GROUNDWATER ANALYSIS REPORT

FINAL

SOUTH BAY SALT POND RESTORATION PROJECT

GROUNDWATER ANALYSIS REPORT FOR
SOUTH BAY SALT POND EIS/R

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ACRONYMS AND ABBREVIATIONS

Alameda County Water District	ACWD
Alameda Creek Flood Control Channel	ACFCC
below ground surface	bgs
Brown and Caldwell	BC
California Department of Fish and Game	CDFG
California Division of Mines and Geology	CDMG
Department of Health Services	DHS
Department of Water Resources	DWR
East Bay Municipal Utility District	EBMUD
Environmental Health Department	EHD
Environmental Impact Statement-Environmental Impact Report	EIS/R
Groundwater Management Plans	GMPs
maximum contaminant level	MCL
mean sea level	msl
milligrams/liter	mg/l
Municipal Water District	MWD
Niles Cone and South East Bay Plain Integrated Groundwater and Surface Water Model	NEBIGSM
parts per million	ppm
parts per thousand	ppt
Philip Williams & Associates, Ltd.	PWA
Project Management Team	PMT
Regional Water Quality Control Board	RWQCB
Resources Legacy Fund	RLF
San Francisco Regional Water Quality Control Board	SFRWQCB
Santa Clara Valley	SCV
Santa Clara Valley Water District	SCVWD
South Bay Salt Pond	SBSP
spills, leaks, investigations and cleanups	SLIC
State Coastal Conservancy	SCC
State Water Resources Control Board	SWRCB
total dissolved solids	TDS
Urban Water Management Plan	UWMP
U.S. Army Corps of Engineers	USACE
U.S. Fish and Wildlife Service	USFWS
U.S. Geological Survey	USGS

1. INTRODUCTION

This section describes the purpose of this groundwater analysis, the scope of work, the approach and methodology, and the limitations of the current analysis.

1.1 Purpose

The purpose of this report is to present the baseline hydrogeologic conditions and to evaluate the potential groundwater impacts of the South Bay Salt Pond (SBSP) Restoration Project and the project alternatives to support the Environmental Impact Statement-Environmental Impact Report (EIS/R) impact analysis. The location of the SBSP Restoration Project and project areas are shown in Figure 1.

1.2 Approach and Methodology

Brown and Caldwell's scope is defined in the Stage 3 Scope of Services prepared by Philip Williams and Associates (PWA) and Brown and Caldwell (BC) dated September 9, 2005. This report is one of the technical studies that will be used in support of the EIS/R by summarizing the potential impacts that the proposed activities will have on the groundwater basin and resources.

Regional hydrogeologic characteristics and groundwater levels and quality for Section 2 were summarized based primarily on existing literature and groundwater data from Alameda County Water District (ACWD), Santa Clara Valley Water District (SCVWD), and other miscellaneous sources (Attachments A, B, C respectively). Groundwater level data were obtained from SCVWD and for the Santa Clara Subbasin (including the Alviso project area) and from ACWD for the Niles Cone and East Bay Plain Subbasins (including the Eden Landing area). Regional water level data were relied upon for the San Mateo Plain (and Ravenswood area) (Fio and Leighton 1995; Regional Water Quality Control Board 2003). The groundwater quality analysis focused primarily on salinity because of historic saltwater intrusion in the South Bay and because this is considered to be the only significant potential effect of restoration on local groundwater supplies.

The predictions of the potential changes to the groundwater conditions (water levels and chemistry) that may result from the implementation of the restoration project alternatives and the Phase 1 activities is a qualitative assessment based on a review of available published hydrogeologic literature, historical water level and quality data, and best professional judgment. Historical, present, and projected pond and slough salinities were also considered as a basis of comparison. This evaluation did not include either groundwater flow or fate and transport modeling, which would be necessary for quantitative predictions of future conditions.

1.3 Limitations

This report was prepared solely for PWA, the California State Coastal Conservancy (SCC) and the Resources Legacy Fund (RLF) in accordance with the standards of the engineering consulting industry at the time the services were performed and in accordance with the agreement between PWA and Brown and Caldwell dated September 20, 2005. This report is governed by the specific scope of work authorized by PWA, the SCC, and RLF, and is not intended to be relied upon for purposes other than the SBSP EIS/R. We have relied in part on information provided by the local water agencies and from other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

2. BASELINE HYDROGEOLOGIC CONDITIONS

This section characterizes the existing physical setting of the South San Francisco Bay with respect to groundwater hydrology and quality conditions. The physical setting is described at both the regional and Phase 1 project levels, including:

- Geology
- Groundwater hydrology
- Groundwater quality (including salinity intrusion issues)
- Artificial pathways
- Groundwater management

This section summarizes the groundwater hydrology and quality of the SBSP Restoration Project portions of the Santa Clara Valley (SCV) that are included in the project area, which are part of the San Francisco Bay Hydrologic Region according to the California Department of Water Resources (DWR) (Department of Water Resources 2003). The project area includes portions of the following four groundwater subbasins of the Santa Clara Valley Groundwater Basin (DWR# 2-9, as shown in Figure 2):

- Santa Clara (# 2-9.02)
- San Mateo Plain (# 2-9.03)
- Niles Cone (# 2-9.01)
- East Bay Plain (# 2-9.04)

The Alviso project area is primarily within the Santa Clara Subbasin, but the northeastern portion is part of the Niles Cone Subbasin (Coyote Creek is the boundary). The Ravenswood project area is located within the San Mateo Plain Subbasin. The Eden Landing project area straddles Old Alameda Creek, which forms the boundary between DWR's Niles Cone and East Bay Plain Subbasins. Some studies (Regional Water Quality Control Board 2004) have classified the entire Eden Landing area as lying within the Niles Cone Subbasin.

2.1 Regional Project Setting

Groundwater and surface water are typically hydraulically connected to some degree. Under certain physical conditions, surface water infiltrates into the subsurface and becomes groundwater, and under other conditions groundwater discharges to the surface and becomes surface water. Groundwater must therefore be considered in conjunction with surface water. While the SBSP Restoration Project has primarily surface water components, groundwater hydrology and quality are analyzed in this report to determine their relationship to surface water in the SBSP project area. One of the main questions to be addressed is whether hydraulic connections between groundwater and ponds (future restoration areas) would increase the potential for the intrusion of salt water into the groundwater, which would pose a risk to local groundwater quality (an environmental impact to the groundwater resource).

Five main factors ultimately control whether the likelihood of an increased potential for saltwater intrusion would actually occur as a result of the project and are thus discussed in the regional and project settings below:

- **Geology** – controls the permeability of the sediments and thus the rate of surface water infiltration and groundwater flow in the subsurface
- **Groundwater hydrology** – primarily reflected in water levels, which control the relative hydraulic heads between surface water and groundwater (and between groundwater at different locations or depths) and thus the direction of flow
- **Groundwater quality** – primarily salinity, since concentration contrasts between two water bodies are required for an impact to occur from flow
- **Artificial pathways** – Man-made conduits for preferential flow (primarily created through dredging or improperly constructed or abandoned wells) that short-circuit natural geologic barriers
- **Groundwater management** – groundwater data collection, evaluation, and actions to preserve and protect a basin's groundwater resource (both quantity and quality)

All five of the above factors are summarized in this section to provide the basis for the environmental impacts analysis in Section 3.

2.1.1 Geology

The San Francisco Bay Area is located at the boundary between the Pacific and North American plates, two large crustal plates that are separated by the north-northwest trending San Andreas Fault (and related sub-parallel faults including the Hayward and Calaveras faults). The north-northwest-trending faults largely define the boundaries between the uplifted bedrock mountain ranges and the down-dropped Southern San Francisco Bay within the sediment-filled Santa Clara Valley Basin.

Geologic units are classified according to geologic time periods. The most recent time period is the Quaternary Period which covers from 1.8 million years ago to present. The Quaternary Period is subdivided into the Pleistocene Epoch (1.8 million years ago to 11,000 years ago) and the Holocene Epoch (11,000 years ago to present). The Pleistocene includes a number of world-wide glacial (relatively cold) periods of low sea level stands, when sea level was typically two to three hundred feet below present. During these glacial periods the shoreline was tens of miles west of the Golden Gate, and non-marine deposition predominated in the region. The two most recent and significant interglacial (relatively warm) periods with high sea level stands when estuarine (bay) muds have been deposited in San Francisco Bay are the Sangamon (70,000 to 120,000 years ago) and the Holocene (less than 10,000 years ago) (Atwater and others 1977; Helley and Graymer 1979). The depositional processes and resulting Bay mud deposits are shown in the schematic diagram in Attachment C (p. C-1).

Southern San Francisco Bay is a north-northwest trending subsiding basin that has been filled primarily with Quaternary alluvium (stream and alluvial fan) deposits eroded from the surrounding uplifted mountains and some eolian (wind blown) sand deposits. The alluvium consists primarily of sediments eroded from the surrounding topographic upland highs, namely the Santa Cruz Mountains to the west and Diablo Range to the east (Attachment C, p. C-1). These alluvial sediments were transported and deposited by streams and alluvial fans and include a mixture of sands, gravels, silts, and clays with highly variable permeability (a measure of the material's ability to transmit water). The coarser alluvial deposits of sand and gravel form the region's important water supply aquifers (materials that have sufficient permeability to store and transmit significant quantities of water to wells). The discontinuous alluvial clays and silt horizons form local horizons that impede vertical groundwater flow and together create a regional low permeability zone (known as an aquitard, a unit that impedes the vertical flow of groundwater and confines the deeper water supply aquifers).

The youngest Holocene Bay muds underlie almost all of the original Bay (Atwater and others 1977; Helley and Graymer 1979), including the SBSP Restoration Project area. The Holocene Bay muds are as much as 30 to 50 feet thick beneath the Bay. The older Pleistocene Sangamon Bay muds have a similar thickness, but their extent is not as well defined as that of the Holocene Bay muds. The Sangamon Bay muds were also deposited at or near sea level, but have since subsided to approximate depths of 100 to 150 feet below sea level (due to the natural ongoing subsidence of the basin since the Sangamon interglacial period). The two Bay mud units are separated by Pleistocene alluvium, and both units thin and pinch out (terminate) near the historical edge of the bay where they interfinger with the coarser alluvial deposits (Attachment C, p. C-1). The fine-grained Bay muds have very low permeability and where sufficiently thick generally form an effective natural barrier to significant vertical groundwater flow (known as aquicludes, a unit that prevents the flow of groundwater). The aquifers and aquitards in the general vicinity of the Ravenswood area are shown schematically in Attachment C (p. C-2).

Due to the nature of the salt ponds and the conditions that were there prior to their existence, virtually all of the salt ponds and much of the project area is underlain by Holocene Bay mud. The Holocene Bay mud is relatively impermeable to both infiltration and groundwater flow. The thickness (and depth to the contact with underlying alluvium) of Holocene Bay mud along Alviso Slough and up into the Guadalupe River ranges from approximately 5 feet to 25 feet below mean sea level (msl). Some Holocene levee deposits and alluvium overlie parts of these areas. The depth of Bay mud along Coyote Creek ranges between approximately 2 and 22 feet below sea level. Young alluvium overlies the Bay mud in the upper reaches of Coyote Creek. Bay mud depths around the edges of the Alviso ponds range from surface level to as deep as approximately 22 feet below msl. The extent of the Bay muds ends close to the edge of the Alviso ponds, and in some areas Holocene alluvium underlies Alviso ponds (Woodward-Lundgren & Associates 1971). The other areas of the SBSP project exhibit similar Bay mud distribution and thicknesses.

The Santa Clara Valley Groundwater Basin contains two primary water-bearing formations: the Santa Clara Formation (Plio-Pleistocene age) and Pleistocene-Holocene Alluvium (Department of Water Resources 2003). The exposures of the Santa Clara Formation are limited to the upland areas, where the unit is generally composed of coarse-grained and poorly sorted alluvium that overlies the relatively impermeable Mesozoic bedrock of the Diablo and Santa Cruz Mountains. The unit dips 10 to 30 degrees towards the Bay, where it becomes nearly flat-lying. The Santa Clara Formation (and the overlying Quaternary alluvium) generally contains increasing amounts of fine-grained sediments (silts and clays) toward the Bay and becomes indistinguishable from the overlying alluvium (Attachment C, p. C-1). Together, the sedimentary units are on the order of 1000 to as much as 2000 feet thick beneath the central part of the basin (Department of Water Resources 2003).

Although the Santa Clara Valley Basin is largely defined by faults, most active and mapped faults are restricted to at or near the basin margins. Only two sub-parallel faults, the Silver Creek and Evergreen faults, are mapped in the SBSP project area. Both cut north-northwest across Coyote Creek near the eastern edge of the Alviso project area (Hanson and others 2004). The Silver Creek is classified as Quaternary (meaning it has had movement within the last 1.8 million years) (California Department of Conservation and Division of Mines and Geology 1992). According to the U.S. Geological Survey (USGS), the faults are considered to be primarily barriers to horizontal flow (Hanson and others 2004).

Local land elevations, particularly in the South Bay, have subsided from their original pre-development elevations primarily due to the historical extraction of significant amounts of groundwater. Land subsidence due to the over-extraction of groundwater is well documented in numerous basins (Freeze and Cherry 1979) and in the South Bay is primarily due to over-pumping in the early part of the 1900s (Iwamura 1995; Santa Clara Valley Water District 1980). Land adjacent to the Bay in Santa Clara Valley was reported to have subsided 2 to 8 feet from 1912 to 1967 (Helley and Graymer 1979), and up to 13 feet locally (Groundwater Committee of the California Regional Water Quality Control Board San Francisco Bay Region and others 2003). Subsidence was virtually halted by 1971 when groundwater pumping decreased with surface water importation from the San Francisco Regional Water System and State Water Project. As a result, groundwater levels in the region have since recovered (Helley and Graymer 1979). Due to current awareness and management of this problem, water level declines below historical lows and further land subsidence are not expected in the future.

2.1.2 Groundwater Hydrology

Upland areas (known as the forebay of the basin) serve as recharge areas for the Santa Clara Valley Basin, where precipitation infiltrates into the soil and percolates to the groundwater table, before flowing downgradient towards the natural discharge points at the margins of and beneath the bay. Under natural conditions before historical development, precipitation and recharge in upland areas and discharge in surface springs and beneath the Bay was sufficient to prevent the infiltration of surface water from the Bay (Department of Water Resources 2003). It was when these natural conditions were altered (primarily by increased groundwater extraction) that historical saltwater intrusion occurred.

Groundwater in the Santa Clara Valley Basin currently generally flows towards the Bay (keeping salinity intrusion from occurring), as indicated by recent groundwater level measurements (Alameda County Water District 2006; Department of Water Resources 2003; Fio and Leighton 1995; Santa Clara Valley Water District 2005a) and groundwater modeling results (Santa Clara Valley Water District 2005a; Water Resources & Information Management Engineering Inc 2005). Groundwater flow towards the Bay is also confirmed by the fact that contaminated groundwater plumes in the South Bay (most of which are west of Highway 101) migrate towards the Bay (Groundwater Committee of the California Regional Water Quality Control Board San Francisco Bay Region and others 2003; Regional Water Quality Control Board 2004). Groundwater flow in the area would be expected to continue to flow towards the Bay in the future unless there was a significant change in groundwater pumping (which will be addressed in Section 3). Groundwater flow towards the Bay indicates that there is currently no significant risk of saltwater intrusion under the baseline conditions for this analysis.

The hydrology of the Santa Clara Valley Basins is presented in two sections:

- Santa Clara and San Mateo Plain Subbasins (includes Ravenswood and most of Alviso Pond project areas)
- Niles Cone and Southern East Bay Plain Subbasins (includes Eden Landing and Alameda County portion of Alviso Pond area)

Santa Clara and San Mateo Plain Subbasins

The deep aquifers beneath most of the Santa Clara Valley are separated from the Bay and shallow ground aquifer (above approximately 100 feet deep) by a combination of the Bay mud aquicludes and the alluvial aquitards that together act as a natural confining layer. This confining layer, which is shown on Figure 2 and in Attachment C (p. C-3), occupies the northern portion of the Santa Clara Subbasin (at an average depth of 100 to 200 feet) and extends northward beneath the Bay and along its margins on both the east and west sides. Unless absent or compromised, this confining layer provides protection from infiltration of salt water or contaminated groundwater into the deeper water supply aquifers.

Groundwater levels for wells within or near the Alviso pond complex were reviewed using data from the SCVWD groundwater database and published reports. The data indicate that after groundwater levels declined to as much as 100 feet below msl in the 1960s, the declines were arrested by the delivery of imported State Water Project surface water to the SCVWD. This trend is shown in the SCV Subbasin Index Well 07S01E07R013 hydrograph (a graph of water levels relative to sea level over time) (Attachment B, p. B-2), which shows current water levels well above sea level and the threshold below which subsidence could be expected to occur (Attachment B, p. B-1). The District’s groundwater elevation contour map for Fall 2003 also indicates water levels 40 to 50 feet above sea level and a northbound flow direction in the vicinity of the Bay (Attachment B, p. B-2).

Historical District data indicates water level declines ranged from zero to as much as 20 feet per year during the 1976-1977 and 1987-1992 droughts. Seasonal fluctuations (normally less than ten to 20 feet but locally as much as 60 to 80 feet) and one or two dry years would therefore generally not be sufficient to reverse the upward vertical gradient. However, during an extended drought surface water deliveries may be reduced.

Recent data indicate that shallow wells (those screened above approximately 100 feet below sea level) in and near the salt ponds have water levels at or near sea level, as would be expected for an aquifer in hydraulic communication with the Bay. Deeper wells near the Bay screened below the regional confining layer (generally below 200 feet msl) indicate that water levels have generally recovered to water levels (pressure heads) above sea level. Although the District does not measure pressure heads and many monitoring wells are screened in multiple aquifer zones, groundwater modeling data indicate that heads are now 40 to 50 feet above sea level in the project area, restoring the aquifer to artesian conditions and creating flowing artesian wells. The District's 2003 groundwater elevation index was approximately 19 feet below the maximum historic level (in 1916) and 213 feet above the minimum groundwater level for the period since (Santa Clara Valley Water District 2005a). This strong upward vertical gradient is a testament to successful groundwater management, and generally precludes salinity intrusion under current conditions.

It should be noted that salinity intrusion can theoretically also occur by molecular diffusion (chemical dispersion) or density-driven advection. Molecular diffusion is generally minor and can generally be ignored in estimating the spread of contaminants unless there is no groundwater flow (Driscoll 1986). The Salinity Intrusion Investigation (Santa Clara Valley Water District 1980) mentions diffusion playing only a small role in the formation, definition, and control of the transition zone between Bay waters and the aquifer. Density-driven downward movement of saline waters is also possible, but aquitards and an upward vertical hydraulic gradient would generally preclude such flow. Neither process has been documented as being important in historical salinity intrusion in the South Bay, nor are they expected to be significant in the future.

Groundwater levels are not available for wells in the Ravenswood area of the San Mateo Plain Subbasin (Figure 2), since there are no municipal water purveyors east of Highway 101 that pump groundwater and have water level monitoring programs. Neither the Menlo Park Municipal Water District (MWD) nor East Palo Alto County Waterworks District, which border the project area to the west, have groundwater wells or monitoring programs. Small wellfields of the Palo Alto Park Mutual (5 wells) and O'Connor Tract Mutual (2 wells) water districts are present near Highway 101, and a few domestic and irrigation wells are present between Highway 101 and the project area (Groundwater Committee of the California Regional Water Quality Control Board San Francisco Bay Region and others 2003). Regional water level data do indicate that the horizontal groundwater gradient is eastward toward the Bay (Fio and Leighton 1995), but pumping in some areas west of Highway 101 has drawn water levels below msl (Regional Water Quality Control Board 2004), indicating a downward vertical gradient and the potential for salinity intrusion.

Niles Cone and the East Bay Plain Subbasins

The shallow aquifer (above approximately 100 feet below msl, and known as the Newark Aquifer in the Niles Cone area) is generally considered to be in communication with the Bay. Overpumping led to water level declines and salinity intrusion, as shown in Attachment A (p. A-1). A review of recent groundwater monitoring data from ACWD shows water levels to have recovered and to be very stable (not fluctuating significantly seasonally from pumping as is typical of deeper wells). According to DWR (Department of Water Resources 1967), interconnections between the Bay and Newark Aquifer in the Niles Cone area may exist due to dredging of the shipping channel in the Dumbarton Bridge area. ACWD (and SCVWD) groundwater monitoring data that indicate high salinity in shallow wells also support the existing hydraulic interconnection between the Bay and shallow groundwater. The relatively thin Holocene Bay muds at the margins of the Bay therefore do not currently isolate the shallow aquifer from the Bay in the area between the current outboard and inboard salt pond levees. However, ACWD water level data clearly indicate that groundwater flow in the shallow Newark aquifer is toward the Bay, thus preventing salinity intrusion (Attachment A, p. A-2).

The Sangamon Bay mud and fine-grained alluvial deposits do generally create differences in hydraulic heads that are evidence of hydraulic separation. Upland of the inboard levees and within the regional setting (below the 100-year flood plain), the fine-grained alluvial deposits alone cause confinement of groundwater (Atwater and others 1977; Helley and Graymer 1979) and a measure of protection for the water supply aquifers (the water-bearing zones).

ACWD groundwater monitoring data indicate that water levels in the Centerville/ Fremont aquifers (between roughly 200 and 350 feet below ground surface [bgs]) have recovered from levels of as much as 100 ft bgs in the early 1960s to within five feet of sea level (Attachment A, pp. A-3 to A-4). However, a downward vertical gradient (from shallow wells to deeper wells) is generally present in clustered wells (Alameda County Water District 2006). While the groundwater levels fluctuate seasonally, there is also a general trend over the last 50 years of increasing groundwater elevations. This is consistent with the regional trend that groundwater levels have increased during the later half of the 1900s due to more awareness of the problems created by over-pumping groundwater, and the resulting measures taken to address subsidence and salinity intrusion (discussed below under groundwater management).

