region 6 SSL at a concentration of 0.095 mg/kg. Drilling refusal was encountered at 2 ft bgs at all sampling locations surrounding the former facility from an underlying basalt flow.

12.6.5 Soil Contamination at Former MST&T Company Maintenance Yard

PCE was detected at soil sampling locations near the edge of the former MST&T Company maintenance property. PCE was detected above the EPA Region 6 SSL to the maximum depth of exploration near the northeastern property boundary at the intersection of Geis Street and Jefferson Avenue. PCE was detected below the Region 6 SSL at depths of 5 ft and 10 ft bgs at the eastern property boundary. TCE and other PCE degradation products were detected primarily in samples collected near the northeastern property boundary. No VOCs were detected in soil samples collected from the southeastern property boundary.

12.6.6 Soil Contamination at Work Shed

PCE and TCE were detected in soil samples collected on the north and south sides of a work shed across Jefferson Avenue from the Allsup's 200 gasoline station. These samples were collected by NMED during the SI and identified PCE below the EPA Region 6 SSL, and TCE above the Region 6 SSL, in samples from 1.5 ft bgs. Samples from 4 ft bgs also had detectable PCE and TCE, but at concentrations below the EPA Region 6 SSLs.

12.7 Nature and Extent of Ground Water Contamination

This section of the ROD describes the nature and extent of ground water contamination at the site. Ground water samples were collected using a direct-push drilling rig and existing monitor wells present over portions of the plume (see Figure 7). Figures 9 and 10 show the horizontal and the vertical extent of the chlorinated solvents contamination in ground water at the site. Horizontally, the plume extends from the two source areas to the south-southeast approximately 1,500 ft. Vertically, the plume extends to a depth of at least 80 ft bgs at the Holiday Cleaners source area.

The Holiday Cleaners was identified as the primary source of PCE in ground water during the RI investigation. PCE emanating from the Holiday Cleaners follows a ground water flow path to the southeast, gradually trending to the south-southeast beyond Geis Street. PCE migrating along this flow path is transported within a thin silty-sand layer to a maximum lateral extent of approximately 1,500 ft downgradient of the Holiday Cleaners, with non-detect concentrations downgradient of this extent. The vertical extent of PCE contamination at the site has not been completely established but will be determined during a Pre-Design Field investigation.

PCE was detected in ground water in the parking lot of the Holiday Cleaners to a depth of at least 55 ft bgs. PCE was detected across First Street from the Holiday Cleaners to a depth of at least 80 ft bgs (the maximum depth explored at that location). In this boring, PCE was detected at a maximum concentration of 3,400 µg/L (680 times the federal MCL [5 µg/L] for ground water) at a depth of approximately 58 ft bgs.

PCE was detected at a concentration of 40,000 µg/L in well GMW-6 across First Street from the Holiday Cleaners. PCE was detected at a maximum concentration of 51,000 µg/L (over 10,000 times the federal MCL) at sampling location DP-48, in the alley approximately 300 ft downgradient of the Holiday Cleaners between First Street and Geis Street.

PCE was detected at high concentrations in ground water near the northeast corner of the intersection of First Street and Jefferson Avenue. Based on ground water flow directions, the source of this contamination would be suspected to be located at the northwest corner of First Street and Jefferson Avenue, but both soil and ground water samples collected from this location have not detected chlorinated VOCs. The Holiday Cleaners is located approximately 200 ft north on First Street, a location that is cross-gradient to the ground water flow direction. As no other source is apparent, it is postulated that PCE and its degradation products may be migrating preferentially within the coarse fill materials surrounding a number of utilities (sewer, water, and gas) installed along First Street. Given the very shallow depth to ground water, it is suspected that the utility trenches intersect the ground water. These trenches are potentially providing a contaminant migration conduit that transports contaminated ground water along the length of the trenches.

The work shed located across Jefferson Avenue from the Allsup's 200 gasoline station may be a source of PCE contamination in ground water, but high PCE detections within an upgradient basement sump in the adjoining residential structure at the northeast corner of First Street and Jefferson Avenue (2,300 μg/L) (NMED, 2001) suggests that the source of ground water contamination is upgradient of the work shed, such as the utility trenches along First Street.

Subsurface petroleum hydrocarbon contamination emanating from the Allsup's 200 gasoline station at the intersection of First Street and Jefferson Avenue appears to be enhancing the degradation of PCE at this location, resulting in the highest concentrations of TCE, cis-1,2-DCE, and vinyl chloride (VC) detected at the GCSP Site.

The Abandoned Dry Cleaning Facility was identified as a second primary source of PCE and its degradation products in ground water. A separate ground water PCE plume emanates from this facility, extending laterally approximately 350 ft southeast of the abandoned facility to just past the R&L Laundry across First Street. PCE was detected at a maximum concentration of 1,600 μg/L (over 300 times the federal MCL) in a shallow ground water sample collected from the southeast property boundary of the facility. PCE was detected to a maximum depth of approximately 30 ft bgs near this same location during the Phase 2 direct-push sampling event, and was non-detect at greater depths.

12.8 Nature and Extent of Soil Vapor Contamination

Soil vapor samples were collected from locations surrounding several structures at which vapor intrusion sampling also was conducted. Figure 8 presents the soil vapor and vapor intrusion sampling locations and results. PCE and TCE concentrations were highest in samples collected adjacent to structures 2 and 3, located across First Street from the Holiday Cleaners. These structures also had the highest PCE and TCE vapor intrusion concentrations. PCE was detected at a concentration of nearly 95,000 micrograms per cubic meter ($\mu g/m^3$) (and TCE was detected at a concentration over 857,000 $\mu g/m^3$ adjacent to structure 2 (closer to Holiday Cleaners). In general, significant concentrations of PCE and its degradation products in soil vapor were only detected at locations within the known lateral extent of PCE ground water contamination.

12.9 Nature and Extent of Indoor Air Contamination

Table 1 shows the criteria EPA used to evaluate indoor air data. Tier 3 action levels require an evaluation of the need for mitigation measures to be implemented at the structure. Tier 2 action levels may require additional vapor intrusion monitoring and Tier 1 action levels do not require any further action. Vapor intrusion (indoor air) samples collected at three structures exceeded EPA Tier 3 PCE and TCE action levels within the GCSP Site (Figure 8).

Two of these structures are located across First Street from the Holiday Cleaners (structures 2 and 3) and the third is located approximately 625 ft downgradient of the Holiday Cleaners (structure 7). PCE and TCE concentrations in vapor intrusion samples collected from structures 2 and 3 are significantly higher than at any other structure, and approximately three times higher than detected at structure 7. These two structures are currently unoccupied. In general, vapor intrusion samples collected from structures outside the known lateral extent of shallow ground water contamination exhibit concentrations below Tier 1 action levels (no further action is warranted). Structures overlying shallow ground water contamination typically exhibit concentrations above either Tier 2 (evaluate whether additional sampling is warranted) or Tier 3 action levels.

12.10 Potential Routes of Contaminant Migration

Migration of contaminants at the GCSP Site occurs by means of several mechanisms, including infiltration of water containing dissolved contaminants to shallow ground water, DNAPL migration within the subsurface, volatilization of contaminants and migration as subsurface soil vapor, and migration of dissolved contaminants within the ground water aquifer.

12.10.1 Infiltration

Infiltration rates through the primarily silt and clay shallow subsurface are expected to be relatively low. However, the very shallow depth to ground water (generally 5 to 7 ft bgs), combined with the potential for an interconnected network of thin sand layers, may allow infiltration of water containing dissolved contaminants to reach ground water within a relatively short time period. Infiltration and distribution also would be facilitated within utility trenches backfilled with coarse fill material. If PCE and its degradation products are migrating through the sanitary sewer (due to potential disposal of water containing these constituents at source areas), leakage of the sanitary sewer also would contribute to enhanced infiltration and distribution of dissolved contaminants to ground water.

12.10.2 DNAPL Migration

The behavior of DNAPL in the subsurface is strongly affected by the nature and heterogeneity of the subsurface media. When DNAPL is released to the unsaturated zone, it can migrate downward, and capillary forces will immobilize some of the liquid in the pore spaces as residual product. In lower permeability media (such as clays present in the shallow subsurface of the GCSP Site), DNAPL may enter through micro-fracture networks where dissolution and subsequent diffusive losses into the bulk matrix can occur. Pools of

DNAPL also may form on top of lower-permeability media, be trapped within coarser layers bounded by low permeability media (such as those observed at the GCSP Site), or collect near the top of the capillary zone. This DNAPL can then begin to vaporize into the gaseous phase and migrate by diffusion away from the source. Pressure or density gradients can result in advective flow of the soil vapor, which can sometimes play a role in the overall transport process. As they migrate, soil vapors will partition into the aqueous phase (or dissolved phase) and the solid phase, tending to retard the rate of vapor migration. Gaseous partitioning into the soil and water phases also will make contaminants more readily available for aqueous transport.

Generally, the potential presence of DNAPL in or near the saturated zone is indicated if concentrations in ground water exceed approximately 1 to 5 percent of chemical solubility limits for the specified dissolved contaminant. The maximum detection of PCE in ground water near the Holiday Cleaners is approximately 30 to 35 percent of the water solubility of PCE, indicating that the presence of residual DNAPL is highly likely. These solubility levels extend 700 ft downgradient of the Holiday Cleaners and 60 ft vertically in the Source Area.

12.10.3 Soil Vapor and Vapor Intrusion

VOCs present in the subsurface as a DNAPL, as dissolved aqueous-phase contamination, and/or as residual soil contamination can volatilize into the vapor phase. Soil vapor may migrate under the influence of pressure or density gradients, or by diffusion away from the source. Advection of soil vapor from the unsaturated zone source areas is not considered the primary source of vapor intrusion into the structures at the GCSP. Rather, local volatilization from dissolved contaminants in shallow ground water, or DNAPL near the source areas, are considered the primary source of soil vapor at any particular location at the GCSP Site.

High concentrations of PCE and its degradation products present in soil vapor near structures overlying the aqueous-phase contaminant plume may enter those structures by a number of means. Soil vapor may intrude through cracks in basements, into crawlspaces beneath structures, or through cracks in structure foundations. Contaminants may then collect within indoor air of the structure. At structure 3 at the GCSP Site, at the intersection of First Street and Jefferson Avenue, an open sump in the basement allows for VOC contaminants in the ground water in the sump to volatilize directly into indoor air.

12.10.4 Aqueous-Phase Transport

PCE migrates within the shallow ground water aquifer as dissolved PCE moving with ground water flow. Shallow ground water at the GCSP Site moves preferentially through thin, laterally extensive silty sand layers, with varying interconnectivity. A 6-inch to 1-ft thick, laterally extensive sand layer was identified in numerous borings at the site, and is shown in the cross sections presented in the RI Report. The lateral extent of sand and silty sand layers within the deeper aquifer are currently unknown, but assumed to be similarly extensive. Such sand layers are currently suspected to represent a primary migration pathway for contaminants within the deeper aquifer.

The alluvial deposits of the shallow aquifer are known to contain thin laterally extensive sand and silty sand layers and at least one thicker sand layer near GMW-1. These sand layers act as the primary mechanism for lateral transport of contaminants within the shallow aquifer. The interconnectivity of various sand layers within the alluvial deposits is uncertain but would be a pathway for migration of contaminants from shallower to deeper portions of the aquifer.

12.10.5 Potential Routes of Human Exposure

The exposure pathways identified for the GCSP Site are ground water exposure, soil and exposure to vapor intrusion. As described in greater detail within the RI Report, ground water exposure cannot be considered an incomplete pathway since property owners are not legally prohibited from using the local ground water. Human exposure could occur through direct contact with shallow ground water through existing wells or excavation. Chlorinated solvent contamination is not currently present in the Grants municipal water supply wells, although the hydrogeologic interaction between the shallow alluvial aquifer and the deeper regional ground water aquifer that serves as the municipal water supply has not been investigated. Volatilization of the primary indicator constituents from the shallow ground water surface provides an exposure pathway through vapor intrusion (indoor air). A detailed discussion of potential exposure pathways is presented in EPA's BHHRA, included in the RI Report.

Potential exposure pathways from VOCs in soil are: (1) direct contact with soil (soil ingestion, dermal contact, and inhalation of volatile emissions to outdoor air); and (2) vapor intrusion from soil to indoor air. Vapor intrusion from soil has been addressed in part through soil gas sampling and indoor air sampling. Further evaluation of potential direct contact exposure pathways was conducted by comparison of total VOC results in soil with NMED SSLs based on residential land use assumptions. The major chemicals of potential concern (COPCs) in this evaluation were PCE and TCE.

The highest PCE concentrations in soil were found around Holiday Cleaners where PCE concentrations were higher than the HHMSSL in selected samples. The total VOC concentrations in soil, combined with the soil gas and indoor air data, suggest that VOCs in soil potentially pose an unacceptable indoor air risk through vapor intrusion. In addition, the highest PCE concentrations in soil (36 mg/kg and 21 mg/kg) are as much as 42 percent of the soil saturation limit (calculated to be 85 mg/kg for a sandy soil), suggesting the potential presence of DNAPL in some locations in soil. Therefore, while direct contact risks potentially associated with VOCs in soil might not exceed risk reduction objectives (i.e., Excess Lifetime Cancer Risk [ELCR] of 1×10^{-5}), soil remediation is warranted in the source areas to address potential vapor intrusion risks and to address the presence of DNAPL in soil as a continuing source of ground water contamination.

12.11 Ground Water Flow and Transport Modeling

A simple preliminary ground water flow and transport model was constructed for the GCSP Site using MODFLOW-SURFACT software, and available data collected during the RI. The purposes of constructing the model were to gain a better understanding of the physical characteristics of the aquifer and to provide an approximate timeframe for remediation of the existing ground water contamination using various technologies (particularly pump and treat), expected to be evaluated as part of the Feasibility Study. Many simplifying assumptions were necessary within the ground water model due to the limited dataset available following the RI. However, sufficient data were available to develop a preliminary model to allow an evaluation of approximate pump-and-treat cleanup times. The existing ground water model is anticipated to be substantially improved following additional field investigation and data collection during a Preliminary Design Field Investigation conducted during the RD. The expanded ground water model will be used during the RD to evaluate selected treatment technologies and provide information regarding expected time of remediation, dosing requirements, and other design components for the selected remedial alternative(s).

Contaminant transport modeling was limited to a “forward-in-time” analysis due to a lack of historical chemical time series data at the GCSP Site. The inability to model the historical generation of the current contaminant distribution meant that a useful component of model calibration could not be performed. However, the model was calibrated in part by adjusting parameters until the model accurately represented the current downgradient and lateral extent of ground water contamination using the current understanding of the time of original release, and assuming continuous source areas.

Anticipated improvements to the preliminary ground water model include aquifer pumping test data (rather than currently available slug test data) from several depth intervals to provide more accurate representation of hydraulic aquifer properties, additional lithology information to provide more accurate model layering, and additional depth profiling of contaminants for more accurate representation of contaminant distribution. The installation of new permanent ground water monitoring wells also will provide improved data on ground water flow directions and flow gradients within downgradient areas of the contaminant plume.

13.0 Current and Potential Future Land and Resource Uses

13.1 Current and Potential Future Land Uses

Land use at the site currently includes mixed residential homes and commercial businesses. Small businesses are mainly located along First Street and properties to the east are mostly residential. A daycare facility is located at the corner of Monroe Avenue and Peek Street and is just outside of the plume area. Other notable nonresidential structures within the plume boundary are the Knights of Columbus building on Geis and Jefferson Avenue and a bowling alley at the corner of Jefferson Avenue and Peek Street. To the east of the plume boundary is an elementary school. Based on the history of the area the future land use is unlikely to change from the current uses.

13.2 Current and Potential Future Ground Water Uses

The shallow ground water at the GCSP Site is currently not used by residents in the area. However, owners are not legally prohibited from using the local ground water. The drinking water source for the City of Grants is from two upgradient wells approximately 2 miles west (upgradient) of the Site. The City of Grants is planning to install an additional supply well within 0.75 miles west of the Site. The interaction between the shallow aquifer and the deeper aquifer is not well known at this time and will be the subject of investigation prior to the design of the remedial alternatives for the GCSP Site. The future ground water use at the Site is as a potential drinking water source for the City of Grants.

14.0 Summary of Site Risks

This section of the ROD provides a summary of the Site's human health and environmental risks. A BHHRA (EPA, 2005b) for the site was completed in July 2005, which estimated the probability and magnitude of potential adverse human health and environmental effects from exposure to contaminants associated with the Site assuming no remedial action was taken. The BHHRA provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action.

14.1 Summary of Human Health Risk Assessment

The BHHRA followed a four-step process:

a. Hazard identification (identification of COCs)

b. Exposure assessment

c. Toxicity assessment

d. Risk characterization

The EPA used an exposure point concentration (EPC) for each COC and the reasonable maximum exposure (RME) scenario to estimate risk. The EPC was the lesser of the maximum detected concentration and the 95 percent upper confidence level (UCL) of the arithmetic mean concentration of the COCs in soil or ground water. A 95 percent UCL is a statistically derived value based on sample data within an exposure area. The RME scenario is the maximum exposure that is reasonably expected to occur at the Site and is based on "upper bound" and "central tendency" estimates. The use of multiple conservative exposure factors makes the RME scenario protective of potential exposures.

14.1.1 Identification of Chemicals of Concern

COCs are chemicals that pose a carcinogenic risk to human health greater than 1 in 1,000,000 ($1 X 10^{-6}$), have a noncarcinogenic hazard index (HI) greater than (>) 1, or are found in site ground water at concentrations that exceed MCLs. While various BTEX (benzene, toluene, ethylbenzene, and xylene) compounds have been identified as COCs at the GCSP Site, they are not targeted for cleanup under the CERCLA Remedial Action as they will be separately addressed by the NMED-PSTB.

The following presents a summary of the evaluation and the constituents that are considered to be COCs at the site:

14.1.1.1 Ground Water

The impacted shallow aquifer is not considered a source of drinking water for the city, but the hydraulic interaction with the deep aquifer is of concern. The site is located within an area served by a monitored public water supply system. City of Grants Ordinance No. 394 requires the "…mandatory connection of homes or other facilities within the City to the public sewer and water system, and the City has the power to require such mandatory connection…".

An existing private well or a new private well could be used for drinking water in the future. Also, the potential does exist for contamination to migrate from the shallow to the deep aquifer and affect city water. The ground water pathway for the shallow aquifer is therefore, considered complete for future use.

COPCs in ground water were identified by comparing the maximum detected chemical concentrations in the wells to the following criteria:

1. Federal MCLs and if no MCLS were available.
2. EPA Region 6 tap water maximum screening levels (MSLs) calculated with a target risk of 1 x 10^{-6} for carcinogens and using a hazard index quotient (HQ) of 0.1 for noncarcinogens.

Chemicals in ground water that were higher than EPA Region 6 tap water MSLs were included as COPCs in the risk assessment. After the risk-based screen was completed, the following chemicals were considered COPCs at the site: benzene; bromoform; cis-1,2-DCE; ethylbenzene; MTBE; PCE; toluene; trans-1,2-DCE; TCE; VC; and total xylenes. Chemicals in ground water that were detected at concentrations higher than MCLs were treated as COCs. All the identified COPCs have MCLs with the exception of MTBE. Therefore, MTBE was further evaluated in the risk assessment and found to pose a carcinogenic risk of 2x10^{-6} for future adult resident and 1 x 10^{-6} for future child resident. The risk from MTBE exposure is within EPA risk range and hence it was excluded from the list of COCs for the site. Based on this evaluation ground water COCs for the site are benzene bromoform, cis-1,2-DCE, trans 1,2-DCE, PCE, TCE, vinyl chloride, and total xylenes.

14.1.1.2 Indoor Air COCs

Potential exposure pathways from indoor air could occur through vapor intrusion. The process of vapor intrusion involves the migration of VOCs from ground water or subsurface soil into overlying structures. In these structures, chemicals may accumulate to concentrations that pose a risk of health effects from long-term exposure. Indoor air sampling results were used to identify COPCs in indoor air, with an emphasis on chlorinated solvents and BTEX.

Initially, the maximum concentrations detected in indoor air at any of the sampled locations were compared with screening levels presented in EPA's *Draft Vapor Intrusion Guidance* (EPA 2002). These screening levels correspond to a 1 x 10^{-6} cancer risk or a noncancer HQ of 1 based on residential land use assumptions. If the maximum concentration of a chemical was lower than the screening level, it was excluded as a COPC. For chemicals that were retained, a further screen was performed, evaluating COPCs on a structure-by-structure basis. In this further screen, if the maximum concentration in an individual residence was below the screening level, that chemical was not included as a COPC for that residence.

Uncertainties in the COPC selection process for indoor air include the presence of background concentrations not associated with vapor intrusion. Direct measurement of concentrations in indoor air also may detect VOCs from other indoor and outdoor sources, such as household products (adhesives, paint, cleaners). In certain cases, COPCs identified for a particular residence may actually be background levels from these other sources. Including COPCs that may be background based potentially overstates risks associated with the vapor intrusion pathway. Based on the evaluation the residential indoor air COCs for the site are benzene, PCE, and TCE.

14.1.1.3 Soil COCs

The process of evaluating soil consisted of comparing detected concentrations of chlorinated solvents and BTEX against NMED screening levels (SLs) for residential direct contact (RES) and for the pathway from soil to ground water (SGW). These SLs are taken from NMED's *Technical Background Document for Development of Soil Screening Levels, Revision 2.0* (February 2004) and are equivalent to either a carcinogenic risk of 1E-05 or a hazard quotient of 1, or to an available MCL endpoint, in the case of the SGW pathway. In addition, for the SGW pathway, the selected SLs correspond to a dilution-attenuation factor of 1, due to the shallow water table.

The 2-ft depth interval was considered in the direct contact screen, and all three depth intervals were considered in the SGW screen. In both cases, the highest detected concentration for each chemical in the appropriate soil intervals throughout the site was compared to its appropriate SL. If the chemical passed the screen, it was not considered further in the process. Non-detects were included in the screen to highlight those chemicals with detection limits above their respective SLs. Based on this evaluation, there are no COPCs for direct contact with the top 2 ft of soil. COPCs for the SGW pathway are PCE, TCE, cis-1,2-DCE, and xylene. Soil COCs for direct residential contact at the site are PCE and TCE.

Tables 2 and 3 (Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations for Ground Water and Soil; and Indoor Air) present the COCs and EPCs for each of the COCs detected in ground water and/or indoor air.

14.1.2 Exposure Assessment

The objectives of the exposure assessment are to evaluate potential current and future human exposures to COCs in all media of concern. The current and potential future human receptors were determined by the site's configuration, land and water use, and activity patterns. Receptors (adult/child) were identified for both current and potential future site conditions. The receptors identified for quantitative analysis for the BHHRA are presented in Table 4 (Selection of Exposure Pathways-Shallow Ground Water and Indoor Air), along with a rationale for selecting the exposure pathways.

The CSM (Figures 4 and 5) shows the potential exposure pathways and human receptors at the site. The CSM was developed based on local land and water use associated with the site. Exposure pathways and routes identified for the site, and driving the remedial activities specified in this ROD, are presented in Table 4 (Selection of Exposure Pathways) and are based on the following:

a. Ground Water Exposure Pathway – Exposure to COCs in the shallow aquifer was evaluated through ingestion, inhalation and dermal exposure routes for the future onsite resident adult, child, and indoor worker.

b. Indoor Air Exposure Pathway – Exposure to COCs in indoor air (via vapor intrusion) through inhalation for the current/future adult and child residents and child attending day care.

Mathematical models were used to calculate the intakes (i.e., the doses) of the COCs for each receptor, using applicable exposure routes. The models used to calculate intakes are presented in Tables 5 and 6. Each table defines the variables used in estimating doses and includes the assumptions, known as exposure parameters, which are used in the model. These parameters include variables, such as daily ingestion rate of water, exposure duration, and body weight. In general, the exposure parameters that were used are standard values recommended by national and EPA Region 6 guidance. Regardless of the exposure route, the intake is presented as an estimated daily dose in units of milligrams of chemical per kilogram of body weight per day (mg/kg-day).

14.1.3 Toxicity Assessment

Toxicity assessment is accomplished in two steps: hazard identification and dose-response assessment. Hazard identification is the process of determining whether exposure to a chemical is associated with a particular adverse health effect and involves characterizing the nature and strength of the evidence of causation. The dose-response assessment is the process of predicting a relationship between the dose received and the incidence of adverse health effects in the exposed population. From this quantitative dose-response relationship, toxicity values are derived that can be used to estimate the potential for adverse effects as a function of potential human exposure to the chemical.

14.1.3.1 Carcinogenic and Noncarcinogenic Effects

Two general groups, carcinogens and noncarcinogens, categorize chemicals depending on the types of effects on human health. Exposure to any substance in high enough doses can result in toxic effects. Therefore, many carcinogens also produce known noncancer health effects. Noncancer toxicity values (reference dose [RfD] and reference concentration [RfC]) were used to evaluate the COCs present at the site in environmental media to determine the noncancer toxic effects. Cancer slope factor (SF) was used to evaluate carcinogenic effects. Tables 7 and 8 show the noncancer and cancer toxicity data for the COCs through oral, dermal, and inhalation routes. The toxicity data were evaluated based on information from Agency for Toxic Substances and Disease Registry (ATSDR), EPA's Integrated Risk Information System (IRIS) database, and National Center for Environmental Assessment (NCEA) issue papers.

14.1.4 Risk Characterization

The risk characterization section of the ROD summarizes and combines outputs of the exposure and toxicity assessments to characterize baseline risk at the site. Baseline risks are those risks and hazards that the site poses if no action were taken.

