SOUTH BAY AQUEDUCT

Watershed Protection Program Plan

Prepared for:
Alameda County Water District

March 2008


ESA

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ABBREVIATIONS

ACFD – Alameda County Fire Department
ACRCD – Alameda County Resource Conservation District
ACWD - Alameda County Water District
AUMs – Animal Unit Months
CDF/Cal Fire – California Department of Forestry and Fire Protection
CDFG – California Department Fish and Game
CDHS – California Department Health Services
CDM – Camp Dresser and McKee
CNDDB – California Natural Diversity Database
DBPs – Disinfection By Products
DWR - Department of Water Resources
DWSA – Drinking Water Source Assessment
EBMUD – East Bay Municipal Utility District
EBRPD – East Bay Regional Parks District
EQIP – Environmental Quality Incentives Program
IPM – Integrated Pest Management
LDV – Lake Del Valle
MIB – 2-methylisoborneol
NRCS – Natural Resources Conservation Service
OHV – Off Highway Vehicle
PBE – Physical Barrier Effectives
PCA – Possible Contaminating Activity
PCBs – Polychlorinated biphenyls
PWTP – Penitencia Water Treatment Plant
RCD – Resource Conservation District
RDM – Residual Dry Matter
RRMP – Range Resource Management Plan
SBA - South Bay Aqueduct
SCVWD – Santa Clara Valley Water District
SFBRWQCB – San Francisco Bay Regional Water Quality Control Board
SFPUC – San Francisco Public Utilities Commission
SWP – State Water Project
SWRCB – State Water Resources Control Board
TMDL – Total Maximum Daily Load
TOC – Total Organic Carbon
UCCE – University of California Cooperative Extension
USDA – United States Department of Agriculture
USEPA – United States Environmental Protection Agency
USGS – United States Geological Survey
WPPP – Watershed Protection Program Plan
Zone 7 – Alameda County Flood Control and Water Conservation District, Zone 7

CHAPTER 1
Executive Summary

Introduction

The initiative to develop a Watershed Protection Program Plan (WPPP) derives from the South Bay Aqueduct (SBA) Contractors' commitment to protect water quality in the SBA system, prevent its further degradation, and where feasible, improve its quality. Prior efforts to assess drinking water sources and conditions in the SBA watersheds, in coordination with the Department of Water Resources (DWR) and the California Department of Health Services (CDHS), culminated in a recommendation to develop a functioning Watershed Management Program for the SBA system in order to protect local water resources and water quality within the SBA system. The SBA Contractors recognize that most of the contaminant loading into the system is derived from the Delta, but this effort focuses on local watershed for several reasons outlined in Chapter 2.

This WPPP was developed under the guidance of a stakeholder-based Watershed Workgroup as part of a Proposition 13 Non-point Source Pollution Control Grant-funded project. The group consisted of representatives of various agencies and groups interested in protecting water quality for various uses and educating the public about local water resources and watershed protection.

Goals, Objectives, and Mission Statement

The goals and objectives listed below were developed by the Watershed Workgroup as guiding principles for the WPPP.

The plan's mission is as follows:

> To protect and enhance the quality of water from the SBA watershed as an important source for drinking water, while recognizing and respecting the agricultural, recreational, environmental, and other uses of these resources.

The goals of the SBA Watershed Protection Program Plan are as follows:

- Develop a stakeholder consensus-based plan to support a sustainable, multiple-use, working landscape within the Lake Del Valle and Bethany Reservoir watersheds;
- Identify partnerships and integrate with broader, ongoing stakeholder efforts in local watershed understanding, protection, and management; and

- Develop education and outreach in the local communities to raise awareness about the character, functions, and uses of water resources in the SBA watershed.

The specific objectives of the SBA Watershed Protection Program Plan are as follows:

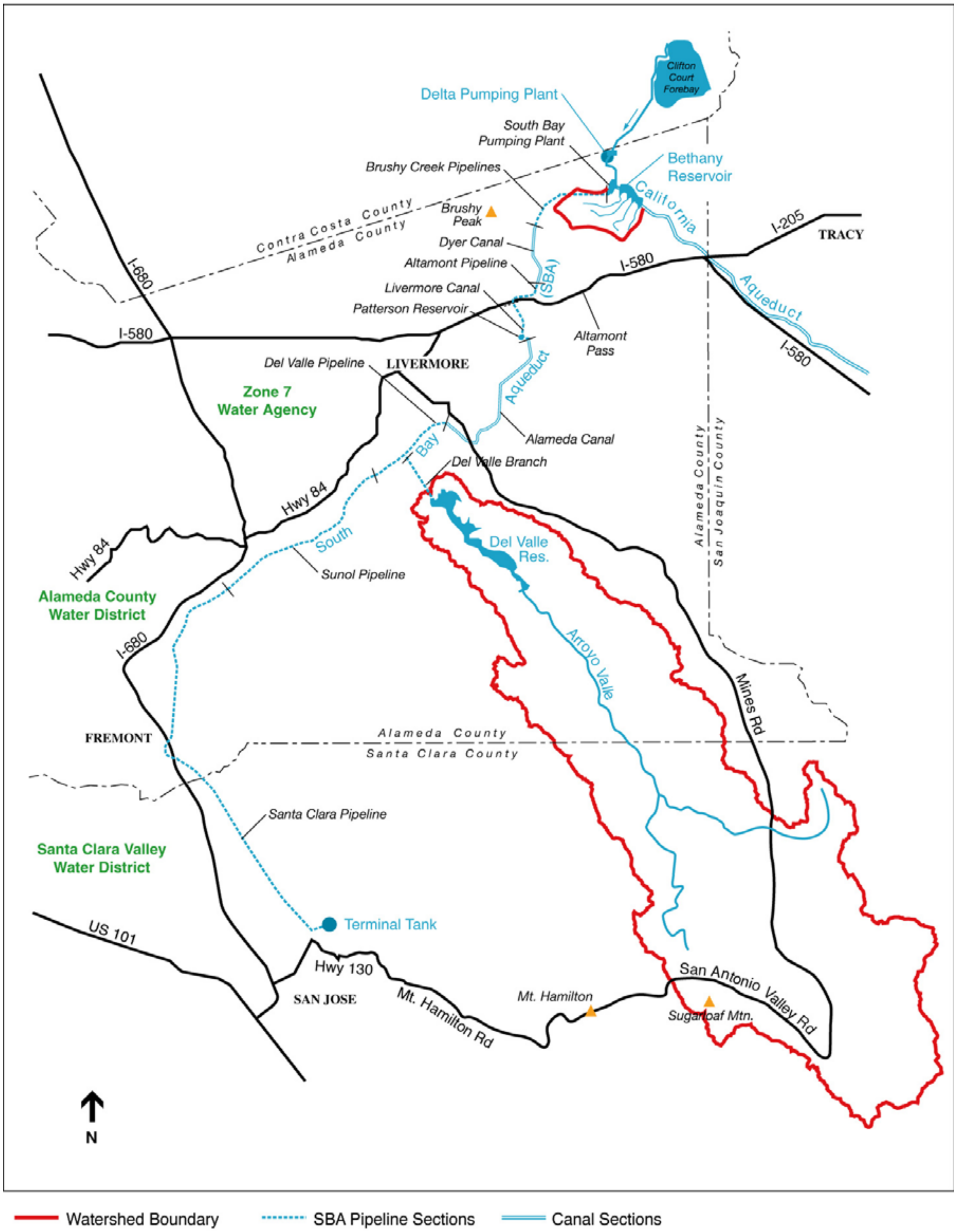
- Identify and prioritize potential and known risks to drinking water quality within the SBA watershed, and develop a strategic approach to reducing risk;
- Document current beneficial activities and practices contributing to the protection of water quality within the SBA Watershed;
- Develop a set of voluntary conservation practices that could be followed by SBA watershed landowners and managers to support and supplement current practices that reduce risks to water quality;
- Identify and help reduce regulatory barriers to conservation and restoration;
- Develop and implement a program of outreach and education to encourage the use of recommended conservation practices and to provide greater understanding of the watershed;
- Outline a long-term strategy for strengthening partnerships with stakeholders to increase the effectiveness of watershed protection;
- Identify funding needs and potential sources of funding for implementing recommended programs.

Description of the SBA Watershed

The SBA System

The SBA consists of a 44.7-mile conveyance system for untreated water that is part of the California State Water Project (SWP) (Figure 1-1). As owner and operator of the SBA, the California Department of Water Resources (DWR) maintains long-term water supply contracts with three water districts: Zone 7 Water Agency of the Alameda County Water Conservation and Flood Control District (Zone 7), Alameda County Water District (ACWD), and the Santa Clara Valley Water District (SCVWD). Through these agencies and their retailers, the SBA provides drinking water to over two million people in Alameda and Santa Clara Counties, including the cities of Livermore, Pleasanton, Dublin, Fremont, Newark, Union City, Milpitas, Santa Clara, San Jose and nine other communities in Santa Clara County.

The majority of SBA water originates from the Sacramento-San Joaquin Delta. The remainder is derived from local watersheds, primarily the Lake Del Valle watershed. SWP water is pumped from the Delta at the Harvey O. Banks Pumping Plant near Byron, and flows a short distance down the California Aqueduct to Bethany Reservoir. Bethany Reservoir is essentially a wide spot on the California Aqueduct, with more or less constant north to south flow through the reservoir. Most SWP water continues south, but a portion is pumped into the SBA at the South Bay Pumping Plant on Bethany Reservoir.



SBA Watershed Management Program Development Watershed Protection Program Plan . 205076

SOURCE: ESA

Figure 1-1
The SBA System

In its entirety, the SBA consists of 10.8 miles of canal, 32.1 miles of pipeline, and 1.8 miles of tunnel, as well as pumping plants and reservoirs. Flow regulation and storage are provided by Lake Del Valle and the Del Valle Pumping Plant. Water can be pumped into Lake Del Valle and Lake Del Valle water can be released into the SBA via a 60-inch common inlet/outlet. The SBA ends in east San Jose at the Santa Clara Terminal Tank, an above-ground tank at the SCVWD Penitencia Water Treatment Plant (PWTP).

Physical Attributes of the SBA Watershed

The Lake Del Valle watershed encompasses 146 square miles, and ranges in elevation from 700 feet to over 4,000 feet. Arroyo Valle (sometimes called Arroyo Del Valle) is the principal stream of the watershed. Lake Del Valle was formed by impounding Arroyo Valle behind the earthen Del Valle Dam, which was completed in 1968 and remains the only flood control reservoir in the Livermore Valley. The Lake Del Valle watershed extends southward from the lake to the San Antonio and Upper San Antonio valleys, east of Mt. Hamilton. With the exception of these valleys and some flat lands along the lower course of Arroyo Valle, the watershed is characterized by rugged, heavily vegetated hills and steep canyons drained by a dense network of small streams.

A large portion of the watershed has relatively steep slopes. The soils in the area are generally shallow, ranging from 6 – 42 inches. The combination of shallow soils and steep slopes has contributed to the high erosion potential of the Lake Del Valle watershed and its proclivity for landslides. The potential for erosion from roads and trails throughout most of the watershed is considered to be very severe.

At 4.4 square miles, the Bethany Reservoir watershed is about 1/33 the size of the Lake Del Valle watershed (Figure 1-1). The Bethany Reservoir watershed includes the lands east of Altamont Pass that drain through several intermittent streams into the west shore of Bethany Reservoir. The watershed ranges from approximately 240 to 1,145 feet in elevation. The land consists of grass-covered hills bisected by alluvial valleys. Cattle grazing and windmills are the principal land uses. The gentler terrain in this watershed results in a much lower erosion potential and many fewer landslides in comparison with the Lake Del Valle watershed.

Hydrology

Most precipitation in the SBA watershed areas occurs as rainfall during the fall and winter months, as is typical of the Central California Coast Ranges. In the Lake Del Valle watershed, annual rainfall varies primarily as a function of altitude, with average annual precipitation ranging from around 16 inches per year at the lower elevations to 36 inches per year on the peaks (DWR, 1974). An isohyetal map of annual rainfall in the watershed is shown Appendix B. The Bethany Reservoir watershed lands receive on average 12-13 inches of precipitation per year (CDF, 2000). Estimates for the 24-hour rainfall event at different recurrence frequencies is shown for several rain gauging stations in the area in Table 3-2.

Lake Del Valle is fed by two sources of inflows – SWP water from the SBA, and natural inflows from the watershed (Figure 3-6). SWP water is pumped into the reservoir prior to the summer months as needed to maintain a supply adequate for recreational uses and water supply. During the fall, water is released from the reservoir into the SBA to provide flood control capacity in the reservoir; the released water is then used by water treatment plants.

Streams in this area tend to be "flashy;" that is, they have little base flow and most of their annual discharge occurs during and immediately following major storm events. The U.S. Geological Survey (USGS) maintains a stream gauge on Arroyo Valle just above Lake Del Valle (Station 11176400 Arroyo Valle below Lang Canyon near Livermore, CA) with a continuous gauging record extending back to October 1963. The highest recorded flow at this gauge (through water year 2004) was 8,790 cubic feet per second, recorded on February 17, 1986. The greatest annual discharge recorded at the gauge (calculated from mean daily discharge) was 128,142 acre feet in 1983. The lowest annual discharge was 224 acre feet in 1977.

The peak discharge rate for the small drainages in the Bethany Reservoir watershed was calculated at 834 cfs for the 100-year event, and 62 cfs for the 2-year event[1]. The Bethany Headlands drainage, which empties into the forebay by the South Bay Pumping Plant, is estimated to account for about half of the total discharge.

Human Use of the SBA Watershed

Lake Del Valle Watershed

The Lake Del Valle watershed encompasses 146 square miles, much of which remains in a natural, undeveloped state. The primary land uses in this drainage include recreation, ranching, residential, and historic mining. More information on historic land uses can be found in Chapter 3. Del Valle Regional Park occupies about 4,000 acres adjacent to the Lake (Appendix B). There are several large ranches around Lake Del Valle and in the Arroyo Valle canyon upstream of the lake. The 2000 U.S. Census data indicate that 131 people, living in 48 households, populate the Del Valle watershed. Most of these households are located in the San Antonio and Upper San Antonio Valleys within Santa Clara County in the southern part of the watershed. The San Antonio Valley is a long-established community based primarily on ranching. Some residential development has occurred there in recent years, but the remoteness of the area – it is about one hour by car via narrow, mountainous roads from Livermore, San Jose, or Patterson – discourages suburban development. In addition to the current recreation and ranching uses of the watershed, mining historically occurred within parts of the watershed. The primary focus of the 35 (now inactive) mines was the magnesium carbonate deposits in the southeastern part of the watershed near Sweetwater Creek (DWR 1974).

[1] The terms "100-year event" and "2-year event" refer to storms of an intensity expected to recur every 100 years and 2 years, respectively.

A large number of roads exist in the Lake Del Valle watershed. Most are single track, unimproved or graveled ranch roads. Only four public roads provide access to the watershed: Mines Road, Puerto Canyon Road, Mt. Hamilton Road, and Del Valle Road. Several roads in varying states of abandonment, once used for access to the mines, are still evident on the land, as are off-highway vehicle (OHV) tracks.

Bethany Reservoir Watershed

The Bethany Reservoir watershed is used primarily for cattle grazing and for wind power generation. Few structures, other than windmill towers, stockponds, and corrals exist in the watershed. Most of the roads are unimproved dirt ranch roads or graveled access roads to the windmill pads. The area adjacent to the north side of the Reservoir is used for recreation and the lake itself is used for body and non-body contact recreation, including boating, swimming, fishing, and picnicking, but no camping is allowed. Visitor attendance ranged from 14,496 in 1995/96 to 26,175 in 1999/00 (DWR 2001a). No people live within the watershed (Figure 3-9).

Beneficial Uses of Lake Del Valle, Arroyo Valle, and Bethany Reservoir

Lake Del Valle and Arroyo Valle

The “Beneficial Uses” of Lake Del Valle and Arroyo Valle are designated by the San Francisco Bay Regional Water Quality Control Board in the current San Francisco Bay Basin Plan (SFBRWQCB, 2005). The existing beneficial uses for Arroyo Valle include the following:

- Cold Freshwater Habitat
- Groundwater Recharge
- Municipal and Domestic Water Supply
- Fish Spawning
- Wildlife Habitat

In addition, Fish Migration and both Contact and Non-Contact Water Recreation are listed as potential beneficial uses of Arroyo Valle.

According to the Basin Plan, the existing beneficial uses for Lake Del Valle include the following:

- Cold Freshwater Habitat
- Municipal and Domestic Water Supply
- Contact Water Recreation
- Non-Contact Water Recreation
- Fish Spawning
- Warm Freshwater Habitat
- Wildlife Habitat

Bethany Reservoir

The Basin Plan for the San Joaquin River Basin and Sacramento River Basin does not separately list beneficial uses for Bethany Reservoir. However, the Beneficial Uses for the California Aqueduct include the following:

- Municipal and Domestic Water Supply
- Agriculture: irrigation
- Agriculture: stock watering
- Industry: process
- Industry: service supply
- Industry: power
- Recreation: contact
- Recreation: other non-contact
- Wildlife Habitat

Water Quality: Contaminants of Concern

Prior sanitary surveys (California Department of Water Resources 2001a) and drinking water source assessments (Archibald and Wallberg 2002a-d, 2005) have identified a number of water quality constituents as contaminants of concern that may threaten drinking water quality in the SBA system (Tables 1-1 and 3-6). These contaminants of concern were identified based on available water quality data for source water and treated water; drinking water regulations and guidelines from federal and state agencies; local knowledge and observations of the SBA system and its watersheds and general knowledge of watershed dynamics and best management practices. While agricultural drainage may contribute pesticide residues, these same studies did not identify this as a water quality concern. Neither have high levels of magnesium and total hardness detected in water quality monitoring, possibly resulting from historical mining of magnesium carbonate deposits in the Del Valle watershed, caused concern (DWR 2001a). However, these water quality parameters are being monitored by water utilities, especially by Zone 7, since the arroyos are used for local groundwater recharge.

Lake Del Valle is a candidate for inclusion on California's 2006 303d list of water quality-limited water bodies. The 303d list is revised every two years by the State Water Resources Control Board (SWRCB), in fulfillment of a requirement under the federal Clean Water Act. The candidate listing is for two pollutants: mercury and polychlorinated biphenyls (PCBs). The source of these pollutants is not known; the candidate listing is based on a finding of elevated levels of these pollutants in the tissues of fish (likely stocked fish) taken from the lake in April 2001 (SWRCB, 2005). While little is known about the extent or source of this contamination, repeated samples of water from Lake Del Valle analyzed by DWR and Zone 7 have shown no detectable levels of mercury or PCB in the water column. It is possible, therefore, that if these contaminants are present in the Lake Del Valle system, they are confined to the Lake's sediments, and bioaccumulate, but do not pose a threat to drinking water quality. Alternatively, it is possible that the samples were taken from stocked fish and the source of these contaminants is outside of the watershed.

TABLE 1-1
DRINKING WATER CONTAMINANTS OF CONCERN IN THE SOUTH BAY AQUEDUCT SYSTEM

Contaminant of Concern	Rationale	Possible Sources
Bacteria: • *E. coli* • *Total coliform* • *Fecal coliform*	These types of bacteria may indicate fecal contamination of water sources.	Stormwater runoff, livestock grazing, wild animal populations, human recreation, and spills or overflows of raw sewage from septic leaching fields and/or wastewater treatment facilities.
Protozoa: • *Giardia* • *Cryptosporidium*	These protozoa are pathogens originating from fecal contamination of water sources. Both *Giardia* and *Cryptosporidium* can cause gastrointestinal diseases when ingested. They are not easily removed from drinking water, and *Cryptosporidium* is especially resistant to disinfection.	Stormwater runoff, livestock grazing, wild animal populations, human recreation, and spills or overflows of raw sewage from septic leaching fields and/or wastewater treatment facilities.
Bromide	Can react with disinfectants used in the treatment process to produce regulated disinfectant byproducts (DBPs) such as trihalomethanes, haloacetic acids, and bromate.	Likely reflects seawater contributions from Delta water at the Banks pumping station.
Total Organic Carbon (TOC)	A concern due to its proclivity to react with disinfectants and produce regulated DBPs.	May derive from stormwater runoff (including decaying plant material, animal wastes, etc.) and septic leaching and/or wastewater treatment facilities.
Total Solids (Dissolved and Suspended)	Total Solids can include dissolved minerals and salts, sediment and other solids such as algae. Algal blooms may be encouraged by nutrient enrichment – see below.	Sediment may be introduced into the SBA from multiple sources including stormwater runoff, livestock grazing, wild animal populations, human recreation, and wastewater treatment facilities.
Nutrients: • *Nitrate* • *Nitrite* • *Phosphorus*	Nutrients including nitrate, nitrite, and phosphorus contribute to algal blooms. Algae can cause operational problems at treatment plants by clogging filters, and can produce compounds such as 2-methylisoborneol (MIB) and geosmin that result in considerable taste and odor problems in SBA water.	Sewage spills, leaks, or leaching, stormwater flows, agricultural activities, decaying plant material, or by wild animal populations.

Arroyo Valle is included on the 303d list for Diazinon, with the potential source given as "Urban Runoff/Storm Sewers." This pesticide is ubiquitous in urban creeks and is currently being phased out of residential use by the USEPA. The priority given for TMDL[2] development is "High."

During 2005 and 2006, available water quality data was collected to establish a baseline for SBA watershed water quality, and stormwater monitoring was conducted to determine relative inputs from SBA system sources. More information on these current water quality conditions can be found in Chapter 4 and in the following sections. The monitoring results confirm that source water quality flowing into Bethany Reservoir, including the California Aqueduct and the Bethany Headlands drainage, is poorer than in sources flowing into Lake Del Valle. As a result of Del Valle water supply operations and the dilution capacity of the lake, contaminant sources in the Del Valle watershed pose a lower risk to SBA water quality than sources in the Bethany watershed.

2 TMDL = Total Maximum Daily Load.

SBA Water Quality Improvement Strategy (Chapter 4)

The CDHS method for evaluating risks to drinking water supply takes into account the proximity of potentially contaminating activities (PCAs) to water courses, the nature of the PCAs themselves, and "physical barrier effectiveness" (PBE), or mitigating effects and circumstances that reduce risk.

The CDHS identifies 3 zones with respect to activities that may have a negative impact on a water supply:

- Zone A: 400 feet from reservoir banks or primary stream boundaries and 200 feet from tributaries
- Zone B: 2,500 feet from intakes
- Zone C: The remainder of a watershed

The overall strategy for minimizing contamination risk in the SBA Watershed is to focus on potentially contaminating activities within Zones A and B. For the remainder of the watershed area, Zone C, the more general strategy is to reduce erosion and delivery of sediment and other contaminants to streams and reservoirs; and to reduce potential contamination of groundwater. In the sparsely populated lands of the SBA Watershed, these strategies can be accomplished through appropriate vegetation management (including grazing management) to reduce the risk of fire, protect the ground surface, and keep decaying plant material out of the water; appropriate design and maintenance of roads and road crossings to minimize their sediment delivery to stream channels; and good stewardship around rural residences and at facilities where livestock is concentrated, such as corrals and watering locations. These strategies are developed further in Chapter 5, with recommendations for specific conservation practices.

The following discussion describes specific portions of the SBA Watershed delineated by a commonality of geography, land use, and potentially contaminating activities. For each watershed area, there is a description of Zones A and B, and discussion of potentially contaminating activities and conditions that contribute to physical barrier effectiveness.

Lake Del Valle Watershed

The Lake Del Valle Watershed may be divided into three areas for the purpose of targeting high priority areas and activities for reducing risks to the drinking water supply: the area that drains into Lake Del Valle itself; Arroyo Valle Watershed from the upstream boundary of the park to the San Antonio Valley; and the San Antonio and Upper San Antonio Valleys.

Lake Del Valle

This area includes the lands around Lake Del Valle and Arroyo Valle to the upstream border of the park. The most sensitive areas (Zone A) are within 400 feet of the lakeshore and Arroyo Valle, and within 200 feet of the small tributary channels that feed into the lake; Zone B includes areas within 2,500 feet of the SBA intake, which is located near the dam at the northern end of the lake. Stormwater monitoring during the winter of 2005-2006 found relatively high levels of total organic carbon, nutrients, *E. coli*, and total coliform in samples taken from Cedar Creek, while samples from the lake near the dam (and SBA intake) indicated consistently good water quality indicating the capacity of the lake to assimilate or dilute contaminants during these events. The small size of the streams that drain into the reservoir, and the relatively lengthy storage period and seasonality of storage in the reservoir may provide a substantial PBE level. In addition, most recreational activities (including swimming in designated areas) take place at the southern end of the lake, well away from the SBA intake, and are less intensive during the wet season.

The water quality of Lake Del Valle is generally very good; however, there are a number of potentially contaminating activities that take place within Zone A and Zone B. These activities include body contact and non-body contact recreation in the lake itself. Shoreline recreational activities include camping, hiking, fishing, picnicking, and equestrian use. In addition, cattle are allowed to graze in stream channels and to the water's edge; their use of the shoreline and main stream channels for water access may depend on the availability of other seasonal water sources or off-site troughs. Feral pigs have at times been prevalent around the reservoir. Other wildlife is commonly observed. There are a few private residences, public restrooms and septic systems within this area (such as in the Cedar Creek drainage; see Figure 3-11 in Chapter 3) and some household activities can have an impact on water quality. Few roads or trails follow stream courses, and most are set back from the lakeshore, but there are a number of road and trail crossings of streams where sediment inputs may occur. The implementation of conservation practices, including the continuation of those currently in place, would help protect water quality in Lake Del Valle.

Arroyo Valle: Lake Del Valle to San Antonio Valley

The Lake Del Valle to San Antonio Valley area encompasses the majority of the Lake Del Valle watershed. It is a very sparsely populated area, with only a few residences associated with the N3 Ranch headquarters and other rural residences. The primary land uses are grazing, open space and seasonal recreation (hunting, snowplay). Wildlife is commonly observed in the area. There is a limited ranch road network. Stormwater monitoring in the winter of 2005-2006 at the downstream limit of this area indicates that Arroyo Valle delivers the highest quality water among the inputs to the SBA system.

The most sensitive areas (Zone A) within this portion of the watershed are the lands within 400 feet of Arroyo Valle and its year-round tributaries, Colorado Creek, Sycamore Creek, and Eylar Canyon; and within 200 feet of other tributary channels. This includes the stream channels themselves, riparian areas, and limited floodplain areas and lower canyon walls. There are no Zone B areas within this portion of the watershed. Several factors all contribute a relatively high PBE for this portion of the SBA Watershed, including: the distance from much of the watershed area to Lake Del Valle, the large watershed, holding time in the reservoir, the large volume of water stored in the reservoir, and the distance from the mouth of Arroyo Valle at the southern end of the lake to the SBA intake at the northern end of the lake (about 5 miles).

Because Arroyo Valle delivers the highest quality and largest quantity of water among the local inputs to the SBA system, minimizing risks in this area to preserve water quality for the future is important. Potentially contaminating activities identified as occurring within Zone A for which conservation practices should be developed include grazing, roads and road crossings, corrals and other concentrations of livestock, and rural residential uses. Feral pigs are also present in this area.

San Antonio Valley and Upper San Antonio Valley

The San Antonio Valley and Upper San Antonio Valley have relatively higher population density and greater intensity of land use than the remainder of the Lake Del Valle watershed. Zone A, where PCAs would produce a higher risk to water quality, include land within 400 feet of San Antonio Creek and Jumpoff Creek, the main streams draining the valleys; and within 200 feet of other tributary streams. There are no Zone B areas within this portion of the watershed. Factors that contribute to a high PBE for this area include: the low gradient of the valleys, stream distance to Lake Del Valle, the size of the watershed, vegetation management within the watershed, holding time in Lake Del Valle, and the large volume of water stored in Lake Del Valle.

Potentially contaminating activities in the San Antonio Valley and Upper San Antonio Valley include grazing, roads and road crossings (including OHV trails), on-stream stock watering ponds, livestock corrals, private residences, household activities, septic systems, and future rural residential development (including septic systems, grading, runoff). The potential for old mine tailings to contaminate the water supply is unknown. Historic magnesite (magnesium carbonate, $MgCO_3$) mining in the San Antonio Valley could potentially contribute to stream sediment loads and hardness, if runoff from mine and mine tailing sites reaches the stream system.