In the Niles Cone area, ACWD extracts saline groundwater from the Centerville/Fremont Aquifer as part of its aquifer reclamation project. Groundwater extraction in the Newark area creates a cone of depression (an area of inward sloping groundwater levels) in the Centerville/Fremont Aquifer, but this area is east of the impermeable bedrock of the Coyote Hills and south of the Alameda Creek Flood Control Channel (ACFCC) (and thus outside the project area).

Summary of Hydrology

The groundwater hydrology of the project area generally indicates shallow aquifers in communication with the Bay, and deeper aquifers that are isolated from shallow aquifers by aquitards. A possible exception to this is present in the vicinity of Coyote Creek, where the confining layer over the deep aquifer is thin or absent (Figure 2). Groundwater levels have been historically depleted by overpumping, but recently (within the past 40 years) restored by regional groundwater management actions. Today, flow is generally bayward and, in the Santa Clara Subbasin, generally artesian, providing a measure of protection from salinity intrusion as long as current groundwater levels are maintained.

There is no guarantee that the generally successful groundwater management that has characterized the last 40 years will be as successful in the future as water demands increase, water supplies become increasingly scarce and expensive, infrastructure (such as the large surface water importation projects) ages and is subject to earthquakes, terrorism, or other interruptions, or as the frequency and severity of major droughts increases with global warming. The possibility of greatly increased groundwater pumping in the basin is something that is beyond the control of the SBSP project. This analysis assumes that long-term overdraft is unlikely to occur in the future, given the current knowledge of the factors affecting saltwater intrusion, the risks of saltwater intrusion and land subsidence, and the current awareness level of local water boards, utilities, and the public. Both ACWD and SCVWD can and will no doubt continue, if not increase, surface water deliveries, artificial recharge, conservation, recycling, and other activities to the degree possible. However, neither have the regulatory authority to curtail pumping by the various municipal water agencies and private pumpers in the basin, and the potential for future long-term overdraft conditions therefore cannot be ruled out and is considered in Section 3.

2.1.3 Groundwater Quality

According to DWR (Department of Water Resources 2003), groundwater quality in the Santa Clara Valley Basin is generally of a bicarbonate type, with sodium or calcium being the principal ions. Although often hard, it is of good to excellent mineral composition and suitable for most uses.
The mineral character in the principal aquifer zones of the SCV Subbasin is shown in Attachment B (p. B-3). The general trend of increasing TDS (total dissolved solids), sodium, and chloride northward toward the Bay is evident. All drinking water standards are met at public supply wells without the use of treatment. Some areas of elevated nitrate concentrations occur in the southern portion of the basin, and a number of groundwater contaminant plumes (primarily fuels and chlorinated solvents) are present locally. According to SCVWD and RWQCB (Regional Water Quality Control Board) data (Groundwater Committee of the California Regional Water Quality Control Board San Francisco Bay Region and others 2003), the plumes are generally at least a mile from the salt ponds. Typical concentrations of inorganic constituents and summaries of organic contaminant detections in the SCV Subbasin are included in Attachment B (pp. B-4 to B-6), as are the general locations of contaminant plumes and spills, leaks, investigations and cleanups (SLIC) cases (Attachment B, p. B-7). Specific plumes in the vicinity of Moffett Field and Cooley Landing (Groundwater Committee of the California Regional Water Quality Control Board San Francisco Bay Region and others 2003) should be considered in the project-level evaluations.

Salinity in the South Bay waters is typically 30 to 32 ppt (parts per thousand), (near oceanic levels of 33 ppt), since the Bay receives very little fresh water inflow (U.S. Fish and Wildlife Service and California Department of Fish and Game 2003). Historical salinity concentrations in the salt ponds varied considerably, ranging from as low as the Bay to brines with salinity concentrations several times that of the Bay.

Saltwater intrusion is characterized by the movement of saline water into a freshwater aquifer. Under natural conditions, coastal aquifers typically discharge to the ocean, keeping salinity at bay (Attachment C, p. C-5). However, the development of groundwater resources can reduce or even reverse this seaward flow, causing seawater to enter and penetrate inland aquifers (Attachment C, p. C-5). With high groundwater demands in the South Bay after World War II and continuing subsidence, saltwater intrusion conditions encompassed a significant area. Saltwater intrusion degrades aquifers and renders them virtually unusable, and is difficult and costly to reverse (Santa Clara Valley Water District 1980).

High concentrations of salinity (measured as total dissolved solids, or TDS) cause drinking water to taste salty and can make it unusable for other beneficial uses as well. California Department of Health Services (DHS) has established a secondary drinking water standard (known as a maximum contaminant level, or MCL) for TDS of 500 mg/l (ppm [parts per million]) (recommended) to 1,000 mg/l (maximum). Concentrations of 1500 mg/l may be permissible on a short-term basis. Typical TDS concentrations in the primary water supply aquifers of the Santa Clara Valley are below the recommended MCL, but concentrations in the upper aquifer zones are locally higher. Two wells in the principal aquifer and three in the upper aquifer exceeded the standard in 2003 in the SCV Subbasin (Santa Clara Valley Water District 2005a). It should be noted that almost all of the SCVWD monitoring points are located well inland (south) of the project area (Attachment B, p. B-1).

Groundwater monitoring data in the Alviso pond area from SCVWD's salinity intrusion monitoring program also indicates elevated salinity levels in shallow wells (screened above 100 feet below msl) within and near the salt ponds. Only one functioning monitoring well cluster (defined as one or more co-located monitoring wells screened at different discrete depths) is located within the salt ponds themselves on Alviso Slough near the boundary between ponds A7 and A8 (wells L001, L002, and L003). The most recent data (June 20, 2006) indicate very low chloride concentrations in the two screened zones below 250 feet msl, but the shallow aquifer zone has a chloride concentration of 19,500 mg/l (roughly equivalent to a TDS of 40 ppt). The data demonstrate that the shallow aquifer is already impacted by salinity from the salt ponds and/or Bay.

The Saltwater Intrusion Investigation by the Iwamura (Santa Clara Valley Water District 1980) indicated the maximum areal extent of saltwater intrusion (as indicated by chloride concentrations above 100 ppm) by the mid-1970s was as far southeast as the vicinity of intersection of Highways 101 and 880 (Attachment C, pp. C-6 to C-7). The salinity intrusion was apparently driven by the movement of saline waters from the Bay up the Guadalupe River and Coyote Creek, during high tides and low stream flow as documented through surface water sampling. Salinity intrusion from the waterways was exacerbated by subsidence, dredging, and improperly abandoned wells. The Holocene Bay muds were shown to be leaky and allow for downward migration of salinity into the upper aquifer zone. High salinity was also present in the lower aquifer zone beneath San Jose along the Guadalupe River and in the Palo Alto area (Santa Clara Valley Water District 1980). Recent SCVWD data indicate that salinity remains elevated in the upper aquifer as much as five to six miles inland (southeast) of the salt ponds along the Guadalupe River and Coyote Creek (Attachment B, pp. B-8 to B-9) (Santa Clara Valley Water District 2005a).

The shallow Newark Aquifer in the Eden Landing area has high salinity due to its hydraulic connection with the Bay and the historical salt ponds (Attachment A, p. A-5). Although monitoring data are not available for most of the salt pond area, ACWD monitors salinity in eleven shallow wells located near the eastern edge of the salt ponds between Highway 92 and the ACFCC. The data indicate Fall 2005 salinities (measured as total dissolved solids, or TDS) in the range of 10 to 132 ppt (shown in ppm in Attachment A, p. A-5). The salinity concentrations several times that of the Bay waters (which are 30 to 32 ppt) are a result of shallow groundwater interaction with the brines of adjacent salt ponds. Historically, pumping impacts in the Niles Cone area have resulted in significant cross-communication between the shallow (Newark), intermediate (Centerville-Fremont), and deeper aquifer (350 to 600 feet bgs) as documented in previous studies of the area (Luhdorff & Scalmanini Consulting Engineers 2003). Current data indicate that salinities up to 3.9 ppt are present beneath the City of Newark, but salinity in the Eden Landing area in the Centerville/Fremont Aquifer is generally excellent (below .5 ppt salinity). An area of elevated salinity (up to .97 ppt in the Centerville/Fremont Aquifer and 3.2 ppt in the Deep Aquifer in Fall 2005) is present just south of Highway 92 in the general vicinity of ponds E12 and 13 (Alameda County Water District 2006) (Attachment A, pp. A-6 to A-7). The origin of this anomaly is unknown (it could be a natural window in the confining aquitard or an artificial pathway), but it should be investigated further before proceeding with restoration of these ponds to prevent worsening of the problem.

Groundwater quality data are generally lacking in the SBSP project area in the San Mateo Subbasin (including the Ravenswood area). As discussed in other sections of this section, there is no groundwater management agency and hence no groundwater monitoring. Salinity intrusion was a historic problem in the basin in the mid-1900s, and most municipal wellfields were abandoned with the delivery of imported surface water. The City of East Palo Alto borders the Ravenswood area on the south and relies on surface water. It has one emergency well mid-way between Highway 101 and the salt ponds at Bay Road and Gloria Way (Integrated Resource Management LLC 2006), but it is used only for nonpotable water due to poor water quality (presumably due to elevated salinity). The City of Menlo Park on the west side of the Ravenswood area has no groundwater wells. Groundwater conditions with elevated salinities in the shallow aquifer similar to those in and adjacent to the other project areas can be assumed.

2.1.4 Artificial Pathways

The confining aquitards beneath the Bay, salt ponds and adjacent land normally provide an effective barrier to vertical flow of saline waters downward to the groundwater aquifers as described above. Natural pathways exist in the form of windows and thin zones in the confining aquitards (through which seepage can occur), and saline water may also spill over the edges of aquitards. Fault zones can act as conduits for flow in some circumstances, but are more typically barriers to horizontal flow as appears to be the case in the SCV (Hanson and others 2004). However, a number of anthropogenic causes can short-circuit aquitards, creating pathways for the downward vertical movement of saline waters. The two significant artificial pathways are dredging and the drilling of wells.

Dredging has historically been conducted to deepen and maintain shipping channels in the Bay and to enlarge stream channels to improve flood protection. Both have been hypothesized to have contributed to thinning or eliminating aquitards in the SCV basin (Department of Water Resources 1967; Santa Clara Valley Water District 1980).

The second common artificial pathway is improperly constructed, degraded, or improperly abandoned wells. It is not uncommon for water supply wells to be constructed in multiple aquifer zones (to maximize yields). In such cases the well may serve as vertical conduit for flow between aquifers, as shown in the figures in Attachment A (p. A-1) and Attachment C (p. C-8). If water quality is poor in one aquifer, it may thus contaminate an aquifer with good water quality. ACWD, SCVWD, and San Mateo County require drilling permits for well construction (as well as repairs, reconstruction, or abandonment) to prevent the installation of new improperly constructed wells.

Degraded wells may also lead to saltwater intrusion. Wells are constructed of both solid casing (in zones that do not yield water to the well) and screened or perforated sections (that are open to the aquifer to allow water to flow into the well). Even if solid casing is used across a shallow aquifer with poor water quality, the solid casing designed to prevent the flow of poor quality water into the well may degrade over time. Saltwater is particularly corrosive to steel well casings, and can lead to degradation and the potential for the casing to fail and poor quality water to enter the well and migrate to an aquifer with good quality water.

Improperly abandoned wells are also a common conduit for vertical migration of saline waters. Both ACWD and SCVWD have standards for the proper abandonment (decommissioning) of wells that are no longer being used in order to protect groundwater supplies and prevent potential physical hazards.
The typical procedure in the north SCV Subbasin (classified as Zone 2 by SCVWD and covered by District County Ordinance 90-1) is to fill the well with grout, as well as to perforate the well casing and place a seal at a clay layer at about 150 feet bgs (to eliminate the potential for cross-contamination). Unfortunately, records are often incomplete and some wells are not properly abandoned (and in fact are sometimes forgotten). Both ACWD and SCVWD have made attempts in the past to locate and properly abandon old wells (Alameda County Water District 2001; Santa Clara Valley Water District 1980), but the completeness of these attempts (particularly in the salt pond area) is unknown. Future well abandonment programs should follow the California Well Standards (Department of Water Resources 1990), local county ordinances, and accepted guidelines (Groundwater Committee of the California Regional Water Quality Control Board San Francisco Bay Region and others 2003) (Appendix G).

2.1.5 Groundwater Management

In California, multiple entities are responsible for groundwater management, which is defined as the planned and coordinated monitoring, operation, and administration of a groundwater basin. Unlike the system of appropriative rights for surface water rights administered by the State Water Resources Control Board (SWRCB), percolating groundwater has never been regulated by the State. However, if local groundwater management needs cannot be directly resolved at the local agency level, additional actions such as enactment of local government ordinances, passage of laws by the state legislature, or decisions by the courts may be necessary. The State's role (DWR) is primarily to provide technical and financial assistance to local agencies for their groundwater management efforts (Department of Water Resources 2003).

Groundwater management in the Santa Clara Valley has been conducted at the local level. None of the counties in the South Bay (Alameda, San Mateo and Santa Clara) have passed groundwater management ordinances. In addition, there has not been a court adjudication of groundwater rights in the basin (Department of Water Resources 2003).

Local water agencies manage groundwater under the authority of the California Water Code and other applicable state statutes. One approach for groundwater management by local agencies is development of local Groundwater Management Plans (GMPs), which were originally formalized under AB3030 (water code section 10750 et seq.). As of January 1, 2003, amendments to the Water Code Section resulting from the passage of SB1938 require and recommend additional GMP components. The SCVWD adopted a GMP in July 2001 (Santa Clara Valley Water District 2001), with the goal of ensuring that groundwater resources are sustained and protected. The District has also developed an Integrated Water Resources Plan (Santa Clara Valley Water District 1997), and every five years completes an Urban Water Management Plan (UWMP) (Santa Clara Valley Water District 2005b) that reports and projects water usage (including groundwater).

Historical overdraft (defined as long-term pumping that exceeds recharge) that resulted in historical land subsidence and salinity intrusion has led to extensive investigations by the California DWR (Department of Water Resources 1967; Department of Water Resources 1973; Department of Water Resources 1975; Department of Water Resources 1981) and local groundwater management by both SCVWD and ACWD, which are overarching water management agencies that have comprehensive groundwater management programs and have conducted numerous comprehensive groundwater studies. Within the regional project setting, the SCVWD manages the entire Santa Clara Subbasin, while ACWD manages those portions of the East Bay Plain and Niles Cone Subbasins that cover the regional project area. There is no equivalent overarching groundwater management agency in the San Mateo Plain Subbasin, in part because the groundwater resource is much more limited and is not a significant municipal supply.

Santa Clara Valley Water District

Groundwater overdraft and land subsidence led to the formation of the SCVWD in the late 1920s. SCVWD continues to serve as a water resource management agency for the entire Santa Clara County. SCVWD operates and manages 10 surface reservoirs and associated creeks and recharge facilities, three groundwater subbasins, three water treatment plants, imported Central Valley Project and State Water Project water, and recycled water (Santa Clara Valley Water District 2005b).

The primary mission of the SCVWD's groundwater program is ensuring the sustainability and protection of groundwater resources. To achieve this mission, SCVWD implements numerous groundwater management activities, including: in-stream recharge (controlled and uncontrolled), off-stream recharge (percolation ponds and abandoned gravel pits), periodic water balances, direct injection recharge facilities, water use efficiency programs, operational storage capacity estimations, and subsidence and groundwater flow modeling.

Groundwater monitoring by SCVWD occurs to ensure that groundwater quality, levels, and extractions are within acceptable ranges and that the land surface does not subside further (Santa Clara Valley Water District 2001). SCVWD monitors groundwater levels in 168 wells on a monthly basis and in 108 wells on a quarterly basis, as well as miscellaneous water quality in 10 wells and Title 22 water quality in 234 wells (Department of Water Resources 2003). Various groundwater quality programs are managed by SCVWD, including nitrate management, saltwater intrusion prevention, well construction and destruction, wellhead protection, toxics cleanup, land use and development, and public outreach and education programs (Santa Clara Valley Water District 2001). The SCVWD has recently participated in a cooperative investigation of the SCV Subbasin with the USGS, which included the updating and revision of the District's numerical groundwater flow model to support effective groundwater management (Hanson and others 2004; Santa Clara Valley Water District 2005a).

Groundwater pumping in the Santa Clara Subbasin has decreased from roughly 165,000 acre-ft/year in the early to mid-1980s, with an abrupt decline in the drought year 1989 as a result of a District appeal for conservation and increased surface water deliveries (Attachment B, pp. B-10 to B-11). Groundwater extraction averaged 108,000 acre-ft/year through the 1990s, and has remained at similar levels since, with the most recently available data indicating a total of 97,000 acre-ft/year in 2003. In 2002, groundwater production consisted of approx 104,000 acre-ft/year of municipal and industrial pumping and 700 acre-ft/year agricultural pumping. Estimated artificial recharge by the District was 72,000 acre-ft/year and natural recharge from rainfall and other sources was 20,000 to 22,000 acre-ft/year in 2002 (Santa Clara Valley Water District 2005a).

Alameda County Water District

Formed in 1914, ACWD manages groundwater under the County Water District Act and additional powers were granted to ACWD for groundwater management under Chapter 1942 of the Statutes of 1961 called the Replenishment Assessment Act of Alameda County Water District. ACWD's Amended Groundwater Management Policy (ACWD Policy) was adopted by the Board of Directors on March 22, 2001 (Alameda County Water District 2001). The ACWD Policy ensures that the Niles Cone Groundwater Basin is protected and managed effectively to provide reliable and high quality multi-purpose water supplies. To safeguard against saltwater intrusion, ACWD sustains groundwater elevations above sea-level in the Niles Cone upper aquifer (the Newark Aquifer), which is hydraulically connected to the San Francisco Bay. In drought periods, ACWD may lower the Newark Aquifer groundwater table within the inland area to elevations lower than sea-level (with a minimum elevation of 5 feet below mean sea-level). ACWD recharges the groundwater system through percolation ponds, which account for the primary recharge source, while other recharge also occurs through rainfall and applied water (Alameda County Water District 2005). ACWD also operates an aquifer restoration project to extract and treat brackish water from the aquifers, as shown in Attachment C (p. C-9). ACWD monitors groundwater levels in 350 wells annually and 32 weekly as well as groundwater quality in 120 wells annually (in addition to DHS Title 22 requirements for 9 to 12 wells) (Department of Water Resources 2003).

As a result of groundwater management activities by ACWD and others, estimated groundwater pumping in the South East Bay Plain has declined from levels of roughly 10,000 acre-ft/yr in the late 1960s to approximately 3,200 acre-ft/yr in the year 2000. Pumping in the Niles Cone Subbasin declined over the same period from roughly 42,000 ac-ft/yr to 31,000 (including about 6,500 ac-ft/yr for aquifer reclamation of historical salinity intrusion) (Water Resources & Information Management Engineering Inc 2005).

Recent studies by ACWD include a joint study with East Bay Municipal Utility District (EBMUD) of the relationships between the South East Bay Plain and the Niles Cone Groundwater Basin. The study results concluded that the two subbasins are hydraulically interconnected (Luhdorff & Scalmanini Consulting Engineers 2003). As part of the project, the Niles Cone and South East Bay Plain Integrated Groundwater and Surface Water Model (NEBIGSM) was developed to simulate the relationship of the two subbasins and Niles Cone Subbasin surface and groundwater interactions. The NEBIGSM provides the agencies with a useful tool for evaluating groundwater hydrology, surface and groundwater interactions, and water quality (Water Resources & Information Management Engineering Inc 2005).

San Mateo Plain Subbasin

There is no groundwater management agency in the San Mateo Plain Subbasin (including the Ravenswood area) of San Mateo County, although there are two private water agencies (California Water Service Company and Burlingame Water Services) and the following public water agencies in the subbasin:

- Belmont Community Water District
- City of Millbrae
- City of Palo Alto
- City of San Bruno
- East Palo Alto Water County Waterworks
- Estero Municipal Improvement District
- Menlo Park Municipal Water District
- Santa Clara Valley Water District
- County of San Mateo Health Services Division

Protection of the groundwater resource falls primarily to the County of San Mateo Health Services Division, and a permit is required for soil borings, well installations, and well destruction, all of which must conform to California Well Standards (Department of Water Resources 1990).

Groundwater pumping in the San Mateo Subbasin has not been quantified (Department of Water Resources 2003). Based on the preponderance of surface water use by the municipal and private water agencies in the region, annual groundwater production is judged to be minimal (no more than a couple thousand acre-ft/year) in the general vicinity of the Ravenswood area (primarily for irrigation).

2.2 Phase 1 Setting

The Phase 1 setting refers to ponds that are proposed as restoration areas in Phase 1 of the SBSP Restoration Project. These ponds, shown in Attachment D, are as follows:

- Ponds E12 / 13 (Eden Landing Area)
- Ponds E8A / E9 / E8X (Eden Landing Area)
- Pond A6 (Alviso Area)
- Pond A8 (Alviso Area)
- Pond A16 (Alviso Area)
- Pond SF2 (Ravenswood)

Due to the nature of the current ponds and the conditions that were there prior to their existence, most if not all of the project area is underlain by one or two layers of Bay mud (an older Pleistocene Sangamon Bay mud deposit and a younger Holocene Bay mud deposit) as well as alluvial silts and clays. These layers are relatively impermeable and separate the project site from the deeper water supply aquifers below the Bay muds (below approximately 200 feet bgs). Unless compromised, these conditions typically preclude a hydraulic connection between the project area and the deeper water supply aquifers, providing a natural resistance to saltwater intrusion.

