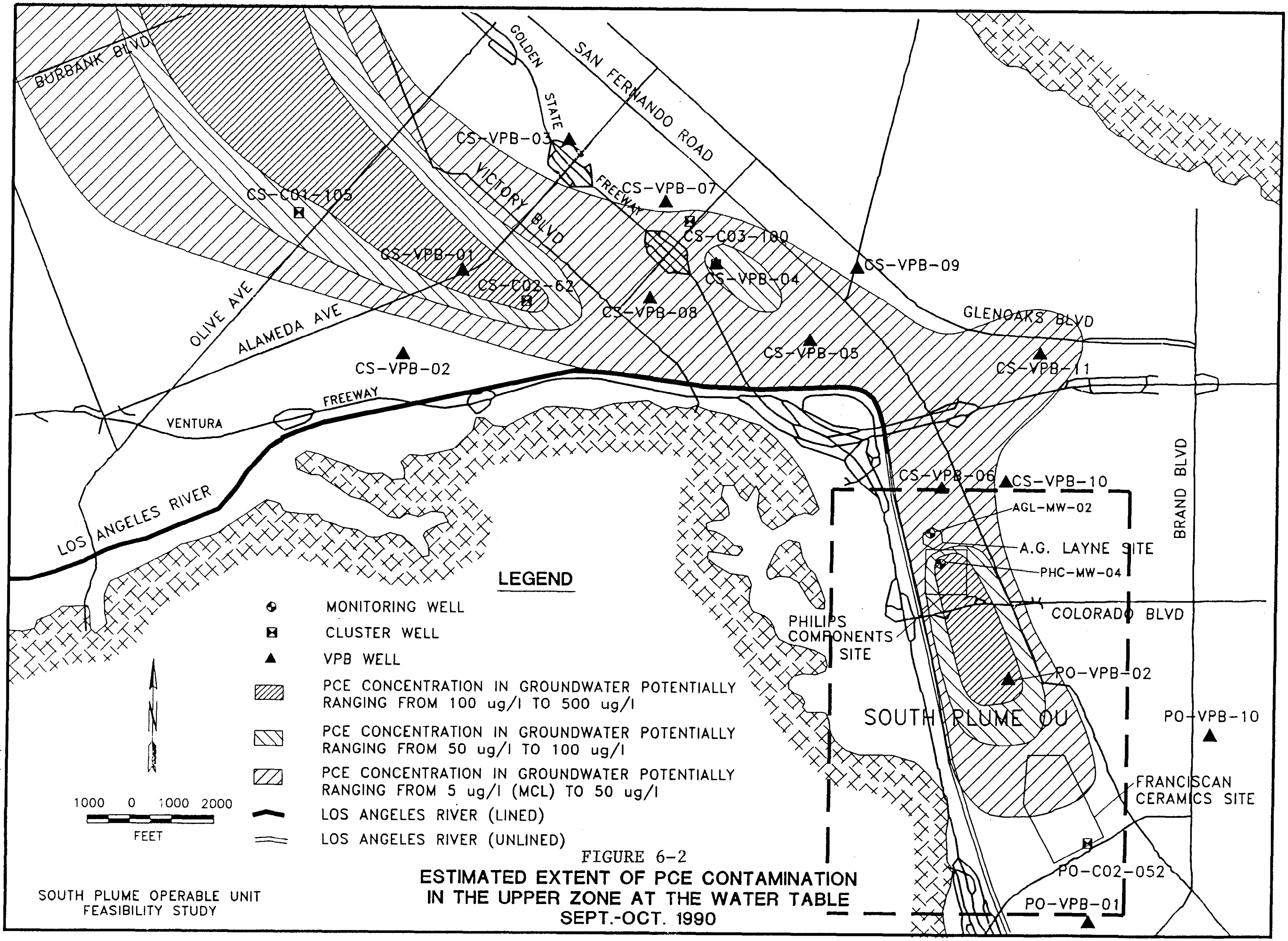
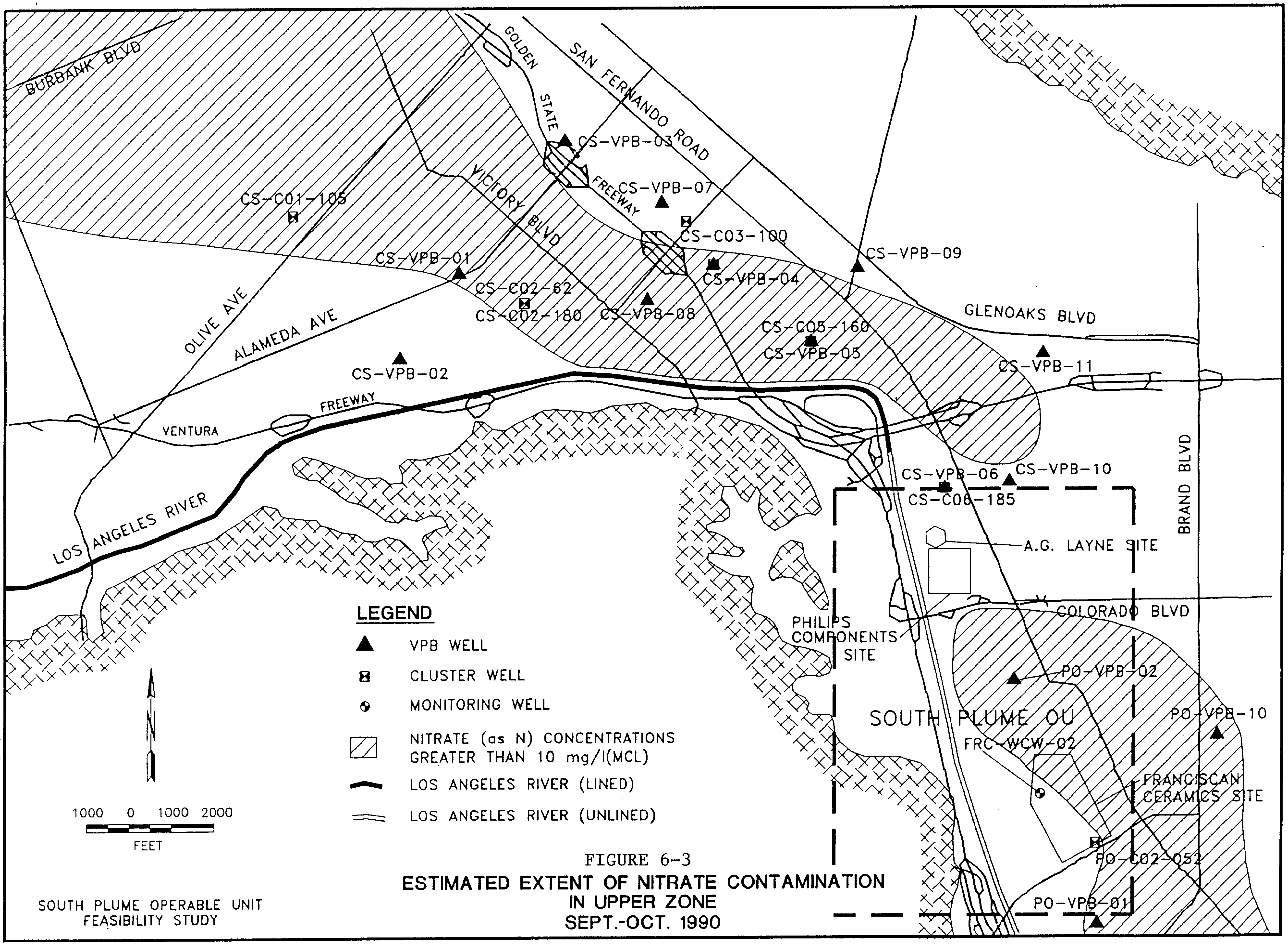