Bethany Reservoir Watershed

The Bethany Headlands drainage produces the worst water quality among the inputs to the SBA. Of particular concern are the *Giardia* and *Cryptosporidium* present in samples taken from the small stream that empties into Bethany Reservoir at the SBA pumping plant. While this stream contributes only a tiny fraction of the water delivered by the SBA, even small numbers of *Giardia* cysts and *Cryptosporidium* oocysts entering the water supply are problematic.

The Bethany Headlands drainage flows into a 300-ft concrete channel, which ends less than 50 feet away from the Stage 1 pump intake, within Zone B. Because the channel discharges so close to the pumps that transfer water from Bethany Reservoir into the SBA, there is an opportunity for short-circuiting and the discharge from the channel may not be completely diluted by the comparatively large volume of water in Bethany Reservoir before it reaches the pump intakes. It is therefore very important to protect the quality of the water traveling through this concrete channel. In addition to the stream, water entering the channel directly through weepholes and drains should also be considered. Also of concern is the potential for the Bethany Headlands watershed to produce large amounts of sediment during very large, infrequent storm events. Such an occurrence could affect the SBA Pumping Plant intakes and cause high turbidity in the water supply.

The Bethany Headlands drainage, particularly the stream course and the lands within 400 feet of the stream course and the pond should be considered high priority for risk reduction. Included in this high risk area are the roads and road drainage structures (ditches, flumes, culverts, and scuppers) within the DWR right-of-way that drain to the Bethany Headlands drainage. The large pond within the Bethany Headlands Drainage, located approximately 3,000 feet upstream of Bethany Reservoir, rarely overtops, and may be regarded as an effective physical barrier to contamination of the water supply (high PBE) in most circumstances. Therefore, the lands above this pond should be considered lower priority. The pond itself should be regarded as an important structure for limiting contamination from upstream land uses, and also for serving as a sediment basin during very large, infrequent storm events.

The land uses that pose risks to SBA water quality in the Bethany Watershed for which conservation practices should be developed are rangeland management, roads, road crossings, and ponds. Furthermore, to the extent that the pond in the Bethany Headlands drainage is vulnerable to damage or failure during a very large, infrequent storm event, it should also be considered high priority for development of conservation practices and careful maintenance.

TABLE 1-2
HIGH PRIORITY WATERSHED AREAS AND ACTIVITIES – ZONES A & B

	Bethany Reservoir	Lake Del Valle	Arroyo Valle: Lake Del Valle to San Antonio Valley	San Antonio Valley and Upper San Antonio Valley
Zone A	Bethany Headlands drainage, within 400’ of stream channel	Within 400 feet of lakeshore and Arroyo Valle; within 200’ of tributaries	Within 400 feet of Arroyo Valle and year-round tributaries; within 200’ of other tributaries	Within 400’ of San Antonio Creek and Jumpoff Creek; within 200’ of other tributaries
Zone B	Bethany Headlands drainage and Bethany Reservoir and its shoreline within 2,500 feet of the SBA Pumping Plant	Lake Del Valle and shoreline within 2,500 feet of the SBA intake near the dam at the north end of the reservoir	No areas within Zone B	No areas within Zone B
PCAs	Grazing, roads, road crossings; pond (Zones A and B), boating and fishing (Zone B).	Water contact and non-contact recreation; lakeshore recreation; grazing; road and trail crossings; wildlife (Zones A and B); residential and public development (Zone A)	Grazing; livestock concentrations; in-stream stock ponds; rural residential development; wildlife; roads and road crossings, trails	Grazing; livestock concentrations; in-stream stock ponds; rural residential development; roads and road crossings; mine tailings; feral pigs
PBE	Pond in Bethany Headlands drainage; seasonality of stream flow.	Volume of lake; lower levels of activity around water supply intake; seasonality of water withdrawal from the lake; seasonality of stream flow; seasonality of grazing; seasonality of recreational use.	Distance to lake, volume of lake, size of watershed, low density; seasonality of stream flow; seasonality of grazing.	Distance to lake, volume of lake, size of watershed, low gradient; seasonality of stream flow; seasonality of grazing.

Conservation Practices to Protect and Enhance Water Quality in the SBA Watershed

Based on the analysis presented in Chapters 3 and 4, the primary land uses that have the potential for introducing drinking water contaminants into the SBA system are rangeland management; roads and trails; rural residential development; and recreation. Chapter 5 provides guidance to interested land owners and managers engaged in these land uses for conservation strategies and specific practices that they may adopt voluntarily to protect and improve water quality. In addition to water quality benefits, these practices are designed to increase the sustainability and productivity of land uses.

Recommended strategies, practices, and information sources are presented for the following:

- Rangeland Management
- Conservation of Agricultural and Open Space Lands
- Roads and Trails
- Rural Residential Home Ownership and Development
- Recreation

Specific conservation practices recommended for the two watershed areas are discussed below.

Conservation Practices for Lake Del Valle Watershed

The Lake Del Valle watershed supports a variety of recreational uses, including water contact and non-water contact recreation, camping, hiking, picnicking, equestrian riding, and recreational vehicle riding (OHVs). As well, a large portion of the watershed is managed as rangeland. Since the Lake Del Valle watershed is about 33 times the size of the Bethany Reservoir Watershed, it is not possible to be as prescriptive at specific locations. Instead, this section describes conservation practices that could be incorporated into plans to protect water quality by reducing the likelihood of contamination to zones of highest risk.

1. Grazing Land Management
    a. Forage Management: Encourage private landowners and livestock operators to work with the Natural Resources Conservation Service (NRCS) and University of California Cooperative Extension (UCCE) to set target RDM levels or other appropriate management guidelines.
    b. Structural Range Improvements: Work with NRCS and UCCE to encourage private landowners and livestock operators to limit access to riparian and shoreline areas; to establish grassland buffers; fence riparian areas as appropriate; and to develop alternative drinking and feeding sites.
    c. Livestock Management: Encourage private landowners and livestock operators to develop a herd health program, and to schedule calving to occur during the dry season or to limit access by calves to the lake.
    d. Wildlife Control: Encourage lawful feral pig control as appropriate for the landowner and consider lawful control of large concentrations of rodents and other wildlife, as appropriate.

2. Road and Trail Design and Maintenance

    a. Work with NRCS, RCD and UCCE to provide assistance to private landowners to conduct inventories of their road systems, to develop road system plans, and to implement low-maintenance and low-impact design and maintenance practices.

3. Rural Residential – Encourage landowners to:

    a. consult County standards for design, installation, and abandonment of septic systems and wells.

    b. consider design principles to reduce erosion potential for any hillside construction and runoff management.

    c. properly manage debris, household chemicals and household hazardous wastes.

4. Recreation

    a. Install signs explaining the role that Lake Del Valle plays in drinking water delivery, and those activities that are appropriate and inappropriate in the watershed.

    b. Include discussion of the Lake Del Valle watershed as a drinking water source during talks given by Park Rangers.

    c. Include discussion of the Lake Del Valle watershed as a drinking water source in water quality-related training sessions for Del Valle park rangers and lifeguards.

    d. Limit access to the area of the lake in close proximity to the SBA intake structure.

Conservation Practices for Bethany Reservoir Watershed

Water quality in the Bethany Reservoir Watershed may be improved by a combination of conservation practices that include limiting cattle access to riparian zones, improving infrastructure to manage sediment loads (particularly yields from large events), and altering road drainage to reduce erosion and sediment delivery to the reservoir.

Due to the relatively small size of the Bethany watershed, it is feasible to recommend conservation practices that are location-specific. These practices would be subject to local permitting requirements:

1. Create capacity to store the estimated 100-year sediment load (Schaaf and Wheeler 2004) in watersheds (upstream of access-road crossing and downstream from access-road crossing to the concrete flume).

    a. Enlarge existing "basin-like sediment trap" upstream of access-road crossing above concrete intake chute, creating a 20 acre-feet capacity.

    b. Develop a smaller 0.9 acre-feet sediment basin between access-road and concrete flume.

2. Improve road drainage on DWR roads in the Forebay, including outsloping roads where feasible and redirecting roadside drainage to hillslopes and swales; disconnect ditches from the flume and from the reservoir.

3. Grazing Land Conservation Practices including
   a. Forage Management: work with NRCS and UCCE to set target RDM levels or other appropriate management guidelines.
   b. Structural Range Improvements: limit access to riparian and shoreline areas
   c. Land Treatments: adopt low-maintenance road practices.
   d. Livestock Management: develop a herd health program, including timing of calving, if one is not already in place.
4. Support DWR to Develop Grazing Lease Strategy based on AUMs[3] for DWR lands
5. Recreation Outreach
   a. Include discussion of Bethany Reservoir as a drinking water source and water quality protection in training sessions for State park rangers.
   b. Install signs explaining the role that Bethany Reservoir plays in drinking water delivery, and those activities that are appropriate and inappropriate in the watershed.

Plan Implementation

Chapter 6 presents a general plan for implementation of the SBA Watershed Protection Program. Included are an outline of an educational program; identification of funding sources and incentives for implementation of the conservation practices outlined in Chapter 5; and a framework for roles, responsibilities, and actions for plan implementation, as described below.

Implementation of the SBA Watershed Protection Program will require commitments from several agencies to implement different portions of the Program. The cooperation and assistance of various parties will be necessary for successful implementation of the program, including government agencies, organizations, and individual landowners. Implementation will include the following:

- Commitment of SBA Contractors for staff time and other resources for:
  - Watershed Protection Program Plan maintenance and revision;
  - Coordination of ongoing education and outreach programs, both those implemented in 2006 - 2007, and beyond; and
  - Coordination of an ongoing stakeholder group to guide implementation policies and priorities.
- Continued cooperation between agencies involved in water quality protection and improvement of land management practices, including the RCDs, NRCS, UC Cooperative Extension, Alameda County Agricultural Advisory Committee and the SBA Contractors. This may include joint funding (for example to support cost-share programs) or sponsorship of programs, workshops, and outreach programs;

[3] AUMs = Animal Unit Months. One AUM is the amount of forage required by one animal unit (defined as a 1,000 lb beef cow with or without a nursing calf) for one month.

- Ongoing cooperation and joint program development with agencies with a direct stake in the SBA and the SBA Watershed, including Department of Water Resources, Department of Parks and Recreation, East Bay Regional Parks District, and the SBA Contractors.
- Ongoing cooperation and joint program development with other agencies with an interest in water quality protection and watershed health, including the California Department of Health Services, county Environmental Health Services, Alameda County Planning Department.
- Participation in watershed groups, such as the Alameda Creek Watershed Steering Committee.
- Legislative advocacy when needed to ensure continuation, expansion and funding of the activities and partners described in this plan.
- Participation in County ordinance and general plan review and updating to ensure consistency with the needs of this plan.
- In consultation with the RCD, NRCS and UCCE, review current and future watershed management research and new technologies and its application to the objectives of this plan.

CHAPTER 2

Goals and Objectives of the Watershed Protection Program Plan

The initiative to develop a Watershed Protection Program Plan (WPPP) derives from the South Bay Aqueduct (SBA) Contractors' commitment to protect water quality in the SBA system, prevent its further degradation, and where feasible, improve its quality. Prior efforts to assess drinking water sources and conditions in the SBA watersheds[1], in coordination with the Department of Water Resources (DWR) and the California Department of Health Services (CDHS), culminated in a recommendation to develop a functioning Watershed Management Program for the SBA system in order to protect local water resources and water quality within the SBA system.

The South Bay Contractors recognize that most of the contaminant loading into the SBA system is derived from the Delta. This effort specifically focuses on the SBA watersheds for the following reasons:

- Other efforts are already underway to tackle much larger contaminant loading issues in the Delta. For example, a Sanitary Survey Update for the entire State Water Project (SWP), including the Delta, is scheduled for completion in 2007. The 2007 Sanitary Survey Update is intended to identify continuing major water quality issues in the SWP and to develop a plan of action for addressing them. There are also watershed management programs in place for the Sacramento and San Joaquin River watersheds, which are the major contributors to the Delta. The Municipal Water Quality Investigations Program branch of the Department of Water Resources is actively investigating the impacts of agricultural drainage and urban stormwater runoff on water quality in the Delta. There are many more such programs working on Delta water quality issues.

- The SBA Contractors and local stakeholders have some control and/or influence over the SBA watersheds and can therefore develop a feasible management strategy for these areas.

- By addressing water quality issues locally, the SBA Contractors strengthen their position to lobby for increased efforts to manage the water quality of water entering the SBA system from the Delta.

- A functioning Watershed Management Program for the SBA system will enable the SBA Contractors and other stakeholders to seek funding from federal and state agencies for further improvements to protect or enhance the system's water quality.

[1] Department of Water Resources 2001a, Archibald and Wallberg 2002a-d, 2005

- Finally, as responsible members of the community, we have an obligation to promote environmental stewardship through the implementation of good conservation practices in our local areas.

This WPPP was developed under the guidance of a stakeholder-based Watershed Workgroup as part of a Proposition 13 Non-point Source Pollution Control Grant-funded project. The group consisted of representatives of various agencies and groups interested in protecting water quality for various uses and educating the public about local water resources and watershed protection. The goals and objectives listed below were developed by the Watershed Workgroup as guiding principles for the WPPP.

Mission, Goals, and Project Objectives for the SBA Watershed Protection Program Plan

The plan's mission is as follows:

> To protect and enhance the quality of water from the SBA watershed as an important source for drinking water, while recognizing and respecting the agricultural, recreational, environmental, and other uses of these resources.

The goals of the SBA Watershed Protection Program Plan are as follows:

- Develop a stakeholder consensus-based plan to support a sustainable, multiple-use, working landscape within the Lake Del Valle and Bethany Reservoir watersheds;
- Identify partnerships and integrate with broader, ongoing stakeholder efforts in local watershed understanding, protection, and management; and
- Develop education and outreach in the local communities to raise awareness about the character, functions, and uses of water resources in the SBA watershed.

The specific objectives of the SBA Watershed Protection Program Plan are as follows:

- Identify and prioritize potential and known risks to drinking water quality within the SBA watershed, and develop a strategic approach to reducing risk;
- Document current beneficial activities and practices contributing to the protection of water quality within the SBA Watershed;
- Develop a set of voluntary conservation practices that could be followed by SBA watershed landowners and managers to support and supplement current practices that reduce risks to water quality;
- Identify and help reduce regulatory barriers to conservation and restoration;
- Develop and implement a program of outreach and education to encourage the use of recommended conservation practices and to provide greater understanding of the watershed;
- Outline a long-term strategy for strengthening partnerships with stakeholders to increase the effectiveness of watershed protection;

- Identify funding needs and potential sources of funding for implementing recommended programs.

References

Archibald and Wallberg Consultants. 2005. Assessment of Watershed Contaminant Sources for South Bay Aqueduct, Bethany Reservoir, Lake del Valle. Prepared for Alameda County Water District.

Archibald & Wallberg Consultants. 2002a. Drinking Water Source Assessment, Del Valle Water Treatment Plant Intake on South Bay Aqueduct. Prepared for Zone 7 Water Agency of the Alameda County Flood Control and Water Conservation District.

Archibald & Wallberg Consultants. 2002b. Drinking Water Source Assessment, Mission San Jose Water Treatment Plant and Water Treatment Plant No. 2 Intakes on South Bay Aqueduct. Prepared for Alameda County Water District.

Archibald & Wallberg Consultants. 2002c. Drinking Water Source Assessment, Patterson Pass Water Treatment Plant Intake on South Bay Aqueduct. Prepared for Zone 7 Water Agency of the Alameda County Flood Control and Water Conservation District.

Archibald & Wallberg Consultants. 2002d. Drinking Water Source Assessment, South Bay Aqueduct Terminal Tank. Prepared for Santa Clara Valley Water District.

California Department of Water Resources. 2001a. Sanitary Survey Update Report 2001. Volume 1. Prepared under the direction of the State Water Contractors.

CHAPTER 3
The SBA Watershed

Introduction and Background

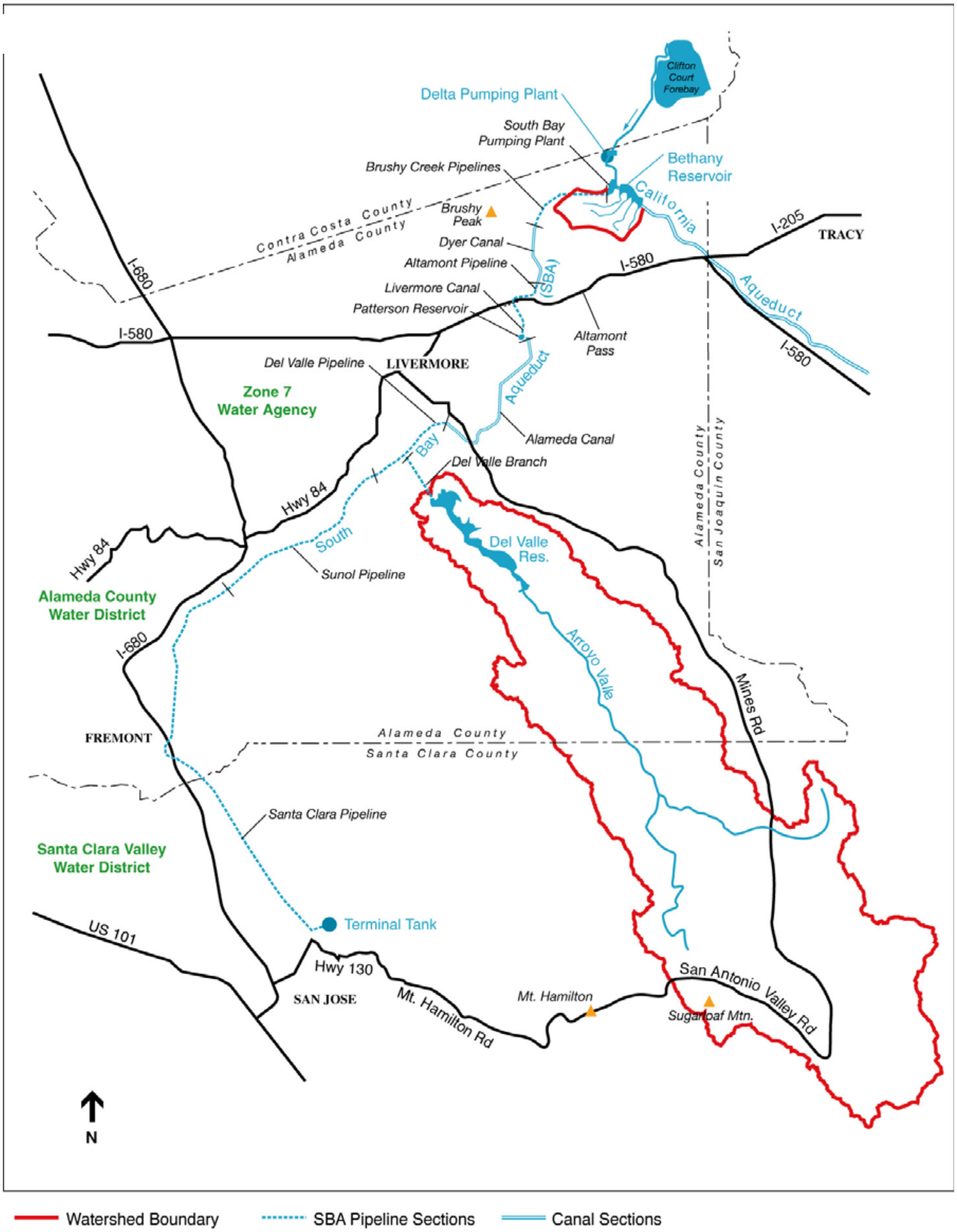
The SBA consists of a 44.7-mile conveyance system for untreated water that is part of the California State Water Project (SWP) (Figure 3-1). As owner and operator of the SBA, the California Department of Water Resources (DWR) maintains long-term water supply contracts with three water districts: Zone 7 Water Agency of the Alameda County Water Conservation and Flood Control District (Zone 7), Alameda County Water District (ACWD), and the Santa Clara Valley Water District (SCVWD). Through these agencies and their retailers, the SBA provides drinking water to over two million people in Alameda and Santa Clara Counties, including the cities of Livermore, Pleasanton, Dublin, Fremont, Newark, Union City, Milpitas, Santa Clara, San Jose and nine other communities in Santa Clara County.

The majority of SBA water originates from the Sacramento-San Joaquin Delta. The remainder is derived from local watersheds, primarily the Lake Del Valle watershed. SWP water is pumped from the Delta at the Harvey O. Banks Pumping Plant near Byron, and flows a short distance down the California Aqueduct to Bethany Reservoir. Bethany Reservoir is essentially a wide spot on the California Aqueduct, with more or less constant north to south flow through the reservoir. Most SWP water continues south, but a portion is pumped into the SBA at the South Bay Pumping Plant on Bethany Reservoir.

In its entirety, the SBA consists of 10.8 miles of canal, 32.1 miles of pipeline, and 1.8 miles of tunnel, as well as pumping plants and reservoirs. Flow regulation and storage are provided by Lake Del Valle and the Del Valle Pumping Plant. Water can be pumped into Lake Del Valle and Lake Del Valle water can be released into the SBA via a 60-inch common inlet/outlet. The SBA ends in east San Jose at the Santa Clara Terminal Tank, an above-ground tank at the SCVWD Penitencia Water Treatment Plant (PWTP). From Bethany Reservoir to the Santa Clara Terminal Tank, the following pumping facilities, pipelines and canals comprise the SBA:

- Brushy Creek Pipelines
- Dyer Canal
- Altamont Pipeline
- Livermore Canal
- Alameda Canal
- Del Valle Branch Pipeline (to Del Valle Reservoir)
- Sunol Pipeline
- Santa Clara Pipeline
- La Costa Tunnel
- Mission Tunnel

Water leaving the SBA is either treated at water treatment plants and delivered to customers, or can be used for groundwater recharge to replenish local groundwater supplies for future use.



SBA Watershed Management Program Development Watershed Protection Program Plan . 205076

SOURCE: ESA

Figure 3-1
The SBA System

Sanitary Surveys and Watershed Assessments Completed

A sanitary survey conducted by DWR (2001a) and subsequent drinking water source assessments (DWSAs) (Archibald and Wallberg 2002a-d, 2005) identified the Delta as the primary source of contaminants to the SBA; however, there are potential contaminant sources between the Delta and the water treatment plant intakes along the SBA. These include stormwater runoff into open canal sections of the SBA, and stormwater runoff into, as well as recreational use of, Bethany Reservoir and Lake Del Valle.

The 2005 DWSA report (Archibald and Wallberg, 2005) recommended that the SBA Contractors conduct stormwater monitoring to assess the significance of stormwater as a contaminant source, assess effectiveness of management practices currently in place, and determine status and trends of water quality constituents. ACWD was awarded a Proposition 13 Watershed Protection Grant by the State Water Resources Control Board (SWRCB) to develop a Watershed Management Program for the SBA system, that included development of a long-term strategy to improve water quality by reducing the input of pollutants into the system and sampling for water quality constituents identified as likely contaminants (DWR 2001a, Archibald and Wallberg 2002a-d, 2005).

SBA Improvement/Enlargement Project

In 1998, Zone 7 re-evaluated water supply needs within the Zone 7 service area. A Water Conveyance Study (CDM, 2001) identified a conveyance capacity need of an additional 130 cubic feet per second (cfs) to meet peak monthly demands within the Zone 7 service area at build-out under the approved General Plans within its service area. DWR completed a feasibility study on enlarging and improving the SBA (DWR, 2003). The Improvement and Enlargement Project is scheduled for completion in 2009; although the enlargement portions of the project are being undertaken by Zone 7, SCVWD and ACWD are actively involved in the improvement portions of the project.

In addition to restoring original design capacity and increasing the current system's capacity to 300 cfs, the Improvement and Enlargement Project will address some water quality concerns by removing all existing major drainage to the SBA's open canal sections, replacing existing farm bridges that cross the canals and may act as conduits for sources of contamination, grading the canal right-of-ways away from the canals, and removing 2,000 to 3,000 cubic yards of sediment in the Bethany intake channel just upstream of the South Bay Pumping Plant in 2008 and 2009. Since the SBA Improvement and Enlargement Project will mitigate local sources of potential water quality contamination to the open canal sections of the SBA by 2009, the Watershed Protection Program Plan (WPPP) is not addressing this section of the SBA and instead is focused on contributions from Bethany Reservoir, Lake Del Valle, and their drainage areas.

Overview of the SBA Watershed

Historic Land Uses

Prior to the arrival of people of European descent, the Livermore-Amador Valley region was inhabited by Ohlone Indians. Arrowheads and grinding stones were recovered at Lake Del Valle, revealing the existence of Ohlone settlements (Wood 1883). Residents have found arrowheads and other Native American artifacts in the San Antonio Valley, in the upper Lake Del Valle watershed; some of these are on display at the Junction Coffee Shop in the San Antonio Valley. Native Americans who lived in the Bethany Reservoir area were probably Northern Valley Yokuts. Because the reservoir area is on higher ground outside the Delta and lacks trees, Native Americans apparently spent little time there. Artifacts found during construction of Bethany Reservoir include an obsidian knife, a chert core tool, and the remains of a human skeleton found near the South Bay Pumping Plant (DWR 2001b).

Following Mexico's secularization of the California Missions in 1834, large tracts of land in the area, which had been part of Mission San Jose, were granted to prominent Mexican citizens. The Ranchos focused primarily on raising free-roaming stock and subsistence farming, though there were early forays into viticulture and horticulture. Lake Del Valle occupies part of the former 64,000 acre Rancho El Valle de San Jose, which the Mexican government granted to the families of Agustin Bernal and Antonio Sunol. The Ranchos were dismembered after California became a State.

In the latter half of the 19th Century, the Livermore-Amador Valley and the Altamont Pass area developed with more diverse urban and agricultural land uses. With the boom in wheat farming in the Central Valley and the construction of the Central Pacific Railroad, the population in the region grew rapidly. Vineyards and lumber yards also developed during this time. The Tesla Coal mine opened in 1890 and was the largest producer of coal in California from 1897 to 1905, when production ceased and mining activity turned to sand and clay. Around the same time, the Westvaco magnesite mine was developed on Mines Road in the San Antonio Valley.

Physical Attributes

The Lake Del Valle watershed encompasses 146 square miles, and ranges in elevation from 700 feet to over 4,000 feet. Arroyo Valle (sometimes called Arroyo Del Valle) is the principal stream of the watershed. Lake Del Valle was formed by impounding Arroyo Valle behind the earthen Del Valle Dam, which was completed in 1968 and remains the only flood control reservoir in the Livermore Valley. The Lake Del Valle watershed extends southward from the lake to the San Antonio and Upper San Antonio valleys, east of Mt. Hamilton. With the exception of these valleys and some flat lands along the lower course of Arroyo Valle, the watershed is characterized by rugged, heavily vegetated hills and steep canyons drained by a dense network of small streams.

A large portion of the watershed has relatively steep slopes (Figure 3-2, Table 3-1). The soils in the area are generally shallow, ranging from 6 – 42 inches. The combination of shallow soils and steep slopes has contributed to the high erosion potential of the Lake Del Valle watershed and its

SOURCES: Topography: National Elevation Dataset, USGS, 2005
Slopes: Derived from topography by Environmental Science Associates, 2005, using ESRI 3D Analyst software
Hydrography: California Spatial Information Library, 2005

Figure 3-2
Slopes and Major Streams

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TABLE 3-1
CHARACTERIZATION OF SLOPES, EROSION, AND LANDSLIDE HAZARDS IN THE BETHANY RESERVOIR AND LAKE DEL VALLE WATERSHEDS

Watershed Attribute	Bethany Reservoir Watershed[a]	Lake Del Valle Watershed[a]
Size (square miles)	4.4 sq mi	146 sq mi
Slopes 0%–40%	95	61
Slopes 40%–60%	4	31
Slopes > 60%	1	8
Off-road/Off-trail Erosion Hazard – Very Severe	4	77
Off-road/Off-trail Erosion Hazard – Severe	9	10
Off-road/Off-trail Erosion Hazard – Moderate	77	8
Erosion Hazard for Roads/Trails – Severe	6	> 98
Erosion Hazard for Roads/Trails – Moderate	90	0
Erosion Hazard for Roads/Trails – Slight	3	< 1
Landslides – Mostly	11	57
Landslides – Few	81	40

NOTES:

- Off-road/Off-trail Erosion Hazard Very Severe – Significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.
- Off-road/Off-trail Erosion Hazard Severe – Erosion is very likely and erosion-control measures, including revegetation of bare areas, are advised.
- Road/Trail Erosion Hazard Severe – Significant erosion is expected; roads or trails require frequent maintenance, and costly erosion-control measures are likely needed.
- Road/Trail Erosion Hazard Moderate – Some erosion is likely; roads or trails may require occasional maintenance, and only simple erosion-control measures are likely needed.
- Road/Trail Erosion Hazard Slight – Little or no erosion is likely.
- Mostly Landslide - consists of mapped landslides, intervening areas typically narrower than 1500 feet, and narrow borders around landslides; defined by drawing envelopes around groups of mapped landslides.
- Many Landslides – consists of mapped landslides and more extensive intervening areas than in 'Mostly Landslide'; defined by excluding areas free of mapped landslides; outer boundaries are quadrangle and county limits to the areas in which this unit was defined.
- Few Landslides – contains few, if any, large mapped landslides, but locally contains scattered small landslides and questionably identified larger landslides; defined in most of the region by excluding groups of mapped landslides but defined directly in areas containing the 'Many Landslides' unit by drawing envelopes around areas free of mapped landslides.