However, the landward extent of the Bay muds is roughly equivalent to the extent of the salt ponds, and the Bay muds thin and pinch out completely in the general area of the landward levees. Water levels and salinity concentrations in the upper aquifer cited above demonstrate the ineffectiveness of the shallow Holocene Bay mud (saltwater has either leaked through or spilled over the landward edge). Fortunately, the alluvial clay and silt aquitards provide a secondary (although not as impermeable) separation between the shallow and lower aquifers.

Two project areas have significant exceptions to this general hydrogeologic framework that have bearing on the potential for salinity intrusion where relatively large creeks have deposited relatively coarse-grained alluvial fan deposits that contain relatively less aquitard material. One area is located just to the east of the Alviso project area (Figure 2), where the alluvium associated with Coyote Creek produces a window in the confining layer where Bay muds and fine-grained alluvium are locally absent and there is thus little or no confining layer (Attachment C [p. C-3]). This area is over two miles east of Pond A16 and even further from A6 and A8 (Attachment D), so it is well outside all the Phase 1 pond areas . However, since salinity intrusion has occurred along Coyote Creek and the Guadalupe River in the past, this area warrants particular attention for impacts and will be further evaluated in Section 3.

The second location is in the south Eden Landing area of the Niles Cone Subbasin, where relatively coarse alluvial fan deposits of the large Alameda Creek have similarly created a less effective confining layer than elsewhere in the Basin. These deposits, collectively referred to as the Niles Cone aquifers, contain much less clay and silt than is typical. The Niles Cone aquifers are well developed in the southern part of the Eden Landing area in the vicinity of the ACFCC northward to approximately Old Alameda Creek. The geology transitions northward to more typical fine-grained confining layers of the East Bay Plain between Old Alameda Creek and Highway 92. The Phase 1 project ponds E8a, E8X and E9, E12 and E13 are therefore over confined aquifers and are no more susceptible to saltwater intrusion than the rest of the SBSP area. The presence of saltwater intrusion just south of Highway 92 in the lower and deep aquifers (Section 2.1.3) is more likely due to improperly abandoned well(s), and warrants special attention.

In addition to the potential for natural vertical conduits above, there are reportedly some unused wells in the Eden Landing pond complex that have not been properly abandoned. Alameda County, in accordance with an agreement with Cargill, is reportedly in the process of developing a program to locate and properly abandon these wells. According to the agreement, this process must be complete prior to any restoration efforts. This activity will help to avoid increased potential for groundwater contamination via surface water infiltration through the improperly abandoned wells (Alameda County Water District 2004).

Improperly abandoned wells may also be present in the Ravenswood area. Historical wells located in the Ravenswood area were not immediately sealed after abandonment, and the eventual method (effectiveness) of sealing was questioned by the SCVWD (Santa Clara Valley Water District 1980).

SCVWD has had a well abandonment program in the past, but it is unknown if all old wells in the project area have been located and properly abandoned. A program to locate improperly abandoned wells in the Alviso project area is currently being considered as part of the Shoreline Study.

Future well abandonment programs will be part of each phase of implementation (including Phase 1 actions) and should follow the California Well Standards (Department of Water Resources 1990), County ordinances, and accepted local guidelines (Groundwater Committee of the California Regional Water Quality Control Board San Francisco Bay Region and others 2003).

3. ENVIRONMENTAL CHANGES

A preliminary list of potential environmental impacts of the SBSP Restoration Project was developed and reviewed by the SBSP Project Management Team (PMT). This list was revised based on comments received, and refined to include only one potential impact in the EIS/R related to groundwater: seawater intrusion into regional groundwater sources (SBSP Impact 3.4.5).

This section evaluates the potential for a substantial change in the groundwater quality due to salinity intrusion from the Bay into deep potable aquifers. This would be indicated by a project-related increase in salinity (TDS or chloride concentrations) at monitoring wells protecting water supplies that exceeded the narrative objective for salinity, the numeric objective for TDS, or violated the State's anti-degradation policy by unreasonably degrading the quality of high-quality water. The water quality objective for TDS in municipal water supplies is 500 mg/l (0.5 ppt) (recommended), 1000 mg/l (upper), and 1,500 mg/l (short-term). Equivalent objectives for chloride are 250, 500, and 600 mg/l.

3.1 Project-Level Evaluation

As discussed in Section 2, five main factors control groundwater conditions and are thus germane to the evaluation of potential changes of the project on groundwater hydrology and quality. Whether there is a significant increased potential for saltwater intrusion as a result of the project must thus consider all of these factors:

- **Geology** – controls the permeability of the sediments and thus the rate of surface water infiltration and groundwater flow in the subsurface
- **Groundwater hydrology** – primarily reflected in water levels, which control the relative hydraulic heads between surface water and groundwater (and between groundwater at different locations or depths) and thus the direction of flow
- **Groundwater quality** – primarily salinity, since concentration contrasts between two water bodies are required for an impact to occur from flow
- **Artificial pathways** – Man-made conduits for preferential flow (primarily created through dredging or improperly constructed or abandoned wells) that short-circuit natural geologic barriers
- **Groundwater management** – groundwater data collection, evaluation, and actions to preserve and protect a basin's groundwater resource (both quantity and quality)

As described in the Section 2, historic overdraft conditions during the early to mid-1900s that lowered groundwater levels have been reversed over the past forty years. Today, groundwater generally flows from groundwater basins into the Bay and there is an upward vertical gradient (potential groundwater flow is from the deep aquifers to the Bay). As long as these hydrologic conditions persist, there is little or no significant risk of salinity intrusion into drinking water aquifers. However, if groundwater levels drop due to long-term drought and/or increased pumping (long-term overdraft), then project activities that move saltwater towards conduits between surface waters and shallow aquifers to deeper drinking water aquifers could contribute to significant impacts to drinking water supplies. Seasonal fluctuations or one or two dry years are not considered sufficient to significantly change the overall hydrologic conditions. A world-wide global rise in sea level of up to two feet by 2010 is predicted by the U.S. Environmental Protection Agency (equivalent to roughly one foot during the 50-year project). Such a change could increase the likelihood and timing of levee failure, but would not substantially change the hydraulic regime or the potential for salinity intrusion (assuming that the inboard levees are maintained).

Alternative A No Action. Under the no action alternative, the primary risk of changes would be inadvertent levee failures that either inundate improperly abandoned wells, or expose levees with old improperly abandoned wells (or even existing wells in good condition) to erosion and failure. Under Alternative A, 35% of ponds are assumed to become tidally inundated from unplanned breaches within the 50-year project period. Once inundated, it would be very difficult to locate and properly abandon old wells. This would pose a risk only if groundwater levels are below sea level at that time or subsequently.

Breaching of levees and tidal inundation of levee areas or low lying ponds could inundate improperly abandoned wells. Although both ACWD and SCVWD have had programs to properly seal old wells, it is uncertain how effective these measures have been, particularly since the ponds were not the primary focus. A well identification and abandonment program is therefore included in each phase of implementation.

Water levels are currently at or near sea level in the ponds. The flooding of some ponds in Alternative A will not cause a large change in the vertical hydraulic gradients. A surface water elevation change of no more than five feet is expected, which is not sufficient to change the direction of vertical flow under current conditions. However, if long-term overdraft occurs in the future (producing significant water level elevation declines in the deep aquifers), a rise in surface water elevations of a few feet in the ponds could result in the earlier onset of a downward vertical gradient either seasonally or during a dry year or drought.

The flooding of the ponds will not result in a significant change in the regional horizontal hydraulic gradient under current conditions (the overall groundwater flow direction would still be toward the Bay). However, a change in surface water elevations of a few feet could alter local groundwater flow directions, but this would not be significant with respect to the salinity intrusion potential. Such a change could affect local contaminant plume migration, and should be evaluated at the project level, particularly in the vicinity of Moffett Field and near Cooley Landing (where several plumes are present, according to the Groundwater Committee of the California Regional Water Quality Control Board San Francisco Bay Region and others (2003)).

Alternative B Managed Pond Emphasis. Similar to the no-action alternative, the primary risk of salinity intrusion from Alternative B activities comes from the potential to move saline waters towards conduits to deeper aquifers during times of groundwater overdraft. Project activities will not introduce new conduits between surface waters, shallow aquifers, and deeper drinking water aquifers, since the depth of excavations for the pond and channel modifications are minimal compared to the thicknesses of the aquitards that protect the basin.

Stream channel modifications or operational changes may also pose a potential risk of salinity intrusion, especially considering that migration of Bay waters up creeks and sloughs was documented as a historical cause of salinity intrusion. As with inundation of abandoned wells, this normally poses a risk only if groundwater levels drop due to long-term overdraft or extended drought in the future.

Preliminary results of PWA's hydrodynamic modeling impact analysis of salinity changes indicate that salinity will increase approximately 2.4 to 3.9 ppt at the southeast edge of the project area in Coyote Creek as a result of Alternative C at the end of the 50-year modeling period. Alternative B is assessed as a mid-point between Alternatives A and C. Salinity increases continue up Coyote Creek for an unknown distance under Alternative C. The increased salinity concentrations reach at least as far as the area of the unconfined portion of the Santa Clara Valley Subbasin on Coyote Creek in the vicinity of Milpitas. However, since the baseline conditions are already brackish, this is judged to not substantially increase the salinity intrusion potential as long as long-term groundwater overdraft or drought conditions do not cause substantial declines in water levels.

To address the increased potential for salinity intrusion, the U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), and California Department of Fish and Game (CDFG) (Project proponents) should coordinate with ACWD, SCVWD, and San Mateo County on adequate programs for monitoring groundwater levels and quality to establish baseline conditions and monitor changes over the life of the program. The Project proponents should also coordinate with ACWD, SCVWD and San Mateo County to develop and implement a communication and outreach strategy so that groundwater users are regularly updated on groundwater levels, quality, usage, and the linkage between groundwater overdraft and potential salinity intrusion. Well abandonment programs need to be a component of each project implementation phase.

An advantage of Alternative B over the no action alternative is that project activities will motivate regionally coordinated groundwater protection over the 50 year project lifetime. An additional benefit of this alternative compared to the no-action alternative is that inboard levees will be maintained in the project area, thus reducing the likelihood of salinity intrusion.

Alternative C Tidal Habitat Emphasis. The issues for Alternative C are similar to Alternative B. The main difference is that the project moves from a 50:50 tidal / pond ratio towards a 90:10 ratio. This could require an accelerated level of effort in implementing the monitoring and well abandonment programs described above. The same coordination between the Project proponents and ACWD, SCVWD and San Mateo County on monitoring and to develop and implement a communication and outreach strategy applies to Alternative C.

An advantage of Alternative C over the no action alternative is that project activities will motivate regionally coordinated groundwater protection over the 50 year project lifetime through the mitigation measures. An additional benefit of this alternative compared to the no-action alternative is that inboard levees will be maintained in the project area, thus reducing the likelihood of salinity intrusion.

3.2 Phase 1 Evaluation

The ponds in the Phase 1 areas (Attachment D) are as follows:

- Ponds E12 / 13
- Ponds E8A / E9 / E8X
- Pond A6
- Pond A8
- Pond A16
- Pond SF2

The stream channel modifications and operational changes in the Phase 1 ponds would not be expected to make a substantial change in the potential for salinity intrusion, since none of the ponds are close to the unconfined portion of the basin, there are no known contaminant plumes close to the Phase 1 ponds, and improperly abandoned wells will be addressed during implementation.

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Source files for this report are located at PWA:
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FIGURES

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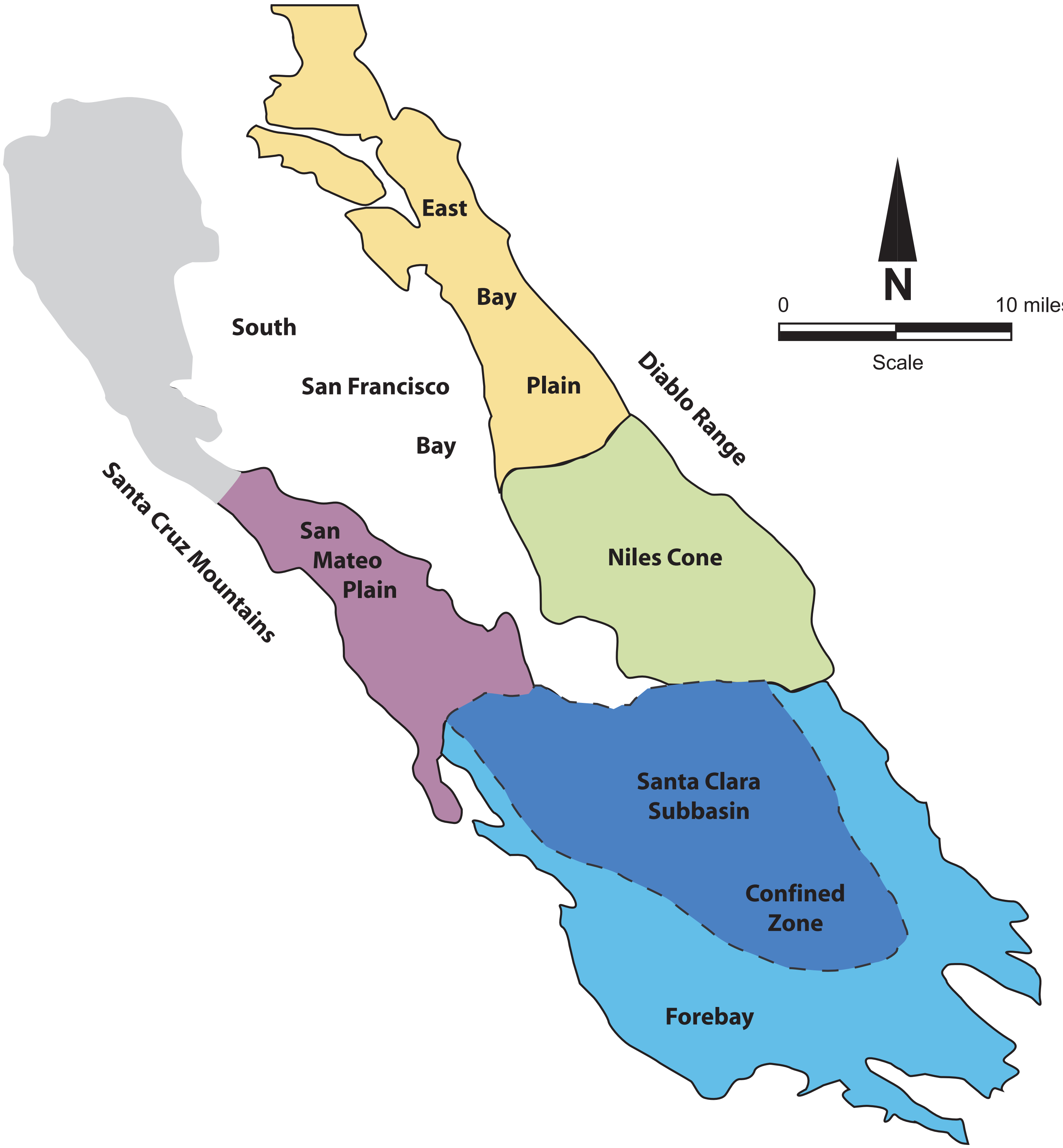