14.1.4.1 Carcinogenic Risk

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

$$ELCR = CDI \times SF$$

where:

ELCR = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer

CDI = chronic daily intake averaged over 70 years, expressed as mg/kg-day

SF = slope factor, expressed as $(mg/kg\text{-}day)^{-1}$

These risks are probabilities that are expressed in scientific notation (e.g., 1×10^{-6}). An ELCR of 1×10^{-6} indicates that an individual experiencing the Reasonable Maximum Exposure

(RME) estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an ELCR because it would be in addition to the risks of cancer individuals face from other nonsite-related causes such as smoking or exposure to too much sun. The chance of an individual developing cancer from all other causes has been estimated to be as high as 1 in 3. The EPA's generally acceptable risk range for site-related exposures is 1.0×10^{-4} to 1.0×10^{-6}, or a 1 in 10,000 to 1 in 1,000,000 chance, respectively, of an individual developing cancer.

Tables 9 and 10 present summaries of cancer risk and noncancer hazards to receptors due to contact with COCs in shallow ground water, as well as inhalation of indoor air due to vapor intrusion. The RME scenario is used as the basis for decision at the Site.

14.1.4.2 Noncarcinogenic Risk

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

$$\text{Non-cancer HQ} = \text{CDI}/\text{RfD}$$

where:

HQ = hazard quotient (unitless)

CDI = chronic daily intake (mg/kg-day)

RfD = reference dose (mg/kg-day)

14.1.5 Uncertainties

Some level of uncertainty is introduced into the risk characterization process every time an assumption is made. In regulatory risk assessment, the methodology dictates that assumptions err on the side of overestimating potential exposure and risk. The effect of using numerous assumptions that each overestimate potential exposure provides a conservative estimate of potential risk.

The large number of assumptions made in the risk characterization could potentially introduce a great deal of uncertainty. Any one individual's potential exposure and subsequent potential risk are influenced by their individual exposure and toxicity parameters and will vary on a case-by-case basis. Understanding the uncertainties in the assessment should result in decisions that are more informed.

At least three sources of uncertainties exist in the BHHRA:

- Uncertainty around environmental data
- Uncertainty around exposure assumptions
- Uncertainty related to toxicity assumptions

14.1.5.1 Uncertainty In Environmental Data

A sampling plan is used to determine and evaluate the full nature and extent of contamination to support the analysis. The sampling plan in turn relies on known site data to determine sampling locations. In addition, seasonal variation of concentrations may occur because of fluctuations in the water levels, and sampling and analytical procedures are likely to introduce variability. At the GCSP Site, ground water locations were sampled for chlorinated solvents from numerous wells and direct-push borings. Therefore, concentration of organic chemicals are likely to be representative of fluctuations expected in ground water and unlikely to contribute to any systemic bias of the results.

Indoor air samples were collected at least twice from most homes to account for seasonal variability, but in a few cases, only one sample was collected. A single detected value is not likely representative of indoor air concentration. Additionally, measured values in indoor air were attributed solely to vapor intrusion and not to any other indoor source. This may overestimate the risk from vapor intrusion in the homes. Finally, benzene, which was detected in ambient outdoor air, also can produce elevated contaminant concentrations in indoor air not related to vapor intrusion. Possible outdoor air sources of benzene include motor vehicle emissions and emissions from a nearby gasoline service station.

14.1.5.2 Uncertainty in Exposure Assumptions

A number of uncertainties are associated with assumptions made in the exposure assessment. Areas of uncertainty include the calculation of intakes and the selection of exposure parameters. Uncertainties regarding exposure assumptions result from the variability of the different parameters, such as ingestion rates and exposure durations both within and across populations. Best estimates from data sources compiled by regulatory agencies were used in assessing potential exposures. How well these assumptions fit the community is unknown. The 95th percentile values from the exposure ranges were incorporated into the exposure assumptions to make the assessment more reflective of community demographics. Assumptions of resource use patterns may have included unlikely scenarios, or conversely, missed likely uses. In any case, because of the use of the 95th percentile values and conservative assumptions for potential exposures reflected in the RME, the BHHRA should provide a reasonable estimate of risk.

14.1.5.3 Uncertainty in Toxicity Assumptions

Assumptions of toxicity at expected exposure doses were based on unit exposure values determined by regulatory agencies. Because of uncertainties in the studies used in determining toxicity, single to multiple order-of-magnitude adjustments were made in the process of determining safe exposure levels. Therefore, it is anticipated that the values will tend to overestimate expected toxicity at a given level of exposure.

Multiple chlorinated solvents may act on similar target organs and systems to produce similar toxic responses. Additivity of responses is assumed, but it is unknown if straight additivity is a valid assumption. Synergistic, or more than additive, responses might occur with exposure to multiple contaminants acting on similar tissues. This potential is somewhat balanced by the assumption that co-exposures to the highest levels of all contaminants would occur. In reality, the composition of the plume changes with distance from the source as PCE degrades into its breakdown products, which increase in relative concentration. It is, therefore, difficult to predict the net effect of these predicted interactions on risk values.

In addition, BTEX present within portions of the site might have synergistic or additive effects if co-exposures occurred. BTEX is co-located with the chlorinated solvents in portions of the plume, so there is a possibility that co-exposures could occur. Laboratory data are generally difficult to find on chemical-chemical interactions because of the limitless combinations of exposure concentrations and difficulties in interpretation for even the best-designed studies.

Finally, although there may be sensitive subsets of the population at the site, the toxicity reference values incorporate uncertainty factors that should be protective of these sensitive subpopulations. Combined with the RME exposure assumptions, the net result of the evaluation should be protective of those members of the population.

14.2 Ecological Risk Assessment

An ecological risk assessment was not performed for the GCSP Site, primarily due to the volatility of the contaminants. VOCs do not normally persist in surface media that would be considered for ecological risk – namely, surface soil and surface water. Concurrent with the planning phase of the RI, EPA and NMED collected water samples from eight locations along the Rio San Jose to investigate the shallow ground-water/surface-water interface (hyporheic zone) in the vicinity of the GCSP Site. PCE was not detected in these samples; however, 1,1-Dichloroethane (1,1-DCA) and cis-1,2-DCE were detected in four of the samples, and TCE was detected in one of the samples. All detected concentrations were less than their respective MCLs. All detected concentrations also were less than ecological screening values for fresh water available from various state agencies. It does not appear that these chlorinated VOC compounds in the hyporheic zone are related to the primary release locations identified during the SI or RI. The presence of these compounds indicates that chlorinated solvents are entering the Rio San Jose from another undefined source, potentially near First Street, and the concentrations are well below levels that would indicate a concern for ecological receptors.

14.3 Basis for Remedial Action

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

1. The ground water COCs are present in concentrations above their MCLs; therefore, they present an unacceptable risk to human health and the environment.
2. The shallow aquifer that is contaminated will continue to pose vapor intrusion risk to residents.
3. The indoor air COCs present either a carcinogenic risk greater than 1×10^{-5} or a noncarcinogenic HQ greater than 1.

15.0 Remedial Action Objectives

The Remedial Action Objectives (RAOs) provide general descriptions of what the Superfund cleanup is designed to accomplish. The RAOs are established on the basis of the nature and extent of the contamination, the resources that are currently and potentially threatened, and the potential for human and environmental exposure. The remedial goals are media-specific, quantitative goals that define the extent of cleanup required to achieve the RAOs. These goals serve as the design basis for the Selected Remedy identified in this ROD.

15.1 Remedial Action Objectives for Ground Water

RAOs, remediation goals, and remediation strategies developed for the GCSP Site assume that the GCSP Site consists of residential and commercial properties, and will continue to consist of residential and commercial properties for the foreseeable future. The GCSP Site remedy will address affected residential exposure pathway. The RAOs for ground water at the GCSP Site are:

- Protect human health from exposure to chemical constituents in concentrations above MCLs or Applicable or Relevant and Appropriate Requirements (ARARs).
- Restore the ground water at the GCSP Site such that it contains concentrations of the COCs less than the applicable MCLs or ARARs in a timely manner.
- Prevent DNAPL, if present, from causing concentrations of COCs in ground water to exceed MCLs or ARARs.
- Reduce the concentration of COCs in ground water to mitigate vapor intrusion.

15.2 Remedial Action Objectives for Soil

The RAOs for the soil at the GCSP Site are:

- Prevent the ground water from being impacted above MCLs through transport of COCs from the unsaturated zone.
- Protect human health from exposure to chemical constituents in soil.
- Reduce the concentration of COCs in soil and soil vapor to mitigate the vapor intrusion pathway.

15.3 Remedial Action Objectives for Vapor Intrusion

The RAO for vapor intrusion at the GCSP Site is:

- Prevent vapor intrusion into structures that results in human exposure to vapor-phase COCs in excess of a 10^{-5} ELCR.

15.4 Basis and Rationale for Remedial Action Objectives

The basis for the RAOs for the ground water and soil is to clean up the site to residential standards, the current and anticipated future land use for the site. The chlorinated solvents in ground water are present above ARARs and have migrated beneath residential properties. There are no prohibitions that prevent the use of the shallow ground water contaminated by the chlorinated solvent plume. Although currently no one is exposed to contaminated ground water in the shallow aquifer, the risk is unacceptable as the future use of ground water in the area is potentially drinking water. It is EPA's policy to take action at ground water contaminated sites when contaminants exceed MCLs. Remedial Actions at the GCSP Site are expected to reduce the chlorinated solvent concentrations to less than MCLs and the New Mexico Water Quality Control Commission (WQCC) standards. The

Remedial Action in the source area will address DNAPL, the principal threat waste and eliminate the source for contamination and restore soil and ground water. The Remedial Action in the remaining portion of the site will address any DNAPL present and restore ground water to drinking water standards and remove vapor intrusion risk to residents in the area.

Within the source areas at the GCSP Site, concentrations of COCs in ground water are believed to be caused in part by residual PCE in soil. The soil RAOs are intended to address the residual COCs in soil as part of the Selected Remedy. COCs in soil will be treated or removed to prevent soil contamination from being a continuing source of unacceptable dissolved- and vapor-phase COCs.

COCs have been identified in soil within source areas at the GCSP Site. Exposure to local residents near the source areas and to construction workers working within the source areas are of concern. The Remedial Action is intended to reduce the concentrations of COCs such that potential exposure to the COCs at concentrations that exceed target risk levels will be prevented. Once the COCs are no longer present in the soil at the source areas, the pathway to the vapor phase will no longer be complete, thus preventing impact to indoor air in adjacent residential structures.

Vapor-phase COCs from ground water and soil vapor intrusion are present in residential structures within the GCSP Site at concentrations that exceed the target indoor air risk levels. The Remedial Action addressing vapor intrusion in homes is intended to provide a remedy to remove the completed pathway for the COCs to indoor air.

15.5 Risks Addressed by the Remedial Action Objectives

Implementing active remedies in the source area, shallow plume core and hot spot, shallow plume periphery and deeper plume will address the risks associated with chlorinated solvents in ground water at the site. PCE concentrations vary from a high of 51,000 µg/L in the plume core to 1,000 µg/L in the plume periphery. Implementation of the Selected Remedy is expected to reduce the concentrations of chlorinated solvents in ground water to safe drinking water standards. The cancer risk of 2×10^{-3} associated with inhalation of vapors in three residences will be addressed by installing vapor mitigation system in homes. The vapor mitigation systems are anticipated to reduce the cancer risk to below the acceptable level of 1×10^{-5}. The EPA's decision to install an additional eleven homes with vapor mitigation system will ensure any future risks for these residences do not exceed the 1×10^{-5} risk level.

16.0 Description of Alternatives

The following are the alternatives that EPA reviewed for each site-impacted area:

Indoor Air Alternatives

- Alternative 1 – No Action
- Alternative 2 – Vapor Mitigation (Selected Alternative)

Source Area Treatment Alternatives

- Alternative 1 – No Action
- Alternative 2 – Thermal Treatment (Selected Alternative)
- Alternative 3 – ISCO w/Follow-On ERD
- Alternative 4 – ERD (Gridded)

Shallow Plume Core and Hot Spot

- Alternative 1 – No Action

- Alternative 2 – Zero-Valent Iron (ZVI) Permeable Reactive Barrier (PRB)-Multiple Transects
- Alternative 3 – ISCO w/Follow-On ERD (Selected Alternative)
- Alternative 4 – ERD (Bio-Barrier)
- Alternative 5 – Pump and Treat

Shallow Plume Core Periphery

- Alternative 1 – No Action
- Alternative 2 – Monitored Natural Attenuation (MNA)
- Alternative 3 – ZVI PRB-Multiple Transects
- Alternative 4 – ERD (Bio-Barrier) (Selected Alternative)
- Alternative 5 – Pump and Treat

Deeper Ground Water

- Alternative 1 – No Action
- Alternative 2 – Monitored Natural Attenuation (MNA)
- Alternative 3 – ZVI PRB-with Deep ERD
- Alternative 4 – ERD (Bio-Barrier) (Selected Alternative)
- Alternative 5 – Pump and Treat

16.1 Common Elements of Each Remedial Component

This section of the ROD describes those components that are common to each of the remedial alternatives except the No Action Alternative. Common remedial components to all or most of the remedial alternatives include the need for a Preliminary Design Field Investigation to collect site-specific data for the RD, a ground water monitoring program, and Five-Year Reviews.

16.1.1 Preliminary Design Field Investigation

Additional field work is required at the GCSP Site prior to the RD to collect essential site data for final design of the selected treatment alternatives. Monitoring wells were not installed as part of the RI and the current extent of the PCE ground water plume is based on direct-push sampling results. Sufficient soil sampling to fully delineate the horizontal and vertical extent of DNAPL and soil contamination in source areas was not performed during the RI and the current extent of soil contamination above Preliminary Remedial Goals (RGs) is unknown.

The Preliminary Design Field Investigation will provide a network of monitoring wells to enable the complete horizontal and vertical delineation of PCE in ground water, particularly at depths below 20 ft bgs. The wells will allow for continued monitoring of VOC concentrations throughout the plume. The Preliminary Design Field Investigation will perform additional soil and ground water sampling within the two source areas identified during the RI, the Holiday Cleaners and the Abandoned Cleaners, and will assess the source areas for the presence of DNAPL.

Additional lithologic characterization will be performed to better define the CSM, and aquifer testing will be conducted within several of the new ground water monitoring wells. Other aquifer properties specific to the treatment technologies included within the Selected Alternative will also be evaluated, including soil oxidant demand, sulfate concentrations in ground water, and sustainable injection rates. The additional data collected during the Preliminary Design Field Investigation will be vital to developing the final design(s) for the selected remedial alternatives.

16.1.2 Ground Water Monitoring Program

Ground water sampling will be required as part of the Remedial Action for treatment of various aspects of the GCSP Site. To confirm that treatment goals are being met, a period of 40 years of ground water sampling and monitoring is anticipated to track the progress of the treatment alternatives. The ground water sampling program will be fully developed during the RD, and will include an exit strategy for discontinuing the program if the RAOs are met before the end of the sampling period.

It is assumed that approximately 36 monitoring wells will be installed during the Preliminary Design Field Investigation and the six existing NMED monitoring wells will serve as the monitoring well network and will adequately monitor the overall progress of the Remedial Action, track the reduction of concentrations within the sitewide plume, and allow monitoring of the potential migration of contaminants. Ground water monitoring at a minimum will be conducted semi-annually for the first 5 years after remedy construction is complete and annually thereafter unless otherwise determined in consideration of site conditions.

16.1.3 Five-Year Reviews

Five-Year Reviews will be required at the GCSP Site since varying amounts of contamination will remain onsite that would prohibit unlimited and unrestricted use. Five-Year Reviews will be conducted until restoration goals are met, anticipated to take about 40 years.

16.1.4 Institutional Controls

To protect human health from the existing ground water contamination while cleanup is ongoing, the EPA and NMED will request the New Mexico Office of State Engineer (OSE) to issue an order restricting future well drilling within a portion of the aquifer contaminated by the plume until remediation goals for the ground water are met. The order will only apply to new requests for water well permits and cannot be enforced against existing water well permit holders. The OSE does not have a vested enforcement authority but has the ability to enforce with a court order. The EPA will work with NMED to issue a health advisory not to consume ground water from the existing wells within the plume area.

16.2 Distinguishing Features of Each Alternative

16.2.1 Indoor Air Alternatives

Concentrations of PCE and/or TCE currently exceed the RGs for indoor air at three residential structures at the GCSP Site. The alternatives selected for evaluation for treatment of indoor air at the GCSP Site are no action or the installation of radon-type vapor mitigation systems.

16.2.1.1 Alternative 1: No Action

Estimated Time for Design/Construction:	*Not applicable*
Estimated Time to Reach Remediation Goals:	*Not applicable*
Estimated Capital Cost:	*$ 0*
Estimated Life Time O&M Costs:	*$ 0*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 0*
Numbers of Years Cost Is Projected:	*Not Applicable*

The No Action Alternative is included as a baseline for evaluation of the other remedial alternatives, as required by the NCP. Under Alternative 1, no remedy will be implemented and indoor air at these structures would continue to exceed the RGs such that the RAOs for indoor air would not be met.

16.2.1.2 Alternative 2: Vapor Mitigation

Estimated Time for Design/Construction:	*Less than 1 year*
Estimated Time to Reach Remediation Goals:	*Less than 1 year*
Estimated Capital Cost:	*$ 425,000*
Estimated Life Time O&M Costs:	*$ 6,500*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 331,500*
Number of Years Cost Is Projected:	*20 years*

Under Alternative 2, the EPA will install vapor intrusion mitigation systems at residential structures where concentrations of PCE and/or TCE currently exceed the RGs for indoor air. In addition, EPA will install vapor mitigation systems in additional residences that are located directly above the ground water plume where concentrations of TCE or PCE exceed 1,000 µg/L. The EPA is taking this additional step to eliminate future risks to residents that live directly above the most affected portion of the plume. The systems would be installed in those residential structures shown in Figure 11. Following is a listing and description of the remedy components for Alternative 2:

Vapor Intrusion

1. **Treatment Components.** Vapor mitigation systems do not treat indoor air but rather prevent vapor intrusion. There is no treatment component for this alternative.

2. **Containment Components.** Vapor intrusion mitigation systems would be functionally similar to radon mitigation systems and consist of placing a plastic liner between the ground surface and the residential living space for residences with crawlspaces, and ventilating between the liner and the ground surface to remove vapors before they can enter the living space. Currently, only three residences

exceed RGs for indoor air. However, EPA is proposing to install vapor intrusion mitigation systems at 14 residences that are located directly above the ground water plume where concentrations of TCE or PCE in ground water exceed 1,000 µg/L and indoor air concentrations exceed a 1 x 10^{-5} risk level.

3. **Operations and Maintenance Components.** Once installed, the relatively low electrical costs to run the system will be the responsibility of the homeowner. NMED will pay for any replacement parts and installation within the mitigation system during the life of the system.

4. **Monitoring Components.** Vapor mitigation systems have proven to be very reliable and robust across the country. However, EPA will conduct monitoring prior to construction and after construction to verify effectiveness of the system. EPA may choose to monitor at least once every 5 years during the Five-Year Review cycle to establish protectiveness of the remedy.

16.2.2 Source Area Alternatives

The EPA evaluated the following five alternatives for treating the source area soil and ground water at the GCSP Site. Approximately a total of 47,556 cubic yards (yd^3) of aquifer matrix in the primary and secondary source areas is targeted for treatment in the Source Area.

16.2.2.1 Alternative 1: No Action

Estimated Time for Design/Construction:	*Not applicable*
Estimated Time to Reach Remediation Goals:	*Not applicable*
Estimated Capital Cost:	*$ 0*
Estimated Life Time O&M Costs:	*$ 0*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 0*

Number of Years Cost Is Projected: *Not Applicable*

The No Action Alternative is included as a baseline for evaluation of the other remedial alternatives, as required by the NCP. Under Alternative 1, no remedy will be implemented and source areas will not meet RAOs for the site.

16.2.2.2 Alternative 2: Thermal Treatment

Estimated Time for Design/Construction:	*Less than 1 year*
Estimated Time to Reach Remediation Goals:	*2 years*
Estimated Capital Cost:	*$ 8,018,000*
Estimated Life Time O&M Costs:	*Not Applicable*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 8,018,000*
Number of Years Cost Is Projected:	*1 year*

Soil Contamination

1. **Treatment Components.** Approximately a total of 47,556 yd^3 of aquifer matrix in the primary and secondary source areas is targeted for treatment using an in-situ thermal remediation system. The treatment is targeted to address principal threat wastes in the soil and ground water in the source areas. Treated soils are left in place and not excavated in this alternative. Thermal treatment utilizes soil vapor extraction as a principal component of the technology, which will provide treatment of unsaturated soils at the source areas. Given the high concentrations in the source area, thermal treatment would need to achieve 99.9 percent or more removal rate to meet the final clean up goals. After completion of thermal treatment, a final polishing step requiring additional treatment via an alternative technology may be required to treat any remaining low-level wastes.

2. **Operation and Maintenance Components.** Active treatment using the thermal technology is anticipated to require less than 1 year of system operation once constructed. There are no long-term operations and maintenance costs for this technology.

3. **Monitoring Components.** Performance monitoring would be conducted throughout the active thermal treatment period and during the cool-down period following treatment, and includes monitoring of ground water concentrations and subsurface temperatures.

Ground Water Contamination

1. **Treatment Components.** Approximately a total of 47,556 yd^3 of aquifer matrix in the primary and secondary source areas is targeted for treatment using an in-situ thermal remediation system. The treatment is targeted to address principal threat wastes in the soil and ground water in the source areas. Thermal treatment raises the temperature of the subsurface to approximately 100 degrees Celsius, inducing volatilization and boiling of chlorinated solvents and steam flushing of the aquifer. Steam and volatilized vapors are collected within an integral soil vapor extraction system. Given the high ground water concentrations in the Holiday Cleaners source area, thermal treatment would need to achieve a 99.9 percent or more removal rate to meet the RGs. If RGs are not met following completion of thermal treatment, a final polishing step requiring additional treatment via an alternative technology may be required to treat any remaining low-level wastes.

2. **Operation and Maintenance Components.** Active treatment using the thermal technology is anticipated to require less than 1 year of system operation once constructed. There are no long-term operations and maintenance costs for this technology.

3. **Monitoring Components.** Performance monitoring would be conducted throughout the active thermal treatment period and during the cool-down period following

treatment, and includes monitoring of ground water concentrations and subsurface temperatures.

16.2.2.3 Alternative 3: ISCO with Follow-On ERD

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*7years*
Estimated Capital Cost:	*$ 6,257,000*
Estimated Life Time O&M Costs:	*$ 3,179,000*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 9,436,000*
Number of Years Cost Is Projected:	*8 years*

Soil Contamination

1. **Treatment Components.** Approximately a total of 47,556 yd^3 of aquifer matrix in the primary and secondary source areas is targeted for treatment using ISCO with follow-on ERD. In this alternative a total of approximately 638 yd^3 of soil would be excavated from the primary and secondary source areas. Excavated soil would be disposed of as either hazardous or nonhazardous waste depending on soil sampling data.

2. **Operation and Maintenance Components.** There are no operations and maintenance components associated with the initial soil excavation.

3. **Monitoring Components.** Monitoring of ground water generated from the initial soil excavation would be conducted prior to discharge.

Ground Water Contamination

1. **Treatment Components.** Following excavation of soils, ISCO with follow-on ERD would be applied to treat ground water and saturated soils. In-situ chemical oxidation is effective for rapid mass reduction within source areas and high-concentration portions of ground water plumes. ERD is a slower process, but has the advantage of being a potentially more technically- and cost-effective method of reliably reaching MCLs when COC concentrations are moderate (i.e., DNAPL is absent). The strengths of ISCO and ERD can be combined for treatment of source areas. In addition to ISCO with follow-on ERD, up to 100,000 gallons of PCE-contaminated ground water may be removed from the initial soil excavations during this period. Extracted ground water would be treated onsite and disposed either in the Rio San Jose channel, the sanitary sewer or reinjected back in to the aquifer.

2. **Operations and Maintenance Components.** Five carbon source amendment injections would occur once every 15 months following the soil excavation and ISCO treatment. ERD injections would occur in the same permanent injection wells used for ISCO.

3. **Monitoring Components.** Performance monitoring would consist of direct-push sampling to confirm the distribution of oxidants and carbon amendments within the subsurface, and ground water sampling during, and upon completion of, the active treatment period.

16.2.2.4 Alternative 4: ERD (Gridded)

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*15 years*
Estimated Capital Cost:	*$ 2,391,000*
Estimated Life Time O&M Costs:	*$ 6,074,000*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 8,465,000*

Number of Years Cost Is Projected: *15 years*

Soil Contamination

1. **Treatment Components.** Alternative 4 is similar to Alternative 3. A total of approximately 470 yd^3 of soil would be excavated from the primary and secondary source areas. Excavated soil would be disposed of as either hazardous or nonhazardous depending on soil sampling data.
2. **Operation and Maintenance Components.** There are no operations and maintenance components associated with the initial soil excavation.
3. **Monitoring Components.** Monitoring of ground water generated from the initial soil excavation would be conducted prior to discharge.

Ground Water Contamination

1. **Treatment Components.** Following excavation, ERD would be applied to treat the ground water and saturated soils. ERD is a slower process, but has the advantage of being a potentially more technically- and cost-effective method of reliably reaching MCLs when COC concentrations are moderate (i.e., DNAPL is absent). In addition, up to 100,000 gallons of PCE-contaminated ground water may be removed from the initial soil excavation. Extracted ground water would be treated onsite and disposed either in the Rio San Jose channel, the sanitary sewer, or reinjected back in to the aquifer.
2. **Operations and Maintenance Components.** Twelve carbon source amendment injections would occur once every 15 months following the soil excavation.
3. **Monitoring Components.** Performance monitoring would consist of direct-push sampling to confirm the distribution of carbon amendments within the subsurface, and ground water sampling during, and upon completion of, the active treatment period.