FIGURE 6-2

ESTIMATED EXTENT OF PCE CONTAMINATION IN THE UPPER ZONE AT THE WATER TABLE SEPT.-OCT. 1990

SPOUPLUM FIG12-4 REV. 08/08/92



SOUTH PLUME OPERABLE UNIT
FEASIBILITY STUDY

FIGURE 6-3
ESTIMATED EXTENT OF NITRATE CONTAMINATION IN UPPER ZONE SEPT.-OCT. 1990

10 mg/l for nitrate as nitrogen. Nitrate concentrations did not exceed MCLs in any of the Lower Zone wells. The nitrate contamination is likely the result of past agricultural practices and/or septic systems in the San Fernando Valley. Nitrate is not a CERCLA hazardous substance. However, the interim OU remedies in the San Fernando Valley involve the distribution of treated water to public water supply systems and therefore, EPA has been compelled to address the nitrate contamination in developing remedial alternatives.

From the sampling and analyses of the EPA wells, only one metal (chromium) has been detected above the MCL (when field filtering of samples occurred). No metals were detected in the Lower Zone above the MCL. An analysis of these data was performed by EPA's contractor to examine the likelihood that chromium was a waterborne contaminant rather than a sampling artifact (i.e., residual particulates from well construction and development) was presented in a technical memorandum entitled: Review of Metals Data from Monitoring Wells located in the Glendale Study Area, North Operable Unit (June 16, 1992). This memorandum, available for review in the administrative record for the Glendale South OU, concluded that the metal exceedances were most likely the result of sampling artifacts. EPA has continued to analyze groundwater samples collected under the quarterly monitoring program for priority pollutant metals. In a technical memorandum dated May 17, 1993 (available for review in the administrative record for Glendale South), recent sampling of monitoring wells for metals is summarized. Within the Glendale South OU, one well had chromium levels above MCLs; total chromium was reported as high as 733 ppb and hexavalent (dissolved) chromium as high as 182 ppb. This well likely represents contamination from a local source that would not impact extraction wells. However, if necessary, the extracted groundwater will be treated for chromium if this contaminant exceeds drinking water standard.

