4.3 HYDROGEOLOGY

This section draws from the six phases of geologic and hydrologic characterization activities completed to date at the project site. The initial study was completed by Geotechnical Consultants, Inc. (GCI) for the County of San Diego and the U.S. Department of Interior (GCI, 1989). Geraghty and Miller (G&M, 1988, 1990), completed the second and third phases. The fourth phase comprised the work of Woodward-Clyde Consultants completed in 1991 and reported in 1995 (WCC, 1995). The fifth phase was the hydrogeologic study completed by GeoLogic Associates (GLA, 1997), and the sixth phase addressed geotechnical issues (GLA, 1998). Phase 5, which addresses hydrogeologic issues, is contained in Appendix G. In addition, GLA completed a Leachate Generation Analysis (1998) which is summarized in this section and contained in Appendix G.

4.3.1 EXISTING CONDITIONS

4.3.1.1 Regional Hydrogeology

Hydrology, which is the study of water, encompasses the occurrence, distribution, movement, and chemistry of all waters of the earth, including water in rivers, oceans, lakes, and underground. Hydrogeology is the field of hydrology that studies the interrelationships of geologic materials and processes with water, with an emphasis on groundwater. Groundwater is water that occurs below the ground surface and occupies open-pore spaces, voids, and fractures in sediment and rock. Any rock or sediment that is water-bearing and that yields economical quantities of water to wells and springs is referred to as an aquifer (Driscoll, 1986). One or more aquifers composed primarily of unconsolidated deposits found in valleys of major rivers and streams are generally defined as groundwater basins. A hydrologic unit is the designation given by the State Water Resources Control Board (SWRCB) to define groundwater basins using surface drainage divides (highlands) to classify total watershed areas, including water-bearing and nonwater-bearing formations. Each Hydrologic Unit is further divided into Hydrologic Areas (and Hydrologic Subareas) with unit boundaries generally based on surface drainage boundaries (Regional Water Quality Control Board, San Diego Region [RWQCB], 1994).

Gregory Canyon is located in the San Diego Hydrologic Basin, which occupies approximately 3,900 square miles of San Diego County and portions of Orange and Riverside Counties in southwestern California. This hydrologic basin lies within the Peninsular Ranges physiographic province of California. The Peninsular Ranges physiographic province is a geographic area of southern California that is characterized by a relatively narrow coastal plain on the west, and rugged mountains and steep-walled, narrow valleys inland that generally trend from east to west.

The Gregory Canyon watershed is tributary to the San Luis Rey River and is part of the San Luis Rey Hydrologic Unit [RWQCB,1994]. This Hydrologic Unit is a semi-rectangular area of about 565 square miles, bounded by Riverside County to the north, the cities of Vista and Escondido to the south, and the Cleveland National Forest to the east. The Camp Pendleton Marine Corps Base forms the northwest boundary, and the City of Oceanside is located in the western portion of the watershed. Within the Hydrologic Unit, the San Luis Rey River occupies a narrow valley filled with water-bearing alluvial sediments bounded by sedimentary rocks (lower reach of the basin), or igneous and metamorphic rocks (middle and upper reaches of the basin) at the valley margins. The San Luis Rey Hydrologic Unit is divided into three hydrologic areas, which include the Warner, Monserate and Lower San Luis (Mission), from east to west. The Monserate Hydrologic Area occupies approximately the middle one-third of the San Luis Rey Hydrologic Unit. The Monserate Hydrologic Area is further subdivided into three hydrologic subareas which include from east to west, the La Jolla Amago, Pauma and Pala Hydrologic Subareas (RWQCB 1994). The SWRCB issued a tentative decision on November 23, 1999, classifying groundwater in both the Pala and Pauma Basins as part of a subterranean stream flowing through known and definite channels. Gregory Canyon is located in the Pala Hydrologic Subarea (Exhibit 4.3-1).

Recharge to the Monserate Hydrologic Area occurs by infiltration of precipitation, subsurface flow from the Warner Hydrologic Area to the east, and infiltration of runoff from the surrounding mountain areas. Surface water flow in the San Luis Rey River is impounded by the dam at Lake Henshaw in the Warner Hydrologic Area, located upstream of the project area. Because groundwater recharge is inconsistent and seasonal, historical depth-to-water measurements from the period 1965 to 1990 for the alluvial aquifer indicate that groundwater levels for a particular well may fluctuate from the ground surface to approximately 25 feet below ground surface (bgs) in the center of the river valley [California Department of Water Resources (CDWR) 1971; U.S. Geological Survey (USGS) 1990]. Colluvial deposits consisting of sediments ranging in size from clay to boulders interfinger with the alluvial sands and gravels along the margins of the river valley, and underlie the tributary canyons as well. The alluvial deposits of the San Luis Rey River, which are composed of clay-to gravel-size material, and the colluvium occupying the valley margins and tributary canyons overlie variably weathered bedrock.

Total thickness of the alluvial sediments in the Pala Hydrologic Subarea ranges from zero at the basin margins to at least 120 feet near the center of the river valley, based on available drillers' logs (CDWR 1971). Typical thickness of the alluvium near the center axis of the valley appears to range from 50 to 100 feet (CDWR 1971; USGS 1990). According to the boring log for well GMW-2, the maximum thickness of alluvium at the mouth of Gregory Canyon is about 50 feet (G&M 1990).

Aquifer properties help to evaluate the site groundwater occurrence and behavior, and are defined by hydrogeologic investigation and testing. Investigation tools, including pumping from the wells constructed into a particular aquifer, provide information on the well yield[1] and the specific capacity[2] of the aquifer. Knowing the hydraulic conductivity[3] helps to assess the average velocity of groundwater flow through the aquifer. However, it will vary within the aquifer based on the size and shape of the pores and their interconnection within the geologic material, and, therefore, it will not be uniform across the aquifer. Where the material is coarse and the pore spaces are large and interconnected (e.g., gravel), or where there are frequent or wide fractures in bedrock, the hydraulic conductivity will be high, compared with finer materials or bedrock with few or narrower fractures.

Reported well yields for alluvium in the Pala Hydrologic Subarea range from 10 to 400 gallons per minute (gpm) (CDWR 1971). Specific capacities for alluvium along the axis of the subarea range from 13 to greater than 115 gallons per minute per foot (gpm/ft) of drawdown (Moreland 1974). Alluvium along the axis of the subarea may have hydraulic conductivities ranging from

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1 *Well yield* is defined as the amount of water that can be pumped over a given period of time.

2 *Specific capacity* is defined as the rate of water discharge or yield per foot of drawdown.

3 *Hydraulic conductivity* measures the ability of geologic material to transmit water.

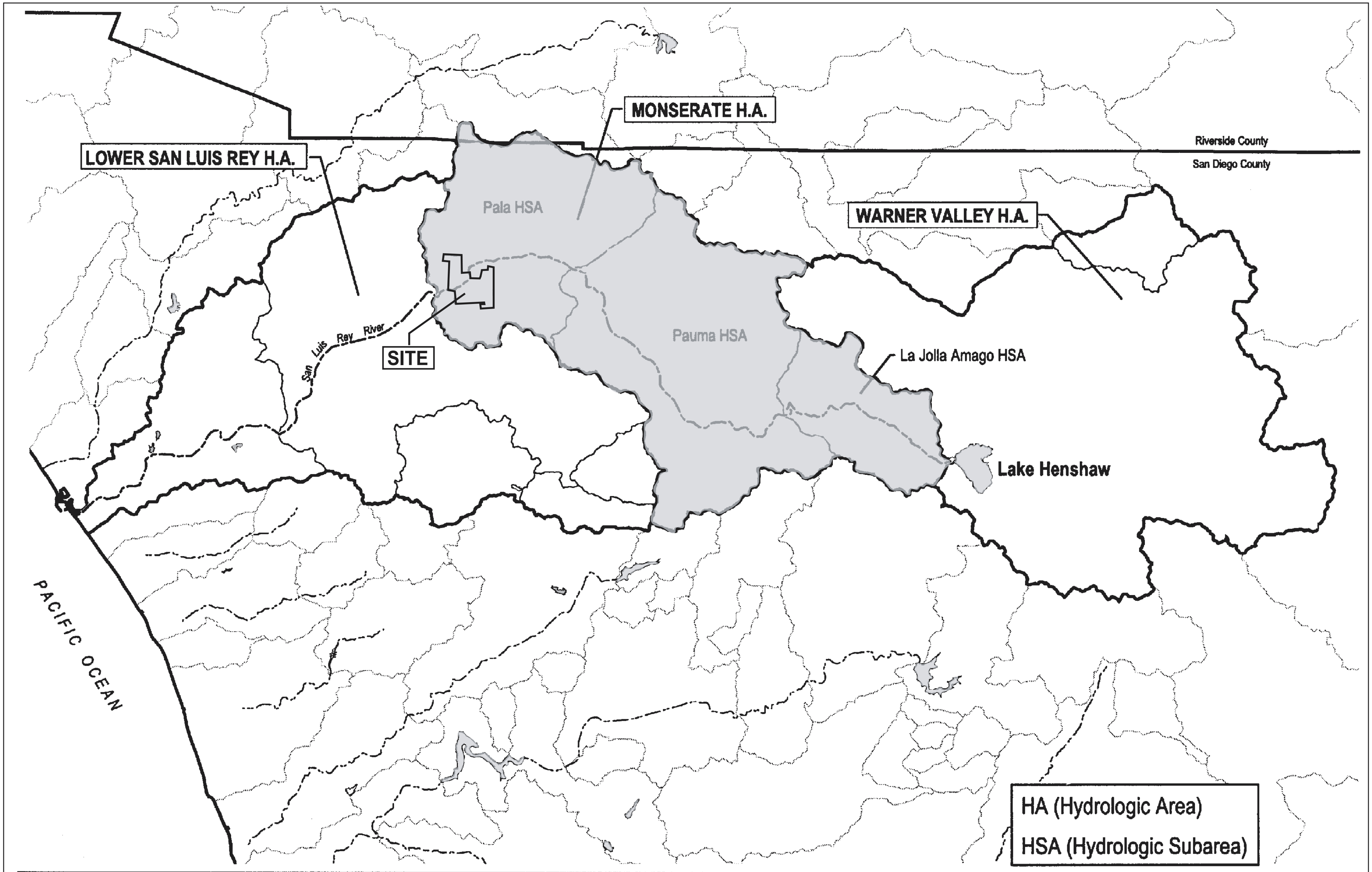

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Exhibit 4.3-1
Hydrologic Planning Areas

Sources: SANDAG GIS Data, 1997; David Evans and Associates, Inc., 1999;
PCR Services Corporation, 1999

750 to 1000 gpd/ft^2. The gross groundwater storage of the Pala Basin is 50,000 acre-feet. The San Luis Rey Municipal Water District (SLRMWD), which controls the water activity in the lower third of the Pala Basin, calculated the current average pumping rate in the Pala Basin to be 2,400 acre-feet per year (AFY) or approximately 7.8 million gallons per year (Owen, 1995).

Beneath the alluvium/colluvium and in the adjacent upland areas are granitic and basic crystalline rocks (bedrock). The bedrock is recharged by infiltration of precipitation and it in turn recharges the alluvium, although its contributions are relatively small. In bedrock, groundwater occurrence and movement will vary widely depending upon the size and amount of fractures in the rock, and the interconnection between the fractures. When the bedrock is highly fractured, it behaves in a way similar to a granular aquifer and thus the groundwater flow patterns can be predicted and identified. GLA reviewed bedrock well logs for wells within about one mile of the proposed Gregory Canyon Landfill footprint. Results of this review indicate that at the time of construction, the greatest number of reported bedrock well yields fall in the range of one to 20 gpm. Based on available data, the average gross groundwater storage in the fractured crystalline rock might be less than and acre-foot of water per acre (less than about 0.3 million gallons per acre).

4.3.1.2 Surrounding Water Uses

The Porter-Cologne Water Quality Control Act and the Federal Water Pollution Control Act Amendments of 1972 require that Water Quality Control Plans (Basin Plans) be prepared for the nine state-designated hydrologic basins in the State of California. The proposed Gregory Canyon landfill site is located in the San Diego Hydrologic Basin (Region 9). The San Diego Region Basin Plan (Basin Plan) was approved by the State Water Resources Control Board (SWRCB) on March 20, 1975. An update to the Basin Plan was drafted in 1994 (RWQCB 1994). The purpose of the San Diego Region Basin Plan is to identify beneficial water uses, establish water quality objectives, implement a program to meet these objectives, and establish a surveillance program to monitor the effectiveness of the plan.

Existing beneficial uses and water quality objectives have been established by the RWQCB for groundwater in the Pala Hydrologic Subarea. Groundwater in the Pala Hydrologic Subarea is used for municipal, agricultural, and industrial purposes.

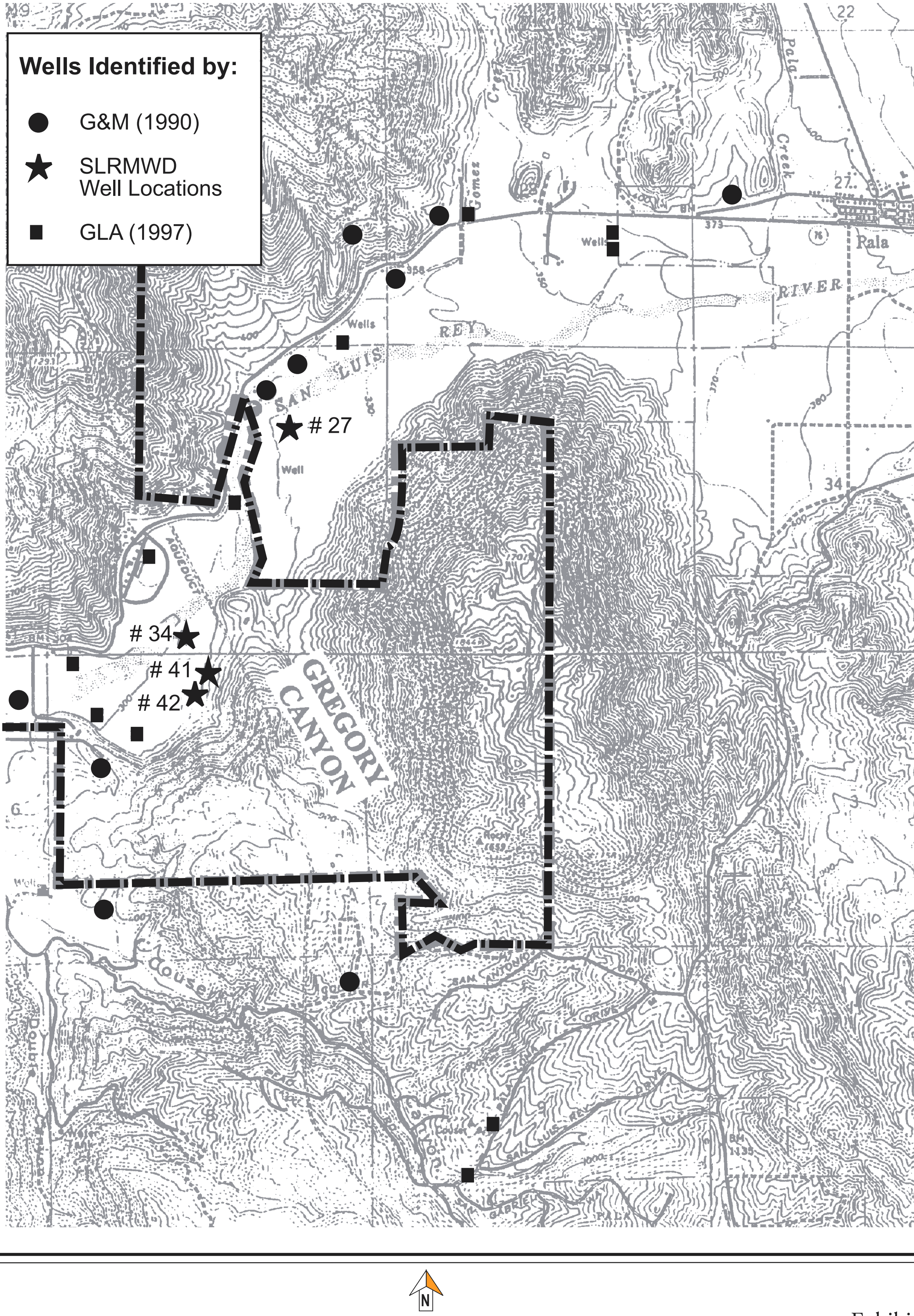
Because groundwater in the Pala Hydrologic Subarea is designated for use as domestic or municipal supply, chemical constituents in groundwater must not exceed the maximum contaminant levels (MCLs) as specified by both state and federal regulations. The primary standards are provided in California Code of Regulations, Title 22, Chapter 15, Article 4, Sections 64431 and 64444, Tables 64431-A and 64444-A and the Code of Federal Regulation, Title 40, part 141. The primary standards are threshold concentrations for specific minerals and chemicals to protect human health. The state has also developed secondary standards for constituents that may adversely affect the taste, odor or appearance of the water. These secondary MCLs are provided in the California Code of Regulations, Title 22, Chapter 15, Article 4, Section 64449, Tables 64449-A and -B. Since groundwater in the Pala Hydrologic Subarea is also designated for use as an agricultural supply, the water must not contain concentrations of chemical constituents that may adversely affect this use.