16.2.3 Shallow Plume Core and Hot Spot Alternatives

Alternative 1: *No Action*

Alternative 2: *ZVI PRB-Multiple Transects*

Alternative 3: *ISCO w/Follow-On ERD*

Alternative 4: ERD (Bio-Barrier)

Alternative 5: Ground Water Extraction and Ex-Situ Treatment

16.2.3.1 Alternative 1: No Action

Estimated Time for Design/Construction:	*Not applicable*
Estimated Time to Reach Remediation Goals:	*Not applicable*
Estimated Capital Cost:	*$ 0*
Estimated Life Time O&M Costs:	*$ 0*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 0*
Number of Years Cost Is Projected:	*Not Applicable*

The No Action Alternative is included as a baseline for evaluation of the other remedial alternatives, as required by the NCP. Under Alternative 1, no remedy would be implemented and the shallow ground water plume core and hot spot would not meet RAOs for the site.

16.2.3.2 Alternative 2: ZVI PRB

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*40 years*
Estimated Capital Cost:	*$ 4,937,000*
Estimated Life Time O&M Costs:	*$ 837,000*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 5,744,000*
Number of Years Cost Is Projected:	*40 years*

Ground Water Contamination

1. **Treatment Components.** A total of approximately 140 million gallons (MG) is estimated to be impacted with chlorinated solvents contamination. A portion of the impacted aquifer would be treated with this approach. PRB walls incorporating ZVI provide passive treatment of contaminants as ground water flows through the wall under natural ground water flow gradients. A total of approximately 600 ft of ZVI-PRB walls would be installed as multiple transects across the shallow plume core and at the downgradient extent of the shallow ground water hot spot. Under this scenario, the ZVI-PRB wall transects would be spaced approximately 150 to 200 ft apart along the length of the shallow plume core. The ZVI-PRB walls would be installed using slurry trenching techniques, where a biodegradable slurry is maintained within the trench during excavation to stabilize the trench. The material excavated during installation of PRB walls would require offsite disposal.

2. **Operation and Maintenance Components.** The service life of the PRB wall is expected to be 20 years. At the end of the 20-year life cycle, a new PRB wall would be installed to replace the existing wall.

3. **Monitoring Components.** Performance monitoring would be conducted during the active treatment period to evaluate the effectiveness of the system.

16.2.3.3 Alternative 3: ISCO with Follow-On ERD Bio-Barrier

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*8 years*
Estimated Capital Cost:	*$ 4,*444,000
Estimated Life Time O&M Costs:	*$ 2,287,000*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 6,731,000*
Number of Years Cost Is Projected:	*8 years*

1. **Treatment Components.** In-situ chemical oxidation is effective for rapid mass reduction within source areas and high concentration portions of ground water plumes. ERD is a slower process, but has the advantage of being a more technically and potentially cost-effective method of reliably reaching MCLs when COC concentrations are moderate (i.e., DNAPL is absent). The strengths of ISCO and ERD can be combined for treatment of the shallow ground water plume core and hot spot. ISCO is initially applied to rapidly lower dissolved-phase COC concentrations to moderate levels. The ISCO phase is then followed by injecting carbon source amendments (ERD) as a polishing step for final reduction of COCs.

2. **Operation and Maintenance Components.** After the initial application of ISCO, a total of five ERD applications would occur once every 15 months to treat the COCs.

3. **Monitoring Components.** Performance monitoring would consist of direct-push sampling to confirm the distribution of oxidants and carbon amendments within the subsurface, and ground water sampling, during, and upon completion of, the active treatment period.

16.2.3.4 Alternative 4: ERD Bio-Barrier

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*20 years*
Estimated Capital Cost:	*$ 576,000*
Estimated Life Time O&M Costs:	*$ 1,300,000*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 1,876,000*
Number of Years Cost Is Projected:	*20 years*

1. **Treatment Components.** Treatment of the shallow ground water plume core and hot spot would be performed using ERD in the form of injected carbon source amendment barriers, called bio-barriers. Bio-barriers are installed as transects across the ground water plume axis by closely spaced injection of carbon source amendments. Within these carbon-rich zones, or barriers, biologically mediated reductive dechlorination of the COCs is enhanced and the process forms a continuous ERD treatment zone to intercept the plume. Installation of multiple bio-barriers in series achieves RAOs as ground water passes through each treatment area. Injection points along each transect will be spaced approximately 25 ft apart with an assumed injection radius of influence (ROI) of approximately 15 ft. Permanent injection wells would be installed, as they would be cost effective due to the need for multiple injections of carbon source amendments over an extended time period to meet RAOs. Each injection well will be screened from 8 ft bgs to 20 ft bgs for treatment of shallow plume core and hot spot. Bio-barriers would be installed as multiple transects across the shallow plume core and hot spot, with an assumed total bio-barrier length of approximately 600 ft. Under this scenario, the bio-barriers would be spaced approximately 150 to 200 ft apart along the length of the shallow plume core, with short bio-barriers installed across the shallow hot spot.

2. **Operation and Maintenance Components.** A total of 16 ERD applications would occur once every 15 months to treat the COCs.

3. **Monitoring Components.** Performance monitoring would be conducted by installing and sampling up to 10 ground water monitoring wells on either side of various bio-barriers to determine the effectiveness of the treatment technology, and to track overall progress during the active treatment period. Semi-annual sampling will be conducted during the course of active treatment.

16.2.3.5 Alternative 5: Ground Water Extraction and Ex-Situ Treatment

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*40 years*
Estimated Capital Cost:	*$ 3,539,000*
Estimated Life Time O&M Costs:	*$ 9,970,000*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 13,509,000*
Number of Years Cost Is Projected:	*40 years*

1. **Treatment Components.** Under this alternative, a network of extraction wells would be located within the shallow plume core and hot spot. Due to the shallow depths targeted for treatment, dual-phase extraction is anticipated. Dual-phase extraction involves the installation of extraction wells screened both below and slightly above the ground water table and application of vacuum to the wells to extract both soil vapor and ground water. With dual-phase extraction, relatively high extraction rates are used to actively dewater the upper portions of the shallow aquifer. This dewatering provides for rapid removal of highly contaminated ground water and exposes additional vadose zone for soil vapor extraction (SVE).

Extracted soil vapor and ground water would be conveyed to a central treatment plant where ex-situ treatment would include two treatment trains, one for extracted soil vapor and one for extracted ground water. Soil vapor would be directed through a granular activated carbon (GAC) filter prior to discharge to the atmosphere. Ground water would be pre-filtered and pre-treated to appropriate pH requirements prior to passage through an air-stripper unit. Air-stripper offgas would then be directed through a GAC filter prior to discharge to the atmosphere. Treated ground water would be reinjected into the shallow aquifer, at a location either west or upgradient of the shallow ground water plume. A total of approximately six dual-phase extraction wells would be installed within the shallow ground water plume core and hot spot, the central treatment plant would be located adjacent to the Holiday Cleaners building, and a total of approximately 10 reinjection wells would be required. Due to the low permeability of the shallow aquifer, an extended infiltration gallery may be considered in place of reinjection.

2. **Operation and Maintenance Components.** Ongoing O&M will be required throughout the active remediation period of 40 years.

3. **Monitoring Components.** Performance monitoring would be conducted utilizing existing monitoring wells, and sampled as part of the long-term ground water sampling program.

16.2.4 Shallow Plume Periphery Alternatives

Alternative 1: *No Action*

Alternative 2: *Monitored Natural Attenuation*

Alternative 3: *ZVI PRB-Multiple Transects*

Alternative 4: *ERD (Bio-Barrier)*

Alternative 5: *Ground Water Extraction and Ex-Situ Treatment*

16.2.4.1 Alternative 1: No Action

Estimated Time for Design/Construction:	*Not applicable*
Estimated Time to Reach Remediation Goals:	*Not applicable*
Estimated Capital Cost:	*$ 0*
Estimated Life Time O&M Costs:	*$ 0*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 0*
Number of Years Cost Is Projected:	*Not Applicable*

The No Action Alternative is included as a baseline for evaluation of the other remedial alternatives, as required by the NCP. Under Alternative 1, no remedy will be implemented and source areas will not meet RAOs for the site.

16.2.4.2 Alternative 2: Monitored Natural Attenuation (MNA)

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*40 years*
Estimated Capital Cost:	*$ 269,000*
Estimated Life Time O&M Costs:	*$ 1,632,000*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 1,901,000*
Number of Years Cost Is Projected:	*40 years*

1. **Treatment Components.** MNA is not an active treatment remedy and there are no treatment components in this alternative. Under the right conditions, natural

attenuation processes have the potential to address ground water contamination and achieve RAOs over a relatively long period of time. Approximately four additional ground water monitoring wells would be constructed using this alternative.

2. **Operation and Maintenance Components.** Operation and maintenance components consist exclusively of routine ground water monitoring over the course of the treatment period.

3. **Monitoring Components.** The MNA alternative would primarily utilize the network of ground water monitoring wells installed during the Preliminary Design Field Investigation as the means to routinely monitor the nature and extent of contamination at the GCSP Site and track the progress of the alternative toward meeting the RAOs at the site. Semi-annual sampling of the 36 wells installed during the Preliminary Design Field Investigation plus the four new shallow monitoring wells would occur for 5 years. After 5 years, sampling of all wells would reduce to an annual basis for 35 additional years (40 total years), concurrent with the sitewide ground water monitoring program. Sampling may be terminated earlier if RAOs are met sooner. Sampling of all existing wells is assumed necessary to confirm that the contaminant plume is stable during application of MNA and for comparisons of aquifer processes at various depths.

16.2.4.3 Alternative 3: ZVI PRB

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*40 years*
Estimated Capital Cost:	*$ 12,999,000*
Estimated Life Time O&M Costs:	*$ 927,000*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 13,926,000*
Number of Years Cost Is Projected:	*40 years*

Ground Water Contamination

1. **Treatment Components.** A total of approximately 140 MG is estimated to be impacted with chlorinated solvents contamination. A portion of the impacted aquifer would be treated with this approach. PRB walls incorporating ZVI provide passive treatment of contaminants as ground water flows through the wall under natural ground water flow gradients. A total of approximately 1,700 ft of ZVI-PRB walls would be installed as multiple transects across the shallow plume and at the downgradient extent of the shallow plume periphery. Under this scenario, the ZVI-PRB wall transects would be spaced approximately 200 ft to 400 ft apart along the length of the shallow plume. The ZVI-PRB walls would be installed using slurry trenching techniques, where biodegradable slurry is maintained within the trench during excavation to stabilize the trench. The material excavated during installation of PRB walls would require offsite disposal.

2. **Operation and Maintenance Components.** The service life of the PRB wall is expected to be 20 years. At the end of the 20-year life cycle, a new PRB wall would be installed to replace the existing wall.

3. **Monitoring Components.** Performance monitoring would be conducted during the active treatment period to evaluate the effectiveness of the system.

16.2.4.4 Alternative 4: ERD Bio-Barrier

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*20 years*
Estimated Capital Cost:	*$ 921,000*
Estimated Life Time O&M Costs:	*$2,352,000*
Discount Factor:	*7%*

Estimated Total Present Worth Cost: *$ 3,273,000*

Number of Years Cost Is Projected: *20 years*

1. **Treatment Components.** Treatment of the shallow ground water plume periphery would be performed using ERD in the form of injected carbon source amendment barriers, called bio-barriers. Bio-barriers are installed as transects across the ground water plume axis by closely spaced injection of carbon source amendments. Within these carbon-rich zones, or barriers, biologically mediated reductive dechlorination of the COCs is enhanced and the process forms a continuous ERD treatment zone to intercept the plume. Installation of multiple bio-barriers in series achieves RAOs as ground water passes through each treatment area. Injection points along each transect will be spaced approximately 25 ft apart with an assumed injection radius of influence of approximately 15 ft. Permanent injection wells would be installed as they would be cost effective due to the need for multiple injections of carbon source amendments over an extended time period to meet RAOs. Each injection well will be screened from 8 ft bgs to 20 ft bgs for treatment of the shallow ground water plume periphery. Bio-barriers would be installed as multiple transects across the shallow ground water plume periphery, with an assumed total bio-barrier length of approximately 2,400 ft. Under this scenario, the bio-barriers would be spaced approximately 200 ft apart along the length of the shallow plume periphery.

4. **Operation and Maintenance Components.** A total of sixteen ERD applications would occur once every 15 months to treat the COCs.

5. **Monitoring Components.** Performance monitoring would be conducted by installing and sampling up to 30 ground water monitoring wells on either side of various bio-barriers to determine the effectiveness of the treatment technology, and to track overall progress during the active treatment period. Semi-annual sampling will be conducted during the course of active treatment.

16.2.4.5 Alternative 5: Ground Water Extraction and Ex-Situ Treatment

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*40 years*
Estimated Capital Cost:	*$ 3,539,000*
Estimated Life Time O&M Costs:	*$ 9,970,000*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 13,509,000*
Number of Years Cost Is Projected:	*40 years*

1. **Treatment Components.** Under this alternative, a network of extraction wells would be located within the shallow plume periphery. Due to the shallow depths targeted for treatment, dual-phase extraction is anticipated. Dual-phase extraction involves the installation of extraction wells screened both below and slightly above the ground water table and application of vacuum to the wells to extract both soil vapor and ground water. With dual-phase extraction, relatively high extraction rates are used to actively dewater the upper portions of the shallow aquifer. This dewatering provides for rapid removal of highly contaminated ground water and exposes additional vadose zone for SVE.

   Extracted soil vapor and ground water would be conveyed to a central treatment plant where ex-situ treatment would include two treatment trains, one for extracted soil vapor and one for extracted ground water. Soil vapor would be directed through a GAC filter prior to discharge to the atmosphere. Ground water would be pre-filtered and pre-treated to appropriate pH requirements prior to passage through an air-stripper unit. Air-stripper offgas would then be directed through a GAC filter prior to discharge to the atmosphere. Treated ground water would be reinjected into the shallow aquifer, at a location either west or upgradient of the shallow ground water plume. A total of approximately eight dual-phase extraction wells would be installed within the shallow ground water plume periphery, the central treatment plant would be located adjacent to the Holiday Cleaners building, and a total of approximately 15 reinjection wells would be required. Due to the low permeability of the shallow aquifer, an extended infiltration gallery may be considered in place of reinjection.

2. **Operation and Maintenance Components.** Ongoing O&M will be required throughout the active remediation period of 40 years.

3. **Monitoring Components.** Performance monitoring would be conducted utilizing existing monitoring wells, sampled as part of the long-term ground water sampling program.

16.2.5 Deeper Ground Water Alternatives

Alternative 1: *No Action*

Alternative 2: *Monitored Natural Attenuation*

Alternative 3: *ZVI PRB-with Deep ERD*

Alternative 4: *ERD (Bio-Barrier)*

Alternative 5: *Ground Water Extraction and Ex-Situ*

16.2.5.1 Alternative 1: No Action

Estimated Time for Design/Construction:	*Not applicable*
Estimated Time to Reach Remediation Goals:	*Not applicable*
Estimated Capital Cost:	*$ 0*
Estimated Life Time O&M Costs:	*$ 0*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 0*
Number of Years Cost Is Projected:	*Not Applicable*

The No Action Alternative is included as a baseline for evaluation of the other remedial alternatives, as required by the NCP. Under Alternative 1, no remedy will be implemented and source areas will not meet RAOs for the site.

16.2.5.2 Alternative 2: Monitored Natural Attenuation

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*40 years*
Estimated Capital Cost:	*$ 344,000*
Estimated Life Time O&M Costs:	*$ 1,693,000*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 2,037,000*
Number of Years Cost Is Projected:	*40 years*

1. **Treatment Components.** MNA is not an active treatment remedy and there are no treatment components in this alternative. Under the right conditions, natural attenuation processes have the potential to address ground water contamination and achieve RAOs over a relatively long period of time. Approximately six additional ground water monitoring wells would be constructed using this alternative.
2. **Operation and Maintenance Components.** Operation and maintenance components consist exclusively of routine ground water monitoring over the course of the treatment period.
3. **Monitoring Components.** The MNA alternative would primarily utilize the network of ground water monitoring wells installed during the Preliminary Design Field Investigation as the means to routinely monitor the nature and extent of contamination at the GCSP Site and track the progress of the alternative toward meeting the RAOs at the site. Semi-annual sampling of the 36 wells installed during

the Preliminary Design Field Investigation plus the six new shallow monitoring wells would occur for 5 years. After 5 years, sampling of all wells would reduce to an annual basis for 35 additional years (40 total years), concurrent with the sitewide ground water monitoring program. Sampling may be terminated earlier if RAOs are met sooner. Sampling of all existing wells is assumed necessary to confirm that the contaminant plume is stable during application of MNA and for comparisons of aquifer processes at various depths.

16.2.5.3 Alternative 3: ZVI PRB with Deep ERD Bio-Barrier

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*40 years*
Estimated Capital Cost:	*$24,640,000*
Estimated Life Time O&M Costs:	*$3,093,000*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 27,733,000*
Number of Years Cost Is Projected:	40 years

1. **Treatment Components.** A total of approximately 140 MG is estimated to be impacted with chlorinated solvents contamination. A portion of the impacted aquifer would be treated with this approach. PRB walls incorporating ZVI provide passive treatment of contaminants as ground water flows through the wall under natural ground water flow gradients. A total of approximately 1,000 ft of ZVI-PRB walls up to 60 ft deep would be installed as multiple transects across the deeper ground water plume. The ZVI-PRB walls would be installed using slurry trenching techniques, where biodegradable slurry is maintained within the trench during excavation to stabilize the trench. The material excavated during installation of PRB walls would require offsite disposal. Treatment below 60-ft depth would be

accomplished by ERD bio-barriers since the installation of sufficiently-thick ZVI-PRB walls at depths greater than 60 ft bgs is not considered practical.

2. **Operation and Maintenance Components.** The service life of the PRB wall is expected to be 20 years. At the end of the 20-year life cycle, a new PRB wall would be installed to replace the existing wall. For the deep ERD application, a total of 16 carbon source amendment injections are assumed over a 20-year period (one injection every 15 months) to meet the RAOs for ground water at this depth.

3. **Monitoring Components.** Performance monitoring would be conducted during the active treatment period to evaluate the effectiveness of the system.

16.2.5.4 Alternative 4: ERD Bio-Barrier

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*20 years*
Estimated Capital Cost:	*$ 1,630,000*
Estimated Life Time O&M Costs:	*$5,592,000*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 7,222,000*
Number of Years Cost Is Projected:	20 years

1. **Treatment Components.** Treatment of the deeper ground water would be performed using ERD in the form of injected carbon source amendment barriers, called bio-barriers. Bio-barriers are installed as transects across the ground water plume axis by closely spaced injection of carbon source amendments. Within these carbon-rich zones, or barriers, biologically mediated reductive dechlorination of the COCs is enhanced and the process forms a continuous ERD treatment zone to intercept the plume. Installation of multiple bio-barriers in series achieves RAOs as ground water passes through each treatment area. Injection points along each

transect will be spaced approximately 25 ft apart with an assumed injection ROI of approximately 15 ft. Permanent injection wells would be installed as they would be cost effective due to the need for multiple injections of carbon source amendments over an extended time period to meet RAOs. Each injection well will be screened from 60 ft bgs to at least 80 ft bgs. Bio-barriers would be installed as multiple transects across the deeper ground water plume, with an assumed total bio-barrier length of approximately 1,250 ft.

2. **Operation and Maintenance Components.** A total of 16 ERD applications would occur once every 15 months to treat the COCs.

3. **Monitoring Components.** Performance monitoring would be conducted by installing and sampling up to 10 ground water monitoring wells on either side of various bio-barriers to determine the effectiveness of the treatment technology, and to track overall progress during the active treatment period. Semi-annual sampling will be conducted during the course of active treatment.

16.2.5.5 Alternative 5: Ground Water Extraction and Ex-Situ Treatment

Estimated Time for Design/Construction:	*1 year*
Estimated Time to Reach Remediation Goals:	*40 years*
Estimated Capital Cost:	*$ 3,829,000*
Estimated Life Time O&M Costs:	*$ 9,970,000*
Discount Factor:	*7%*
Estimated Total Present Worth Cost:	*$ 13,799,000*
Number of Years Cost Is Projected:	*40 years*

1. **Treatment Components.** Under this alternative, a network of extraction wells would be located within the deeper ground water plume. Extracted ground water

would be conveyed to a central treatment plant where ex-situ treatment would include air-stripping and offgas control. Ground water would be pre-filtered and pre-treated to appropriate pH requirements prior to passage through an air-stripper unit. Air-stripper offgas would then be directed through a GAC filter prior to discharge to the atmosphere. Treated ground water would be reinjected into the deeper aquifer, at a location either west or upgradient of the shallow ground water plume. A total of approximately six extraction wells would be installed within the deeper ground water, the central treatment plant would be located adjacent to the Holiday Cleaners building, and a total of approximately 10 reinjection wells would be required.

2. **Operation and Maintenance Components.** Ongoing O&M will be required throughout the active remediation period of 40 years.

3. **Monitoring Components.** Performance monitoring would be conducted utilizing existing monitoring wells, sampled as part of the long-term ground water sampling program.

16.3 Other Common Elements and Distinguishing Features of Each Alternative

Common elements and distinguishing features unique to each alternative include key ARARs, long-term reliability of the remedy, quantities of untreated wastes, and uses of presumptive remedies. Table 11 (Summary ARARs) and Table 12 (Description of ARARs for Selected Remedy) summarize the ARARs pertaining to the main elements of each of the remedial alternatives and the Selected Remedy. Several of the remedial alternatives have elements in common, including excavation and waste disposal requirements.

16.3.1 Key Applicable or Relevant and Appropriate Requirements

With the exception of the No Action Alternative, it is assumed that an appropriate design for all retained technologies, or technology combinations, can be developed for each media of concern to meet applicable ARARs. The primary difference in technology combinations for the different contaminated media with regard to complying with ARARs is the length of time required before ARARs would be achieved. Table 11 (Summary of ARARs) summarizes the ARARs for alternatives and shows how they will be complied with.

16.3.2 Long-Term Reliability of the Remedy

The magnitude of risk will remain indefinitely if no action is taken at the site. All of the alternative technologies considered for remedial action will provide long-term reliability once all DNAPL is removed, provided that ICs remain effective until that time. However if residual DNAPL cannot be completely removed from the ground water at the site, the remedy may no longer provide long-term reliability. If the remedy cannot be implemented as planned then EPA will develop an alternate plan. At this time the EPA cannot determine the cost for replacement of the remedy, as there is insufficient data for analysis of such site circumstances.

16.3.3 Quantities of Untreated Wastes

16.3.1.1 Indoor Air (Vapor Intrusion Mitigation)

The No Action Alternative does not provide treatment. The vapor mitigation systems do not provide active treatment, but physically block contaminants from entering a structure.

16.3.1.2 Source Area, Shallow Plume Core and Hot Spot, Shallow Plume Periphery, and Deeper Ground Water Treatment

Approximately 44.5 MG of ground water and 6,500 yd^3 of soil will be treated at the site. Pilot-scale and bench-scale testing is required to determine the exact quantity of COCs, which will be treated by the various technologies, including thermal treatment, ISCO, ERD, ZVI PRBs, MNA, and pump and treat. It is anticipated that each of the proposed technologies can remove sufficient COCs to meet the site RAOs.

16.3.4 Uses of Presumptive Remedies

The following presumptive remedies prescribed by EPA guidance (EPA, 1993) were evaluated in the FS.

16.3.4.1 VOCs in Soil

- Soil Vapor Extraction (SVE)
- Ex-Situ Thermal Desorption
- Ex-Situ Thermal Incineration

The only presumptive technology provided in current EPA guidance for VOCs in soils that was retained is soil vapor extraction, with enhancements such as pneumatic fracturing, sealing the ground surface, and the use of horizontal vapor wells. The other presumptive technologies were each rejected based on site-specific conditions, which severely limit the effectiveness of the technologies at the GCSP Site. A dual-phase SVE technology was selected as part of the thermal treatment system for the Source Areas.

16.3.4.2 VOCs in Ground Water

- Ground Water Extraction and Ex-Situ Treatment

Current EPA guidance for treatment of VOCs dissolved in ground water includes only ground water extraction and ex-situ treatment. Ground water extraction and ex-situ treatment is a proven technology for treatment of VOCs in ground water, and can be implemented at the GCSP Site. Ground water extraction and ex-situ treatment was not selected for the site based on current site conditions.

16.4 Expected Outcomes of Each Alternative

Implementation of any of the alternatives considered for this site, other than the No Action Alternative, is expected to reduce the human health risk over time at the GCSP Site. However, the time required to achieve the RAOs for each site-impacted media varies anywhere from 1 years for to 40 years depending on the alternative used. The vapor mitigation systems will be able to achieve RAOs for indoor air as soon as installation is complete. In the Source Areas implementation of the thermal treatment is expected to be achieve RAOs relatively sooner than ISCO and ERD. In the shallow ground water and hot spot area, implementation of the ISCO with follow-on ERD is expected to achieve the RAOs sooner than with ZVI-PRB, ERD and pump and treat. In the shallow ground water plume periphery, implementation of the ERD bio-barrier is expected to achieve the RAOs sooner than with MNA, ZVI and pump and treat. For deeper ground water implementation of the ERD bio-barrier is expected to achieve the RAOs sooner than with the MNA, ZVI-PRB followed with ERD, pump and treat.

The outcome of the remedy is not expected to change the land and ground water use at the site as it will likely continue to be residential and light commercial. Implementation of the Selected Remedy will reduce risk to human health and restore the ground water to beneficial use.

