Table ES-1
Comparative Analysis of Remedial Alternatives
Griggs and Walnut Ground Water Plume
Las Cruces, New Mexico

Remedial Alternative	**Alternative 1 - No Action**	**Alternative 2 - Ground Water Extraction with Blending**	**Alternative 3 - Ground Water Extraction with Treatment**	**Alternative 4 - Enhanced Ground Water Extraction with Treatment**	**Alternative 5 - In-Well Stripping in Higher Concentration Areas of the Ground Water Plume**
THRESHOLD CRITERIA[1]					
Overall protection of human health and the environment[1]	NO – No action would be performed and RAOs would not be met. Elevated levels of contaminants exist above the MCLs and will continue to threaten human health and the environment through migration and possible increases in contaminant detections in municipal supply wells.	YES – Hydraulic containment and reduction in contaminant detections in the aquifer by pumping and blending ground water will meet RAOs, thereby reducing risk to human health and the environment.	YES – Hydraulic containment and reduction in contaminant detections in the aquifer by pumping and active treatment will meet RAOs, thereby reducing risk to human health and the environment.	YES – Hydraulic containment and reduction in contaminant detections in the aquifer by pumping higher-concentration zones and active treatment will meet RAOs, thereby reducing risk to human health and the environment.	YES – Hydraulic containment and reduction in contaminant detections in the aquifer by active treatment will meet RAOs, thereby reducing risk to human health and the environment.
		Removal of contaminants from the ground water restores the aquifer to its beneficial use. The JSP ground water fate and transport model predicts elevated levels of PCE will persist for about 23 years.	Removal of contaminants from the ground water restores the aquifer to its beneficial use. The JSP ground water fate and transport model predicts elevated levels of PCE will persist for about 21 years.	Removal of contaminants from the ground water restores the aquifer to its beneficial use. The JSP ground water fate and transport model predicts elevated levels of PCE will persist for about 14 years.	Removal of contaminants from the ground water restores the aquifer to its beneficial use. Based on JSP ground water fate and transport modeling of other alternatives, it is anticipated with this alternative that elevated levels of PCE will persist for about 20 years.
		Provides protection of human health through blending of contaminated ground water to below MCLs with clean water prior to distribution into the public drinking water supply. Note: blending can be effective, but does not constitute “treatment”.	Provides protection of human health through treatment of contaminated ground water to below MCLs prior to distribution into the public drinking water supply.	Provides protection of human health through treatment of contaminated ground water to below MCLs prior to distribution into the public drinking water supply.	Provides protection of human health through treatment of contaminated ground water to below MCLs prior to distribution into the public drinking water supply.

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Overall protection of human health and the environment, continued[1]		This alternative relies on above-ground (ex-situ) blending which does not constitute treatment. The contaminant remains in the water and is simply diluted.	This alternative relies on above-ground (ex-situ) treatment, which will, depending on the technology chosen, either transfer the contaminants from ground water to another medium (e.g. air) or destroy the contaminants (e.g. chemical/UV oxidation).	This alternative relies on above-ground (ex-situ) treatment, which will, depending on the technology chosen, either transfer the contaminants from ground water to another medium (e.g. air) or destroy the contaminants (e.g. chemical/UV oxidation).	This alternative relies on a combination of in-well treatment using air stripping and above-ground (ex-situ) treatment using Granular Activated Carbon (GAC), both of which transfer the contaminants from ground water to another medium (e.g. air).
		Active long-term monitoring in the aquifer and the blending effluent is required to confirm hydraulic containment and compliance with ARARs (e.g. MCLs). Maintaining a proper blending program is less reliable than treatment alternatives due to the potential fluctuation in concentrations. More frequent monitoring may be required than for other alternatives to ensure blending ratio is appropriate and concentrations are consistently maintained below the MCL prior to distribution into the public drinking water supply.	Active long-term monitoring in the aquifer and in the treatment effluent is required to confirm hydraulic containment and compliance with ARARs (e.g. MCLs).	Active long-term monitoring in the aquifer and the treatment effluent is required to confirm hydraulic containment and compliance with ARARs (e.g. MCLs).	Active long-term monitoring in the aquifer and the treatment effluent is required to confirm hydraulic containment and compliance with ARARs (e.g. MCLs).
		This alternative involves low risk to workers from affected ground water or the	This alternative involves low risk to workers from affected ground water or the	This alternative involves low risk to workers from affected ground water or the	This alternative involves low risk to workers from affected ground water or the