The SWRCB has established general water quality objectives whereby existing water quality superior to the established water quality objectives is to be maintained unless provided for otherwise by SWRCB Resolution No. 68-16. The objective requires that the activities of users of the area should not depress dissolved oxygen concentrations in groundwater by more than ten percent of natural conditions, and pH shall not vary more than 0.2 pH units from natural conditions. The locations of known off-site wells in the vicinity of Gregory Canyon are shown on Exhibit 4.3-2. The filled circles are wells identified by Geraghty & Miller (1990), the filled stars are wells identified by the SLRMWD, and those identified by filled squares were identified during a two-day survey performed by GLA (1997). The largest concentration of wells is in the alluvial basin of the San Luis Rey River, with a few additional domestic wells serving dwellings in Couser Canyon. According to the operators of orchards south of Gregory Canyon that were interviewed, irrigation water for these orchards is derived from the First San Diego Aqueduct and not from wells.

The First San Diego County Water Authority (SDCWA) is a public agency that was founded in 1944 to supply imported water into the San Diego Region to supplement existing supplies. In response to continued demand for water and the decreased reliability of imported water sources, over the last several years SDCWA has been evaluating the potential to develop additional local water supplies and water storage. SDCWA is considering water conservation, water transfers, water reclamation and purification, and groundwater resource development and management. SDCWA has developed a Groundwater Resource Development Report (June 1997) to assist in developing a Groundwater Implementation Plan and to serve as a reference and resource document to be updated periodically. In this report, the Mission, Bonsall, Pala and Pauma basins within the San Luis Rey River Basin, were considered (among others) as productive shallow alluvial aquifers within the SDCWA service area.

Several SDCWA member agencies and other water agencies have either implemented groundwater projects or are planning or evaluating potential projects to develop potable water supply. Within the Lower San Luis Rey River Hydrologic Area, the City of Oceanside is extracting 2,200 acre-feet per year (AFY) of groundwater from the Mission Basin and that project is being expanded to include an additional 4,900 AFY of potable water supply. A conceptual project has been identified by the City of Oceanside to expand groundwater development in the Mission basin by an additional 15,300 AFY of supply. In addition, the Rainbow Municipal Water District is evaluating the development of 3,000 AFY of potable supply from the Bonsall basin. For the Monserate Hydrologic Area, in which Gregory Canyon is located, the Yuima Municipal Water District is pumping up to 2,700 AFY from the Pauma basin.

SDCWA assigned a high score to the Pala/Pauma Basins, along with several other groundwater basins and surface reservoirs, during its initial “Regional Screening of New Sources of Water.” Accordingly, these basins were targeted for further analysis under the “Analysis of Alternatives.” However, the analysis of alternatives ranked the Pala/Pauma groundwater basins in a lower group (less attractive), and therefore they were not considered further as a viable new source of water. Primary reasons for the low ranking included very low groundwater elevations that would require extensive pumping facilities, relatively little emergency storage capacity, and the need for extensive infrastructure.



PCR

Exhibit 4.3-2
Location of Known Wells

Sources: Base Map: USGS, 1988, 7.5 minute Pala Quadrangle; GeoLogic Associates, 1999; David Evans and Associates, Inc., 1999

4.3.1.3 Local Hydrogeology

Setting

The area surrounding the project site is mixed use, with a predominantly rural character. Agricultural uses are located on the valley floor. Pala Rey Ranch is located to the west of the site, H.G. Fenton Materials, a sand and gravel mining operation with a concrete batch plant, is located to the northeast, lower Rice Canyon to the northwest, Couser Canyon is to the south, and the Pala Indian Reservation, which includes a portion of Gregory Mountain, is located to the east.

Agricultural land refers to areas supporting active agricultural cultivation or cattle grazing. About 97 acres of agricultural land, primarily grazing areas, exist on the project site. The dairies on the project site, which are considered agricultural lands, were mapped as a combination of agricultural land and developed land and occupy 88.3 acres. The abandoned Lucio Family Dairy, which closed in 1986, is located north of the San Luis Rey River, and south of SR 76. The operational Pete Verboom Dairy exists to the west of the Lucio Dairy and is adjacent to and south of SR 76. Existing land uses within the general area include a pear orchard, pastures, various farm outbuildings, and dirt access roads along fields. Pastures and a hay shed are situated on the valley floor on the south side of the river. The H.G. Fenton Material Company's sand and gravel mining operation and concrete batch plant is located approximately 1,200 feet upstream of the current First San Diego Aqueduct crossing of the San Luis Rey River.

Springs

Although no permanent springs have been identified in Gregory Canyon, the vigorous development of riparian vegetation along the thalweg[4] of the canyon, and its main tributaries, suggests that the piezometric level of the underlying aquifer is close to the surface along the lowest points of the canyon. In a strict sense, a spring forms when groundwater flows naturally from the rock onto the land surface, so in the absence of water flow the presence of riparian vegetation is insufficient to define the existence of a spring. On the other hand, this vegetation is a good indication that the elevation of the thalweg of the canyon is very close to the elevation of the equipotential or piezometric surface. If the equipotential surface[5] were to rise and reach the ground surface, for example during a year with high precipitation and infiltration, then ephemeral topographic springs might form.

In themselves, springs are commonplace hydrogeologic features, which appear and disappear naturally in response to fluctuations in the elevation of the equipotential surface. The presence or absence of springs helps us understand the configuration of the piezometric surface. In the case of Gregory Canyon, the water elevation data collected from wells clearly establishes this configuration.

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4 Thalweg is defined as the flow line (deepest points) of the canyon.

5 The equipotential elevation is the elevation at which water would rise in a well. The elevations at different well sites define a surface, which receives the name of equipotential surface. An equipotential surface in a fractured aquifer is slightly different than a water table, in that the bulk of the aquifer is dry and water is only present in open continuous fractures. A spring would form only if such a fracture intersects the ground surface and lies below the equipotential elevation at the point of intersection.

Groundwater

There are two distinct groundwater zones within Gregory Canyon. An alluvial aquifer hosted by the sediment wedge at the mouth of the canyon, and a bedrock hosted by the fractured tonalite that forms the substrate of the canyon. The general direction of groundwater movement in both aquifers is to the north, toward the alluvial aquifer of the San Luis Rey River (Exhibits 4.3-3 and 4.3-4).

Alluvial Aquifer

An alluvial wedge occupies the lower reaches of Gregory Canyon. It pinches out to the south, before reaching the footprint of the proposed development, and thickens to the north and eventually merges with the channel deposits of the San Luis Rey River. Well GMW-2, near the mouth of the canyon, cuts through a 50-foot section of alluvial deposits before reaching the underlying bedrock.

WCC (1995) concluded that groundwater within the alluvium forms an unconfined aquifer[6] recharged by direct infiltration from precipitation or runoff from the bedrock ridges east and west of the canyon, and by underflow through weathered bedrock. Reported hydraulic conductivities for alluvium in the Pala basin range from 750 to 1,000 gpd/ft^2 (Moreland 1974), but WCC (1995) estimated that the hydraulic conductivity of alluvial and colluvial materials in the canyon ranges between 0.9 and 16 gpd/ft^2. Exhibit 4.3-3 shows a contour map of the water table in the alluvial aquifer based on data collected on December 16, 1996. This aquifer appears to merge with the San Luis Rey alluvial aquifer to the north. Its extent to the south is limited, however, as indicated by dry wells MW-4, WCC-1, WCC-2, and MW-5. The available data suggest groundwater flow is to the north, under a gradient of about 0.045 ft/ft.

Bedrock Aquifer

There are 20 bedrock monitoring wells within the proposed landfill footprint and along the periphery of the site. Based on their estimated recovery rates when blown dry, the wells that encountered water can be divided into low-yield and average-yield categories. Those with low recovery rates (< 5 gpm) are located on the western ridge. The low-yield of these wells, coupled with the hard and sparsely fractured nature of the substrate, suggests that the western and southern ridges act as low permeability barriers along the periphery of the site.

Boreholes drilled within the canyon itself encountered tonalite with various degrees of hydrothermal alteration, and a significant amount of fracturing in the upper 50 to 100 feet. These wells have estimated yields of 5 to 20 gpm, and do not appear to correlate with geophysical anomalies or geomorphic lineaments. That is, the upper 50 to 100 feet of the underlying rock substrate appear to be pervasively fractured, and this facilitates groundwater flow. Water-bearing fractures become sparse at depths greater than 100 feet, as discussed below.

The horizontal average linear velocity of groundwater moving through a fracture, or group of fractures, can be estimated using the borehole dilution method. COLOG, Inc. (GLA, 1997a) adapted the borehole dilution method, using de-ionized water as the tracer and fluid electric conductivity as a measure of "concentration" of the tracer. The results obtained by COLOG, Inc. after applying this technique in the logging of 13 wells are summarized below.

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6 An *unconfined aquifer* is defined as an aquifer whose upper boundary is the water table, and not an impermeable unit. The water table is at atmospheric pressure, and the pores in the sediment or rock are saturated with water beneath it.

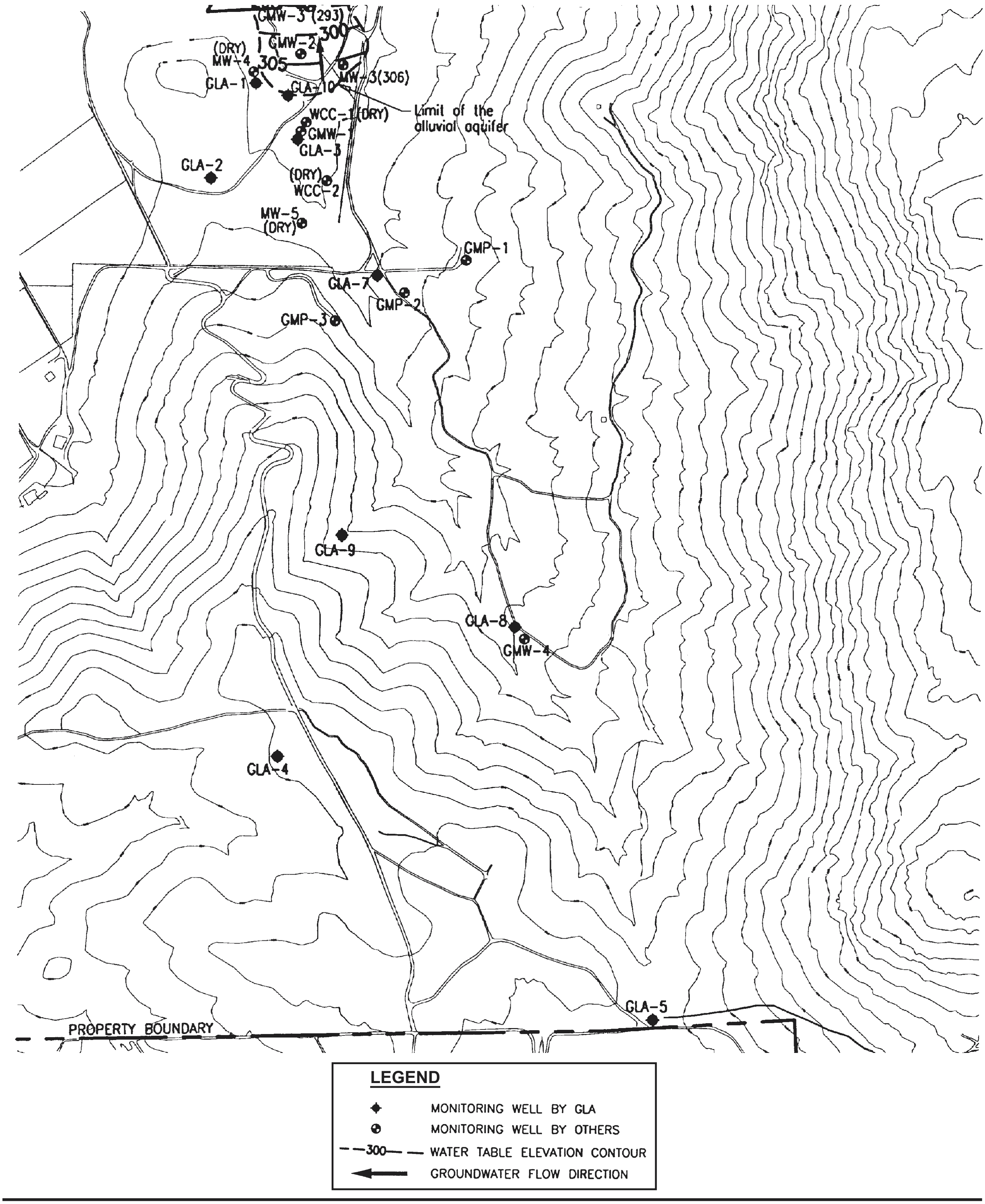
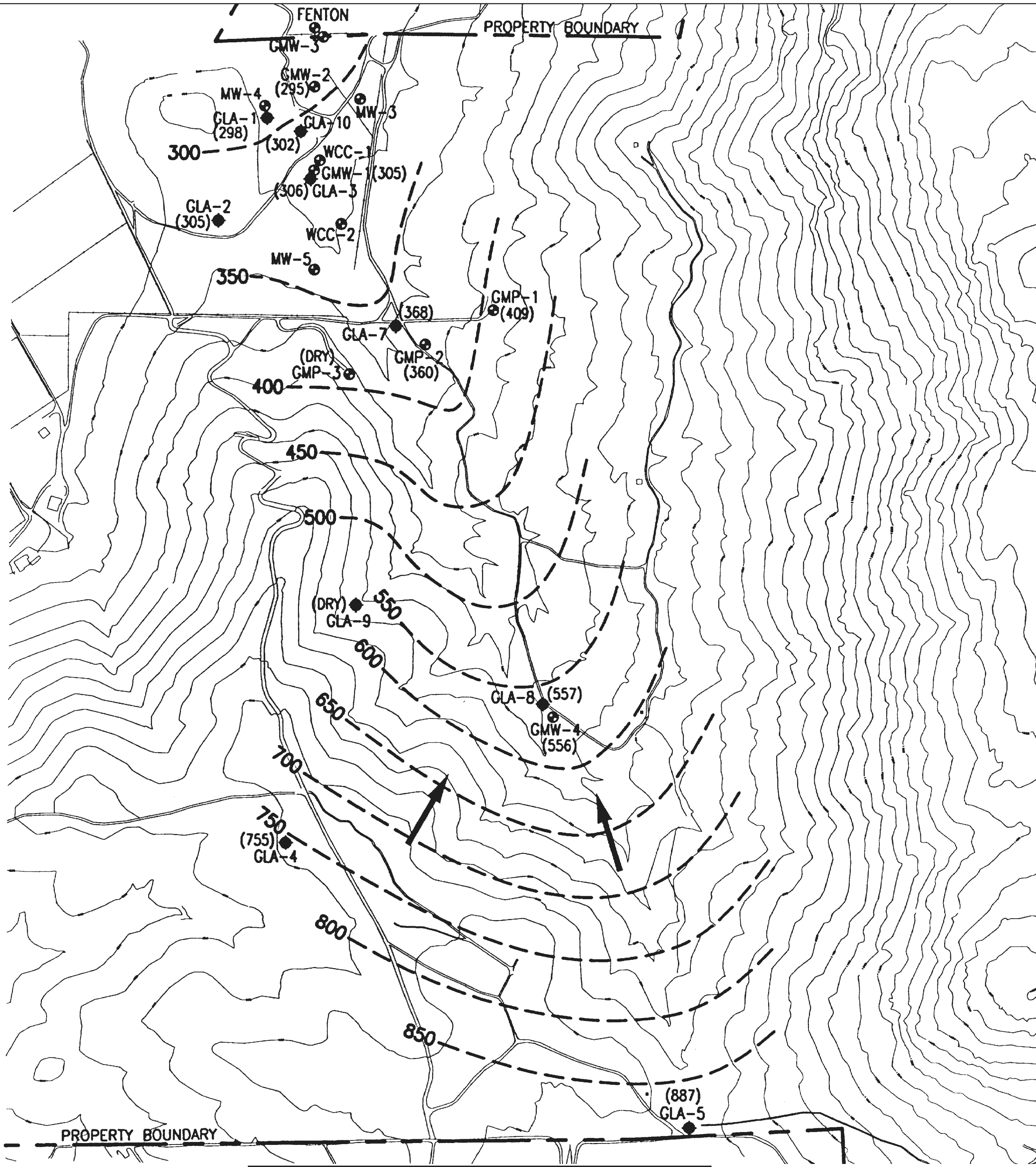