Thirty-one wells in the Glendale Study Area were sampled for naturally-occurring radionuclides as part of EPA's quarterly monitoring program. The samples were taken during the period of July 31 to August 7, 1992. The results of this third quarter 1992 groundwater sampling for radionuclides indicate that all EPA groundwater monitoring wells in the Glendale Study Area are in compliance with current MCLs for radionuclides (gross alpha, gross beta, gross radium, radium-226, strontium-89, strontium-90, gross uranium, tritium, and radon). In addition, the samples were also in compliance with all proposed radionuclide MCLs, except radon. The proposed MCL for Radon is 300 pCi/l. Most of the groundwater samples from the 31 monitoring wells exceeded the proposed MCL for radon. If necessary, this factor will be taken into account for remedial design. Radionuclides in the groundwater of the Glendale Study Area are discussed in greater detail in: Technical Memorandum San Fernando Valley Superfund Site, Radionuclides in the Glendale Study Area, dated March 2, 1993. This memorandum is available for review in EPA's Administrative Record for the Glendale South OU.

In addition, analysis of hydrogeology and groundwater modeling conducted during the RI for the Glendale Study Area showed that the groundwater in the area is a source of recharge for the Los Angeles River.

7.0 SUMMARY OF SITE RISKS

Data regarding contaminants in the south plume of groundwater contamination in the Glendale Study Area obtained by EPA during the remedial investigation were used to estimate the health risks associated with exposure to the groundwater. This estimate, called a risk assessment, was then used to identify which contaminants pose risks to human health. The data used for the Glendale South OU risk assessment are presented in the Remedial Investigation Report for the Glendale Study Area (January 1992) and in other documents included in the Glendale South OU Administrative Record.

Baseline risk assessments are conducted at Superfund sites to fulfill one of the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The NCP (40 CFR Part 300) requires development of a baseline risk assessment at sites listed on the National Priorities List (NPL) under CERCLA. The CERCLA process for baseline risk assessments is intended to address both human health and the environment. However, due to the highly urbanized setting of the Glendale Study Area, the focus of the baseline risk assessment for the Glendale South OU was on human health issues, rather than environmental issues.

The objective of the baseline risk assessment for the Glendale South OU was to evaluate the human health and environmental risks posed by the contaminated groundwater beneath the south plume portion of the Glendale Study Area if it were to be used as a source of drinking water without treatment. The baseline risk assessment incorporated the water quality information generated during the basinwide groundwater RI field investigation and sampling program to estimate current and future human health and environmental risks. The groundwater data used for the Glendale South OU risk assessment included the water quality information from the PO-VPB wells (with the exception of PO-VPB-10 which is outside the plume area), cluster wells, Philips Components wells, Franciscan Ceramics wells, and A.G. Layne wells.

The risk assessment for the Glendale South OU was conducted in accordance with EPA guidance including: Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA (USEPA, 1988), Risk Assessment Guidance for Superfund, Vol. I Health Evaluation Manual (Part A) and Vol. 2 Ecological Assessment (USEPA, 1989), The Exposure Factors Handbook (USEPA, 1989), and Risk Assessment Guidance for Superfund Human Health Risk Assessment, USEPA Region IX Recommendations (USEPA, 1989).

A risk assessment involves the qualitative or quantitative characterization of potential health effects of specific chemicals on individuals or populations. The risk assessment process comprises four basic steps: 1) hazard identification, 2) dose-response assessment, 3) exposure assessment, and 4) risk characterization. The purpose of each element is as follows:

- Hazard identification characterizes the potential threat to human health and the environment posed by the detected constituents.
- Dose response assessment critically examines the toxicological data used to determine the relationship between the experimentally administered animal dose and the predicted response (e.g., cancer incidence) in a receptor.
- Exposure assessment estimates the magnitude, frequency, and duration of human exposures to chemicals.
- Risk characterization estimates the incidence of or potential for an adverse health or environmental effect under the conditions of exposure defined in the exposure assessment.

Human Health Risk Assessment

Risk assessments estimate the possibility that one additional occurrence of cancer will result from exposure to contamination. A risk of 1 in 1,000,000 (one million) means that one person in one million exposed could develop cancer as a result of the exposure. EPA considers risks greater than one in ten thousand (10^{-4}) "unacceptable."

In preparing risk assessments, EPA uses very conservative assumptions that weigh in favor of protecting public health. For example, EPA may assume that individuals consume two liters of drinking water per day from wells situated within a contaminant plume, over a 70-year lifetime or that a person is exposed to a chemical, 24 hours a day, 365 days a year, for a 30-year period, even though typical exposure to the chemical would be less.

The baseline risk assessment for the Glendale South OU is presented in Section 8.0 of the Remedial Investigation Report for the Glendale Study Area (January 1992). The risk assessment estimated the potential risks to public health under current situations and potential future situations. The risk assessment examined the potential health effects if individuals were exposed to contaminated groundwater from the upper and lower zones of the aquifer of the Glendale South plume groundwater contamination in the Glendale Study Area. Although no production wellfields are located in the area encompassed by the South Plume OU, the potential exists for use of this groundwater as a source of drinking water in the future.

Chemicals of potential concern for the Glendale South OU used in the risk assessment calculations included: TCE; PCE; carbon tetrachloride; 1,1-DCA; 1,2-DCA; 1,1-DCE; nitrate and others including the metals arsenic and chromium. A list of all potential compounds of concern for both the upper and lower aquifer zones included in the quantitative risk assessment for the Glendale South OU are presented in Table 7-1. Due to the potential for adverse health effects to infants from consumption of water with high nitrate levels, a quantitative evaluation of this compound for chronic non-carcinogenic risks was calculated.