[a] All figures are percent of watershed area, unless otherwise indicated.

SOURCE: *Natural Resources Conservation Service 2001 Digital Soil Survey*.

proclivity for landslides (Figure 3-3, Table 3-1). The potential for erosion from roads and trails throughout most of the watershed is considered to be very severe (Figure 3-4, Table 3-1).

At 4.4 square miles, the Bethany Reservoir watershed is about 1/33 the size of the Lake Del Valle watershed (Figure 3-2, Table 3-1). The Bethany Reservoir watershed includes the lands east of Altamont Pass that drain through several intermittent streams into the west shore of Bethany Reservoir. The watershed ranges from approximately 240 to 1,145 feet in elevation. The land consists of grass-covered hills bisected by alluvial valleys. Cattle grazing and windmills are the principal land uses. The gentler terrain in this watershed results in a much lower erosion potential and many fewer landslides in comparison with the Lake Del Valle watershed (Figure 3-3,

Figure 3-4**,** Table 3-1,). This is true of the Bethany Headlands drainage, which empties into the forebay where the SBA Pumping Plant is located. The other small drainages in the watershed enter Bethany Reservoir downstream of the SBA pumping plant and are assumed to have little, if any, influence on SBA water quality.

Bedrock

Located within the Diablo Range, the Lake Del Valle watershed includes several bedrock types (Figure 3-5). The dam and most of the Lake are on the Upper Cretaceous Panoche Formation of the Great Valley Geomorphic Province (DWR 2001a). The upper watershed consists of the Franciscan Formation that includes Graywacke sandstone, minor clay shale, and chert interbeds with some metamorphic rocks (DWR 2001a; USGS, 1995). The Bethany Reservoir watershed is underlain by sandstone, mudstone, and shale units of the Panoche formation (Figure 3-5).

Soils

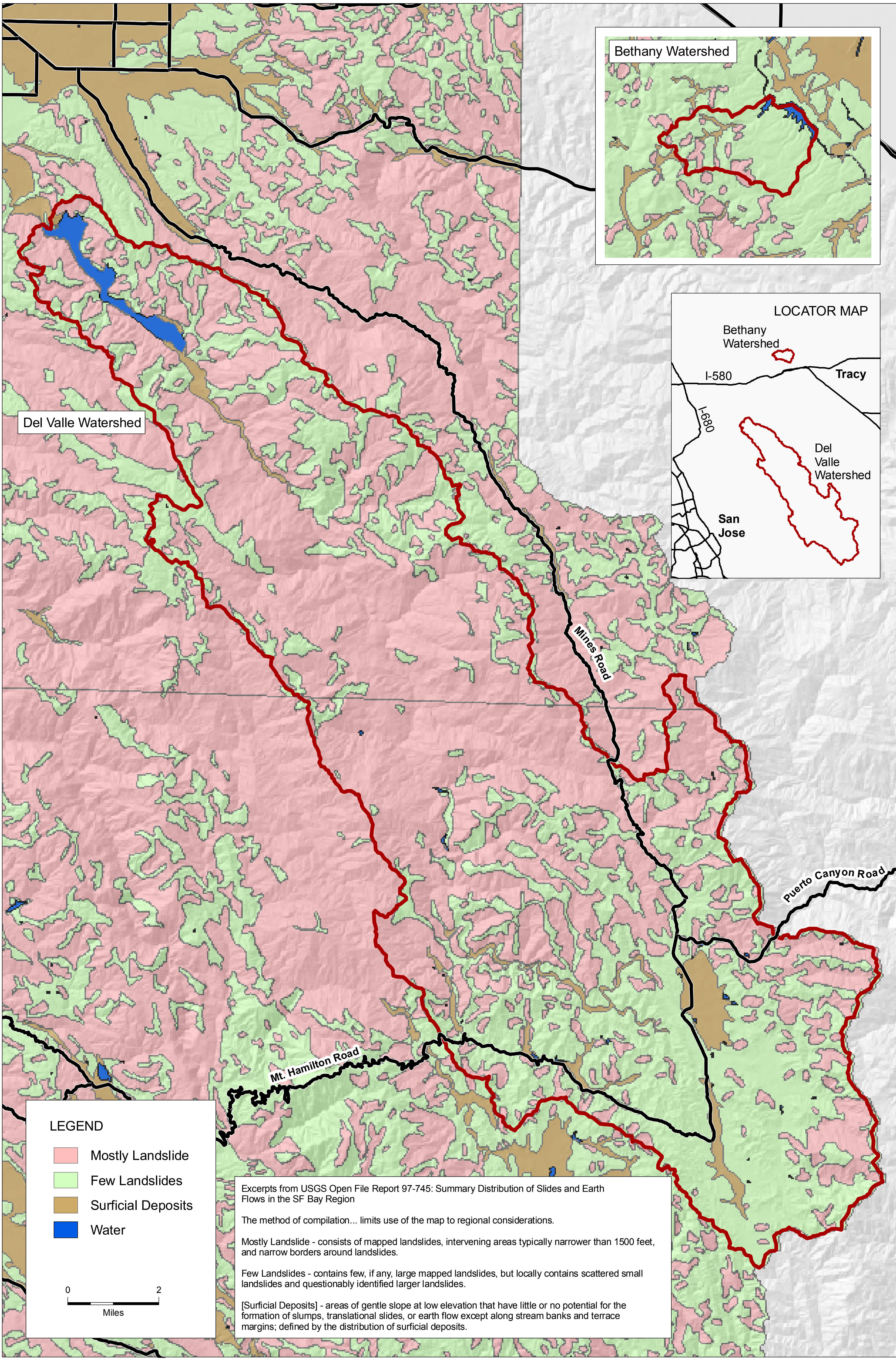
Upland soils occupy most of the Lake Del Valle watershed, and primarily consist of Gaviota, Vallecitos, Parrish, Shedd, and Henneke series (DWR 2001a). Valley soils, occurring in the upper portion of the Arroyo Valle drainage basin, including the San Antonio Valley and Upper San Antonio Valley, consist of various types of alluvium, including Yolo, Hillgate, Garretson, San Ysidro, Cortina, Zamora, Clear Lake, and Positas series (DWR 2001a). The Bethany Reservoir watershed is composed primarily of the Altamont clay soil series, a relatively deep soil with high shrink-swell potential, with San Ysidro loam occurring in the valley bottoms and alluvial fan deposits (USDA, 1966).

Faults

The Livermore fault crosses the SBA near mile marker 18, runs within 800 feet of the Del Valle Dam, and along the eastern edge of the Lake. Several other active faults exist in the SBA and Lake Del Valle areas: the Greenville fault is six miles east of Lake Del Valle; the Calaveras fault is eight miles west of Lake Del Valle; the Hayward fault is 20 miles west of Lake Del Valle; and the San Andreas Fault is 55 miles west of Lake Del Valle (DWR 2001a).

Hydrology

Most precipitation in the SBA watershed areas occurs as rainfall during the fall and winter months, as is typical of the Central California Coast Ranges. In the Lake Del Valle watershed, annual rainfall varies primarily as a function of altitude, with average annual precipitation ranging from around 16 inches per year to 36 inches per year on the peaks (DWR, 1974). An isohyetal map of annual rainfall in the watershed is shown in Appendix B. The Bethany Reservoir watershed lands receive on average 12-13 inches of precipitation per year (CDF, 2000). Estimates for the 24-hour rainfall event at different recurrence frequencies is shown for several rain gauging stations in the area in Table 3-2.



SOURCES: Topography: National Elevation Dataset, USGS, 2005
Landslide Data: USGS Open File Report 97-745, 1997

Figure 3-3
Landslides

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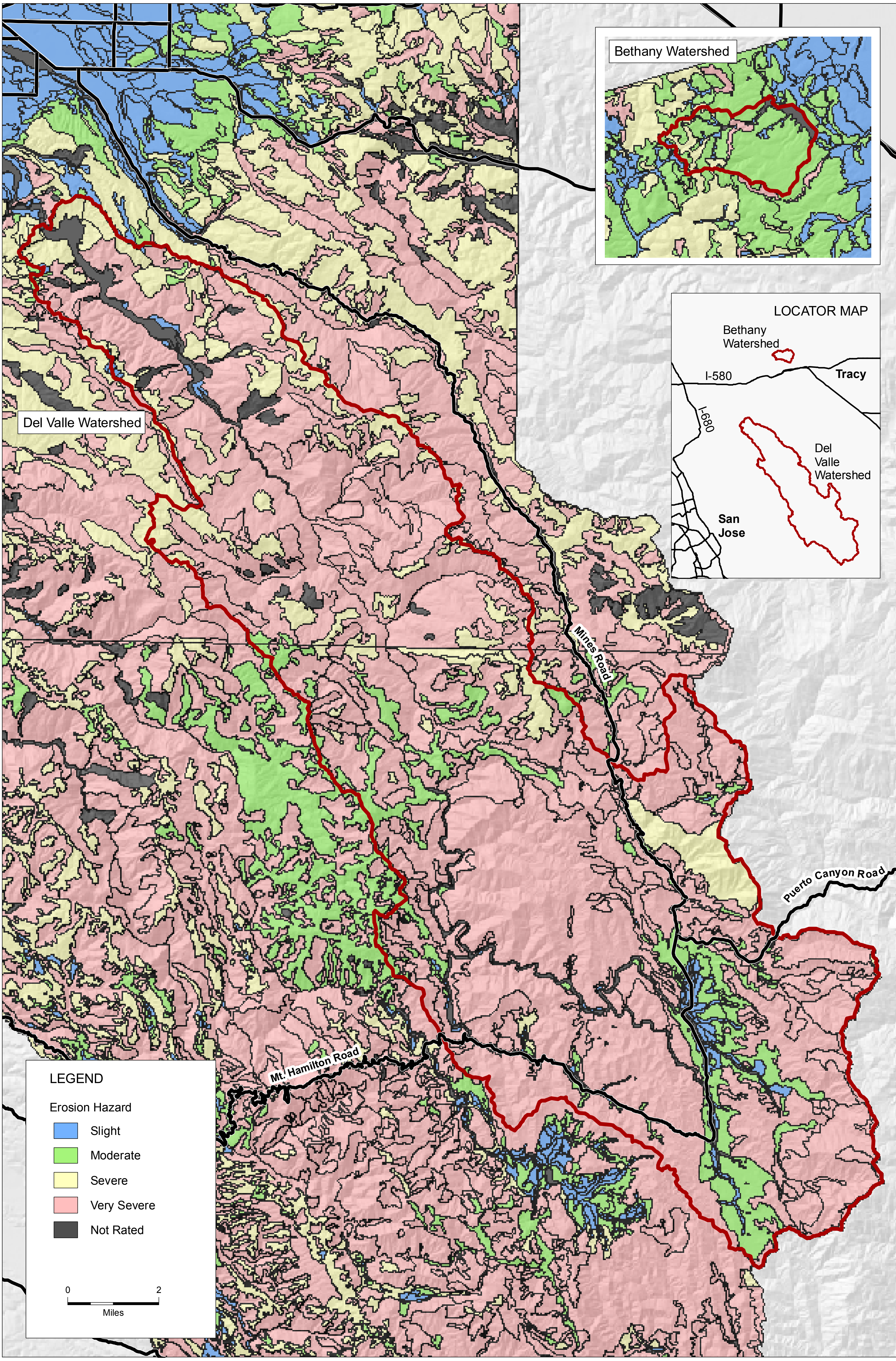

SOURCES: Topography: National Elevation Dataset, USGS, 2005
Erosion Potential: SSURGO Soils Reports Database, USDA Natural Resources Conservation Service, 2005

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Figure 3-4
Off-Road Erosion Potential

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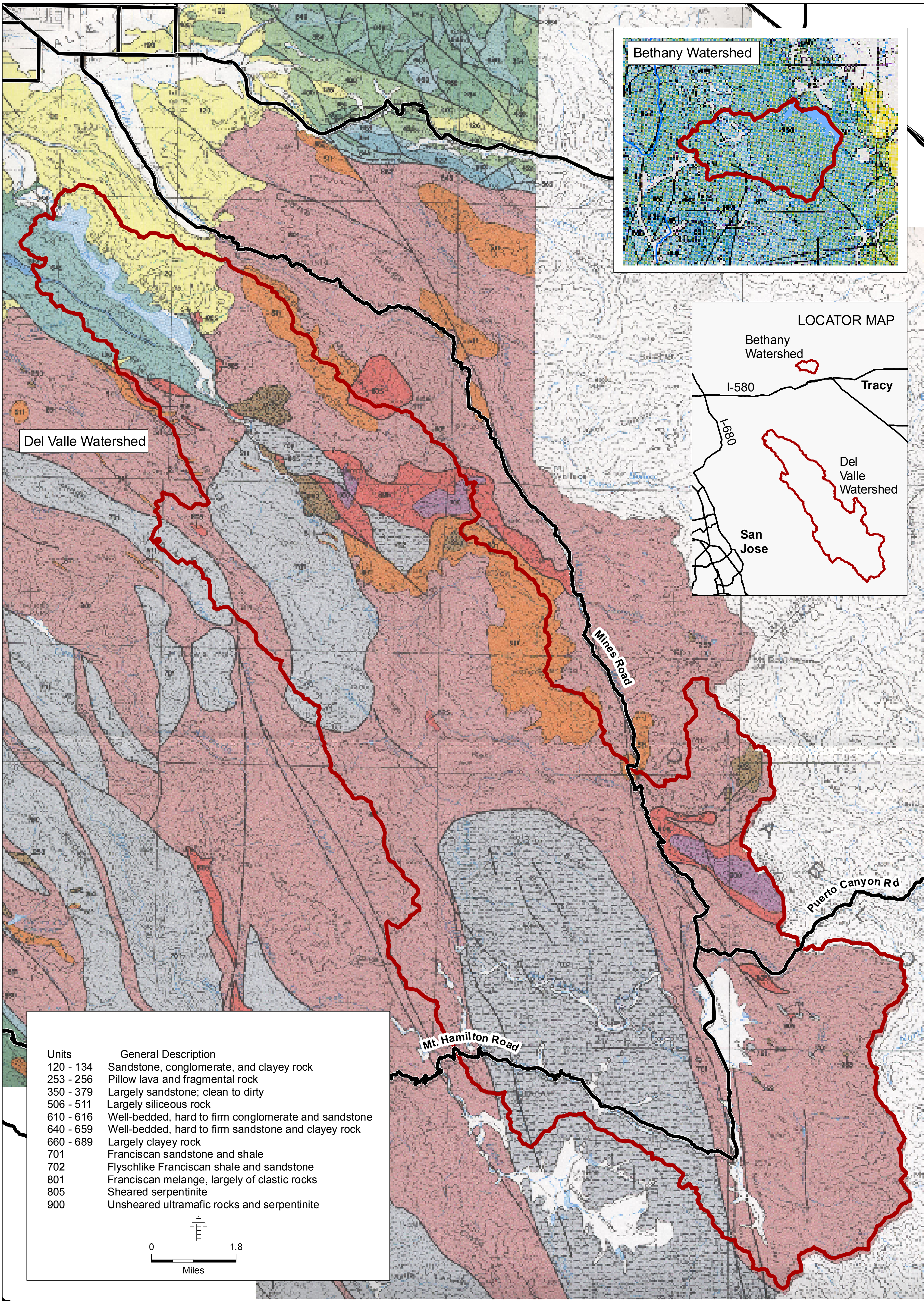

SOURCES: Rock Types: USGS Professional Paper 1357, 1995

Figure 3-5
Geology

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TABLE 3-2
REGIONAL RAINFALL FREQUENCY ESTIMATES

Station	Years of Record	24 hour Rainfall (inches)					
		2-year	5-year	10-year	25-year	50-year	100-year
Altamont	44	1.19	1.67	1.99	2.39	2.69	2.98
Arroyo Mocho	42	1.55	2.17	2.60	3.12	3.51	3.89
Livermore	107	1.32	1.86	2.22	2.67	3.00	3.32
Mt. Hamilton	116	2.05	2.88	3.43	4.13	4.64	5.14

SOURCE: Goodridge, 2005

Lake Del Valle is fed by two sources of inflows – SWP water from the SBA, and natural inflows from the watershed (Figure 3-6). SWP water can be pumped into the reservoir prior to the summer months as needed to maintain a supply adequate for recreational uses and water supply. During the fall, water is released from the reservoir into the SBA to provide flood control capacity; this water is then used by water treatment plants. Within its 146-mile drainage, Arroyo Valle has several major tributaries, including Trout Creek, Sycamore Creek, Colorado Creek, Sweetwater Creek, and San Antonio Creek (Figure 3-2). Colorado and Sweetwater Creeks drain portions of the watershed known to contain high hardness and alkalinity levels (DWR 2001a). Streams in this area tend to be "flashy;" that is, they have little base flow and most of their annual discharge occurs during and immediately following major storm events. The US Geological Survey (USGS) maintains a stream gauge on Arroyo Valle just above Lake Del Valle (Station 11176400 Arroyo Valle below Lang Canyon near Livermore, CA) with a continuous gauging record extending back to October, 1963. The highest recorded flow at this gauge was 8,790 cubic feet per second, recorded on February 17, 1986. The greatest annual discharge recorded at the gauge (calculated from mean daily discharge) was 128,142 acre feet in 1983. The lowest annual discharge was 224 acre feet in 1977. Table 3-3 shows the estimated peak flow for several flood frequencies for the Arroyo Valle below Lang Canyon gauge, and for another gauge located below the dam, which is no longer in operation. Figure 3-6a shows the daily flow duration curve for the Arroyo Valle below Lang Canyon gauge, and indicates that mean daily flow is zero about 37% of the time, and exceeds 100 cubic feet per second (cfs) only about 5% of the time. The "S" curve shown in this figure is typical of ephemeral streams.

Figures 3-6b and 3-6c show the hydrographs for the Arroyo Valle below Lang Canyon gauge in water years 1999 and 2000[1] plotted against accumulated rainfall at the Livermore rain gauge. These figures show several peaks in mean daily flow occurring in the winter and spring of each year, with a wet-season base flow between runoff events. Several inches of rain occurred in each year prior to the onset of significant discharge. Flow diminishes through the spring and ceases in June or July. Figure 3-6d shows the compiled mean and median daily flow values for this gauge

1 The water year begins October 1 and ends September 30. Water year 1999 began October 1, 1998 and ended September 30, 1999

TABLE 3-3
ARROYO VALLE FLOOD FREQUENCY ESTIMATES

USGS Gauge	Drainage Area (sq. miles)	Peak Flow (cfs)					
		2-year	5-year	10-year	25-year	50-year	100-year
Arroyo Valle near Livermore (11176500)	147	980	4,550	9,240	18,400	27,600	38,900
Arroyo Valle below Lang Canyon (11176400) [a]	130	867	4,024	8,171	16,272	24,408	34,401

[a] Prorated (using relative drainage area) from the estimates for 11176500. Hunrichs et al. (1998) estimated the peak flow of 3,010 cfs recorded at this gauge during the January 1997 storm to have a recurrence interval of 4 years.

SOURCE: Waananen and Crippen, 1977

for the 40-year period of record, and indicates that, typically, water flows in Arroyo Valle beginning in November, peaking in February, and ending in June or July.

The USGS conducted suspended sediment sampling at the Arroyo Valle below Lang Canyon gauge during the 1970s. The sampling results are shown in Table 3-4, and graphed in Figures 3.6e and 3.6f. Figure 3.6e plots both the rating curve for the gauge, showing the relationship between stage (water level elevation) and discharge, and the instantaneous suspended sediment levels, plotted against the discharge at the time of sampling. The figure shows the general relationship between stage, discharge, and the amount of suspended sediment carried by the stream. Figure 3.6f also plots the suspended sediment levels against discharge, and adds a linear trend line. The R^2 for the line is 0.6636, indicating a good statistical relationship between discharge and suspended sediment levels; in other words, the amount of suspended sediment carried by Arroyo Valle can be reasonably well predicted based on discharge.

The peak discharge rate for the small drainages in the Bethany Reservoir watershed was calculated at 834 cfs for the 100-year event, and 62 cfs for the 2-year event (Schaaf & Wheeler, 2004). The Bethany Headlands drainage, which empties into the forebay by the South Bay Pumping Plant, is estimated to account for about half of the total discharge (ibid). Zone 7 placed a gauge at the mouth of the Bethany Headlands drainage during the 2004-2005 wet season, but did not record any discharge.

Biological Attributes

Vegetation

Within the Lake Del Valle watershed, common vegetation communities include Northern Mixed Chaparral, Blue Oak and Coast Live Oak, Annual Grasslands, Mixed Hardwoods, and Chamise. Gray Pine is also found, as are patches of Valley Oak and Mixed Riparian Hardwoods in the valleys and along stream channels (Figure 3-7). Blue Oak communities are typically found on south-facing slopes, with Coast Live Oak series on north-facing slopes. Vegetation in the Bethany Reservoir watershed is largely Annual Grasslands, with some freshwater wetland species along drainages.

SOURCES: Topography: National Elevation Dataset, USGS, 2005
Hydrography: California Spatial Information Library, 2005

Figure 3-6
Streams and Waterways

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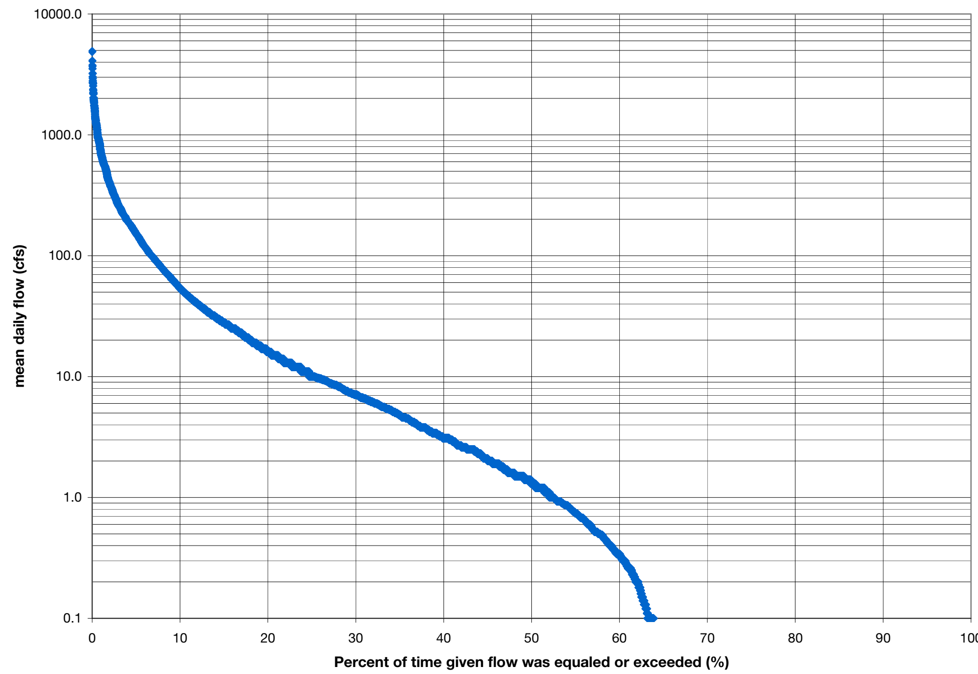
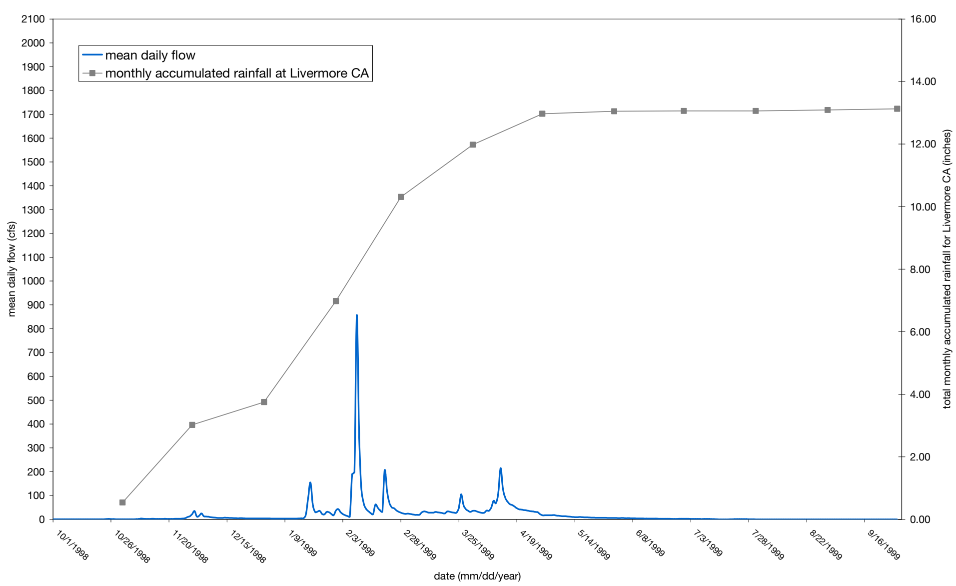


SBA Watershed Management Program Development Watershed Protection Program Plan . 205076

SOURCE: ESA

Figure 3-6a

Arroyo Valle (USGS 11176400) Daily Flow Duration Curve, Water Years 1964–2004

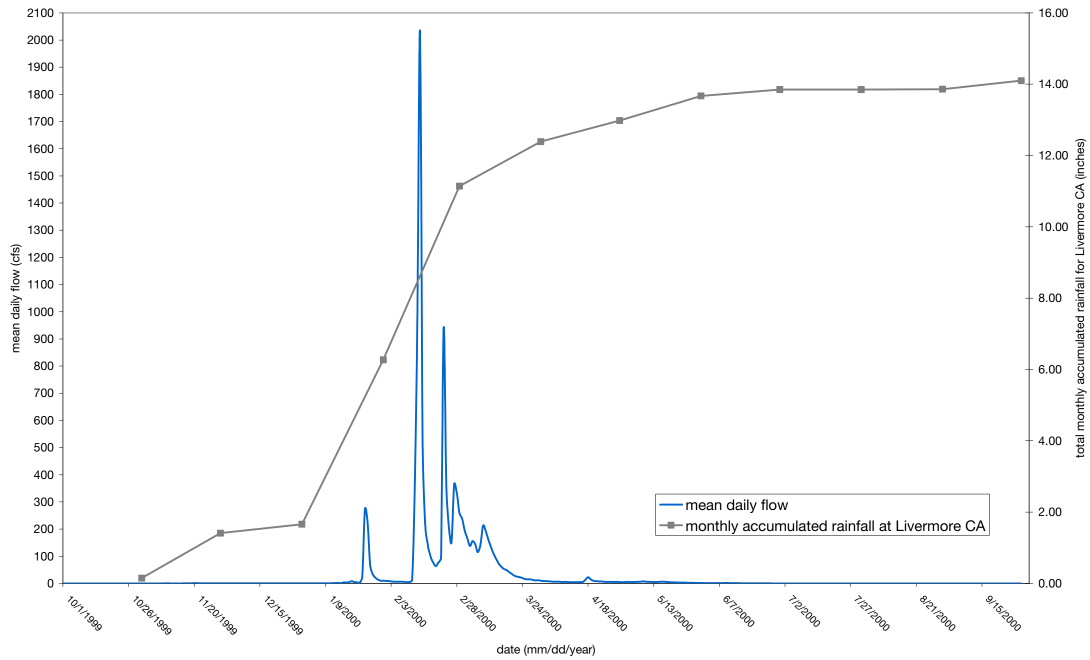


SBA Watershed Management Program Development Watershed Protection Program Plan . 205076