Exhibit 4.3-3
Configuration of the Water Table in the Alluvial Aquifer

Sources: GeoLogic Associates, 1999; David Evans and Associates, Inc., 1999; PCR Services Corporation, 1999



LEGEND

- MONITORING WELL BY GLA
- MONITORING WELL BY OTHERS
- --750-- PIEZOMETRIC SURFACE ELEVATION CONTOUR
- GROUNDWATER FLOW DIRECTION

PCR

N

0 700 Feet

Exhibit 4.3-4
Configuration of the Piezometric Surface in the Bedrock Aquifer

Sources: GeoLogic Associates, 1999; David Evans and Associates, Inc., 1999; PCR Services Corporation, 1999

In shallow wells (e.g., GMW-1, GMW-4, and GMP-2), or in the shallow portions of wells GLA-5 and GLA-7, the transmissive intervals (i.e., intervals that transmit groundwater) are broad and continuous, in a way characteristic of a porous medium. This behavior is consistent with the deeply weathered nature of the tonalite, which for all practical purposes behaves as a silty sand. In the deeper portion of the GLA wells, where the tonalite is only slightly weathered, there are very few transmissive intervals. They range in thickness between two and eight feet, and represent between one and five percent of the total length of the bedrock section. This behavior is characteristic of a fracture-flow regime.

For the deep GLA wells, in all but one instance, the intervals of groundwater flow are within 60 feet of the piezometric surface.[7] This means that groundwater flow is largely restricted to shallow fracture zones; in the one instance, deeper fractures have a much lower transmissivity, perhaps on account of larger compressive stresses.

It is estimated that the porosity of the subgrade is on the order of one percent. Given that specific discharge values[8] calculated for the deeper transmissive intervals range between 0.3 and 0.02 ft/day, and the assumption of 1 percent porosity, the equivalent specific discharge for a porous-medium would be between 0.003 and 0.0002 ft/day. The hydraulic conductivity for an equivalent porous-medium would range between 0.02 and 0.0013 ft/day (7.1×10^{-6} cm/sec to 4.6×10^{-7} cm/sec). Based on site-specific aquifer characteristics, it is estimated that the gross groundwater stored within the bedrock aquifer is less than an acre foot of water per acre (less then 0.3 million gallons per acre).

Data obtained on September 13, 1999, indicates that the contours of the piezometric surface in the fractured-rock aquifer are similar to the contours shown on Exhibit 4.3-4. Therefore, the groundwater flow in the canyon is consistent over time and is thus predictable (GLA, 1999). A piezometric surface is slightly different than a water table, in that the bulk of the aquifer is dry and water is only present where an open continuous fracture lies below the piezometric level. Using standard contouring and hydrogeologic procedures, the available data suggest groundwater flow toward and down the axis of the canyon. In the upper reaches of the canyon the gradient is comparatively steep (about 0.2 ft/ft to the north). The gradient becomes shallower toward the mouth of the canyon (about 0.1 ft/ft to the north).

<u>Groundwater Quality</u>

The project site includes existing agricultural, dairy and cattle grazing uses. Agricultural irrigation return water is the wastewater which runs off or leaches through an irrigated area. The two major concerns with agricultural irrigation return water are salt loading and the release of applied chemicals. Since the water supply in the San Diego region is generally quite high in salts and the climate is dry, irrigation with this relatively saline water causes salt accumulation in the soil. Crop roots absorb only essentially pure water while leaving total dissolved solids (TDS) behind. If these salts are not leached out by regularly applying more irrigation water than is needed for evapotranspiration, salts accumulate in the root zone and the land eventually becomes too salty for agriculture. However, the saline soils may be reclaimed by leaching. The

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[7] *Piezometric surface* is the surface that represents the level to which water will rise in a well.

[8] *Specific discharge* is the calculated apparent velocity of groundwater flow through the aquifer. It is typically reported in ft^3/ft^2 day, which can be simplified as feet per day (ft/day).

percolation of the water used to leach salts from the soil can be a serious source of groundwater degradation.

Modern agriculture is based on the extensive use of applied chemicals such as fertilizers, pesticides and herbicides to obtain high crop yields. The improper use of these applied chemicals may lead to serious degradation of both groundwater and surface water quality. Some of the chemicals applied to farm land move down with deep-percolation water from crop root zones and can contaminate underlying groundwater.

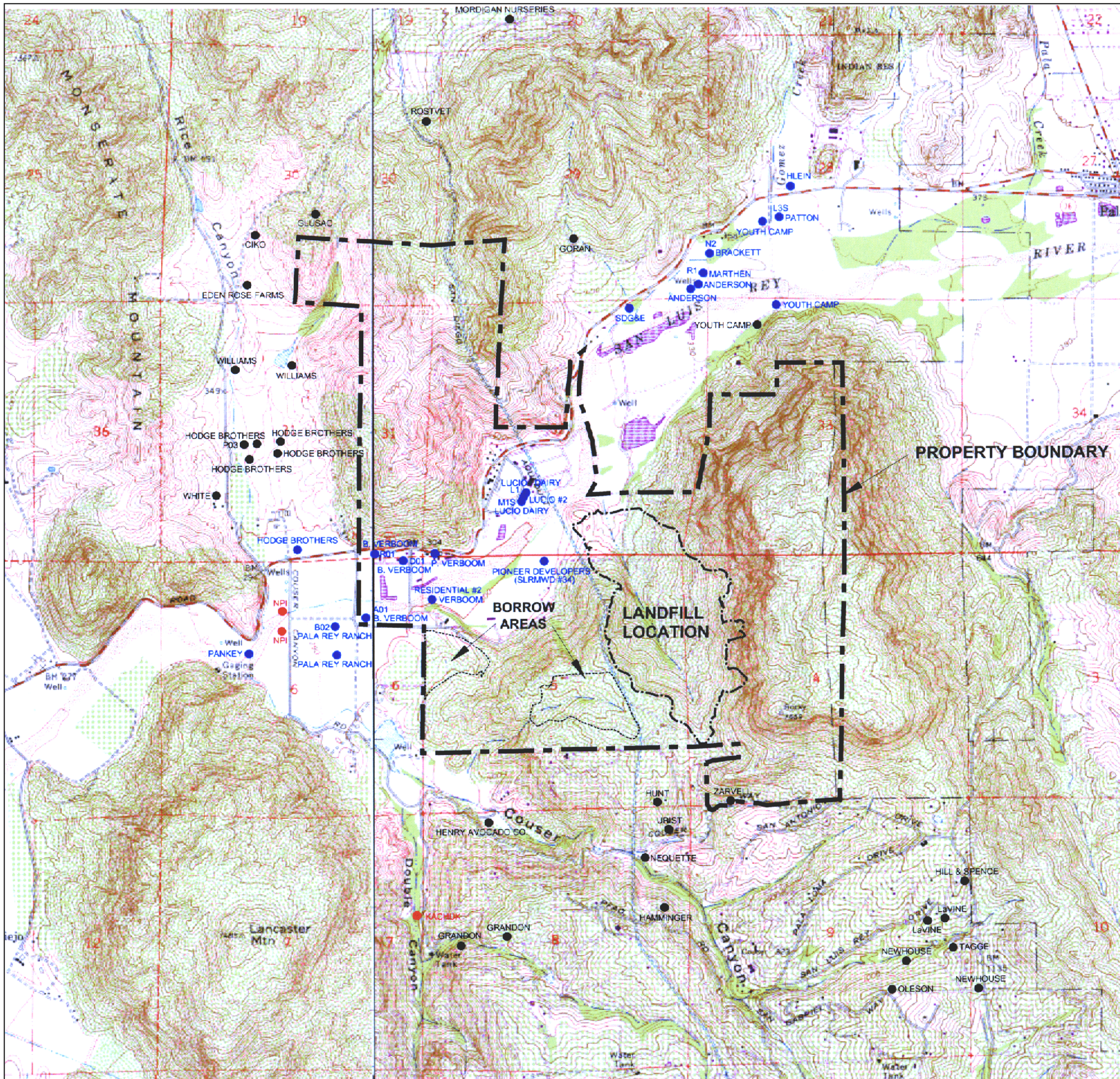
The release of applied chemicals into surface and groundwaters can have adverse effects on the quality of those waters and the beneficial uses supported by them. Aquatic toxicity, as measured by toxicity bioassay tests, has been found in many waters within the state. The application of agricultural chemicals, in some cases, has been linked directly to this toxicity and is suspect in many other impaired water bodies. In addition to degradation of the aquatic environment, the contamination of ground and surface waters by pesticides and fertilizers is believed to also pose a threat to human health. Pesticides for example are known to bioaccumulate.

Problems associated with dairy operations in the San Diego region include groundwater mineralization, the addition of nitrates to groundwater, surface runoff of biodegradable and suspended material, nuisance odors, the addition of nutrients to adjacent surface water streams and other miscellaneous problems.

H.G. Fenton Materials Company is located northeast of the project site. The largest volume of waste from sand and gravel processing operations results from product washing. Many of the sedimentary deposits mined for sand and gravel in the San Diego region contain a high percentage of silt and clay. Extensive washing is required to remove the fine material. Other waste includes cement truck wash water, sediment separated from the wash water, and rejected product. Recycled wash waters are discharged to storage ponds and can contain high concentrations of TDS because of evaporation and leaching from product materials. The percolation of these recycled waters can adversely affect groundwater quality.

In the course of performing the hydrogeologic evaluation for the site, a limited water quality evaluation was performed in August 1999 from on-site monitoring wells, residential/production wells and the San Luis Rey River to assess the current groundwater quality in the vicinity of the project site. The results of this water quality evaluation are provided herein. Specifically, samples were obtained from upgradient monitoring wells GLA-4 and GLA-5 and downgradient wells GLA-2, GLA-7 and GLA-10 (Exhibit 4.3-3). Three residential/production wells identified as Residential wells 2, 3 and 4, were also sampled within the San Luis Rey River valley. Residential well 2 is located on the west side of the site near the Verboom residence, Residential well 3 coincides with the SLRMWD well #34, and Residential well 4 (Lucio well #2) is located on the north side of the river on the Lucio Family Dairy property (Exhibit 4.3-4A). The samples were analyzed for the indicator parameters (chloride, nitrate as nitrogen, pH, sulfate, total dissolved solids and volatile organic compounds [by EPA Method 8260]).

TDS in groundwater samples collected from wells during the August 1999 sampling event ranged from 444 to 992 mg/l, and pH values ranged from 6.42 to 7.10. Nitrate as nitrogen concentrations ranged from 0.077 mg/l to 26.2 mg/l. Only the groundwater sample from upgradient well GLA-4 (444 mg/l) actually met the state recommendation maximum contaminant level (MCL) of 500 mg/l TDS for drinking water and beneficial groundwater use area designation (RWQCB 1994). It should be noted that water delivered by the San Diego County



LEGEND

ROSTVET ● APPROXIMATE LOCATION OF LOCAL GROUNDWATER WELL SCREENED IN BEDROCK (NOT FIELD VERIFIED)

PANKEY ● APPROXIMATE LOCATION OF LOCAL GROUNDWATER WELL SCREENED IN ALLUVIUM (NOT FIELD VERIFIED)

NPI ● APPROXIMATE LOCATION OF LOCAL GROUNDWATER WELL SCREENED IN ALLUVIUM AND BEDROCK (NOT FIELD VERIFIED)

PCR

N

0 2000 4000 Feet

Sources: U.S.G.S. 7.5 Minute Pala (1988) and Bonsall (1975) California Quads and California Department of Water Resources Water Well Drillers Reports; GLA, 2002.

Exhibit 4.3-4A
Known Wells Within One-Mile Radius of Project Site

Water Authority and its member agencies to users throughout the county has typical TDS concentrations ranging between 550 and 750 mg/l, so with respect to this parameter the groundwater resource at Gregory Canyon can be considered average for San Diego County. In addition, samples collected from upgradient well GLA-5 contained concentrations of nitrate as nitrogen (16.6 mg/l) and sulfate (306 mg/l) above the state recommended MCLs of 10 mg/l and 250 mg/l, respectively. Downgradient well GLA-2 contained the highest concentrations of nitrate as nitrogen (26.2 mg/l) and also exceeded the state and federal MCLs for this constituent. Based on a review of these 1999 groundwater quality data, they are generally consistent with those obtained from earlier water quality studies.