As indicated by the table, fewer compounds of potential concern were identified in samples from wells installed in the deep aquifer. Therefore, a separate characterization of risk was performed for the upper and lower groundwater zones.

Table 7-2 lists the wells in the Upper and Lower Zones that were incorporated in the risk assessment. The concentrations of contaminants in these wells used in the risk assessment are from the August and September 1990 sampling for EPA wells (PO-VPBs and PO-Cluster wells), from July 1990 sampling at A.G. Layne wells (AGLs), from August 1990 sampling at Phillips Components wells (PHCs), and March 1989 sampling at the Franciscan Ceramic wells (FRCs). A compound was totally excluded if it was not detected in any of these wells. Half of the detection limit was used if a compound was not detected in a particular well.

An exposure assessment was conducted to identify potential transport pathways (e.g., groundwater, surface water, air); routes of exposures (e.g., ingestion, inhalation, dermal contact); and potential on-site and off-site receptor populations. Exposure assessment involves the consideration of particular transport pathways and routes of exposure to potential receptors which may include current users of the site as well as adjacent populations that may be exposed to chemicals that have been transported off site. Receptors may also include aquatic and terrestrial biota.

A critical step in assessing the potential risk to public health is to identify the pathways through which exposure could occur. The major transport pathway considered in the Glendale South OU baseline risk assessment was the use of contaminated groundwater. The point of potential contact with the contaminated groundwater is through water use from the upper or lower zone.

EPA evaluated two potential methods of exposure to water from the upper and lower zones of the aquifer: (1) exposure during

TABLE 7-1

COMPOUNDS OF POTENTIAL CONCERN INCLUDED IN THE QUANTITATIVE RISK ASSESSMENT FOR THE GLENDALE SOUTH PLUME OU

Constituent	Upper Zone (YES/NO)	Lower Zone (YES/NO)
VOCs		
Benzene	Y	N
Carbon Tetrachloride	Y	N
1,1-Dichloroethane	Y	N
1,2-Dichloroethane	Y	N
1,1-Dichloroethene	Y	N
Ethylbenzene	N	N
Methylene Chloride	Y	N
1,1,2,2-Tetrachloroethane	Y	N
Tetrachloroethene	Y	N
Toluene	Y	N
1,1,1-Trichloroethane	Y	N
Trichloroethene	Y	Y
Vinyl Chloride	Y	N
Xylene, Total	Y	N
BNAs		
Bis(2-ethylhexyl)phthalate	N	Y
Di-n-octylphthalate	N	Y
2-Methylnaphthalene	Y	N
Naphthalene	Y	N
Priority Pollutant Metals		
Arsenic	Y	N
Chromium	Y	N
Inorganics		
Nitrate	Y	Y

TABLE 7-2

SUMMARY OF MONITORING WELLS USED IN THE BASELINE RISK ASSESSMENT FOR THE GLENDALE SOUTH PLUME OU

Aquifer Zone	Monitoring Wells Included in Quantitative Risk Evaluation	
Upper	PO-VPB-01	PHC-MW-11
	PO-VPB-02	PHC-MW-12
	PO-CO2-52	PHC-MW-13
	AGL-MW-1	PHC-MW-14
	AGL-MW-2	PHC-MW-15
	AGL-MW-3	PHC-OS-01
	PHC-MW-01	PHC-EW-01
	PHC-MW-02	FRC-OW-01[a]
	PHC-MW-03	FRC-OW-02[a]
	PHC-MW-04	FRC-OW-03[a]
	PHC-MW-05	FRC-OW-04[a]
	PHC-MW-06	FRC-OW-05[a]
	PHC-MW-07	FRC-WCW-01[a]
	PHC-MW-08	FRC-WCW-02[a]
	PHC-MW-09	FRC-WCW-03[a]
	PHC-MW-10	FRC-WCW-04[a]
Lower	PO-CO1-195	
	PO-CO1-354	
	PO-CO2-205	

[a] Results available only for priority pollutant metals and nitrate

residential use and (2) exposure from discharge into the Los Angeles River.

EPA included three potential exposure routes in the Glendale North OU risk assessment: (1) drinking the groundwater during residential use and (2) inhaling the chemicals in groundwater vapors during showering. Dermal contact was also considered but was found by EPA not to pose a significant risk.

In accordance with current scientific opinion concerning carcinogens, it is assumed that any dose, no matter how small, has some associated response. This is called a nonthreshold effect. In the risk assessment for the Glendale South OU, the non-threshold effect was applied to all probable carcinogens. EPA has classified carcinogens with regard to the epidemiologic and toxicologic data available. The assessment of noncarcinogenic effects is complex. There is a broad interaction of time scales (acute, subchronic, and chronic) with varying kinds of effects. In addition, there are various levels of "severity" of effect. The Hazard Index is used to determine the potential for adverse health effects resulting from exposure to non-carcinogenic chemicals.