SOURCE: ESA

Figure 3-6b

Arroyo Valle (USGS 11176400) Mean Daily Flow Hydrograph and Monthly Accumulated Rainfall, Water Year 1999

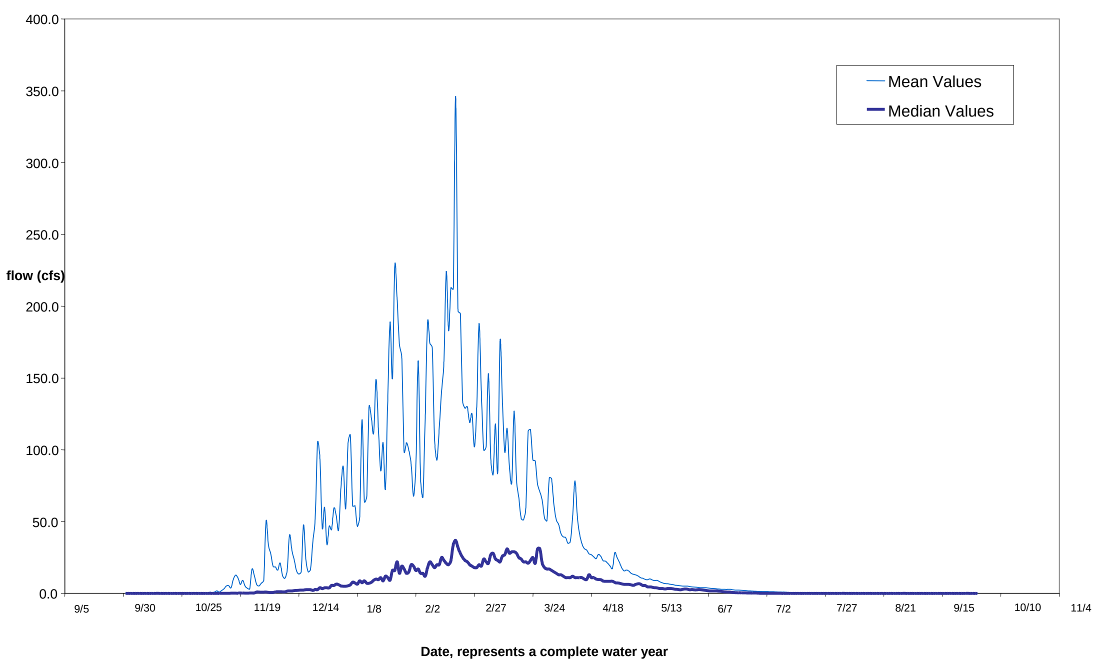


SBA Watershed Management Program Development Watershed Protection Program Plan . 205076

SOURCE: ESA

Figure 3-6c

Arroyo Valle (USGS 11176400) Mean Daily Flow Hydrograph and Monthly Accumulated Rainfall, Water Year 2000



SBA Watershed Management Program Development Watershed Protection Program Plan . 205076

SOURCE: ESA

Figure 3-6d

Arroyo Valle (USGS 11176400) Mean Daily Flow Hydrographs for Period of Record, Water Years 1964–2004

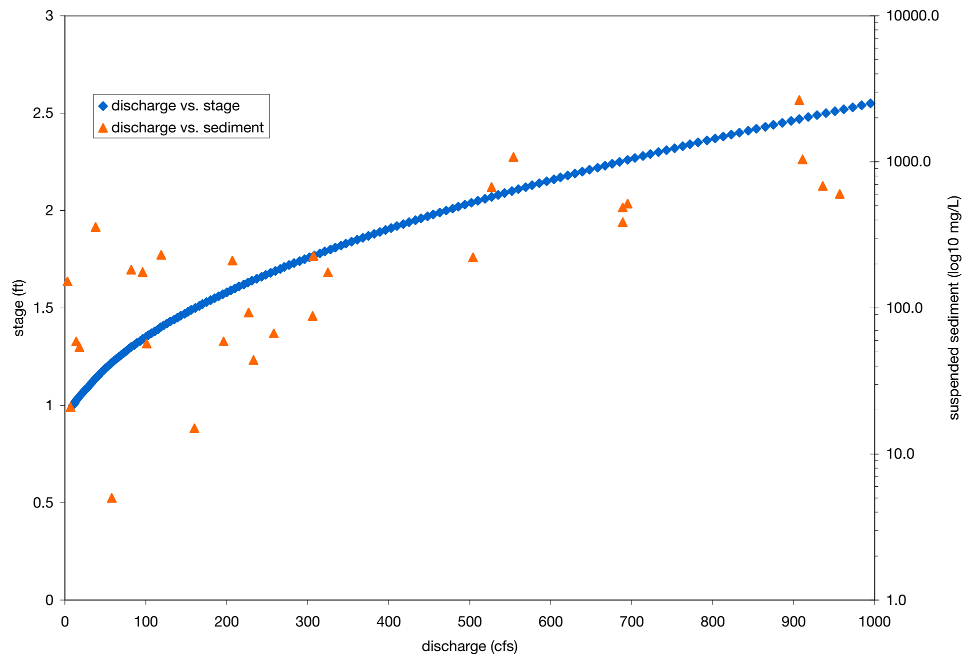
TABLE 3-4
USGS SUSPENDED SEDIMENT SAMPLING ON ARROYO VALLE BELOW LANG CANYON

Station ID		Date	Time	Suspended Sediment (mg/L)	Instant. Discharge (cfs)
USGS	11176400	11/6/1973	13:40	358.0	38.0
USGS	11176400	12/1/1973	12:15	1040.0	911.0
USGS	11176400	12/1/1973	16:10	488.0	689.0
USGS	11176400	12/22/1973	10:15	57.0	101.0
USGS	11176400	1/12/1974	15:45	44.0	233.0
USGS	11176400	3/1/1974	15:10	176.0	96.0
USGS	11176400	3/2/1974	17:15	222.0	504.0
USGS	11176400	3/5/1974	17:15	15.0	160.0
USGS	11176400	3/11/1974	17:15	5.0	58.0
USGS	11176400	3/28/1974	17:05	175.0	325.0
USGS	11176400	4/1/1974	17:00	2650.0	907.0
USGS	11176400	4/3/1974	17:20	67.0	258.0
USGS	11176400	12/3/1974	12:10	54.0	18.0
USGS	11176400	12/27/1974	16:50	152.0	3.2
USGS	11176400	1/7/1975	12:55	59.0	14.0
USGS	11176400	2/1/1975	17:25	93.0	227.0
USGS	11176400	2/4/1975	8:55	227.0	307.0
USGS	11176400	2/7/1975	13:50	231.0	119.0
USGS	11176400	2/13/1975	16:30	518.0	695.0
USGS	11176400	3/7/1975	17:30	1950.0	1310.0
USGS	11176400	3/7/1975	13:00	672.0	527.0
USGS	11176400	3/22/1975	17:00	386.0	689.0
USGS	11176400	3/2/1976	13:55	21.0	7.0
USGS	11176400	1/10/1978	10:00	59.0	196.0
USGS	11176400	1/14/1978	15:05	603.0	957.0
USGS	11176400	1/17/1978	17:00	684.0	936.0
USGS	11176400	2/7/1978	13:30	1080.0	554.0
USGS	11176400	3/7/1978	14:15	88.0	306.0
USGS	11176400	1/11/1979	15:20	183.0	82.0
USGS	11176400	2/14/1979	15:00	211.0	207.0
USGS	11176400	2/21/1979	15:30	783.0	946.0
USGS	11176400	2/21/1979	14:00	664.0	874.0

Wildlife

Due to its large size and natural state, the Lake Del Valle watershed supports a relatively large assemblage of animal species. The most commonly found mammalian and avian species include blacktailed deer, feral goats, wild pigs, rabbits, hares, raccoons, ground squirrels, quail, doves, woodpeckers, swallows, jays, wrens, warblers, blackbirds, and finches (DWR 2001a). Also found are blue herons, weasels, skunks, opossums, gray fox, coyotes, badgers, bobcats, and mountain lions (DWR 2001a).

Prior to the construction of the Del Valle Dam in 1968, steelhead had access to the upper reaches of Arroyo Valle, at least in some years when stream flow conditions were favorable (Leidy et al. 2005). Only one tributary in the Lake Del Valle watershed, Colorado Creek, has been identified

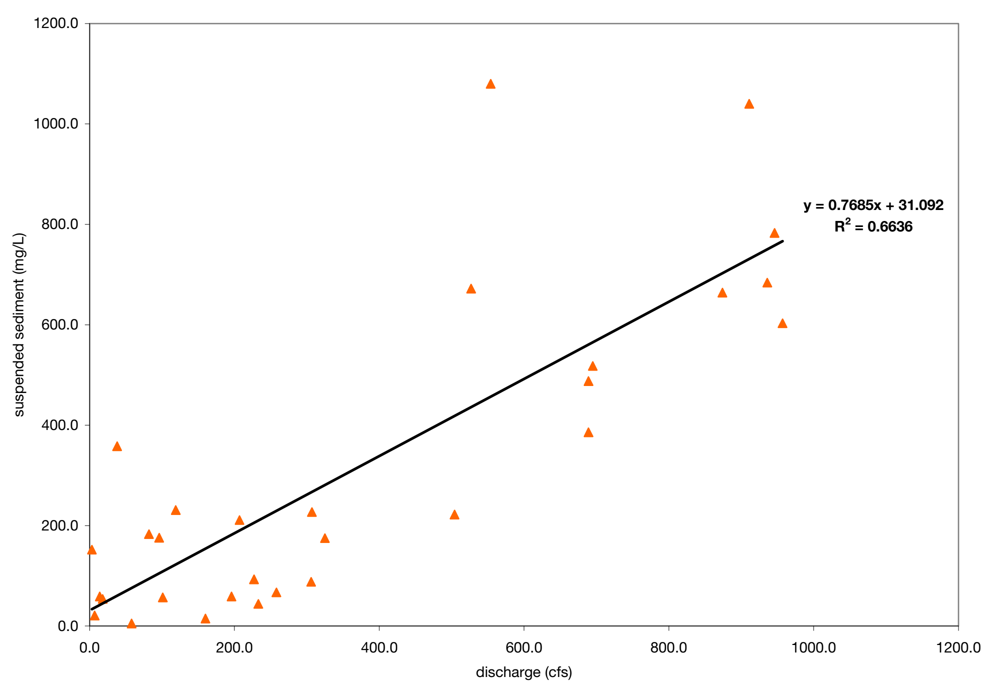


SBA Watershed Management Program Development Watershed Protection Program Plan . 205076

SOURCE: ESA

Figure 3-6e

Rating Curve and Suspended Sediment Samples at USGS 11176400, Arroyo Valle below Lang Canyon

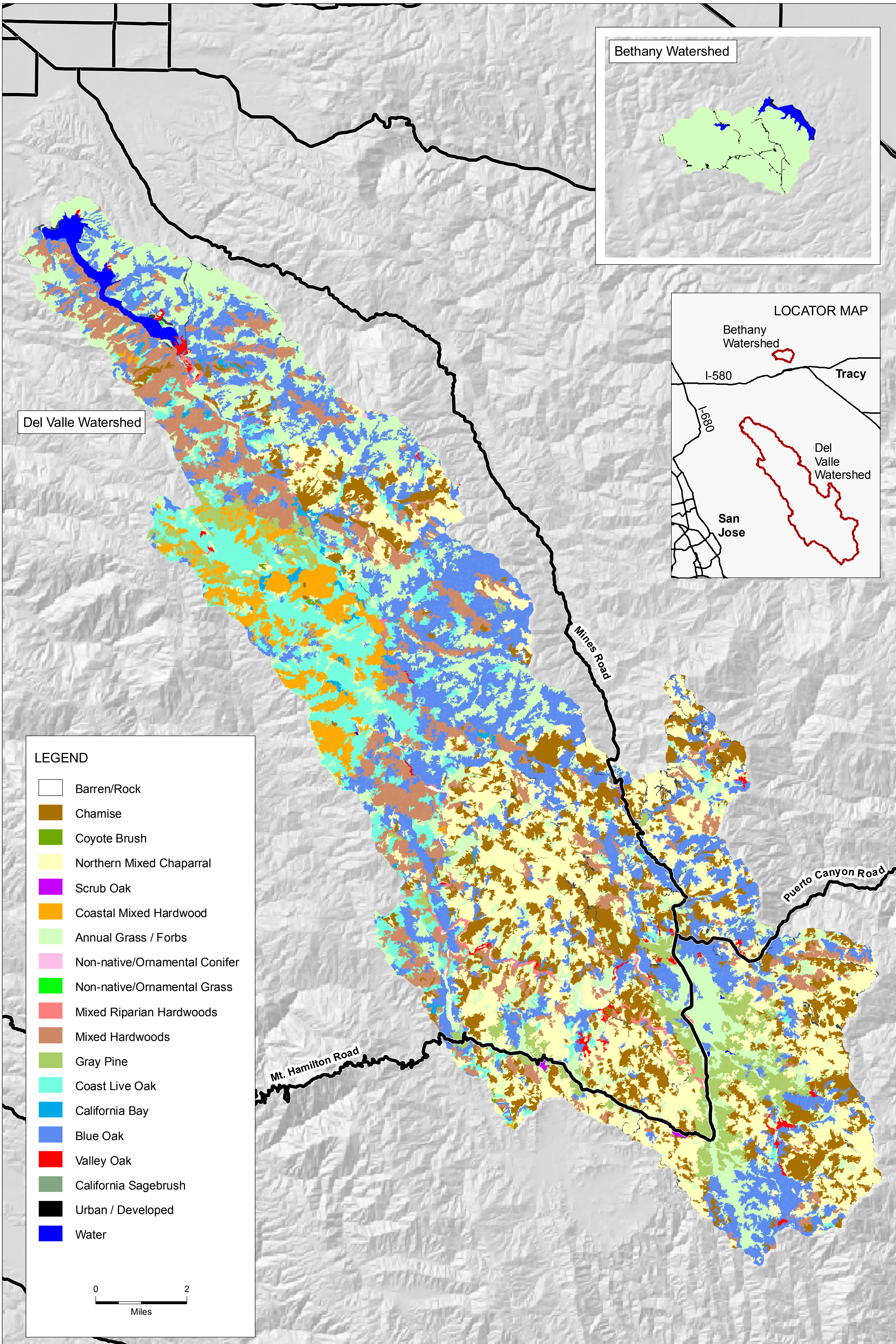


SBA Watershed Management Program Development Watershed Protection Program Plan . 205076

SOURCE: ESA

Figure 3-6f

Discharge vs. Suspended Sediment for USGS 11176400, Arroyo Valle below Lang Canyon



SOURCES: Topography: National Elevation Dataset, USGS, 2005
Vegetation Data: California Land Cover Mapping and Monitoring Program, using Landsat imagery, 1997 - 2002

Figure 3-7
Vegetation

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as recently supporting rainbow trout (the landlocked form of steelhead) (Leidy 1984). Angling is a popular recreational activity at Lake Del Valle. For many years the East Bay Regional Parks District (EBRPD) and the California Department of Fish and Game (CDFG) have operated a put-and-take rainbow trout fishery in Lake Del Valle. Stocking levels vary between years. For example, in 2004, EBRPD planted 45,435 pounds of catchable rainbow trout and 7,460 pounds of channel catfish; in 2005, however, they planted only 1,000 pounds of rainbow trout and no catfish (Alexander, 2005). In 2004, CDFG did not plant any trout or catfish, but in 2005 they planted 2,000 pounds of catchable-size trout (San Jose Mercury News 2005). 2005 was the first year that CDFG stocked salmon in Lake Del Valle: 24,800 Chinook, and 40,112 kokanee (California Department of Fish and Game 2005). In addition, several warmwater fishes have been identified in Lake Del Valle: largemouth bass, smallmouth bass, blue gill, sunfish, redeared sunfish, black crappie, channel catfish, white catfish, and striped bass (EBRPD 2005); also non-game fishes including carp, goldfish, inland silversides, threadfin shad, Sacramento pikeminnow, Sacramento sucker, log perch, hitch and prickly sculpin (Alexander, 2005). Bethany Reservoir hosts fewer warmwater fish species, including perch, catfish, black bass, striped bass, crappie, and carp (Thompson, 2005).

The records included in the California Natural Diversity Database (CNDDB) for special status and uncommon plant and animal species that have been observed in the Del Valle and Bethany watersheds are summarized in Table 3-5 and Figure 3-8. It is important to consider the CNDDB data with the following understanding: (1) records are only generated for locations where observers have been, therefore, the lack of a record for a specific location does not indicate the absence of a species from that location; (2) misidentification is possible; the likelihood depends on the level of knowledge and experience of the observer.

Current Human Uses and Imprint on the Land

Lake Del Valle Watershed

The Lake Del Valle watershed encompasses 146 square miles, much of which remains in a natural, undeveloped state. The primary land uses in this drainage include recreation, ranching, residential, and historic mining. Del Valle Regional Park occupies about 4,000 acres adjacent to the Lake. Visitor use ranged from about 280,000 to 350,000 between 1996 and 1999 (DWR 2001a). Most of the area around Lake Del Valle is publicly owned and grazed as a resource management tool, except for the steeper western side. The Patterson Trust owns large portions of land adjacent to the recreation area and along the northern edge of the lake. Extensive areas of the Del Valle watershed that are privately owned are also used to graze cattle. The largest landowner in the Del Valle watershed, the Naftzger-N3 Cattle Company, operates a ranch in the Arroyo Valle drainage, located southeast of Del Valle Regional Park. Approximately 160 private residences existed in the upper portion of the watershed in 1990 (Brown and Caldwell, 1990). The 2000 US Census data indicate that 131 people, living in 48 households, populate the Del Valle watershed (Figure 3-9). Most of these households are located in the San Antonio and Upper San Antonio Valleys, within Santa Clara County in the southern part of the watershed. The San Antonio Valley is a long-established community based primarily on ranching. Some

TABLE 3-5
SPECIES LISTED IN THE CALIFORNIA NATURAL DIVERSITY DATABASE (CDFG 2005) FOR THE DEL VALLE AND BETHANY WATERSHEDS

Species Scientific Name	Species Common Name	Watershed	Federal Status	State Status	CDFG or CNPS R-E-D
Agelaius tricolor	Tricolored blackbird	B, DV	--	--	SC
Allium sharsmithiae	Sharsmith's onion	DV	--	--	1B/2-1-3
Ambystoma californiense	California tiger salamander	B, DV	Threatened	--	SC
Aquila chrysaetos	Golden eagle	DV	--	--	SC
Campanula exigua	Chaparral harebell	DV	--	--	1B/2-2-3
Campanula sharsmithiae	Sharsmith's harebell	DV	--	--	1B/3-2-3
Cirsium fontinale var. campylon	Mt. Hamilton thistle	DV	--	--	1B/2-2-3
Coreopsis hamiltonii	Mt. Hamilton coreopsis	DV	--	--	1B/3-2-3
Delphinium californicum ssp. interius	Hospital Canyon larkspur	DV	--	--	1B/3-2-3
Emys (=Clemmys) marmorata	Western pond turtle	DV	--	--	SC
Eriastrum brandegeeae	Brandegee's eriastrum	DV	--	--	1B/2-2-3
Eriastrum tracyi	Tracy's eriastrum	DV	--	Rare	1B/3-2-3
Eschscholzia rhombipetala	Diamond-petaled California poppy	B	--	--	1B/3-3-3
Fritillaria falcata	Talus fritillary	DV	--	--	1B/3-2-3
Haliaeetus leucocephalus	Bald eagle	DV	Threatened	Endangered	--
Hesperolinon sp. nov. "serpentinum"	Napa western flax	DV	--	--	1B/3-2-3
Legenere limosa	Legenere	DV	--	--	1B/2-3-3
Lomatium observatorium	Mt. Hamilton lomatium	DV	--	--	1B/3-2-3
Meconella oregana	Oregon meconella	DV	--	--	1B/3-3-2
Phacelia phacelioides	Mt. Diablo phacelia	DV	--	--	1B/3-2-3
Phrynosoma coronatum (frontale)	Coast (California) horned lizard	DV	--	--	SC
Plagiobothrys uncinatus	Hooked popcorn-flower	DV	--	--	1B/2-2-3
Rana aurora draytonii	California red-legged frog	B, DV	Threatened	--	SC
Rana boylii	Foothill yellow-legged frog	DV	--	--	SC
Streptanthus callistus	Mt. Hamilton jewel-flower	DV	--	--	1B/3-1-3
Taxidea taxus	American badger	B	--	--	SC
Vulpes macrotis mutica	San Joaquin kit fox	B	Endangered	Threatened	--

NOTE:

SC = Species of Concern (CDFG)

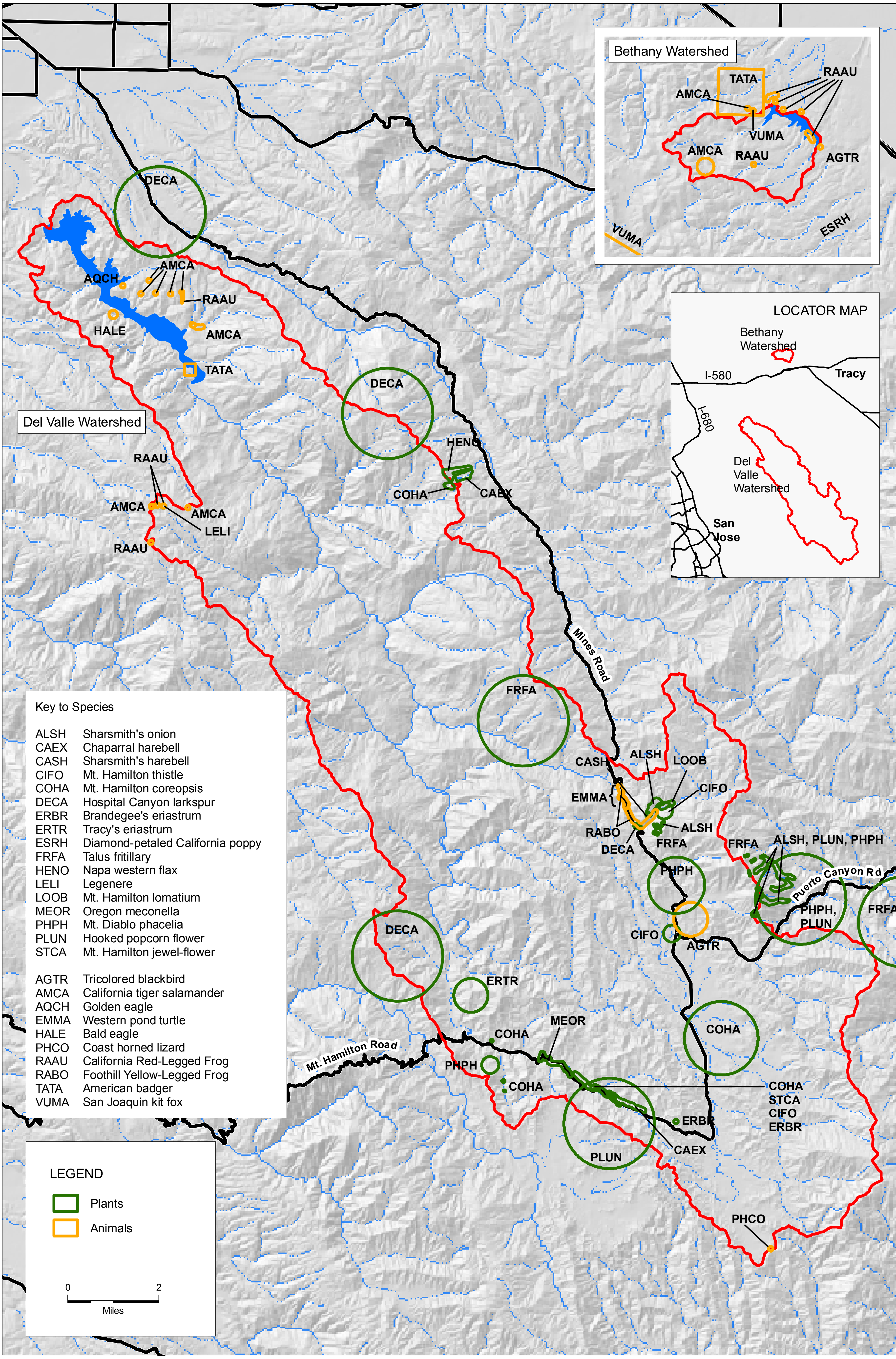
1B = Plants rare, threatened, or endangered in California and elsewhere (CNPS 2001)

R-E-D = Rarity, Endangerment, and Distribution Classification (CNPS 2001)

R (Rarity)
1 Rare, but found in sufficient numbers and distributed widely enough that the potential for extinction is low at this time.
2 Distributed in a limited number of occurrences, occasionally more if each occurrence is small.
3 Distributed in one to several highly restricted occurrences, or present in such small numbers that it is seldom reported.

E (Endangerment)
1 Not endangered.
2 Endangered in a portion of its range.
3 Endangered throughout its range.

D (Distribution)
1 More or less widespread outside of California.
2 Rare outside of California.
3 Endemic to California.



SOURCES: Topography: National Elevation Dataset, USGS, 2005
Species Data: California Natural Diversity Data Base, July 2005

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Figure 3-8
Species Listed in CNDDB

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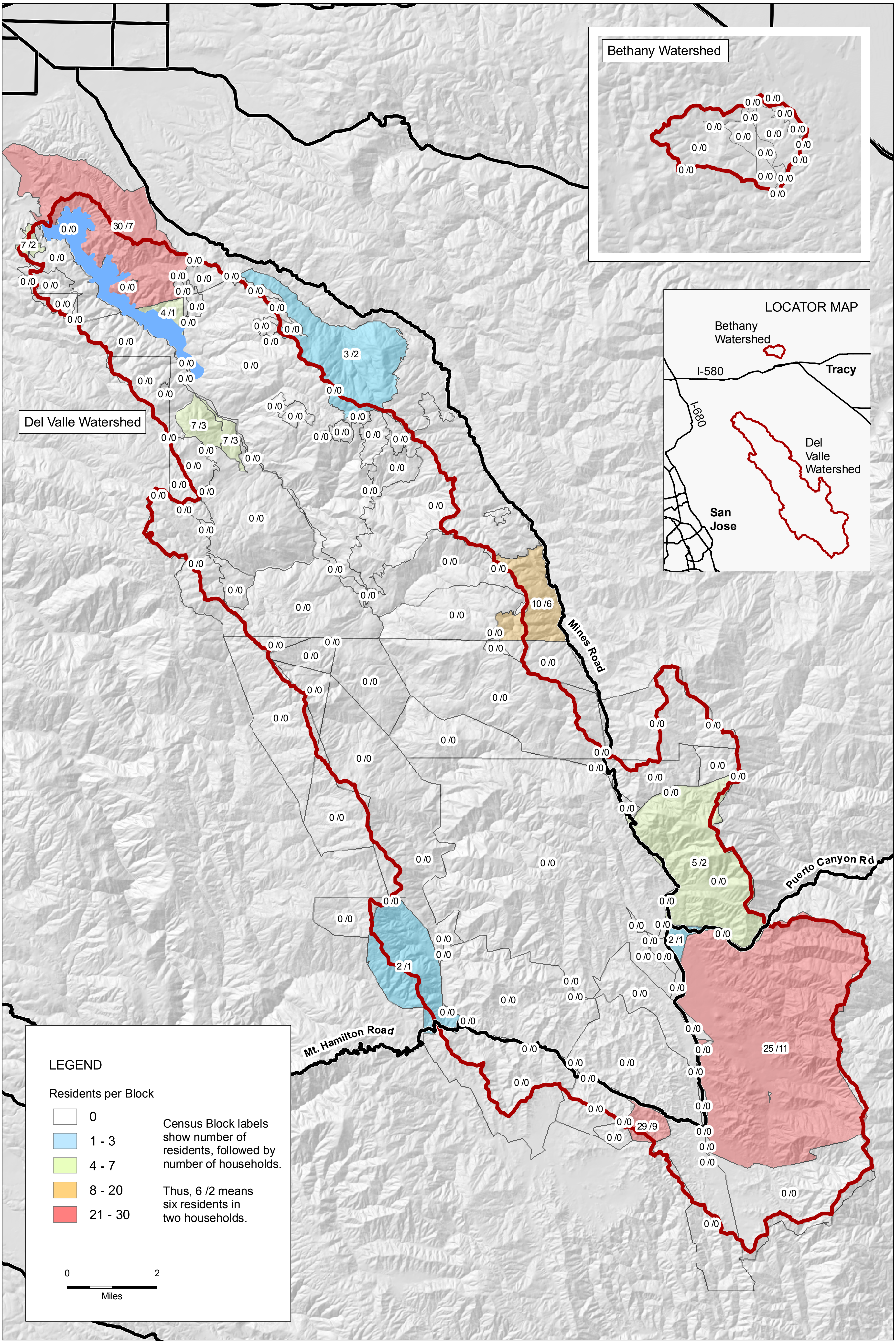

SOURCES: Topography: National Elevation Dataset, USGS, 2005
Demographic Data: US Census 2000, Summary File 1

Figure 3-9
Demographic Data by Census Block

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residential development has occurred there in recent years, but the remoteness of the area – it is about 1 hour by car via narrow, mountainous roads from Livermore, San Jose, or Patterson – discourages suburban development. In addition to the current recreation and ranching uses of the watershed, mining historically occurred within parts of the watershed. The primary focus of the 35 (now inactive) mines was the magnesium carbonate deposits in the southeastern part of the watershed near Sweetwater Creek (DWR 1974).