During the August 1999 water quality investigation, a few volatile organic compounds were detected in the water quality samples. The sample from downgradient well GLA-2 contained estimated trace concentrations (between the laboratory method detection limits and the laboratory reporting limits) of acetone (4.3 micrograms per liter [μg/l]), toluene (0.52 μg/l) and p+m-xylenes (0.69 μg/l). Acetone was also detected in samples from Residential well 4, and the upgradient surface water sample. Acetone is a common solvent used in analytical laboratories and is a likely laboratory contaminant, while toluene and xylenes are commonly associated with gasoline. It should be noted that the measured concentrations of toluene and xylenes are well below the state primary MCLs of 150 μg/l and 1750 μg/l, respectively, and although they may suggest a small gasoline spill, they might be field- or laboratory-introduced contaminants. Finally, chloroform was measured at a concentration of 1.2 μg/l in the sample from Residential well 4. Since chloroform is used in analytical laboratories and is a common constituent in treated drinking water, it too is a suspected laboratory- or field-introduced contaminant.

4.3.2 SIGNIFICANCE CRITERIA

Appendix G of the CEQA Guidelines provides thresholds for determining significant environmental impacts. A project may be deemed to have a significant impact on groundwater resources if the project would:

- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)
- Violate any water quality standards or waste discharge requirements
- Otherwise substantially degrade water quality

4.3.3 POTENTIAL IMPACTS

4.3.3.1 Short-Term (Construction) Impacts

Initial construction activities which include SR 76 road improvements, construction of the bridge and access road, the landfill footprint and associated facilities are analyzed below. Potential impacts of the construction of the future phases of landfill development are analyzed in long-term operations.

Potential Depletion of Groundwater Supplies

Comparison of the proposed grading plan with the bedrock piezometric surface indicates that over a large portion of the footprint the bottom grade is below the piezometric level. The depth of excavation ranges from near zero to about 160 feet deep. The finished elevations of the bottom subgrade or floor area range between approximately 370 feet amsl at the lowest elevation to 440 feet amsl along the southern portion of the bottom area. This excavation into the piezometric layer can be reasonably expected to cause an increase in the relative rate of groundwater outflow.

Because the proposed grading calls for excavation below the piezometric level, groundwater will be encountered in the initial alluvial materials and at depth in fractures within the bedrock during excavation for landfill construction. During construction, as the material is excavated, groundwater will seep to the surface of the excavation and flow down the excavation side slopes by gravity before intercepting temporary drainage controls. The drainages will then route the groundwater from the excavation to a temporary drainage collection basin. If suspended material is entrained within the groundwater, it will fall out of suspension within the desilting basin. This water can then be used for construction or be discharged to surface water under an approved NPDES permit.

Construction would not result in any significant impacts to groundwater production wells. The maximum of 165 acre feet per year (AFY) of groundwater used during project construction (e.g., from dewatering and used for dust suppression) would be less than the 465 AFY of groundwater that has been historically used on the project site for agricultural, dairy and cattle grazing uses. The project's water demand of 165 AFY during initial construction falls within the estimated range of 78 to 187 AFY of current water use on the project site. (See Section 4.15, Public Services and Utilities, for a more detailed discussion.)

Potential Degradation of Groundwater Quality

Construction of the project would remove agricultural, dairy and cattle grazing uses that currently exist on the project site, thereby potentially reducing future impacts to groundwater quality caused by on-going agricultural operations. A Stormwater Pollution Prevention Program Plan (SWPPP) and Monitoring Program and Reporting Requirements (MPRR) have been prepared for the project in accordance with NPDES General Permit requirements. The SWPPP provides the Best Management Practices (BMPs) that will be implemented to control erosion and provide protection of stormwater flows on site during the initial construction and throughout the continued operation, closure and post-closure maintenance period. The primary stormwater BMPs to be implemented at the project site would include a combination of erosion control mats, mulching, coir logs, straw/hay bales, diversion dams, as well as hydroseeding with native plants. Vehicle maintenance and fueling will not occur near any natural or manmade drainage courses. Equipment will be inspected daily for leaks and necessary repairs will be made. In the event that groundwater is encountered during construction operations, dewatering procedures would be implemented to facilitate completion of the excavation and subdrain installation. Groundwater monitoring would be implemented during construction to ensure the effectiveness of the BMPs. With the implementation of BMPs and the assurance from monitoring construction would not result in the exceedance of any water quality standards or waste discharge requirements, and would not substantially degrade groundwater quality. Please see Section 4.4.3.1 for a discussion regarding potential impacts to surface water from short-term, construction activities.

4.3.3.2 Long-Term (Operational) Impacts

Operational impacts include impacts associated with the operation of the landfill and associated uses.

Potential Depletion of Groundwater Supplies

To estimate the rates of groundwater outflow into surface drains, GLA (1997) constructed groundwater flow models of pre-development and after-excavation conditions. The model outflow rates to surface drains were calculated at 303.22 ft^3/day (85 percent of the total flux into the canyon), or about 2,300 gallons of water per day, for pre-development conditions, and 269.13 ft^3/day (93 percent of the total flux into the canyon), or about 2,000 gallons of water per day, for after-excavation conditions. The total flux into the system is lower in the latter case, because draining by the excavation would reduce the piezometric level, and thus the total flux into the canyon.

The subdrain system, which consists of a combination dendritic pipe and continuous gravel blanket system along the bottom and a mechanical backdrain (geonet) on the side slopes (beneath the low-permeability section of the composite liner), will capture the flux of groundwater that daylights into the surface and will convey it to the toe of the landfill. This analysis establishes that project implementation would result in a decrease of 10 to 20 percent in the total flux of the groundwater system over existing conditions. This conclusion is consistent with the low porosity and low permeability characteristics of the bedrock aquifer. As a result, the total volume involved in this change (30 to 60 ft^3/day, or 225 to 450 gpd) is small, the potential impact is not significant.

Operations would not result in any significant impacts to groundwater production wells. The maximum of 193 acre feet per year (AFY) of groundwater during project operations would be less than the 465 AFY of groundwater that has been historically used on the project site for agricultural, dairy and cattle grazing uses. The project's water demand of 193 acre feet during operations is not significantly greater than the estimated range of 78 to 187 AFY of current water use on the project site. (See Section 4.15, Public Services and Utilities, for a more detailed discussion).

The approximate average pumping rate for the area of the SLRMWD that is within the Pala Basin, covering an area of approximately 1,750 acres, is 2,400 AFY. The SLRMWD has determined that this same area could accommodate an average pumping rate of 3,350 acre-feet on a long-term basis, with prudent groundwater management. This information was obtained from a letter report prepared by Don Owen & Associates for the SLRMWD, dated September 13, 1995 and entitled "Groundwater Management Planning Phase II: Analysis of Hydrology and Determination of Available Water Supply."

Detailed studies completed for the project demonstrate the project would not harm or degrade water in the Pala Basin. The recent evaluation of production and pumping data for the existing wells on the Gregory Canyon site indicates the existing wells have the capability to generate approximately 1,000 AFY. The project will need a maximum of 165 AFY during construction and a maximum of 193 AFY during operations. Production capabilities of existing wells on the site far exceed these needs. In addition, an analysis of existing wells in the basin demonstrated that the largest concentration of wells is in the alluvial basin of the San Luis Rey River, with a few additional domestic wells serving dwellings in Couser Canyon. According to the operators of orchards south of Gregory Canyon that were interviewed, irrigation water for these orchards was derived from the San Diego First Aqueduct and not from wells. As stated, the basin is not in an overdraft situation, and there is sufficient capacity in the basin to accommodate the proposed project. No significant impacts to the depletion of groundwater supplies would occur.

<u>Potential Impacts on Groundwater Flow Direction or Recharge</u>

The excavation for the landfill will not affect the direction of groundwater flow, which will continue to be toward the mouth of the canyon (Exhibit 4.3-4). The flow rate will decrease slightly, as described in the previous paragraph, because the excavation will remove shallow permeable zones and will “impose” a gentler surface gradient on the piezometric surface. In addition, results of a more recent (GLA, 2001, which is on file with DEH in the JTD) pumping test indicate that the zone of influence within the bedrock aquifer is not far reaching, and therefore change in the adjacent groundwater divide would not be expected.

Groundwater recharge will also decrease slightly once the landfill is constructed, because the liner system will effectively eliminate infiltration over the footprint area. Assuming an infiltration rate of 1.6 inches per year (about 10 percent of precipitation), this could result in an average decrease in groundwater recharge of 2,960 ft^3/day (2.5 acre-feet per year). In comparison, this rate would be equivalent to a fraction of the output from a single average agricultural well. Thus, the impact is not significant.

<u>Potential Degradation of Groundwater Quality</u>

The recognition in the early 1980's that degradation of groundwater quality is the most significant potential impact of landfill projects on the environment, led to the implementation of laws requiring low-permeability liners and leachate collection and recovery systems on all new landfills.

Solid waste deposited in landfills decomposes by a combination of chemical, physical, and biological processes, and some of the products of this decomposition can be a nuisance at least and toxic at worst. Physical decomposition results from the breakdown of refuse components by physical degradation and by the rinsing and flushing action of water movement. Chemical decomposition includes processes such as hydrolysis, dissolution/precipitation, sorption/ desorption, and ion exchange, which result in greater mobility of refuse components. Biological decomposition takes place in three stages, each with its own environmental and substrate requirements, and each leading to the formation of characteristic end products (McBean et al., 1995). These three stages include:

> “The first stage of biological decomposition encompasses largely aerobic processes, which occur shortly after initial placement of the refuse, while oxygen is still available. During this first stage of decomposition, aerobic microorganisms degrade organic materials to carbon dioxide, water, partially degraded residual organic compounds, and considerable heat. Aerobic decomposition is characteristically rapid (1-2 years), relative to subsequent anaerobic decomposition, and the biological and chemical oxygen demand of the decomposing refuse is high. Leachate is not usually produced in this decomposition stage, because the particular refuse lift is not likely to have reached field capacity in such a short time.
>
> The second stage of refuse decomposition, known as acid-phase anaerobic decomposition, involves acetogenic microorganisms that become dominant as the oxygen is depleted. In this acetogenic or acid-generating phase, high concentrations of organic

> acids, ammonia, hydrogen, and carbon dioxide are produced. Acid fermentation prevails, with characteristic end products being high levels of carbon dioxide, partially degraded acid-organic compounds, and some heat. The production of large amounts of organic acids results in the lowering of the pH of the leachate to the range of 5.5 to 6.5, which in turn causes the dissolution of other compounds. The result is a chemically aggressive leachate with high specific conductance.
>
> The third, and longer, stage of refuse decomposition involves anaerobic methanogenic bacteria that become dominant as oxygen becomes depleted further. These organisms utilize the acid-organic compounds of the previous stage to produce carbon dioxide, methane, water, and some heat. Consumption of the organic acids raises the pH of the leachate to values in the range of 7 to 8, so that it becomes less aggressive chemically."

The stages of refuse decomposition have considerable overlap, but in general one can expect a change in the composition of leachate with time. "Young" leachates would have very high chemical and biological oxygen demands (COD and BOD on the range of 10,000 to 40,000 mg/L), high total organic compounds (TOC) and volatile fatty acids (10,000 to 25,000 mg/L), and low pH (5.5 to 6.5). "Older" leachates would have modest COD, BOD, TOC and volatile fatty acid contents (50 to 1,000 mg/L) and higher pH (7 to 8). A summary of landfill leachate concentrations from nationwide averages and a California case study is presented in Table 4.3-1. The data represent leachates collected from actual landfill sites, field test cells, and laboratory column tests. The sampling of leachates from actual landfill sites was in most cases achieved through monitoring wells placed in and beneath the landfill.

Another source of contaminants in leachate is from landfill gas produced by the landfill. Although there are many factors that effect the rate and quantities of landfill gas produced (e.g., moisture content, refuse density, age and composition), all landfills produce landfill gas in the course of biological decomposition of the waste. The greatest amount of landfill gas is generated during the methanogenesis phase, when the gas concentration reaches 50 percent by volume. This phase may occur in three months in wet refuse to perhaps never in dryer materials. Over time the landfill would be expected to produce methane concentrations at 40 to 70 percent by volume until the refuse organics are depleted sufficiently to create a decline in the production levels. Typically, methane production from refuse may occur in refuse that is older than 30 years, but the rate of production is low (McBean, 1995). In addition, dry conditions reduce the activity of most organisms and can lead to increased air access to the interior of the landfill and reduce the methane generation.

With the continued production and accumulation of landfill gas, gas pressures will increase causing the gas to migrate beyond the confines of the refuse into the atmosphere and into the surrounding area. In rural settings, the most noticeable impact to groundwater from landfills is the detection of volatile organic compounds, such as benzene, trichloroethene, or vinyl chloride. To a large extent, the presence of trace organic compounds in leachates will depend on the concentrations of these compounds in the gas phase within the landfill. Typically, these compounds are mixed with the incoming waste as a liquid but will volatilize in the landfill. The landfill gas will then either escape to the atmosphere, adsorb to soil particles, condense and form liquid, or potentially migrate to groundwater in the gas phase.

Biochemical reactions also occur causing the production or consumption of trace constituents. For example, vinyl chloride is a byproduct of the degradation of trichloroethene. The most

TABLE 4.3-1
LANDFILL LEACHATE CONSTITUENT CONCENTRATION RANGES
NATIONAL SITES AND CALIFORNIA CASESTUDY
(CONCENTRATIONS IN MG/L)

CONSTITUENT	NATIONAL LANDFILL SUMMARY [a]	ACTIVE CALIFORNIA CASE STUDY [b]
COD (Chemical Oxygen Demand)	0 to 750,000	79 to 420
BOD5 (5-day Biochemical Oxygen Demand)	6 to 57,000	6 to 48
TOC (Total Organic Compounds)	6.3 to 27,700	40 to 63
PH	3.7 to 11.5	6.34 to 7.10
TDS (Total Dissolved Solids)	0 to 44,900	1,352 to 1,631
TSS (Total Suspended Solids)	10 to 1,243	19 to 65
Specific Conductance (umhos/cm)	960 to 16,800	2,050 to 2,835
Hardness ($CaCO_3$)	0 to 22,800	816 to 1,250
Inorganic Phosphate	0 to 154	0.05 to 11
NH_4-N (Ammonia as Nitrogen)	0 to 1,106	1.1 to 693
NO_3+NO_2-N (No_x as Nitrogen)	0 to 27.2	0.07 to 11
Total Nitrogen (Kjeldahl) (TKN)	0 to 936	5 to 31
Calcium (Ca)	0 to 7,200	105 to 251
Magnesium (Mg)	0 to 15,600	68 to 158
Sodium (Na)	0 to 7,700	69 to 110
Sulfate (SO_4)	0 to 1,558	80 to 165
Chlorine (Cl)	0 to 3,900	1 to 200
Iron (Fe) (Total)	0 to 5,500	0.8 to 120
Zinc (Zn) (Total)	0 to 370	0.7 to 4.8
Copper (Cu) (Total)	0 to 9.9	0.01 to 0.38
Cadmium (Cd) (Total)	0 to 0.375	0.001 to 0.01
Lead (Pb) (Total)	0 to 2.0	0.04 to 0.16
Mercury (Hg) (Total)	0 to 0.16	0.001 to 0.32
Selenium (Se)	0 to 2.7	0.001 to 0.11
Chromium (Cr) (Total)	0.01 to 18	0.001 to 0.19
Nickel (Ni) (Total)	0.04 to 13.0	0.06 to 0.27

[a] Taken from Production and Management of Leachate from Municipal Landfill: Summary of Assessment. US EPA 1982
[b] Conducted at an unspecified, active, 20-year-old canyon landfill
Source: Woodward-Clyde Consultants, 1995

significant impacts of landfill gas on groundwater occur when landfill gas is allowed to migrate out from the landfill. As it migrates out from the landfill it cools and condenses to form a liquid. This condensate can migrate without a landfill gas extraction system. However, in newer landfills that have banned the disposal of hazardous waste the concentrations of volatile organic compounds in the landfill gas are reduced (Tchobanoglous, 1993). Furthermore, the construction and operation of a landfill gas collection system, which is a design element of the Gregory Canyon Landfill project, minimizes the outward migration of landfill gas so that condensate does not form outside of the landfill footprint.