17.0 Comparative Analysis of Alternatives

The EPA uses nine NCP criteria to evaluate remedial alternatives for the cleanup of a release. These nine criteria are categorized into three groups: threshold, balancing, and modifying. The threshold criteria must be met for an alternative to be eligible for selection. The threshold criteria are overall protection of human health and the environment and compliance with ARARs. The balancing criteria are used to weigh major tradeoffs among alternatives. The five balancing criteria are long-term effectiveness and permanence; reduction of toxicity, mobility or volume through treatment; short-term effectiveness;

implementability; and cost. The modifying criteria are State acceptance and community acceptance. Table 13 (Evaluation Criteria for Superfund Remedial Alternatives) briefly describes the evaluation criteria.

Based on the initial screening of technologies and evaluation of alternatives, a number of remedial alternatives were evaluated for each site-impacted area. Tables 14 through 18 (Comparison of Remedial Alternatives) summarize how these alternatives comply with the nine evaluation criteria specified in the NCP §300.430(f)(5)(i). The No Action Alternative for each media is not considered further in the comparative analysis of alternatives as it cannot meet the threshold criteria or address risks at the site. Following is a comparative analysis of the remedial alternatives other than the No Action Alternative.

17.1 Overall Protection of Human Health and the Environment

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

All of the alternatives, except the No Action Alternative, are protective of human health and the environment by eliminating, reducing, or controlling risks posed by the site through treatment of soil and ground water contaminants, engineering controls, and/or institutional controls. Basic comparative analyses for the technologies, or technology combinations, for the different media of concern are presented below.

17.1.1 Indoor Air (Vapor Intrusion Mitigation)

Only two technical approaches were identified pertaining to indoor air. These technical approaches included either No Action or Installation of Radon-Type Vapor Mitigation Systems.

Under the Installation of Radon-Type Vapor Mitigation Systems, the contaminated vapors are physically isolated from the overlying structure by installing an impermeable vapor barrier and a ventilation system to remove the vapors from beneath the barrier. Human health and the environment are protected since the vapor barrier and venting system remove the pathway for volatile organics present in the subsurface to enter the structure.

17.1.2 Source Area Treatment

Four approaches including the No Action Alternative were identified for source area treatment at the GCSP Site. The three technical approaches to remediating the source area (thermal treatment, ISCO with Follow-on ERD, and ERD Applied in a Grid) would be expected to remove COCs from the source area under the implementation of an appropriately designed program. If residual DNAPL or sorbed soil source material remains after the active treatment periods, these approaches may not achieve RAOs.

Thermal treatment may be less subject to non-uniform treatment distribution in the source area as it is less sensitive to fine-grained or heterogeneous subsurface conditions and would be accomplished in a single treatment event. However, as a one-time event, thermal treatment would need to achieve very high removal efficiency (99.9 percent or more) in that single event to approach RAOs. Since 99.9 percent or more reduction in contaminant volume would constitute very high removal efficiency for any type of remedial technology, it is possible that additional final polishing by another remedial technology may need to be instituted to achieve RAOs.

Since both ISCO and ERD rely on amendments being able to come in contact with COCs in the subsurface, the fine-grained heterogeneous soils in the treatment area may impact the effectiveness and implementability of these technologies. Multiple injection events for both ISCO and ERD carbon-source amendments would be required for these technologies. With regard to ERD or bio-barriers, if reductive dechlorination of the COCs is retarded by site-specific conditions then equally, or more toxic, intermediary by-products of biodegradation may persist.

While the thermal treatment and ISCO option technologies do have the capability of directly treating residual DNAPL to some degree, the effectiveness of all technology options in meeting or approaching RAOs will be limited if residual DNAPL or sorbed soil contamination persists after active remediation.

All of the three technical approaches considered are protective of human health and the environment. The length of time required to achieve protectiveness varies for each approach with thermal treatment being the quickest compared to ISCO and ERD. Thermal treatment also is cost-competitive and will have the least impact on the community.

17.1.3 Shallow Ground Water Plume Core and Hot Spot Treatment

Five approaches including the No Action Alternative were identified for treatment of the shallow ground water plume core and hot spot at the GCSP Site to depths of 20 ft bgs. The four technical approaches to remediating the shallow ground water plume core and hot spot (ZVI-PRB, ISCO with Follow-on ERD, ERD Bio-barriers, and Pump and Treat) would be expected to remediate COCs within the shallow plume core under the implementation of an appropriately designed program. If any residual DNAPL or sorbed soil source material remains after the active treatment periods, these approaches may not achieve RAOs. ISCO is the only identified technology that would have the capability of directly treating residual DNAPL.

Since both ISCO and ERD rely on amendments being able to come in contact with COCs, the fine-grained heterogeneous soils in the treatment area may impact the effectiveness and implementability of these technologies. The low permeability soils at the GCSP Site also may pose difficulties in achieving full ground water capture under the Pump and Treat option. Also, multiple injection events for both ISCO and ERD carbon-source amendments would be specified for these technologies. And with regard to ERD or bio-barriers, if reductive dechlorination of the COCs is retarded by site-specific conditions then equally, or more toxic, intermediary by-products of biodegradation may persist.

PRB application would have the most substantial short-term installation impacts and would require replacement once every 20 years. The natural ground water velocity would limit the treatment time for the shallow ground water plume core and hot spot by PRBs.

The Pump and Treat option is expected to take the longest time period and would require ongoing O&M throughout that period.

Among the four technical approaches considered for the Shallow Plume Core and Hot Spot, ISCO with follow-on ERD would achieve protection of human health and environment relatively quicker than ERD and PRB. ISCO with follow-on ERD is the only technology that can reliably treat any principal threat waste if found in the Shallow Plume Core and Hot Spot.

17.1.4 Shallow Ground Water Periphery

Five approaches including the No Action Alternative were identified for treatment of the shallow ground water periphery at the GPSC Site to depths of 20 ft bgs.

The four technical approaches to remediating the shallow ground water periphery (MNA, ZVI-PRB, ERD Bio-barriers, and Pump and Treat) would be expected to remediate COCs within the shallow plume periphery under the implementation of an appropriately designed program. If any residual DNAPL or sorbed soil source material remains after the active treatment periods, these approaches may not achieve RAOs. None of the identified technologies have the capability of directly treating residual DNAPL during implementation of the Remedial Action.

Since ERD relies on amendments being able to come in contact with COCs, the fine-grained heterogeneous soils in the treatment area may impact the effectiveness and implementability of this technology. The low permeability site soils also may pose difficulties in achieving full ground water capture under the Pump and Treat option. Multiple injection events of ERD carbon-source amendments would be specified for this technology and if reductive dechlorination of the COCs by the bio-barriers is limited by site-specific conditions then equally, or more toxic, intermediary by-products of biodegradation may persist.

PRB application would have the most substantial short-term installation impacts. The natural ground water velocity would limit the treatment time for the shallow ground water periphery by PRBs. The Pump and Treat option and MNA are expected to take the longest time periods to achieve RAOs. While the Pump and Treat option would require ongoing O&M throughout that period, actions to support MNA would be limited to ongoing ground water monitoring.

Among the four technical approaches considered for the Shallow Plume Periphery, ERD Bio-barriers is the least expensive and would achieve protection of human health and environment relatively quicker than MNA, ZVI-PRB and Pump and Treat.

17.1.5 Deeper Ground Water

Five approaches including the No Action Alternative were identified for treatment of the deeper ground water at the GCSP Site below 20 ft bgs. The ground water would remain a continuing source to the downgradient plume and could potentially migrate even deeper in the aquifer, potentially impacting the drinking water aquifer.

The four technical approaches to remediating the deeper ground water (MNA, Bio-barriers, ZVI-PRB in Conjunction with ERD Bio-barriers, and Pump and Treat) would be expected to remediate COCs within the deeper plume under the implementation of an appropriately designed program. If any residual DNAPL or sorbed soil source material remains after the active treatment periods, these approaches may not achieve RAOs. None of the identified technologies have the capability of directly treating residual DNAPL during implementation of the Remedial Action.

Since ERD relies on amendments being able to come in contact with COCs, the fine-grained heterogeneous soils in the treatment area may impact the effectiveness and implementability of this technology. The low permeability site soils also may pose difficulties in achieving full ground water capture under the Pump and Treat option. Multiple injection events of ERD carbon-source amendments would be specified for this technology and if reductive dechlorination of the COCs by the bio-barriers is limited by site-specific conditions then equally, or more toxic, intermediary by-products of biodegradation may persist.

PRB application would have the most substantial short-term installation impacts. The natural ground water velocity would limit the treatment time for the deeper ground water periphery by PRBs. The Pump and Treat option and MNA are expected to take the longest time periods to achieve RAOs. While the Pump and Treat option would require ongoing O&M throughout that period, actions to support MNA would be limited to ongoing ground water monitoring.

Among the four technical approaches considered for the Deeper Ground Water, ERD Bio-barriers is the least expensive and would achieve protection of human health and environment relatively quicker than MNA, ZVI-PRB in conjunction with ERD and Pump and Treat.

17.2 Compliance with ARARs

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations, which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA §121(d)(4). Compliance with ARARs addresses whether a remedy will meet all of the ARARs or provides a basis for invoking a waiver.

With the exception of the No Action Alternative, an appropriate design for all retained technologies, or technology combinations, can be developed for each media of concern to meet applicable RAOs. The primary difference in technology combinations for the different contaminated media with regard to complying with ARARs is the length of time required before RAOs would be achieved.

A key assumption in evaluating technology combinations' ability to comply with ARARs is that an appropriately designed program can be developed to meet ARARs with each technology type. This assumption is based solely on the existing site data.

17.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.

17.3.1 Magnitude of Residual Risk

With the exception of the No Action Alternative, all of the alternatives are expected to meet RAOs given an appropriate design. This assumption is based on only evaluation of the technologies relative to available site data. Achieving RAOs would provide a substantial reduction in long-term residual risk for all impacted media using any of the technology approaches and will be protective of human health in the long-term.

17.3.1.1 Indoor Air (Vapor Intrusion Mitigation)

Installation of radon-type vapor mitigation systems will prevent vapor intrusion of COCs above acceptable risk levels, as long as the barrier and ventilation system are kept in good working order. Human health and the environment are protected since the vapor barrier and venting system remove the pathway for volatile organics present in the subsurface to enter the structure.

17.3.1.2 Source Area Treatment

Each of the active treatment alternatives is anticipated to ultimately lower the risk from vapor intrusion and ground water exposure. An appropriately designed, thermal source-area treatment is expected to approach RGs and RAOs and reduce residual risk in the source areas. Final polishing following thermal treatment may be necessary to meet RGs and RAOs, and may include targeted ERD or ISCO treatments.

ISCO with follow-on ERD treatment can be appropriately designed to meet long-term RGs and RAOs and will reduce residual risk. If DNAPL or sorbed-soil contamination persists following completion of ISCO and ERD treatments, a dissolved-phase plume is likely to persist or rebound within the aquifer and the treatment will no longer limit residual risk.

ERD treatment can be appropriately designed to meet long-term RGs and RAOs and will reduce residual risk. As with ISCO, if DNAPL or sorbed-soil contamination persists following completion of ISCO and ERD treatments, a dissolved-phase plume is likely to persist or rebound within the aquifer and the treatment will no longer limit residual risk.

Among the alternatives considered for the Source Area, thermal treatment is relatively better in not leaving any residual risk in the long-term and be protective of human health and the environment.

17.3.1.3 Shallow Ground Water Plume Core and Hot Spot Treatment

PRBs designed for the site-specific dissolved-phase ground water plume will achieve long-term RGs and RAOs. If DNAPL or sorbed soil contamination persists in the areas between the PRBs and continues to propagate a dissolved-phase plume beyond the designed service life of the PRBs, then this technology will no longer achieve RAOs or limit residual risk. Given the passive nature of this technology, high concentrations of COCs will persist in shallow ground water and continue to support a vapor intrusion risk for many years.

ISCO with follow-on ERD treatment can be appropriately designed to meet long-term RGs and RAOs and will reduce residual risk. If DNAPL or sorbed-soil contamination persists following completion of ISCO and ERD treatments, a dissolved-phase plume is likely to persist or rebound within the aquifer and the treatment will no longer limit residual risk. Until shallow ground water COC concentrations meet RGs, they may continue to support a significant vapor intrusion risk.

ERD treatment can be appropriately designed to meet long-term RGs and RAOs and will reduce residual risk. Once the cleanup goals are achieved this alternative will be protective in the long-term. As with ISCO, if DNAPL or sorbed soil contamination persists following completion of ERD treatments, a dissolved-phase plume is likely to persist or rebound within the aquifer and the treatment will no longer limit residual risk. Until shallow ground water COC concentrations meet RGs, they may continue to support a significant vapor intrusion risk.

Pump and treat methods can be designed to treat the shallow ground water plume and hot spot and meet long-term RGs and RAOs, and eventually limit residual risk. If DNAPL or sorbed soil contamination is present, pump and treat technology in low permeability sediments typical of the GCSP Site may take longer than 40 years to achieve RAOs. Additionally, portions of the aquifer that have been partially remediated may be subject to recontamination or rebound from remaining sorbed or DNAPL contaminant sources. Until shallow ground water COC concentrations meet RGs, they may continue to support a significant vapor intrusion risk.

All of the technologies considered for the Shallow Plume Core and Hot Spot would probably be effective in the long-term and leave no residual risk at the site. However, if principal threat waste is encountered in the Shallow Plume Core and Hot Spot Area, using ISCO with follow-on ERD has the best chance of ensuring long-term effectiveness and permanence.

17.3.1.4 Shallow Ground Water Periphery

MNA of the shallow ground water periphery may achieve long-term RGs and RAOs and eventually limit residual risk. However, given the passive nature of the alternative, high concentrations of COCs will persist in the shallow ground water periphery for an extended period of time, presenting continuing residual risk. If DNAPL or sorbed soil contamination persists in the area, a dissolved-phase plume will persist in the aquifer and MNA may not achieve RAOs or limit residual risk. The ongoing monitoring of the remedial alternative will limit some residual risk by allowing regular evaluation of the effectiveness of the alternative.

PRBs designed for the site-specific, dissolved-phase ground water plume will achieve long-term RGs and RAOs. If DNAPL or sorbed-soil contamination persists in the areas between the PRBs and continues to propagate a dissolved-phase plume beyond the designed service life of the PRBs, then this technology will no longer achieve RAOs or limit residual risk.

ERD treatment can be appropriately designed to meet long-term RGs and RAOs and will reduce residual risk. If DNAPL or sorbed-soil contamination persists following completion of ERD treatments, a dissolved-phase plume is likely to persist or rebound within the aquifer and the treatment will no longer limit residual risk.

Pump and treat methods can be designed to treat the shallow ground water plume periphery and meet long-term RGs and RAOs, and eventually limit residual risk. If DNAPL or sorbed soil contamination is present, pump and treat technology in low permeability sediments typical of the GCSP Site may take longer than 40 years to achieve RAOs. Additionally, portions of the aquifer that have been partially remediated may be subject to recontamination or rebound from remaining sorbed-soil or DNAPL contaminant sources.

All of the technologies considered for the Shallow Plume Periphery would probably be effective in the long-term and leave no residual risk at the site. PRB and Pump and Treat are more expensive and will relatively take longer to achieve cleanup goals compared to ERD. MNA is not proven at the site and may take a long time to achieve cleanup goals.

17.3.1.5 Deeper Ground Water

MNA of the deeper ground water below 20 ft bgs may achieve long-term RGs and RAOs and eventually limit residual risk. However, given the passive nature of the alternative, high concentrations of COCs will persist in the deeper ground water periphery for an extended period of time, presenting continuing residual risk. If DNAPL or sorbed soil contamination persists in the area, a dissolved-phase plume will persist in the aquifer and MNA may not achieve RAOs or limit residual risk. The ongoing monitoring of the remedial alternative will limit some residual risk by allowing regular evaluation of the effectiveness of the alternative.

PRBs, along with supplemental bio-barriers, designed for the site-specific dissolved-phase ground water plume will achieve long-term RGs and RAOs. If DNAPL or sorbed soil contamination persists in the areas between the PRBs and continues to propagate a dissolved-phase plume beyond the designed service life of the PRBs, then this technology will no longer achieve RAOs or limit residual risk.

ERD treatment can be appropriately designed to meet long-term RGs and RAOs and will reduce residual risk. If DNAPL or sorbed soil contamination persists following completion of ERD treatments, a dissolved-phase plume is likely to persist or rebound within the aquifer and will no longer limit residual risk.

Pump and treat methods can be designed to treat the deeper ground water plume and meet long-term RGs and RAOs, and eventually limit residual risk. If DNAPL or sorbed soil contamination is present, pump and treat technology in low permeability sediments typical of the GCSP Site may take longer than 40 years to achieve RAOs. Additionally, portions of the aquifer that have been partially remediated may be subject to recontamination or rebound from remaining sorbed or DNAPL contaminant sources.

All of the technologies considered for the Deeper Ground Water would probably be effective in the long-term and leave no residual risk at the site. PRB and Pump and Treat are more expensive remedies and will relatively take longer to achieve cleanup goals compared to ERD. MNA is not proven at the site and may take a long time to achieve cleanup goals.

17.3.2 Adequacy and Reliability of Controls

With the exception of the No Action alternatives, each of the proposed remedial technologies can provide adequate and reliable treatment of COCs. Long-term adequacy and reliability of any controls for the downgradient portions of the site also will ultimately depend on the corresponding remediation of the source area media.

17.3.2.1 Indoor Air (Vapor Intrusion Mitigation)

For the indoor air media, the Radon-type Vapor Mitigation System is expected to provide more adequate and reliable controls in meeting RAOs than the No Action Alternative. However, long-term adequacy and reliability of this control will ultimately depend on elimination of the vapor intrusion pathway by remediation of the shallow ground water sources.

17.3.2.2 Source Area Treatment

Thermal treatment involves volatilization of COCs from the subsurface and collection of vapors using soil vapor extraction. Thermal heating is a highly reliable method of causing volatilization and soil vapor extraction is a reliable method of vapor collection when appropriately designed and implemented. Thermal resistive treatment of the source area would be accomplished in a single application event at the site and would not require repeat treatments. However, meeting RAOs at the source area with a single application will require an extremely high removal efficiency and thermal treatment alone may not fully meet RAOs following the single application. Additional polishing treatment may be required and can include natural active biological treatment during the cool-down period, or active application of ISCO or ERD. A loss of process control (incomplete vapor recovery using SVE) could lead to escape of COC vapors to the atmosphere or into structures overlying the treatment zone or the recondensing of COC vapors outside the treatment area. Both ISCO and ERD would, by design, require multiple treatments over an extended time period to meet RAOs due to the limited residence times of the injected materials in the aquifer (although ERD amendments far outlast oxidant amendments). Individual treatment events over time would be discrete efforts and substantial O&M of these technologies would not be required between events. Both ISCO and ERD have been proven reliable methods of treating the COCs, but both require injection of amendments into the subsurface that can be difficult to control. ISCO is more sensitive to injection uniformity and initial contact with contaminants than is ERD since ERD amendments have a much longer residence time and can migrate with ground water to interact with contaminants. Ineffective distribution of ISCO or ERD amendments can lead to untreated DNAPL or residual sorbed-phase contaminants.

17.3.2.3 Shallow Ground Water Plume Core and Hot Spot Treatment

For the shallow ground water plume core and hot spot media, appropriately designed and implemented measures should adequately and reliably meet RAOs. If sorbed-phase contaminants remain following any of treatments, it would substantially impact the adequacy of the control. The ZVI-PRBs have been designed for a service life of 20 years, and will require replacement at this time since RAOs are not expected to be met for 40 years. Once installed, the ZVI-PRB walls would not require subsequent O&M other than the single replacement of the wall at 20 years.

The adequacy and effectiveness of PRBs will decrease over time as the reactive material in the PRBs degrades, but they have been designed to provide effective treatment through 20 years. The effectiveness of the ZVI-PRB walls also is dependent upon a thorough understanding of the hydraulic flow conditions within the aquifer and, if not properly designed or installed, bypass of ground water around, below, or above the barrier can occur.

Both ISCO and ERD would, by design, require multiple treatments over an extended time period to meet RAOs due to the limited residence times of the injected materials in the aquifer. Individual treatment events over time would be discrete efforts and substantial O&M of these technologies would not be required between events. Both ISCO and ERD have been proven reliable methods of treating the COCs, but both require injection of amendments into the subsurface, which can be difficult to control. ISCO is more sensitive to injection uniformity and initial contact with contaminants than is ERD since ERD amendment have a much longer residence time and can migrate with ground water to interact with contaminants. Ineffective distribution of ISCO or ERD amendments can lead to untreated residual sorbed-phase contaminants.

The infrastructure associated with the pump and treat option for the shallow ground water core and hot spot would be subject to regular O&M needs and components may exceed their service life and require replacement over the course of the extended implementation of this technology. Damage, fouling, or loss of specific capacity of the pump and treat system extraction and/or injection wells may require replacement of these components as well. Significant failures of equipment during treatment may require the cessation of treatment while repairs are conducted.

Although all technologies considered are reliable and adequate, the ISCO with follow-on ERD and ERD Bio-barriers remedy are less expensive; reliable and adequate; and would take the shortest time to achieve cleanup goals compared to PRB, and Pump and Treat.

17.3.2.4 Shallow Ground Water Periphery and Deeper Ground Water

Long-term adequacy and reliability of any controls for the either the shallow or deep ground water periphery will ultimately be dependent on corresponding remediation of upgradient or overlying contamination in the source area, the shallow ground water plume core and hot spot, or the shallow ground water periphery. With MNA, no specific controls or infrastructure are installed. Given appropriate site conditions, MNA can be a reliable method (reductive dechlorinated of site COCs) of reaching RAOs over long time periods. The ZVI-PRBs have been designed for a service life of 20 years, and will require replacement at this time since RAOs are not expected to be met for 40 years. Once installed, the ZVI-PRB walls would not require subsequent O&M other than the single replacement of the wall at

20 years. The adequacy and effectiveness of PRBs will decrease over time as the reactive material in the PRBs degrades, but they have been designed to provide effective treatment through 20 years. The effectiveness of the ZVI-PRB walls also is dependent upon a thorough understanding of the hydraulic flow conditions within the aquifer and, if not properly designed or installed, bypass of ground water around, below, or above the barrier can occur.

ERD would, by design, require multiple treatments over an extended time period to meet RAOs due to the limited residence times of the injected materials in the aquifer. Individual treatment events over time would be discrete efforts and substantial O&M of these technologies would not be required between events. ERD has been proven to be a reliable method of treating the COCs, but requires injection of amendments into the subsurface, which can be difficult to control. Ineffective distribution of ERD amendments can lead to untreated residual sorbed-phase contaminants.

The infrastructure associated with the pump and treat option for the shallow ground water core and hot spot would be subject to regular O&M needs and components may exceed their service life and require replacement over the course of the extended implementation of this technology. Damage, fouling, or loss of specific capacity of the pump and treat system extraction and/or injection wells may require replacement of these components as well. Significant failures of equipment during treatment may require the cessation of treatment while repairs are conducted.

Although all technologies considered are reliable and adequate, the ERD Bio-barrier remedy is the least expensive technology; reliable and adequate; and would take the shortest time to achieve cleanup goals compared to MNA, PRB and Pump and Treat.

17.4 Reduction of Toxicity, Mobility, and Volume

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

With the exception of the No Action Alternative, it is assumed that an appropriate design for all retained technologies, or technology combinations, would be able to be developed to permanently reduce toxicity, mobility, and volume of COCs. One exception is in the case of the Vapor Mitigation option for the indoor air media. In that case, COCs are simply blocked from entering structures to eliminate a completed exposure pathway and the toxicity, mobility, and volume (TMV) of COCs is not affected. Therefore, this technology relies on other methods of treatment within source areas and the shallow ground water plume core to reduce COCs in the subsurface to concentrations that no longer support vapor intrusion above human health risk-based action levels.

17.4.1 Treatment Process Used and Materials Treated

17.4.1.1 Indoor Air (Vapor Mitigation System)

Radon-type vapor mitigation systems do not technically treat any of the COCs but rather prevents them from entering the structure via vapor intrusion. The vapor mitigation system incorporates a plastic barrier between the ground surface and the overlying structure, with the operation of a vapor extraction blower beneath the barrier, which allows vapors to bypass the interior of the structure and be exhausted above the roof.

17.4.1.2 Source Area Treatment

Thermal technologies provide treatment via the volatilization and steam flushing of VOCs (including the COCs) induced by heating of the subsurface, with soil vapor extraction used to recover the vapors and steam. The steam and vapors are collected, condensed, and treated prior to discharge of clean effluent water. ISCO treatment occurs via destructive oxidation of organic contaminants (including the COCs) and mineralization to carbon dioxide, water, and chloride. ISCO is generally capable of treating all organic compounds if adequate contact with oxidant can be achieved. ISCO treatment would be followed by enhanced biologically-mediated reductive dechlorination (ERD) in which carbon-source amendments are injected to enhance natural biological treatment. ERD also can be used as a stand-alone treatment.

All of the technologies considered are effective in permanently reducing toxicity, mobility and volume of COCs. However, thermal treatment would be quicker, cost-competitive and have the least impact on the community.

17.4.1.3 Shallow Ground Water Plume and Hot Spot Treatment

ZVI-PRBs provide treatment via reductive dechlorination as ground water passes through the PRB under natural ground water flow gradients. ZVI-PRBs are effective for treatment of chlorinated ethenes and ethanes (including the COCs), select chlorinated pesticides, and some metals. ISCO treatment occurs via destructive oxidation of organic contaminants (including the COCs) and mineralization to carbon dioxide, water, and chloride.

