Section 4
Water Reuse Opportunities

As a result of population increases throughout California, many communities are approaching, or have already reached, the limits of their available water supplies. Water reuse in these areas has already become necessary for conserving and extending available water supplies, and presents communities with an alternate wastewater disposal method, providing pollution abatement by diverting effluent discharge away from sensitive surface waters.

Water reuse in California is an accepted and growing practice. With 590,000 acre-feet (AF) of recycled water used in California in 2002, California has set forth a statutory goal to recycle 1,000,000 AF of water per year by 2010.

As discussed in this section, recycled water is also an accepted and growing practice in the North San Pablo Bay Restoration and Reuse Project (Project) initial study area, with 9,667 AF of water reused in 2005 and current, local plans underway to deliver about 15,000 acre-feet per year (AFY) in 2020.

This section describes the regulatory guidelines governing the treatment and distribution of recycled water in California and discusses the potential for generating and delivering recycled water within the study area.

4.1 Recycled Water Use Regulations in California

The regulations that pertain to recycled water use in California can be found in a collection of documents commonly referred to as the "Purple Book," which includes excerpts from the following:

- ***Health and Safety Code*** – Division 104 (Environmental Health Services), Part 12 (Drinking Water), Chapter 4 (California Safe Drinking Water Act);
- ***Water Code*** – Division 7 (Water Quality), Chapters 2, 6, 7, 7.5, & 22;
- ***California Code of Regulations (CCR) Title 17*** – Division 1 (State Department of Health Service), Chapter 5 (Sanitation), Group 4 (Drinking Water Supplies); and
- ***CCR Title 22*** – Division 4 (Environmental Health), Chapters 1, 2, & 3. (California Department of Public Health 2001)

Of the documents listed above, the governing document for regulating recycled water use in California is CCR Title 22, Division 4, Chapter 3 (Title 22).

According to Title 22, recycled water can be used for irrigation, wetlands, restricted and non-restricted recreational impoundments, landscape impoundments, industrial or commercial cooling or air conditioning, toilet flushing, and industrial and construction applications.

Title 22 establishes quality and treatment standards for the beneficial use of recycled water. The four recycled water quality standards (organized with the highest level of treatment first and the lowest level of treatment last) are as follows:

Disinfected tertiary recycled water: A filtered and subsequently disinfected wastewater that meets the following criteria:

- The filtered wastewater has been disinfected by either:
  - A chlorine disinfection process following filtration that provides a contact time (the product of total chlorine residual and modal contact time measured at the same point) value of not less than 450 milligram-minutes per liter at all times with a modal contact time of at least 90 minutes, based on peak dry weather design flow; or
  - A disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 99.999 percent of the plaque-forming units of F-specific bacteriophage MS2, or polio virus in the wastewater. A virus that is at least as resistant to disinfection as polio virus may be used for purposes of the demonstration.
- The median concentration of total coliform bacteria measured in the disinfected effluent does not exceed [a most probable number (MPN)] of 2.2 per 100 milliliters [mL] utilizing the bacteriological results of the last seven days for which analyses have been completed, and the number of total coliform bacteria does not exceed an MPN of 23 per 100 mL in more than one sample in any 30-day period. No sample shall exceed an MPN of 240 total coliform bacteria per 100 mL.

Disinfected secondary-2.2 recycled water: Recycled water that has been oxidized and disinfected so that the median concentration of total coliform bacteria in the disinfected effluent does not exceed an MPN of 2.2 per 100 mL utilizing the bacteriological results of the last seven days for which analyses have been completed, and the number of total coliform bacteria does not exceed an MPN of 23 per 100 mL in more than one sample in any 30-day period.

Disinfected secondary-23 recycled water: Recycled water that has been oxidized and disinfected so that the median concentration of total coliform bacteria in the disinfected effluent does not exceed an MPN of 23 per 100 mL utilizing the bacteriological results of the last seven days for which analyses have been completed, and the number of total coliform bacteria does not exceed an MPN of 240 per 100 mL in more than one sample in any 30-day period.

Undisinfected secondary recycled water (also known as oxidized wastewater): Wastewater in which the organic matter has been stabilized, is non-putrescible, and contains oxygen.

Table 4-1 summarizes the water quality standards set by Title 22 for agricultural and urban uses of recycled water. The table is organized with the highest level of treatment at the top and the lowest level of treatment at the bottom.

Table 4-1
Title 22 Standards and Uses of Recycled Water

Treatment Standard	Use
Disinfected tertiary recycled water	• Food crops, including all edible root crops, where the recycled water comes into contact with the edible portion of the crop • Parks and playgrounds • School yards • Residential landscaping • Unrestricted access golf courses • Any other irrigation not prohibited by other sections of the CCR
Disinfected secondary-2.2 recycled water	• Food crops where the edible portion is produced above ground and not contacted by the recycled water
Disinfected secondary-23 recycled water	• Cemeteries • Freeway landscaping • Restricted access golf courses • Ornamental nursery stock and sod farms where access by the general public is not restricted • Pasture for animals producing milk for human consumption • Any non-edible vegetation where access is controlled so that the irrigated area cannot be used as if it were part of a park, playground, or school yard
Undisinfected secondary recycled water	• Orchards where the recycled water does not come into contact with the edible portion of the crop, • Vineyards where the recycled water does not come into contact with the edible portion of the crop • Non-food-bearing trees • Fodder and fiber crops and pasture for animals not producing milk for human consumption • Seed crops not eaten by humans • Food crops that must undergo commercial pathogen-destroying processing before being consumed by humans • Ornamental nursery stock and sod farms provided no irrigation with recycled water occurs for a period of 14 days prior to harvesting, retail sale, or allowing access by the general public

Source: 22 CCR

As described in Section 5.2.1, the Project is proposing to use recycled water for agricultural irrigation, urban landscaping, and environmental restoration in the study area. All the water used in this Project will therefore be treated to meet disinfected tertiary recycled water standards[1]. The potential demands for these uses are discussed in Section 2.2.1.