DATE 8-2-06

PROJECT 129592.007

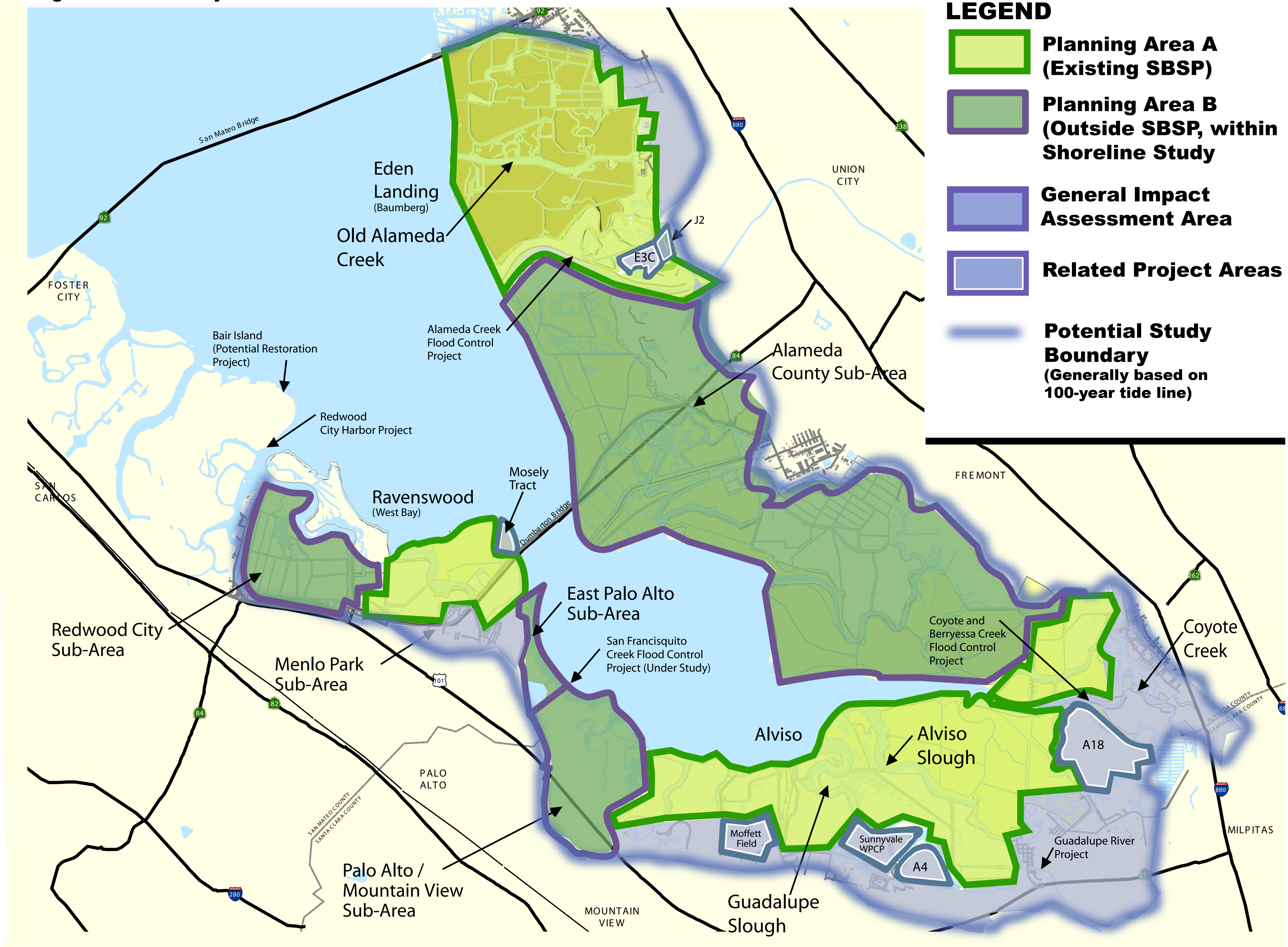
BROWN AND CALDWELL

SITE
South Bay Salt Ponds Restoration

TITLE
Groundwater Subbasins

Figure 1

Figure 2. SBSP Project Area



ATTACHMENT A

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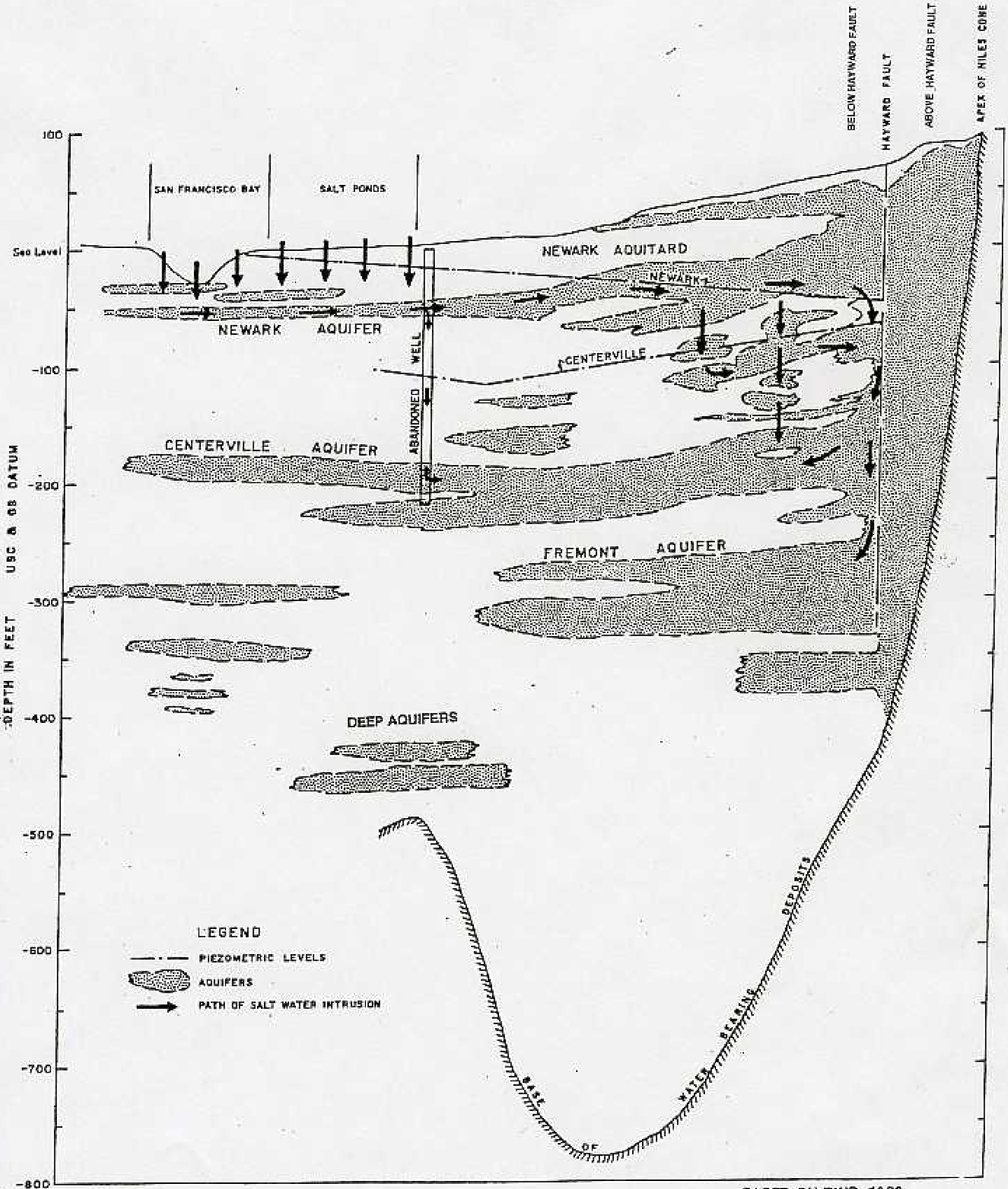
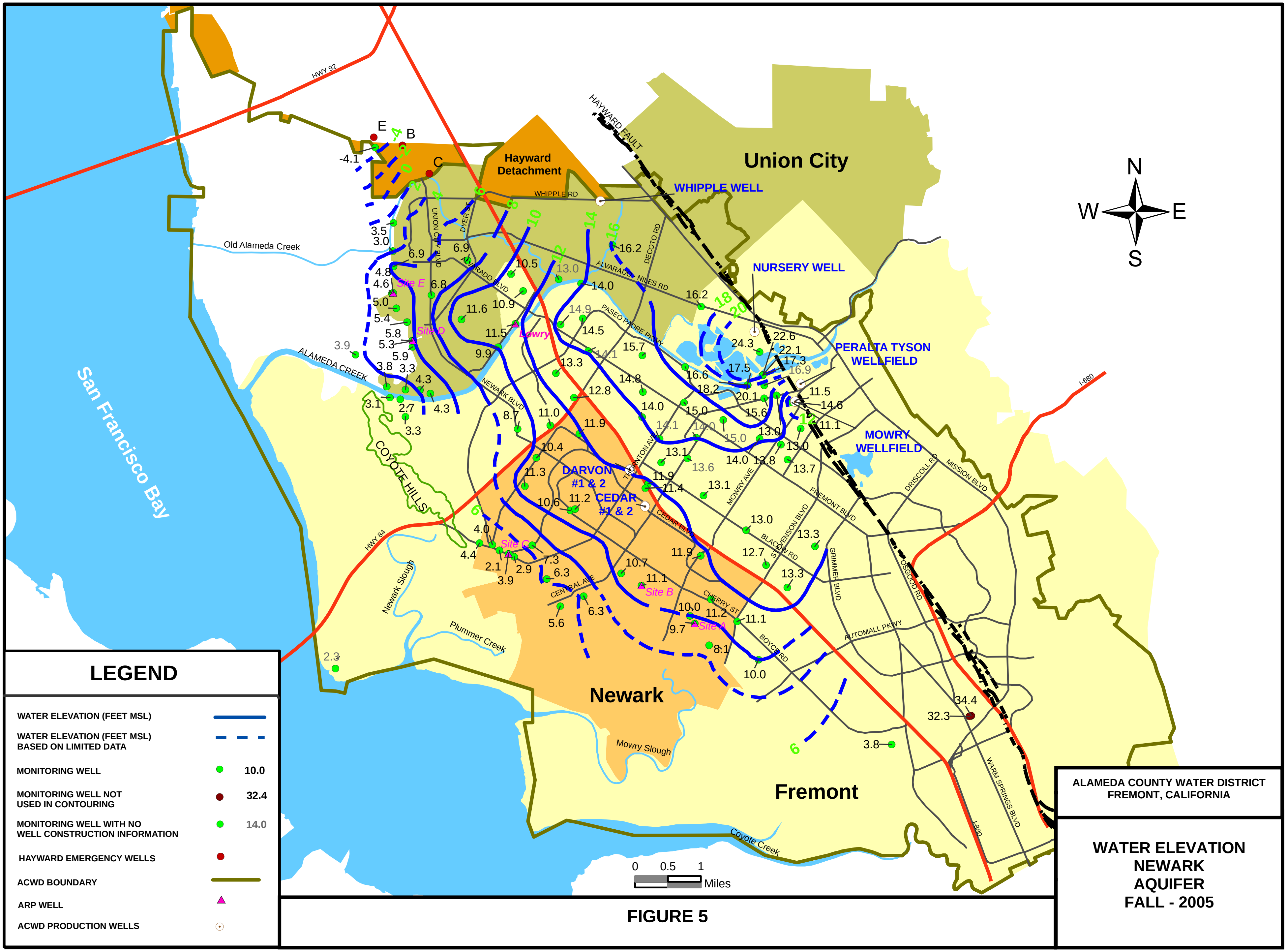


INTRUSION OF SALT WATER INTO THE FREMONT STUDY AREA

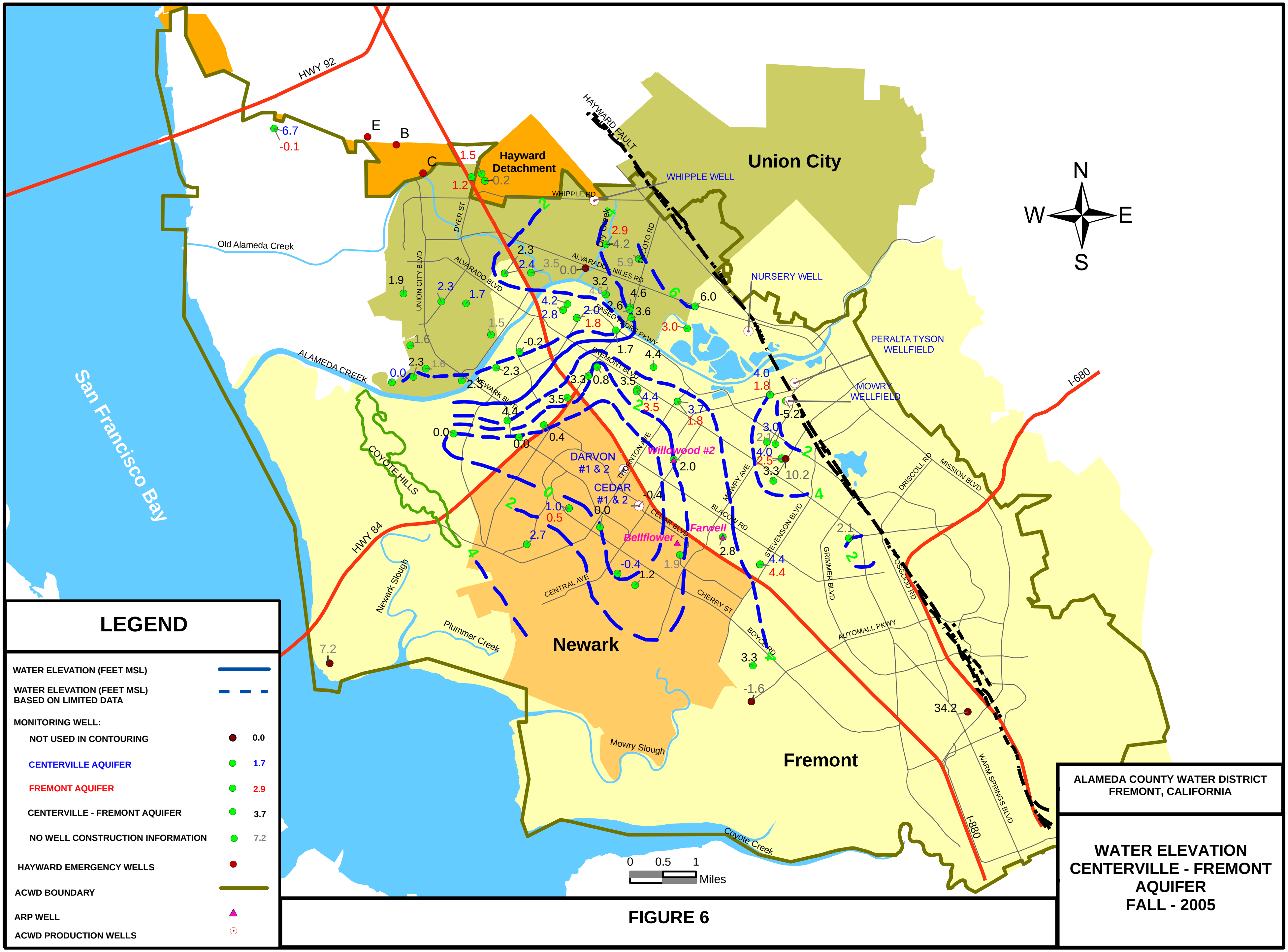
Figure 3



ALAMEDA COUNTY WATER DISTRICT
FREMONT, CALIFORNIA

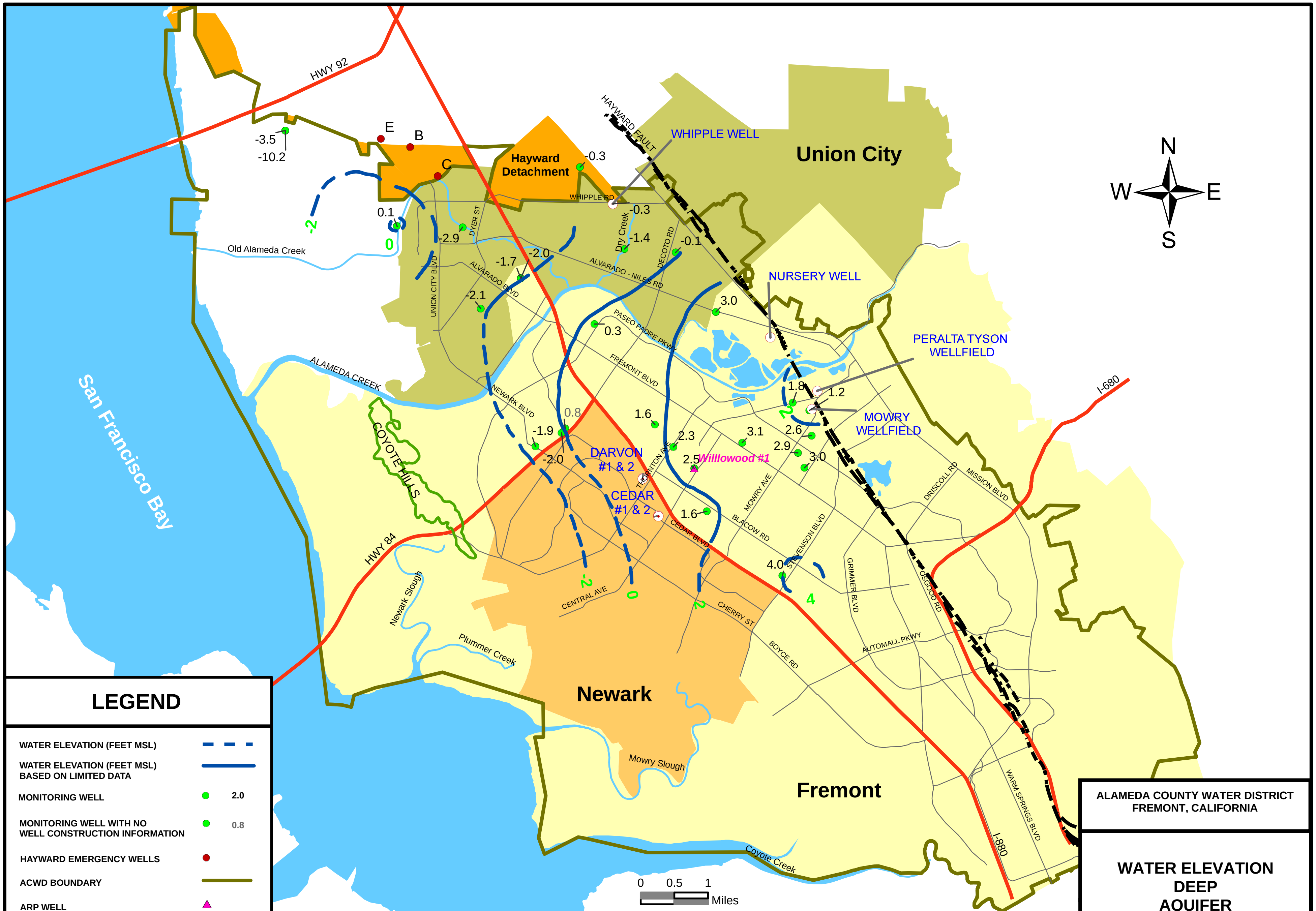
WATER ELEVATION NEWARK AQUIFER FALL - 2005

FIGURE 5



Union City
Newark
Fremont
Hayward Detachment
San Francisco Bay
HWY 92
HWY 84
I-680
I-880
HAYWARD FAULT
WHIPPLE WELL
NURSERY WELL
PERALTA TYSON WELLFIELD
MOWRY WELLFIELD
DARVON #1 & 2
CEDAR #1 & 2
Willowood #2
Farwell
Bellflower
Old Alameda Creek
ALAMEDA CREEK
COYOTE HILLS
Newark Slough
Plummer Creek
Mowry Slough
Coyote Creek
ALVARADO BLVD
ALVARADO NILES RD
UNION CITY BLVD
DYER ST
DECOTO RD
PASEO PADRE PKWY
FREMONT BLVD
NEWARK BLVD
THORNTON AVE
CEDAR BLVD
CENTRAL AVE
CHERRY ST
BOYCE RD
BLACOW RD
STEVENSON BLVD
MOWRY AVE
GRIMMER BLVD
OSGOOD RD
AUTOMALL PKWY
DRISCOLL RD
MISSION BLVD
WARM SPRINGS BLVD
WHIPPLE RD
N
S
E
W
0 0.5 1 Miles
LEGEND
WATER ELEVATION (FEET MSL)
WATER ELEVATION (FEET MSL) BASED ON LIMITED DATA
MONITORING WELL:
NOT USED IN CONTOURING 0.0
CENTERVILLE AQUIFER 1.7
FREMONT AQUIFER 2.9
CENTERVILLE - FREMONT AQUIFER 3.7
NO WELL CONSTRUCTION INFORMATION 7.2
HAYWARD EMERGENCY WELLS
ACWD BOUNDARY
ARP WELL
ACWD PRODUCTION WELLS
ALAMEDA COUNTY WATER DISTRICT
FREMONT, CALIFORNIA
WATER ELEVATION
CENTERVILLE - FREMONT AQUIFER
FALL - 2005

FIGURE 6



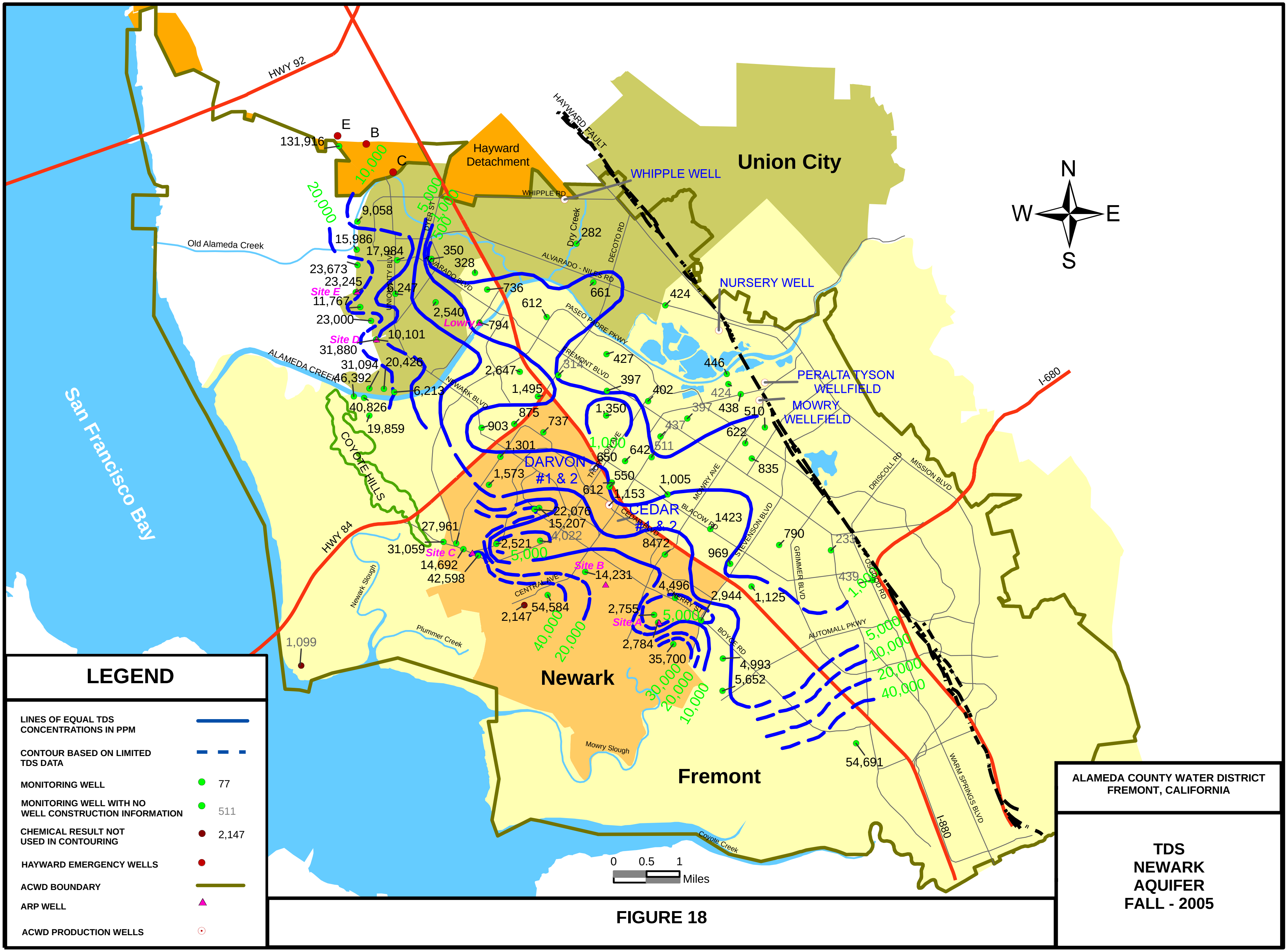
LEGEND

- WATER ELEVATION (FEET MSL)
- WATER ELEVATION (FEET MSL) BASED ON LIMITED DATA
- MONITORING WELL 2.0
- MONITORING WELL WITH NO WELL CONSTRUCTION INFORMATION 0.8
- HAYWARD EMERGENCY WELLS
- ACWD BOUNDARY
- ARP WELL
- ACWD PRODUCTION WELLS

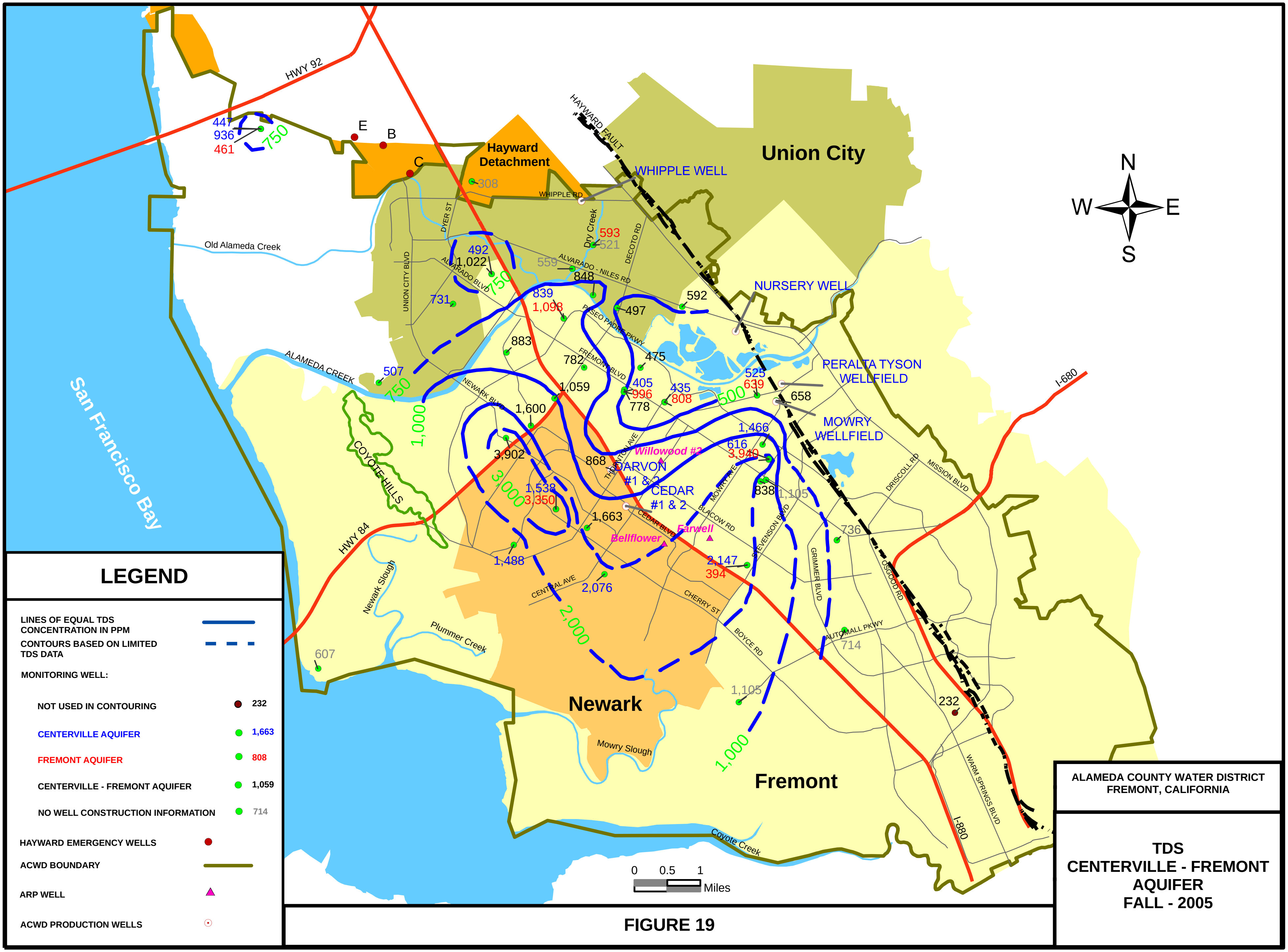
ALAMEDA COUNTY WATER DISTRICT
FREMONT, CALIFORNIA