ISCO is generally capable of treating all organic compounds if adequate contact with oxidant can be achieved. ISCO treatment would be followed by enhanced biologically-mediated reductive dechlorination (ERD) in which carbon-source amendments are injected to enhance natural biological treatment. ERD also can be used as a stand-alone treatment. Ground water extraction and treatment provides treatment by extracting ground water, stripping (volatilizing) VOCs (including the COCs), and treating the vapor stream using granular activated carbon prior to discharge to the atmosphere. The treated water effluent is then re-injected into the subsurface.

All of the technologies considered are effective in permanently reducing toxicity, mobility and volume of COCs. However, even though ISCO with follow-on ERD is more expensive than ERD Bio-barrier cleanup goals would be reached quicker.

17.4.1.4 Shallow Ground Water Periphery and Deeper Ground Water

MNA provides treatment via naturally-occurring bacteria, which provide biologically-mediated reductive dechlorination given appropriate site conditions. MNA can be effective for many organic compounds, including the COCs. ZVI-PRBs provide treatment via reductive dechlorination as ground water passes through the PRB under natural ground water flow gradients. ZVI-PRBs are effective for treatment of chlorinated ethenes and ethanes (including the COCs), select chlorinated pesticides, and some metals.

ERD provides treatment via enhanced biologically-mediated reductive dechlorination in which carbon-source amendments are injected to enhance natural biological treatment. ERD is effective for a variety of organic compounds, including chlorinated ethenes and ethanes (COCs). Ground water extraction and treatment provides treatment by extracting ground water, stripping (volatilizing) VOCs (including the COCs), and treating the vapor stream using granular activated carbon prior to discharge to the atmosphere. The treated water effluent is then re-injected into the subsurface.

All of the technologies considered are effective in permanently reducing toxicity, mobility and volume of COCs. However, ERD is less expensive than the other alternatives.

17.4.2 Amount of Hazardous Materials Destroyed or Treated

17.4.2.1 Indoor Air (Vapor Intrusion Mitigation)

The vapor mitigation systems do not provide active treatment, but physically block contaminants from entering a structure.

17.4.2.2 Source Area, Shallow Plume Core and Hot Spot, Shallow Plume Periphery, and Deeper Ground Water Treatment

Approximately 44.5 MG of ground water and 6,500 yd^3 of soil will be treated at the site. It is anticipated that each of the proposed technologies can remove the quantity of COCs to meet the site RAOs.

17.4.3 Degree of Expected Reductions in Toxicity, Mobility, and Volume

17.4.3.1 Indoor Air (Vapor Intrusion Mitigation)

The vapor mitigation systems do not provide active treatment of COCs, but physically block contaminants from entering a structure.

17.4.3.2 Source Area Treatment

The thermal treatment is anticipated to provide substantial reductions in toxicity, mobility, and contaminant volume (TMV) and is likely to provide the greatest percent reduction in source-area concentrations following a single treatment. ISCO is anticipated to provide substantial reductions in TMV if the oxidants can be adequately distributed to provide contact with COCs. Follow-on ERD also is anticipated to provide substantial reductions in TMV if the carbon-source amendments can adequately sustain biologically-mediated subsurface reactions. Depending on site-specific conditions to be further characterized during the Remedial Design, ISCO and ERD can lead to the generation of equally or more toxic intermediary products during treatment. These intermediary products are generally only temporarily present during treatment and can include cis-1,2-DCE or VC with ERD, or acetone and leached metals (such as hexavalent chromium) with ISCO. As with follow-on ERD, stand-alone ERD is anticipated to provide substantial reductions in TMV.

17.4.3.3 Shallow Ground Water Plume Core and Hot Spot Treatment

ZVI-PRBs have been designed to provide complete treatment of ground water to the RAOs upon a single pass through the wall and therefore provide substantial reduction of TMV, although technically the ZVI-PRB results in an increase in anthropogenic materials in the subsurface due to the placement of iron. The presence of sorbed-phase COCs between PRB walls will provide for continued dissolution and recontamination of ground water between the walls, and will require an extended treatment time.

ISCO is anticipated to provide substantial reductions in TMV if the oxidants can be adequately distributed to provide contact with COCs. Follow-on ERD also is anticipated to provide substantial reductions in TMV if the carbon-source amendments can adequately sustain biologically-mediated subsurface reactions. Depending on site-specific conditions to be further characterized during the Remedial Design, ISCO and ERD can lead to the generation of equally or more toxic intermediary products during treatment. These intermediary products are generally only temporarily present during treatment and can include cis-1,2-DCE or VC with ERD, or acetone and leached metals (such as hexavalent chromium) with ISCO. As with follow-on ERD, stand-alone ERD is anticipated to provide substantial reductions in TMV.

The pump and treat technology is anticipated to quickly reduce toxicity by removing ground water with high-concentrations of COCs, and will limit mobility by providing hydraulic plume containment. The volume of the plume is expected to gradually be reduced as treatment proceeds. As with ZVI-PRBs, sorbed-phase contaminants are expected to provide a long-term source of COCs in ground water, requiring an extended treatment time.

17.4.3.4 Shallow Ground Water Periphery and Deeper Ground Water

MNA may provide sustained moderate reductions in TMV over long time periods if appropriate site conditions are confirmed at the Site. ZVI-PRBs have been designed to provide complete treatment of ground water to the RAOs upon a single pass through the wall and therefore provide substantial reduction of TMV, although technically the ZVI-PRB results in an increase in anthropogenic materials in the subsurface due to the placement of iron. The presence of sorbed-phase COCs between PRB walls will provide for continued dissolution and recontamination of ground water between the walls, and will require an extended treatment time.

ERD is anticipated to provide substantial reductions in TMV if the carbon-source amendments can adequately sustain biologically-mediated subsurface reactions. Depending on site-specific conditions to be further characterized during the Remedial Design, ERD can lead to the generation of equally or more toxic intermediary products during treatment. These intermediary products are generally only temporarily present during treatment and can include cis-1,2-DCE or VC.

The Pump and Treat technology is anticipated to quickly reduce toxicity by removing ground water with high-concentrations of COCs, and will limit mobility by providing hydraulic plume containment. The volume of the plume is expected to gradually be reduced as treatment proceeds. As with ZVI-PRBs, sorbed-phase contaminants are expected to provide a long-term source of COCs in ground water, requiring an extended treatment time.

17.4.4 Type of Residuals Remaining After Treatment

17.4.4.1 Indoor Air (Vapor Intrusion Mitigation)

With the vapor mitigation systems, the vapor intrusion pathway is removed by installing a physical barrier and residual COCs inside the structure will quickly dissipate. If no other active treatment is conducted at the site, the original COCs will remain in the subsurface as residuals since the barriers do not provide treatment. Given active treatment of the site, virtually no residuals are ultimately anticipated in the subsurface.

17.4.4.2 Source Area Treatment

Completely successful thermal treatment leaves virtually no residual volatile COCs behind, as they are all volatilized. Residuals following direct oxidation by ISCO will include carbon dioxide, water, and chloride. Depending on the oxidant used, other residuals may include metal oxides (such as manganese oxide) or dissolved metals (such as dissolved manganese). After follow-on ERD (or stand-alone ERD), residuals will proceed through the series of degradation products TCE, DCE, VC, ethene, and ultimately to carbon dioxide, water, and chloride. If an oversupply of carbon-source amendment is applied, then residual amendment could remain in the subsurface for a period of time following treatment, but will ultimately be consumed.

17.4.4.3 Shallow Ground Water Plume Core and Hot Spot Treatment

As ground water passes through each ZVI-PRB wall, reductive dechlorination will progress from PCE through TCE, DCE, VC, and ethene, then ultimately to carbon dioxide, water, and chloride as water passes out of the barrier. Following treatment, the ZVI material will remain in the subsurface. Residuals following direct oxidation by ISCO will include carbon dioxide, water, and chloride. Depending on the oxidant used, other residuals may include metal oxides (such as manganese oxide) or dissolved metals (such as dissolved manganese). After follow-on ERD (or stand-alone ERD), residuals will proceed through the series of degradation products TCE, DCE, and VC, ethene, and ultimately to carbon dioxide, water, and chloride. If an oversupply of carbon-source amendment is applied, then residual amendment could remain in the subsurface for a period of time following treatment, but will ultimately be consumed. Residuals following pump and treat include GAC, which will require offsite disposal or recycling and remediated ground water that will require reinjection.

17.4.4.4 Shallow Ground Water Periphery and Deeper Ground Water

With MNA, residuals following reductive dechlorination of PCE will proceed through TCE, DCE, VC, ethene, and ultimately to carbon dioxide, water, and chloride. As ground water passes through each ZVI-PRB wall, reductive dechlorination will progress from PCE through TCE, DCE, VC, and ethene, then ultimately to carbon dioxide, water, and chloride as water passes out of the barrier. Following treatment, the ZVI material will remain in the subsurface. As ERD is applied, residuals will proceed through the series of degradation products TCE, DCE, VC, ethene, and ultimately to carbon dioxide, water, and chloride. If an oversupply of carbon-source amendment is applied, then residual amendment could remain in the subsurface for a period of time following treatment, but will ultimately be consumed. Residuals following pump and treat include granular activated carbon, which will require offsite disposal or recycling and remediated ground water that will require reinjection.

17.5 Short-Term Effectiveness

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

The technology combinations for all impacted media have variable impacts with respect to requiring protection of workers during remedial construction, protection of community during Remedial Action, and environmental impacts of Remedial Action. The No Action Alternatives have no impact because there is no remedial construction. For essentially all active remedial technologies for any impacted media, intrusive work and installation of required infrastructure, ranging from monitoring wells to PRBs, will present some exposure to site workers. Risks to site workers can be managed through appropriate health and safety practices.

17.5.1 Protection of Community During Remedial Actions

All active treatments may require appropriate traffic or access control and notification to prevent community members from entering a hazardous condition or to prevent community members from posing a risk to workers conducting remedial activities.

17.5.1.1 Indoor Air

The vapor mitigation systems involve short-term inconvenience impacts to the specific property owners where vapor mitigation systems will be installed. The installation of the systems will require access to the crawlspace or basement beneath the structure for placement of the plastic barrier, the installation of ventilation piping through the floor and to the roof within a wall or other inconspicuous location, and installation of a roof vent. RAOs in indoor air will be achieved by eliminating the vapor intrusion pathway into the homes.

17.5.1.2 Source Area

The implementation of thermal treatment will require several actions for the protection of the surrounding community. Air monitoring will be required during drilling, excavation, and other intrusive infrastructure installation activities. Recovery of vapors with an SVE system would be necessary to prevent discharge of vapors to the atmosphere or into overlying structures. Large electricity-handling devices and aboveground treatment equipment also will be present onsite (electricity distribution system would be underground) during treatment and will require adequate fencing, setbacks, and warning notifications. The implementation of ISCO also will require several actions for the protection of the surrounding community. Air monitoring will be required during drilling and other intrusive activities. Appropriate safety measures must be implemented when handling oxidants to prevent contact by community members. Injection of oxidants also must be controlled to prevent surfacing of oxidants. The implementation of ERD will require air monitoring during drilling or other invasive activities. RAOs will be achieved in the Source Area by treating principal threat waste.

17.5.1.3 Shallow Ground Water Plume Core and Hot Spot

The installation of ZVI-PRBs will require several actions for the protection of the community. Air monitoring will be required during excavation and other invasive installation activities. Depending on the installation method selected, large open trenches that may or may not be filled with supportive liquid slurries will be excavated within residential areas. Substantial notification, fencing, and other access control will be required to prevent community members from entering the trenches (especially children). The excavation of soil during installation is likely to generate hazardous waste, which will require offsite disposal and must be transported through the community.

Due to the shallow nature of ground water, highly contaminated ground water also may be generated and will require onsite storage and treatment or offsite disposal. In addition, the installation activities are likely to produce significant disruptions to local traffic and could impact the ability of property owners to access their driveways or to utilize their property. To be effective, PRBs must be installed in precise orientations, and it is unlikely that such an installation could be performed in a residential area without requiring trenching across private property.

The implementation of ISCO also will require several actions for the protection of the surrounding community. Air monitoring will be required during drilling and other intrusive activities. Appropriate safety measures must be implemented when handling oxidants to prevent contact by community members. Injection of oxidants also must be controlled to prevent surfacing of oxidants. The implementation of ERD will require air monitoring during drilling or other invasive activities.

The implementation of pump and treat will require air monitoring during drilling or other invasive activities. Air monitoring or modeling also will be necessary to demonstrate protection of the community from unacceptable air emissions from the treatment plant.

Community-protection measures also will be necessary during trenching activities for the installation of conveyance piping.

17.5.1.4 Shallow Ground Water Periphery and Deeper Ground Water

During implementation of MNA, there would be limited impacts to the community; however, air monitoring would be necessary during drilling and well installation activities. The installation of ZVI-PRBs will require several actions for the protection of the community. Air monitoring will be required during excavation and other invasive installation activities. Depending on the installation method selected, large open trenches that may or may not be filled with supportive liquid slurries will be excavated within residential areas. Substantial notification, fencing, and other access control will be required to prevent community members from entering the trenches (especially children). The excavation of soil during installation is likely to generate hazardous waste, which will require offsite disposal and must be transported through the community. Due to the shallow nature of ground water, highly contaminated ground water also may be generated and will require onsite storage and treatment or offsite disposal. In addition, the installation activities are likely to produce significant disruptions to local traffic and could impact the ability of property owners to access their driveways.

The implementation of ERD will require air monitoring during drilling or other invasive activities. The implementation of pump and treat will require air monitoring during drilling or other invasive activities. Air monitoring or modeling also will be necessary to demonstrate protection of the community from unacceptable air emissions from the treatment plant.

Community-protection measures also will be necessary during trenching activities for the installation of conveyance piping.

The MNA Alternative presents the least potential for exposure or risk to site workers, the community, or the environment as no, or minimal, intrusive work would be conducted.

17.5.2 Protection of Workers During Remedial Actions

All active treatments may require appropriate traffic or access control to provide protection to workers conducting remedial activities. Risks posed to workers can be effectively managed through appropriate health and safety practices and use of appropriate personal protective equipment (PPE).

17.5.2.1 Indoor Air (Vapor Intrusion Mitigation)

During installation of vapor mitigation systems, air monitoring will be conducted and workers will wear appropriate PPE including respirators, if conditions warrant.

17.5.2.2 Source Area Treatment

Air monitoring will be required during installation of thermal treatment infrastructure and appropriate measures must be taken to protect those working with electrical-handling equipment, both during installation and during active treatment. Air monitoring will be required during drilling and other invasive activities associated with ISCO and ERD. Appropriate safety precautions must be taken to prevent exposure to workers from oxidants when applying ISCO.

17.5.2.3 Shallow Ground Water Plume Core and Hot Spot Treatment

Air monitoring will be required during installation of ZVI-PRBs. Excavation and intrusive onsite work may pose a threat to workers during installation of ZVI-PRBs. The potential presence and offsite transport of hazardous waste or highly-contaminated ground water poses additional threats to workers. Risks can be managed through appropriate waste-handling practices. Air monitoring will be required during drilling and other invasive activities associated with ISCO and ERD, and appropriate safety precautions must be taken to prevent worker exposure to oxidants when applying ISCO. Protection of workers during installation of a pump and treat system will primarily involve air monitoring during drilling and invasive activities, trenching safety for conveyance piping, and general construction safety.

17.5.2.4 Shallow Ground Water Periphery and Deeper Ground Water

Air monitoring will be required during drilling and well-installation activities associated with MNA. Air monitoring also will be required during installation of ZVI-PRBs. Excavation and intrusive onsite work may pose a threat to workers during installation of ZVI-PRBs. The potential presence and offsite transport of hazardous waste or highly-contaminated ground water poses additional threats to workers. Risks can be managed through appropriate waste-handling practices. Air monitoring will be required during drilling and other invasive activities associated with ERD. Protection of workers during installation of a pump and treat system will primarily involve air monitoring during drilling and invasive activities, trenching safety for conveyance piping, and general construction safety.

17.5.3 Environmental Impacts

17.5.3.1 Indoor Air (Vapor Intrusion Mitigation)

The vapor mitigation systems will exhaust extracted soil vapors into the atmosphere. The extracted vapors are treated onsite prior to discharge into the atmosphere.

17.5.3.2 Source Area Treatment

Thermal treatment will require the control of offgas emissions during the active treatment period. No adverse environmental conditions are anticipated for the ISCO or ERD treatments other than the potential generation of intermediary products during treatment (such as, acetone or leached metals for ISCO or VC for ERD).

17.5.3.3 Shallow Ground Water Plume Core and Hot Spot Treatment

The installation of ZVI-PRBs can pose a threat to the environment since hazardous waste is likely to be generated and transported offsite for disposal. Environmental risk can be managed using appropriate hazardous waste handling practices. There may be limited environmental risk due to the residual iron in the subsurface following treatment, but little study has been conducted regarding any such risk. No adverse environmental conditions are anticipated for the ISCO or ERD treatments other than the potential generation of intermediary products during treatment (such as, acetone or leached metals for ISCO or VC for ERD). For the pump and treat system, no environmental impacts are anticipated if appropriate air emissions treatment is incorporated and ground water reinjection is successful.

17.5.3.4 Shallow Ground Water Periphery and Deeper Ground Water

Treatment using MNA is passive in nature and high concentrations of COCs may persist in ground water for an extended period of time, and may present unacceptable risk to the environment. The installation of ZVI-PRBs can pose a threat to the environment since hazardous waste is likely to be generated and transported offsite for disposal. Environmental risk can be managed using appropriate hazardous waste handling practices. There may be limited environmental risk due to the residual iron in the subsurface following treatment, but little study has been conducted regarding any such risk. No adverse environmental conditions are anticipated for the ERD treatment other than the potential generation of intermediary products during treatment (such as, VC). For the pump and treat system no environmental impacts are anticipated if appropriate air emissions treatment is incorporated and ground water reinjection is successful.

17.5.4 Time Until Remedial Action Objectives Are Achieved

The time over which RAOs would be met varies by technology combination and media. Generally speaking, based on the available information, the following extended Remedial Action time periods are assumed for the following technologies to meet RAOs: PRB wall remediation applications will require over 40 years; ISCO with follow-on ERD would roughly require 8 years; ERD or bio-barrier applications will require roughly 20 years; Pump and Treat options will require 40 years of operation or more; and MNA options are assumed to require at least 40 years of active monitoring. The indoor air vapor mitigation option would essentially immediately achieve RAOs although long-term compliance with

RAOs would likely require additional source area and shallow ground water treatment options to be implemented.

Key assumptions in evaluating the potential time it will take for technology combinations to meet RAOs are the currently understood site conceptual models for each medium.

17.6 Implementability

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

Technical or administrative implementability issues are not expected to be substantially different for the different technology combinations for the different media. Generally speaking, the technologies as described in this ROD are considered constructible and appropriate vendors and equipment are available for hire. However, certain options such as thermal treatment and PRB installation are somewhat specialized technologies so there are fewer vendors from which to choose. Administrative exemptions or approvals will probably be required prior to injection of oxidants, carbon amendments, or reinjection of treated ground water into the subsurface. Additionally, administrative notifications may be necessary for the discharge of treated offgas streams.

17.7 Cost

Cost includes estimated capital and O&M costs as well as present worth costs. Present worth cost 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. Estimated costs associated with each of the remedial alternatives are summarized in Table 18 (Cost

Summary for Remedial Alternatives). The estimated costs associated with the Selected Remedy are detailed in Appendix B (Cost Estimate Details for Selected Remedy). The total cost for the Preferred Remedy for the Site is approximately $29.5 million.

Source Area

The cost is competitive among all alternatives with the exception of the No Action Alternative and is within 1 percent difference. The cost for thermal treatment, the Preferred Alternative, is approximately $8.02 million.

Shallow Ground Water Plume Core and Hot Spot

The cost for the Pump and Treat remedy is the most expensive and the ERD Bio-barriers is the least expensive. ZVI-PRB and ISCO with ERD are of intermediate cost. ISCO with Follow-On ERD, the Preferred Alternative is approximately $6.73 million.

Shallow Ground Water Plume Periphery

ZVI-PRB and Pump and Treat are the most expensive remedies. MNA is the least expensive and ERD Bio-barriers, the Preferred Alternative, is approximately $3.27 million.

Deeper Ground Water Plume

ZVI-PRB in combination with ERD Bio-barriers and Pump and Treat are the most expensive remedies. MNA is the least expensive and ERD Bio-barriers alone, the Preferred Alternative, is approximately $7.22 million.

17.8 State Acceptance

The NMED agrees with EPA's recommendations of the Selected Remedy.

17.9 Community Acceptance

The EPA conducted a public meeting on April 20, 2006, to present the Proposed Plan (EPA 2006) to the public and presented the following preferred alternative for the various impacted media at the site:

1. Indoor Air – Vapor Mitigation
2. Source Area – Thermal Treatment
3. Shallow Plume Core and Hot Spot – ISCO with Follow-on ERD (Flexible)
4. Shallow Ground Water Plume Periphery – ERD Bio-barrier
5. Deeper Ground Water – ERD Bio-barrier

The community did not present any opposition to any of the alternatives presented including the Selected Remedy either during the meeting or during the 30-day comment period. Based on the comments received the community accepts all of the alternatives including the Selected Remedy presented in this ROD.

17.10 Summary of Comparative Analysis of Alternatives

A summary of the comparative analysis is shown in Tables 14 through 18.

18.0 Principal Threat Wastes

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a Site wherever practicable (NCP §300.430(a)(1)(iii)(A)). Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile, which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, nonprincipal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied.

The source areas and portions of the downgradient ground water at the site are contaminated with chlorinated solvents possibly containing DNAPL. DNAPL's are considered to be "principal threat wastes" because COCs concentrations are present that pose a significant risk under a residential exposure scenario. Through the use of treatment as a principal element, the response action will satisfy the preference for treatment and reduce the mobility of the hazardous source material that constitutes the principal threat wastes at the site. The EPA has determined that the potential future use of ground water at the site is drinking water. The principal threat wastes, if left in the source areas and downgradient ground water, would pose a significant risk to residents living in the area.

In the Source Area, thermal Treatment and ISCO with follow-on ERD will treat the principal threat waste to achieve RGs. ERD alone may not be sufficient to treat principal threat waste in the Source Area. The shallow plume core and hot spot is not anticipated to contain principal threat waste. However, should principal threat waste be present within the Shallow Plume Core and Hot Spot, ISCO with follow-on ERD is expected to provide effective treatment. Other considered technologies may not be sufficient to treat principal threat waste, if present within the shallow plume core and hot spot.

19.0 Selected Remedy

The EPA will implement the Selected Remedy in phases to optimize the treatment in the various site-impacted media. The Selected Remedy for the various impacted media and the order in which they will be implemented is as follows:

- Indoor Air – Installation of Vapor Mitigation Systems
- Source Area – Thermal Treatment
- Shallow Ground Water Plume Core and Hot Spot – ISCO with Follow-On ERD
- Shallow Ground Water Plume Periphery – ERD Bio-Barrier
- Deeper Ground Water – ERD Bio-Barrier

19.1 Summary of the Rationale for the Selected Remedy

19.1.1 Indoor Air: Vapor Mitigation System

The EPA chose to install vapor mitigation systems as they were the only active remedy that would protect human health. Vapor mitigation systems are proven and used extensively across the country to mitigate radon. Chlorinated solvents would be mitigated similar to radon gas through use of this alternative.

19.1.2 Source Area: Thermal Treatment

The EPA chose the thermal treatment alternative over the other alternatives because this alternative best meets the cleanup objectives by treating contaminated soils and ground water with concentrations exceeding RGs at the site. This alternative reduces mobility and toxicity at the Site by removing the source materials. This alternative is expected to be completed in approximately 1 year following construction. Implementation of this alternative will have less impact on the community than the other alternatives. The cost for implementation of this remedy is slightly less than other active alternatives.

19.1.3 Shallow Plume Core and Hot Spot – ISCO with Follow-On ERD (Flexible)

The EPA chose ISCO with Follow-on ERD for the shallow plume core because ISCO is more effective in rapidly removing source materials in the core area. The ISCO technology combined with follow-on ERD, though more expensive than some of the other alternatives, will be more effective in removing the COCs in the shortest amount of time. EPA and the NMED believe this alternative would be protective of human health and the environment, would comply with ARARs, would be cost-effective, and would utilize permanent solutions to the maximum extent practicable.

The EPA will be flexible in applying this component of the Selected Remedy in the Shallow Plume Core and Hot Spot Area. Based on additional information gathered during the Pre-Design Field Investigation and after implementation of the Thermal Treatment at the Source Area, EPA will determine the suitability of using the ISCO component and the degree of ERD bio-barrier treatment required. If the Predesign Field Investigation indicates the presence of DNAPL in the Shallow Plume Core and Hot Spot Area, EPA will fully implement the ISCO with Follow-On ERD. If on the other hand ground water investigation does not indicate DNAPL and ERD is demonstrated to be an effective alternative, then EPA may choose to implement only the ERD bio-barrier component.

The EPA believes the flexible approach is more prudent for the Shallow Plume Core and Hot Spot Area because of existing data gaps. While this approach will ensure that the remedy is protective of human health and the environment, it could save unnecessary costs. If the ISCO component is not required and only ERD bio-barrier is implemented, the cost for the Selected Remedy will be reduced by approximately $5 million dollars.

19.1.4 Shallow Plume Periphery, Deeper Plume: ERD Bio-barrier

The EPA chose this alternative over others for the above two impacted areas because this alternative best meets the cleanup objectives by treating ground water contaminants exceeding RGs from the site. Using ERD bio-barriers for both of these impacted ground water areas would optimize the infrastructure necessary for the remedy and in turn save costs. Although it is slower than chemical oxidation, ERD provides longer residence time for the amendments to act. ERD is less dependent on uniform distribution during injection than ISCO, and the longer residence time allows penetration into low-permeability sediments. It is less intrusive on private properties since public access can be used for injecting the amendments. It is the least expensive alternative. Based on information available at this time, the EPA and the NMED believe the Preferred Alternative would be protective of human health and the environment, would comply with ARARs, would be cost-effective, and would utilize permanent solutions to the maximum extent practicable. Because it would treat the source materials constituting principal threats, the remedy also would meet the statutory preference for the selection of a remedy that involves treatment as a principal element for these areas.