4.2 Potential Supplies of Recycled Water

Five wastewater treatment plants (WWTPs) were initially evaluated to determine their viability as sources of recycled water for the proposed Project[2]. The Napa Sanitation District (Napa SD) is in Napa County, the Sonoma Valley County Sanitation District (SVCSD) and City of Petaluma WWTPs are in Sonoma County, and the Novato Sanitary District (Novato SD) WWTP and Las Gallinas Valley Sanitary District (LGVSD) WWTP are in Marin County (see Figure 1-1 for locations).

Each of these agencies has been encouraged by state regulators to reduce the volume of treated wastewater discharged to San Pablo Bay and its tributaries in order to improve the quality of these water bodies. During the dry season, the San Francisco Bay Regional Water Quality Control Board (RWQCB) does not allow the discharge of treated wastewater to receiving water bodies.

Several of the agencies have developed recycled water use agreements with local vineyards, dairies, hay growers, golf courses, and parks. During the dry season, the agencies send treated wastewater that is in excess of their agreed recycled water commitments to holding ponds, wetlands, or rely upon the spreading and evapotranspiration of recycled water on local grassland.

Implementing the Project would allow increased beneficial use of recycled water. New recycled water users would then no longer be entirely dependent on surface or groundwater, thereby reducing the demand, potential water quality degradation, and groundwater level declines caused by use of these supplies.

The following sections describe the five wastewater agencies and their wastewater treatment facilities, including existing and future recycled water supplies available for the purposes of this Project.

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[1] The only exception occurs in initial Alternative 1, as described in Section 5, in which the pasture reuse areas south of the Petaluma wastewater treatment plant would receive disinfected secondary recycled water under a plan developed by the City of Petaluma. That local project is now no longer included in the Project (see Sections 1.3 and 5.4).

[2] As discussed in Section 1.3, Petaluma was initially evaluated in the Project, but is no longer participating.

4.2.1 Las Gallinas Valley Sanitary District

The LGVSD WWTP provides sanitation service to approximately 32,000 people within the area of Marinwood, Lucas Valley, Terra Linda, Santa Venetia, Los Ranchitos, and Smith Ranch Road (Williams 2008b).

Treatment capacities for the LGVSD WWTP are as follows:

- Preliminary Treatment: 24 million gallons per day (mgd)
- Primary Treatment: 20.5 mgd
- Secondary Treatment: 8 mgd (Williams 2008a)

During the wet season (November 1 through May 31), treated wastewater is discharged to the tidal portion of Miller Creek and ultimately to San Pablo Bay. During the non-discharge dry season (June 1 through October 31), treated wastewater is stored in ponds and used to irrigate local pasture and maintain wetlands. LGVSD also provides secondary treated wastewater to the Marin Municipal Water District (MMWD) for further treatment prior to reuse, as described below.

4.2.1.1 Recycled Water System

During the dry season, LGVSD sends approximately 1.0 to 1.5 mgd (3.1 to 4.6 AF per day) of its secondary effluent to an MMWD facility on-site where it is treated to Title 22 disinfected tertiary levels (Williams 2003). MMWD distributes the recycled water for use in local car washes, laundries, and cooling towers, and the irrigation of ballparks, business parks, and residences. LGVSD applies the remainder of the secondary treated effluent to 385 acres of adjacent land, which includes 20 acres of wildlife marsh, 40 acres of storage ponds, 10 acres of salt marsh, 20 acres of irrigated landscaping, and 200 acres of irrigated pasture (LGVSD 2005).

4.2.1.2 WWTP Flows

Because LGVSD has no raw water storage available on site, its daily influent flow pattern is effectively equal to its daily discharge flow pattern. The facility has a permitted average dry weather discharge flow of 2.92 mgd. Typical average dry and wet weather flows (ADWF and AWWF) for 2002 were 2.1 mgd and 3.2 mgd, respectively.

LGVSD's *Wastewater Treatment Plant Capital Improvement Plan* (Nute Engineering 2001) includes projections for wastewater generation at buildout. This plan approximates that ADWF and AWWF would be 3.9 mgd and 6.7 mgd at full buildout (estimated to be 2040).

Discussions with the LGVSD General Manager indicated that the anticipated future flow rates at buildout will likely be lower than those stated in the 2001 plan due to an aggressive local water conservation and collection system rehabilitation plan currently being developed and implemented. As a result of these measures, ADWF at buildout is expected to be 2.65 mgd (Petrie 2004). Figure 4-1 presents the LGVSD WWTP monthly average flow rates for 2002 operations, and the anticipated flows for 2020.