The Hazard Quotient is defined as the ratio of a single exposure level over a specified time period to a reference dose for that substance derived from a similar exposure period. A reference dose (RfD) is EPA's preferred toxicity value for evaluating non-carcinogenic effects resulting from exposures at Superfund sites. The Hazard Index is the sum of more than one Hazard Quotient for multiple substances or multiple pathways. The Hazard Index is calculated separately for chronic, sub-chronic and shorter-duration exposures. A Hazard Index greater than 1.0 indicates the potential for adverse health effects. However, it should be noted that a Hazard Index value of 1.0 or greater does not mean that an adverse health effect is certain. It is a benchmark value indicating a greater probability for a possible adverse effect.

A quantitative analysis for potential human exposures was performed during the remedial investigation of the Glendale Study Area. The groundwater quality data were used to calculate the arithmetic mean and upper confidence limit (95 percent) of the arithmetic mean for the upper zone and the lower zone of the South Plume OU.

The methods and equations used to calculate the exposure due to ingestion of drinking water and inhalation of vapors during showering are described in Section 7.3.4 of the Remedial Investigation Report for the Glendale Study Area (January 1992). The results of the baseline risk characterization for the upper and lower zones of the aquifer are summarized in Tables 7-3 and 7-4 of this ROD. A summary of hazard index calculations for nitrate in groundwater is included in Table 7-5 of this ROD. A detailed discussion of the data presented in these tables is included in

TABLE 7-3

SUMMARY OF RISK CHARACTERIZATION FOR THE UPPER ZONE AQUIFER FOR THE GLENDALE SOUTH PLUME OU

Exposure Scenario	Arithmetic Mean[1]	RME[2]	Maximum[3]	Type of Risk
Adult Ingestion	8.00E-04	2.00E-03	1.00E-02	Cancer Risk
	2.00E+01	7.00E+01	1.00E+02	Hazard Index
Shower Inhalation	1.00E-03	4.00E-03	2.00E-02	Cancer Risk
	2.00E+01	6.00E+01	9.00E+01	Hazard Index

1 Average Value

2 Reasonable Maximum Exposure. The highest exposure that is reasonable expected to occur at a site (95% upper confidence limit of observed concentrations).

3 The exposure scenario using the highest observed concentration in any monitoring well in the south plume of groundwater contamination in the Glendale Study Area. EPA considers this scenario to be unreasonably high.

TABLE 7-4

SUMMARY OF RISK CHARACTERIZATION FOR THE LOWER ZONE AQUIFER FOR THE GLENDALE SOUTH PLUME OU

Exposure Scenario	Arithmetic Mean[1]	Maximum[2]	Type of Risk
Adult Ingestion	2.00E-05	5.00E-05	Cancer Risk
	2.00E-01	4.00E-01	Hazard Index
Shower Inhalation	5.00E-07	8.00E-07	Cancer Risk
	1.00E-01	4.00E-01	Hazard Index

1 Average Value

2 The exposure scenario using the highest observed concentration in any monitoring well in the south plume of groundwater contamination in the Glendale Study Area. EPA considers this scenario to be unreasonably high.

TABLE 7-5

SUMMARY OF HAZARD INDEX CALCULATIONS FOR NITRATE IN GROUNDWATER FOR THE GLENDALE SOUTH PLUME OU

Aquifer Zone	Arithmetic Mean[1]	RME[2]	Maximum[3]
Upper	1E+00	2E+00	2E+00
Lower	4E-01	----[a]	8E-01

---

1 Average Value

2 Reasonable Maximum Exposure. The highest exposure that is reasonable expected to occur at a site (95% upper confidence limit of observed concentrations).

3 The exposure scenario using the highest observed concentration in any monitoring well in the south plume of groundwater contamination in the Glendale Study Area. EPA considers this scenario to be unreasonably high.

a Not calculated due to small sample set.

Section 8.0 of the RI Report.

The risk associated with ingestion of groundwater from the upper zone found that the major contributors to the total risk value are methylene chloride, arsenic, benzene, 1,1-DCE, vinyl chloride, PCE and TCE, in descending order of risk contribution. For shower inhalation risks, methylene chloride is the most significant contributor to the overall risk. Benzene, 1,1-DCE, and TCE are secondary contributors.

As can be seen from Table 7-3, the total cancer risk values for estimates of concentrations at point of exposure for this pathway (i.e., ingestion of groundwater from the upper zone) are 8E-04, 2E-03, and 1E-02 for the arithmetic mean, upper bound 95 percent confidence interval, and the maximum concentrations in groundwater, respectively. The total noncarcinogenic risk values for estimates of concentrations at point of exposure for this pathway are 2E+01, 7E+01, and 1E+02 for the arithmetic mean, upper bound 95 percent confidence interval, and the maximum concentrations in groundwater, respectively. The noncarcinogenic risk values for exposure to nitrate in the upper zone is 2E+00, for the upper bound 95 percent confidence interval, which exceeds the benchmark of 1.0.

Table 7-3 also contains a summary of risk characterization for inhalation of groundwater from the upper zone. The total carcinogenic risk values for estimates for concentrations at point of exposure for this pathway are 1E-03, 4E-03, and 2E-02 for the arithmetic mean, upper bound 95 percent confidence interval, and the maximum concentrations in groundwater, respectively. Methylene chloride is the most significant contributor to the overall risk. The total noncarcinogenic risk values for estimates of concentrations at point of exposure for this pathway are 2E+01, 6E+01, and 9E+01 for the arithmetic mean, upper bound 95 percent confidence interval, and the maximum concentrations in groundwater, respectively. Benzene is the single most significant contributor to the elevated hazard index.