19.2 Description of the Selected Remedy

Following is a description of each component of the Selected Remedy. Although the EPA does not expect significant changes to this remedy, it may change "somewhat" as a result of the RD and construction processes. Any changes to the remedy described in this ROD would be documented using a technical memorandum in the Administrative Record, an Explanation of Significant Differences, or a ROD Amendment, as appropriate and consistent with the applicable regulations.

19.2.1 Indoor Air

Vapor intrusion mitigation systems will be installed in those residential structures shown in Figure 11. The vapor intrusion mitigation systems would be designed and installed consistent with the EPA Office of Air and Radiation guidance *Building Radon Out, A Step-by-Step Guide on How to Build Radon-Resistant Homes* (EPA, 2001).

Specific design elements would depend on the type of foundation at the home. Currently, only three residences have been evaluated for installation of the vapor mitigation systems. Of these, two of the residences are built over crawlspaces and one residence has a basement. The remaining 11 structures in the area are assumed to be similar in construction to the three evaluated, although one of the structures may be of slab-on-grade construction. Vapor intrusion mitigation systems would be functionally similar to radon mitigation systems and consist of placing a plastic liner between the ground surface and the residential living space for residences with crawlspaces, and ventilating between the liner and the ground surface to remove vapors before they can enter the living space. Structures with basements and slab-on-grade construction will require additional components in the design of the vapor mitigation systems. Specific design elements will be developed during the RD. The structure located behind the Holiday Cleaners requires further evaluation because of close proximity to the Holiday Cleaners building. The structure will be monitored further to ensure that the indoor air is not influenced by the operations of the dry cleaner. Once the background sources are evaluated further, the EPA will determine if installation of a vapor mitigation system is warranted for this structure.

19.2.2 Source Areas

Figure 12 shows the extent of source areas at the Holiday Cleaners and the Abandoned Dry Cleaners buildings. Thermal treatment technology can involve either conductive or electrical resistance heating of the subsurface. Conductive heating utilizes high temperatures at subsurface heater probes, installed within steel-cased, steel-screened vapor extraction wells, to induce heating of the adjacent aquifer matrix by heat conduction. Water adjacent to the heater probe/ extraction well is fully vaporized, and steam is extracted using the vapor extraction well. Electrical resistive heating (ERH) utilizes the subsurface resistance to electrical current applied between subsurface electrodes/extraction wells to heat the subsurface less vigorously, vaporizing only a portion of the water within the subsurface. Steam generated by volatilizing water flushes volatile contaminants to the vadose zone for extraction by the vapor extraction wells. The two methods are competitively priced and either can be an effective thermal source area treatment at the GCSP Site.

The selection of the specific thermal treatment version (conductive versus electrical resistive) would be made during the RD, based on more detailed Site characterization data collected during the Preliminary Design Field Investigation.

Regardless of the specific version, thermal treatment would be applied to raise the subsurface temperature within the treatment volume of the source area to approximately 100 degrees Celsius (°C). The period of time required to reach this temperature is dependent upon the number and spacing of heater probes/electrodes installed at the site, but typically requires between 2 to 4 months. During this period of increasing subsurface temperatures, volatilization of volatile contaminants is encouraged and vapors are collected within the vapor extraction wells. Once the subsurface temperature reaches the boiling point of the solvent (typically in the range of 88 to 92°C for PCE depending on its depth below ground water), the PCE begins to boil, and PCE vapors rise to the vadose zone where they are collected by the SVE system. When the subsurface temperature has been brought to 100°C, water begins to vaporize and steam begins flushing volatile contaminants from the subsurface for collection in the vapor extraction wells. The heating is continued until concentrations approach the treatment goals. The SVE system provides process control during thermal treatment, and prevents the migration of vapor or steam outside the treatment area.

Final polishing to treatment goals can sometimes be achieved through additional volatilization over subsequent months as the subsurface slowly cools. Bioactivity is also likely to increase during the cool-down period and can act as a polishing treatment. However, due to the one-time nature of this technology, if DNAPL or sorbed-phase soil contamination remains in the subsurface after the thermal treatment is complete, additional final polishing by another remedial technology may need to be instituted to achieve RAOs. For the GCSP Site, it is likely that thermal treatment would need to continue for an extended period of time once the target subsurface temperature has been reached to even approach the treatment goals. Additionally, given the very elevated COC levels in the source area, thermal treatment would need to achieve a very high percentage removal rate (e.g. 99.9 percent or more) to meet the strict RAOs and RGs for the site. It is possible that final polishing via another treatment technology within the source area or in downgradient locations, or MNA over time might be necessary.

For either thermal treatment method, a network of heater probes or subsurface electrodes would be installed within steel-cased, steel-screened vapor extraction wells. The heater probe/electrode vapor extraction wells would be spaced approximately 15 to 25 ft apart, with approximately 60 heater probe/electrode vapor extraction wells located across the larger Holiday Cleaners source area and approximately 10 to 20 heater probe/electrode wells located across the Abandoned Dry Cleaner source area. Each heater probe/electrode vapor extraction well would be plumbed to a vapor extraction system to collect steam and volatilized contaminants and process them at an onsite treatment facility. In addition to the vapor extraction plumbing, electrical power cables also would be extended to each well to provide the electricity for the thermal treatment. Temperature monitoring probes also would be installed to track the increase in subsurface temperatures during treatment. If a site were undeveloped, the piping and electrical cables would generally be left aboveground; however, this is not viable in the developed GCSP source areas. Therefore, all plumbing and electrical components would need to be installed in the subsurface. As a potential enhancement to the SVE system, horizontal vapor extraction wells could be installed at the same time as other subgrade plumbing and electrical infrastructure, using a coarse backfill to enhance vapor recovery.

19.2.3 Shallow Plume Core and Hot Spot

ISCO is initially applied to rapidly lower dissolved-phase COC concentrations to moderate levels. The ISCO phase is then followed by injecting carbon-source amendments as a polishing step for final reduction of COCs.

For treatment of the shallow ground water plume core and hot spot, ISCO would be applied using a network of closely spaced permanent injection points, screened within the targeted treatment zone. In this case, the injection points are anticipated to be placed using on-center spacing of approximately 24 ft. Approximately 221 injection points will be required for treatment of the area encompassing the shallow plume core and hot spot using ISCO. The ISCO treatments would be applied from a depth of approximately 8 ft bgs (the top of the silty sand layer that has been identified as a preferential pathway) to a depth of approximately 20 ft bgs using the permanent injection points. A conceptual layout of the ISCO treatment area under this alternative is presented in Figure 13.

The injected oxidant is assumed to be potassium and/or sodium permanganate. Other oxidants are similarly priced and a final product selection will be made during the RD, based on more detailed Site characterization data collected during the Preliminary Design Field Investigation.

ISCO would be applied at the GCSP Site with the intent to replace one full pore volume with oxidant during an initial injection event, followed by a similar injection at only one-half the injection wells on a second event. The second injection event would be conducted within approximately 6 months following the conclusion of the initial event, and would specifically target plume core or hot spot locations with remaining contamination.

Site-specific soil oxidant demand (SOD) significantly impacts the dosing frequency required to reach RAOs in a cost-effective manner. Oxidant dosing assumptions utilized in the FS (EPA, 2006b) are based on a conservative assumed SOD of 5 mg/kg. SOD values in the range of 1 mg/kg may reduce the cost of ISCO by 15 to 20 percent, while SOD values in the range of 10 mg/kg could make ISCO both technically infeasible and cost prohibitive. SOD will be characterized during the Preliminary Design Field Investigation and those data will be used to establish appropriate oxidant dosing during the RD.

ISCO injections are anticipated to be performed using high-pressure injection pumps and a mobile injection trailer. It is assumed that oxidant can be injected into the subsurface at a rate of 6 gallons per minute (gpm) based on assumptions utilized in the FS (EPA, 2006b). If this injection rate, at a minimum, cannot be supported at the site, the costs associated with this alternative may increase significantly due to the large volume of oxidant that must be injected. Significant additional labor and perhaps infrastructure would be required to deliver the needed volume of oxidant into the subsurface. If only very low injection rates can be achieved, it may not be technically feasible to implement this alternative. The supportable injection rate will be characterized during the Preliminary Design Field Investigation and those data will be utilized during the RD.

As a polishing treatment for the shallow plume core and hot spot areas, ERD will be applied within the same permanent injection wells. Each injection well is assumed to be screened from approximately 8 ft bgs (the top of the silty sand layer that has been identified as a preferential pathway) to approximately 20 ft bgs for treatment of the shallow plume core and hot spot.

The carbon-source injections will be performed following conclusion of the ISCO injection events. For cost estimation purposes, the carbon-source amendment was assumed to be emulsified vegetable oil (EPA, 2006b). Other carbon-source amendments are similarly priced and a final product selection will be made during the RD, based on more thorough Site characteristics data collected during the Preliminary Design Field Investigation.

The ERD polishing injections will be applied within the shallow plume core and hot spot areas with the intent to replace one-half of a full pore volume, within the ROI of each injection well, with the carbon-source amendment during each injection event. Carbon-source amendment dosing is based on an assumed dissolved-sulfate concentration of 2,000 mg/L, based on available data from the RI. Dissolved-sulfate concentrations and other geochemical conditions will be further characterized during the Preliminary Design Field Investigation for use in the RD. A total of five carbon-source injections, performed once every 15 months, are assumed to complete the ground water polishing and meet the RAOs.

If the Preliminary Design does not indicate the presence of DNAPL, the EPA in concurrence with NMED may choose to implement only the ERD bio-barrier component of the remedy. A conceptual layout of the ERD bio-barrier is shown in Figure 14.

19.2.4 Shallow Ground Water Plume Periphery

Bio-barriers are installed as transects across the ground water plume axis by closely-spaced injection of carbon-source amendments. Within these carbon-rich zones, or barriers, biologically mediated reductive dechlorination of the COCs is enhanced and the process forms a continuous ERD treatment zone to intercept the plume. Installation of multiple bio-barriers in series achieves RAOs as ground water passes through the treatment areas. At the GCSP Site, the bio-barriers will be placed utilizing linear transects of permanent injection points. Injection points along each transect are anticipated to be spaced approximately 25 ft, on center, with an assumed injection ROI of approximately 15 ft. The use of permanent wells versus remobilization of a direct-push drilling rig over multiple events will provide significant cost savings.

Each injection well is assumed to be screened from approximately 8 ft bgs (the top of the silty sand) to approximately 20 ft bgs for treatment of the shallow plume periphery. Bio-barriers will be installed as multiple transects across the shallow plume periphery, with an assumed total bio-barrier length of approximately 2,400 ft. Under this scenario, the bio-barriers will be spaced approximately 200 ft apart along the length of the shallow ground water plume. If combined with the bio-barrier treatment portion of the shallow ground water plume core and hot spot, bio-barriers would be located so as to provide multiple transects across the full width of the plume. A conceptual layout of the bio-barrier plume periphery treatment is presented in Figure 15, and illustrates how the plume periphery bio-barriers could be used in conjunction with plume core bio-barriers.

The injected ERD carbon-source amendment is assumed to be emulsified vegetable oil. Emulsified vegetable oil has advantages of being one of the longer lasting available carbon sources as well as being one of the less viscous amendments, which aids distribution within low-permeability materials. Other carbon-source amendments are similarly priced and a final product selection will be made during the RD, based on more detailed site characterization data collected during the Preliminary Design Field Investigation.

The bio-barriers will be applied within the shallow ground water plume periphery with the intent to replace approximately one-half the full pore volume, within the ROI of each injection well, with the carbon-source amendment during each injection event. Site-specific geochemical conditions, particularly sulfate concentrations, will impact the carbon-source amendment dosing selected in the RD. Sulfate generally dominates the carbon demand, interrupting the reductive dechlorination of the COC, and thereby having a significant impact on carbon-source amendment dosing needs to reach RAOs in a reasonable timeframe. Dissolved-sulfate concentrations and other geochemical conditions will be further characterized during the Preliminary Design Field Investigation for use in the RD. Carbon-source amendment dosing is based on an assumed dissolved-sulfate concentration of 2,000 mg/L, based on available data from the RI. A total of 16 carbon-source amendment injections are assumed over a 20-year period (one injection every 15 months) to meet the RAOs within the shallow ground water plume periphery.

19.2.5 Deeper Ground Water Plume

The complete vertical extent of contamination is not fully defined at this time. Further characterization will be conducted during the Preliminary Field Investigation and the remedy will be implemented such that the entire vertical extent is addressed. The remedy will be re-evaluated during the design phase if new information regarding the vertical and horizontal extent of the plume is determined.

Bio-barriers are installed as transects across the ground water plume axis along which closely-spaced injection of carbon-source amendments will occur to form a continuous ERD treatment zone across the plume. The bio-barriers will be placed using permanent injection wells, due to the extended time period and numerous injections required to meet RAOs with ERD. The use of permanent wells versus remobilization of a direct-push drilling rig over multiple events will provide significant cost savings.

Bio-barriers will be installed as multiple transects across the deeper ground water plume, with an assumed bio-barrier length of approximately 1,000 ft for treatment of contamination at a depth up to 60 ft bgs, and an additional bio-barrier length of approximately 250 ft for treatment of contamination at a depth up to 80 ft bgs. Two 80-ft deep bio-barriers, each approximately 125-ft long, are anticipated to be installed to address the deepest known contamination at the Site, with one transect anticipated to be located on First Street and another anticipated to be located in the alleyway between First Street and Geis Street. Injection wells along these deeper transects will be screened between approximately 60 ft and 80 ft bgs. Multiple approximately 60-ft-deep bio-barriers will be installed with short lengths anticipated to be located along First Street, in the alleyway between First Street and Geis Street, near the midpoint of the plume on Geis Street, near the downgradient extent of the deeper plume, and limited injections at accessible points at the far downgradient extent of the deeper plume. A conceptual layout of this arrangement is presented in Figure 16.

The injected ERD carbon-source amendment is assumed to be emulsified vegetable oil. Other carbon-source amendments are similarly priced and a final product selection will be made during the RD, based on more detailed Site characterization data collected during the Preliminary Design Field Investigation. The bio-barriers will be applied within the deeper ground water plume with the intent to replace approximately one-half the full pore volume, within the ROI of each injection well, with the carbon-source amendment during each injection event. Carbon-source amendment dosing is based on an assumed dissolved-sulfate concentration of 2,000 mg/L, based on available data from the RI. Dissolved-sulfate concentrations will be further characterized during the Preliminary Design Field Investigation, since sulfate generally dominates the carbon demand and has a significant impact on carbon-source amendment dosing. A total of 16 carbon-source amendment injections are assumed over a 20-year period (one injection every 15 months) to meet the RAOs within the deeper ground water plume.

19.3 Contingency Remedy

EPA will evaluate the site conditions to determine if monitored natural attenuation (MNA) is a viable remedial alternative after the first Five-Year Review and after source control has been established in the Source Areas and the Shallow Ground Water Plume. If ground water data demonstrates evidence that MNA is occurring such that RAOs will be met in a timely manner, then EPA may consider proposing MNA as the remedial strategy for the Shallow Ground Water Periphery and the Deeper Ground Water Plume. If this alternative is determined to be the most efficient and effective remedy, then EPA with NMED's concurrence will issue an Explanation of Significant Differences (ESD) to document the change in the remedy. MNA is not a component of the Selected Remedy.

MNA is a proven ground water remedy at many sites; however, at this time there is insufficient data to select MNA as a component of the Selected Remedy at the GCSP Site. The EPA will collect the necessary data for MNA evaluation during the pre-design investigation phase. The contingency will be invoked not because of a potential failure of the Selected Remedy but rather as an alternative that would not only achieve final cleanup goals but also provide significant cost savings to the agency.

MNA is a proven ground water remedy at many sites; however, at this time there is insufficient data to select MNA as a component of the Selected Remedy at the GCSP Site. The EPA will collect the necessary data for MNA evaluation during the predesign investigation phase. The contingency will be invoked not because of a potential failure of the Selected Remedy but rather as an alternative that would not only achieve final cleanup goals but also provide significant cost savings to the agency.

If the Selected Remedy does not appear to be making progress toward achieving the remedial objectives, the EPA may propose a new remedy in the form of a ROD amendment or other appropriate regulatory mechanism. "Triggers" that will signal unacceptable performance of the Selected Remedy include, but are not limited to, the following:

a. Contaminant concentrations in the groundwater at specified locations exhibit an increasing trend not originally predicted during remedy selection,

b. Near-source wells exhibit large concentration increases indicative of a new or renewed release,

c. Contaminants are identified in MWs located outside of the original plume boundary,

d. Contaminant concentrations are not decreasing at a sufficiently rapid rate to meet the remediation objectives, and

e. Changes in land and/or groundwater use

19.4 Cost Estimate for the Selected Remedy

Appendix B includes details of the estimated costs to implement and construct the Selected Remedy. The estimated total cost to implement and construct the Selected Remedy presented in this ROD is $29,500,000. The information in this cost estimate for the Selected Remedy is based on the best available information regarding the anticipated scope of the Remedial Alternative.

Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the Remedial Alternative. Major changes may be documented in the form of a technical memorandum in the Administrative Record file, an ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

19.5 Expected Outcomes of the Selected Remedy

Following are the expected outcomes of the Selected Remedy in terms of resulting land and ground water uses, the cleanup levels and the risk reduction achieved as a result of the response action, and the anticipated community impacts.

19.5.1 Available Land Uses

The homes that have indoor vapor mitigation systems will no longer present long-term risk to residents. The cancer risk from inhalation in the three homes that exceeded the Tier 3 level will be reduced to below the EPA risk of 1×10^{-5}. An additional eleven homes will receive vapor mitigation system to prevent future risk from vapor intrusion.

19.5.2 Available Ground Water Uses

The remedy will be protective of ground water because all of the source areas will be removed and active treatment of the plume will reduce the ground water concentrations of chlorinated solvents below the federal MCL. Remediation at the site will prevent any potential for vertical migration of contaminants into the deeper aquifer that is the source of drinking water for the City of Grants. The planned implementation of the Institutional Controls will help prevent use of ground water before cleanup goals are met.

19.5.3 Final Cleanup Levels

Table 20 shows the final cleanup level for the COCs. The results of the BHHRA indicate that existing conditions at the site pose an ELCR of greater than 1×10^{-5} for indoor air. In addition ground water COCs exceed MCLs and state ARARs. Soil COCs exceed NMED safe levels for residential use. The Selected Remedy will address indoor air through the installation of vapor mitigation systems and will address ground water and soil through active treatment. The final cleanup levels are protective of human health and are expected to restore the ground water and soil. The site is expected to be available for continued unrestricted residential and commercial land use as a result of the remedy.

20.0 Statutory Determinations

Under CERCLA §121 and the NCP §300.430(f)(5)(ii), the EPA must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against offsite disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

20.1 Protection of Human Health and the Environment

The Selected Remedy for the indoor air, soil, and ground water at this site will be protective of human health and the environment. Installation of vapor mitigation systems will address vapor intrusion and reduce cancer risk to below safe levels.

Removal of the principal threat wastes in the soil and ground water in the source areas and active treatment of ground water in the shallow plume core and hot spot, shallow plume periphery, and deeper plume is expected to restore the ground water to below drinking water standards.

20.2 Compliance with Applicable or Relevant and Appropriate Requirements

The NCP §300.430(f)(5)(ii)(B) and (C) require that a ROD describe the Federal and State ARARs that the Selected Remedy will attain or provide justification for any waivers. ARARs include substantive provisions of any promulgated Federal or more stringent State environmental standards, requirements, criteria, or limitations that are determined to be legally ARARs for a CERCLA site or action. Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements are requirements that, while not legally "applicable" to circumstances at a particular CERCLA site, address problems or situations sufficiently similar to those encountered at the site that their use is relevant and appropriate. The ARARs are presented below and in more detail in Table 12.

Chemical, location, and action-specific ARARs include the following:

- Safe Drinking Water Act MCLs (40 CFR Part 141), which specify acceptable concentration levels in ground water that serves as a potential drinking water aquifer
- Clean Air Act applicable to emissions from stationary sources
- Clean Water Act for any discharges from the site
- Hazardous Waste Regulations (40 CFR 261) for waste disposal
- U.S. Department of Transportation (DOT) Regulations for transportation of hazardous waste (49 CFR 171 and 180)
- New Mexico Hazardous Waste Regulations (20.4 New Mexico Administrative Code [NMAC])
- New Mexico Air Regulations (20.2 NMAC)
- New Mexico Water Quality Control Commission Regulations (20.6.2 NMAC)

20.3 Cost Effectiveness

The Selected Remedy is cost effective because the remedy's costs are proportional to its overall effectiveness (see 40 CFR §300.430(f)(l)(ii)(D)). This determination was made by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria (i.e., that are protective of human health and the environment and comply with all Federal and any more stringent State ARARs, or as appropriate, waive ARARs). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). The overall effectiveness of each alternative was then compared to each alternative's costs to determine cost effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence represents a reasonable value for the money to be spent.

The estimated present worth cost of one component (ISCO with Follow-On ERD for Shallow Plume Core and Hot Spot) is pushing the total cost of the Selected Remedy slightly higher compared to other alternative combinations providing active treatment. However, the Selected Remedy offers a much higher degree of protectiveness and overall effectiveness than any of the other alternatives because it offers mitigation, treatment, and removal of all wastes versus no action.

20.4 Utilization of Permanent Solutions to the Maximum Extent Practicable

EPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the EPA has determined that the Selected Remedy provides the best balance of tradeoffs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element, bias against offsite treatment and disposal, and considering State and community acceptance.

The Selected Remedy treats the source area soil and ground water potentially containing DNAPL constituting principal threats at the Site. The Selected Remedy satisfies the criteria for long-term effectiveness by removing all chlorinated solvents contamination from the soil and ground water. The Selected Remedy does not present short-term risks different from the other treatment alternatives. There are no special implementability issues that set the Selected Remedy apart from any of the other alternatives evaluated.

20.5 Preference for Treatment as a Principal Element

The EPA has determined that the treatment of the source area wastes satisfies the statutory preference for the selection of a remedy that involves treatment as a principal element. By treating the contaminated soils and ground water by active remediation technologies, the

Selected Remedy addresses principal threats posed at the site utilizing treatment as a significant portion of the remedy.

20.6 Five-Year Review Requirements

CERCLA §121(c) and the NCP §300.430(f)(5)(iii)(C) provide the statutory and legal bases for conducting Five-Year Reviews. Because this remedy is expected to take at least 20 years to achieve the RAOs within portions of the GCSP Site, it will result in hazardous substances remaining onsite in the ground water and possibly in the soils (below 1.5 ft bgs) above levels that allow for unlimited use and unrestricted exposure. A statutory review will be conducted within 5 years after initiation of the RA to ensure that the remedy is, or will be, protective of human health and the environment.

21.0 Documentation of Significant Changes From Preferred Alternative of Proposed Plan

The EPA has not made any significant changes to the remedy, as originally identified in the Proposed Plan. The Proposed Plan was released for public comment on April 12, 2006. The public comment period for the Proposed Plan was held from April 12, 2006 to May 11, 2006. The EPA held a public meeting on April 20, 2006 to present the preferred alternative in the Proposed Plan. The EPA reviewed and responded to written and verbal comments submitted during the public comment period in the Responsiveness Summary (Part 3 of this ROD).

22.0 State Role

The NMED, on behalf of the State of New Mexico, has reviewed the various alternatives and has indicated its support for the Selected Remedy. NMED's position on the other alternatives are indicated in Tables 14-18.

The State has also reviewed the RI/FS (EPA, 2005a), BHHRA (EPA, 2005b), to determine if the Selected Remedy is in compliance with applicable or relevant and appropriate State environmental laws and regulations. The State of New Mexico concurs with the Selected Remedy for the Site (Appendix C – NMED Concurrence with the Selected Remedy).

Part 3.
Responsiveness Summary

Part 3: Responsiveness Summary

23.0 Responsiveness Summary

The Responsiveness Summary (Appendix D) summarizes information about the views of the public and the support agency regarding both the remedial alternatives and general concerns about the site submitted during the public comment period. This summary also documents, in the record, how public comments were integrated into the decision making process.

The Administrative Record file for the site, located at the University of New Mexico Campus, Grants and the EPA's Region 6 office, contains all of the information and documents supporting this ROD. The comment period for the Proposed Plan for the Site opened on April 12, 2006 and ended on May 11, 2006. This Administrative Record file includes a transcript of the public meeting held by the EPA on April 20, 2006 to describe the preferred alternative.

23.1 Stakeholder Issues and Lead Agency Responses

23.1.1 NMED Comments

Comment 1

In reference to the Land and Ground Water Use Assumptions - NMED emphasizes that the New Mexico Water Quality Control Commission (NMWQCC) Regulations, NMAC 20.6.2.4101.A(1) requires that all ground water of the State of New Mexico with a TDS of <10,000 mg/l be remediated or protected for use as domestic and agricultural water supply. Although the contaminated ground water (from 5 to 80 ft bgs) at the site is not currently used as a drinking water supply, there are no enforceable institutional controls that would prohibit the use of this aquifer, now or in the future, as a drinking water supply. The fact that three shallow private wells exist within the site boundaries is evidence that the aquifer can be used for beneficial use. As proposed, ground water must be remediated to the more stringent requirements of the Federal Safe Drinking Water standards (MCLs) and/or NMWQCC standards.