Surface water infiltration of liquids within the waste itself may also produce leachate, potentially posing a threat to groundwater if allowed to migrate away from the landfill. State and federal regulations require new landfills to control external sources of water, such as precipitation and surface water run-on, to prevent leachate generation in the landfill. For example, under standard operating practices the working face is reduced to the smallest practical area, so that when it rains only a small portion of the exposed refuse can come in contact with rainfall. The landfill cover systems also limit the rain infiltration. Daily cover, consisting of a minimum of 6 inches of compacted soil, is placed on the fill during and at the end of each day, and the landfill is graded to drain surface water off of the footprint to drainage control structures. Additional intermediate cover (at least 12 inches of compacted soil) and a final cover system are also applied to the landfill as it reaches the design grade.

In addition, required environmental protection systems (base liner, leachate control and recovery and landfill gas collection systems) have proven efficiencies of at least 99 percent in the removal of leachate (and landfill gas) before it can leak from the landfill. For example, for the climatic conditions of Gregory Canyon and assuming an interim cover condition, the average annual precipitation of 14.59 inches per year would induce an average infiltration rate into the refuse prism of approximately 1.12 inches per year, which one can equate as the leachate generation rate. Assuming a liner with one 1 cm^2 hole per acre, 1.12 inches per year would be collected at the liner interface by the leachate collection and recovery system, which would result in a leakage rate of 0.001 inches per year. This equates to a 99.91 percent leachate collection efficiency. Therefore, with the construction of the liner system (from top to bottom: a drainage gravel blanket or a drainage geonet, a 60-mil HDPE plastic geomembrane and a two-foot layer of compacted soil with a hydraulic conductivity no more than 1 x 10-7 cm/sec) and other design features (such as best management practices for run-on and run-off control, and construction of a subdrain system), the potential for degradation of groundwater quality is reduced to a level of less than significant. This conclusion is supported by a recent study (Bonaparte et al., 1989) that indicates that a well designed, constructed, and inspected liner system (in accordance with an approved Construction Quality Assurance [CQA] plan) can protect groundwater, so that impacts to groundwater would not occur. Two more recent studies confirm this result (Giroud et. al. [1992], Bonaparte & Gross [1990]).

A distinction must be made between a liner (a simple plastic membrane) and a liner system (drainage layer, plastic membrane and low-permeability soil). Plastic liner membranes may have small defects and punctures, so they cannot be considered completely impermeable and as such cannot be relied on exclusively to avoid leaks. Leakage control, however, results from the combination of drainage layers, liners and soil barriers of low permeability performing complementary functions. Assume, for example, a simple plastic membrane with a small hole that is resting directly on permeable gravel. The simple liner would leak as soon as the leachate accumulates on it, and the rate of leakage would increase as more and more leachate ponds above it (in other words, leakage rate increases proportionally to the "head" of leachate over the liner). Because the plastic rests on permeable gravel that can "take" as much leachate as leaks through the hole, the only limiting factor is the size of the hole itself. In contrast, a liner system like the one described would include a drainage layer above the plastic membrane to remove the leachate before it can pond over the hole, so the rate of leakage is kept to a minimum. In addition, the hole in the plastic liner cannot drain freely, because now instead of permeable gravel there is a low-permeability clay that "resists" the passage of the leakage leachate. Just like in a plugged sink, the leachate backs up in the hole and into the drainage layer, where it is removed into the leachate and recovery system. Landfill construction, and inspections will be performed in accordance with a site-specific CQA plan that has been reviewed and approved by the RWQCB and LEA as part of the landfill permitting process.

Estimated Leachate Production Rates

Modeling of potential leachate generation was performed using the U.S. Army Corps of Engineers HELP3 (Hydrologic Evaluation of Landfill Performance) computer program, which uses representative rainfall and evapo-transpiration data to determine the amounts of leachate that might be generated in municipal solid waste landfills. The program takes into account the total area landfilled, representative precipitation patterns, representative evapo-transpiration, and the hydraulic conductivity of various construction materials to calculate leachate generation and accumulation. The initial climate properties (excluding precipitation) were selected from HELP3 default values for the City of San Diego, and corrected for the latitude of the proposed Gregory Canyon Landfill. Precipitation data were adjusted to a conservative 50-year annual average of 18 inches, with a minimum yearly total of 4.40 inches and a maximum yearly total of 24.79 inches. The annual average precipitation value was evaluated for consistency by reviewing data compiled by Wright et al, (1991) from 116 rainfall stations throughout the county and presented on a map prepared for the County of San Diego Department of Public Works. On this map, the Gregory Canyon site falls between the 15- and 18-inch average annual precipitation contours. In addition, review of the National Oceanic and Atmospheric Administration (1974) database, indicated an estimated average annual precipitation of 16 inches in this part of the county. It should be noted that heavy rain does not necessarily result in increased leachate generation, because leachate generation is a function of infiltration, not precipitation.

Modeling was performed by subdividing the 185-acre landfill (excludes the three transmission pads on the eastern edge) into eight zones for the "floor" area (40.6 acres), and another eight for the "slope" areas (145.8 acres). Modeling of refuse placement was performed taking into account the anticipated timing and volumes of refuse that will be placed, as well as the footprint areas and elevations that are expected as the landfill incrementally approaches capacity. During active phases of landfilling at any given zone, it was conservatively assumed that refuse was left uncovered, but it was also assumed that an interim cover was placed at the conclusion of refuse placement on that zone. For the model, leachate drains in the Leachate Collection and Recovery System (LCRS) were positioned at 500-foot intervals within the bottom LCRS gravel. Along the side slopes, drains were positioned at 100-foot intervals (measured along the slope). Closure of the proposed Gregory Canyon Landfill was modeled using a prescriptive CCR, Title 27 low-permeability final cover.[9]

The results of the HELP3 analysis indicate generally low values for both the total leachate generation and peak daily leachate generation until the final cover is placed in year 31, with the exception for significant "spikes" associated with heavy precipitation over a considerable length of time to allow significant infiltration during years 3, 16 and 22. After the final cover is placed in year 31, leachate generation would be expected to decrease substantially. The amount of leachate generated reaches a maximum value in year 16, when the projected total leachate generation is estimated at 53,984 ft^3 (403,854 gallons), of which 8,187 ft^3 (61,247 gallons) are generated from the floor area and 45,797 ft^3 (342,607 gallons) are generated from the slope area. The peak daily leachate generation is estimated to be 142 ft^3 (1,062 gallons) for the floor areas

[9] As indicated in Section 3.7.1.5, if an alternative final cover design were to be considered, the appropriate modeling would be performed and presented to the reviewing agencies to ensure consistency with the performance of a prescriptive cover system. In addition, while this EIR evaluates the environmental impacts of closure to ensure that all phases of the project have been considered, a separate discretionary action and CEQA review and clearance will be required prior to approval of the Final Closure Plan.

and 1,094 ft^3 (8,184 gallons) for the slope areas during the 16th year. Calculated peak daily head on the liner reaches a maximum at 0.25 inches during the 16th year. The proposed LCRS design complies with Federal Standards Title 40, Section 258.40 of Subpart D, which allows a 12-inch range.

Potential Contamination of Adjacent Groundwater Supplies

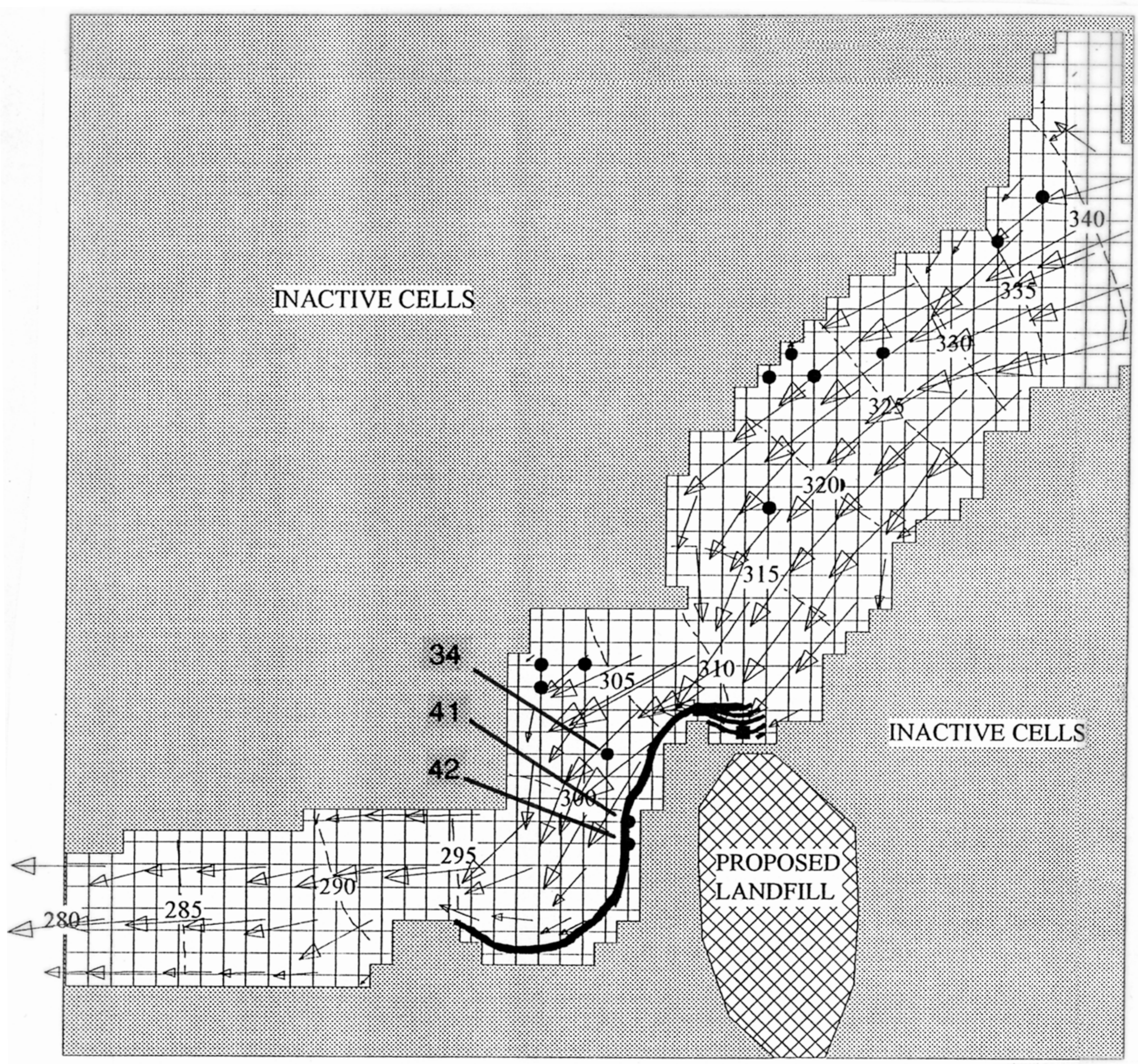
The proposed landfill will occupy one of the tributary canyons to the Pala groundwater basin (Exhibit 4.3-1). The western part of the basin is managed by the San Luis Rey Municipal Water District (SLRMWD). In 1995, SLRMWD requested that Gregory Canyon Ltd. perform an assessment of potential impacts that could occur to the basin if leachate was released from the proposed landfill. GLA (1995) performed computer model simulations of groundwater flow for the Pala basin in the vicinity of the proposed landfill, estimated worst-case leakage from the landfill, and identified production wells (ones from which water is extracted) within the basin that could be impacted by a leachate release. The analysis assumed that the leachate containment systems incorporated in the project design meet the requirements for environmental protection mandated by U.S. and California EPAs.

GLA (1995) developed a two-dimensional groundwater flow model using the finite difference computer program Flowpath (Franz and Guiguer, 1992). Constituent transport modeling with the Flowpath computer program is accomplished with the use of particle tracking techniques, which simulate constituents as "particles" that follow the groundwater flowlines. The particle tracking method is a case of simple advective transport where no dispersion, absorption or decay are allowed. Particles are tracked until they are pulled into a modeled pumping well, or until they stagnate and are overwhelmed by a much larger flux of groundwater.

Two conditions were simulated using the groundwater flow model. The first (Exhibit 4.3-5) was to simulate groundwater flow under existing conditions with a worst-case leakage through the liner of 10 gallons per day per acre (1,850 gallons per day for the entire site) and head conditions in the Pala basin at levels approximately equal to those as provided by the SLRMWD from measurements taken in 1993. (The GLA study assumed a landfill footprint of 185 acres, which excludes the three transmission pads on the eastern edge of the landfill.) The release is assumed to be a point source and is modeled as an injection well. The second simulation (Exhibit4.3-6) involved dropping groundwater approximately 10 feet lower than ground surface in the southwest corner of the basin, as could happen if increased pumping took place during extended drought periods.

The first model showed that steady-state groundwater flow in the Pala basin can be reasonably assumed to follow the topography, with flow lines following the general trend of the river (Exhibit 4.3-5). Owing to slightly increased recharge in the vicinity of the river, groundwater velocities are higher immediately adjacent to the trace of the river. Exhibit 4.3-5 also shows the predicted pathways of particles released from the proposed landfill. The particle pathways are shown to extend past the on-site wells #41 and #42 (San Luis Rey Water District designations) when allowed to flow under steady state conditions.

The particle pathways then extend along the southern perimeter of the canyon until the particles intercept the point of constriction within the canyon, on the western side of the site at the base of the bluff where the Verboom homestead is located. (This is within the site at least 1/3 of a mile from the down gradient boundary.) At this point the pathway merges with the underflow of the San Luis Rey River. The particles do not extend beyond this point because the computer



Case 1. Equipotential levels similar to the ones measured currently
(approximately 10 feet lower than ground surface)

- Pumping well
- Hypothetical point of release
- 315 Equipotential line (in feet amsl)
- Groundwater flow velocity vectors
- Release pathway

PCR

NOT TO SCALE

Exhibit 4.3-5
Model 1: Contaminant Transport Paths

Sources: GeoLogic Associates, 1999; PCR Services Corporation, 1999

program stops tracking them when they enter a model cell with much higher flux, as under these circumstances the liquid release would be strongly diluted. On a transient simulation, the particles would need approximately 5.5 years to travel the distance of 2,000 feet between the toe of the landfill and wells #41 and #42, at an average flow velocity of approximately one foot per day.