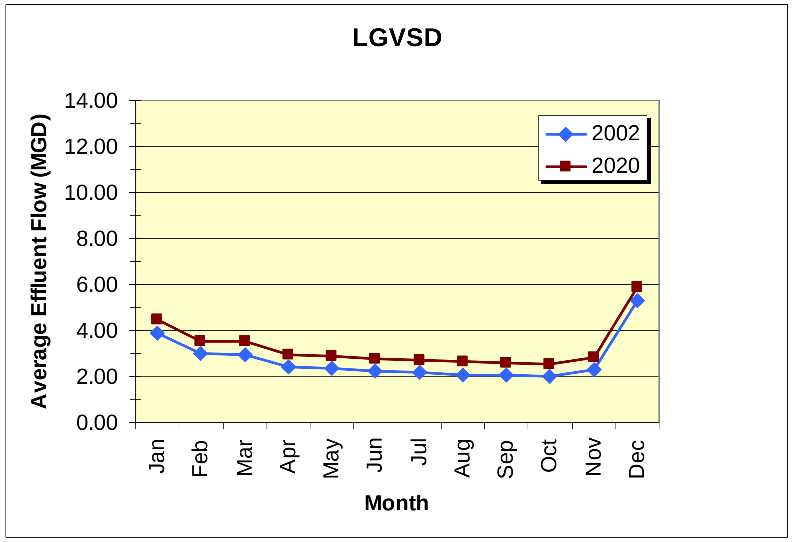

Figure 4-1
Average Current and Projected Monthly Flow
Las Gallinas Valley Sanitary District

4.2.1.3 Potential for WWTP Expansion and Upgrade

LGVSD's *Wastewater Treatment Plant Capital Improvement Program* includes the following goals for future upgrades (Nute Engineering 2001):

- Improve effluent quality during dry and wet weather to continue meeting National Pollutant Discharge Elimination System (NPDES) requirements;
- Meet peak wet weather flows; and
- Provide effluent volume and quality satisfactory for MMWD's production of Title 22 tertiary recycled water.

In addition to its plans for water conservation and collection system rehabilitation, LGVSD plans to implement WWTP system improvements to eliminate wet weather flow blending. This will be addressed with a new secondary clarification process, additional process piping, and process reconfiguration (Nute 2008).

During the summer of 2008, LGVSD will be increasing the WWTP's primary treatment from 20.05 mgd to 23.5 mgd. LGVSD will also be completing additional testing during the 2008/2009 winter to explore increasing secondary treatment capacity to at least 10 mgd (Williams 2008a).

4.2.2 Novato Sanitary District

The Novato SD WWTP provides service to about 60,000 residents within the City of Novato, an area of 28 square miles, and surrounding areas (Novato SD 2006). The WWTP discharges an average annual flow of 6.3 mgd, and can treat up to 6.55 mgd during the dry season. The RWQCB does not permit effluent discharge to San Pablo Bay between June 1 and August 31. Discharge during May and September is subject to lower limits for biochemical oxygen demand and suspended solids.

As specified in the district's NPDES permit, the Novato WWTP treats flows up to 9.0 mgd with primary clarification, activated sludge, secondary clarification, nitrification, gravity filtration, and disinfection with hypochlorite (James 2003). Flows between 9.0 and 16.0 mgd receive primary treatment followed by gravity filtration and disinfection. Flows above 16.0 mgd receive gravity filtration followed by disinfection.

4.2.2.1 Recycled Water System

During the dry season, the Novato SD sends secondary effluent to three District-owned irrigation parcels (totaling approximately 820 acres), two treated water storage ponds, and 15 acres of wildlife habitat. These parcels are on Route 37, approximately 1 mile northeast of the Ignacio pump station. The discharge pipe passes through the reclamation area to the San Pablo Bay mudflats where treated flow is discharged. In 2008, Novato SD began operating a new 0.5 mgd (1.5 AF per day) facility east of the Novato WWTP that is able to provide treatment to Title 22 tertiary levels. The facility is operational and is expandable to 1.0 mgd. The facility is located near the WWTP's discharge pipeline in the current irrigation fields and is designed to supply approximately 269 AFY of recycled water to the local Stone Tree Golf Course and other users (James 2003).

Novato SD is conducting a joint study with the North Marin Water District (NMWD) to identify additional future recycled water users in the City of Novato. If the local project were fully funded and implemented in the North and Central service areas, it could deliver an additional 177 million gallons per year (MG/Y) (542 AFY) of recycled water to urban users, primarily for landscaping irrigation (NMWD and Novato SD 2006).

4.2.2.2 WWTP Flows

In early 2008, Novato SD consolidated treatment operations from two WWTPs to one WWTP. Novato SD provided historical flow and water quality data for the Novato WWTP and former Ignacio WWTP for July 1, 2000 through June 30, 2003. Figure 4-2 presents monthly average flow rates that were derived from the total daily combined effluent flow rates. Because neither of Novato SD's WWTPs had raw water storage available on site, its daily influent flow pattern is effectively equal to its daily discharge flow pattern. The 2002 ADWF and AWWF flows for the combined facilities were 5.0 and 6.9 mgd, respectively.