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		blending process during active remedial action and O&M.	treatment process during active remedial action and O&M.	treatment process during active remedial action and O&M.	treatment process during active remedial action and O&M.
Compliance with ARARs[1]	NO - Not compliant. No action would be performed, and drinking water would not meet MCLs.	YES – Provides drinking water that meets MCLs. Also, provides restoration of the aquifer to its beneficial use as a drinking water supply (within about 23 years as predicted by the JSP model). May require more frequent monitoring than other alternatives to ensure MCLs are met prior to distribution to the drinking water supply.	YES – Provides drinking water that meets MCLs. Also, provides restoration of the aquifer to its beneficial use as a drinking water supply (within about 21 years as predicted by the JSP model). Requires monitoring to ensure MCLs are met prior to distribution to the drinking water supply.	YES – Provides drinking water that meets MCLs. Also, provides restoration of the aquifer to its beneficial use as a drinking water supply (within about 21 years as predicted by the JSP model). Requires monitoring to ensure MCLs are met prior to distribution to the drinking water supply.	YES – Provides drinking water that meets MCLs. Also, provides restoration of the aquifer to its beneficial use as a drinking water supply (within about 20 years as estimated based on the JSP modeling of other alternatives). Requires monitoring to ensure MCLs are met prior to distribution to the drinking water supply.
BALANCING CRITERIA					
Long-term effectiveness and permanence	No action would be performed. Contaminants would remain in the aquifer above MCLs for an indefinite period (predicted by the JSP model to be longer than 30 years).	Removal of contaminants from the ground water will meet RAOs and restore the aquifer to its beneficial use (within the JSP model-predicted time frame of about 23 years).	Removal of contaminants from the ground water will meet RAOs and restore the aquifer to its beneficial use (within the JSP model-predicted time frame of about 21 years).	Removal of contaminants from the ground water will meet RAOs and restore the aquifer to its beneficial use (within the JSP model-predicted time frame of about 14 years).	Removal of contaminants from the ground water will meet RAOs and restore the aquifer to its beneficial use (within about 20 years, as estimated based on the JSP modeling for other alternatives).
	The JSP ground water fate and transport model predicts future plume expansion, with impacts to well GWMW11 and CLC Well No. 26.	The potential for plume expansion is minimized through the use of hydraulic containment.	The potential for plume expansion is minimized through the use of hydraulic containment.	The potential for plume expansion is minimized through the use of hydraulic containment.	The potential for plume expansion is minimized through the use of hydraulic containment.

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Long-term effectiveness and permanence, continued		Pumping rates set at the minimum long-term average pumping rate needed to maintain hydraulic containment.	Higher pumping rates than used in Alternative 2 provide higher likelihood of success in achieving and maintaining hydraulic containment and restoring the aquifer.	Targeted pumping provides higher likelihood of success in restoring the aquifer in a shorter period compared to Alternatives 2 and 3.	Targeted in-situ treatment provides higher likelihood of success in restoring the aquifer compared to Alternatives 2 and 3.
Reduction of toxicity, mobility, or volume (TMV) through treatment	No action would be performed and no overall reduction of TMV through treatment would occur.	No overall reduction of TMV in the contaminated ground water through treatment would occur (blending does not constitute treatment).	Provides overall reduction of TMV in the contaminated ground water through treatment.	Provides overall reduction of TMV in the contaminated ground water through treatment.	Provides overall reduction of TMV in the contaminated ground water through treatment.
Short-term effectiveness	No action would be performed, and drinking water would not meet MCLs.	Low risks to workers, the community, and the environment in the short-term are expected. Low risk to the community associated with the use of the blended ground water for drinking water as long as pumping rates to control blending to below the MCL are maintained and adequate controls are in-place to warn of system failure. There is the potential for failures in the blending process, including but not limited to, mechanical failure of equipment, control logic failures, or incorrect blending ratio.	Minimal to low risks to workers, the community, and the environment in the short-term are expected. Minimal risk to the community associated with the use of treated ground water for drinking as long as adequate controls are in place to warn of system failure. There is minimal potential for failure in the treatment process, including but not limited to, mechanical failure of equipment or control logic failures.	Minimal to low risks to workers, the community, and the environment in the short-term are expected. Minimal risk to the community associated with the use of treated ground water for drinking as long as adequate controls are in place to warn of system failure. There is minimal potential for failure in the treatment process, including but not limited to, mechanical failure of equipment or control logic failures.	Minimal to low risks to workers, the community, and the environment in the short-term are expected. Minimal risk to the community associated with the use of treated ground water for drinking as long as adequate controls are in place to warn of system failure. There is minimal potential for failure in the treatment process, including but not limited to, mechanical failure of equipment or control logic failures.