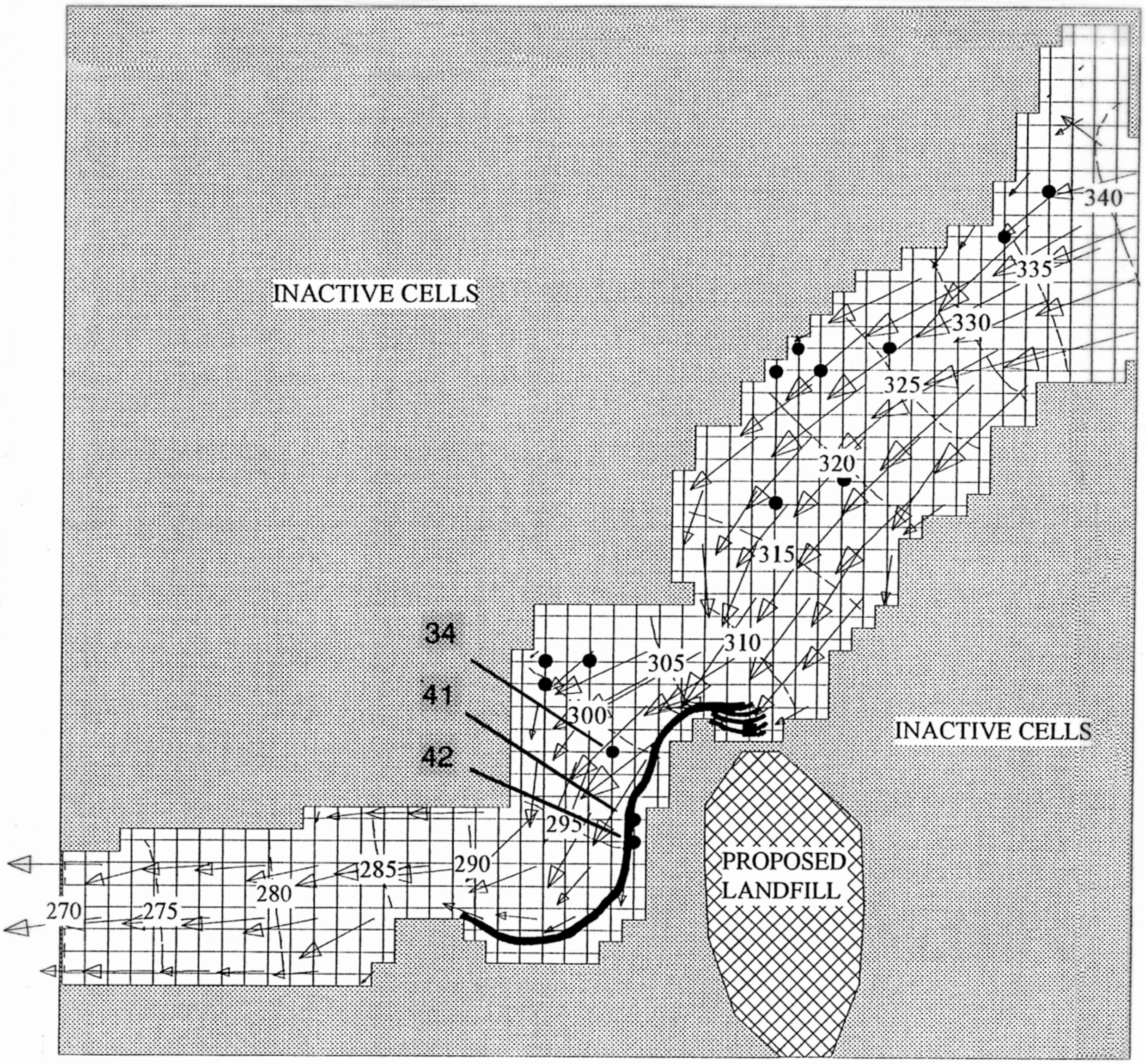
Exhibit 4.3-6 shows the second groundwater flow simulation for the case where groundwater head levels have been reduced by 10 feet in the southwest part of the basin to a level approximately 20 feet below ground surface, potentially as a result of drought conditions. Owing to the reduced groundwater head levels in the downgradient part of the model, a steeper groundwater gradient is induced. The net effect is slightly higher groundwater flow velocities in the central portion of the basin. The change in the trajectories of particles is very small, however, as demonstrated by almost identical particle tracks calculated for the second simulation (Exhibit 4.3-6). Under these conditions, the particles would need approximately 4.9 years to travel the 2,000 feet between the toe of the landfill and wells #41 and #42, at an average flow velocity of approximately 1.1 feet per day. Under increased pumping conditions, well #34 could also be impacted. Mitigation has been included in Section 4.3.4 to mitigate this potentially significant environmental impact. After the incorporation of mitigation measures, no adverse effects would occur.

Assuming a worst-case leakage scenario (10 gallons per day per acre) and using the model data, volatile organic compounds, or increased concentrations of sodium, chloride, and total dissolved solids could impact Wells #34, #41, and #42. Based on typical concentrations and estimated quantities of leachate generation, GLA (1995) estimated that as much as 1.0 pound/day of sodium, 7.5 pounds/day TDS, and 1.2 pounds/day of chloride could be added to the basin by this worst-case leakage scenario. Mitigation has been included in Section 4.3.4 to mitigate this potentially significant environmental impact. As previously stated, the gross groundwater storage of the Pala Basin is 50,000 acre-feet. Any contribution (i.e., leachate or landfill gas) from the landfill would be minor both in volume and concentration. In addition, the Pala Basin, although a beneficial use aquifer, has not been designated for additional groundwater storage. Finally, if a release from the landfill were to occur, it would be detected and remediated on-site. After the incorporation of mitigation measures, no adverse effects would occur.

Under both scenarios, it would take approximately 5 years for contaminants from the landfill to reach the closest downgradient alluvial wells. In addition, these wells are located within the boundaries of the project site. The landfill environmental and control systems would detect a release long before contaminants could reach these wells under both these scenarios. If a release of contaminants were to occur, the landfill operator would immediately take corrective action.

The model results are supported by historical and recent data, and observations of groundwater piezometric elevation, fracture orientation and detailed site-specific investigations, which suggest that groundwater flows are contiguous and flow from the tops of the canyon toward the mouth of the canyon with no mechanism for “short-circuiting” within the fractured rock aquifer.

Groundwater monitoring will occur as part of the project implementation. The monitoring will be performed at two different “levels.” Because the landfill excavation would extend below the piezometric level, the liner would have an underlying gravel subdrain to collect seeping groundwater and convey it to a single collection point at the toe of the landfill. The subdrain system also provides a unique opportunity to monitor potential impacts of the landfill on groundwater. In effect, the subdrains will collect all water that comes within five feet of the



Case 2. Equipotential levels 20 feet lower than ground surface along the western edge of the model

- ● Pumping well
- ■ Hypothetical point of release
- 315 Equipotential line (in feet amsl)
- Groundwater flow velocity vectors
- Release pathway

PCR

NOT TO SCALE

Exhibit 4.3-6
Model 2: Contaminant Transport Paths

Sources: GeoLogic Associates, 1999; PCR Services Corporation, 1999

refuse, thus providing a very extensive "sample" of the quality of groundwater immediately below the liner system.

The second "level" of monitoring includes a series of wells located at both the upgradient and downgradient portions of the landfill, as required by section 20415(b) of Title 27 of the California Code of Regulations (CCR). The downgradient wells will sample groundwater that has moved beneath the landfill through the fractures of the substrate and the water quality data will be compared with the data obtained from the upgradient (background) well(s). Because the landfill is located entirely over bedrock, a release, should it occur, would be detected in the fractured rock aquifer first, and subsequently in the alluvial aquifer. Therefore, the detection monitoring system includes dedicated monitoring wells in the bedrock and alluvial aquifers.

Because this substrate is not a porous medium, COLOG, Inc. (in GLA, 1997) performed three cross-hole aquifer tests to assess the interconnectivity of the bedrock aquifer. Testing was conducted in the existing wells as part of the hydrogeologic investigation (GLA, 1998) to assess whether there is enough interconnection between the fractures for the samples to be representative of significant portions of the bedrock aquifer in order to evaluate what spacing would be required to monitor the entire point of compliance. The well pairs used in cross hole testing are shown in Table 4.3-2:

TABLE 4.3-2
WELLS USED IN CROSS HOLE TESTING

PUMPING WELL	OBSERVATION WELL	DISTANCE AND TREND BETWEEN WELLS	GENERAL LOCATION IN THE CANYON
GMW-1	GLA-3	51 feet; N36E	Lower reach
GMP-2	GLA-7	167 feet: N56W	Middle reach
GMW-4	GLA-8	30 feet; N10E	Upper reach
Source: GeoLogic Associates, 1997			

For cross-hole flow assessment, the formation water in the observation well is replaced with deionized water (DI) while the nearby well is pumped. After emplacement, a series of fluid electric conductivity (FEC) and temperature logs are run in the observation well as the pumping continues, to identify changes in the fluid column associated with fluid flow. In effect, formation water coming into the observation well "enriches" the electric conductivity of the DI "tracer" (which is not conductive) so that inflow velocities can be estimated through the borehole dilution method discussed at the beginning of this section.

The hydraulic connection between the pumping and observation wells is estimated by comparing the flow conditions in the observation well under ambient flow conditions and under cross-hole pumping conditions. By comparing the horizontal flow velocities of transmissive intervals under these two different pressure states, a qualitative evaluation of which intervals are hydraulically connected can be achieved. Those intervals which display the greatest change in flow between the two pressure conditions can be reasonably assumed to be hydraulically connected.

All three cross-hole tests documented hydraulic connectivity between the pumping and the observation well. Doubling the 167-foot capture radius documented by the pair GMP-2/GLA-7, GLA (1997) concluded that monitoring wells at an average spacing of 300 feet can be expected to detect potential groundwater impacts in bedrock wells under the proposed landfill. A subsequent pumping test was conducted in bedrock well GLA-3 using wells GMW-1 and GLA-

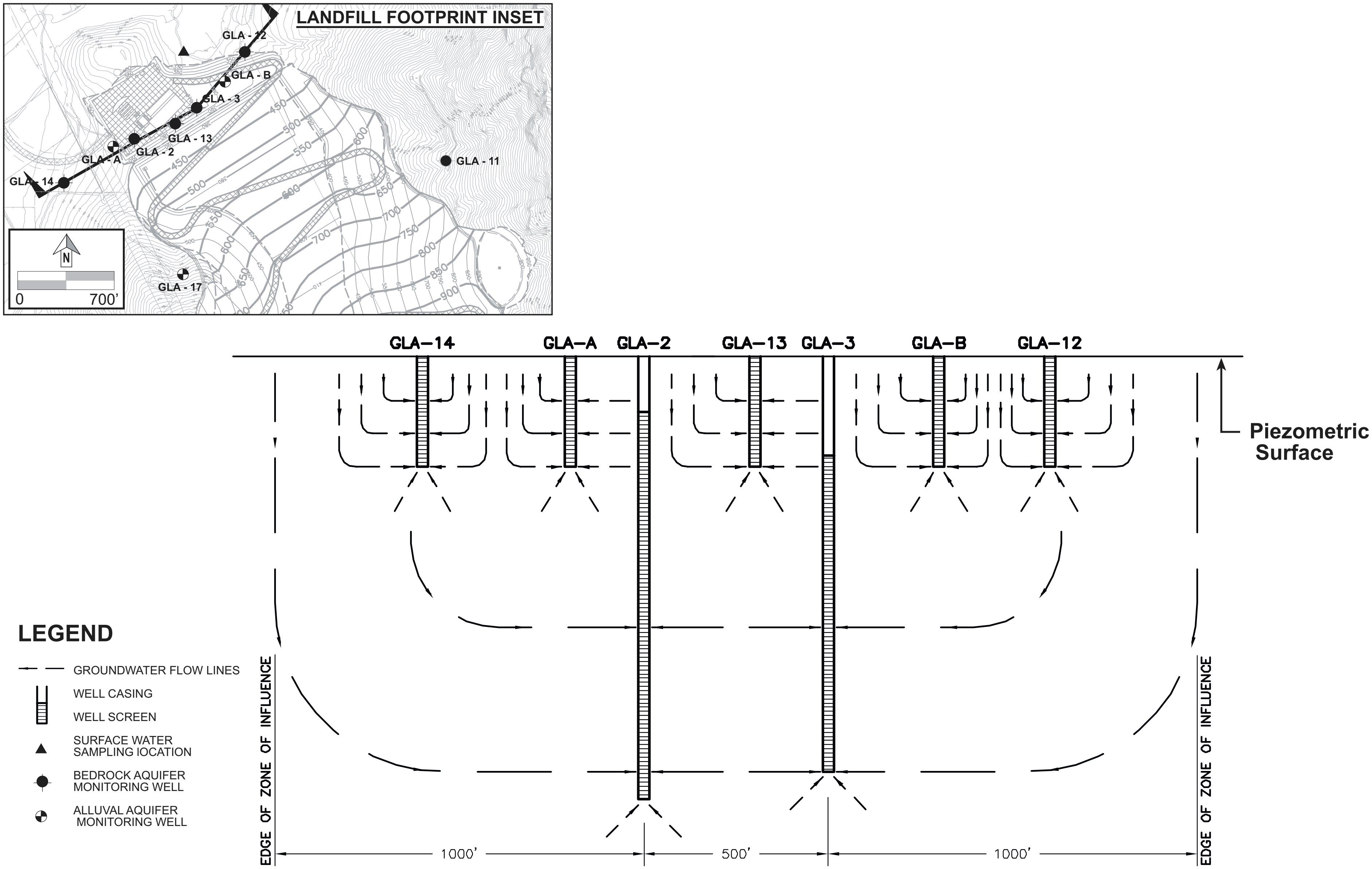
13 as observation wells (GLA, 2001). Results of this pumping test indicated an effective radius of influence from well GLA-3 of 1,000 ft. Exhibit 4.3-6A provides a schematic diagram of the monitoring well network in the bedrock aquifer based on site-specific data. The wells would need to be submitted to cross-hole testing to confirm the extent of their capture zones, and the spacing between the wells reduced if needed based on the pumping test data. Also, the purging protocols may need to be modified (e.g., by pumping a volume significantly larger than the traditional three borehole volumes), to impose enough “stress” in the aquifer to force convergence into the borehole of water carried by distant fractures.

The alluvial aquifer monitoring wells are screened only within the alluvial material. Potential contaminant distribution in the alluvial aquifer will be influenced by hydrodynamic flow conditions (i.e., groundwater flows under the natural gradient from the bedrock aquifer into the alluvium) and, therefore, fewer wells of this kind are necessary to provide contaminant capture. Alluvial monitoring well placement was based primarily on the predictive flowpath model performed by GLA (1995) and described in this section of the EIR.

The monitoring program will meet the requirements set by the waste discharge permit issued by the RWQCB prior to operation of the facility, as set forth by Section 20420 of Title 27 of the CCR. The monitoring program includes downgradient wells to collect representative samples of groundwater at the downgradient limit of the landfill, or “point of compliance,” and upgradient wells to collect samples of groundwater that are representative of “background” conditions. As shown on Exhibit 4.3-7, the proposed monitoring well network will include a total of 16 wells. Specifically, existing wells GLA-2, GLA-3, GLA-12, GLA-13 and GLA-14 will monitor the downgradient water quality in addition to three new wells (GLA-A and GLA-B) constructed at the toe of the landfill, while existing wells GLA-4, GLA-5, GLA-11, and proposed wells GLA-17 (located on the west ridge between the landfill and the aqueduct) and GLA-18 (located on the east side of the landfill footprint) will be background wells. Of these wells only well GLA-18 cannot be constructed prior to landfill operation because of the steep and currently inaccessible location proposed. GLA-18 will be constructed following grading of the utility pad as part of relocation of the transmission lines. In addition, existing wells GLA-1 and GLA-10 located north of the compliance wells at the toe of the canyon will remain and serve as water level measuring stations and may be used for future groundwater quality monitoring, if necessary. The water quality monitoring program will also include monitoring in the San Luis Rey River valley from existing Lucio Dairy well #2 and well GMW-3, located upgradient of the project area, and wells #34 (SLRMWD designation), and GLA-16 downgradient of the facility relative to groundwater flow direction. Under this monitoring program, existing wells within the landfill footprint will be properly abandoned as the landfill is developed while maintaining the groundwater monitoring system for the life of the landfill through the post-closure period.