A large number of roads exist in the Lake Del Valle watershed. Most are single track, unimproved or graveled ranch roads. Some maintenance roads exist within Del Valle Regional Park. Only four public roads provide access to the watershed: Mines Road, Puerto Canyon Road, Mt. Hamilton Road, and Del Valle Road. Several roads in varying states of abandonment, once used for access to the mines, are still evident on the land, as are off-highway vehicle tracks.

Bethany Reservoir Watershed

The Bethany Reservoir watershed is used primarily for cattle grazing and for wind power generation. Few structures, other than windmill towers, stockponds, and corrals exist in the watershed. Most of the roads are unimproved dirt ranch roads or graveled access roads to the windmill pads. The area adjacent to the north side of the Reservoir is used for body and non-body contact recreation, including boating, swimming, fishing, and picnicking, but no camping is allowed. Visitor attendance ranged from 14,496 in 1995/96 to 26,175 in 1999/00 (DWR 2001a). No people live within the watershed (Figure 3-9).

Beneficial Uses of Lake Del Valle, Arroyo Valle, and Bethany Reservoir

Lake Del Valle and Arroyo Valle

The “Beneficial Uses” of Lake Del Valle and Arroyo Valle are designated by the San Francisco Bay Regional Water Quality Control Board in the current San Francisco Bay Basin Plan (SFBRWQCB, 2005). The existing beneficial uses for Arroyo Valle include the following:

- Cold Freshwater Habitat
- Groundwater Recharge
- Municipal and Domestic Water Supply
- Fish Spawning
- Wildlife Habitat

In addition, Fish Migration and both Contact and Non-Contact Water Recreation are listed as potential beneficial uses of Arroyo Valle.

According to the Basin Plan, the existing beneficial uses for Lake Del Valle include the following:

- Cold Freshwater Habitat
- Municipal and Domestic Water Supply
- Contact Water Recreation

- Non-Contact Water Recreation
- Fish Spawning
- Warm Freshwater Habitat
- Wildlife Habitat

Bethany Reservoir

The Basin Plan for the San Joaquin River Basin and Sacramento River Basin does not separately list beneficial uses for Bethany Reservoir. However, the Beneficial Uses for the California Aqueduct include the following:

- Municipal and Domestic Water Supply
- Agriculture: irrigation
- Agriculture: stock watering
- Industry: process
- Industry: service supply
- Industry: power
- Recreation: contact
- Recreation: other non-contact
- Wildlife Habitat

Water Quality: Contaminants of Concern

Prior sanitary surveys (California Department of Water Resources 2001a) and drinking water source assessments (Archibald and Wallberg 2002a-d, 2005) have identified a number of water quality constituents as contaminants of concern that may threaten drinking water quality in the SBA system (Table 3-6). These contaminants of concern were identified based on available water quality data for source water and treated water; drinking water regulations and guidelines from federal and state agencies; local knowledge and observations of the SBA system and its watersheds and general knowledge of watershed dynamics and best management practices. While agricultural drainage may contribute pesticide residues, these same studies did not identify this as a water quality concern. Neither have high levels of magnesium and total hardness detected in water quality monitoring, possibly resulting from historical mining of magnesium carbonate deposits in the Del Valle watershed, caused concern (DWR 2001a). However, these water quality parameters are being monitored by water utilities, especially by Zone 7, since the arroyos are used for local groundwater recharge.

Lake Del Valle is a candidate for inclusion on California's 2006 303d list of water quality-limited water bodies. The 303d list is revised every two years by the State Water Resources Control Board (SWRCB), in fulfillment of a requirement under the federal Clean Water Act. The candidate listing is for two pollutants: mercury and polychlorinated biphenyls (PCBs). The source of these pollutants is not known; the candidate listing is based on a finding of elevated levels of these pollutants in the tissues of fish (likely stocked fish) taken from the lake in April, 2001 (SWRCB, 2005). While little is known about the extent or source of this contamination, repeated samples of water from Lake Del Valle analyzed by DWR and Zone 7 have shown no detectable levels of mercury or PCB in the water column. It is possible, therefore, that if these contaminants are present in the Lake Del Valle system, they are confined to the Lake's sediments, and

TABLE 3-6
DRINKING WATER CONTAMINANTS OF CONCERN IN THE SOUTH BAY AQUEDUCT SYSTEM

Contaminant of Concern	Rationale	Possible Sources
Bacteria: • *E. coli* • *Total coliform* • *Fecal coliform*	These types of bacteria may indicate fecal contamination of water sources.	Stormwater runoff, livestock grazing, wild animal populations, human recreation, and spills or overflows of raw sewage from septic leaching fields and/or wastewater treatment facilities.
Protozoa: • *Giardia* • *Cryptosporidium*	These protozoa are pathogens originating from fecal contamination of water sources. Both *Giardia* and *Cryptosporidium* can cause gastrointestinal diseases when ingested. They are not easily removed from drinking water, and *Cryptosporidium* is especially resistant to disinfection.	Stormwater runoff, livestock grazing, wild animal populations, human recreation, and spills or overflows of raw sewage from septic leaching fields and/or wastewater treatment facilities.
Bromide	Can react with disinfectants used in the treatment process to produce regulated disinfectant byproducts (DBPs) such as trihalomethanes, haloacetic acids, and bromate.	Likely reflects seawater contributions from Delta water at the Banks pumping station.
Total Organic Carbon (TOC)	A concern due to its proclivity to react with disinfectants and produce regulated DBPs.	May derive from stormwater runoff (including decaying plant material, animal wastes, etc.) and septic leaching and/or wastewater treatment facilities.
Total Solids (Dissolved and Suspended)	Total Solids can include dissolved minerals and salts, sediment and other solids such as algae. Algal blooms may be encouraged by nutrient enrichment – see below.	Sediment may be introduced into the SBA from multiple sources including stormwater runoff, livestock grazing, wild animal populations, human recreation, and wastewater treatment facilities.
Nutrients: • *Nitrate* • *Nitrite* • *Phosphorus*	Nutrients including nitrate, nitrite, and phosphorus contribute to algal blooms. Algae can cause operational problems at treatment plants by clogging filters, and can produce compounds such as 2-methylisoborneol (MIB) and geosmin that result in considerable taste and odor problems in SBA water.	Sewage spills, leaks, or leaching, stormwater flows, agricultural activities, decaying plant material, or by wild animal populations.

bioaccumulate, but do not pose a threat to drinking water quality. Alternatively, it is possible that the samples were taken from stocked fish and the source of these contaminants is outside of the watershed.

Currently, Arroyo Valle is included on the 303d list for Diazinon, with the potential source given as “Urban Runoff/Storm Sewers.” This pesticide is ubiquitous in urban creeks and is currently being phased out of residential use by the USEPA. The priority given for TMDL[2] development is “High.”

2 TMDL = Total Maximum Daily Load.

Trends in Contaminant Levels

In order to provide a comprehensive baseline of water quality conditions in the SBA system, water quality data collected by the SBA Contractors and DWR were summarized by season for selected water years (EOA 2005). Three water years were selected to represent water quality conditions under different hydrologic conditions: a drought year (1990–1991); a wet year (1997–1998); and an average year (2001–2002). Each water year is defined as October 1st of the first year listed to September 30th of the second year listed. These selections were based on rainfall data, and in the case of the average year, on the basis of receiving 70%[3] of the State Water Project allocation. The preferred water year to represent drought was 1976–1977 because it was the driest single year of California's measured hydrologic record (DWR, 2005). However, limitations of data completeness and accessibility for this year resulted in selection of 1990–1991, which falls within California's most recent multi-year drought, which occurred from 1987–1992. The complete results of this analysis are included in a technical memorandum (EOA 2005). The following summarizes the trends observed:

- Water quality constituents of concern were generally found in higher concentrations in the wet season than in the dry season for each of the three water years.
- The analysis did not yield clear trends in water quality between upstream and downstream locations along the SBA.
- The seasonal mean values for six of the 13 constituents for which water quality standards have been defined—total dissolved solids, pH, specific conductance, nitrite, nitrate, and sulfate—did not exceed water quality standards at any of the eight sampling sites during the three water years analyzed.
- Seasonal mean values for *Giardia* and *Cryptosporidium* did not exceed the respective water quality standards, however, one sample from the ACWD Water Treatment Plant 2 (WTP2) raw water during the wet season of the wet year detected both pathogens.
- The constituent that most frequently exceeded water quality standards was bromide (96%), followed by turbidity (77%), total organic carbon (70%), and total coliform (52%).
- For all constituents that exceeded water quality standards, except turbidity, the standards were exceeded more during the wet season than during the dry season. High turbidity episodes are experienced in the dry season due to wind-induced re-suspension of sediments in Clifton Court Forebay.

3 The criterion originally proposed was 73% allocation (the average SWP allocation over the last 15 years), however, it was not met within recent decades in which monitoring data were available.

Stormwater Monitoring Results

As part of the background study for preparation of the WPPP, ESA conducted stormwater monitoring at the major inputs to the SBA during the winter of 2005-2006. The complete Stormwater Monitoring Report, including the Stormwater Monitoring Plan and the Quality Assurance Project Plan for the stormwater monitoring, is included in Appendix A; methods and conclusions are summarized here.

Stormwater samples were taken during five storm events from seven sampling stations representing major inputs to the SBA system. Stations included the California Aqueduct upstream of Bethany Reservoir, the Bethany Headlands drainage (the small stream that flows into Bethany Reservoir near the SBA Pumping Plant), the South Bay Aqueduct at the Dyer Surge Pool, Lake Del Valle near the SBA intake, Cedar Creek (a small stream that flows directly into Lake Del Valle), and Arroyo Valle. Field analysis and laboratory analysis were performed for 19 physical, chemical, and pathogenic water quality parameters from grab samples. Laboratory analysis was performed by the Zone 7 Water Agency Laboratory and by Biovir Laboratory.

The monitoring results confirm that source water quality flowing into Bethany Reservoir, including the California Aqueduct and the Bethany Headlands drainage, is poorer than in sources flowing into Lake Del Valle. Water quality is much poorer from the Bethany Headlands drainage than from any other monitored source. Of particular concern is the consistent finding of *Giardia* and *Cryptosporidium* organisms in samples taken from the Bethany Headlands drainage, and the proximity of the mouth of this drainage to the SBA Pumping Plant. While the volume of water contributed by this small drainage is dwarfed by that of the California Aqueduct, the issue of parasitic organisms consistently present in source water is of urgent concern.

Samples taken from Lake Del Valle near the SBA intake confirm that the lake water is a much higher quality source than the Delta, and also demonstrate the benefits of dilution, distance from inputs to the intake, and retention time in the lake in reducing pollutant loads. This is perhaps best demonstrated by the substantially lower levels of bacteriological parameters in lake samples, several no-detects for chemical and nutrient parameters, and the non-detection of parasites. It would appear that current management of Lake Del Valle and its immediate watershed are effective in protecting water quality.

At Lake Del Valle, the generally poorer quality of the water found in Cedar Creek compared to Arroyo Valle may be reflective of the relatively intensive, mixed land uses found in the small Cedar Creek watershed, the lack of dilution, and perhaps also the natural geology of the area. As with the Bethany Headlands drainage, however, the contribution of Cedar Creek – and the several similar small drainages flowing directly into Lake Del Valle – is much less than Arroyo Valle.

Some pollutant levels in Arroyo Valle itself correlate well with discharge, suggesting that stormwater runoff is a major source of pollutants carried by this stream. While overall the quality of water from Arroyo Valle is the highest among the monitored flowing sources, the monitoring results point to the need for conservation of the existing low-density and low-intensity land uses in the Arroyo Valle watershed that have contributed to the protection of water quality in this area.

The results of the stormwater monitoring consistently show that all monitored sources and stations regularly exceeded at least some water quality standards or objectives for municipal drinking water supply. While the monitoring locations represent raw or untreated water supplies, the finding indicates the continuing need not just to protect but also to improve water quality from the watershed areas that contribute to the SBA, including the Lake Del Valle watershed, the Bethany Headlands watershed, and the Sacramento-San Joaquin Delta.

Potential Sources of Contaminants from the SBA Watershed

As noted in Chapter 2, although the Delta contributes most of the water to the SBA from a vast watershed, and contributes most of the contaminant load to the system, the Watershed Protection Program Plan is focusing on potential contaminant contributions from those watersheds contributing locally to the SBA, that is, the Bethany Reservoir and Lake Del Valle watersheds. It should be noted, however, that local runoff is seasonal and therefore contaminant loading from local sources will depend on the seasonality of both runoff and the presence of the contaminant.

Possible contaminating activities (PCAs) in the SBA watershed have been identified in a series of recent studies: a sanitary survey (DWR 2001a), Drinking Water Source Assessments (DWSAs) for SBA water treatment plant intakes (Archibald & Wallberg 2002a-d), and an Assessment of Watershed Contaminant Sources (Archibald & Wallberg 2005) that was a follow-up study to the DWSAs. The study published in 2005 prioritized the most significant sources that potentially could be improved by management practices. These are presented below.

DWSAs, which are used specifically to evaluate water sources from a drinking water quality perspective, involve the delineation of physical zones of risk, and an analysis of the vulnerability of water quality within each of these zones. Protection zones within a watershed are delineated to define portions of the watershed where activities have a higher risk of contaminating the water supply. The vulnerability analysis evaluates the PCAs within the context of the characteristics of the source and its site, taking into account the “physical barrier effectiveness” (PBE) of the drinking water source, and the type and proximity to the water supply of activities that could release contaminants. For surface water, the PBE evaluation considers several parameters, including the size of, and detention time in, the reservoir, topography, geology, soils, vegetation, precipitation and ground water recharge. The size of the watershed is also important to consider, in terms of its potential for dilution or retardation of contaminants. In order to get a high PBE ranking, all the parameters for a source must have values that indicate an effective barrier. For example, a source with a high PBE would be in flat terrain, with low precipitation and non-erosive soils covered by grassland. A source is considered to have low PBE (i.e. high potential for contamination), if any of the parameters have values that do not indicate an effective barrier. For example, a source would be considered to have a low PBE if the watershed has steep slopes or if the soils are erodible or have high runoff potential.

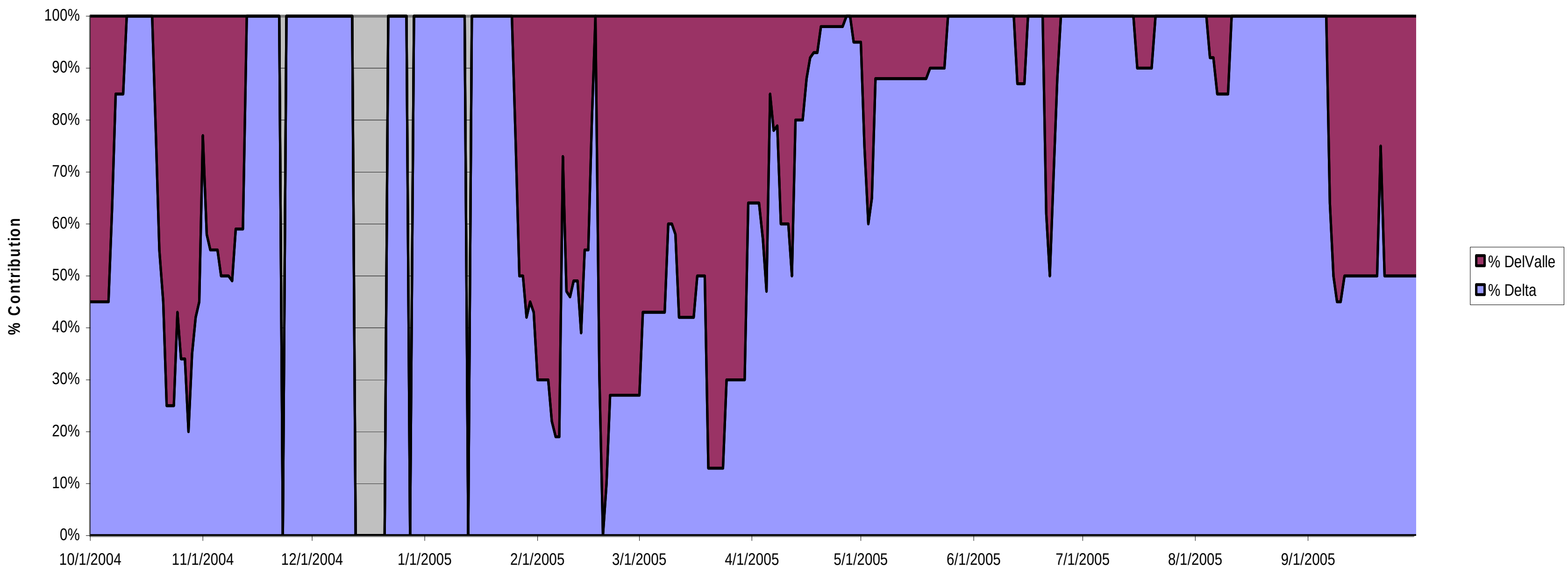
Lake Del Valle

The water stored in Lake Del Valle is a combination of runoff from the watershed and Delta water pumped into the lake. The water contributed to the SBA from Lake Del Valle is generally a higher quality source than the Delta. Water is released into the SBA during the fall months as the lake is lowered to about 25,000 acre-feet in anticipation of winter runoff. In wet years, Arroyo Valle starts to flow into the lake in December and continues through June or July. Water is not released into the SBA during the first several storms of the season as the lake is filled with local runoff. In wet years, water is released into the SBA when inflow from storms causes the lake storage to exceed 39,000 acre-feet. In dry years, water is pumped into Lake Del Valle from the SBA to bring summer lake storage up to 40,000 acre-feet. Thus, Lake Del Valle contains a mixture of stored water from the previous year, inflow from the winter storms, and water pumped in from the Delta. This mixture or blend changes from year to year based on wetness and water demands. As a result of Del Valle water supply operations and the dilution capacity of the lake, contaminant sources in the Del Valle watershed pose a lower risk to SBA water quality than sources in the Bethany watershed. Contaminant sources in the Del Valle watershed can potentially affect SBA water quality only during the periods of time that Del Valle water is released to the SBA.

Livestock and Runoff from Grazing Land

Cattle grazing is extensive in the Lake Del Valle watershed and may introduce pathogens, nutrients, sediment, and total organic carbon into the reservoir (note that the 2005-2006 stormwater monitoring indicated that turbidity in Arroyo Valle is highly correlated with discharge; see Appendix A). In the area immediately around Lake Del Valle, East Bay Regional Park District (EBRPD), which manages Del Valle Regional Park, views cattle grazing as a resource management tool to maintain and enhance plant and animal diversity, protect endangered species, and prevent wildland fires. Most of the northern lakeshore near the dam is privately owned and grazed. With the exception of the recreational boating area, the eastern shore is grazed by cattle through an EBRPD lease. To reduce the potential impact of cattle on water quality, the cattle lessee and EBRPD received a Natural Resources Conservation Service contract to construct a shoreline fence along the extent of Park land. The grant also supports development of alternative off-lake water sources for cattle. When completed in 2008, these measures will prevent cattle from directly accessing the lake, thereby reducing the likelihood that pathogens, sediment, nutrients, and organic carbon will be introduced to the drinking water supply via cow manure. Tributaries on the northern and eastern shore may still be accessed by cattle, and may attract cattle if they are primary sources of shade or water. Under such circumstances, contaminants might only be introduced to the lake via storm runoff.

Similarly, cattle grazing in the Lake Del Valle watershed upstream of the lake may contribute contamination to the drinking water supply via Arroyo Valle and its tributaries. Although the Natural Resource Conservation Service (NRCS) and the University of California Cooperative Extension Service (UCCES) staff have worked with ranchers in the Lake Del Valle watershed to develop Rangeland Water Quality Management Plans, information on who has completed these is not publicly available because the plans are voluntary and not required by existing regulations (Huff, 2005; Barry, 2005). Ranchers volunteer for the program and develop Rangeland Water



SBA Watershed Management Program Development Watershed Protection Program Plan . 205076

SOURCE: DWR

Figure 3-9a
Delta / Lake Del Valle Blend in SBA
October 2004 – September 2005

Quality Management Plans when they apply for Environmental Quality Incentives Program (EQIP) funding through the USDA Natural Resources Conservation Service (NRCS).

Horses

Horse manure is a potential source of pathogens, nutrients and organic carbon. On average, 4 to 6 percent of adult horses shed *Giardia* and 0.5 to 1 percent shed *Cryptosporidium* (Atwill, 2003). The loading rate for adult horses, at 4,000 to 6,000 oocysts/animal/day, is similar to the loading rates of beef and dairy cattle (Atwill, 2003). Two campgrounds at Del Valle Regional Park allow horses, and one staging area is designated for equestrian use. EBRPD has implemented policies to prevent equine contamination of the lake. Watering troughs are provided at the camps and the staging area, and visitors to these areas are required to dispose of horse manure in designated bins. Manure is generally not collected from trails, however, equestrian trails are located on the hillsides above the lake and are most frequented by equestrians in summer months when dessication of fecal matter likely renders any pathogens unviable. Therefore, Archibald and Wallberg (2005) consider the potential for horse manure to contaminate the SBA water supply to be minimal.

The horse population in the upper Lake Del Valle watershed is unknown, but horses are thought to be kept by several residents in the San Antonio and Upper San Antonio Valleys. Horses may also be kept on or brought onto the large ranches closer to Lake Del Valle. Horses have access on public trails and in waterways.

Wildlife

While no extensive wildlife surveys exist to document the type and extent of wildlife populations in the Lake Del Valle watershed, the sheer size and undeveloped nature of the watershed suggests that it supports many types of wild animals. Feral pigs are present in the watershed, but the population is unknown (Archibald and Wallberg 2005). EBRPD has a feral pig trapping program that has substantially reduced the porcine population of the park. Flocks of geese have been observed frequenting the lake, and may have contributed to spikes in coliform counts sampled during winter months (Lunn, 2005). Wildlife have direct access to the tributaries to Lake Del Valle, and to the Lake, particularly in the evenings and winter months when human visitation is lowest. Deposited fecal matter could introduce pathogens, nutrients and total organic carbon into the Lake. Currently the contribution of wild animals relative to other sources of pathogens to Lake Del Valle is unknown.

Recreational Usage

Recreational activities at Lake Del Valle include swimming, wind-surfing, boating, fishing, camping, picnicking, horseback riding, and hiking. Del Valle Regional Park occupies 4,000 acres on the southeastern and southwestern shores of the reservoir. Developments include two swimming beaches, a boat launch, a main family campground, six additional group campsites, wastewater treatment facilities, and parking and road infrastructure. There is an extensive trail system around the reservoir that connects with the Ohlone Trail.

The greatest contaminants of concern associated with recreational activities at Lake Del Valle are introductions of microbial pathogens *Giardia* and *Cryptosporidium*, and turbidity caused by soil erosion. The swimming beaches are regularly monitored for bacterial contamination. Total coliform data are collected every two weeks throughout the year by EBRPD, and DWR collects total coliform data monthly from Lake Del Valle at the outlet to the SBA. The SBA Contractors generally review the DWR data monthly. The total coliform levels at the Del Valle outlet are typically less than 10 MPN/ml throughout the year. During the heavy recreational use summer months, coliform levels at the beaches sometimes exceed the 100 MPN/ml water quality standard. Archibald and Wallberg (2005) found no evidence that recreational usage of Lake Del Valle is having an adverse impact on SBA coliform levels. Data on petroleum products in water discharged to the SBA from Lake Del Valle are not available, but since MTBE was banned as a gasoline additive in 2003, petroleum products have not been identified as a water quality concern.

Wastewater Handling Facilities

Wastewater is not directly discharged to Lake Del Valle, but the recreational areas include flush toilets in 21 buildings, and 15 chemical toilets that are pumped out three times per week in summer months (Archibald and Wallberg 2005). Though some spills have occurred in the past five years, several measures have been implemented to upgrade the wastewater collection and treatment system in recent years, including replacing lift stations and relocating some facilities further away from the lake, relining evaporation ponds, increasing the height of berms around wastewater lagoons, and converting to low-flush toilets. The most recent spill was contained before it reached the lake, and water quality monitoring showed no evidence of contamination (Miller, 2005). The 2005 DWSA (Archibald and Wallberg, 2005) concluded that the wastewater handling facilities were not likely contributing to contamination of the SBA water.

An estimated 160 private residences in the upper Del Valle watershed in 1990 were all on septic systems (Brown and Caldwell, 1990). The 2000 US Census identified 48 households, with 131 people in the Lake Del Valle Watershed (Figure 3-9). Presumably, all households in the watershed have septic systems. Septic system performance is greatly dependent on regular maintenance as well as soils, slope, and rainfall pattern. Many of the septic systems in the watershed have probably not been inspected since they were installed. While the number, location, and condition of septic systems in the watershed is unknown, they pose a potential threat to water quality. The magnitude of the threat is unknown. Septic systems in Alameda County are regulated by the County under the Onsite Wastewater Treatment System and Individual/Small Water System Regulations, effective April 2007, which provide minimum standards for the construction and operation of both standard septic systems and advanced treatment systems.

Roads

Although not specified in the most recent DWSA (Archibald and Waller 2005), many roads, especially unpaved and graveled roads, have been constructed in association with residential, ranching, and historic mining uses in the watershed. Roads pose a substantial risk to water quality in the watershed, due to erosion from road surfaces, from concentrated runoff, and from poorly constructed, undersized, or failed road crossings. The principal contaminant risk from roads is sediment; however, roads may also contribute petroleum products, manure, and other contaminants to the stream system, and ultimately to the drinking water supply.

Bethany Reservoir

Livestock

While the shore of Bethany Reservoir is owned by the State of California, DWR leases the land on the western shore for grazing. Cattle have direct access to the water and have been observed in the water by DWR staff (Archibald and Wallberg 2005). Pathogens, sediment, nutrients, and organic carbon may be introduced to surface waters via direct deposition of fecal matter. Calves under four months of age pose the highest risk of shedding *Cryptosporidium* (8% of the population versus 0.6% of the adult population) (Atwill 2003). Cattle also graze the uplands that drain to the Bethany Intake Channel. Stormwater events may transport contaminants derived from grazing activity into the Reservoir. Stormwater monitoring in the Bethany Headlands drainage during the winter of 2005-2006 indicates that this small stream regularly contains both Cryptosporidium and Giardia. While the source of these pathogens is unknown, the prevalence of grazing as a land use in the Bethany Headlands watershed suggests that cattle could be the source. The risk of sediment input to Bethany Reservoir from the Bethany Headlands drainage is decreased by the presence of a large stock pond, located about ½ mile upstream of the Reservoir, which probably contains all but the largest runoff events.

Wildlife

Wild animals may also introduce pathogens, sediment, nutrients, and organic carbon into the Bethany Reservoir. Feral pigs may be influential sources, as they are known to greatly disrupt riparian areas by their wallowing and foraging activities. Unlike cattle, both adult and juvenile feral pigs shed *Cryptosporidium* at high rates, making them a potentially important source of pathogen contamination. Currently, it is not known whether feral pigs exist in the Bethany watershed nor whether any such animals would be infected with *Cryptosporidium*. However, based on work conducted by Atwill (2003), it is likely that infected wildlife are present and pose a contamination risk.