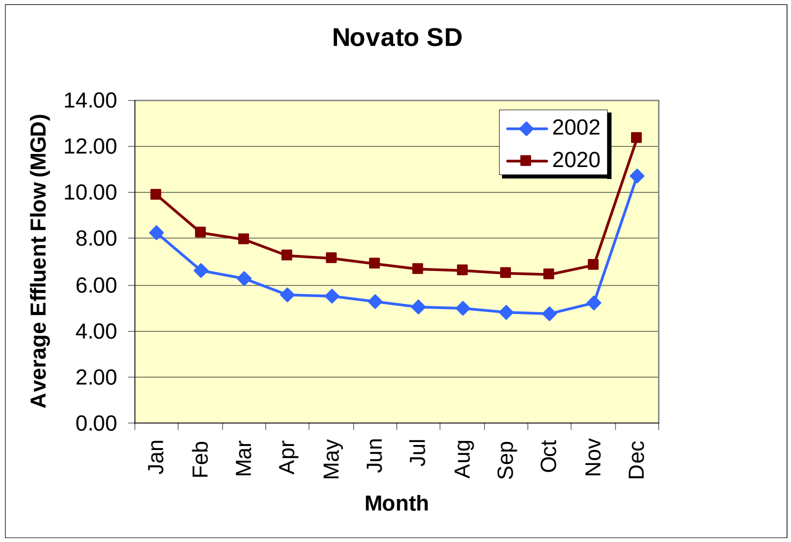

Figure 4-2
Average Current and Projected Monthly Flow
Novato Sanitary District

The *Novato Sanitary District Strategic Plan* (Larry Walker & Associates 2001) includes projected flows for 2020. Because a range of possible future ADWF was provided in the plan (6.06 to 7.17 mgd for 2020), the average of these values was used as the target ADWF for modeling purposes. The resulting flow curves for 2002 and 2020 are presented in Figure 4-2.

4.2.2.3 Potential for WWTP Expansion and Upgrade

The *Novato Sanitary District Strategic Plan* was developed to address district growth, new regulatory requirements, more stringent discharge enforcement, and facility upgrades. The Strategic Plan projected a population of 71,180 residents in 2020 using the Association of Bay Area Government's (ABAG) population projections from 2000 and the City of Novato's 1996 General Plan[3]. The Strategic Plan predicted future ADWF for the projected population using six methods, which resulted in the range of flows identified in Section 4.2.2.2. Novato SD plans to complete future facility upgrades within the next five to six years. The District is constructing an upgraded treatment plant that will have an average dry weather capacity of 7.05 mgd and will be capable of providing full secondary treatment and disinfection for wet weather

[3] ABAG's Projections 2005 forecasts a population of 61,900 for Novato's sphere of influence (ABAG 2004).

flows up to 40 mgd. The Strategic Plan discusses in detail the construction of the recycled water facility and identification of recycled water users.

4.2.3 City of Petaluma

The City of Petaluma[4] provides wastewater collection and treatment services to approximately 57,700 customers within the city limits and for the unincorporated Sonoma County community of Penngrove.

The existing treatment plant has an ADWF design capacity of 5.2 mgd, and is able to achieve secondary treatment levels. The plant presently discharges an ADWF of 4.5 mgd and annual average flow of about 5.2 mgd. During the period from October 21 through April 30, treated wastewater is discharged to the Petaluma River. As is the case for the other WWTPs in the region, the RWQCB does not permit the Petaluma WWTP to discharge to the Petaluma River during the dry season (May 1 through October 20). During this time, treated wastewater is reused for agricultural irrigation.

The regional planning agency forecasts a 2020 population of 65,300 for Petaluma and its sphere of influence (ABAG 2004). Because the existing treatment facility does not have adequate capacity for the future wastewater flows, the City plans to construct a new Water Recycling Facility; the new facility will be able to treat flows up to 6.7 mgd at secondary levels, and flows up to 5.2 mgd at tertiary levels.

4.2.3.1 Recycled Water System

The Petaluma WWTP annually supplies the Adobe Creek Golf Course with approximately 100 MG (317 AF) of secondary recycled water (City of Petaluma 2004). In the summer of 2004, Petaluma WWTP supplied the Rooster Run Golf Course with approximately 138 MG (424 AF) of secondary recycled water (City of Petaluma 2004). One small vineyard utilizes approximately 4 MG (12.3 AF) per dry weather season. Depending upon wet weather season precipitation levels and length, 533 to 822 MG (1,636 to 2,524 AF) is currently applied to approximately 800 acres of local pasture land to meet the no-discharge requirement during the summer months. Once tertiary recycled water becomes available through the new Water Recycling Facility, the City of Petaluma will provide approximately 485 MG (1,489 AF) of tertiary and 515 MG (1,581 AF) of secondary recycled water to both urban and agricultural customers. The City's calculations indicate that all the water generated from the Ellis Creek Recycling Facility during the dry season can be locally reused through the secondary and tertiary recycling programs.

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[4] As discussed in Section 1.3, Petaluma was initially evaluated in the Project, but is no longer participating.

4.2.3.2 WWTP Flows

The Petaluma WWTP's average annual discharge flow was 7.2 mgd and average annual secondary recycled water flow was 3.5 mgd for 2003. The maximum discharge season flow was 14 mgd and the maximum recycled flow was 7.7 mgd for 2003. The current facilities are permitted for an ADWF of 5.2 mgd and the new facilities are being designed for an ADWF of 6.7 mgd. Because data was not available from Petaluma, daily flow patterns from the neighboring Novato WWTP (serving an area of similar population and extent) was used as a surrogate to develop the 2020 Petaluma WWTP flow curves. Figure 4-3 presents the anticipated flow rates for the City of Petaluma WWTP in 2020, which simulate a flow pattern with an ADWF of 6.7 mgd.