Table 7-4 summarizes the risk characterization for the lower zone aquifer. The total carcinogenic risk values for estimates for concentrations at point of exposure for ingestions are 2E-05 and 5E-05 for the arithmetic mean and the maximum concentrations in groundwater, respectively. TCE and bis(2-ethylhexyl)phthalate were the only carcinogenic compounds detected in the lower zone carried into the quantitative assessment for risk through ingestion. Of these, bis(2-ethylhexyl)phthalate is the most significant contributor to risk levels above 1E-06. The total noncarcinogenic risk values for all three of the compounds quantified are below the benchmark of 1.0 for the arithmetic mean and maximum concentrations at point of exposure for ingestion of groundwater from the lower zone. The noncarcinogenic risk values calculated for nitrate were also below the benchmark of 1.0.

TCE was the only carcinogenic compound detected in the lower zone to be quantified for risk due to inhalation. The risk levels for the estimates of concentrations for this pathway are 5E-07 and 8E-07 for the arithmetic mean and maximum values, respectively. Both risk values are below 1E-06. The sum of noncarcinogenic risk values for all three of the compounds quantified are below the benchmark of 1.0 for the arithmetic mean and maximum concentrations at point of exposure for inhalation of groundwater from the lower zone.

The uncertainties associated with the Glendale South OU risk assessment are discussed in detail in Section 8.6 of the Remedial Investigation Report for the Glendale Study Area (January 1992).

In summary, the results of the human health portion of the Glendale South OU risk assessment indicated that contaminant levels in the upper zone of the aquifer of the Glendale Study Area would pose an unacceptable (2 x 10^{-3}) risk to human health if this water were to be delivered directly to local residents, without being treated. This means that an individual exposed to the conservatively high conditions used in the risk assessment (eg, consume two liters of untreated water every day over a 70-year lifetime) would have an increased chance (1 in 500) of developing cancer during their lifetime.

Environmental Risk Assessment

An ecological risk assessment was also performed for the Glendale South OU to address the potential ecological risks to flora and fauna in the area (see Section 8.7 of the Remedial Investigation Report for the Glendale Study Area, January 1992). This assessment provided a qualitative evaluation of potential current and future risks represented by the present site conditions, assuming no remedial action is taken in the Glendale Study Area.

The Glendale Study Area is zoned for commercial and industrial establishments. The surrounding area is a mixture of residential and commercial zoning. Although an extensive ecological survey was not performed for the area, the presence of a significant wildlife population was not indicated. In addition, the developed condition of the site excludes the potential for significant natural vegetative cover.

The release pathway of primary concern at this site is contaminated groundwater to the Los Angeles River. Discharge occurs under rising water conditions in the aquifer due to lack of production well pumping in this area. However, discharges are expected to be infrequent, seasonal, and localized.

Given the present developed condition of the site and the major exposure pathway consideration of contaminated groundwater, there was no expectation for significant impact to potential environmental receptors. Urbanization has already replaced habitat potential; therefore, no significant number of receptors appeared to be present. There appeared to be no apparent mechanism for exposure to environmental receptors from contaminated groundwater. Also, there was no indication that future site plans would reinstate habitat and thereby recreate a potential for environmental receptors in the future.

8.0 DESCRIPTION OF ALTERNATIVES

Based on the results of the RI, EPA identified several cleanup alternatives for addressing groundwater contamination in the Glendale South Plume. The alternatives were developed to meet the following specific cleanup objectives for the Glendale South OU:

- o To inhibit vertical and horizontal migration of groundwater contamination in the South Plume of the Glendale Study Area

- o To begin to remove contaminant mass from the upper zone of the aquifer in the South Plume of the Glendale Study Area.

All of the alternatives, with the exception of the "no action" alternative (Alternative 1), involve groundwater extraction and treatment for the shallow aquifer system in the Glendale area of the San Fernando Valley. The upper zone or shallow-most portion of the aquifer is where the majority of the VOC contamination has been identified. Detailed descriptions of the various alternatives are presented in the Feasibility Study for the Glendale Study Area South Plume Operable Unit (August 1992).

Initially, all of the alternatives were screened for: 1) effectiveness at protecting public health and the environment, 2) technical feasibility (implementability), and 3) cost. As a result of this initial screening, six alternatives were evaluated using nine specific criteria: 1) Overall Protection of Human Health and the Environment, 2) Compliance with Applicable or Relevant and Appropriate Requirements (ARARs), 3) Long-term Effectiveness and Permanence, 4) Reduction of Toxicity, Mobility or Volume through Treatment, 5) Short-term Effectiveness, 6) Implementability, 7) Cost, 8) State Acceptance, and 9) Community Acceptance. Each of EPA's nine evaluation criteria is summarized below.

Overall Protection of Human Health and the Environment: This criterion assesses whether each alternative provides for both short term and long term overall protection of human health and the environment from unacceptable risks posed by the hazardous substances, pollutants, or contaminants present in the South Plume. The assessment draws upon the evaluation of short-term effectiveness, long-term effectiveness, implementability, reduction of toxicity, mobility and/or volume through treatment, and compliance with ARARs.