WATER ELEVATION DEEP AQUIFER FALL - 2005

FIGURE 7



LEGEND
LINES OF EQUAL TDS CONCENTRATIONS IN PPM
CONTOUR BASED ON LIMITED TDS DATA
MONITORING WELL 77
MONITORING WELL WITH NO WELL CONSTRUCTION INFORMATION 511
CHEMICAL RESULT NOT USED IN CONTOURING 2,147
HAYWARD EMERGENCY WELLS
ACWD BOUNDARY
ARP WELL
ACWD PRODUCTION WELLS
ALAMEDA COUNTY WATER DISTRICT
FREMONT, CALIFORNIA
TDS
NEWARK
AQUIFER
FALL - 2005
FIGURE 18
Union City
Newark
Fremont
Hayward Detachment
San Francisco Bay
WHIPPLE WELL
NURSERY WELL
PERALTA TYSON WELLFIELD
MOWRY WELLFIELD
DARVON #1 & 2
CEDAR #1 & 2
HAYWARD FAULT
COYOTE HILLS
HWY 92
HWY 84
I-680
I-880
Old Alameda Creek
ALAMEDA CREEK
Newark Slough
Plummer Creek
Mowry Slough
Coyote Creek
Dry Creek
Site A
Site B
Site C
Site D
Site E
Lowry
N
W
E
S
0 0.5 1
Miles



ALAMEDA COUNTY WATER DISTRICT
FREMONT, CALIFORNIA

TDS
CENTERVILLE - FREMONT AQUIFER
FALL - 2005

FIGURE 19

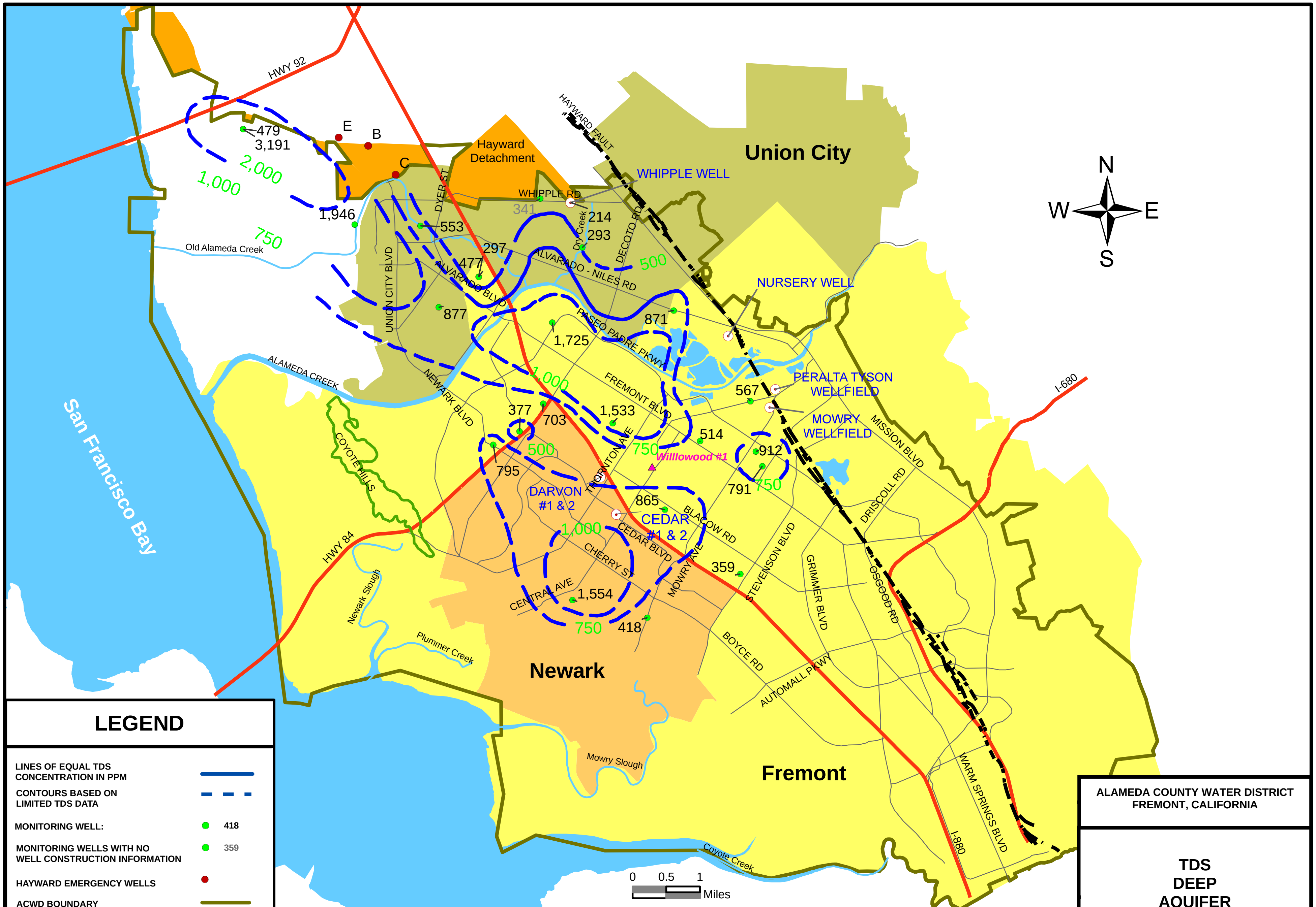


FIGURE 20

ALAMEDA COUNTY WATER DISTRICT
FREMONT, CALIFORNIA

TDS DEEP AQUIFER FALL - 2005

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ATTACHMENT B

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Figure 3-2
Hydrograph for the Santa Clara Valley Subbasin Index Well (07S01E07R013)

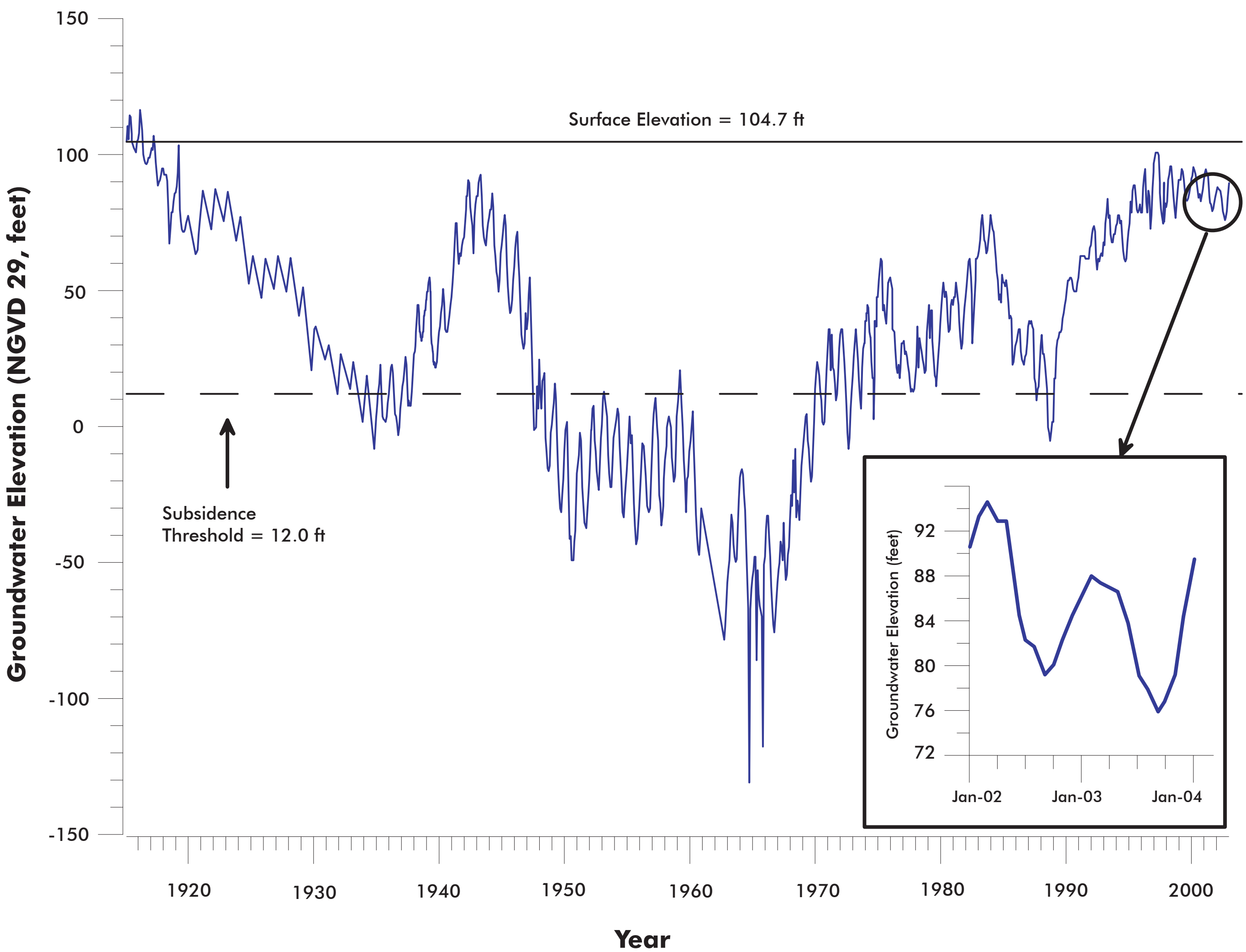


Figure 3-6
North County Groundwater Elevation Contour Map - Fall 2003

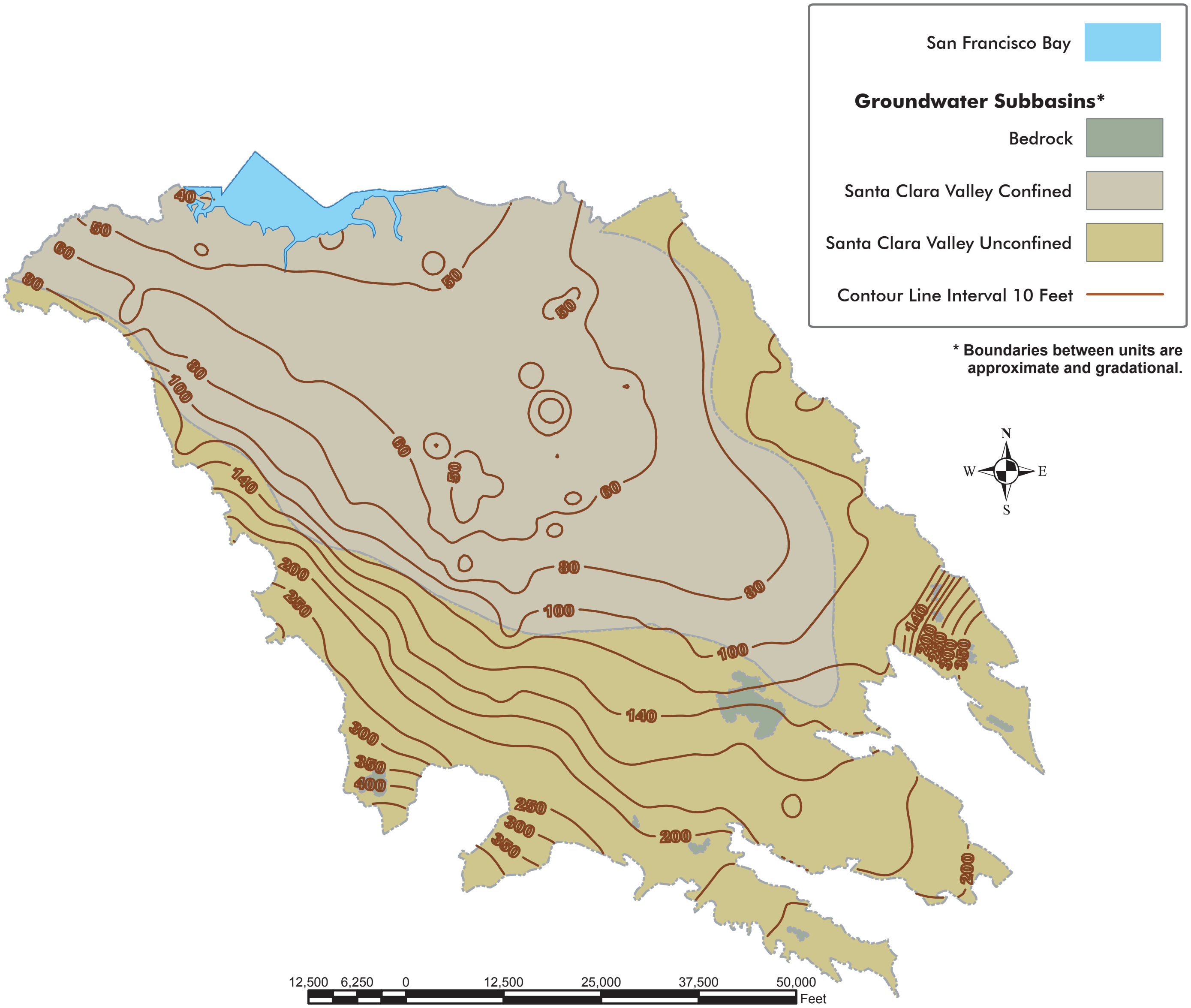
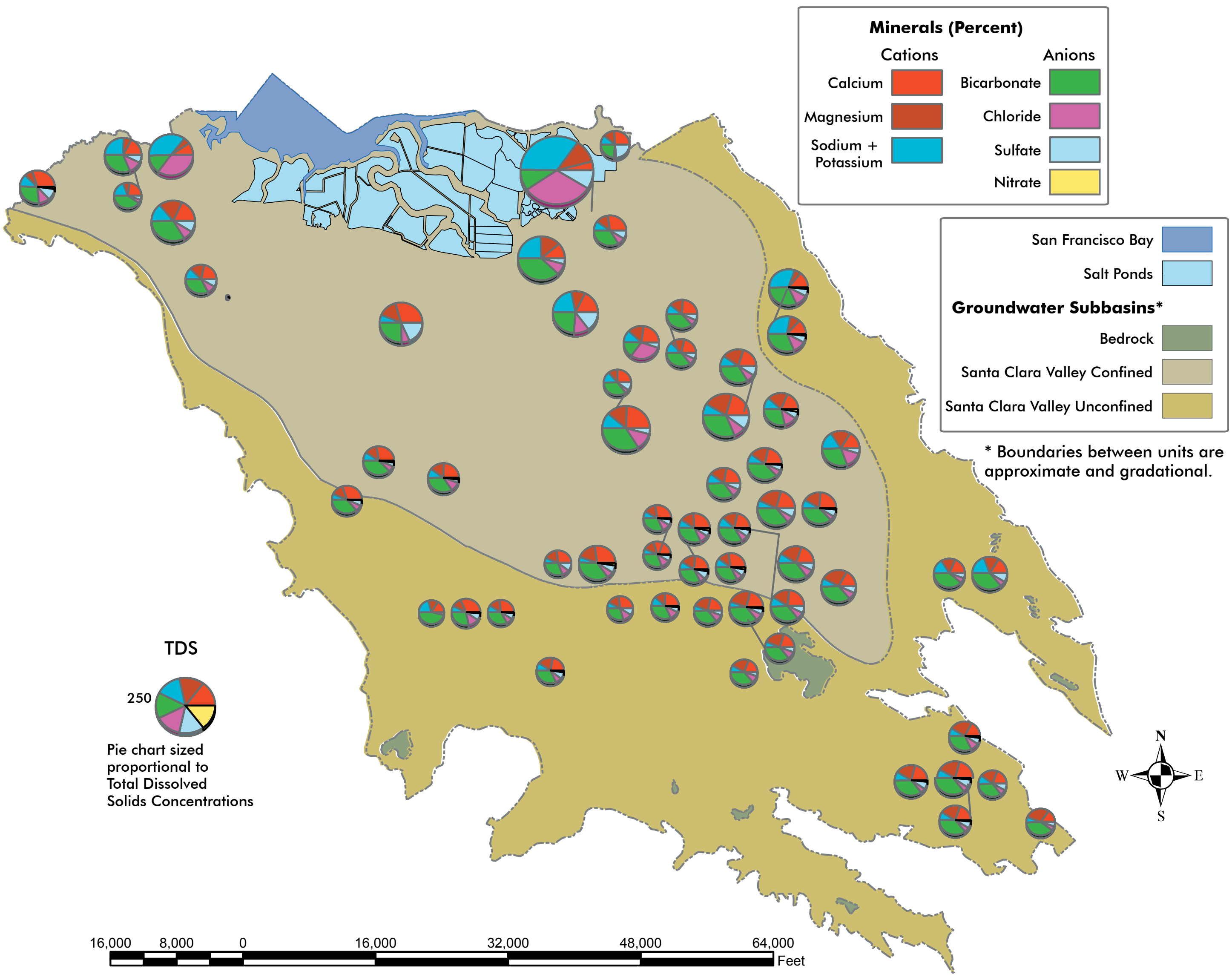


Figure 5-5
Mineral Character of Principal Aquifer Zones in North County 2003



Groundwater Quality

Table 5-2

Typical Concentration Ranges for Common Inorganic Constituents*

Constituent	Santa Clara Valley Subbasin		Coyote Subbasin	Llagas Subbasin		Drinking Water Standard[e]	Agricultural Objective[f]
	Principal Aquifer Zone[c]	Upper Aquifer Zone[d]	Principal Aquifer Zone[c]	Principal Aquifer Zone[c]	Upper Aquifer Zone[d]		
Aluminum (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.100	1.0	5.0
Arsenic (mg/L)	<0.002	<0.002	<0.002	<0.002	<0.002	0.050	0.1
Barium (mg/L)	0.075 to 0.130	0.052 to 0.170	<0.100 to 0.126	<0.100 to 0.254	<0.100 to 0.250	1.0	-
Beryllium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	0.1
Boron (mg/L)	0.120 to 0.150	0.100 to 0.165	<0.100 to 0.132	<0.100 to 0.108	<0.100 to 0. 284	-	0.5, 0.75 [g]
Bromide (mg/L)	0	0	0	0	0	-	-
Cadmium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	0.005	0.01
Calcium (mg/L)	67 - 75	49 - 81	37 - 69	40 - 48	41 - 98	-	-
Chloride (mg/L)	40 - 47	35 - 70	17 - 40	22 - 70	32 - 156	600[h]	355
Chromium, Total (mg/L)	<0.010 to 0.002	NA	<0.001 to 0.002	NA	NA	0.050	0.10
Copper (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050	1.0	0.20
Fluoride (mg/L)	<0.100	<0.100	<0.100	<0.100	<0.100	1.7	2
Hardness (mg/L as $CaCO_3$)	262 - 310	192 - 340	180 - 294	215 - 362	184 - 465	-	-
Iron (mg/L)	<0.100	<0.100	<0.100 to 0.700	<0.100 to 0.210	<0.100 to 0.210	0.300[i]	5.0
Lead (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	0.015[i]	5.0
Magnesium (mg/L)	25 - 28	16 - 36	22 - 43	25-52	25-64	-	-
Manganese (mg/L)	<0.020	<0.020 to 0.054	<0.020	<0.020	<0.020	0.050	0.2
Mercury (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	-
Nickel (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010 to 0.0 22	0.100	0.2
Nitrate (mg/L as NO_3)	13 - 16	2 - 12	6 - 48	25 - 34	16 - 46	45	135
Selenium (mg/L)	<0.005	<0.005	<0.002 to <0.005	<0.005	<0.005	0.050	0.020
Silver (mg/L)	<0.010	<0.010	<0.001 to <0.010	<0.010	<0.010	0.100	-
Sodium (mg/L)	26.5 - 35	35 - 67	17 - 33	18 - 35	17 - 75	-	-
Specific Conductance (uS/cm)	602 - 691	628 - 954	516 - 625	482 - 685	649 - 1270	2,200[h]	3,000
Sulfate (mg/L)	41 - 46	40 - 67	30 - 60	17 - 68	31 - 113	600[h]	-
Total Dissolved Solids (mg/L)	361 - 440	340 - 500	270 - 430	300 - 630	320 - 740	1,500[h]	10,000
Zinc (mg/L)	<0.050	<0.050	<0.050	<0.066	<0.050	5.0	2.0

Table 5-2

Typical Concentration Ranges for Common Inorganic Constituents Legend

[a] Typical concentration ranges at the approximate 95% Confidence Interval estimate of the true population median.
[c] Principal Aquifer Zone: Aquifer zone from which most water supply wells pump.
[d] Upper Aquifer Zone: Shallow aquifer zone above the regional confining layer in the Santa Clara Valley and Llagas Subbasins.
[e] Drinking Water Standard: Maximum Contaminant Level (MCL) specified in Title 22 of the California Code of Regulations.
[f] Agricultural Objective: Agricultural water quality objective in the 1995 Water Quality Control Plan for the San Francisco Bay Basin, Regional Water Quality Control Board and the 1988 Basin Plan for the California Regional Water Quality Control Board Central Coast Region.
[g] Agricultural Objective for the San Francisco Bay Region is 0.5 mg/l and 0.75 mg/l for the Central Coast Region.
[h] Short-term Maximum Contaminant Level (MCL) as specified in Title 22 of the California Code of Regulations.
[I] Secondary Drinking Water Standard based on customer acceptance limit of taste and/or odor.
[i] Action level. California has not established a MCL for lead. However, there is a 15 ug/L action level for lead. The action level is exceeded if the concentration of lead in more than 10 percent of tap water samples is greater than 15 ug/L.