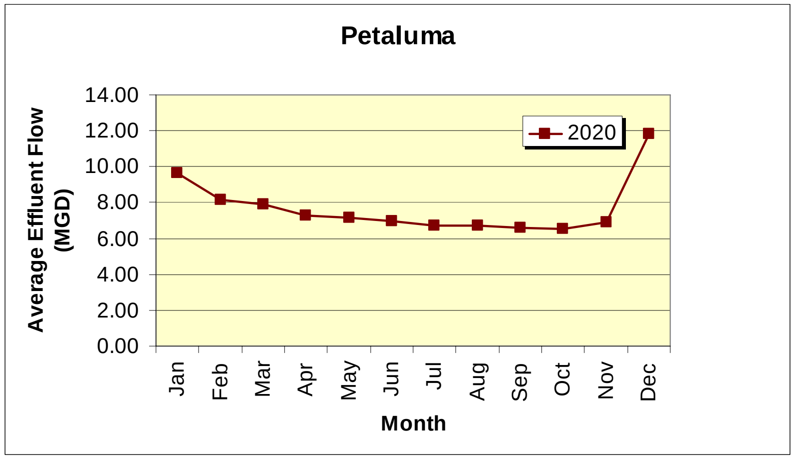

Figure 4-3
Average Projected Monthly Flow
City of Petaluma

4.2.3.3 Potential for WWTP Expansion and Upgrade

The new Ellis Creek Water Recycling Facility will allow the plant to treat 5.2 mgd to Title 22 tertiary standards and 6.7 mgd to secondary treatment standards for agricultural reuse. The City plans on using all of its tertiary recycled water for customers within the City of Petaluma and its secondary recycled water for customers that irrigate agricultural land adjacent to the new water recycling facility.

In 2007, the City indicated it did not want to be included in the Project, but would continue to develop its local projects on its own.

4.2.4 Sonoma Valley County Sanitation District

The SVCSD WWTP began operations in 1954 and provides service to 17,027 equivalent single-family dwellings within a 7-square-mile area (SVCSD 2006). The service area includes the City of Sonoma and incorporated areas of Glen Ellen, Boyes Hot Springs, and Agua Caliente, which has approximately 13,450 residents. The facility has the capacity to treat 16 mgd to a tertiary treatment level (Booker 2008c).

Between May 1 and October 31, the RWQCB does not permit the WWTP to discharge to local water bodies; therefore, SVCSD recycles the water for local irrigation and habitat projects. Between November 1 and April 30, SVCSD discharges treated wastewater into Schell Slough and Hudeman Slough, which ultimately flow into San Pablo Bay.

4.2.4.1 Recycled Water System

SVCSD has a well-established system and significant infrastructure for the conveyance, storage, and distribution of recycled water to local users. SVCSD delivers approximately 1,200 AF of recycled water to local users annually. Existing recycled water users are along Highway 121 and Highway 12, Thiodoro Road, Millerick Lane, Ramal Road, and Skaggs Island Road in the western part of the Los Carneros American Viticultural Area. The remaining treated wastewater discharges to wetlands owned by SVCSD and the California Department of Fish and Game. The discharge wetlands are approximately 3.5 miles southeast of the treatment plant.

4.2.4.2 WWTP Flows

SVCSD provided flow and water quality data for 1996 through 2002. During this period, the WWTP ADWF and AWWF flows were approximately 2.75 and 5.06 mgd, respectively.

SVCSD modeled its system to determine potential future flows. These calculations indicate the future plant ADWF flows at buildout, which may not occur until after 2020, will be 3.85 mgd (HDR 2002). The WWTP flow data from 2002 and the projected 2020 flow volumes are presented in Figure 4-4.

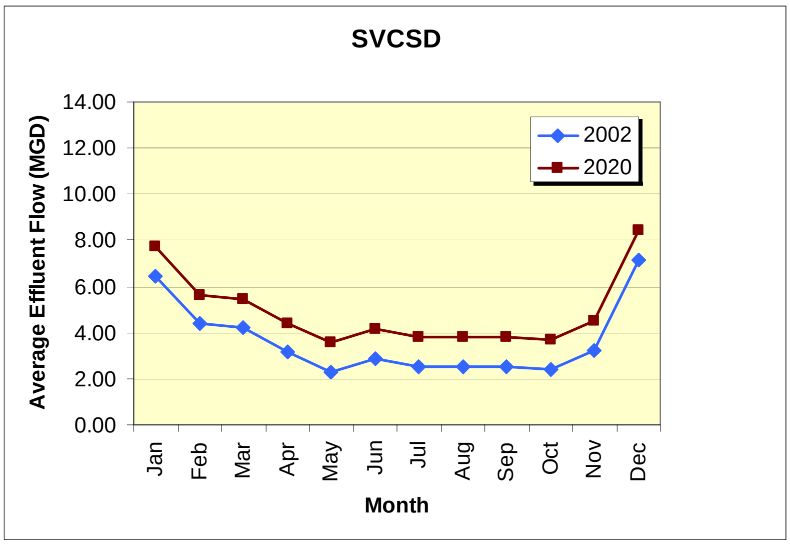

Figure 4-4
Average Current and Projected Monthly Flow
Sonoma Valley County Sanitation District

4.2.4.3 Potential for WWTP Expansion and Upgrade

SVCSD has upgraded its facility to add filtration as a tertiary treatment process element. The new tertiary element has a design capacity of 16 mgd (HDR 2002). Several mechanical components of the current plant limit the discharge capacity to 12 mgd and would require upgrades in the future.

4.2.5 Napa Sanitation District

The Napa SD treats wastewater from the City of Napa and surrounding unincorporated communities, and includes approximately 33,000 service connections (Napa SD 2006). Napa SD's WWTP has an average annual discharge of between 9.5 and 11.0 mgd, and a dry weather design capacity of 15.4 mgd.

Napa SD distributes recycled water for irrigation between May 1 and October 31. The RWQCB permits Napa SD to discharge to the Napa River between November 1 and April 30. As a result of plant upgrades completed in 2001, the facility is capable of generating 8.8 mgd of recycled water at a quality that meets the requirements of Title 22 disinfected tertiary levels for unrestricted use (Healy 2003).