Compliance with ARARs: This criterion is used to determine whether the alternative meets all of the chemical-, action- and location-specific ARARs identified in Section 10 of this ROD. Since the remedial action established by the Glendale South OU ROD is an interim action, chemical-specific requirements to be attained in the aquifer at the end of the final remedy are not ARARs for this action. Action-specific ARARs address the groundwater response actions that may be taken as part of this interim action for the Glendale South OU. All of the alternatives, except no action, include groundwater extraction followed by treatment and use as potable supply or disposal. Therefore, specific levels for treatment of the contaminated water prior to disposal or to delivery to the drinking water purveyor are chemical-specific and action-specific ARARs for the Glendale South OU.

Long-Term Effectiveness and Permanence: Long-term effectiveness refers to the period after the remedial action is complete. Each alternative is assessed for its long-term effectiveness and permanence in reducing the risk to human health and the environment at the end of the 12-year period. The long-term effectiveness evaluation focuses on how well the contamination has been contained by the remedial action and what are the contaminant concentrations remaining in the aquifer at the end of the 12-year period.

Reduction of Toxicity, Mobility, and/or Volume through Treatment: This criterion addresses how well the remediation technologies permanently and significantly reduce the toxicity, mobility and/or volume of the hazardous substances. The evaluation based on this criterion focuses on the quantity of hazardous materials destroyed or treated, the degree to which the remedial action is irreversible, the type and quantity of residuals that are remaining after the remedial action is complete, and whether the alternative satisfies the statutory preference for treatment as a principal element of the remedy.

Short-Term Effectiveness: Each alternative is evaluated based on its effectiveness in protecting human health and the environment during the construction and implementation period. The short-term effectiveness evaluation for each alternative focuses on how well the alternative removes contaminant mass, inhibits the movement of the contaminant plume, and how well the treatment system meets the cleanup levels in the extracted and treated groundwater during the 12-year period. Short-term effectiveness also addresses the effectiveness of the alternative in reducing potential risks to people living in the vicinity of the Glendale South Plume and to workers' health and safety during construction of the proposed facilities and implementation of the interim remedy.

Implementability: The implementability criterion includes both the technical and administrative feasibility of implementing an alternative. The technical feasibility refers to the ability to construct, reliably operate and maintain, and meet cleanup levels for process options. Administrative feasibility refers to the ability to obtain approvals from other offices and agencies, the availability and capacity of treatment, storage, and disposal services, and the availability of specific equipment and technical specialists.

Cost: The NCP requires that the following types of costs be evaluated: 1) Capital costs, including both direct and indirect costs, 2) Annual operation and maintenance costs and 3) Net present value of capital and operations and maintenance (O&M) costs. Capital and O&M costs presented in the Glendale South OU FS report have an accuracy of +50 percent to -30 percent, as specified by the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988). Capital costs include a contingency of 20 percent of total field costs (TFC) and a contractor's overhead and profit (OH&P) at 30 percent of the sum of TFC and contingency. Evaluating present worth costs assumes an interest rate of 10 percent and operating period of 12 years. The O&M cost evaluation assumes an operating load factor of 90 percent.

State Acceptance: This criterion considers the concerns of the State (technical and administrative) regarding the alternatives.

Public Acceptance: This criterion assesses the components of alternatives that interested persons in the community support, have reservations about or oppose.

EPA's preferred alternative, as well as the other five alternatives were described in EPA's Proposed Plan for the Glendale South OU (September 1992).

The Glendale South OU is an interim action and is not the final remedy for cleanup of contaminated groundwater in the Glendale area. With the exception of the no action alternative, all of the alternatives involve the extraction of 2,000 gpm of groundwater for a period of 12 years. The total duration of the remedy is 15 years, but during the first three years the remedy will be in the remedial design and construction phases and no extraction or treatment of groundwater will be taking place. A computer model called a solute transport model was developed and used to determine that the extraction rate of 2,000 gpm over a 12 year period would result in the most effective inhibition of plume migration and effective contamination removal for this interim action. With the exception of Alternative 1 - No Action, all of the alternatives would involve the construction and operation of a VOC treatment system.

With the exception of Alternative 1 - No Action, the six alternatives analyzed and compared during the FS and presented in the Glendale South OU FS report include four major elements: 1) extraction of contaminated groundwater at the rate of 2000 gpm, 2) treatment of the VOCs, 3) treat/blend/no action for nitrates, and 4) one of three options for final use - distribution to a public water supply system, spreading at an existing spreading grounds, or discharge to the Los Angeles River (See Table 8-1). The major elements of each of six alternatives are listed below.