Sampling of representative landfill perimeter wells (GLA-2, GLA-4, GLA-5, GLA-10, GLA-11, GLA-12, GLA-13, and GLA-14, and the wells within the San Luis Rey River valley (Lucio #2, SLRMWD #34 and GLA-16), will be conducted on a quarterly basis beginning at least one year prior to the placement of waste at the site, to develop a database on the water quality prior to landfill activities. Water levels will also be measured in each of the wells monthly during the first year, and quarterly thereafter once the highest and lowest expected water levels are established.

During the first year, the samples will be analyzed for the full suite of “constituents of concern” (COCs) as defined by the Code of Federal Regulations (40 CFR Part 258, Appendix II). The COCs include a broad range of general chemistry and metals, as well as volatile organic



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HORIZONTAL SCALE

0 400 Feet

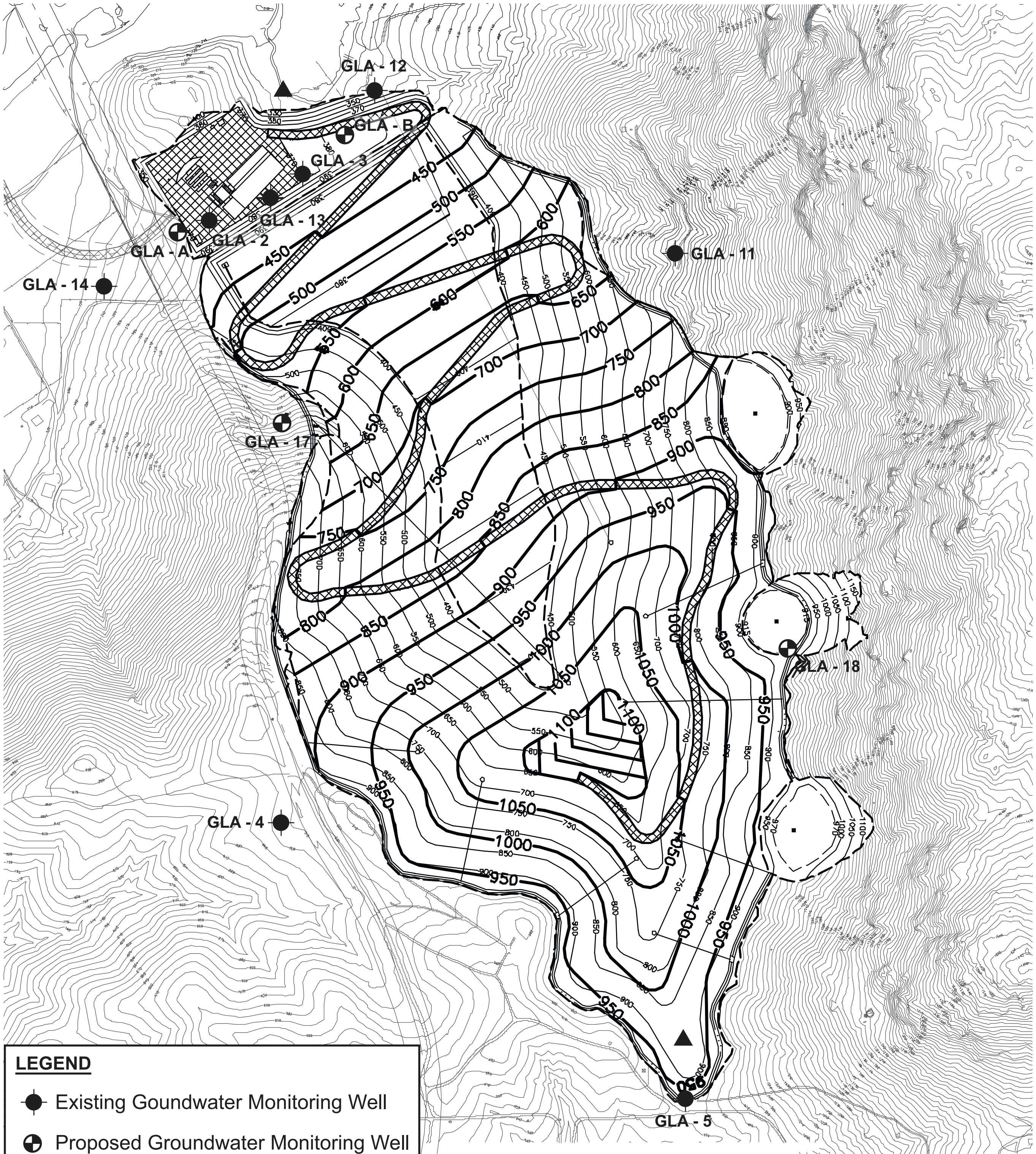
VERTICAL SCALE

0 25 Feet

Exhibit 4.3-6A

Schematic Diagram of Flow Lines Within the Zone of Influence of Groundwater Monitoring Wells Under Pumping Conditions

Sources: GeoLogic Associates, 2002



NOTE: Please see Exhibit 3-3 in this EIR for the complete monitoring network system.

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N

0 700 Feet

Sources: GeoLogic Associates, 1999; David Evans and Associates, Inc., 1999; PCR Services Corporation, 1999

Exhibit 4.3-7
Groundwater Monitoring Network

compounds, semi-volatile organic compounds, pesticides, herbicides and polychlorinated biphenyls (PCBs). Upon completion of four quarters of COC constituents, subsequent samples collected will be analyzed for a reduced suite of constituents, as deemed appropriate by the RWQCB (e.g., total dissolved solids, pH, chloride, nitrate as nitrogen, sulfate, calcium, magnesium, sodium, and volatile organic compounds). In addition, individual constituents from the COC list whose mean annual concentration in background exceeds one-half of their Federal MCL will be added to the routine (quarterly) monitoring parameter list, or any other constituent(s) that the RWQCB requires to be included due to local concerns. In accordance with state and federal regulations, the lowest possible detection limits shall be achieved by the laboratory for each constituent in the program. Once the database has been established, the laboratory data will be analyzed for statistical significance using the procedures set forth in Section 20415 of Title 27 of the CCR. Finally, the results and interpretation of the data obtained during sampling, the rate and groundwater flow direction determined from measurement of depths to groundwater in the monitoring wells, sampling and analytical methods, quality control procedures, landfill recordkeeping and on-site inspections will be reported to the RWQCB on a quarterly basis. This data will also be provided to the SLRMWD as required in the agreement with Gregory Canyon Ltd.

After landfill construction starts, sampling will also include quarterly collection of liquid from the subdrain system collection tank, and, at a minimum, will include analysis for the constituents included in the groundwater and surface water monitoring program. The LCRS tank will be sampled as required annually in October at a minimum and the analysis will include the full suite of COCs. Any constituent identified in the October leachate sample that is not currently included as a water quality monitoring parameter and is confirmed to be present by a retest sample collected and analyzed in April of the following year will be added to the list of routine (quarterly) water quality monitoring parameters.

With the exception of the LCRS, the more extensive analytical program for COCs will also be conducted every five years for all media (e.g., groundwater monitoring wells, surface water, and subdrain water), and the results will be compared with the background sample data. Any constituent that exceeds its respective laboratory method detection limit and is found in less than 10 percent of the background samples taken during that sampling period will be added to the list of routine analytes or as specified by RWQCB.

Implementation of the groundwater monitoring program ensures that in the event of an impact to any downgradient wells the impact will be identified at the earliest possible stage and before significant impact to the San Luis Rey aquifer. If contamination were detected in a well located adjacent to the landfill and/or the downgradient production wells, and its source is the landfill, the landfill operator is responsible for treatment of contaminated water. Upon determination that there is evidence of a release, the discharger must make a verbal notification to the RWQCB immediately and provide written notification by certified mail within seven days. As mandated by law (Sections 20425 and 20430 of Title 27 of the CCR), if a landfill release is detected, the applicant shall implement an Evaluation Monitoring Program (EMP) and a Corrective Action Program (CAP), under the regulatory guidance of the RWQCB. Within 90 days of determining a release, a report of waste discharge must be submitted to the RWQCB, including a detailed description of the measures to be taken as part of the EMP. Within 180 days of determining a release, an initial engineering feasibility study (EFS) for a corrective action program must be submitted to the RWQCB providing a detailed description of the measures that could be taken for the CAP. The EMP shall be used to assess the nature and extent of the release, and to design the CAP. The CAP will consist of engineering measures aimed at treating groundwater so that it meets the water quality standards set by the RWQCB, and in accordance with all appropriate permitting agencies. These engineering measures would include common remediation technologies used in the treatment of groundwater affected by landfills. These common remediation technologies can be grouped into four major categories: source control (e.g., placement of impervious cover, landfill gas extraction wells), plume containment (e.g., barriers, hydraulic controls), mass reduction methods (e.g., pump-and-treat, soil vapor extraction), in-situ attenuation of contaminants (e.g., bioremediation, funnel-and-gate treatment "curtains", air sparging, natural attenuation). These remediation technologies are often combined to form a complete remediation program to address the high diversity in the level and type of contaminants and hydrogeologic conditions specific to the site. A brief description of the four major categories is provided below.

Source control remediation methods eliminate the contamination at the source and are thereby highly efficient in preventing the release of leachate. Such methods typically include liner systems, LCRS, landfill gas control systems, and daily and final covers, all of which would be included in the project. Plume containment remediation methods limit migration and spreading of contaminants by constructing physical barriers or hydraulic controls. Physical barriers such as slurry walls, grout curtains, and sheet piling prevent or funnel the flow of groundwater. Hydraulic controls may involve the formation of a hydraulic barrier around a release through a series of injection wells along the perimeter of the impacted area. These wells effectively push the plume in the desired direction, where a simple string of injection or extraction wells or a partial slurry wall could be used to funnel contaminants into a passive treatment system (e.g., a metal enhanced reactive system). Mass reduction remediation methods include pump-and-treat and soil vapor extraction (SVE). Pump-and-treat methods involve pumping of contaminated water to the surface where above-ground groundwater treatment technologies are used. Such treatment technologies include aeration channels, air stripping, chemical oxidation, granular activated carbon systems, filtration systems, incineration, flare evaporation, and reverse osmosis. SVE involves the reduction of the mass of contaminant in the ground by extracting the air out of the soil through an SVE well and venting the air directly into the atmosphere or into an emissions control device. In-situ attenuation of contaminants can occur through a variety of methods. Bioremediation usually involves stimulating the indigenous subsurface microorganisms by the addition of nutrients and an electron acceptor (and for some VOC contaminants, an inert gas) to biodegrade the contaminants of concern. Another in-place treatment of contaminant plumes is a funnel-and-gate system, which involves the use of low permeability cutoff walls with gaps that contain reactors that remove contaminants by abiotic or biological processes. Another method is air sparging, which involves the forced injection of air into the saturated zone under sufficient pressure to form bubbles in groundwater. The air flow sweeps through the aquifer to strip dissolved and adsorbed phase VOCs, adds oxygen to the water to spur in-situ aerobic biodegradation processes, and establishes, in some cases, large circulation cells to move contaminated water to extraction wells. Air sparging methods are commonly performed in conjunction with SVE. Natural attenuation, which relies on naturally occurring processing such as dispersion, diffusion, sorption, degradation, volatilization, and dilution, to reduce the concentration of contaminants dissolved in groundwater, is an in-situ remediation method that is used for low-intensity contamination that does not pose significant risk to human health or the environment.

The landfill operator shall ensure that impacted water is treated to the established concentration limits as defined by Title 27 of the CCR, Section 20400 (a)(1). These regulations preclude any releases from a Class III landfill that could affect the beneficial use of the aquifer. Specifically, the RWQCB will establish a list of constituents of concern (COCs) that might reasonably be expected to be in or derived from the landfill. For each of these COCs, generally a concentration limit is established that does not exceed the site background concentration. For those COCs that are not present in background water quality samples (e.g., volatile organic compounds), the laboratory method detection limits are used. In event that a proposed concentration limit is greater than a background concentration, it may not pose a substantial present or potential hazard to human health or the environment and cannot exceed a Maximum Contamination Level (MCL) as established under the federal Safe Drinking Water Act. As such, beneficial uses of the water will be preserved.

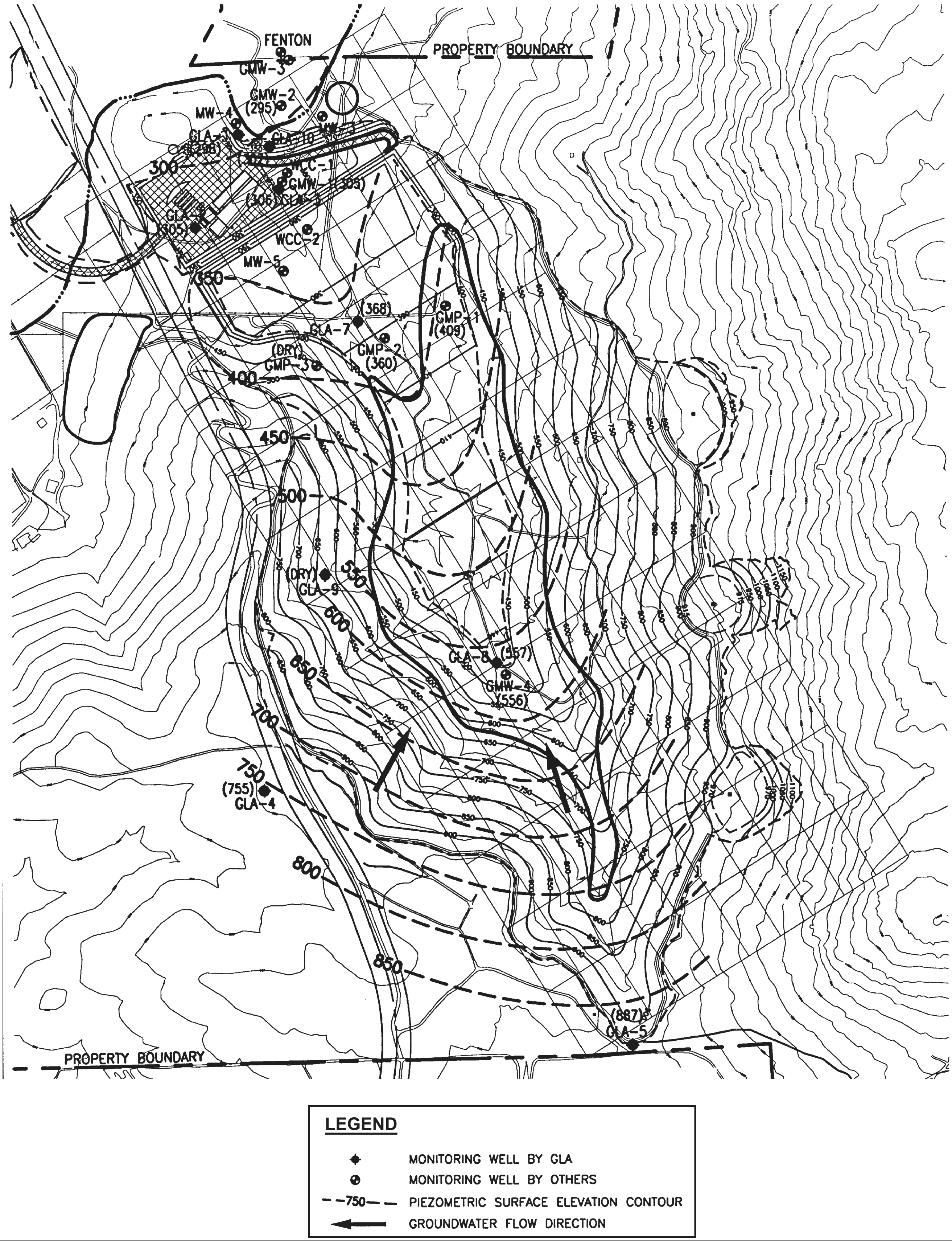
Potential Encroachment of Groundwater into the Landfill

A comparison of the proposed grading plan with the bedrock piezometric surface indicates that over a large portion of the footprint the bottom grade is below the piezometric level (Exhibit 4.3-8). The difference in elevation is nearly 160 feet. This condition is not very common at landfill sites. If the landfill environmental protection and control systems were improperly designed, groundwater could potentially exert an uplift pressure on the low permeability liner, which could considerably reduce its stability or the groundwater could potentially leak into the landfill through defects in the liner, which would increase the volume of leachate to be managed.