4.2.5.1 Recycled Water System

The Napa SD Water Recycling Facility has two 10-AF recycled water reservoirs on-site. The adjacent WWTP includes four oxidation ponds that total 344 acres. Napa SD typically stores raw water in these ponds and then treats the water immediately before distribution. It may be possible for Napa SD to adjust its operations at the WWTP and use these ponds to store an additional 501 MG (1,540 AF) of recycled water for the project.

Existing Napa SD recycled water users include Chardonnay Golf Course and Vineyards, Somsky Ranch, Jameson Canyon Reclamation Site, Napa Airport, Hakusan Sake Factory, and Napa Corporate Park (Napa SD 2005). Recycled water users are along the discharge pipeline at Highway 29 and Jameson Canyon Road and further north along the Napa Valley Highway. In 2005, recycled water customers received 426 MG per year (1,307 AFY) (Napa SD 2005). Napa SD has identified potential future recycled water users including Kennedy Golf Course, Napa Valley College Ballfield, and Napa State Hospital.

4.2.5.2 WWTP Flows

Napa SD provided flow and water quality data for the years 1998 through 2002. Figure 4-5 presents effluent flows from 2002 and estimated 2020 flow data.

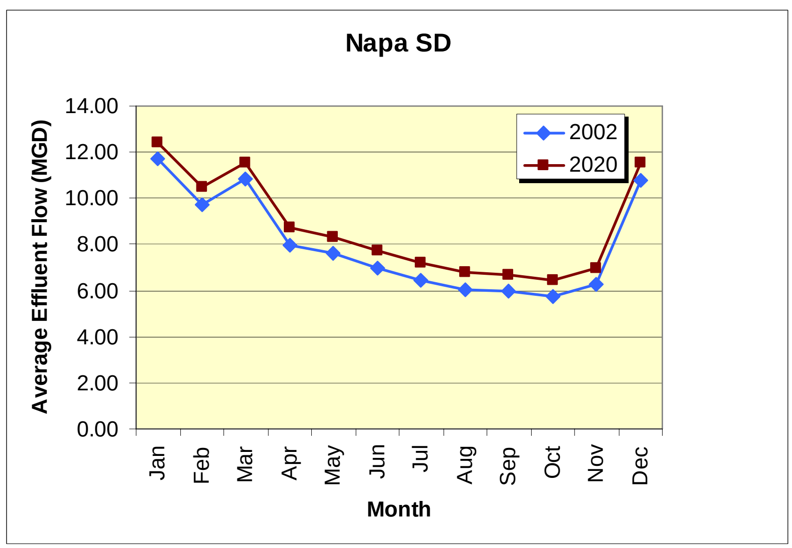

Figure 4-5
Average Current and Projected Monthly Flow
Napa Sanitation District

The projected discharge flow rate in 2020 was obtained from Napa SD's report *Strategic Plan for Recycled Water Use in the Year 2020* (Napa SD 2005). The report predicts that the Napa SD service area will grow to include 35,650 service connections by the year 2020, which will increase total annual flows to 3,548 MG/yr. However, incorporating pond evaporation and treatment process losses, it is anticipated that only 3,192 MG/yr (9,800 AFY) would remain for distribution to recycled water customers.

4.2.5.3 Potential for WWTP Expansion and Upgrade

Napa SD does not currently have a timeframe for future upgrades at the WWTP following the addition of the DynaSand filtration system and extension of the chlorination basin in 2001 (Healy 2003). The facility upgrade included allowances for future addition of four DynaSand filtration cells, extension of the chlorination basin, and addition of a third 3.2-MG recycled water reservoir. The addition of four DynaSand cells would allow the capacity of the filters to be increased to 17.6 mgd (twice the current flow); however, the facility's tertiary capabilities may then be limited by the treatment capacity of the chlorination basin.

Napa SD is currently developing an additional 4.1 miles of recycled water delivery pipelines. Pipeline alignments currently include: a segment north toward the Napa State Hospital, a segment south to the Napa County Airport, and a segment southeast to the Napa Valley Gateway Business Park. Napa SD's *Strategic Plan for Recycled Water Use in the Year 2020* expands upon these current development plans by evaluating the potential to extend the recycled water distribution system further north along the Silverado Trail and west across the Napa River into the Carneros region. The report also includes the addition of a proposed 1.5-MG reservoir in the vicinity of the Napa State Hospital (Napa SD 2005).

4.2.6 Summary of Existing WWTP Conditions

Table 4-2 summarizes the capacity and level of both existing and future anticipated treatment (combination of secondary and tertiary) at each of the WWTPs presented in Sections 4.2.1 through 4.2.5[5].

Table 4-2
Summary of WWTP Discharge Volumes (mgd)

	LGVSD WWTP	*Novato WWTP*	*Petaluma[1] WWTP*	*SVCSD WWTP*	*Napa SD WWTP*
Current NPDES Dry Season Discharge Limit	2.92	6.55	5.2	3.0	15.4
ADWF (2002)	2.1	5.0	4.4	2.6	6.2
AWWF (2002)	3.2	6.9	6.2	4.4	9.3
ADWF (2020) [2]	2.7	6.6	6.7	3.9	7.0
AWWF (2020) [2]	3.7	8.6	8.4	5.7	10.0

Notes:
1: Petaluma volumes are assumed.
2: 2020 flows are projected.

5 As discussed in Section 1.3, Petaluma was initially evaluated in the Project, but is no longer participating.

As can be viewed in Table 4-2, the existing dry weather discharge capacity at the Novato SD, Petaluma, and SVCSD WWTPs does not appear to be sufficient to handle the anticipated ADWFs in 2020; these WWTPs are currently undergoing capacity improvements. LGVSD and Napa SD appear to have ADWF adequate capacity until at least 2020.