Alternative 1	No Action
Alternative 2	Extract/Treat VOCs (either air stripping w/vapor-phase GAC or liquid-phase GAC)/Blending for Nitrate/Public Water Supply
Alternative 3	Extract/Treat VOCs (perozone)/ Blending for Nitrate/Public Water Supply
Alternative 4	Extract/Treat VOCs (either air stripping w/vapor-phase GAC or liquid-phase GAC)/No nitrate treatment/River
Alternative 5	Extract/Treat VOCs (either air stripping w/vapor-phase GAC or liquid-phase GAC)/Ion Exchange for nitrate/Recharge at Headworks Spreading Ground
Alternative 6	Extract/Treat VOCs (either air stripping w/vapor-phase GAC or liquid-phase GAC)/No nitrate treatment/Recharge at Headworks Spreading Grounds

The highlights of the six alternatives are summarized briefly below. More detailed descriptions of the alternatives are presented in the Feasibility Study for the Glendale Study Area South Plume Operable Unit (August 1992).

Alternative 1: No Action

The No Action alternative serves as a "baseline" against which other alternatives are compared. This alternative is evaluated to determine the risks that would be posed to public health and the environment if no action were taken to treat or contain the contamination. The no action alternative would involve only

TABLE 8-1
SUMMARY OF ALTERNATIVES

COMPONENTS	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
Groundwater Extraction	None	Extract 2000 gpm of groundwater.	Same as Alternative 2.
Treatment	None	Treat VOCs with either air stripping and vapor-phase GAC or liquid-phase GAC. Meet nitrate MCL by blending. Chromium treatment to be added if necessary.	Treat VOCs with perozone oxidation, airstripping and vapor-phase GAC. Same as Alternative 2. Same as Alterantive 2.
Final Use	Monitor groundwater quality	Convey treated, blended water to water purveyor.	Same as Alternative 2.
CRITERIA	EVALUATION		
Effectiveness and Permanence	Not effective in the short- or long-term	Inhibit vertical and lateral mitration of contaminant plume. Significantly reduced contaminated groundwater discharge to LA River. Remove contaminant mass from aquifer. Treated, blended groundwater would meet drinking water standards.	Same as Alternative 2. Same as Alternative 2. Same as Alternative 2. Same as Alternative 2.
Reduction of Toxicity, Mobility, Volume through Treatment	No reduction of toxicity, mobility, or volume	Estimated to reduce TCE concentrations in the aquifer from 200 ppb to less than 10 ppb after 12 years. Removes 80% of the initial mass of TCE in the aquifer.	Same as Alternative 2. Same as Alternative 2.
Compliance with ARARs	Will not meet ARARs	Will meet ARARs.	Same as Alternative 2.
Overall Protection of Human Health and Environment			
(Human Health)	Assuming no institutional controls, increased cancer risk of ingesting contaminated groundwater is estimated to be 1 in 500.	Protective of human health.	Same as Alternative 2.
(Environment)	Not protective of environment.	Environmental degradation will be reduced because migration of groundwater containing TCE concentrations inhibited and TCE mass removed.	Same as Alternative 2.
Implementability (Technical)	Monitoring wells easy to construct. Spread of groundwater plume could make future remediation difficult.	Can be implemented	Can be implemented. Perozone oxidation only proven in pilot-scale tests.
ESTIMATED COSTS			
Total Capital Cost Annual O&M Total Present Worth	$211,000* $109,000* $769,000*	$15,540,000* $1,852,000* $25,020,000*	$16,620,000* $1,729,000* $25,470,000*

* If chromium treatment is needed, additional capital costs are expected to be $2,950,000, additional annual O&M $611,000, and additional total present worth costs $6,750,000.

TABLE 8-1 (Continued)
SUMMARY OF ALTERNATIVES

ALTERNATIVE 4	ALTERNATIVE 5**	ALTERNATIVE 6
Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Same as Alternative 2. No nitrate treatment. Same as Alternative 2.	Same as Alternative 2. Treatment of nitrate with ion exchange. Same as Alternative 2.	Same as Alternative 2. No nitrate treatment. Same as Alternative 2.
Discharge treated water to Los Angeles River.	Discharge treated water to Headworks Spreading Grounds.	Same as Alternative 5.
Same as Alternative 2. Same as Alternative 2. Same as Alternative 2. Treated groundwater would meet drinking water standards for VOCs and surface discharge standards for nitrates.	Same as Alternative 2. Same as Alternative 2. Same as Alterantive 2. Treated groundwater would meet drinking water standards for VOCs and nitrates.	Same as Alternative 2. Same as Alternative 2. Same as Alternative 2. Treated groundwater would meet drinking water standards for VOCs and recharge requirements.
Same as Alternative 2. Same as Alternative 2.	Same as Alternative 2. Same as Alternative 2.	Same as Alternative 2. Same as Alternative 2.
Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Same as Alternative 2. Same as Alternative 2.	Same as Alternative 2. Same as Alternative 2.	Same as Alternative 2. Same as Alternative 2.
Can be implemented. Administrative concerns associated with objection to non-beneficial use of water.	Can be implemented, except issues associated with waste brine disposal from nitrate treatment facility and availability of Headworks Spreading Grounds	Can be implemented; one administrative issue may be the availability of the Headworks Spreading Grounds for recharge.
$10,611,000* $1,384,000* $17,700,000*	$25,140,000* $2,464,000* $37,750,000*	$14,160,000* $1,613,000* $22,420,000*

** Alternative 5 was formerly Alternative 8 in the Feasibility Study for the Glendale Study Area: South Plume Operable Unit (August 1992)