EPA Response:

Comment noted. EPA's final clean up levels for the COCs at this Site is federal MCL and NMWQCC standards.

Comment 2

Preliminary Remediation Goals and use of 1×10^{-4} excess lifetime cancer risk (ELCR) as the targeted cleanup level - The National Contingency Plan established a targeted risk level 1×10^{-6} as a "point of departure" for determining remediation goals. There has been no justification presented by EPA to modify this targeted risk level and justify the use of a less stringent risk-based clean up level. At a minimum, an ELCR of 1×10^{-5} and an HI of 1 which is consistent with the NMWQCC Regulations and NMED's *Technical Background Document for Development of Soil Screening Levels, Revision 3.0, August 2005,* should be used for establishing targeted cleanup levels for indoor air and soil. NMED requests that the PRGs for COCs in soil and from vapor impacts be established using at least a 1×10^{-5} ELCR and an HI of 1 and a residential land use scenario.

EPA Response:

1E-06 is the point of departure, and EPA has the flexibility to modify cleanup levels for carcinogens within the range of 1E-06 to 1E-04, especially when considering site-specific conditions. This is indicated in the NCP (40 CFR 300.430(e)(2)(i)(A)(2):

"For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} using information on the relationship between dose and response."

The EPA agrees with NMED's concerns regarding uncertainties at the Site and will take Remedial Action at the lower risk level (1×10^{-5}).

Comment 3

In reference to risk and the preliminary remediation goals. NMED does not support the use risk based clean up levels that are less stringent than residential clean up levels for this site. The site is located in a mixed commercial and residential use area and there are no enforceable institutional controls that can be implemented to restrict future land use. Therefore, the more restrictive clean up levels, i.e. residential, should be used.

EPA Response:

EPA will use NMED's Guidance document (Technical Background Document for Development of Soil Screening Levels, Revision 3.0, August 2005) on Soil Screening Levels to establish clean up levels based on residential use.

Comment 4

In reference to the flexible approach in selection of the final remedy for the Shallow Plume Core and Hot Spot Area - NMED is concerned with how the final selection between ISCO and ERD will be determined due to the difficulties associated with detecting the DNAPL in the field. NMED is concerned that a significant amount of time and expense could be expended without conclusively determining whether or not DNAPL is absent from this area. In addition, the pre-design investigations proposed in the Feasibility Study did not include investigation activities associated with determining the nature and extent of DNAPL but instead concentrated on definition of the dissolved phase plume and soil contamination in the two source areas. As stated in the RI report and in literature on the subject, it is generally assumed that DNAPL is present if ground water exceeds 1 to 5 percent of the chemicals solubility limit in water and the dissolved PCE concentrations observed within the Plume Core Area are as high as 35%. At this concentration it should be assumed that DNAPL is present in close proximity to the sample locations and ISCO is better suited for this condition. Finally, because ISCO with follow-on ERD alternative addresses the entire plume through the installation of a grid pattern of wells the ISCO alternative is more amenable to treating the Core Plume/Hotspot area verses the passive nature of diffusion associated with the ERD alternative. If residual DNAPL is present between the ERD bio-barriers, the likelihood of effective and timely clean-up using the ERD bio-barrier alternative is greatly reduced. Therefore, NMED may not support the use of ERD as the stand alone remedial technology for the Shallow Plume Core and Hot Spot area.

EPA Response:

EPA's policy is to treat principal threats posed by the Site through use of treatment technologies. By utilizing treatment as a significant portion of the Selected Remedy, the statutory preference for remedies that employ treatment as a principal element is satisfied. The EPA agrees and will select ISCO with Follow-On ERD (Flexible) treatment approach for the Shallow Plume Core and Hot Spot for the following reason:

Thermal treatment at the Source Area is expected to achieve complete removal of principal threat waste. After Source Area treatment is complete and if it can be demonstrated that the principal threat waste no longer exists in the Shallow Plume Core and Hot Spot area then the EPA will re-evaluate the two treatment technologies (ISCO/with Follow-On ERD or ERD alone) to determine which one of these better meets the Statutory Preference for Treatment. Based on this determination the EPA will implement either of the two technologies to address the Shallow Plume Core and Hot Spot Area.

23.1.2 Community Comments

The following comments were received from members of the public that were in attendance at the Proposed Plan public meeting held on April 20, 2006.

Comment 1

How was the contamination originally verified at the GCSP Site?

EPA Response:

The NMED-PSTB discovered chlorinated solvents in ground water at the GCSP Site during a UST investigation at the Allsup's 200 gas station in 1993. Following the discovery, NMED conducted two years of ground water monitoring at the Allsup's monitoring wells to verify contamination.

Comment 2
Are the depths of the City Drinking Water wells known?

EPA Response:

Yes. City well Grants B-40 is screened at a depth from 246 feet (ft) below ground surface (bgs) to 346 ft bgs and the total depth of the well is 367 ft bgs. The second City well, Grants B-38, is screened between 149 ft bgs and 300 ft bgs and the total depth of this well is 300 ft bgs. Both of these wells are upgradient and are located approximately 1.5 miles northwest of the GCSP Site.

Comment 3
Are the City wells located in the same aquifer that is impacted at the GCSP Site?

EPA Response:

No. The contamination at the GCSP Site is in a shallow aquifer and the vertical extent is not fully known at this time. The City drinking water wells pump water from much greater depths, and are upgradient of the GCSP Site. The maximum depth at which contamination was detected during the RI is 85 ft bgs. The EPA will fully characterize the maximum depth of contamination during the Pre-Design Field Investigation.

Comment 4
Is the project funded for the Remedial Design?

EPA Response:

Yes. Funding for Remedial Design has been planned for fiscal Year 2006.

Comment 5
Are there many other sites in the country similar to Grants?

EPA Response:

Yes. There are a number of other Superfund sites in the country that are similar to Grants. In New Mexico alone there are five sites, including the GCSP Site, where EPA is cleaning up ground water contaminated with chlorinated solvents. These five sites include Fruit

Avenue Plume, Albuquerque; North Railroad Avenue Plume, Espanola; McGaffey and Main, Roswell; Griggs and Walnut, Las Cruces; and the GCSP Site, Grants.

Comment 6
Is the bio-barrier wall a physical wall installed underground?

EPA Response:

Bio-barrier walls are not actual physical walls but function as a wall when nutrients are injected across sections of the plume. Injection points are closely spaced along a line across the plume, such that the aquifer between each injection point is filled with the injected oxidant or carbon source amendment. When the oxidant or carbon source amendments are injected into the ground they permeate into the aquifer and begin treating the ground water.

Zero-valent iron permeable reactive barriers are actual physical walls constructed of iron filings installed within trenches dug across the plume. The walls required for the GCSP Site would be as thick as 36 inches and up to 60 ft deep. A zero-valent iron permeable reactive barrier was considered as one of the alternatives for the Site but was not chosen as the Selected Remedy.

Comment 7
Will the public be notified when a final decision is made regarding the Preferred Remedy?

EPA Response:

Yes. The EPA will notify the community of the final selection of the remedy after it reviews and responds to all the comments received during the comment period. Newspaper notification will be made in the local newspaper when the Record of Decision is signed.

24.0 References

EPA, 2006a. Proposed Plan (referenced on pg 2-9)

EPA, 2006b. FS (referenced on pg 2-10)

EPA, 2005a. Remedial Investigation Report, Grants Chlorinated Solvents Plume Site, Grants, Cibola County, New Mexico. U.S. Environmental Protection Agency. July.

EPA, 2005b. Baseline Human Health Risk Assessment, Grants Chlorinated Solvents Plume, Superfund Site, Grants, New Mexico. July.

EPA, 2002. *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils*. U.S. Environmental Protection Agency.

EPA, 2001. *Building Radon Out, A Step-by-Step Guide on How to Build Radon-Resistant Homes.*

EPA, 1999. *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*. OSWER Directive Number 9200.4-17P. April.

EPA, 1993. *Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Site With Volatile Organic Compounds in Soils.*

NMED, Ground Water Quality Bureau, Superfund Oversight Section, 2001. *Site Inspection Report, Grants Chlorinated Solvents Plume Site, CERCLIS ID: NM0007271768, Cibola County, New Mexico.* April.

Tetra Tech EM, Inc., 2003. *Secondary Investigation Report, Allsup's 200.*

Appendix A.
Administrative Record Index

Prepared for

United States Environmental Protection Agency

Region 6

RECORD OF DECISION
ADMINISTRATIVE RECORD

for

GRANTS CHLORINATED SOLVENTS SUPERFUND SITE

EPA ID No. NM0007271768

GS09K99BHD0010
Task Order No. T0703BG1026

Sairam Appaji
Remedial Project Manager
U.S. EPA Region 6

Prepared by

Science Applications International Corporation
555 Republic Drive, Suite 300
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JULY 17, 2006

PREAMBLE

The purpose of this document is to provide the public with an index to the Administrative Record File (AR File) for the U.S. Environmental Protection Agency's (EPA) selected remedial action to respond to conditions at the Grants Chlorinated Solvents (the "Site"). EPA's action is authorized by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Section 9601 et seq.

Section 113 (j)(1) of CERCLA, 42 U.S.C. Section 9613 (j)(1), provides that judicial review of the adequacy of a CERCLA response action shall be limited to the Administrative Record (AR). Section 113 (k)(1) of CERCLA, 42 U.S.C. Section 9613 (k)(1), requires the EPA to establish an AR upon which it shall base the selection of its remedial actions. As the EPA decides what to do at the site of a release of hazardous substances, it compiles documents concerning the site and it's decision into an "AR File." This means that documents may be added to the AR File from time to time. After the EPA Regional Administrator or the Administrator's delegate signs the Action Memorandum or the Record of Decision memorializing the selection of the action, the documents which form the basis for the selection of the response action are then known as the Administrative Record "AR."

Section 113(k)(1) of CERCLA requires the EPA to make the AR File available to the public at or near the site of the response action. Accordingly, the EPA has established a repository where the AR File may be reviewed near the Site at:

New Mexico State University
Grants Campus
1500 Third Street
Grants, New Mexico
Contact: Steven Thomas
Telephone:

The public also may review the AR File at the EPA Region 6 office in Dallas, Texas, by contacting the Remedial Project Manager at the address listed below. The AR File is available for public review during normal business hours. The AR File is treated as a non-circulating reference document. Any document in the AR File may be photocopied according to the procedures used at the repository or at the EPA Region 6 office. This index and the AR File were compiled in accordance with the EPA's Final Guidance on Administrative Records for Selecting CERCLA Response Actions, Office of Solid Waste and Emergency Response (OSWER) Directive Number 9833.3A1 (December 3, 1990).

Documents listed as bibliographic sources for other documents in the AR File might not be listed separately in the index. Where a document is listed in the index but not located among the documents which the EPA has made available in the repository, the EPA may, upon request, include the document in the repository or make the document available for review at an alternate location. This applies to documents such as verified sampling data, chain of custody forms, guidance and policy documents, as well as voluminous site-specific reports. It does not apply to documents in EPA's confidential file. (Copies of guidance documents also can be obtained by calling the RCRA/Superfund/Title 3 Hotline at (800) 424-9346.)

These requests should be addressed to:

Sairam Appaji
Remedial Project Manager
U.S. EPA Region 6
1445 Ross Avenue
Dallas, Texas 75202-2733
(214) 665-3126

The EPA response selection guidance compendium index has not been updated since March 22, 1991 (see CERCLA Administrative Records: First Update of the Compendium of Documents Used for Selecting CERCLA Response Actions [March 22, 1991]); accordingly, it is not included here. Moreover, based on resource considerations, the Region 6 Superfund Division Director has decided not to maintain a Region 6 compendium of response selection guidance. Instead, consistent with 40 CFR Section 300.805(a)(2) and 300.810(a)(2) and OSWER Directive No. 9833.3A-1 (page 37), the AR File Index includes listings of all guidance documents which may form a basis for the selection of the response action in question.

The documents included in the AR File index are arranged predominantly in chronological order. The AR File index helps locate and retrieve documents in the file. It also provides an overview of the response action history. The index includes the following information for each document:

- **Doc ID**- The document identifier number.
- **Date** - The date the document was published and/or released. “01/01/2525" means no date was recorded.
- **Pages** - Total number of printed pages in the document, including attachments.
- **Title -** Descriptive heading of the document.
- **Document Type** - General identification, (e.g. correspondence, Remedial Investigation Report, Record of Decision.)
- **Author -** Name of originator, and the name of the organization that the author is affiliated with. If either the originator name or the organization name is not identified, then the field is captured with the letters “N/A”.
- **Addressee**- Name and affiliation of the addressee. If either the originator name or the organization name is not identified, then the field is captured with the letters “N/A”.

Appendix B.
Cost Estimate for Selected Remedy

Table B-1
Cost Estimate Summary for the Selected Remedy

Remedy Component	Item Description	Quantity	Unit	Unit Cost	Cost
Vapor Intrusion Mitigation Capital Costs	Install 14 Vapor Mitigation Systems		LS		$ 425,000.00
	One-time Vapor Pump Replacement	14	EACH	$ 500.00	$ 7,000.00
	Vapor Intrusion Mitigation Capital Costs				$ 395,000.00
	Vapor Intrusion Mitigation O&M Costs (see Table B-2)				$ 46,560.00
	NM Gross Receipts Tax (7.5%)				$ 33,120.00
	Vapor Intrusion Mitigation Subtotal				**$ 474,680.00**
Source Area - Thermal Treatment Capital Costs (vendor price quote with adjustment for local drilling rates)	Vendor Design and Permitting Input		LS		$ 150,000.00
	Mobilization and Procurement		LS		$ 79,000.00
	Drill and Install Borings, Wells, and Sub-Grade Infrastructure		LS		$ 1,523,000.00
	Vapor Cover Installation		LS		$ 104,000.00
	Electrical Construction		LS		$ 105,000.00
	Mechanical Construction		LS		$ 185,000.00
	Vapor and Water Treatment System		LS		$ 750,000.00
	Commissioning		LS		$ 80,000.00
	Maintenance Hardware, Etc.		LS		$ 218,000.00
	Operations Labor, Per Diem		LS		$ 417,000.00
	Power ($0.072 per kWh)		LS		$ 1,014,000.00
	Process Sampling and Analysis		LS		$ 37,000.00
	Waste and GAC		LS		$ 32,500.00
	Rental and Fees		LS		$ 30,000.00
	Demobilization		LS		$ 55,000.00
	Vendor Reporting		LS		$ 30,000.00
	Vendor Travel, Office, and Engineering Support		LS		$ 647,000.00
	Licensing Fees		LS		$ 199,000.00
	Vendor Contingency and Indirect Cost		LS		$ 774,000.00
	Total Thermal Source Area Treatment Vendor Costs				$ 6,429,500.00
	Total Thermal Source Area Treatment O&M Costs (see Table B-2)				$ -
	Thermal Source Area Program Management and Support (10%)				$ 643,000.00
	Thermal Source Area Project Design (6% of Capital Costs)				$ 386,000.00
	NM Gross Receipts Tax (7.5%)				$ 559,000.00
	Thermal Source Area Treatment Subtotal				**$ 8,017,500.00**
Shallow Plume Core and Hot Spot - ISCO With Follow-On ERD Capital Costs	Pre-Construction Activities (Including Pilot-Scale Testing)		LS		$ 419,450.00
	Injection and Monitoring Well Construction		LS		$ 474,100.00
	Trailer-Mounted Injection System		LS		$ 36,000.00
	Initial ISCO Injection - Mobilization		LS		$ 51,000.00
	Initial ISCO Injection - Potassium Permanganate	527,793	LBS	$ 1.55	$ 818,079.00
	Initial ISCO Injection - Potassium Permanganate Shipping	527,793	LBS	$ 0.13	$ 68,613.00
	Initial ISCO Injection - Sodium Thiosulfate (Oxidant Neutralizer)	550	GAL	$ 7.25	$ 3,988.00
	Initial ISCO Injection - Sodium Thiosulfate Shipping	1	LOAD	$ 600.00	$ 600.00
	Initial ISCO Injection - Water	1,795	1,000 GAL	$ 1.64	$ 2,944.00
	Initial ISCO Injection - Mixing Equipment and Material		LS		$ 50,000.00
	Initial ISCO Injection - Equipment Setup and Related Expenses		LS		$ 59,900.00
	Initial ISCO Injection - Royalties, Construction Management Fees, and Markup		LS		$ 126,600.00
	Initial ISCO Injection Labor		LS		$ 241,375.00
	Second ISCO Injection - Mobilization		LS		$ 22,500.00
	Second ISCO Injection - Potassium Permanganate	263,945	LBS	$ 1.55	$ 409,115.00
	Second ISCO Injection - Potassium Permanganate Shipping	263,945	LBS	$ 0.13	$ 34,313.00
	Second ISCO Injection - Sodium Thiosulfate (Oxidant Neutralizer)	550	GAL	7.25	$ 3,988.00
	Second ISCO Injection - Sodium Thiosulfate Shipping	1	LOAD	$ 600.00	$ 600.00
	Second ISCO Injection - Water	898	1,000 GAL	$ 1.64	$ 1,473.00
	Second ISCO Injection - Mixing Equipment and Material		LS		$ 5,000.00

Table B-1
Cost Estimate Summary for the Selected Remedy

Remedy Component	Item Description	Quantity	Unit	Unit Cost	Cost
Shallow Plume Core and Hot Spot - ISCO With Follow-On ERD Capital Costs	Second ISCO Injection - Equipment Setup and Related Expenses		LS		$ 34,000.00
	Second ISCO Injection - Royalties, Construction Management Fees, and Markup		LS		$ 61,300.00
	Second ISCO Injection Labor		LS		$ 127,700.00
	Primary Performance Monitoring		LS		$ 15,000.00
	Reporting		LS		$ 31,200.00
	Undefined Scope and Market Allowance		LS		$ 464,800.00
Total ISCO With Follow-On ERD Shallow Plume Core Treatment Capital Costs					$ 3,563,638.00
Total ISCO With Follow-On ERD Shallow Plume Core Treatment O&M (ERD Treatments) Costs (see Table B-2)					$ 1,933,857.00
Shallow Plume Core and Hot Spot Treatment Program Management and Support (10%)					$ 549,750.00
Shallow Plume Core and Hot Spot Project Design (6% of Capital Costs)					$ 213,800.00
NM Gross Receipts Tax (7.5%)					$ 469,600.00
Shallow Plume Core and Hot Spot Treatment Subtotal					**$ 6,730,645.00**
Shallow Plume Periphery - ERD Bio Barriers Capital Costs	Pre-Construction Activities (Including Pilot-Scale Testing)		LS		$ 250,770.00
	Injection and Monitoring Well Construction		LS		$ 355,600.00
	Trailer-Mounted Injection System		LS		$ 36,000.00
	Undefined Scope and Market Allowance		LS		$ 96,360.00
Total ERD Shallow Plume Periphery Treatment Capital Costs					$ 738,730.00
Total ERD Shallow Plume Periphery Treatment O&M (ERD Treatments) Costs (see Table B-2)					$ 1,989,050.00
Shallow Plume Periphery Treatment Program Management and Support (10%)					$ 272,800.00
Shallow Plume Periphery Project Design (6% of Capital Costs)					$ 44,320.00
NM Gross Receipts Tax (7.5%)					$ 228,370.00
Shallow Plume Periphery Treatment Subtotal					**$ 3,273,270.00**
Deep Plume Treatment - ERD Bio Barriers Capital Costs	Pre-Construction Activities (Including Pilot-Scale Testing)		LS		$ 263,270.00
	Injection and Monitoring Well Construction		LS		$ 837,500.00
	Trailer-Mounted Injection System		LS		$ 36,000.00
	Undefined Scope and Market Allowance		LS		$ 170,520.00
Total ERD Deep Plume Treatment Capital Costs					$ 1,307,290.00
Total ERD Deep Plume Treatment O&M (ERD Treatments) Costs (see Table B-2)					$ 4,729,000.00
Deep Plume Treatment Program Management and Support (10%)					$ 603,630.00
Deep Plume Project Design (6% of Capital Costs)					$ 78,440.00
NM Gross Receipts Tax (7.5%)					$ 503,880.00
Deep Plume Treatment Subtotal					**$ 7,222,240.00**
RD/RA Project Management					$ 589,730.00
Project Planning Documents (Work Plan, QAPP, HASP)					$ 138,668.00
Preliminary Design Field Investigation					$ 1,230,019.00
Ground Water Sampling Program					$ 1,383,910.00
Five-Year Reviews					$ 180,000.00
Required RD/RA Components Subtotal					**$ 3,522,327.00**
Total Present Worth Estimated Cost of Preferred Remedy					**$ 29,240,662.00**

Notes

Capital cost estimates are not discounted because the construction work will be performed in the first year. O&M costs are reported as present worth estimates given a 7% discount rate over the duration of the respective treatment period (6 years for shallow plume core; 20 years for shallow plume periphery; 20 years for deep plume). O&M costs are detailed in subsequent Tables B-2 and B-3. Cost estimates are based on estimated quantities and assumptions described in the Feasibility Study, and may be refined following the Preliminary Design Field Investigation and during the Remedial Design. Cost estimates are within +50 to -30% accuracy expectation.

LS = Lump Sum
GAL = Gallon
LBS = Pound
kWh = Kilowatt-hour
QAPP = Quality Assurance Project Plan
HASP = Health and Safety Plan

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Table B-2
Estimated O&M Costs for the Selected Remedy

Remedy Component	Item Description	Quantity	Unit	Unit Cost	Cost	Present Worth O&M Cost [1]
Vapor Intrusion Mitigation O&M Costs [2]	Five-Year Indoor Air Sampling Event		LS		$ 38,118.00	
	Ten-Year Indoor Air Sampling Event		LS		$ 38,118.00	
Vapor Intrusion Mitigation O&M Costs					$ 76,236.00	
Present Worth Cost of $38,118 expended during years 5 and 10 at 7% discount rate =						**$ 46,560.00**
Thermal Source Area Treatment O&M Costs	No O&M Costs for Thermal Treatment			$ -	$ -	
Thermal Source Area Treatment O&M Subtotal					$ -	**$ -**
Shallow Plume Core and Hot Spot - ISCO With Follow-On ERD O&M (ERD Treatments) Costs	Injection Mobilization; Site Trailer		LS		$ 12,000.00	
	Emulsified Edible Oil	121	DRUM	$ 1,050.00	$ 127,050.00	
	Emulsified Edible Oil - Shipping	2	LOAD	$ 1,200.00	$ 2,400.00	
	Water	875	1,000 GAL	$ 1.64	$ 1,435.00	
	Rentals, Equipment, and Materials		LS		$ 6,500.00	
	Injection Labor		LS		$ 167,280.00	
	Reporting		LS		$ 24,850.00	
	Performance/Effectiveness Monitoring		LS		$ 64,200.00	
Total ISCO With Follow-On ERD Shallow Plume Core Treatment O&M Costs					$ 405,715.00	
O&M Period					6 Years	
Present Worth Cost of $405,715 per year for 6 years at 7% discount rate =						**$ 1,933,900.00**
Shallow Plume Periphery - ERD O&M Costs	Injection Mobilization; Site Trailer		LS		$ 9,000.00	
	Emulsified Edible Oil	66	DRUM	$ 1,050.00	$ 69,300.00	
	Emulsified Edible Oil - Shipping	2	LOAD	$ 1,200.00	$ 2,400.00	
	Water	317	1,000 GAL	$ 1.64	$ 519.88	
	Rentals, Equipment, and Materials		LS		$ 9,500.00	
	Injection Labor		LS		$ 62,320.00	
	Reporting		LS		$ 24,850.00	
	Performance/Effectiveness Monitoring		LS		$ 56,800.00	
O&M Period					20 Years	
Total ERD Shallow Plume Periphery Treatment O&M Costs					$ 234,689.88	
Total Annual Shallow Plume Periphery Treatment O&M Costs (Injection Every 15 Months)					$ 187,751.90	
Present Worth Cost of $187,752 per year for 20 years at 7% discount rate =						**$ 1,989,050.00**
Deep Plume - ERD O&M Costs	Injection Mobilization; Site Trailer		LS		$ 21,000.00	
	Emulsified Edible Oil	184	DRUM	$ 1,050.00	$ 193,200.00	
	Emulsified Edible Oil - Shipping	6	LOAD	$ 1,200.00	$ 7,200.00	
	Water	1,000	1,000 GAL	$ 1.64	$ 1,640.00	
	Rentals, Equipment, and Materials		LS		$ 14,000.00	
	Injection Labor		LS		$ 190,240.00	
	Reporting		LS		$ 48,900.00	
	Performance/Effectiveness Monitoring		LS		$ 81,800.00	
O&M Period					20 Years	
Total ERD Deep Plume Treatment O&M Costs					$ 557,980.00	
Total Annual Deep Plume Treatment O&M Costs (Injection Every 15 Months)					$ 446,384.00	
Present Worth Cost of $446,384 per year for 20 years at 7% discount rate =						**$ 4,729,000.00**

Notes

1: Present value costs use a discount rate of 7% over the O&M performance period.

2: Vapor mitigation system O&M costs include indoor air sampling after 5 years and 10 years. Present value costs assume a 7% discount rate.

Thermal source area treatment does not have an O&M component as costs are expected to be incurred during the first year of the RA.

LS = Lump Sum

GAL = Gallon

Appendix C.
NMED Concurrence With the Selected Remedy

State of New Mexico
ENVIRONMENT DEPARTMENT
Office of the Secretary
Harold Runnels Building
1190 St. Francis Drive, P.O. Box 26110
Santa Fe, New Mexico 87502-6110
Telephone: (505) 827-2855
Fax: (505) 827-2836

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

DERRITH WATCHMAN-MOORE
DEPUTY SECRETARY

June 16, 2006

Mr. Samuel J. Coleman, P.E.
Director
Superfund Division
USEPA Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

RE: Concurrence on Record of Decision for the Grants Chlorinated Solvents Plume Superfund Site, Grants, New Mexico
EPA CERCLIS ID #NM0007271768

Dear Mr. Coleman,

The New Mexico Environment Department (NMED) has reviewed the United States Environmental Protection Agency's (EPA) Draft Record of Decision (ROD) for the Grants Chlorinated Solvents Plume Superfund Site located in Grants, New Mexico.