4.3 WWTP Water Quality

Recycled water is used for numerous agricultural applications throughout California and the United States. In addition to the filtration and disinfection requirements that recycled water must meet for agricultural use, discussed in Section 4.1, additional water quality parameters should also be reviewed relative to a given plant's tolerance to certain constituents sometimes found in recycled water. The chemical constituents to consider for agricultural irrigation are salinity, sodium, trace elements, excessive chlorine residual, and nutrients. Recycled water may have higher concentrations of these constituents than the groundwater or surface water sources from which the water supply is drawn.

The types and concentrations of constituents in recycled water depend upon the municipal water supply, the influent waste streams (i.e., domestic and industrial contributions), amount and composition of infiltration in the wastewater collection system, the wastewater treatment process, and type of storage facilities. A description of these constituents is provided below.

Salinity: Salinity is the single most important parameter in determining the suitability of the water to be used for irrigation. It is important to review the salinity of irrigation water because high levels of salinity could reduce growth and production of grapevines and other plants. As the salt concentration of the water in the root zone increases above a threshold level the plant must expend more energy to absorb water, and both the growth rate and ultimate size of the crop progressively decrease. However, the threshold and the rate of growth reduction vary widely among different crop species. Crops must be chosen carefully to ensure that they can tolerate the salinity of their irrigation water (USEPA 2004).

Sodium: Excessive sodium in irrigation water could contribute to soil dispersion and structural breakdown, where the finer soil particles fill many of the smaller pore spaces, sealing the surface and greatly reducing water infiltration rates (USEPA 2004).

Trace elements: Nickel and zinc have visible adverse effects in plants at lower concentrations than the levels harmful to animals and humans. Cadmium, copper, and molybdenum, however, can be harmful to animals at concentrations too low to impact plants. Although boron is an essential element required for plant growth, it is nonetheless potentially harmful in the soil should the concentrations become too high. Grapes are particularly sensitive to boron in irrigation water and can develop injury to leaves and shoots if concentrations exceed certain limits (USEPA 2004).

Chlorine Residual: Free chlorine residual at concentrations of less than 1 milligram per liter (mg/L) usually poses no problem to plants. However, some sensitive crops may be damaged at levels as low as 0.05 mg/L. Some woody crops may accumulate chlorine in the tissue to toxic levels. Excessive chlorine has a similar leaf-burning effect as sodium and chloride when sprayed directly on foliage (USEPA 2004).

Nutrients: The nutrients most important to a crop's needs are nitrogen, phosphorus, potassium, zinc, boron, and sulfur. Recycled water usually contains enough of these nutrients to supply a large portion of a crop's needs. The most beneficial nutrient is nitrogen. Both the concentration and form of nitrogen need to be considered in irrigation water. While excessive amounts of nitrogen stimulate vegetative growth in most crops, it may also delay maturity and reduce crop quality and quantity. The nitrogen in recycled water may not be present in concentrations great enough to produce satisfactory crop yields, and some supplemental fertilizer may be necessary In addition, excessive nitrate in forages can cause an imbalance of nitrogen, potassium, and magnesium in grazing animals. This is could be an issue if the forage is used as a primary feed source for livestock; however, such high concentrations are usually not expected with municipal recycled water (USEPA 2004).

The University of California (UC) Division of Agriculture and Natural Resources completed a study in 2006 which examined the quality of Napa SD's recycled water and its appropriateness for vineyard applications. The study concluded that Napa SD recycled water is satisfactory for vineyards with respect to salinity, chloride, sodium, boron, calcium to magnesium ratio, phosphorus, and potassium. The study also concluded that long-term salinity accumulation should not occur when using Napa SD recycled water. Nitrogen levels in recycled water can be beneficial for vineyards and other crops. For vineyards that do not currently fertilize with nitrogen additives, the use of appropriate cover crops and additional irrigation sources can offset the low amount of nitrogen present in recycled water. The study also stated that recycled water use is consistent with the National Organic Program standards for certified organic vineyards (UC Division of Agriculture and Natural Resources 2006).

Table 4-3 summarizes water quality data for the participating WWTPs' effluent from 2000 to 2003[6]. The table also presents the water quality guidelines for the use of recycled water by the U.S. Environmental Protection Agency (USEPA), the 2006 study by the UC Division of Agriculture, and from the North Bay Watershed Association (NBWA).

Based on the data from 2000 to 2003, in almost all cases the effluent of the participating WWTPs meets the water quality recommended levels for each of the constituents listed in Table 4-3 for agricultural application. Only the constituents of chlorine residual, sodium, and specific conductance (as measured at Napa SD for chlorine residual, and SVCSD and Napa SD for sodium and specific conductance) are present at levels higher than those recommended by the NBWA study; however,

[6] Water quality data from Petaluma WWTP was not available.

these constituents have no recommended maximum level by USEPA or the UC Division of Agriculture. It is likely that as the tertiary treatment capacity of each WWTP is increased, the constituent levels in the participating WWTPs will also be reduced due to the improved filtration requirements of Title 22 tertiary treated recycled water.

4.4 Summary of Current and Potential Future Recycled Water Supplies

As discussed in Sections 4.2.1 through 4.2.5, and Section 2.2.2.3, several of the WWTPs in the initial study area[7] supply recycled water to local customers. The Project assumes that the WWTPs will continue to honor these commitments as they each continue to develop local projects for additional recycled water use.