Nitrate Agricultural Objective: The value listed in the Basin Plan is 30 mg/L NO3+NO2 (as N), which is approximately equivalent to 135 mg/L nitrate as nitrate.

Groundwater Quality

Table 5-3

2002 Volatile Organic Chemical (VOC) Detections

Chemical	Number of Wells with Detections	Maximum Concentration Detected (ug/L)	Drinking Water Standard (ug/L)
Chloroform	2	12	100
Tetrachloroethylene (PCE)	13	2	5
1,1-Dichloroethylene (1,1-DCE)	1	1	6
Toluene	3	1	150
Total Trihalomethanes (TTHMs)	1	1	100
1,1,1-Trichloroethane (1,1,1-TCA)	17	4	200
Trichlorofluoromethane (CCl_3F)	1	4	150
1,1,2-Trichloro-1,2,2-Trifluoroethane (CCl_2F-$CClF_2$)	5	30	1,200

Table 5-4

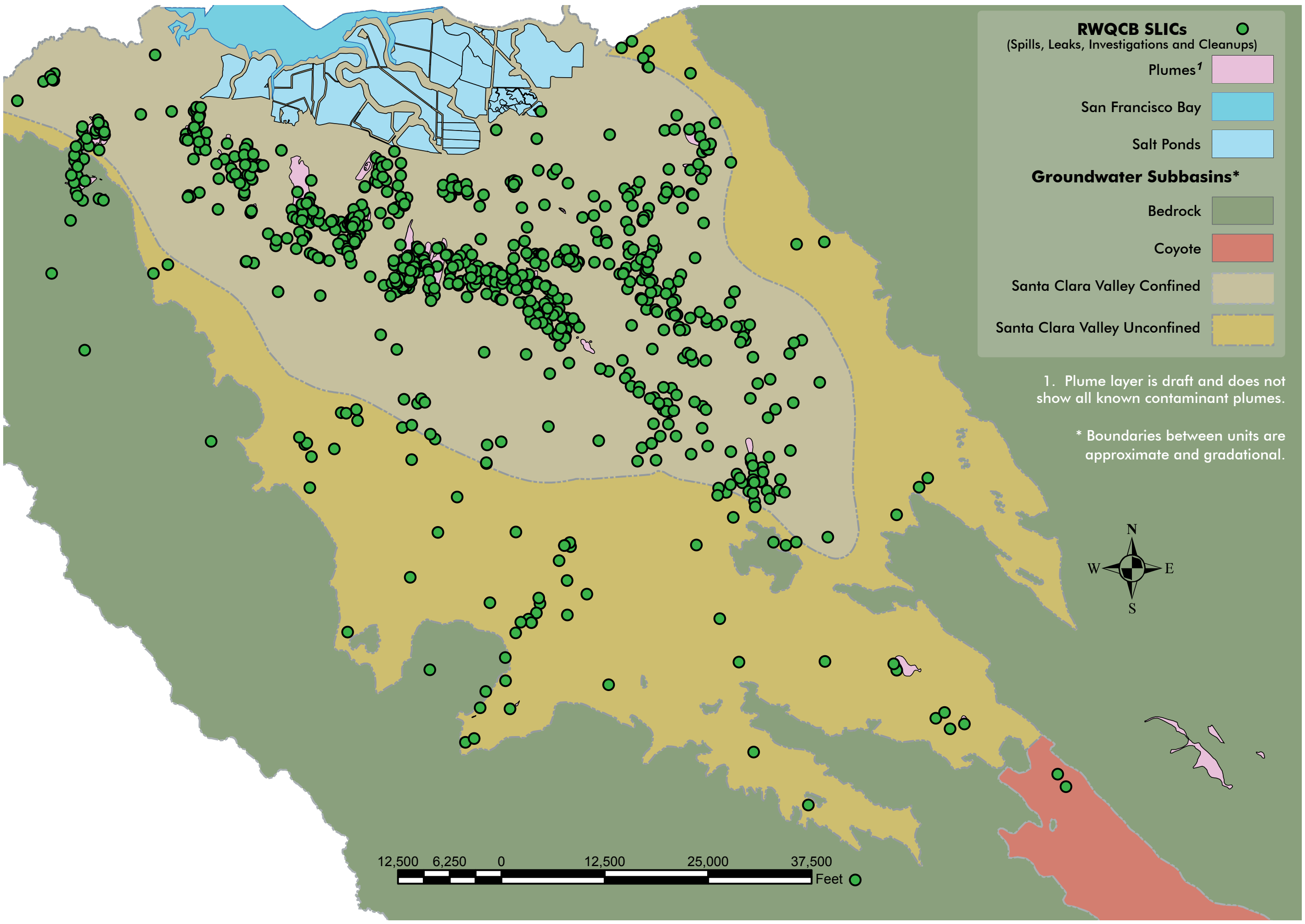
2003 Volatile Organic Chemical (VOC) Detections

Chemical	Number of Wells with Detections	Maximum Concentration Detected (ug/L)	Drinking Water Standard (ug/L)
Chloroform	3	26	100
Tetrachloroethylene (PCE)	2	1.1	1000
Dichlorodifluoromethane (CCl_2F_2)	2	87	--[1]
Toluene	1	0.71	150
Total Trihalomethanes (TTHMs)	3	2.1	100
1,1,1-Trichloroethane (1,1,1-TCA)	13	2.7	200
1,1,2-Trichloro-1,2,2-Trifluoroethane (CCl_2F-$CClF_2$)	1	18.8	1,200

1 Unregulated chemical for which monitoring is required but there is no Public Health Goal or Maximum Contaminant Level established.

Figure 5-11

North County Plumes and SLIC Cases



Groundwater Quality

Figure 5-7

Extent of Salt Water Intrusion in Upper Aquifer Zone 2002

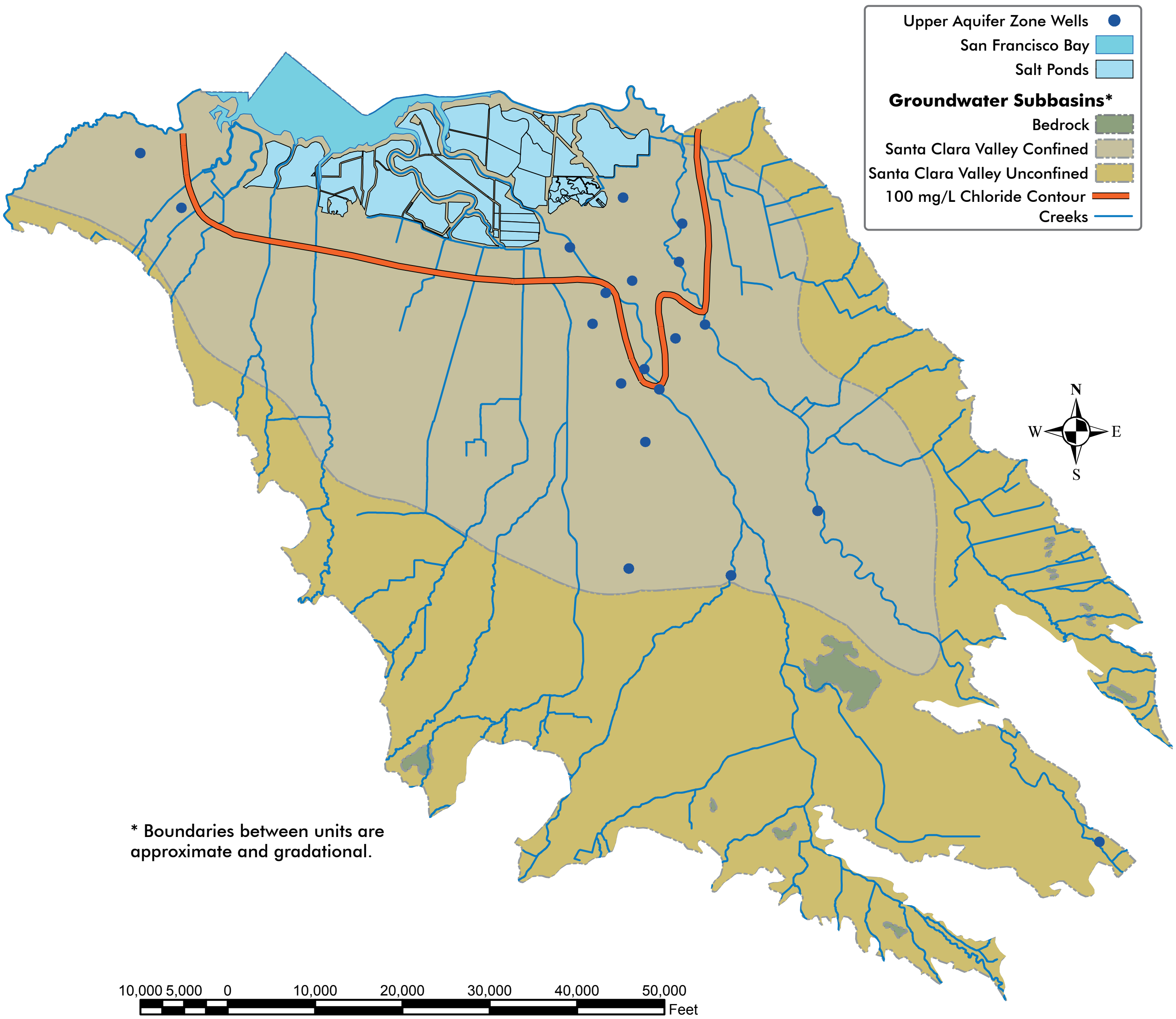


Figure 5-8

Extent of Salt Water Intrusion in Upper Aquifer Zone 2003

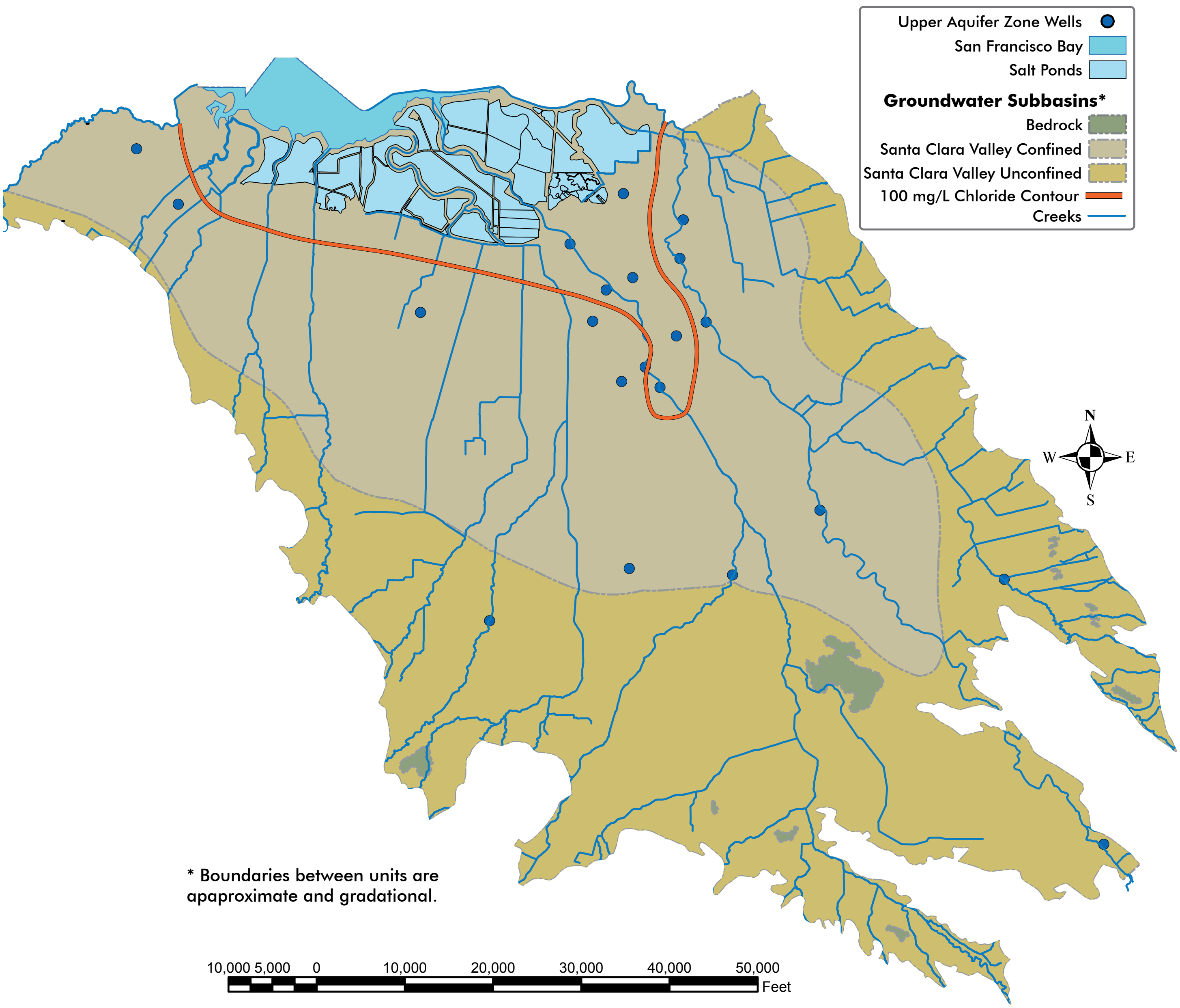
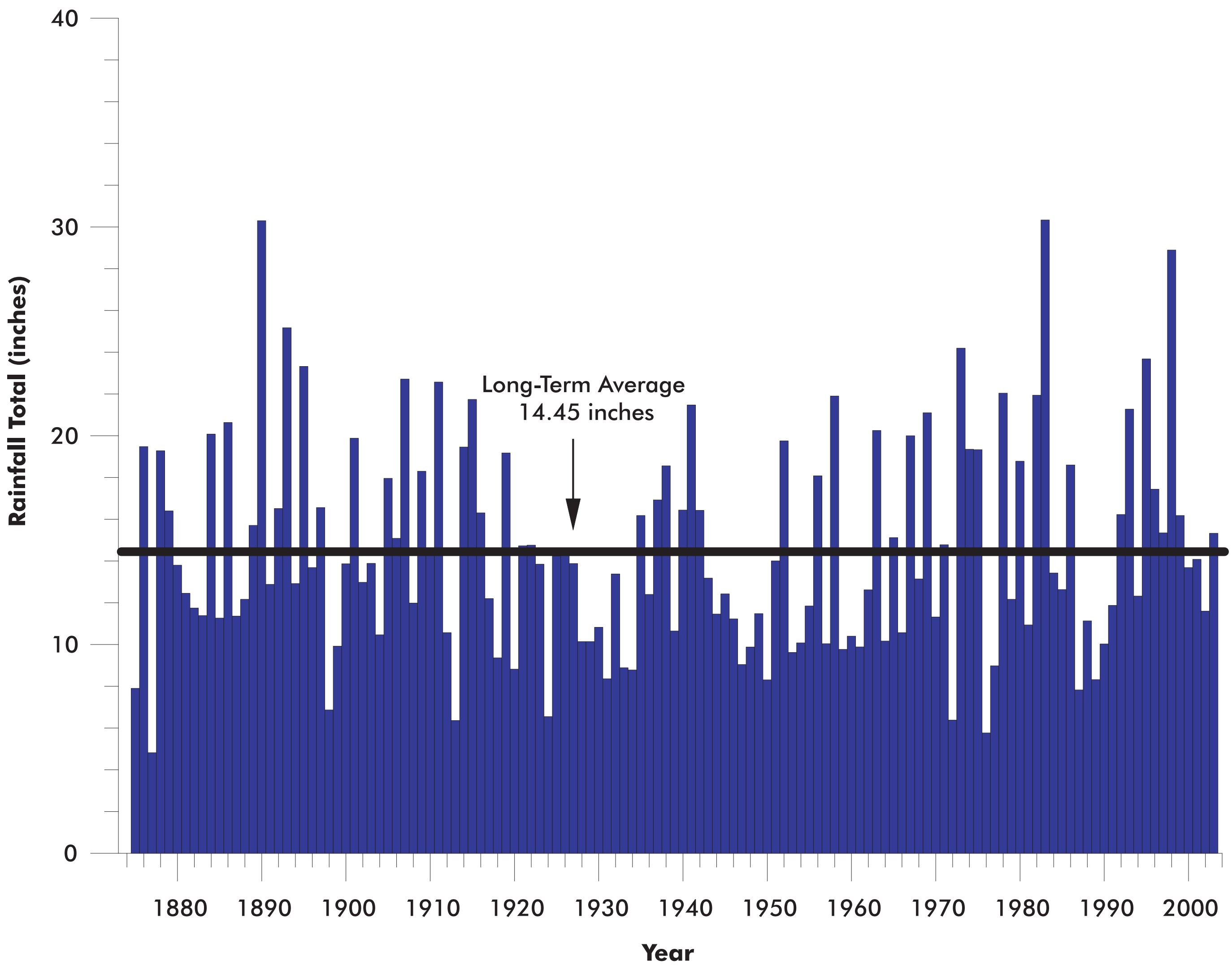


Figure 2-3

Total Annual Rainfall at San Jose Station (Rainfall Years)



County natural recharge at this time. Development of a groundwater flow model for the Llagas Subbasin began in December 2003 and was completed in 2004. This model is expected to improve the District's ability to estimate natural recharge.

Table 2-1
Groundwater Production Summary

	Santa Clara Valley Subbasin			Coyote and Llagas Subbasins[1]			
Calendar Year	Ag (ac-ft)	M&I (ac-ft)	Total (ac-ft)	Ag (ac-ft)	M&I (ac-ft)	Total (ac-ft)	Total District Production (ac-ft)
1981	8,600	151,300	159,900	-	-	-	-
1982	6,300	135,000	141,300	-	-	-	-
1983	5,600	147,100	152,700	-	-	-	-
1984	6,300	172,300	178,600	-	-	-	-
1985	6,200	174,900	181,100	-	-	-	-
1986	5,500	168,700	174,200	-	-	-	-
1987	5,900	165,600	171,500	-	-	-	-
1988	5,500	150,300	155,800	25,000	20,900	45,900	201,700
1989	4,800	84,000	88,800	24,400	17,100	41,500	130,300
1990	4,800	101,900	106,700	24,900	17,700	42,600	149,300
1991	3,800	88,400	92,200	28,300	16,900	45,200	137,400
1992	3,500	103,700	107,200	30,100	17,500	47,600	154,800
1993	3,100	101,900	105,000	27,800	18,200	46,000	151,000
1994	3,000	120,000	123,000	30,400	18,900	49,300	172,300
1995	2,500	110,100	112,600	29,100	19,200	48,300	160,900
1996	2,600	109,900	112,500	29,900	19,700	49,600	162,100
1997	1,900	118,500	120,400	32,800	21,700	54,500	174,900
1998	1,100	99,200	100,300	25,800	20,000	45,800	146,100
1999	1,100	106,400	107,500	29,100	23,800	52,900	160,400
2000	1,000	111,500	112,500	26,900	24,500	51,400	163,900
2001	800	114,600	115,400	28,500	25,400	53,900	169,300
2002	700	104,100	104,800	27,500	25,500	53,000	157,800
2003	400	96,200	96,600	26,000	24,300	50,300	146,900

[1] District assumed management of South County subbasins in 1987. No earlier groundwater production data is available.