NMED concurs with the remedial actions outlined in the draft ROD to address contamination associated with this Site including:

1. Indoor Air – Vapor Mitigation System
2. Source Area – Thermal Treatment
3. Shallow Ground Water Plume and Hot Spot – In-Situ Chemical Oxidation (ISCO) with Follow-On Enhanced Reductive Dechlorination (ERD)
4. Shallow Ground Water Plume Periphery – ERD
5. Deeper Ground Water contamination – ERD

NMED appreciates EPA's acceptance of a 1×10^{-5} risk factor for soil and vapor intrusion clean up levels which are in line with NMED risk based clean up guidance. In addition, NMED is pleased with the aggressive treatment technology selected to address Indoor Air Vapor Intrusion, the Source Area and the Shallow Ground Water Plume Core and Hot Spot.

NMED's concurrence is based on the facts presented in the draft ROD and on available data collected to date. NMED understands that any changes to the selected remedy will require NMED concurrence.

Please note that based upon the current available site data, NMED does not support the contingency in the draft ROD for potentially using Enhanced Reductive Dechlorination (ERD) as a stand alone technology in the Shallow Ground Water Plume Core and Hot Spot Area as it may adversely impact the overall effectiveness and timeframe of the clean up. Similarly, at this time, it is NMED's position that the contingency in the draft ROD for the potential use of Monitored Natural Attenuation as a remedial strategy for the Shallow Ground Water Plume Periphery and Deeper Ground Water contamination is not appropriate for the same reasons listed above. NMED also understands that any new information associated with this site, including adverse health risks or data regarding the extent of contamination and migration of contaminants, identified during subsequent design investigations and not presented in this draft ROD will be addressed by EPA as part of this Superfund site.

This draft ROD is a culmination of cooperative work conducted by the EPA and NMED. As in the past, NMED project staff will continue to work closely with EPA staff on design and implementation of the remedy. NMED appreciates the continued supportive working relationship with EPA in these matters. If you have any questions, please call me at (505) 827-2855, or Steve Jetter of my staff at (505) 827-2334.

Sincerely,

Ron Curry
Secretary

RC:sj

cc: Sai Appaji, EPA Remedial Project Manager
Don Williams, EPA, Team Leader
Dana Bahar, NMED Superfund Oversight Section Manager
Steve Jetter, NMED Project Manager

Appendix D.
Responsiveness Summary

Stakeholder Issues and Lead Agency Responses

NMED Comments

Comment 1

In reference to the Land and Ground Water Use Assumptions - NMED emphasizes that the New Mexico Water Quality Control Commission (NMWQCC) Regulations, NMAC 20.6.2.4101.A(1) requires that all ground water of the State of New Mexico with a TDS of <10,000 mg/l be remediated or protected for use as domestic and agricultural water supply. Although the contaminated ground water (from 5 to 80 ft bgs) at the site is not currently used as a drinking water supply, there are no enforceable institutional controls that would prohibit the use of this aquifer, now or in the future, as a drinking water supply. The fact that three shallow private wells exist within the site boundaries is evidence that the aquifer can be used for beneficial use. As proposed, ground water must be remediated to the more stringent requirements of the Federal Safe Drinking Water standards (MCLs) and/or NMWQCC standards.

EPA Response:

Comment noted. EPA's final clean up levels for the COCs at this Site is federal MCL and NMWQCC standards.

Comment 2

Preliminary Remediation Goals and use of $1x10^{-4}$ excess lifetime cancer risk (ELCR) as the targeted cleanup level - The National Contingency Plan established a targeted risk level 1×10^{-6} as a "point of departure" for determining remediation goals. There has been no justification presented by EPA to modify this targeted risk level and justify the use of a less stringent risk-based clean up level. At a minimum, an ELCR of 1×10^{-5} and an HI of 1 which is consistent with the NMWQCC Regulations and NMED's *Technical Background Document for Development of Soil Screening Levels, Revision 3.0, August 2005,* should be used for establishing targeted cleanup levels for indoor air and soil. NMED requests that the PRGs for COCs in soil and from vapor impacts be established using at least a 1×10^{-5} ELCR and an HI of 1 and a residential land use scenario.

EPA Response:

1E-06 is the point of departure, and EPA has the flexibility to modify cleanup levels for carcinogens within the range of 1E-06 to 1E-04, especially when considering site-specific conditions. This is indicated in the NCP (40 CFR 300.430(e)(2)(i)(A)(*2*):

"For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} *and* 10^{-6} *using information on the relationship between dose and response."*

The EPA agrees with NMED's concerns regarding uncertainties at the Site and will take Remedial Action at the lower risk level ($1x10^{-5}$).

Comment 3

In reference to risk and the preliminary remediation goals. NMED does not support the use risk based clean up levels that are less stringent than residential clean up levels for this site. The site is located in a mixed commercial and residential use area and there are no enforceable institutional controls that can be implemented to restrict future land use. Therefore, the more restrictive clean up levels, i.e. residential, should be used.

EPA Response:

EPA will use NMED's Guidance document (Technical Background Document for Development of Soil Screening Levels, Revision 3.0, August 2005) on Soil Screening Levels to establish clean up levels based on residential use.

Comment 4

In reference to the flexible approach in selection of the final remedy for the Shallow Plume Core and Hot Spot Area - NMED is concerned with how the final selection between ISCO and ERD will be determined due to the difficulties associated with detecting the DNAPL in the field. NMED is concerned that a significant amount of time and expense could be expended without conclusively determining whether or not DNAPL is absent from this area. In addition, the pre-design investigations proposed in the Feasibility Study did not include investigation activities associated with determining the nature and extent of DNAPL but instead concentrated on definition of the dissolved phase plume and soil contamination in the two source areas. As stated in the RI report and in literature on the subject, it is generally assumed that DNAPL is present if ground water exceeds 1 to 5 percent of the chemicals solubility limit in water and the dissolved PCE concentrations observed within the Plume Core Area are as high as 35%. At this concentration it should be assumed that DNAPL is present in close proximity to the sample locations and ISCO is better suited for this condition. Finally, because ISCO with follow-on ERD alternative addresses the entire plume through the installation of a grid pattern of wells the ISCO alternative is more amenable to treating the Core Plume/Hotspot area verses the passive nature of diffusion associated with the ERD alternative. If residual DNAPL is present between the ERD bio-barriers, the likelihood of effective and timely clean-up using the ERD bio-barrier alternative is greatly reduced. Therefore, NMED may not support the use of ERD as the stand alone remedial technology for the Shallow Plume Core and Hot Spot area.

EPA Response:

EPA's policy is to treat principal threats posed by the Site through use of treatment technologies. By utilizing treatment as a significant portion of the Selected Remedy, the statutory preference for remedies that employ treatment as a principal element is satisfied. The EPA agrees and will select ISCO with Follow-On ERD (Flexible) treatment approach for the Shallow Plume Core and Hot Spot for the following reason:

Thermal treatment at the Source Area is expected to achieve complete removal of principal threat waste. After Source Area treatment is complete and if it can be demonstrated that the principal threat waste no longer exists in the Shallow Plume Core and Hot Spot area then the EPA will re-evaluate the two treatment technologies (ISCO/with Follow-On ERD or ERD alone) to determine which one of these better meets the Statutory Preference for Treatment. Based on this determination the EPA will implement either of the two technologies to address the Shallow Plume Core and Hot Spot Area.

Community Comments

The following comments were received from members of the public that were in attendance at the Proposed Plan public meeting held on April 20, 2006.

Comment 1
How was the contamination originally verified at the GCSP Site?

EPA Response:

The NMED-PSTB discovered chlorinated solvents in ground water at the GCSP Site during a UST investigation at the Allsup's 200 gas station in 1993. Following the discovery, NMED conducted two years of ground water monitoring at the Allsup's monitoring wells to verify contamination.

Comment 2
Are the depths of the City Drinking Water wells known?

EPA Response:

Yes. City well Grants B-40 is screened at a depth from 246 feet (ft) below ground surface (bgs) to 346 ft bgs and the total depth of the well is 367 ft bgs. The second City well, Grants B-38, is screened between 149 ft bgs and 300 ft bgs and the total depth of this well is 300 ft bgs. Both of these wells are upgradient and are located approximately 1.5 miles northwest of the GCSP Site.

Comment 3
Are the City wells located in the same aquifer that is impacted at the GCSP Site?

EPA Response:

No. The contamination at the GCSP Site is in a shallow aquifer and the vertical extent is not fully known at this time. The City drinking water wells pump water from much greater depths, and are upgradient of the GCSP Site. The maximum depth at which contamination was detected during the RI is 85 ft bgs. The EPA will fully characterize the maximum depth of contamination during the Pre-Design Field Investigation.

Comment 4
Is the project funded for the Remedial Design?

EPA Response:

Yes. Funding for Remedial Design has been planned for fiscal Year 2006.

Comment 5
Are there many other sites in the country similar to Grants?

EPA Response:

Yes. There are a number of other Superfund sites in the country that are similar to Grants. In New Mexico alone there are five sites, including the GCSP Site, where EPA is cleaning up ground water contaminated with chlorinated solvents. These five sites include Fruit Avenue Plume, Albuquerque; North Railroad Avenue Plume, Espanola; McGaffey and Main, Roswell; Griggs and Walnut, Las Cruces; and the GCSP Site, Grants.

Comment 6
Is the bio-barrier wall a physical wall installed underground?

EPA Response:

Bio-barrier walls are not actual physical walls but function as a wall when nutrients are injected across sections of the plume. Injection points are closely spaced along a line across the plume, such that the aquifer between each injection point is filled with the injected oxidant or carbon source amendment. When the oxidant or carbon source amendments are injected into the ground they permeate into the aquifer and begin treating the ground water.

Zero-valent iron permeable reactive barriers are actual physical walls constructed of iron filings installed within trenches dug across the plume. The walls required for the GCSP Site would be as thick as 36 inches and up to 60 ft deep. A zero-valent iron permeable reactive barrier was considered as one of the alternatives for the Site but was not chosen as the Selected Remedy.

Comment 7

Will the public be notified when a final decision is made regarding the Preferred Remedy?

EPA Response:

Yes. The EPA will notify the community of the final selection of the remedy after it reviews and responds to all the comments received during the comment period. Newspaper notification will be made in the local newspaper when the Record of Decision is signed.

Appendix E.
NRRB Comments and EPA Region 6 Responses

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
DALLAS, TX 75202

MEMORANDUM

SUBJECT: Response to the National Remedy Review Board (NRRB) Comments for the Grants Chlorinated Solvents Plume Superfund Site

FROM: Samuel Coleman, Director
National Remedy Review Board 5/25/06

THROUGH: Donald Williams
Team Leader, Supefund Division

TO: David E. Cooper, Chair
National Remedy Review Board
U.S EPA

Purpose

This memorandum documents the Region 6's response on the Grants Chlorinated Solvents Plume Site (Site) comments received from the NRRB's advisory committee.

NRRB Comments and EPA Region 6 Responses

NRRB Comment 1

The site information package acknowledges that data characterizing subsurface conditions, contaminant distribution, fate and transport, and risk are limited. These unknowns produce significant uncertainties in the selection, design, and implementation of remedial options and the estimated costs and time frames associated with these options. The Board recommends that the Region consider a ROD that contains a phased approach that allows flexibility in remedy design and implementation as additional characterization and performance monitoring data become available. For example, Phase I could include actions to eliminate exposure to vapors intruding into homes and thermal treatment of the source area. Phase II could include remediation of the Shallow Ground Water Plume Core and Hot Spot Area, along with shallow ground water peripheral plume and deep ground water actions.

EPA Region 6 Response to Comment 1
Region 6 agrees with the Board comment and believes that a phased approach and a ROD providing flexibility during Remedial Design (RD) and implementation will work better at the Site. Using a phased approach, additional site characterization data collected during the early phases will allow a more detailed evaluation of how best to implement subsequent phases and will streamline the work effort and provide the greatest opportunity for cost savings.

A phased approach would allow data collection efforts conducted during early phases of work to provide the evidence necessary to support the selection of MNA for certain portions of the Site. The ROD for the Site will have a contingency to switch to MNA if it can be demonstrated as an effective alternative.

NRRB Comment 2
The Board notes there is uncertainty regarding the existence of dense non-aqueous phase liquids (DNAPL) in the Shallow Plume Core and Hot Spot Area. As a result, the Board understands the concern expressed by the State of New Mexico that the enhanced reductive dechlorination (ERD) remedy may not be sufficiently effective. Therefore, the Board recommends that the Region consider the results of Phase 1 (as recommended in comment #1 above) and investigate the presence or absence of DNAPL in the Shallow Plume Core and Hot Spot Area prior to implementing a final remedy for this area.

EPA Region 6 Response to Comment 2
Region 6 agrees with the Board recommendation and has selected the more aggressive ISCO/with follow-on ERD for the Shallow Plume Core and Hot Spot Area. However, the ROD will be flexible enough to revert to using only ERD if conditions warrant. EPA Region 6 will evaluate ground water data after source removal and if it can be demonstrated that DNAPL no longer exists then EPA with NMED's concurrence will implement only the ERD component for the Shallow Plume Core and Spot Area.

NRRB Comment 3
The Board recommends, based on the results of Phase I and the investigations for the presence or absence of DNAPL, that the Region consider evaluating an alternative which uses ISCO followed by a less extensive ERD component for the Shallow Plume Core and Hot Spot Area. If ISCO is used to treat the Shallow Plume Core and Hot Spot Area aggressively, ISCO could address the potential DNAPL and significantly reduce the high concentrations of volatile organic compounds (VOCs) in ground water. The ERD component could then be optimized, which should result in a reduced number of wells, thus reducing cost. This approach would likely eliminate the bulk of the VOC contamination quickly, but may result in a longer timeframe to achieve cleanup levels. This approach may still be protective and consistent with the NCP expectation to restore ground water to beneficial use in a time frame that is reasonable given the particular circumstances of the site (e.g., given that the shallow aquifer is not currently being used).

EPA Region 6 Response to Comment 3
The EPA Region 6 agrees with the board recommendation and has structured the ROD to be flexible in applying treatment in the Shallow Plume Core and Hot Spot Area.

NRRB Comment 4
The Board recommends that the Region further evaluate the implementation of ISCO as a remedial alternative in the Source Area. In the ISCO alternative presented to the Board for the Source Areas, significant costs are included for soil excavation and disposal, as well as trench dewatering and water treatment. However, the soil excavation and disposal followed by trench dewatering and treatment components may not be required. ISCO can be an effective option for remediating organic contaminants in the unsaturated zone and its use in unsaturated zones is becoming increasingly common, thereby eliminating the need to excavate and dispose of contaminated soils. ISCO also could be used to treat organic compounds in water that collects in trenches. Oxidant injection and mixing directly in the trench would be easily implementable and likely to be successful at this site for oxidizing these contaminants, as well as for providing residual oxidant to the underlying aquifer through infiltration. Potential limitations to using the ISCO technology at the site given subsurface conditions at the site (soil, geologic, and hydrologic settings), as expressed by the New Mexico Environmental Department (NMED), also need to be considered. Further evaluation of these technical issues is recommended.

EPA Region 6 Response to Comment 4
EPA Region 6 agrees with the Board recommendation and further evaluated the ISCO alternative for the Source Area. However, given the soil conditions at the site Region 6 believes that Thermal Treatment is a better technology than ISCO for treating the Source Area. Thermal Treatment will remove the principal waste in a relatively very short time frame compared to ISCO that will require at least six years.

NRRB Comment 5
The Board agrees with the Region's preference not to include a zero-valent iron permeable reactive barrier as part of the preferred alternative. The clay and thin sandy layers present at the site may not lend themselves to this technology. Smearing of the clay along the face of the trench during excavation could significantly decrease permeability. Also, a barrier containing 100% iron and constructed to depths of 60 feet would need further study to demonstrate implementability and effectiveness. The Board recommends that the Region include a discussion of the potential limitations of installing such a deep trench and the likely decrease in permeability due to the 100% iron composition of the barrier in the decision documents to further explain its preference against this alternative.

EPA Region 6 Response to Comment 5
Comment Noted. The ZVI-PRB alternative is very expensive and would be extremely disruptive to the community when installed in a residential area. The recommended discussion will be provided in the decision document.

NRRB Comment 6
As part of the Region's preferred alternative presented to the Board, vapor intrusion mitigation systems would be installed in three residential structures. Long-term indoor air

monitoring would be undertaken at a larger number of residences situated above the ground water plume. Given the high costs of air monitoring in relation to the mitigation systems, the Board recommends that the Region consider expanding the installation of mitigation systems to all residences potentially impacted by indoor air contamination. In the event that long-term monitoring is chosen, homes above and in the proximity of the ground water plume, especially the homes near the Source Area, should be monitored to take into account preferential subsurface pathways that may exist at this site. The Board also recommends that the Region consider taking action under removal authorities at those occupied residences with vapor intrusion risks exceeding 1 x 10^{-4} lifetime excess cancer risk.

EPA Region 6 Response to Comment 6
Region 6 agrees with the Board's recommendation and has plans to install vapor mitigation systems in all homes potentially impacted by indoor air contamination (14 homes). However, the Region prefers to address vapor intrusion under its Remedial authority, as the risk is more a long term issue than imminent.

NRRB Comment 7
The Region's preferred remedial alternative for indoor air consists of the installation of three vapor mitigation systems and an indoor air monitoring program for a minimum period of five years. If the Region decides to implement the air monitoring program as described to the Board, then indoor air samples will be collected from within 14 structures overlying the groundwater plume where it exceeds a concentration of 1,000 ug/l perchloroethylene (PCE) in ground water. The Board suggests that the area to be considered for indoor air monitoring also be based on concentrations of trichloroethylene (TCE) in ground water. The Board recommends this because the Region's indoor air preliminary remediation goals (PRGs) are based on PCE *and* TCE, and the risks from TCE appear to be driving the indoor air response action more than PCE. The Board also recommends that the Region not define the study area too narrowly, considering the uncertainties in the correlation between TCE concentrations in ground water and vapor concentration.

EPA Region 6 Response to Comment 7
The text of the FS report was modified to provide for indoor air monitoring of structures overlying portions of the ground water plume exceeding PCE and/or TCE concentrations of 1,000 ug/L.

NRRB Comment 8
It is unclear from the package presented to the Board whether benzene, toluene, ethylbenzene, xylene, and methyl tert-butyl ether (MTBE) are contaminants of concern for the site, because they are related to a different source and are being addressed by NMED-Petroleum Storage Tank Bureau. Similarly, the package does not provide much information on bromoform, but it is also identified as a contaminant of concern. The Region should be clear in decision documents whether these contaminants are actually contaminants of concern for the site. If they are, then remedial goals addressing these contaminants should be developed.

EPA Region 6 Response to Comment 8
MTBE was not identified as a contaminant of concern (COC) for site ground water within the Baseline Human Health Risk Assessment Report (BHHRA). BTEX compounds were identified as COCs for the site within the BHHRA, but the FS report discusses the fact that the BTEX compounds are being addressed separately under the NMED Petroleum Storage Tank Bureau (PSTB). BTEX compounds that are co-mingled in the chlorinated solvent plume will be addressed as part of the remedy. However, Region 6 is concerned that BTEX remedial goal will not be attained in areas that are not co-mingled. Therefore no specific remedial goals have been set for BTEX.

Bromoform was identified in samples submitted to the Contract Laboratory Program (CLP) labs during the Remedial Investigation, but was not detected in split samples submitted to a separate laboratory. Bromoform is not considered a common laboratory contaminant, but is one of three trihalomethane compounds commonly associated with water disinfection processes. A determination of the presence or absence of bromoform in site ground water is anticipated during the Preliminary Field Investigation.

NRRB Comment 9
The Board recommends that the cost estimates provided be reviewed and, as appropriate, revised to ensure accuracy and consistent consideration of costs in the decision documents. The following are specific concerns identified by Board members that should, at a minimum, be addressed in this cost review:

a. Ground water pump and treat costs for the three zones are shown as individual cost estimates in the package. The decision documents should also contain information on the cost for pump and treat as a stand-alone, site-wide remedy. This alternative can clarify that all ground water pump and treat costs are not cumulative; for example, the cost to install the treatment plant will not be incurred a second time if pump and treat is selected for both Shallow Ground Water Plume Core and Deeper Ground Water.
b. The thermal treatment costs are not sufficiently itemized and appear to be low, based on the experience of other Regions.
c. The costs to conduct five-year review evaluations appear to be over-estimated based on the experience of other Regions.
d. The O&M for vapor intrusion remediation should not be zero, as the cost of blower replacements should be considered.
e. It was unclear to the Board how cost of treatability studies was included.
f. Costs for the ISCO alternative for the Source Area appear to be over-estimated based on the experience of other Regions. See comment 4 on components that may warrant reconsideration.

EPA Region 6 Response to Comment 10
The EPA has reviewed the cost estimates as recommended by the Board and has the following responses to the specific concerns raised by the Board:

a. Region 6 has evaluated the pump and treat costs for the three zones as a stand-alone, site-wide remedy. However, based on site characteristics, the region did not include this stand-alone remedial alternative in the Record of Decision.

b. The thermal treatment costs are based on two separate vendor quotes and were increased based on the contractor's experience with costs for drilling in New Mexico. The vendors did not provide a detailed breakdown of costs but the contractor has provided a more detailed cost estimated to Region 6. One potential reason for a reduced estimated cost for thermal treatment at the GCSP site is the low permeability of the shallow aquifer leading to a low flux of recharge water through the treatment zone which otherwise create a significant cooling effect.
c. The Five-Year Review costs are comparable to other sites in the region. The region expects that after the first Five-Year Review subsequent review costs to be lower.
d. The region has included O&M Costs for vapor mitigation systems and provided these in the Record of Decision.
e. Treatability studies (pilot-scale tests) of applicable treatment technologies were included in the estimated costs for 'Pre-Construction Activities' within the summary cost tables provided in the FS report.
f. Region 6 has requested the experts at the National Risk Management Research Laboratory, Ada, OK, to review costs for the ISCO alternative in the Source Area. Any revisions to the estimated costs will be updated as part of the Remedial Design.

NRRB Comment 10
Based on the information presented to the Board, the Board understands that the Region has been planning to implement the remedy in the primary Source Area while leaving the relatively large building housing the dry cleaner in place. Because the effectiveness of the shallow ground water remedy is dependent on thorough removal of the Source Area, the Region should fully evaluate the effectiveness of any remedy for the area under the building.

EPA Response to Comment 10
While Source Area treatment would be greatly simplified (and less expensive) without an overlying building, the thermal treatment and the other alternatives considered in the FS are effective even with the building in place. The region evaluated the implementation of the Source Area remedy without the dry cleaner building in place. However, cleanup can be accomplished without removing the building. This reduces EPA costs and any hardship to the business related to removing the building.

NRRB Comment 11
The Board notes that the New Mexico soil screening guidance is not an Applicable or Relevant and Appropriate Requirement (ARAR). It might be a "to be considered" guidance under the National Contingency Plan for the soil cleanup itself. The Board recommends that the Region explain the role, if any, of the soil screening guidance in selecting soil cleanup levels for ground water protection, where maximum contaminant levels are ARARs at this site.

EPA Response to Comment 11
Region 6 agrees that New Mexico soil screening levels (SSLs) are not ARARs, but they are To-Be-Considered (TBC) criteria. However, NMED has clearly stated that because of the

residential setting at the site soil cleanup should be performed to protect the public from exposure to contaminated soil.

NRRB Comment 12

The preferred alternative includes monitored natural attenuation (MNA) as a contingent remedy. However, no data were presented to the board to demonstrate that MNA is occurring or will occur in the future; consequently, the Board cannot evaluate the effectiveness of MNA. However, based on the presentation and discussion at the meeting, the Board recommends that the Region consider MNA as a component of the preferred alternative which will follow active remediation rather than as a contingent remedy if the active remedy does not work. Active remediation can be used to significantly reduce the mass of contamination, with the MNA component used to achieve final cleanup levels. The Board recommends that the Region clarify in the decision documents how MNA may be triggered and its technical basis, consistent with Use of Monitored Natural Attenuation at Superfund, RCRA, Corrective Action, and Underground Storage Tank Sites, OSWER Directive 9200.4-17P, April 21, 1999.

EPA Response to Comment 12

Region 6 will evaluate the site conditions to determine if monitored natural attenuation (MNA) is a viable remedial alternative during the Five-Year Review reporting period. Once source control has been established in the source areas and Shallow Ground Water Plume data indicates evidence of MNA, EPA, with NMED concurrence, may switch from the active remedy to MNA for the Shallow Ground Water Periphery and Deeper Ground Water Plume. The ROD for the site documents the stated language.

NRRB Comment 13

The Board notes that one of the costs associated with site cleanup appears to be payment of State tax on engineering services. The Board encourages the Region's efforts in working with the State to reach agreement on issues involving a waiver of this tax. The Board recommends for this situation that the Region ensure that the New Mexico tax be handled in a manner that is consistent with the Agency's ongoing cost management initiative.

EPA Response to Comment 12

Comment noted. Region 6 will continue to pursue relief from the tax where appropriate with the New Mexico Department of Taxation and Revenue regulations.

Region 6 thanks the NRRB for the recommendations and appreciates the value it brings to the Superfund Program. Please call me at (214) 665-6701 should you have any questions.

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