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Short-term effectiveness, continued		Low risk to workers and to the environment from affected ground water are anticipated during production and O&M.	Low risk to workers during construction and maintenance of the ex-situ treatment unit. The use of a non-destructive treatment technology (i.e., air stripping or GAC) transfers the contaminants to another medium, posing a short-term risk to human health and the environment by the production of air emissions or a waste that requires proper handling and disposal. The chemicals used for certain treatment units (i.e., air stripper with pretreatment and chemical/UV oxidation) provide a risk to workers if not properly handled and disposed. Meeting ARARs for emissions and waste handling and OSHA-training for workers minimizes short-term risks to workers.	Low risk to workers during construction and maintenance of the ex-situ treatment unit. The use of a non-destructive treatment technology (i.e., air stripping or GAC) transfers the contaminants to another medium, posing a short-term risk to human health and the environment by the production of air emissions or a waste that requires proper handling and disposal. The chemicals used for certain treatment units (i.e., air stripper with pretreatment and chemical/UV oxidation) provide a risk to workers if not properly handled and disposed. Meeting ARARs for emissions and waste handling and OSHA-training for workers minimizes short-term risks to workers.	Low risk to workers during construction and maintenance of the in-well and ex-situ treatment units. The use of a non-destructive treatment technology (i.e., air stripping or GAC) transfers the contaminants to another medium, posing a short-term risk to human health and the environment by the production of air emissions or a waste that requires proper handling and disposal. The chemicals used for certain treatment units (i.e. air stripper with pretreatment) provide a risk to workers if not properly handled and disposed. Meeting ARARs for emissions and waste handling and OSHA-training for workers minimizes short-term risks to workers.
		This alternative requires installation of additional wells (for ground water monitoring) that could pose a low risk to workers during installation. OSHA-training for workers minimizes short-term risks to workers.	This alternative requires installation of additional wells (for ground water monitoring) that could pose a low risk to workers during installation. OSHA-training for workers minimizes short-term risks to workers.	This alternative requires installation of additional wells (for ground water extraction and monitoring) that could pose a low risk to workers during installation. OSHA-training for workers minimizes short-term risks to workers	This alternative requires installation of additional wells (for ground water treatment, extraction, and monitoring) that could pose a low risk to workers during installation. OSHA-training for workers minimizes short-term risks to workers.