ATTACHMENT C

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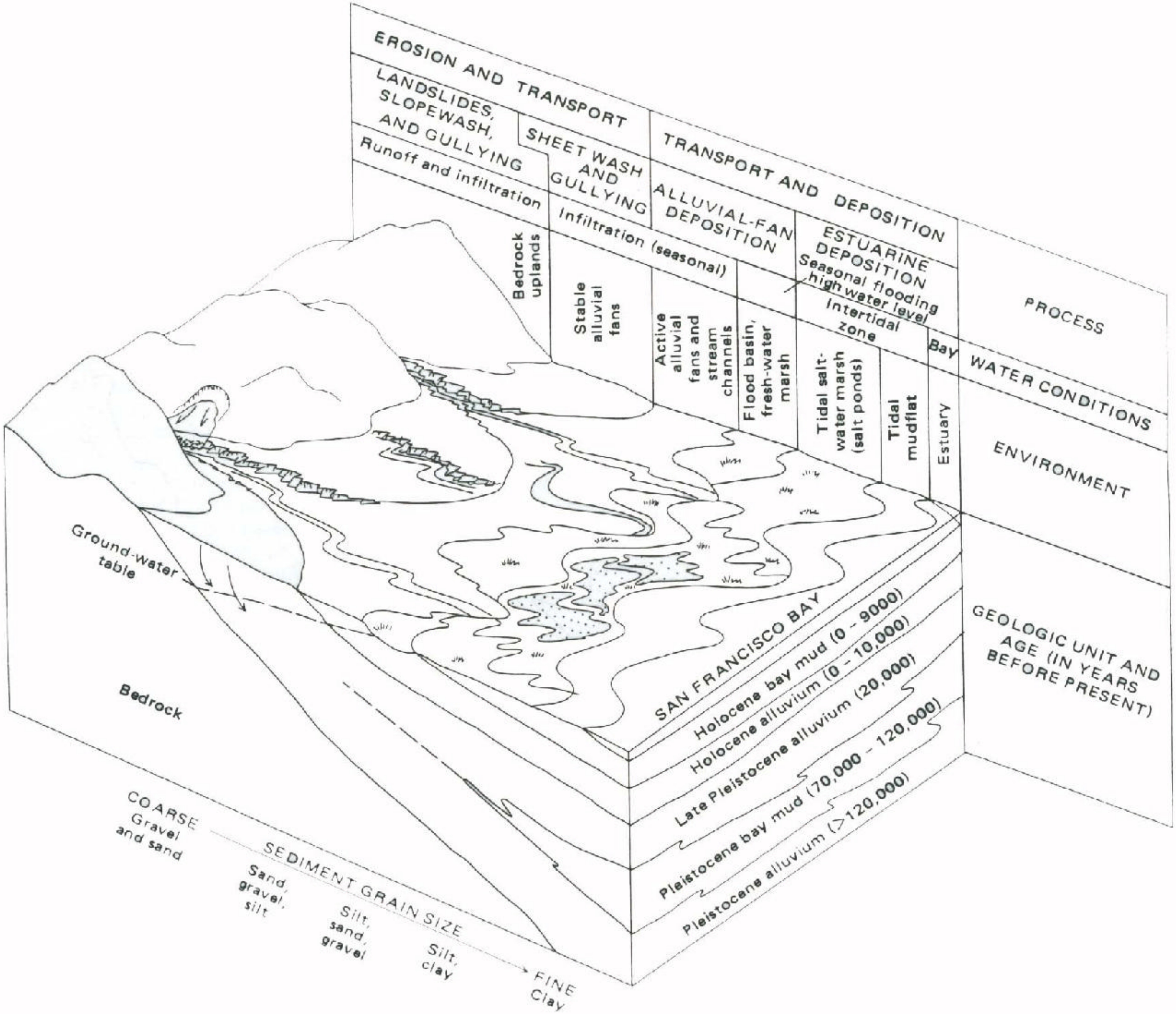
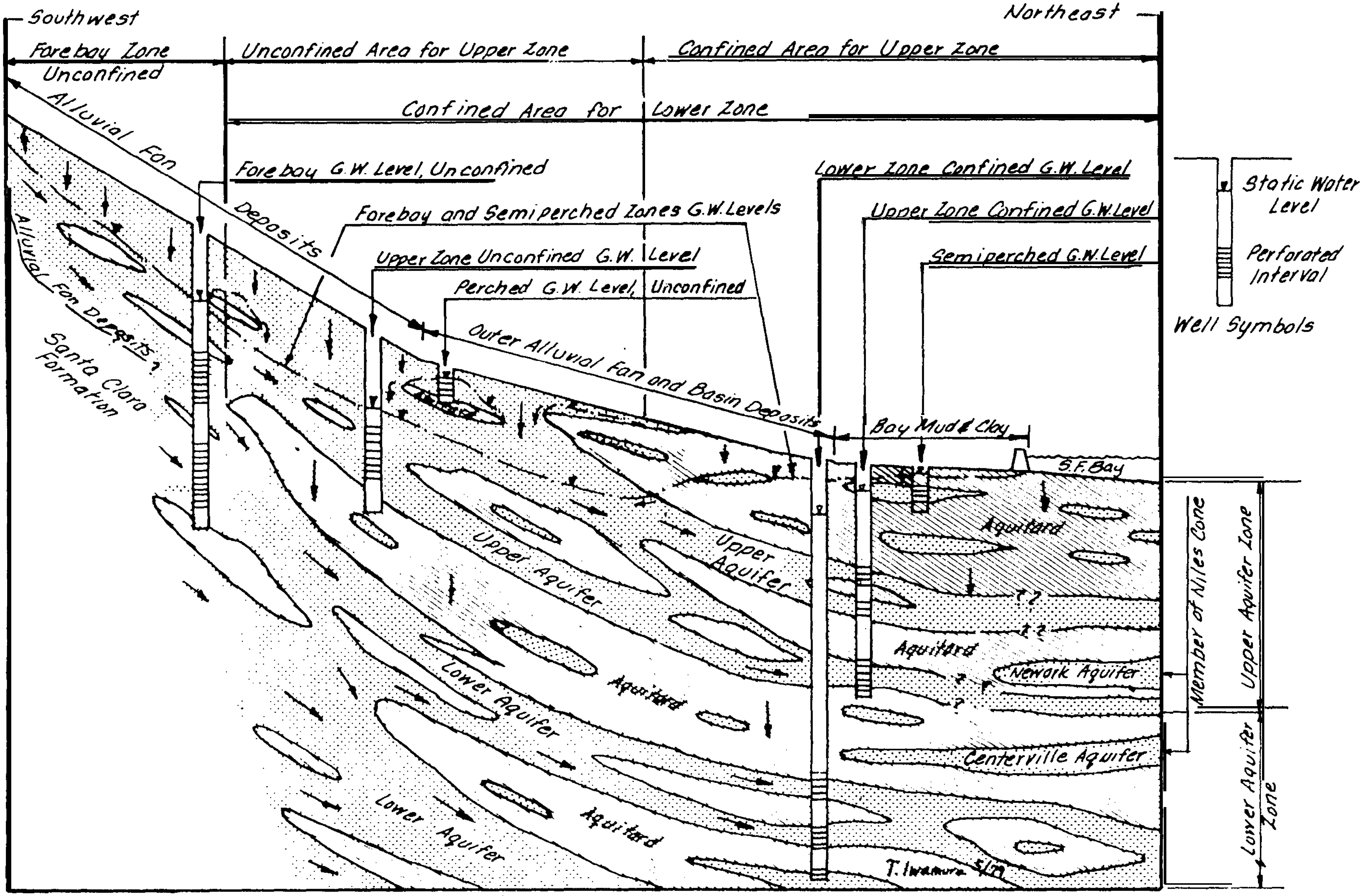


Figure 10: San Mateo Plain Conceptual Model of Alluvial Fan Deposition *(Source: Halley et al., 1979)*



Note: Arrows indicate direction of groundwater movement without regard to quantity.

FIGURE 2. DIAGRAMMATIC GEOLOGIC PROFILE DEPICTING MODES OF OCCURRENCE OF GROUNDWATER, PALO ALTO-MOUNTAIN VIEW AREA

FIGURE 2

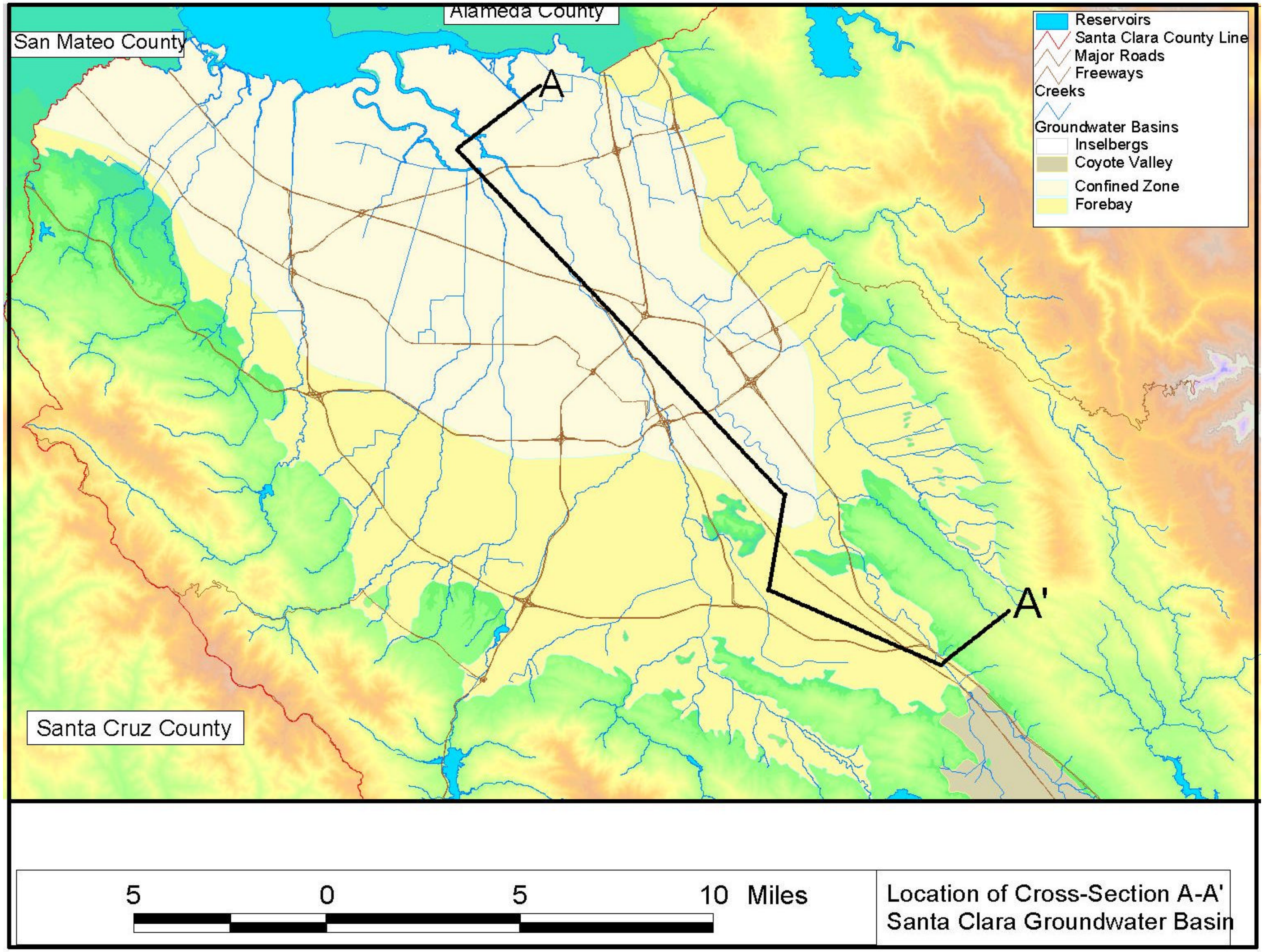


Figure 7: Santa Clara Valley Groundwater Basin *(Source: Santa Clara Valley Water District)*

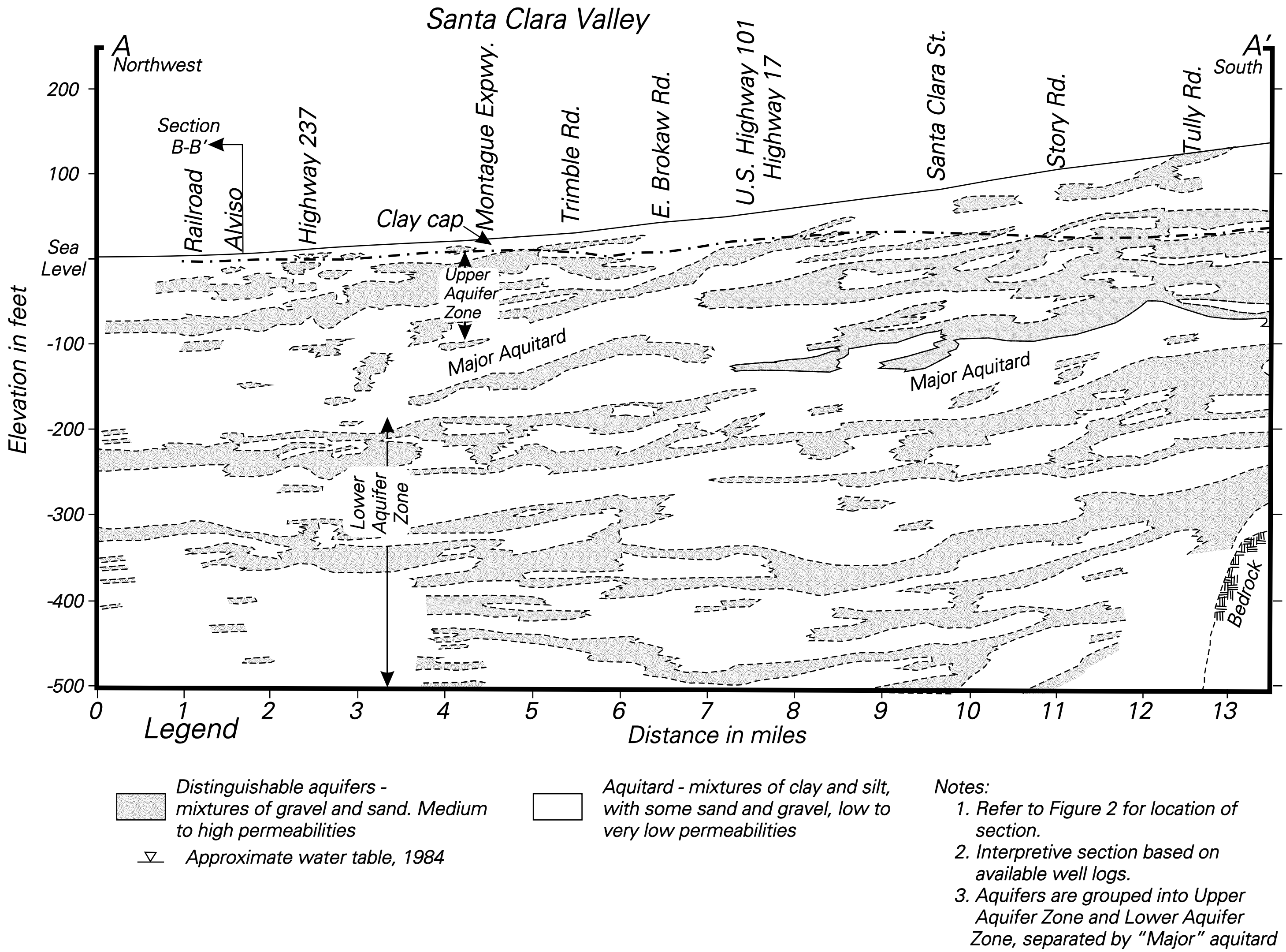
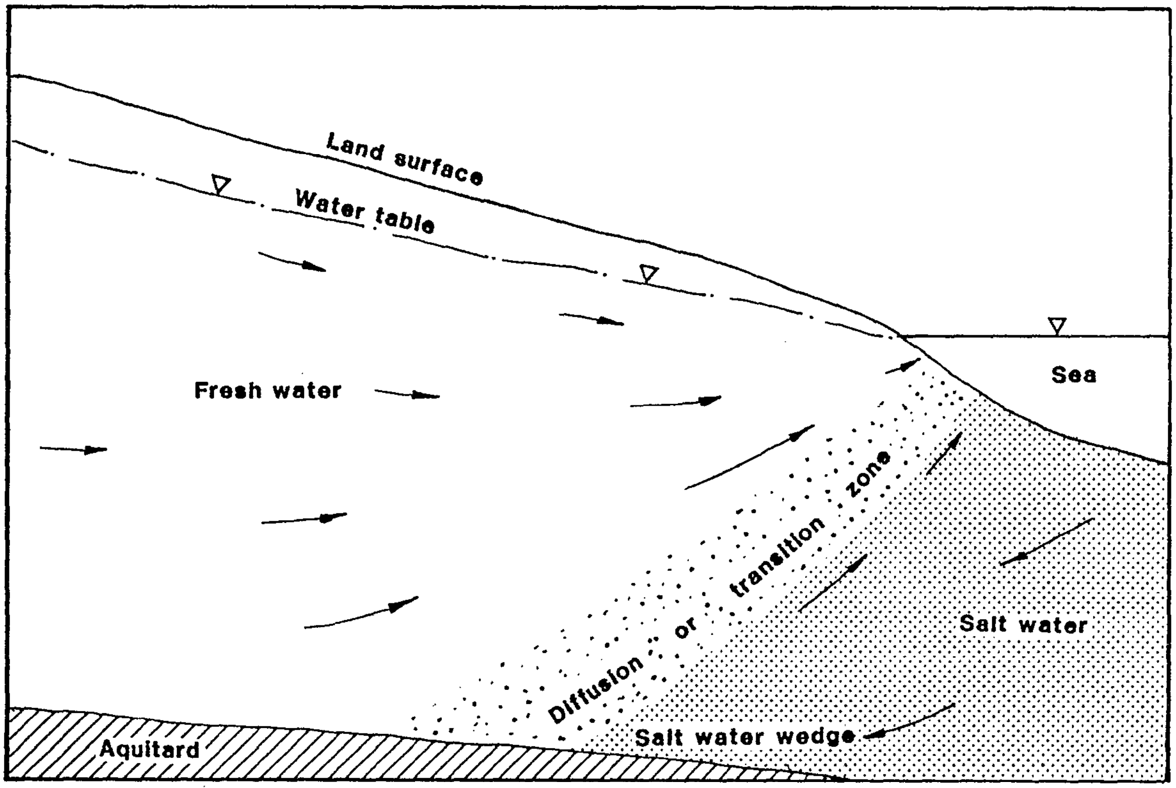
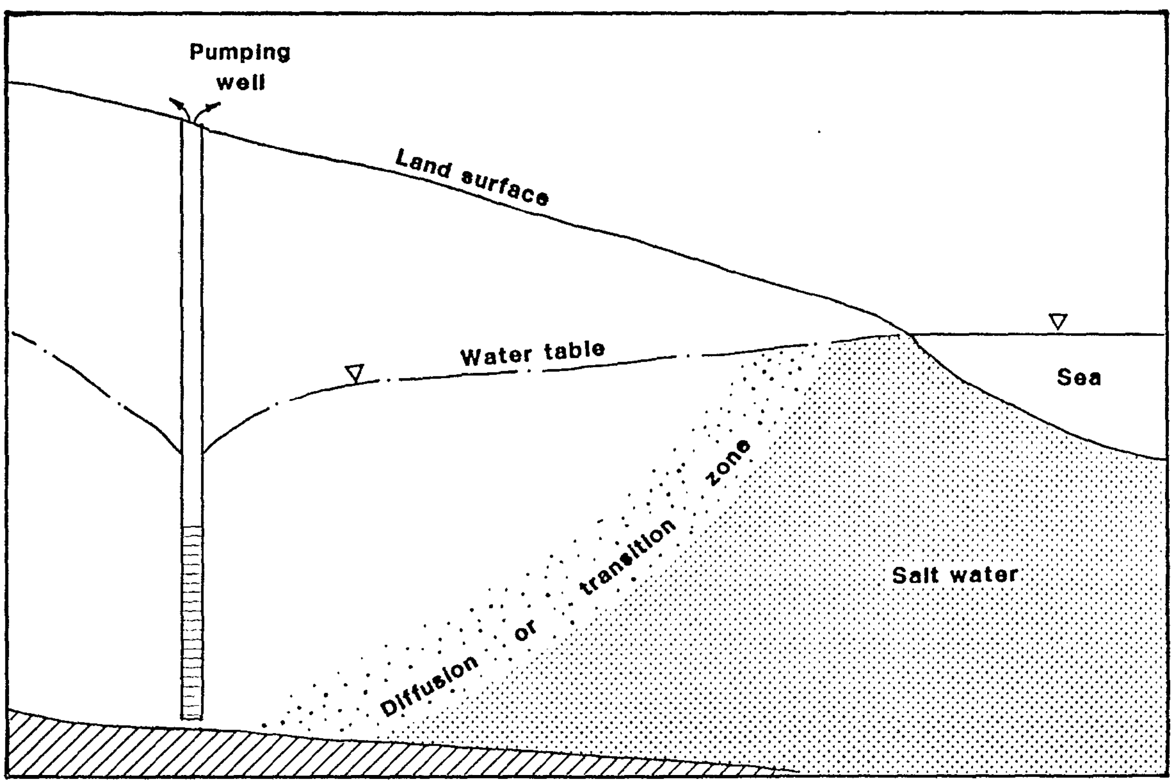


Figure 8a: Santa Clara Valley Groundwater Basin Cross-section Schematic *(Source: Iwamura 1995)*

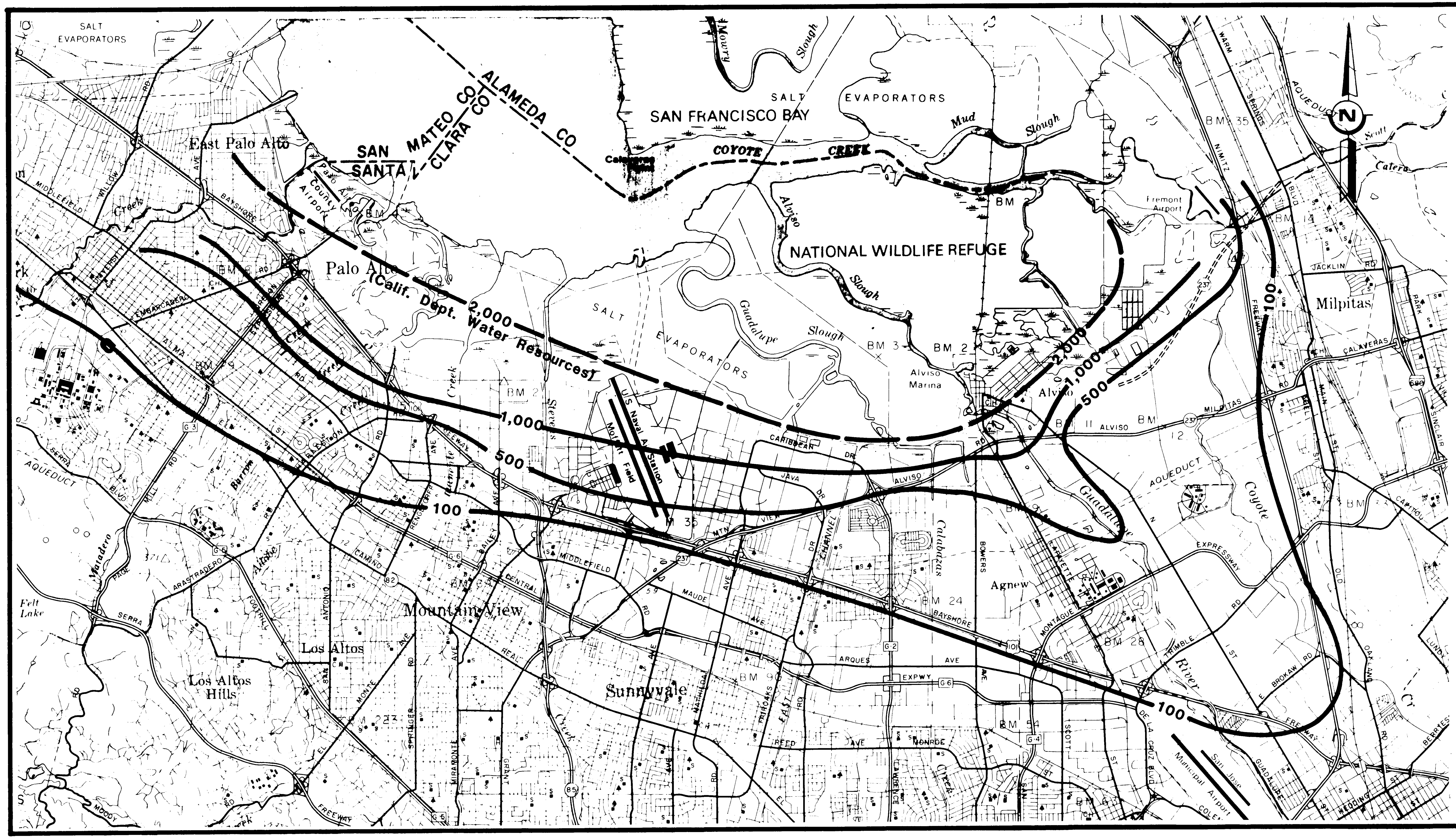


A. Balance between fresh water and salt water in coastal aquifer in which the interface is static (largely after Hilton H. Cooper Jr., 1964).