Recreational Usage

Body contact recreation at Bethany Reservoir may introduce pathogens and nutrients. Power-boat recreation may introduce petroleum products to the Reservoir. Visitation to the Bethany Reservoir State Park is relatively low and stable. Archibald and Wallberg (2005) considered recreational usage at Bethany Reservoir to be an unlikely source of water quality contamination in the SBA.

Wastewater Handling Facilities

The recreational area is serviced by four restroom facilities with chemical toilets that are considered to be adequate to service the recreational usage at this site. The wastewater handling facilities serving the South Bay Pumping Plant are being relocated as part of the SBA

Improvement and Enlargement Project, and therefore, will no longer present a contamination risk (Archibald and Wallberg 2005).

Roads

Roads in the Bethany Reservoir watershed include ranch access roads, access roads for windmill pads, and DWR access roads for the California Aqueduct, the SBA Pumping Plant, and the shore of the reservoir. No public roads exist in the watershed. In the Bethany Headlands drainage, there is a ranch road that parallels the small creek for much of its length. The DWR access road on the western shore of the reservoir crosses the Bethany Headlands creek. Field observations of this crossing indicate that runoff from the road collects in a ditch and discharges to the stream.

Contamination Risk Assessment

As stated previously, Drinking Water Source Assessments require delineation of protection zones within a watershed to define portions of the watershed where Possible Contaminating Activities (PCAs) have a higher risk of contaminating the water supply. The setback distances recommended by the California Department of Health Services CDHS (1999) are listed below. PCAs within Zone A pose relatively higher potential risks to water quality than when located in Zones B or C.

- Zone A: 400 feet from reservoir banks or primary stream boundaries and 200 feet from tributaries
- Zone B: 2,500 feet from intakes
- Zone C: The remainder of a watershed

CDHS evaluates the risk potential for various PCAs, by zone. Based on the general nature of the PCAs and the contaminants associated with them, CDHS assigns a risk potential of low, moderate, high, or very high. For example, grazing operations with more than 5 animals per acre are considered to pose a high risk in Zone A, and a moderate risk in Zones B and C.

Selected Analysis of Orthophotos

To improve our understanding of the spatial extent of different types of PCAs, several orthophotographs (GlobeXplorer 2005) of some of the more intensively used portions of the Lake Del Valle and Bethany Reservoir watersheds were analyzed. Two orthophotos (Figures 3-10, 3-11) correspond to the areas surrounding two sampling stations included in the Stormwater Monitoring Plan (ESA 2005). A third (Figure 3-12) includes part of the San Antonio Valley, the most densely populated section of the upper watershed, while a fourth (Figure 3-13) shows a portion of the Bethany Headlands watershed.

From these photos we identified PCAs and the estimated risk for contamination associated with these activities given their location within 200-feet of a tributary – that is, within Zone A (CDHS 1999). The results are shown in Table 3-7. As this work has not been checked on the ground, these findings must be considered preliminary and are intended to be used to generate a list of potential Best Management Practices for the WPPP (see Chapter 5).

SOURCE: GlobeXplorer, 2004

SBA Watershed Protection Program Plan . 205076

Figure 3-10

Monitoring Point LDV-1

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SOURCE: GlobeXplorer, 2004

SBA Watershed Protection Program Plan . 205076

Figure 3-11

Monitoring Point LDV-2

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SOURCE: GlobeXplorer, 2004

SBA Watershed Protection Program Plan . 205076

Figure 3-12

Highway 130 / Mines Road Junction

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SOURCE: GlobeXplorer, 2004

Figure 3-13
Portion of Bethany Reservoir Watershed

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TABLE 3-7
POSSIBLE CONTAMINATING ACTIVITIES (PCAs) AND ASSOCIATED RISK LEVELS

Possible Contaminating Activity	Zone A Risk Level (c)	Identified in Zone A in Orthophoto? LDV1 (Figure 3-10)	LDV2 (Figure 3-11)	San Antonio Valley (Figure 3-12)	Bethany Headlands (Figure 3-13)
Septic Systems	High	**Yes**	**Yes**	**Yes**	No
Roads/Streets	Low	**Yes**	**Yes**	**Yes**	**Yes**
Road Crossings	High[a]	**Yes**	**Yes**	**Yes**	**Yes**
Grazing	High	**Yes**	**Yes**	**Yes**	**Yes**
Animal Feed Operations[c]	Very High	**Yes** [b]	No	No	**Yes**
Instream Stock Ponds	Very High	No	**Yes**	No	**Yes**
Campground	Low	No	**Yes**	No	No

[a] Road crossings are not listed by CDHS as a PCA. However, given that most of the roads in the SBA Watershed are comprised of dirt/gravel, and that road crossings are known as common sources of sediment input to stream channels, they likely pose at least a high risk – if not a very high risk -- of contaminating a stream via sediment contributions.
[b] There is uncertainty whether this activity is occurring in this photo.
[C] Besides cattle, this can include horse stables and riding areas; chickens; goats and sheep; swine

SOURCE: CDHS 1999

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CHAPTER 4
SBA Water Quality Improvement Strategy

As noted in Chapter 3, the California Department of Health Services (CDHS) method for evaluating risks to drinking water supply takes into account the proximity of potentially contaminating activities (PCAs) to water courses, the nature of the PCAs themselves, and “physical barrier effectiveness” (PBE), or mitigating effects and circumstances that reduce risk. Table 3-7 in Chapter 3 provides a partial listing (since it is based on analysis of air photos covering only a small portion of the SBA Watershed) of PCAs, their associated risk levels, and their presence in different areas of the SBA Watershed examined for that exercise.

Based on the information provided in Chapter 3, on the results of the stormwater monitoring program conducted in the winter of 2005-2006 (see Appendix A), on observations of land uses in areas traversed in the course of stormwater monitoring and other field work in the SBA Watershed, and on information and suggestions provided by members of the Watershed Workgroup, this chapter provides a strategic approach to minimizing risks to water quality. The approach focuses on high risk PCAs occurring, or thought to occur, in the more sensitive areas in the SBA watershed, where PBEs are deemed to be low. This information is used in Chapters 5 and 6 to develop recommendations for conservation practices and programs that can be implemented to lower risks to the water supply.

As stated in Chapter 3, the CDHS identifies 3 zones with respect to activities that may have a negative impact on a water supply:

- Zone A: 400 feet from reservoir banks or primary stream boundaries and 200 feet from tributaries
- Zone B: 2,500 feet from intakes
- Zone C: The remainder of a watershed

The overall strategy for minimizing contamination risk in the SBA Watershed is to focus primarily on potentially contaminating activities within Zones A and B. For the remainder of the watershed area, Zone C, the more general strategy is to reduce erosion and delivery of sediment and other contaminants to streams and reservoirs; and to reduce potential contamination of groundwater. In the sparsely populated lands of the SBA Watershed, these strategies can be accomplished through appropriate vegetation management (including grazing management) to reduce the risk of fire, protect the ground surface, and keep decaying plant material out of the water; appropriate design and maintenance of roads and road crossings to minimize their sediment delivery to stream channels; and good housekeeping around rural residences and at facilities where livestock is concentrated, such as corrals and watering locations. These strategies are developed further in Chapter 5, with recommendations for specific conservation practices.

The following discussion describes specific portions of the SBA Watershed delineated by a commonality of geography, land use, and potentially contaminating activities. For each watershed area, there is a description of Zones A and B, and discussion of potentially contaminating activities and conditions that contribute to physical barrier effectiveness. General comments are also provided on water quality, based on results of the stormwater monitoring program in the winter of 2005–2006 (Appendix A).

Lake Del Valle Watershed

The Lake Del Valle Watershed may be divided into three areas for the purpose of targeting high priority areas and activities for reducing risks to the drinking water supply: the area that drains into Lake Del Valle itself; Arroyo Valle Watershed from the upstream boundary of the park to the San Antonio Valley; and the San Antonio and Upper San Antonio Valleys.

Lake Del Valle

This area includes the lands around Lake Del Valle and Arroyo Valle to the upstream border of the park. The most sensitive areas (Zone A) are within 400 feet of the lakeshore and Arroyo Valle, and within 200 feet of the small tributary channels that feed into the lake; Zone B includes areas within 2,500 feet of the SBA intake, which is located near the dam at the northern end of the lake. Stormwater monitoring during the winter of 2005-2006 found relatively high levels of total organic carbon, nutrients, *E. coli*, and total coliform in samples taken from Cedar Creek, while samples from the lake near the dam (and SBA intake) indicated consistently good water quality indicating the capacity of the lake to assimilate or dilute contaminants during these events. The small size of the streams that drain into the reservoir, and the relatively lengthy storage period and seasonality of storage in the reservoir may provide a substantial PBE level. In addition, most recreational activities (including swimming in designated areas) take place at the southern end of the lake, well away from the SBA intake, and are less intensive during the wet season. Grazing also takes place only on a seasonal basis.

The water quality of Lake Del Valle is generally very good; however, there are a number of potentially contaminating activities that take place within Zone A and Zone B. These activities include body contact and non-body contact recreation in the lake itself. Shoreline recreational activities include camping, hiking, fishing, picnicking, and equestrian use. In addition, cattle are allowed to graze in stream channels and to the water's edge; their use of the shoreline and main stream channels for water access may depend on the availability of other seasonal water sources or off-site troughs. Feral pigs have at times been prevalent around the reservoir. Other wildlife is commonly observed. There are a few private residences, public restrooms and septic systems within this area (such as in the Cedar Creek drainage; see Figure 3-11 in Chapter 3) and some household activities can have an impact on water quality. Few roads or trails follow stream courses, and most are set back from the lakeshore, but there are a number of road and trail crossings of streams where sediment inputs may occur. The implementation of conservation practices, including the continuation of those currently in place, would help protect water quality in Lake Del Valle.

Arroyo Valle: Lake Del Valle to San Antonio Valley

The Lake Del Valle to San Antonio Valley area encompasses the majority of the Lake Del Valle watershed. It is a very sparsely populated area, with only a few residences associated with the N3 Ranch headquarters and other rural residences. The primary land uses are grazing, open space and seasonal recreation (hunting, snowplay). Wildlife is commonly observed in the area. There is a limited ranch road network. Stormwater monitoring in the winter of 2005-2006 at the downstream limit of this area indicates that Arroyo Valle delivers the highest quality water among the inputs to the SBA system.

The most sensitive areas (Zone A) within this portion of the watershed are the lands within 400 feet of Arroyo Valle and its year-round tributaries, Colorado Creek, Sycamore Creek, and Eylar Canyon; and within 200 feet of other tributary channels. This includes the stream channels themselves, riparian areas, and limited floodplain areas and lower canyon walls. There are no Zone B areas within this portion of the watershed. Several factors all contribute a relatively high PBE for this portion of the SBA Watershed, including: the distance from much of the watershed area to Lake Del Valle, the large watershed, holding time in the reservoir, the large volume of water stored in the reservoir, and the distance from the mouth of Arroyo Valle at the southern end of the lake to the SBA intake at the northern end of the lake (about 5 miles).

Because Arroyo Valle delivers the highest quality and largest quantity of water among the local inputs to the SBA system, minimizing risks in this area to preserve water quality for the future is important. Potentially contaminating activities identified as occurring within Zone A for which conservation practices should be developed include grazing, roads and road crossings, corrals and other concentrations of livestock, and rural residential uses. Feral pigs (wild boar) are also present in this area.

San Antonio Valley and Upper San Antonio Valley

The San Antonio Valley and Upper San Antonio Valley have relatively higher population density and greater intensity of land use than the remainder of the Lake Del Valle watershed. Zone A, where PCAs would produce a higher risk to water quality, include land within 400 feet of San Antonio Creek and Jumpoff Creek, the main streams draining the valleys; and within 200 feet of other tributary streams. There are no Zone B areas within this portion of the watershed. Factors that contribute to a high PBE for this area include: the low gradient of the valleys, stream distance to Lake Del Valle, the size of the watershed, vegetation management within the watershed, holding time in Lake Del Valle, and the large volume of water stored in Lake Del Valle.

Potentially contaminating activities in the San Antonio Valley and Upper San Antonio Valley include grazing, roads and road crossings (including OHV trails), on-stream stock watering ponds, livestock corrals, private residences, household activities, septic systems, and future rural residential development (including septic systems, grading, runoff). The potential for old mine tailings to contaminate the water supply is unknown. Historic magnesite (magnesium carbonate, $MgCO_3$) mining in the San Antonio Valley could potentially contribute to stream sediment loads and hardness, if runoff from mine and mine tailing sites reaches the stream system.

Bethany Reservoir Watershed

Stormwater sampling during the winter of 2005-2006 indicates that the Bethany Headlands drainage produces the worst water quality among the inputs to the SBA. Of particular concern are the *Giardia* and *Cryptosporidium* present in samples taken from the small stream that empties into Bethany Reservoir at the SBA pumping plant. While this stream contributes only a tiny fraction of the water delivered by the SBA, even small numbers of *Giardia* cysts and *Cryptosporidium* oocysts entering the water supply are problematic.

The Bethany Headlands drainage flows into a 300-ft concrete channel, which ends less than 50 feet away from the Stage 1 pump intake, within Zone B. Because the channel discharges so close to the pumps that transfer water from Bethany Reservoir into the SBA, there is an opportunity for short-circuiting and the discharge from the channel may not be completely diluted by the comparatively large volume of water in Bethany Reservoir before it reaches the pump intakes. It is therefore very important to protect the quality of the water traveling through this concrete channel. In addition to the stream, water entering the channel directly through weepholes and drains should also be considered. Also of concern is the potential for the Bethany Headlands watershed to produce large amounts of sediment during very large, infrequent storm events. Such an occurrence could affect the SBA Pumping Plant intakes and cause high turbidity in the water supply.

The Bethany Headlands drainage, particularly the stream course and the lands within 400 feet of the stream course and the pond should be considered high priority for risk reduction. Included in this high risk area are the roads and road drainage structures (ditches, flumes, culverts, and scuppers) within the DWR right-of-way that drain to the Bethany Headlands drainage. The large pond within the Bethany Headlands Drainage, located approximately 3,000 feet upstream of Bethany Reservoir, rarely overtops, and may be regarded as an effective physical barrier to contamination of the water supply (high PBE) in most circumstances. Therefore, the lands above this pond should be considered lower priority. The pond itself should be regarded as an important structure for limiting contamination from upstream land uses, and also for serving as a sediment basin during very large, infrequent storm events. The seasonality of stream flow may provide some level of PBE.

The land uses that pose risks to SBA water quality in the Bethany Watershed for which conservation practices should be developed are cattle grazing, roads, road crossings, and ponds. Furthermore, to the extent that the pond in the Bethany Headlands drainage is vulnerable to damage or failure during a very large, infrequent storm event, it should also be considered high priority for development of conservation practices. Boating and fishing activities in Bethany Reservoir (Zone B) can also be considered PCAs.

TABLE 4-1
HIGH PRIORITY WATERSHED AREAS AND ACTIVITIES – ZONES A AND B

	Bethany Reservoir	Lake Del Valle	Arroyo Valle: Lake Del Valle to San Antonio Valley	San Antonio Valley and Upper San Antonio Valley
Zone A	Bethany Headlands drainage, within 400' of stream channel	Within 400 feet of lakeshore and Arroyo Valle; within 200' of tributaries	Within 400 feet of Arroyo Valle and year-round tributaries; within 200' of other tributaries	Within 400' of San Antonio Creek and Jumpoff Creek; within 200' of other tributaries
Zone B	Bethany Headlands drainage and Bethany Reservoir and its shoreline within 2,500 feet of the SBA Pumping Plant	Lake Del Valle and shoreline within 2,500 feet of the SBA intake near the dam at the north end of the reservoir	No areas within Zone B	No areas within Zone B
PCAs	Grazing, roads, road crossings; pond (Zones A and B), boating and fishing (Zone B).	Water contact and non-contact recreation; lakeshore recreation; grazing; road and trail crossings; wildlife (Zones A and B); residential and public development (Zone A)	Grazing; livestock concentrations; in-stream stock ponds; rural residential development; wildlife; roads and road crossings, trails	Grazing; livestock concentrations; in-stream stock ponds; rural residential development; roads and road crossings; mine tailings; feral pigs
PBE	Pond in Bethany Headlands drainage; seasonality of stream flow.	Volume of lake; lower levels of activity around water supply intake; seasonality of water withdrawal from the lake; seasonality of stream flow; seasonality of grazing; seasonality of recreational use.	Distance to lake, volume of lake, size of watershed, low density; seasonality of stream flow; seasonality of grazing.	Distance to lake, volume of lake, size of watershed, low gradient; seasonality of stream flow; seasonality of grazing.

CHAPTER 5

Strategic Plan: Conservation Practices to Protect and Enhance Water Quality in the SBA Watershed

Introduction

As stated in Chapter 2, the SBA Watershed Protection Program Plan's mission is as follows:

> To protect and enhance the quality of water from the SBA watershed as an important source for drinking water, while recognizing and respecting the agricultural, recreational, environmental, and other uses of these resources.

Recognizing that the SBA watershed—specifically the Lake Del Valle and Bethany Reservoir watersheds—serve multiple uses, the most effective way to protect and enhance water quality in the SBA is to foster a cooperative relationship or partnership amongst private landowners, ranchers, and resource management agencies that supports/encourages:

- the continuation of existing practices that have protected water quality in the watershed and
- the adoption of voluntary conservation practices designed to reduce further the risk of introducing pollutants to the reservoirs and their tributary streams.

Based on the analysis presented in Chapters 3 and 4, the primary land uses that have the potential for introducing drinking water contaminants into the SBA system are rangeland management; roads and trails; rural residential development; and recreation. This chapter provides guidance to interested land owners and managers engaged in these land uses for conservation strategies and specific practices that they may adopt voluntarily to protect and improve water quality. In addition to water quality benefits, these practices are designed to increase the sustainability and productivity of land uses.

Recommended Conservation Strategies and Practices

Rangeland Management

Rangeland management is the predominant land use in the SBA Watershed. Carefully managed livestock operations and maintenance of roads and culverts can provide significant conservation benefits to the land and water, including protecting water quality, encouraging biodiversity, and reducing fire risk. In addition, compared with other rural and urban land uses, the low-intensity, extensive nature of rangeland management itself affords a level of protection to the water supply. Several agencies, notably University of California Cooperative Extension (UCCE), the USDA Natural Resources Conservation Service (NRCS), the Alameda County Resource Conservation District (RCD) – as well as other RCDs for neighboring counties – provide abundant information, technical assistance, and in some instances funding assistance for improvement of rangeland management. Several pertinent publications, many in the form of short information sheets available on the internet, are referenced under particular conservation practices in Table 5.1. Additional information on maintenance of roads and culverts can be found in the "Roads and Trails" section later in this chapter.

Rangeland Planning

Several agencies have developed materials to promote the development of comprehensive rangeland management plans that have the dual purpose of improving rangeland management and protecting water quality. These are described briefly below.

- **Ranch Water Quality Planning Short Course.** Under the leadership of UCCE rangeland specialists, UCCE and NRCS have developed a short course curriculum that facilitates development of ranch water quality plans. The Ranch Water Quality Planning Short Course entails about 15 hours of classroom and field instruction, and covers clean water laws; monitoring techniques; and management practices for reduction of nonpoint source pollution. Some of the pollution sources typically addressed in the short course are sediment from cattle grazing and trampling, heat from decreased riparian vegetation, and nutrients and pathogens from manure. The short course culminates in each participant developing their own, individualized ranch water quality management plan. The plans identify and prioritize water-quality problems and outline how to address them. To date, the Regional Water Quality Control Boards (RWQCBs) have usually accepted completed and implemented ranch water quality management plans as evidence of voluntary compliance with Total Maximum Daily Load (TMDL) limits; at present, however, there is uncertainty regarding future State Water Resources Control Board regulation of non-point source discharges from farm and ranch lands.

- **Rangeland Water Quality Management Plan – Natural Resources Conservation Service.** In addition to being involved in the Ranch Water Quality Planning Short Course, the NRCS has published a nine-step process for developing conservation plans on grazing lands (NRCS 1997). These steps involve: identifying problems; determining objectives; inventorying resources; analyzing resource data; formulating alternative solutions; evaluating alternative solutions; making decisions on a plan; implementing a plan; and evaluating results.

- **East Bay Regional Parks District.** According to the EBRPD's Wildland Management Policies and Guidelines (EBRPD, 2001), scientific management practices will be used to determine appropriate forage utilization levels and achieve desired conditions on individual grazing units. Monitoring is conducted to insure conformity to lease provisions, to verify compliance with established standards for grazing on park land, and to evaluate whether management goals are being met. Grazing animals will be excluded from areas otherwise suitable for grazing when exclusion is dictated by the need to protect other resource and recreational values.

The EBRPD has a policy of developing site-specific unit management plans (Grazing Unit Management Plans, or GUMPs) for all park wildlands that identify management issues, define objectives, prescribe actions to resolve conflicts with other resource and recreational uses, and provide recommendations for achieving more effective management of the units. GUMPs are evaluated in accordance with EBRPD's Master Plan (EBRPD, 1997). EBRPD has not yet completed a GUMP for Lake Del Valle Recreational Area; however, EBRPD staff provided details on grazing management at Lake Del Valle (Amme, pers. com., 2006). Grazing at Lake Del Valle occurs seasonally. Currently, EBRPD is cooperating with their grazing tenant to develop a fence to restrict cattle from the lakeshore. California Department of Parks and Recreation and the Natural Resources Conservation Service (NRCS) are providing the funding for the fence, which will extend along most or all of the east shore of the lake (the west side is grazed only sparsely, as it is steeper and more heavily wooded). As an alternative water source, EBRPD is developing a network of solar-powered pumps, tanks, and troughs, with water being drawn out of the lake.

EBRPD has established a Residual Dry Matter (RDM) target level of 1,000-1,500 pounds per acre at Lake Del Valle (see discussion of RDM below). This target is written into the grazing lease and is monitored annually for compliance by the Park Superintendent. The tenant owns adjoining land, and is able to rotate cattle on and off of the parkland as necessary. EBRPD notes that they are working with the tenant to develop cross fencing to further control the rotation program. EBRPD also has an active invasive species removal program at Lake Del Valle, and staff notes that native perennial grasslands are in good condition in areas around the lake.

Agencies operating in adjacent watersheds have developed resource management plans that are designed to protect drinking source water quality. These plans provide local information and strategies that are useful for land owners and managers in the SBA Watershed. These include the following:

- A plan prepared for the **San Francisco Public Utilities Commission** (SFPUC) (EDAW 1997) provides a local example of a resource management plan developed for an agency with jurisdiction over grazing lands. This plan's objective was to reduce the risk of contamination by waterborne pathogens to drinking water sources from activities occurring on grazed lands under the jurisdiction of SFPUC. The plan included a grazing management strategy and a leasing strategy. The Grazing Strategy was designed to reduce the risk of viable pathogen discharges into surface waters by enhancing the health of the riparian zones, and maintaining and improving ecological resources in other parts of the watershed to ensure that vegetation growth is well-managed, and does not present a high fire risk. The Leasing Strategy includes criteria for lessee selection and a set of lease requirements and terms related to stocking rate requirements, annual operating plans, water quality protection, timing of calving, and staffing.

- The **East Bay Municipal Utility District** (EBMUD) developed a Range Resource Management Plan (RRMP) to support multiple objectives including water quality, biodiversity, fire control, maintenance of current levels of runoff, and revenue generation (EBMUD 2001). Components of the RRMP include spring and fall field surveys, annual grazing plans, allotment management plans, water quality sampling, integrated pest management, review by Fisheries and Wildlife staff, and management for special status species.

Grazing Management

Grazing is a land management tool utilized by many agencies as well as private landowners to control fire hazard, maintain the general health of natural resources, and to generate revenue. Grazing, however, can introduce contaminants of concern to drinking water sources if not properly managed. The impact of excessive vegetation removal can cause erosion and contribution of sediment and organic matter to drinking water sources. The likelihood of such contamination is higher with proximity of grazing to waterbodies. Manure may contribute nutrients, bacteria, and pathogens to sources of drinking water through direct contact or via runoff. Such impacts can be prevented and mitigated by implementing conservation practices that are designed to manage the intensity, frequency, distribution, and timing of grazing; herd reproduction and health; structural rangeland improvements and treatments; and wildlife control.

Residual Dry Matter Management and Corresponding Stocking Level

Residual dry matter (RDM) is the amount of old plant material left on the ground at the beginning of a new growing season. RDM indicates the previous season's use and can be used to describe the health or condition of annual rangelands.

Properly managed RDM can provide a high degree of protection from soil erosion, nutrient losses, and fire hazard. RDM management requires determining primary productivity potential through site evaluation, and allotting herds at a density (defined as animal unit months[1]) that leaves an appropriate amount of RDM after the growing season to minimize soil erosion and reduce fire hazard. Target RDM levels may vary depending on resource management objectives but are influenced by slope: grazing areas with steeper slopes require higher RDMs to attain resource management objectives. Individual land managers should establish their own RDM target levels, based on their management objectives and the characteristics of their land. Both the RCD/NRCS and UCCE can assist land managers in establishing RDM target levels. RDM target levels used by local agencies vary:

- UCCE (1999)
  1,000 – 2,000 lbs/acre.

- EBMUD (2001)
  a minimum of 800 lbs/acre for gentle slopes (0-5%); 1,120 lbs/acre for moderate slopes (6 – 35%); 1,400 lbs/acre for steep slopes (> 35%).

- EBRPD (2001)
  600 lbs/acre on 0 – 30% slopes: 800 lbs/acre on 30-50% slopes: 1,000 lbs/acre on slopes 50% or greater; EBRPD staff report that the target range for RDM at Lake Del Valle is 1,000-1,5000 lbs/acre (Amme, pers. com., 2006).

Individual landowners and managers should establish their own RDM targets consistent with their resource management objectives and the conditions prevailing on their land; they should then monitor conditions to determine whether modifications to RDM targets may be necessary to meet their objectives.

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1 1 animal unit = 1,000 pounds, or approximately 1 cow or 5 goats.

Rotations/Exclusions

Limiting the amount of time cattle stay in the riparian zone, particularly during winter, and even excluding them from such areas can significantly reduce the likelihood that sediment or pathogens will contaminate source water. Practices may include rotating animals between different pastures to maintain RDM and prevent erosion, excluding them from riparian zones, or limiting the amount of time they spend there – either by herding them or by developing alternative water sources to "lure" them away from riparian zones. Excluding calves from riparian zones during calving season may be particularly effective in reducing risk of contamination from protozoa, since calves are more likely to be infected with these organisms (see next paragraph).

Livestock Management

Dry Season Calving

While there is no scientific evidence that cattle are the primary environmental source of *Cryptosporidium parvum, Giardiasis duodenalis* or pathogenic bacteria for surface water in California, investigations demonstrate that there is about a 5% occurrence of infection of these organisms in livestock (Alameda County RCD, 1999). Researchers have found that shedding of *C. parvum* in cow-calf herds is primarily limited to calves under four months of age (Alameda County RCD, 1999). Therefore, restricting the time of year in which calving occurs can be an effective method of reducing the likelihood that calves infected with such protozoa will contaminate human drinking water sources. SFPUC guidelines include timing calving to be 80% complete by September 30, and 100% complete by October 31 (EDAW 1997).

Herd Health Program

A herd health program designed to maintain healthy immune systems and minimize diarrheal infections can be an effective component of an overall plan designed to reduce the likelihood of contamination of drinking source water. A recommended minimum set of measures (Alameda County RCD, 1999) includes:

1) Routine vaccinations of all cattle for preventing Bovine Virus Diarrhea (which can act as an immunosuppressive disease) and *Leptospira pamona* bacteria infections;

2 Routine internal parasite control (deworming) to prevent clinical parasite infections;

3) Prevention of selenium and copper deficiencies with appropriate supplementation depending on current herd status;

4) Avoidance of overcrowding during calving and subsequent grazing when young stock are present;

5) Keeping herds closed to the introduction of outside suckling (neonatal) calves. Calves from outside the herd may introduce *C. parvum* or other pathogens to the herd;

6) Routine monitoring of herds for disease, prompt treatment of cattle when disease is observed, and keeping records of vaccinations and treatments.

7) Prevent cattle undergoing veterinary treatment including vaccines, antibiotics, medicines, and hormones, etc. from contaminating the water supply.

Structural Range Improvements

Structural improvements to rangelands can also reduce the likelihood of introducing contaminants of concern to drinking water sources.