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Implementability	No action to implement.	Easy to implement because the majority of the initial infrastructure is already in place.	The ground water extraction technologies considered under this alternative are commonly used, and are generally easy to install and maintain.	The ground water extraction technologies considered under this alternative are commonly used, and are generally easy to install and maintain.	The ground water extraction technologies considered under this alternative for hydraulic containment are commonly used and are generally easy to install and maintain.
		If the availability of sufficient clean water for blending decreases with increasing concentrations in the extracted water, significant changes to infrastructure or the addition of another treatment technology could become necessary over time. May require more frequent monitoring than other alternatives to ensure MCLs are met prior to distribution to the drinking water supply.	Of the three treatment options considered under this alternative: (1) the air stripper may require pretreatment for scaling (preliminary evaluations indicate the potential for scaling is borderline); (2) GAC treatment requires periodic carbon replacement and disposal; and (3) chemical/UV oxidation requires a continuous source of chemicals.	Of the three treatment options considered under this alternative: (1) the air stripper may require pretreatment for scaling (preliminary evaluations indicate the potential for scaling is borderline); (2) GAC treatment requires periodic carbon replacement and disposal; and (3) chemical/UV oxidation requires a continuous source of chemicals.	The in-well air stripping might result in scaling in wells, and some chemical addition may be required. Additional mechanical equipment and infrastructure associated with this alternative increases O&M costs over the other alternatives.
		Pretreatment not required.	The potential need for pretreatment to address scaling under air stripping option should be considered in more detail during the RD.	The potential need for pretreatment to address scaling under air stripping option should be considered in more detail during the RD.	The need for pretreatment to address scaling associated with in-well air stripping should be considered in more detail during the RD.
		No modifications to existing wells required, other than the addition of piping between CLC Well Nos. 18 and 27, and O&M.	No modifications to existing wells required, other than the addition of piping between CLC Well Nos. 18 and 27, and O&M.	Modifications to the pumping wells and the addition of new extraction wells somewhat increases the difficulty of this alternative.	Installation of in-situ treatment wells and the addition of an extraction well for containment somewhat increases the difficulty of this alternative.

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Costs (Present worth)	**None** – requires no additional expenditure.	**$10.2 MM**	**$15.6 – $18.4 MM** Air stripping without pretreatment: $16.6 MM[2] GAC: $15.6 MM Chemical/UV oxidation: $18.4 MM	**$13.3 - $15.4 MM** Air stripping without pretreatment: $13.8 MM[2] GAC: $13.3 MM Chemical/UV oxidation: $15.4 MM	**In-well air stripping and GAC for ground water extracted to maintain hydraulic containment: $31.9 MM [3,4]**
-30% to +50% range:	**None** – requires no additional expenditure.	**$7.1 to 15.2 MM**	**$10.9 to $27.6 MM**[2] Air stripping without pretreatment: $11.6-$24.9 MM[2] GAC: $10.9-23.5 MM Chemical/UV oxidation: $12.9-27.6 MM	**$9.3 to $23.1 MM**[2] Air stripping without pretreatment: $9.6-$20.6 MM[2] GAC: $9.3-20.0 MM Chemical/UV oxidation: $10.8-23.1 MM	**$22.3 to 47.8 MM**[3,4]

Notes:

1. To be eligible for selection, an alternative must meet the two threshold criteria, or in the case of ARARs, must justify why a waiver is appropriate. For this reason, each alternative either meets the criterion (i.e., Yes) or does not meet the criterion (i.e., No).
2. A preliminary evaluation indicates the potential for scaling is borderline under the ex-situ air stripping treatment option. The Ryznar Stability Index (RSI) calculated for CaCO3 scaling potential at GWP is 6.1; RSI less than 6 indicates higher potential for scaling. The Langlier Index (LI) calculated for CaCO3 scaling potential at GWP is 0.9; LI greater than 1 indicates higher potential for scaling. Because the assumptions used in making these calculations can greatly affect the result, a more detailed evaluation of scaling potential must be performed during the RD.

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

   Alternative 3: Air stripping with acid pretreatment: $22.9 MM; +50/-30% range: $16.0-34.3 MM

   Alternative 4: Air stripping with acid pretreatment: $18.4 MM; +50/-30% range: $12.9-27.6 MM
3. Costs for Alternative 5 are based on ex-situ treatment using GAC as a representative option for treatment of ground water extracted to maintain hydraulic containment. Other ex-situ treatment technologies such as air stripping or chemical/UV oxidation could also be used.
4. Pretreatment for scaling may also be required for the in-well air stripping described under Alternative 5; vendor-supplied system costs include costs for pretreatment for the in-well air stripping. If the ex-situ treatment option is changed from GAC to air stripping, a more detailed evaluation of the potential for scaling and the need for pretreatment should be performed during the RD (see also Note 2).