To address these potential impacts, the project includes a subdrain system to collect and control groundwater that intersects the subgrade surface and to maintain the separation of five feet between the refuse and groundwater required by federal regulations (40 CFR, Subtitle D, Part 58). The subdrain system consists of draining geonet on the slopes feeding collector pipes in gravel drains constructed along the benches. These bench collectors will carry collected groundwater toward the toe of the landfill by gravity. The bottom subdrain will consist of a gravel blanket with dendritic collector pipes that again will “gravity flow” water to the toe of the landfill.

To properly design the subdrain system an estimate was made of the potential groundwater inflow into the floor of the excavation. A conservative design model yielded seepage rates of 0.00063 to 0.0012 feet per day into the excavation (equivalent to 0.0047 and 0.009 gpd/ft^2, respectively). At an average seepage rate of 0.0009 feet per day, the area of the excavation that is below the piezometric level (2,640,000 ft^2) could yield a total volume of up to 2,380 ft^3/day (equivalent to up to approximately 17,800 gallons per day). These rates of flux into the floor of the excavation were conservative by a factor of 10 over the most likely average conditions (GLA, 1997). If this volume were to be collected, additional tanks would be provided to accommodate the additional subrain water. However, in the most likely scenario, because of the proposed phased development, the total seepage volume would be 270 ft^3/day (equivalent to 2,020 gallons per day), which would not require additional tanks. Therefore, the proposed 10,000 gallon tank would be sufficient.

The subdrain system is designed with adequate capacity to handle in excess of 200 percent of this anticipated flow volume. Additionally, the subdrain discharge will be monitored for the presence of contamination in accordance with the Waste Discharge Requirements (WDR) parameters. With the project design features, no significant impacts to groundwater are anticipated.



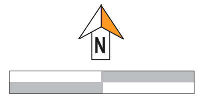


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Exhibit 4.3-8
Comparison Between Grading Plan & Piezometric Surface

Sources: GeoLogic Associates, 1999; PCR Services Corporation, 1999

The RWQCB has determined that the project's mechanical means to maintain the required five-foot separation between the groundwater and the bottom of the refuse is an engineered alternative and, as such, requires a variance from Title 27 CCR (see Section 3.8). The applicant must substantiate that the engineered alternative is consistent with the performance goal addressed by the prescriptive standard and that it would provide equivalent protection against water quality impairment.

The subdrain system of the proposed project has been designed to create a minimum of five feet of separation between groundwater and refuse and is, therefore, consistent with the prescriptive standard. In addition, since it is fully consistent with the prescriptive standard, it is by definition consistent with the performance goal [CCR Title 27 Section 20080(b)(2)(A)]. In comparing the project with a prescriptive design, the project would provide greater protection against water quality impairment since it provides an early detection system. In addition, the project would provide the ability to contain potentially impacted groundwater, would reduce the rate of groundwater migration below the landfill, and would provide fewer migrational pathways for contaminants. (Please see Chapter 6.0 for a more detailed comparison of the project with a Prescriptive Design Alternative.) The proposed project would, therefore, meet the requirements for the variance from the RWQCB.

Gregory Canyon Landfill/San Luis Rey Municipal Water District Agreement

On April 15, 1996, an agreement was executed by the proponents of the Gregory Canyon Landfill, San Luis Rey Municipal Water District (SLRMWD), and several private landowners located downstream of the landfill project (Appendix C). The purpose of the agreement is to ensure that the construction, operation, and closure of the Gregory Canyon Landfill project are carried out in a manner that will protect the quality of the water in the Pala Basin, and thus, the other downgradient basins of the San Luis Rey River. The SLRMWD agreement does not alleviate the project proponents from their obligation to comply with environmental monitoring and abatement requirements, as established by the RWQCB.

Provisions outlined in the landfill agreement include stipulations that address the protection of water supply, water rights, groundwater monitoring, liability, and closure. Section 5(a) of the agreement stipulates that water quality reports be provided to the SLRMWD within ten days of receipt of the water quality monitoring results. Section 5(b) addresses the leachate monitoring system and requires that the applicant coordinate with the SLRMWD concerning the number, specifications, location, and frequency of data collection at the monitoring stations. Section 6(c) requires that a reverse osmosis treatment facility be provided. Finally, Section 9(a) addresses financial assurances and cost estimates. The project incorporates elements as specified in the Agreement and measures are provided to address operational issues as requested by SLRMWD.

4.3.3.3 Site Closure Impacts

Phased closure of the landfill may be implemented throughout development. When the landfill or a designated area for phased closure is brought to final grade, the final cover will be applied. The foundation layer will be a minimum of two feet in thickness and consist of soil material. A comprehensive Quality Assurance/Quality Control (QA/QC) Program will be developed and included in the Final Closure Plan for placement of the final cover. The primary purpose of the QA/QC program is to provide evidence that suitable materials and good practices are used to place the final cover and to document that the cover is placed in a manner consistent with the closure plan design specifications.

State and Federal regulations dictate that the final cover design have a permeability less than or equal to any bottom liner or natural underlying soil. Therefore, because the Gregory Canyon Landfill will be a lined refuse disposal facility, the final cover system design will include a barrier layer consisting of a synthetic cover (i.e., 60-mil liner low-density polyethylene geomembrane). The geomembrane will be overlain in deck areas by a geocomposite layer consisting of two geotextile layers with a high density polyethylene (HDPE) geonet placed between the two layers. This will facilitate drainage for the barrier layer.

The depth of the vegetative layer will be designed to allow for an adequate root depth to sustain natural vegetation while giving protection to the barrier layer from potential root penetration and the drying effects of evapotranspiration. To enhance slope protection and erosion control, final site faces will be planted with native vegetation. The vegetative cover will be a mixture of native grasses and plants which are compatible with the site end-use of nonirrigated, open space. Plants will be selected for their suitability to the local climate, drought resistance, percentage of surface coverage, root zone depths less than one foot, hardiness and low maintenance qualities.

The final deck area will have a minimum grade of three percent to promote drainage and allow for future settlement. Slight modifications to the proposed final contours may be necessary in the future to achieve optimum drainage control and prevent ponding and/or excessive erosion of completed fill areas or to reduce impacts associated with anticipated settlement throughout the post-closure maintenance period.

As required by Title 27 of the California Code of Regulations, groundwater monitoring will continue following closure of the landfill for a minimum of 30 years. At the end of the post-closure maintenance period, if the LEA determines that the landfill still poses a threat to groundwater resources, the post-closure maintenance period can be extended. With long-term groundwater monitoring features and the enforcement of environmental control measures through the mitigation monitoring and reporting process, impacts to post-closure hydrogeology will remain insignificant.

4.3.3.4 First San Diego Aqueduct Relocation Option

No direct hydrogeologic impacts are anticipated with the relocation of the First San Diego Aqueduct. Relocation of the aqueduct would place the aqueduct further from the landfill footprint on the western side of the ridge. Therefore, in the unlikely event of a rupture of one or both of the pipelines, or the future Pipeline No. 6, because of the relocation to the west and the topography of the site, the majority of the water would flow to the west away from the landfill footprint and into the adjacent canyon. If any water were to flow to the east, most of this water would flow above ground and would be captured by the landfill perimeter surface water drainage control system and would flow into the desilting basin. The limited amount of remaining water that infiltrates the surface and would flow to the east towards the landfill footprint would be captured by the subdrain system.

4.3.4 MITIGATION MEASURES AND PROJECT DESIGN FEATURES

<u>Proposition C</u>

Sections 5E and 5G of Proposition C contain the following mitigation measures relative to potential groundwater impacts:

MM 4.3.C5E *A liner and leachate collection system shall be installed and monitored as required by the Regional Water Quality Control Board.*

MM 4.3.C5G *The project shall comply with all requirements of the Regional Water Quality Control Board to ensure protection of surface and underground water quality.*

Project Design Features

- A composite liner and leachate collection system will be installed and monitored as required by the RWQCB. The performance of the landfill will be monitored with the subdrain and groundwater monitoring systems. The subdrain system will be constructed to collect and control groundwater that intersects the subgrade surface. The subdrain system will serve to maintain the separation of five feet between the refuse and groundwater required by federal regulations (40 CFR, Subtitle D, Part 258). The subdrain system will be monitored for the presence of contamination in accordance with the WDR parameters. Monitoring procedures will also be designed consistent with the requirements of the RWQCB.
- The water quality monitoring system will include the installation of monitoring wells at both upgradient (background) and downgradient (point of compliance) locations to the landfill and surface water sampling points both upstream (background) and downstream of the landfill as required by Section 20415 (b) of the Title 27 CCR.
- The project incorporates a combination of engineering controls, (e.g., interim covering of the refuse, suitable slopes for efficient drainage, culverts), and a water quality monitoring program, to ensure that water quality is adequately protected.
- A reverse osmosis (RO) system will be installed in the southwestern portion of the ancillary facilities area. The RO equipment and interconnecting piping will be constructed above ground inside a concrete containment area with a slatted chain link fence around the area. The RO system will be sized to process 50 gpm (although the housing will be sized to allow for a larger system).
- Two 10,000-gallon leachate collection storage tanks will be located in the southwestern portion of the ancillary facilities area. The collection tanks will be monitored for capacity at least once per day.
- Water discharged from the subdrain system will be collected in a 10,000-gallon holding tank in the southwest portion of the ancillary facilities area. Although greater volumes are not anticipated, if needed, additional above ground tanks will be added to collect all of the subdrain system water. Subdrain system drainage water will be reused on-site or may be discharged to the San Luis Rey River only after tests determine the water is not contaminated in accordance with site NPDES permit. Any contaminated water will be treated at the landfill by the on-site reverse osmosis system for on-site use or transported to an appropriate off-site disposal facility.

Impacts and Mitigation Measures

Impact 4.3-1: *Although a liner, LCRS, and water quality monitoring program are incorporated into the project design, the potential release of leachate from the landfill could result in impacts to groundwater quality.*

MM 4.3-1a: For the purpose of providing additional environmental assurance to the San Luis Rey Municipal Water District, in addition to the 13 monitoring wells surrounding the landfill, the water quality monitoring shall include at a minimum monitoring of two production wells (downgradient SLRMWD well #34 and upgradient Lucio well #2), upgradient alluvial monitoring well GMW-3, and downgradient alluvial monitoring well GLA-16 located within the project boundary).

MM 4.3-1b: If contamination is detected in any monitored well, the landfill operator shall be responsible for treatment and disposal of contaminated water. The landfill operator shall ensure that impacted water is treated to acceptable water quality standards, consistent with existing background water quality as provided in CCR Title 27, Section 20400 (a)(1). Adequate treatment shall be implemented to maintain background levels established by the RWQCB at the time of issuance of the waste discharge requirements.

Mitigation Measures from the San Luis Rey Municipal Water District Agreement

As previously discussed there is an agreement between the applicant and San Luis Rey Municipal Water District, Dorothy E. Leavey, J.T. and K.L. McCarthy, Edgar E. and Elizabeth S. Pankey Trust, Pankey Farms, Pankey Ranch, and Blanche Pope, Trustee U/D/T Pope Family Trust, for the protection of groundwater resources. The agreement contains the following mitigation measures:

MM 4.3-1c: The Applicant shall provide to the San Luis Rey Municipal Water District simultaneously with the submission to the RWQCB data collected from the groundwater monitoring program and shall provide to the District and its consultants split samples from any groundwater monitoring station upon reasonable notice given before the next regularly scheduled sampling to enable the District to verify the data collected.

MM 4.3-1d: Prior to the commencement of Phase I construction project grading, the Applicant shall provide the San Luis Rey Municipal Water District and the other parties to the Mitigation agreement with an irrevocable letter of credit in accordance with Section 9 and Exhibit C of the Mitigation Agreement. The Letter of Credit shall be automatically renewed annually.

MM 4.3-1e: Prior to commencement of project operation, the Applicant shall establish, maintain, and administer a trust fund or third party custodial account for the benefit of the San Luis Rey Municipal Water District and the other parties to the Mitigation Agreement in accordance with Section 9 and Exhibit C of the Mitigation Agreement.

MM 4.3-1f: As a condition of any water rights appropriation permit that may be granted by the State Water Resources Control Board, the Applicant shall reduce its diversion of water if the amount of groundwater available within the San Luis Rey Municipal Water District based upon water rights as they existed on April 15, 1996 within the boundaries defined in the Mitigation Agreement, is insufficient to meet the reasonable and beneficial needs of the District or any of the landowners within the District.

MM 4.3-1g: The Applicant shall identify and use an alternate water supply for construction and operation of the project if the amount of groundwater available within the San Luis Rey Municipal Water District is insufficient to meet the reasonable and beneficial needs of the District or any of the landowners within the District.

MM 4.3-1h: If the construction, operation, or closure of the landfill causes degradation of the Pala Basin water or quality of foreign water stored in the Pala Basin for use within the Pala Basin so that it cannot be used for domestic uses and for irrigation, the Applicant shall be liable to the San Luis Rey Municipal Water District to the extent of any degradation of the quality of Pala Basin water or the quality of foreign water stored in the Pala Basin caused by the construction, operation or closure of the landfill, including the cost of remediating the degradation of water quality attributable to the construction, operation or closure of the landfill, or if such remediation is not technologically or economically feasible, of providing an alternative water supply pending permanent remediation measures to the extent necessary to meet the reasonable needs for domestic and irrigation uses of the parties who signed the Mitigation Agreement. The applicant's liability with respect to foreign water shall be limited to remedation of a maximum of 17,694 acre-feet. Remediating the water quality of the Pala Basin or providing an alternative water supply, shall be part of the closure plan and part of the cost estimate required by 14 CCR § 17782.

MM 4.3-1i: The Applicant shall notify the San Luis Rey Municipal Water District and each of the parties to the Mitigation Agreement of any request to modify or to be released from the requirements of the closure plan or the post closure maintenance plan for the project.

MM 4.3-1j: The Applicant shall consult with the San Luis Rey Municipal Water District concerning the number, specifications, location, and frequency of data collection at the monitoring stations. The final decision regarding the need for and adequacy of the number, specifications, location of and frequency of data collection from the monitoring stations will be made by the RWQCB.

4.3.5 LEVEL OF SIGNIFICANCE AFTER MITIGATION

Implementation of the specific design features proposed for the landfill (e.g., liner, LCRS, water quality monitoring, etc.) as well as the mitigation measures identified above, would reduce potential impacts to groundwater resources resulting from project implementation to an insignificant level.