Riparian Zone Management

A very effective means for protecting water quality in grazed rangeland is to control access of cattle to riparian zones. Cattle may be excluded from riparian areas using fencing, or may be attracted away from riparian areas with supplemental water and feed sources. Short grassland buffers, approximately 1.1–2.1 meters wide, can also significantly reduce the transport of sediment, nutrients, bacteria, and pathogens into surface waters (Atwill 2006; Tate et al. 2006). Cattle crossings of creeks should be carefully sited, and if necessary constructed to prevent erosion. Fencing at crossings may be useful to keep cattle from wandering in the stream channel. Enhancing riparian cover can prevent destabilization and erosion of streambanks, act as a buffer to filter contaminants present in runoff, and provide wildlife habitat. When riparian areas are grazed, impacts to tree and shrub foliage may be minimized by carefully timing grazing access: grazing of riparian pastures in the fall should begin once there is adequate new grass growth (> 2 inches) and should end in the late spring/summer once most of the annual grasses have senesced (Alameda County RCD, 1999).

Supplemental Water, Salt, and Feeder Infrastructure

Providing supplemental water, salt, feed and shaded areas away from riparian zones can be an effective way to reduce the likelihood of contaminants entering sources of human drinking water. Strategic placement of supplemental sources of food and water may also be an effective tool for managing livestock distribution to achieve target RDM levels throughout a grazing unit. Developed water sources should be located so that cattle do not have to travel more than .5 to .75 miles in hilly topography to drink (Alameda County RCD, 1999). Springs may provide opportunities, as well as piping from other existing water sources and development of wells. Stock trails or walkways can be constructed to improve grazing distribution and access to food and water. Solar panels may be installed to provide power for pumps where there is no access to the power grid (Pers comm. 2005 Jeff Rasmussen and Dave Ammi, EBRPD).

Grade Stabilization/Erosion Management

Maintaining an appropriate RDM level and achieving favorable distribution of cattle on grazing lands will reduce the likelihood of grade destabilization and erosion. Also important are appropriate siting, design, and construction of roads, culverts, and drainage features. Where grade destabilization is evident, structures such as retaining walls, rock barriers, filter strips, and sediment basins can be constructed to direct and manage runoff and to minimize the likelihood of introducing contaminants to drinking water sources. Gullies and landslides may occur, particularly on lands with steeper slopes and highly erodible soils (as are found in much of the SBA Watershed) even in the absence of structures such as roadways and culverts. In cases where concentrated runoff is the cause of the gully, diverting or spreading the source water and stabilizing the headcut with armoring or plantings of deep-rooting perennial plants may prevent further development of the gully. Further downcutting may be prevented by grading to reduce slopes, accompanied by plantings as well as construction of checkdams and plantings to reduce the speed of water flowing through a gully. Monitoring of gullies will determine whether stabilization measures have been effective. Landslides may also be treated with practices that divert and drain water from the active slide, and by use of stabilizing vegetation, such as perennial grasses, shrubs, and trees.

Wildlife Control Program

Feces and urine from feral and wild animals can contaminate source water with pathogens. Wild animals that may be potential sources of waterborne pathogens and erosion in the SBA Watershed include deer, elk, coyotes, ground squirrels, mice, voles, gophers, beavers and wood rats (Alameda County RCD, 1999). Although waterfowl, fish, and amphibians are not known to be infected by *C. parvum*, they can be the source of other species of *Cryptosporidium* which can cross-react with the procedure for monitoring water for *Cryptosporidium* (Alameda County RCD, 1999*)*. In addition to creating a false positive water test, waterfowl could be responsible for transporting *C. parvum* oocysts from a fecal source to a water source via their digestive systems or their feet (Alameda County RCD, 1999).

Currently, the risk of contamination of drinking water posed by most wildlife species is not clearly understood, making it difficult to prescribe management measures, beyond general maintenance of ecological balance, with predictable outcomes for water quality improvement. Evidence for contributions of *C. parvum* from feral pigs, however, has been confirmed by research (Alameda County RCD, 1999). A flexible control program consisting of trapping and hunting feral pigs, and monitoring their densities and proximities to critical water sources, can reduce the likelihood of contamination. If a persistent, flexible pig population control program becomes infeasible because of legal, social, or other reasons, alternative actions could include strategic fencing, although it is relatively costly and inefficient (Alameda County RCD, 1999).

Invasive Vegetation and Wildlife Management

The range of conservation practices available to manage the type, quantity, and distribution of vegetation on grazed lands must often serve multiple objectives, e.g., forage quantity and quality, fire hazard reduction, wildlife habitat enhancement, and recreational enjoyment, in addition to water quality protection. Mechanical, chemical, biological, and physical methods may be employed to achieve these objectives.

In treating rangeland, woody species are typically targeted to reduce competition for space, moisture, and sunlight for plants with forage value, and to reduce fire hazard. Planting of “critical areas” (Table 5-1, NRCS Std 342), those with unstable and highly erodible soils, can reduce runoff and stream sedimentation, and can improve wildlife habitat and visual resources. Prescribed burns can achieve a number of vegetation management objectives, including reducing wildfire hazards, controlling undesirable vegetation and plant disease, preparing sites for planting, improving quantity and quality of forage, facilitating distribution of grazing animals, improving wildlife habitat, and maintaining ecological integrity. Mechanical treatments of grazed lands can improve plant cover and water quality by aerating the soil, increasing infiltration and available moisture, reducing erosion, and protecting low lying land or structures from siltation.

TABLE 5-1
RANGELAND MANAGEMENT STRATEGIES AND ASSOCIATED CONSERVATION PRACTICES

Conservation Practice	Reference[a]
Forage Management	
Prescribed Grazing	NRCS CPS 528a
Forage Harvest Management	NRCS CPS 511
Annual Range Forage Production	UCCE 2001
Forage Management During Drought	UCCE 2001b
Predict Forage Quality	UCCE 2001c
Residual Dry Matter Management	UCCE, EBRPD 1987 (app D)
Use Exclusion	NRCS CPS 472
Livestock Management Practices	
Livestock Parasite Control	Alameda County RCD, 1999
Timing of Calving	Alameda County RCD, 1999
Livestock Management During Drought	UCCE
Structural Rangeland Improvements	
Access Roads [b]	NRCS CPS 560
Filter Strips [b]	NRCS CPS 393
Grade Stabilization Structures [b]	NRCS CPS 410
Obstruction Removal [b]	NRCS CPS 500
Sediment Basins [b]	NRCS CPS 350
Structure for Water Control [b]	NRCS CPS 587
Underground Outlet [b]	NRCS CPS 620
Spring Development [b]	NRCS CPS 574
Pipelines [b]	NRCS CPS 516
Ponds [b]	NRCS CPS 378
Diversions [b]	NRCS CPS 362
Grassed Waterway [b]	NRCS CPS 412
Supplemental Feeding and Salting	NRCS CPS
Troughs and Tanks	NRCS CPS614
Wells	NRCS CPS 642
Animal Walkways and Trails	NRCS CPS 575
Drainage Water Management	NRCS CPS 554
Landslide Treatments	NRCS CPS 453, Alameda County RCD, 1999
Fencing	NRCS CPS 382
Rock Barrier	NRCS CPS 555
Riparian Zone Management	
Grassed Waterway [b]	NRCS CPS 412
Stream Channel Stabilization [b]	NRCS CPS 584
Riparian Forest Buffer [b]	NRCS CPS 391
Stream Habitat Improvement and Management [b]	NRCS CPS 395
Streambank Protection [b]	NRCS CPS 580
Use Exclusion	NRCS CPS 472
Grassland Buffers	UCCE, Atwill et al. 2006; Tate et al. in press; CBARCD 2003
Monitoring Riparian Grazing Systems	UCCE
Fish Passage	NRCS CPS 394
Channel Stabilization Standard	NRCS CPS 584
Dams	NRCS CPS 402
Stream Crossing	NRCS CPS 578

TABLE 5-1 (continued)
RANGELAND MANAGEMENT STRATEGIES AND ASSOCIATED CONSERVATION PRACTICES

Conservation Practice	Reference[a]
Riparian Zone Management (cont.)	
Streamside Planting Guide	SMCSTPPP
Channel Vegetation Practice	NRCS CPS 322
Constructed Wetland	NRCS CPS 656
Riparian Herbaceous Cover	NRCS CPS 390
Sediment Inventory Monitoring	UCCE Pub 8014
Shallow Water Management for Wildlife	NRCS CPS 646
Visual Assessment Riparian Health	UCCE Pub 8089
Rangeland Treatments	
Critical Area Planting [b]	NRCS CPS 342
Brush Management	NRCS CPS 314
Prescribed Burning	NRCS CPS 334
Firebreak	NRCS CPS 394
Range Planting	NRCS CPS 550
Grazing Land Mechanical Treatment	NRCS CPS 548
Pest Management	NRCS CPS 595; EBRPD 1987
Gopher Management	UCCE 2002
Ground Squirrel Management	UCCE 2002
Rabbit Management	UCCE 2002
Vole Management	UCCE 2002
Wildlife Wetland Habitat Management	NRCS CPS 644
Wildlife-Upland Habitat Management	NRCS CPS 645
Animal Husbandry Facilities	
Closure Waste Impoundments	NRCS CPS 360
Manure Management – management plans (handling, storing, composting, spreading), riparian buffers	Orange and San Diego County 2004; NRCS Equine Facilities Assistance Program 2003; CBARCD 2002 and 2003
Pellet Bedding Management	NRCS Equine Facilities Assistance Program 2003
Roof Runoff Management	NRCS CPS 558
Building and Site Design	Orange and San Diego County 2004
Fire Prevention	CAL FIRE & ACFD (see Table 5-4)

EBRPD = East Bay Regional Park District
CBACRD = Council of Bay Area Resource Conservation Districts
NRCS = Natural Resource Conservation Service
UCCE = University of California Cooperative Extension
SMCSTPPP = San Mateo County Stormwater Pollution Prevention Program
CAL FIRE = California Department of Forestry and Fire Protection
ACFD = Alameda County Fire Department

[a] See Table 5-5 at the end of this chapter for contact information for the information sources used in this chapter.
[b] Conservation Practices that are associated with Alameda County Permit Coordination Program (see Ch 6 for description).

An Integrated Pest Management (IPM) program can be used to minimize the negative impacts of pests on rangeland resources. IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural techniques, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment. The Alameda County Agriculture Department and the Santa Clara County Division of Agriculture can provide additional information and advice on pest control, pesticide use and pesticide safety. The U.C. Davis Weed Research and Information Center also offers information, workshops, seminars, and conferences on weeds and weed control.

Concentrations of Livestock and Domestic Animals

If not managed properly, facilities where livestock and domestic animals are penned, corralled, and raised can be significant sources of contaminants of concern to drinking water sources. In general, the level of risk is relative to the number and size of the animals kept in a confined area, the length of time they are confined, the proximity to waterways, and the season. For example, corrals that are used only for short-term confinement of cattle, and that are located away from waterways, pose little risk to water quality. On the other hand, even a small horse stable, if not properly located and managed, can pose a substantial risk.

Application of siting and design criteria can reduce the risk of transporting contaminants to waterways. Buildings, covered areas, high-use holding and exercising areas, wash racks, manure storage areas, roads, compost/bedding piles, and trails should be set back away from waterways and outside of flood-prone areas. Roof runoff should be diverted away from structures, contaminated areas, and waterways, and then transported to a stable outlet that will not cause erosion. Paddocks should be built with gravel or sand bottoms for percolation and filtration of water and pollutants. Buildings should be located on sites with a slope of less than 10%. Vegetative filter strips should be used to separate holding/exercise areas and manure collection areas from waterways. Manure and bedding should be cleaned regularly, and composted.

Fire Prevention

The San Antonio Valley and Lake Del Valle Watershed is characterized by dry, warm summers and drought-resistant vegetation that is adapted to frequent wildfires. Major sources for wildfires are typically lightning strikes and inappropriate human actions. The goal of fire prevention systems is to reduce the risks associated with wildfires and to provide resource protection and personal safety. It is important for both land managers and homeowners to prevent fire. More information about fire prevention measures also applicable to rangeland fire prevention is located in the Rural Residential Development section on “Fire Prevention” (page 5-17).

Conservation of Agricultural and Open Space Lands

The relatively low density and low intensity of land uses in the Lake Del Valle and Bethany watersheds should be considered important to protection of the integrity of watershed lands, and to the protection of water quality produced by these watersheds. Increases in density or intensity of landuse, for example through residential or recreational subdivision and development of rangelands, or through construction of new roads and railroads,[2] could pose major risks to the water supply. Encouraging landowners to conserve existing land uses is an important element in protecting SBA water quality.

Conservation practices are most commonly viewed within a context of actions that can prevent or mitigate contamination and degradation of resources. Conservation practices, however, may also be viewed more broadly within a context of preserving and maintaining existing rural, low density, and low-impact land uses and landscapes. Strategies for preventing fragmentation of land ownership and for conserving agricultural and open space land uses include conservation easements, Williamson Act contracts, and County zoning. See Table 5-2 for references.

TABLE 5-2
CONSERVATION PRACTICES TO PRESERVE AND MAINTAIN EXISTING RURAL LAND USES

Conservation Activity	Conservation Practice	Reference[a]
Wildlife Habitat Planning	Habitat Conservation Plans; Natural Communities Conservation Plans	Santa Clara County et al. 2005b
Retirement of Agricultural Land	Conservation Cover	NRCS CPS 327
Conservation of Agricultural Land	Agricultural Reserve Contract	California Department of Conservation, Division of Land Resource Protection 2006.
Conservation of Rural Land	Land Purchase and Conservation Easements by Conservation Organizations and Agencies	TNC: http://nature.org/aboutus/howwework/conservationbuyer/help/art11639.html SCOSA: http://www.openspaceauthority.org/Properties/acquisitions/preserved_and_protected_land.htm California Rangeland Trust: www.rangelandtrust.org East Bay Regional Parks District Tri-Valley Conservancy

SCOSA = Santa Clara Open Space Authority
TNC = The Nature Conservancy

[a] See Table 5-5 at the end of this chapter for contact information for the information sources used in this chapter.

[2] In recent years there have been proposals for the construction of both a major new freeway and a high-speed rail line through the upper portion of the Lake Del Valle watershed.

As urban areas encroach on rural areas, rural land uses may be threatened. The California Land Conservation (Williamson) Act provides the opportunity for landowners to enter contracts that maintain specified agricultural uses while providing property tax breaks. Organizations such as The Nature Conservancy, Tri-Valley Conservancy, East Bay Regional Park District, California Rangeland Trust and the Santa Clara Open Space Authority have been actively involved in conserving agricultural and rural land uses in Alameda and Santa Clara Counties. These entities have programs both to acquire lands in fee and to purchase conservation easements on lands while maintaining the original ownership. Practices to establish conservation cover and Habitat Conservation Plans or Natural Community Conservation Plans can contribute to achieving this objective.

Roads and Trails

Roads and trails alter natural drainage patterns, disturb large areas of land, and have the potential to contribute sediment, chemicals, and nutrients to streams and waterways, particularly when they are not well-constructed or well-maintained. In general, the effect of roads and trails on water quality is a function of their size, density, level of use, and location on the landscape. Reducing the density of road and trail networks through proper closure of unneeded, problematic, and high-risk roads and trails, and modifying remaining roads and trails to make them more stable and less likely to concentrate runoff and transport it to waterways, are key concepts for conservation practices for roads and trails. Use of simple road designs to provide adequate grade and drainage, resulting in low-maintenance roads and trails, can greatly reduce the likelihood of causing erosion and transport of contaminants to drinking source water. Conducting road inventories and properly closing roads that are no longer needed can effectively reduce the risk of erosion and contaminant transport.

Road Design and Maintenance Guidelines

Individual landowners should conduct inventories of their road and trail networks and develop their own road and trail plans. The overall goals of a road and trail plan should include the following:

- Maintain the minimum of roads and trails necessary for access and transportation needs.
- Roads and trails should be stable, and should be simple and inexpensive to maintain.
- Roads and trails should be “hydrologically invisible” that is, they should minimize alteration of natural drainage, particularly avoiding concentration of runoff and alteration of natural streambeds and hillsides.
- Roads and trails should avoid sensitive areas, such as riparian areas, habitat for special status species, and steep lands prone to landsliding.

Design, construction, and maintenance guidelines for low-maintenance, low-impact ranch and forest roads are contained in several publications tailored to conditions in California. The EBRPD has its own set of road design and construction guidelines, as well as a trail manual for maintenance and operation of trails within the District. EBRPD also holds periodic workshops on low-impact, low-maintenance roads. See Table 5-3. Some basic guidelines follow:

TABLE 5-3
STRATEGIES FOR REDUCING CONTAMINATION FROM ROADS AND TRAILS AND ASSOCIATED CONSERVATION PRACTICES

Conservation Practice	Reference[a]
Low Maintenance Road Design Principles	Guenther 1999; Alameda County RCD, 1999
Road Planning, Construction, Maintenance, Decommissioning	Mendocino County RCD/ CDF/SCS 1994; Guenther, 1999 EBRPD, 1981
Trail Design and Maintenance	State of California Parks and Recreation Department – http://www.foothill.net/fta/work/maintnotes.html; EBRPD, 1995

[a] See Table 5-5 at the end of this chapter for contact information for the information sources used in this chapter.

Road Location and alignment: Avoid construction of roads in riparian areas and on hillslopes in excess of 40%. Road alignments should minimize stream crossings and should avoid unstable ground and areas that provide habitat for sensitive plant and animal species. Maximum road grade should not exceed 8%, except for short distances. Plan road alignments around control points, such as rock outcrops and stream crossings.

Road Drainage: The basic aim of road drainage should be to allow road surfaces to drain quickly and efficiently, without accumulating water on the road surface or concentrating it once it runs off. For most forest and ranch roads, both all-season and dry-season roads, the most efficient and easy-to-maintain design is an outsloped road with rolling dips as the permanent cross-road drainage structures. Whether using rolling dips, ditch relief culverts, or waterbars, however, cross-road drains should empty onto stable hillslopes where sediment-laden runoff will not reach a stream channel. If inboard ditches are used, ditch relief culverts must be placed with sufficient frequency to prevent gullying during large storms, and ditches and ditch relief culverts should not drain directly to stream channels.

Stream Crossings should be designed to accommodate the 100-year storm event. Bridges and arched culverts are preferable to regular culverts, especially where fish passage is a concern. Ordinary culverts should be placed at the same or steeper gradient as the natural stream channel.

Road Surfaces: Roads that will be used during the wet season should be paved or armored with a sufficient depth of angular rock to prevent damage to the road bed, and to maintain positive drainage. Seasonal roads should be clearly designated as such and should be physically closed if there is a possibility of use during the wet season. Dry season use of an approved road surface tackifier will reduce dust production and help prevent damage to the road surface.

Road Decommissioning: Unneeded, problematic, and poorly located roads should not be abandoned, but should be actively decommissioned. Decommissioning usually involves the same heavy equipment used to build roads: hydraulic excavators and tractor-dozers. Decommissioning may require a Department of Fish and Game permit and involve these steps:

- Pulling back fill slopes and placing fill material on the road bed to attain an extreme outslope, or to reestablish the natural hillslope;
- Removing stream crossings, including bridges or culverts and fill. If necessary reestablishing the natural stream gradient through the crossing site and stabilizing the new banks. Disposal of spoil in a stable location that does not drain to the stream system;
- Mulching and seeding bare earth and disturbed areas to prevent erosion until natural vegetation reestablishes itself.

Road Maintenance: Road maintenance should be used to maintain or reestablish the design gradient and drainage structures, and to achieve a good running surface. Stream crossings, especially culverts, should be checked before the beginning of the rainy season and after large storms to ensure that they are free of debris and that water can flow freely through them. For smaller culverts, use of trash racks at the culvert inlet can help prevent clogs.

Weed Control: Disturbed soil along roadways promotes the spread of weeds and invasive species; roadside grasses and weeds present a risk for wildfire. Road maintenance should include removal of invasive species, cutting back brush, and mowing of roadside grass. Use of herbicides to control weeds and grasses is discouraged. The Alameda County Agriculture Department and the Santa Clara County Division of Agriculture can provide additional information and guidance on weed control.

Trail Design, Maintenance and Repair

- Linear gradient of a trail should be less than 10%; in highly erosive, sandy soils, even a 5% slope may be excessive.
- Construct trails that follow contour lines as much as possible, rather than ones that cross them vertically, allowing water to create trenches and cause erosion.
- Construct a 3%–4% cross-slope to get the water off the trail as soon as possible.
- Avoid creating switchbacks. Although switchbacks are often the only solution to the problems of rock outcrops and steep slopes, they frequently provide hikers with an irresistible temptation to shortcut the trail and cause erosion over a web of indiscriminately created volunteer routes.
- Design trails to avoid sensitive areas.
- Install and maintain water bars. Done well, a series of water bars can effectively eliminate erosion and stabilize a trail for years. Done poorly, water bars can accentuate trail erosion and become dangerous tripping hazards
  - Set the water bar at a 60 degree angle across the trail. A water bar set perpendicular (90 degrees) across the trail will not divert the water off the trail. A water bar set 30 degrees across the trail can be awkward to hike or ride over.

- Extend the water bar such that water is carried completely off the trail to a steep side slope. Otherwise, the water flow will bypass the water bar and erosion will occur.
- Provide rock at the downslope end of the water bar to dissipate the energy of the flowing water, thereby minimizing erosion.
- The top of the water bar should be nearly flush with the trail tread to minimize tripping hazards.
- On trails with equestrian access, the boulders used for rock water bars must be large enough to prevent horses from kicking them out of place. The rocks should overlap like shingles on a roof to prevent water from flowing between rocks and eroding away the integrity of the water bar.
- Maintain water bars regularly. The excess soil and debris that build up at the downslope end of the water bar needs to be periodically graded out to assure that water flows off the trail.

Rural Residential and Commercial Development

Rural residential development pressures in the SBA Watershed are most keenly felt in the area around Lake Del Valle and in the San Antonio Valley. Currently there is little if any development pressure in the Bethany Reservoir watershed. Rural residential development, if not managed properly, can negatively affect water quality in the SBA Watershed, including the potential for increased erosion, increased wastewater loading from septic systems, and increased pesticide and herbicide runoff. Recommended conservation practices for rural residential development are discussed below, and summarized in Table 5-4. Some of these practices are already required by existing regulations as well.

Design and Construction of Rural Homes

Design and siting of rural homes in the SBA Watershed should follow sound principles of low-impact development. These include careful selection of home sites, including gardens, stables, and other outbuildings and facilities, to minimize grading and road building, to enable good drainage, to avoid disturbance of sensitive habitats, and to leave adequate buffers for streams, swales, and riparian areas. Selection criteria for building materials and finishes should include reduction of fire risk and reduction of the potential for contaminated runoff.

Construction of rural homes should adhere to best management practices for erosion control (ABAG, 1986, 1995). These include limiting construction to the dry season, use of temporary sedimentation ponds, protection of waterways, and management of disturbed soil and soil stockpiles. For the latest information on applicable ordinances, contact County Departments of Public Works, Environmental Health, and Planning; Table 5-4 contains a list of references for information available in 2006.

Septic Systems

Handling of sewage waste may contaminate drinking water sources, even when sewage systems are properly located away from such sources (e.g., pumped wastes spilled during transport). For this reason, in addition to adhering to the standards of septic and wastewater treatment installation

TABLE 5-4
STRATEGIES FOR REDUCING CONTAMINATION FROM RURAL RESIDENTIAL DEVELOPMENT AND ASSOCIATED CONSERVATION PRACTICES

Conservation Practice	Reference[a]
Design and Construction	
Construction Erosion Control	ABAG, 1986, 1995
Green Design Principals	Build it Green, 2005; US Green Building Council, 2006
On Site Wastewater Treatment Systems	
Standard and Advanced Septic System Design	Alameda County Dept of Environmental Health 2007 Ordinance & Regulations
	Santa Clara County Code Title B Regulations, Section B11-67
SWRCB Onsite Wastewater Treatment Regulations	http://www.waterboards.ca.gov/ab885/
	http://www.waterboards.ca.gov/ab885/docs/scopingreport.pdf
	http://www.waterboards.ca.gov/ab885/technosite.html
Standard Septic System Installation	Alameda County 2005a
Septic System Abandonment	Alameda County 1997
Wells	
Drinking Water Well Testing	Alameda County 2005
Well installation and protection	University of California Cooperative Extension Pub 8086
	CA Well Standards http://www.dpla2.water.ca.gov/publications/groundwater/CA_Well_Standards_Bulletin74-90_1991.pdf
Article 580: Destruction of Test or Exploration Holes	California Groundwater Association 1999
Yard and Garden	
Residential Pollution Prevention Strategies: Lawn, Garden, and Around the Home	Alameda County Clean Water Program, 2006
Management of Household Hazardous Waste	Alameda County Household Hazardous Waste Program: http://stopwaste.org/home/index.asp?page=293
	Santa Clara County Household Hazardous Waste Program http://www.sccgov.org/portal/site/deh/
Fire Prevention	
Fire Fuel Management	Santa Clara County Firesafe Council: http://www.sccfiresafe.org/
	Diablo Firesafe Council of Alameda and Contra Costa Counties: http://www.diablofiresafe.org/04_aboutus.htm#
Fire Prevention	Alameda County Fire Department www.acgov.org/fire
	California Department of Forestry and Fire Protection www.fire.ca.gov

[a] See Table 5-5 at the end of this chapter for contact information for the information sources used in this chapter.

and abandonment summarized below, it is good practice to develop emergency procedures and reporting protocols for accidental spills.

Design standards for septic systems are codified and regulated by county ordinances in both Alameda and Santa Clara counties. The Alameda County Onsite Wastewater Treatment System Regulations (Alameda County Department of Health 2007) describe septic system requirements, including site and soil conditions required for a standard system, septic tank sizing, sizing of a leachfield based on percolation tests, and leachfield location requirements. Requirements for Standard & Advanced septic systems that additionally include sizing of a leachfield based on percolation tests and performance monitoring requirements for “Advanced” systems are also included. The County also has adopted standards for installation and abandonment of septic systems. The State Water Resources Control Board is also in the process of updating state-wide onsite wastewater treatment regulations and has information on applicable technologies available on their website. (See Table 5-5 for contact information.)

Wells

To prevent contamination of drinking water wells and groundwater, it is important to follow standards for the design, testing, and abandonment of wells. Ensuring that a wellhead is properly sealed can prevent surface contaminants and backflow from entering the well. Proper filling of exploration or test holes that are not developed into wells is also important to prevent potential leakage of surface runoff containing contaminants, or cross contamination between aquifers of different water quality penetrated by the boreholes. General information on groundwater contamination and wells, including a “Guide for the Private Well Owner,” can be obtained from the Santa Clara Valley Water District. Information on well testing can also be obtained from Alameda County Environmental Health. (See Table 5-5 for contact information.)

Yard, Garden, Home, and Auto

Rural yards and gardens can contribute contaminated runoff and increased erosion to waterways. Use of pesticides and herbicides should be minimized and comply with applicable laws to reduce this possibility. Home-scale livestock facilities, including pens, chicken coops, and stables, have the potential to develop sufficient concentrations of nutrients and other contaminants to pose a problem; see the section above on Animal Husbandry Facilities. Driveways, roads, and trails, including off-highway vehicle trails, should follow the design and maintenance guidelines discussed above. Fuel reduction and other practices to reduce the potential for catastrophic fire will also help protect water quality. Other good housekeeping practices that will help prevent water pollution include the following:

- Do not allow garbage or debris to pile up, but dispose of it or recycle it properly and regularly;
- Recycle used motor oil and antifreeze; the California Integrated Waste Management Board's Used Oil Recycling Program supports to properly recycle used motor oil and antifreeze. Used oil can be turned into fuel oils or used as a raw material for the refining and petrochemical industries. Waste antifreeze may contain heavy metals such as lead, cadmium, and chromium in high enough levels to make it a regulated hazardous waste. A

hazardous waste may never be dumped on land or discharged into a sanitary sewer, storm drain, ditch, dry well or septic system. Used motor oil and antifreeze can be recycled at community oil collection centers, service stations, car dealers or other maintenance facilities, and, in some areas, through local curbside recycling programs.

- Avoid purchase of household chemicals that will not be used up; dispose of household hazardous waste, including paint, automotive fluids, batteries, fluorescent tubes, electronic equipment, pesticides, herbicides, and other chemicals at a household hazardous waste facility or collection event;
- Keep cars, trucks, and gas and diesel-powered equipment free of leaks; store fuel in approved containers only, with secondary containment in case of leaks or spills; fuel vehicles and equipment in established locations where spills can be contained;
- Sweep driveways rather than washing them down.