B. Salt water - fresh water interface is advancing inland in response to hydraulic gradient reversal , causing intrusion.

FIGURE 4. STATIC AND "CLASSICAL INTRUSION" CONDITIONS OF GROUNDWATER IN COASTAL AREAS



LEGEND

—100— Lines of equal chloride content in milligrams per liter. These lines delineate areas within which upper aquifer zone waters have been observed to contain the indicated chloride concentration at some time. Areas are generalized and all wells encompassed may not conform.

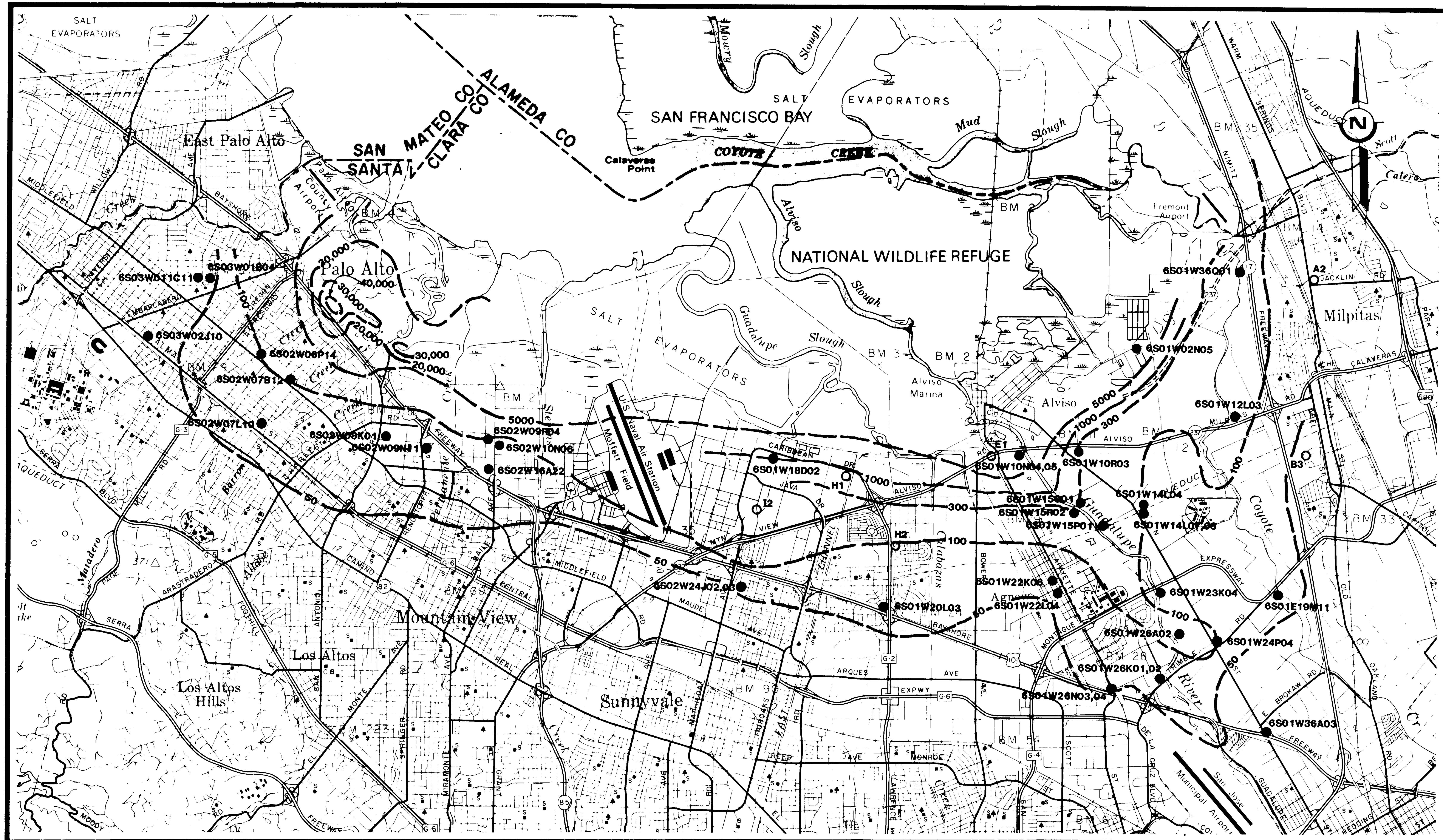
Map is from Arthur J. Inerfield and William C. Ellis, Sept. 1975

SANTA CLARA VALLEY WATER DISTRICT
SALTWATER INTRUSION INVESTIGATION

ISOCHLOR MAP DEPICTING CONDITIONS OF MAXIMUM INTRUSION AT SOME TIME AREALLY UPPER AQUIFER ZONE

SEPTEMBER 1980

SCALE : 1" = 5,000 ft.



LEGEND

100 — Lines of equal chloride content in milligrams per liter, largely for conditions 1972 to 1978. Sources of data include samples and analyses from current salinity monitoring program wells (Plate 6) plus other data from various special study wells. Where numerous repetitive values for a data point were available, the overall prevailing values during the period 1972-74 were used.

● 6S01W15R02 — Salinity monitoring program wells less than 100 feet in depth.

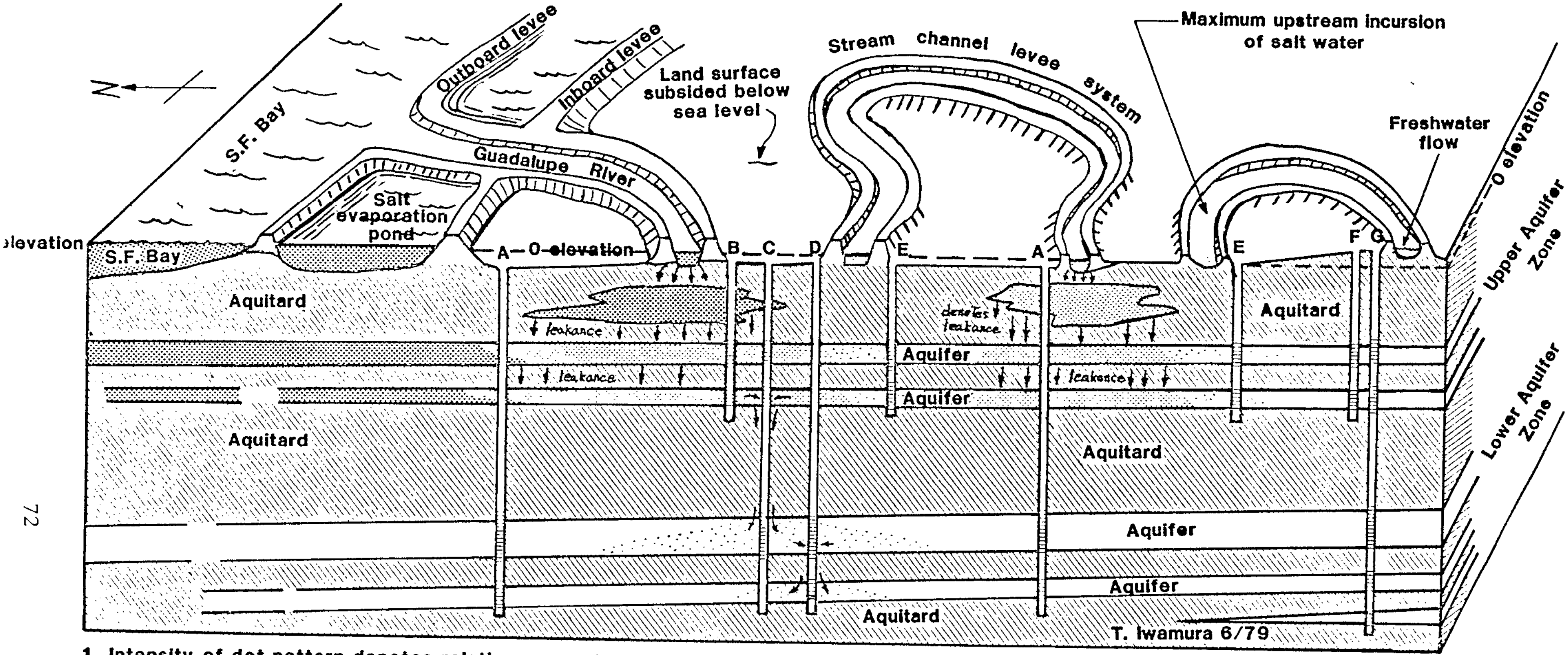
○ B2 — Location of test holes less than 100 feet in depth.

SANTA CLARA VALLEY WATER DISTRICT
SALTWATER INTRUSION INVESTIGATION

PRESENT CONDITIONS ISOCHLOR MAP OF UPPER AQUIFER ZONE

SEPTEMBER 1980

SCALE : 1" = 5,000 ft.



1. Intensity of dot pattern denotes relative concentration of salts in water.

"A" Wells : Perforated only in lower aquifer zone ; no water quality impairment ; previously flowing artesian wells.

"B" Well : Perforated in upper aquifer zone ; water quality impairment of aquifer by salt water intrusion.

"C" Well : Compositely perforated in upper and lower aquifer zone ; contamination of lower aquifer zone resulting from interaquifer transfer of water.

"D" Well : Perforated in lower aquifer zone ; water quality impaired from interaquifer flow occurring in well C.

"E" Wells : Perforated in upper aquifer zone ; water quality slightly impaired as wells are located farther from sources of intrusion.

"F" Well : Perforated in upper aquifer zone ; water quality unimpaired as well is beyond zone of intrusion.

"G" Well : Compositely perforated well ; water quality unimpaired by intrusion.

FIGURE 8. DIAGRAMMATIC INTERPRETATION OF SALT WATER INTRUSION SOUTH OF ALVISO

FIGURE

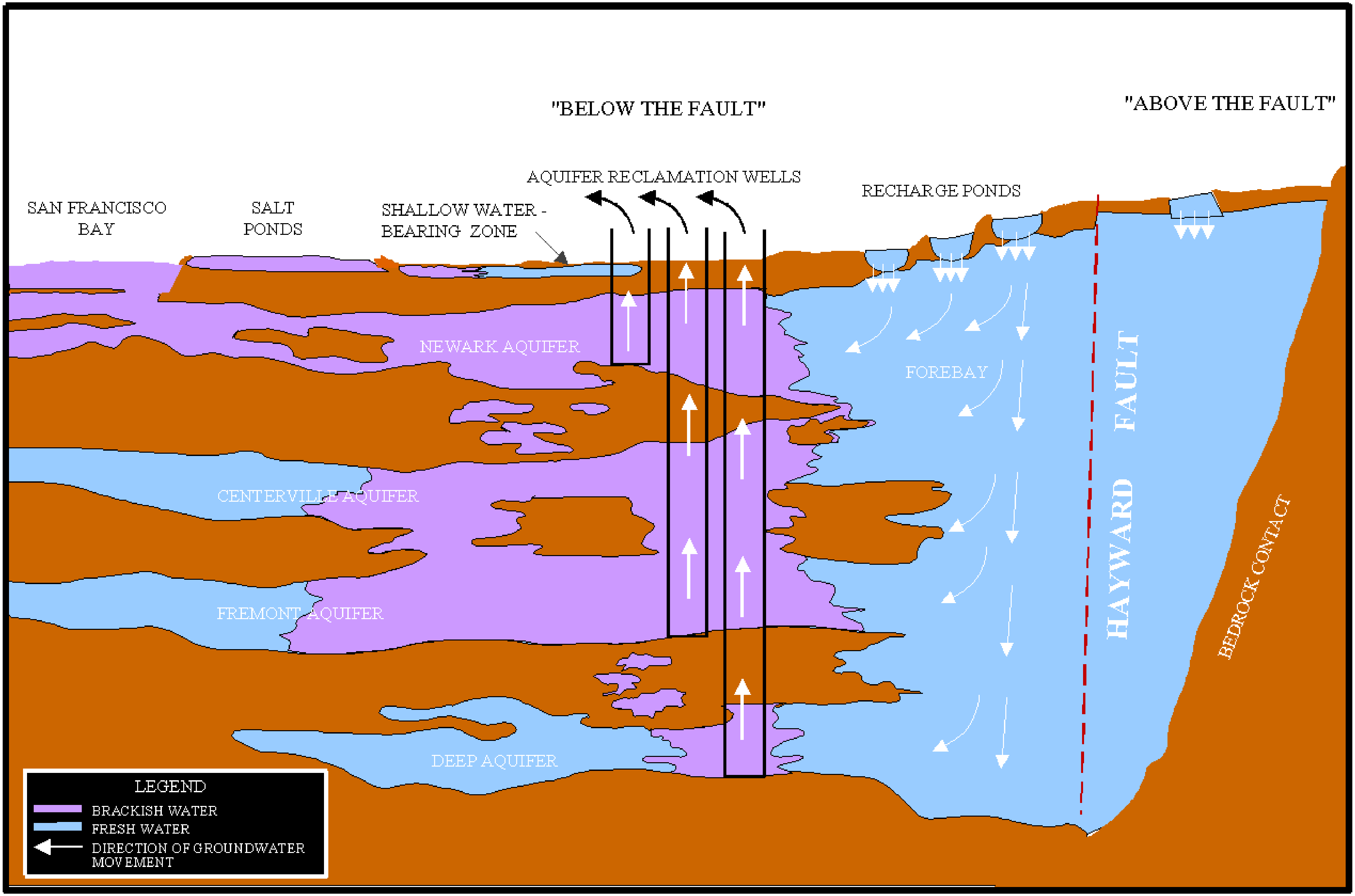


Figure 6: Niles Cone Groundwater Basin Cross-Section Schematic *(Source: Alameda County Water District)*

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ATTACHMENT D

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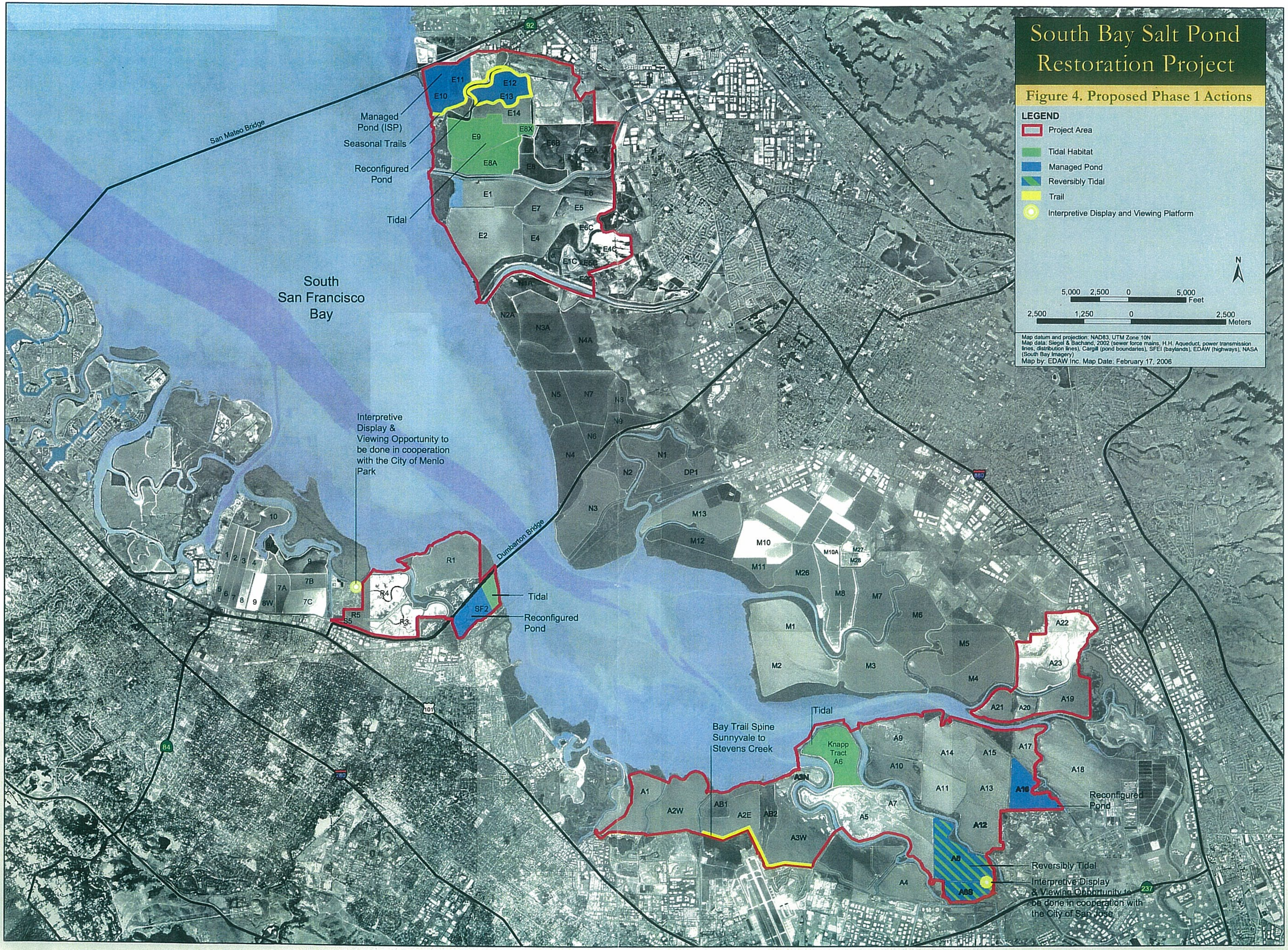
South Bay Salt Pond
Restoration Project
Figure 4. Proposed Phase 1 Actions
LEGEND
Project Area
Tidal Habitat
Managed Pond
Reversibly Tidal
Trail
Interpretive Display and Viewing Platform
N
5,000 2,500 0 5,000 Feet
2,500 1,250 0 2,500 Meters
Map datum and projection: NAD83, UTM Zone 10N
Map data: Siegel & Bachand, 2002 (sewer force mains, H.H. Aqueduct, power transmission lines, distribution lines), Cargill (pond boundaries), SFEI (baylands), EDAW (highways), NASA (South Bay Imagery)
Map by: EDAW Inc. Map Date: February 17, 2006
South
San Francisco
Bay
San Mateo Bridge
Dumbarton Bridge
Managed Pond (ISP)
Seasonal Trails
Reconfigured Pond
Tidal
Interpretive Display & Viewing Opportunity to be done in cooperation with the City of Menlo Park
Tidal
Reconfigured Pond
Bay Trail Spine Sunnyvale to Stevens Creek
Tidal
Knapp Tract A6
Reconfigured Pond
Reversibly Tidal
Interpretive Display & Viewing Opportunity to be done in cooperation with the City of San Jose
E10
E11
E12
E13
E14
E9
E8A
E8X
E1
E7
E5
E2
E4
N2A
N3A
N4A
N5
N7
N4
N6
N1
N2
DP1
N3
M13
M12
M10
M11
M10A
M26
M8
M7
M6
M1
M2
M3
M5
M4
A22
A23
A21
A20
A19
A9
A14
A15
A17
A18
A10
A11
A13
A16
A12
A7
A5
A3W
A4
A8
A1
A2W
AB1
A2E
AB2
R1
R4
R3
R5
SF2
7A
7B
7C
8W
10
92
101
84
880
237