Fire Prevention

Fires – can leave behind areas susceptible to erosion that may contribute sediment and organic matter to drinking water sources. Slopes left uncover by range or forest fires are especially vulnerable to accelerated soil erosion, flash flooding, and debris flows because of the absence of vegetation and roots to bind the soil. The Alameda County Fire Department (Cal Fire) and California Department of Forestry and Fire Protection (ACFD) provide practical fire management advice and fire code information to people living and working rural and agricultural. Building homes in wooded or rural areas is aesthetically pleasing, but homeowners need to be aware of the potential dangers from fire and how to protect their homesites from it. Homes that are even far away from a fire can still be impacted. The best way to control a fire is to prevent it from occurring in the first place. In order to accomplish this homeowner can plan ahead; practice good fire safe habits, and provide adequate defensible space around the home.

Defensible Space Standards

To provide separation from the wildland area and a home, it is important to take into a consideration the clearance required to create "defensible space". Section 4291 of the California Public Resource Code requires clearing flammable vegetation around structures a minimum of 30 feet, and up to 200 feet depending on conditions. In areas of dense vegetation, at least 100 feet of clearance is needed. However, on hillsides where fire spreads more rapidly and with greater intensity, a clearance of 200 feet or more may be advisable.

Vegetation Management

Within 100 feet of any building, structure or within 10 feet of any roadway, highway, street, alley or driveway which is improved or used for vehicle travel, mature trees should be maintained, so that no leafy foliage, twigs or branches are within 6 feet of the ground. Any portion of a tree that extends within 10 feet of the outlet of a chimney or stovepipe should be removed. All combustible rubbish, dead trees, bushes, etc., should be removed from the property and annual grasses or weeds should be maintained at a height of no more that 4 inches. Remove any accumulation of dead leaves, twigs, and other combustible materials from beneath trees or bushes. The roof of a structure should be maintained free of leaves, needles, dead vegetative growth, or other combustible litter.

Rural Fire Management

Anyone operating machinery and equipment in rural areas is advised to have access to appropriate firefighting equipment. The Alameda County Fire Department requires fire extinguishers to be provided in all residential occupancies to protect both the building structure and its contents. The recommended classification of extinguisher is a 2A10BC rated extinguisher. An extinguisher should be placed in the kitchen area and one in the garage or storage area. Basic fire fighting equipment includes: shovels, axes, rakes, pulaskis, and personal safety gear.

Landowners and managers should consider avoiding harvesting, grinding, welding, mowing or driving vehicles though dry grass or crop during a time of extreme fire danger.

Landowners are advised to carry out proper vegetation management to control risk of fire. Livestock grazing as discussed earlier in this chapter can be used on all public and private lands as a cost-effective method of avoiding dangerous fuel buildup. In the absence of a grazing program, other means of vegetation management must be employed to avoid an increase in average fuel loading rates.

For more information regarding fire prevention, see Table 5-5 on the end of this chapter for contact information for Alameda County Fire Department or California Department of Forestry and Fire Protection. People living and working in rural areas are encouraged to join local community groups to help improve fire safety on their property and in their community.

Recreation

The principal recreational facilities in the SBA Watershed are centered on the two reservoirs themselves: Lake Del Valle, the centerpiece of Del Valle Regional Park, which is part of the East Bay Regional Park District; and Bethany Reservoir State Recreation Area, managed by the California Department of Parks and Recreation. As noted in Chapter 3, Bethany Reservoir is used primarily for non-contact water recreation as well as for contact water recreation. Lake Del Valle Regional Park offers a broad array of recreational opportunities, including water recreation, fishing, camping, picnicking, and multi-use trails.

Providing an adequate quantity and distribution of sanitary facilities and trash receptacles, and properly siting and monitoring recreational facilities, will help minimize the risk of contaminating the drinking water supply. In areas not equipped with restrooms, information about appropriate methods of human sanitation may be posted. Parks can develop and enforce ordinances and/or programs that reduce risk of contamination. For example, ordinances have been implemented in the EBRPD that prohibit incontinent individuals from water contact activities in non-chlorinated swimming areas, that require swim breaks, and that exclude dogs from bathing beaches. In addition, at Lake Del Valle, EBRPD maintains sanitary facilities, collects trash, and maintains cleanliness on roads, trails, picnic areas, and campgrounds. EBRPD has recently upgraded their wastewater collection and treatment system to prevent spills and system overloads.

Education and effective dissemination of information to park visitors can also greatly minimize the risk that humans and their companion animals will contaminate source water with microorganisms. Pamphlets, signs, maps, and presentations can be used to educate visitors about activities that affect water quality, the linkage between their activities and the drinking water supply, and measures to protect water quality. EBRPD posts information on water quality at the Lake Del Valle swimming beaches, and provides information to the public on keeping the park, and the water supply, safe and clean.

Conservation Practices for Lake Del Valle Watershed

The Lake Del Valle watershed supports a variety of recreational uses, including water contact and non-water contact recreation, camping, hiking, picnicking, equestrian riding, and recreational vehicle riding (OHVs). As well, a large portion of the watershed is managed as rangeland. Since the Lake Del Valle watershed is about 33 times the size of the Bethany Reservoir Watershed, it is not possible to be as prescriptive at specific locations. Instead, this section describes conservation practices that could be incorporated into plans to protect water quality by reducing the likelihood of contamination to zones of highest risk.

1. Grazing Land Management
    a. Forage Management: Encourage private landowners and livestock operators to work with the Natural Resources Conservation Service (NRCS) and University of California Cooperative Extension (UCCE) to set target RDM levels or other appropriate management guidelines.
    b. Structural Range Improvements: Work with NRCS and UCCE to encourage private landowners and livestock operators to limit access to riparian and shoreline areas; to establish grassland buffers; fence riparian areas as appropriate; and to develop alternative drinking and feeding sites.
    c. Livestock Management: Encourage private landowners and livestock operators to develop a herd health program, and to schedule calving to occur during the dry season or to limit access by calves to the lake.
    d. Wildlife Control: Encourage lawful feral pig control as appropriate for the landowner and consider lawful control of large concentrations of rodents and other wildlife, as appropriate.
2. Road and Trail Design and Maintenance
    a. Work with NRCS, RCD and UCCE to provide assistance to private landowners to conduct inventories of their road systems, to develop road system plans, and to implement low-maintenance and low-impact design and maintenance practices.
3. Rural Residential – Encourage landowners to:
    a. consult County standards for design, installation, and abandonment of septic systems and wells.

   b. consider design principles to reduce erosion potential for any hillside construction and runoff management.
   c. properly manage debris, household chemicals and household hazardous wastes.

4. Recreation
   a. Install signs explaining the role that Lake Del Valle plays in drinking water delivery, and those activities that are appropriate and inappropriate in the watershed.
   b. Include discussion of the Lake Del Valle watershed as a drinking water source during talks given by Park Rangers.
   c. Include discussion of the Lake Del Valle watershed as a drinking water source in water quality-related training sessions for Del Valle park rangers and lifeguards.
   d. Limit access to the area of the lake in close proximity to the SBA intake structure.

Conservation Practices for Bethany Reservoir Watershed

Water quality in the Bethany Reservoir Watershed may be improved by a combination of conservation practices that include limiting cattle access to riparian zones, improving infrastructure to manage sediment loads (particularly yields from large events), and altering road drainage to reduce erosion and sediment delivery to the reservoir.

Due to the relatively small size of the Bethany watershed, it is feasible to recommend conservation practices that are location-specific:

1. Create capacity to store the estimated 100-year sediment load (Schaaf and Wheeler 2004) in watersheds (upstream of access-road crossing and downstream from access-road crossing to the concrete flume).
   a. Enlarge existing “basin-like sediment trap” upstream of access-road crossing above concrete intake chute, creating a 20 acre-feet capacity.
   b. Develop a smaller 0.9 acre-feet sediment basin between access-road and concrete flume.

2. Improve road drainage on DWR roads in the Forebay, including outsloping roads where feasible and redirecting roadside drainage to hillslopes and swales; disconnect ditches from the flume and from the reservoir.

3. Grazing Land Conservation Practices including
   a. Forage Management: work with NRCS and UCCE to set target RDM levels or other appropriate management guidelines.
   b. Structural Range Improvements: limit access to riparian and shoreline areas
   c. Land Treatments: adopt low-maintenance road practices.
   d. Livestock Management: develop a herd health program, including timing of calving, if one is not already in place.

4. Support DWR to Develop Grazing Lease Strategy based on AUMs[3] for DWR lands

5. Recreation Outreach

    a. Include discussion of Bethany Reservoir as a drinking water source and water quality protection in training sessions for State park rangers.

    b. Install signs explaining the role that Bethany Reservoir plays in drinking water delivery, and those activities that are appropriate and inappropriate in the watershed.

Information Sources

Table 5-5 lists the sources of information and published documents referenced in this chapter. Many documents are available in PDF format on the internet.

[3] AUMs = Animal Unit Months. One AUM is the amount of forage required by one animal unit (defined as a 1,000 lb beef cow with or without a nursing calf) for one month.

TABLE 5-5
INFORMATION SOURCES FOR CONSERVATION PRACTICES

Agency or Organization	Acronym	Physical Address(es)	Phone Number(s)	Website	Notes
Alameda County Agriculture Department		**Main Office** 224 W. Winton Ave. Room 184 Hayward, CA 94544 **Field Office** 3575 Greenville Rd. Livermore, CA 94550	(510) 670-5232 (925) 245-0846	http://www.acgov.org/cda/awm/agprograms/pesticide.htm	For general gardening questions, insect identification, plant diseases: University of California Agricultural Extension Service, Master Gardeners (510) 567-6812 http://cealameda.ucdavis.edu/index.cfm http://www.ipm.ucdavis.edu/
Alameda County Environmental Health	ACEH	1131 Harbor Bay Parkway Alameda, CA 94502-6577	(510) 567-6700	http://www.acgov.org/aceh/septic/index.htm (Septic System & Drinking Water Testing Information) http://www.acgov.org/aceh/drink/index.htm (Drinking Water Program Information)	
Alameda County Fire Department	ACFD	835 East 14th Street, Suite 200, San Leandro, CA 94577	(510) 670-5853	www.acgov.org/fire (Alameda County Fire Department)	
Alameda County Household Hazardous Waste Program		5584 La Ribera Street Livermore, CA 94550	(800) 606-6606	http://stopwaste.org/home/index.asp?page=293	Address is for the drop-off facility in Livermore; check website for hours and days of operation
Alameda County Resource Conservation District	ACRCD	3585 Greenville Rd. Suite 2 Livermore, CA 94550	(925) 371-0155	http://carcd.org/wisp/alameda/	
Alameda Countywide Clean Water Program		951 Turner Court, Room 300 Hayward, CA 94545	(510) 670-5543	http://cleanwaterprogram.org/publications_home.htm	
Association of Bay Area Governments	ABAG	101 Eighth Street Oakland, CA 94607	(510) 464-7900	http://www.abag.ca.gov/abag/overview/pub/erosion.html	
Build It Green		1434 University Avenue Berkeley, CA 94702	(510) 845-0472	http://www.builditgreen.org/	
California Rangeland Trust		1221 H Street Sacramento, CA 95814-1910	(916) 444-2096	http://www.rangelandtrust.org/crt/	
California Association of Resource Conservation Districts	CARCD	801 K St., Suite 1415 Sacramento. CA	(916) 457-7904	http://www.carcd.org/	
California Department of Conservation, Division of Land Resource Protection	DOC-DLRP	801 K Street, MS 18-01 Sacramento, CA 95814-3528	(916) 324-0850	http://www.consrv.ca.gov/DLRP/	
California Department of Forestry and Fire Protection	CAL FIRE	15670 S. Monterey Street Morgan Hill, CA 95037	(408) 779-2121	www.fire.ca.gov	

TABLE 5-5 (continued)
INFORMATION SOURCES FOR CONSERVATION PRACTICES

Agency or Organization	Acronym	Physical Address(es)	Phone Number(s)	Website	Notes
California Department of Parks and Recreation	DPR	1416 9th Street Sacramento, CA 95814	(800) 777-0369	http://www.parks.ca.gov/?page_id=23071	See on-line trail manual at: http://www.foothill.net/fta/work/maintnotes.html
Diablo Firesafe Council of Alameda and Contra Costa Counties		P.O. Box 20801 El Sobrante, CA 94820	(510) 435-1405	http://www.diablofiresafe.org/04_aboutus.htm#	
East Bay Regional Park District	EBRPD	2950 Peralta Oaks Court P.O. Box 5381 Oakland, CA 94605	(510) 635-0135	http://www.ebparks.org/	(510) 562-PARK (24-hour automated information)
California Groundwater Association	CGA	PO Box 14369 Santa Rosa, CA 95402	(707) 578-4408	http://www.groundh2o.org/	
Guadalupe-Coyote Resource Conservation District	GCRCD	888 N. First Street # 204 San Jose, CA 95112	(408) 288-5888	http://home.pacbell.net/gcrcd/	
Mendocino County Resource Conservation District	MCRCD	206 Mason St., Suite F Ukiah CA 95482	(707) 462-3664	http://mcrcd.org/	The Handbook for Forest and Ranch Roads is available only as hardcopy, for sale by MCRCD.
Natural Resources Conservation Service	NRCS	3585 Greenville Rd. Suite 2 Livermore, CA 94550	(925) 449-6682	http://efotg.nrcs.usda.gov/treemenuFS.aspx	eFOTG section IV on the left side of the web page for the Conservation Practice Standards
Orange and San Diego Counties Equine Program		5555 Overland Avenue, Suite 3101 San Diego, CA 92123	(858) 694-3122	http://www.co.san-diego.ca.us/ awm/docs/equestrian_bmp.pdf	
San Mateo County Stormwater Pollution Prevention Program	SMCSTPPP	c/o City/County Assn. of Governments 555 County Center, Fifth Floor Redwood City, CA 94063	(650) 363-4305	http://www.flowstobay.org/	
Santa Clara County Division of Agriculture		**San Jose Office:** 1553 Berger Drive San Jose, CA 95112	(408) 918-4600	http://www.sccgov.org/portal/site/ag/	San Jose - Agricultural Biologist Office Duty phone line: (408) 918-4610
		Morgan Hill Office: 605 Tennant Avenue, Suite G Morgan Hill, CA 95037	(408) 465-2900		Morgan Hill - Agricultural Biologist Office Duty phone line: (408) 465-2908
Santa Clara County Department of Environmental Health		Department of Environmental Health Household Hazardous Waste Program 1555 Berger Drive, Suite 300 San Jose, CA 95112-2716	(408) 299-7300	http://www.sccgov.org/portal/site/deh/menuitem.244564f66e6d425580b558bb35cda429/?path=%2Fv7%2FEnvironmental%20Health%2C%20Department%20of%20%28DEP%29%2FHazardous%20Materials%20Compliance%20Division%2FHousehold%20Hazardous%20Waste%20Home	
Santa Clara County Firesafe Council	SCFSC	n.a.	(408) 779-2121	http://www.sccfiresafe.org/	

TABLE 5-5 (continued)
INFORMATION SOURCES FOR CONSERVATION PRACTICES

Agency or Organization	Acronym	Physical Address(es)	Phone Number(s)	Website	Notes
Santa Clara Open Space Authority	SCOSA	6830 Via Del Oro, Suite 200 San Jose, CA 95119	(408) 224-7476	http://www.openspaceauthority.org/	
Santa Clara Valley Natural Community Conservation Plan and Habitat Conservation Plan	SCVHCP/ NCCCP	70 West Hedding Street East Wing, 7th Floor San Jose, CA 95110	(408) 299-5789	http://www.sccgov.org/portal/site/hcp/	
Santa Clara Valley Water District	SCVWD	5750 Almaden Expressway San Jose, CA 95118-3686	(408) 265-2600	www.valleywater.org	Information on wells & contamination: http://www.valleywater.org/Water/Where_Your_Water_Comes_From/Local_Water/Wells/index.shtm http://www.valleywater.org/Water/Where_Your_Water_Comes_From/Local_Water/Groundwater/index.shtm Guide to the private well owner: http://www.valleywater.org/media/pdf/Guide%20for%20Well%20Owners.pdf Groundwater Guardian Information: http://www.valleywater.org/media/pdf/guardian2.pdf
State Water Resources Control Board	SWRCB	1001 I Street Sacramento, CA 95814	(916) 341-5250	http://www.swrcb.ca.gov/ab885/index.html	Information on state-wide onsite wastewater treatment regulatory developments and available technologies.
Tri-Valley Conservancy		1736 Holmes Street Livermore, CA 94550	(925) 449-8706	http://www.trivalleyconservancy.org/	
The Nature Conservancy	TNC	California Chapter 201 Mission Street, 4th Floor San Francisco, CA 94105-1832	(415) 777-0487	http://www.nature.org/wherewework/northamerica/ states/california/	
U.S. Green Building Council	USGBC	1800 Massachusetts Avenue NW Suite 300 Washington, DC 20036	(202) 828-7422	http://www.usgbc.org/	
University of California Cooperative Extension	UCCE	Santa Clara County 1553 Berger Drive, Bldg. 1 San Jose, CA 95112	(408) 282-3110	http://californiarangeland.ucdavis.edu/water_quality/ best%20mgt%20prac.htm	Many publications available at this site
University of California Cooperative Extension Weed Research and Information Center	Weed RIC	University of California, Davis One Shields Ave. Davis, CA 95616	(530) 752-1748	http://wric.ucdavis.edu/	

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CHAPTER 6
Implementation Plan

Introduction

This chapter presents a general plan for implementation of the SBA Watershed Protection Program. Included are an outline of an educational program, which will be further developed by the Education Subcommittee of the Watershed Workgroup during the summer of 2006; identification of funding sources and incentives for implementation of the conservation practices outlined in Chapter 5; and a framework for roles, responsibilities, and actions for plan implementation.

Education Program

The basic initial components of the Education Program are spelled out in the grant agreement for this project, and include the following:

- Detailed development of the educational program by a committee of the Watershed Workgroup;
- Development and distribution of three to four brochures targeting stakeholder groups to raise awareness of water quality issues and to encourage protection of water quality;
- Development and placement of four signs at Bethany Reservoir and Lake Del Valle to raise awareness of water quality issues and to encourage protection of water quality;
- Development of materials for two types of workshops targeting specific stakeholder groups; hold four workshops, prepare, distribute, and collect survey of participants;
- Prepare a report on the results of the education program.

The Education Committee of the Watershed Workgroup is currently developing the specifics of the initial education program elements.

In addition, the Watershed Workgroup expressed interest in developing a long-term education program that might include some of the following elements:

- Coordination of efforts with ongoing Alameda Creek Watershed programs;
- Volunteer monitoring of water quality in SBA system inputs, especially the Lake Del Valle watershed;

- Involvement of school groups in activities and programs to restore and to increase understanding of local watersheds;
- Development of an educational video about water quality protection for viewing in the Lake Del Valle Visitors' Center.
- Ongoing education efforts to increase knowledge and understanding of local water supply and water quality issues, including the Sacramento-San Joaquin Delta.
- Continued maintenance of signs developed as part of the initial education program.
- Continued distribution of brochures developed as part of the initial education program.
- Support for future workshops on water quality protection topics in the watershed areas.

All three SBA Contractors currently have public educational programs in place that can be used to enhance the public's understanding of the SBA Watershed. For example, Zone 7 has previously coordinated water quality monitoring activities with Camp Arroyo, located downstream of Lake Del Valle, during World Water Monitoring Day. Zone 7 also has a Schools Program, in which Zone 7 staff work with high school students and their teachers on various science fair projects related water supply and protection. Similarly, ACWD has an Education Program that includes water-related classroom presentations and teacher workshops, and the SCVWD has a community education and outreach program for teachers and presentations at schools that focuses on pollution prevention, water conservation, groundwater, and water treatment.

Implementation of Conservation Practices

The conservation practices described in Chapter 5 are intended for use primarily by individual landowners and managers, both public and private, interested in reducing the impact of past and present land use activities on water quality. Continued and expanded voluntary adoption of conservation practices by landowners and managers in the SBA watershed who are interested in improving management of their own land is an essential component of the SBA Watershed Protection Program implementation.

In addition to the three SBA Contractors, agencies and organizations that are already involved in assisting landowners to adopt conservation practices to protect water quality include the following:

- **Resource Conservation Districts (RCDs).** RCDs are special districts, usually formed within county boundaries. They have independent boards of directors (often appointed by the County Board of Supervisors) that establish conservation goals for the district. The SBA watershed is within two RCDs: the Alameda County RCD and the Guadalupe-Coyote RCD (north Santa Clara County). In addition, the Stanislaus County RCD provides some services to the San Antonio Valley and Upper San Antonio Valley. RCDs work closely with the US Department of Agriculture, Natural Resources Conservation Service (NRCS – see below) to provide technical and financial assistance to interested private landowners for implementation of conservation practices in line with the district's conservation goals. Typically, conservation goals may include maintenance and improvement of soil fertility and productivity of agricultural lands; water conservation and protection of water quality; natural resources enhancement; and the continuation of agricultural land uses. RCDs are not regulatory agencies.

- **The United States Department of Agriculture Natural Resources Conservation Service (NRCS)** partners with local RCDs to provide advice and other assistance to the RCD board and staff, as well as technical assistance and financial support for ranchers and farmers and other landowners and land use planners.
- **University of California Cooperative Extension** conducts applied research and works with private ranchers and farmers to disseminate research results and to provide technical assistance to improve practices, including protection of water quality and sensitive habitat.

The following describes several local programs already in place that may be able to assist in promoting the adoption of the conservation practices outlined in Chapter 5. These programs provide technical assistance and/or funding.

Alameda County Permit Coordination Program

Lead Agencies: ACRCD, USDA-NRCS in collaboration with USFWS, NMFS, USACE, CDFG, SFRWQCB, ACPWA

Purpose: To streamline the permitting process for voluntary conservation projects on non-Federal lands in Alameda County.

Target Audience: Landowners with conservation projects receiving technical and financial assistance from ACRCD and NRCS may be eligible for permit coverage under permit coordination program.

Description: Eligible projects tier off of programmatic biological opinions and other programmatic agreements or master permits developed in advance by ACRCD and NRCS in collaboration with partnering regulatory agencies. A conservation project must consist of at least one of 18 federally standardized NRCS conservation practices designed to improve wildlife habitat and soil stability on agricultural lands as well as along rural and urban waterways (see Table 5.1). Landowner must agree to comply with the permit conditions required by each agency.

Environmental Quality Incentives Program (EQIP)

Lead Agency: USDA-NRCS

Purpose: To promote agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical help to assist eligible participants in installing or implementing structural and management practices on eligible agricultural land.

Target Audience: Farmers and ranchers who are engaged in livestock or agricultural production on eligible land.

Description: Voluntary conservation program that offers contracts with a minimum term that ends one year after the implementation of the last scheduled practices and a maximum term of ten years. These contracts provide incentive payments and cost-shares to implement conservation practices. EQIP activities are carried out according to an environmental quality incentives program plan of operations developed in conjunction with the producer that identifies the appropriate conservation practice or practices to address the resource concerns. The practices are subject to NRCS technical standards adapted for local conditions. The local Resource Conservation District approves the plan. EQIP may cost-share up to 75 percent of the costs of certain conservation practices. Incentive payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the incentive. However, limited resource producers and beginning farmers and ranchers may be eligible for cost-shares up to 90 percent. Farmers and ranchers may elect to use a certified third-party provider for technical assistance. An individual or entity may not receive, directly or indirectly, cost-share or incentive payments that, in the aggregate, exceed $450,000 for all EQIP contracts entered during the term of the Farm Bill.

Wildlife Habitat Incentives Program (WHIP)

Lead Agency: USDA-NRCS

Purpose: To establish and improve fish and wildlife habitat

Target Audience: Conservation-minded landowners who are unable to meet the specific eligibility requirements of other USDA conservation programs.

Description: Voluntary program for people who want to develop and improve wildlife habitat primarily on private land but also on federal land when the primary benefit is on private or Tribal land, State and local government land on a limited basis, and Tribal land. The program targets wildlife habitat projects on all lands and aquatic areas. WHIP provides both technical assistance and up to 75 percent cost-share assistance. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed. There are shorter-term agreements to install practices that are needed to meet wildlife emergencies, as approved by the NRCS State Conservationist. NRCS also provides greater cost-share assistance to landowners who enter into agreements of 15 years or more for practices on essential plant and animal habitat. NRCS can use up to 15 percent of its available WHIP funds for this purpose. NRCS does not place limits on the number of acres that can be enrolled in the program or the amount of payment made. NRCS continues to provide assistance to landowners after completion of habitat development activities. This assistance may be in the form of monitoring habitat practices, reviewing management guidelines, or providing basic biological and engineering advice on how to achieve optimum results for targeted species.

Grassland Reserve Program (GRP)

Lead Agency: USDA-NRCS, Farm Service Agency, National Forest Service

Purpose: To conserve vulnerable grasslands from conversion to cropland or other uses and conserve valuable grasslands by providing landowners the opportunity to protect, restore, and enhance grassland, rangeland, pastureland, shrubland and certain other lands on their property while maintaining viable ranching operations. To rehabilitate grasslands.

Target Audience: Landowners with grasslands

Description: The program emphasizes support for working grazing operations; enhancement of plant and animal biodiversity; and protection of grassland and land containing shrubs and forbs under threat of conversion to cropping, urban development, and other activities that threaten grassland resources. Applications may be filed for a permanent easement, thirty-year easement, a rental agreement, or a restoration agreement with NRCS or FSA at any time. Participants voluntarily limit future use of the land while retaining the right to conduct common grazing practices; produce hay, mow, or harvest for seed production (subject to certain restrictions during the nesting season of bird species that are in significant decline or those that are protected under Federal or State law); conduct fire rehabilitation; and construct firebreaks and fences. GRP contracts and easements prohibit the production of crops (other than hay), fruit trees, and vineyards that require breaking the soil surface and any other activity that would disturb the surface of the land, except for appropriate land management activities included in a conservation plan. Each state will establish ranking criteria that will prioritize enrollment of working grasslands. The ranking criteria will consider threats of conversion, including cropping, invasive species, urban development, and other activities that threaten plant and animal diversity on grazing lands.

Ranch Water Quality Planning and Rural Road Management Courses

Lead Agency: UCCE, NRCS

Purpose: Train ranchers to evaluate water quality and how their ranching practices may influence it, and to implement water quality protection practices.

Target Audience: Rangeland property owners, ranch managers

Description: The Ranch Water Quality Planning course teaches the basic concepts of watersheds, nonpoint source pollution (NPS), self-assessment techniques, and evaluation techniques. Management goals and practices are presented for a variety of rangeland situations. Participants work toward developing a Ranch Water Quality Plan for their property during the course. An additional course on Rural Road Management has also been available in the past.

Implementation Roles and Responsibilities

Implementation of the SBA Watershed Protection Program will require commitments from several agencies to implement different portions of the Program. The cooperation and assistance of various parties will be necessary for successful implementation of the program, including government agencies, organizations, and individual landowners. Implementation will include the following:

- Commitment of SBA Contractors for staff time and other resources for:
  - Watershed Protection Program Plan maintenance and revision;
  - Coordination of ongoing education and outreach programs, both those implemented in 2006 - 2007, and beyond; and
  - Coordination of an ongoing stakeholder group to guide implementation policies and priorities.
- Continued cooperation between agencies involved in local water quality protection and improvement of land management practices, including the RCDs, NRCS, UC Cooperative Extension, Alameda County Agricultural Advisory Committee and the SBA Contractors. This may include joint funding (for example to support cost-share programs) or sponsorship of programs, workshops, and outreach programs that will provide water quality benefits in high priority areas or target high priority conservation practices;
- Ongoing cooperation and joint program development with agencies with a direct stake in the SBA and the SBA Watershed, including Department of Water Resources, Department of Parks and Recreation, East Bay Regional Parks District, and the SBA Contractors.
- Ongoing cooperation and joint program development with other agencies with an interest in local water quality protection and watershed health, including the California Department of Health Services, county Environmental Health Services, Alameda County Planning Department.
- Participation in watershed groups, such as the Alameda Creek Watershed Steering Committee.
- Legislative advocacy when needed to ensure continuation, expansion and funding of the activities and partners described in this plan.
- Participation in County ordinance and general plan review and updating to ensure consistency with the needs of this plan.
- In consultation with the RCD, NRCS and UCCE, review current and future watershed management research and new technologies and its application to the objectives of this plan.