Table 4-4 summarizes the volume of water utilized by each WWTP in 2005 for beneficial reuse (recycled water served to customers) and the projected increase in WWTP flows and beneficial reuse, assuming the full implementation of local projects.

Each of the Project participants agrees that the Project must be able to deliver high quality water to potential users in order to be an attractive and effective regional solution. All the WWTPs except Petaluma are able to treat to Title 22 tertiary levels. As discussed in the Project's Hydraulic Studies Technical Memorandum, the hydraulic modeling performed assumes that the WWTPs will treat both daily and stored secondary treated effluent to tertiary levels only as required to meet daily user demands, or to prepare for upcoming user demands. The tertiary treatment capacity of each WWTP is assumed to increase under the Project to reflect the peak daily dry weather flow demands of the anticipated local users supplied by the WWTP. Tables 4-5 and 4-6 summarize the level of treatment (in units of mgd and AF per day, respectively) available at each treatment plant, in both their current and future plans for upgrades. See Section 6 for a discussion of how much additional tertiary treatment capacity is needed at each WWTP under the Project alternatives.

[7] As discussed in Section 1.3, Petaluma was initially evaluated in the Project, but is no longer participating.

Table 4-3
WWTP Effluent Water Quality

Constituent	Units	Water Quality Guidelines: Recommended Maximum Level for Vineyard Water Quality Needs (1)	Water Quality Guidelines: Recommended Constituent Limits in Recycled Water for Irrigation (2)	NBWA Values, Degree of Restrictions on Use (3): None	NBWA Values: Slight to Moderate	NBWA Values: Severe	LGVSD (4) Minimum	LGVSD Average	LGVSD Maximum	Novato SD (6) Minimum	Novato SD Average	Novato SD Maximum	SVCSD (7) Desired Range (8)	SVCSD Minimum	SVCSD Average	SVCSD Maximum	Napa SD (11) Minimum	Napa SD Average	Napa SD Maximum
Aluminum	mg/L	5.0	5.0										None	< 0.05	0.16833	0.59	0.030	0.170	0.480
Arsenic	mg/L	0.1	0.10					0.001 (5)		0.0005	0.0018	0.0040	None	< 0.002	0.002	0.0024	< 0.0005	0.0008	0.0012
Beryllium	mg/L	0.1	0.10										None		< 0.001 (9)				
Bicarbonate[4]	mg/L			<90	90 - 500	>500							75	72	119	160	70	157	290
Boron	mg/L	1	0.75	<0.7	0.7 - 3.0	>3.0							< 0.5	0.40	0.49	0.65	0.3	0.4	0.6
Cadmium	mg/L	0.01	0.01				0.0001	0.0004	0.0006	0.0000	0.0001	0.0002	None		< 0.001 (9)			< 0.1 (9)	
Chloride	mg/L	262		<140	140 - 350	>350							30	55	78	100	110	162	220
Chlorine residual[4]	mg/L			<1.0	1.0 - 5.0	>5.0											8.0	9.2	10.8
Chromium	mg/L	0.1	0.1				0.0008	0.0013	0.0022	0.0005	0.0042	0.0222	None		< 0.002 (9)		0.0003	0.0006	0.0010
Cobalt	mg/L	0.05	0.05										None		< 0.02 (9)		< 0.0005	0.0006	0.0006
Copper	mg/L	0.2	0.2				0.007	0.012	0.019				None	0.0020	0.0072	0.0370	< 0.0005	0.0027	0.0110
Dissolved Solids	mg/L			<450	450 - 2000	>2000							< 500	378	447	510			
Fluoride	mg/L	1.0	1.0										None	< 0.1	0.18	0.34			
Iron	mg/L		5.0	<0.1	0.1 - 1.5	>1.5							None	< 0.1	0.12	0.21	< 0.05	0.08	0.10
Lead	mg/L	5.0	5.0				0.0004	0.0011	0.0050	0.0003	0.0013	0.0030	None		< 0.002 (9)		< 0.0001	N/A	< 0.0003
Lithium	mg/L	2.5	2.5										None	0.0128	0.0169	0.021	0.009	0.011	0.012
Manganese	mg/L	0.2	0.2	<1.0	1.0 - 5.0	>5.0							None	< 0.02	0.025	0.038	0.012	0.047	0.083
Molybdemum	mg/L	0.01	0.01										None		< 0.02 (9)		0.0008	0.0019	0.0041
Nickel	mg/L	0.2	0.2				0.0026	0.0043	0.0073	0.0023	0.0043	0.0073	None	0.0020	0.0031	0.0055	0.0029	0.0041	0.0056
pH					6.5 - 8.4		6.53	7.26	8.10				6.5 - 8.0	6.86	8.17	9.95	6.67	7.34	8.40
Selenium	mg/L	0.02	0.02				0.0008	0.0010	0.0012	0.0004	0.0009	0.0010	None		< 0.005 (9)			< 0.001 (9)	
Sodium	mg/L			<3	3 - 9	>9							< 30	58	66	80	94	124	150
Sodium Adsorption Ratio	units	3											< 6.0	2.05	2.21	2.63	3.1	4.0	4.8
Specific Conductance	mmhos/cm (12)			<0.7	0.7 - 3.0	>3.0							< 750	421	710	910			
Vanadium	mg/L	0.1	0.2										None		< 0.1 (9)			< 0.0005 (9)	
Zinc	mg/L	2.0	2.0				0.061	0.091	0.110	0.0160	0.0318	0.0500	None	0.013	0.051	0.140	0.002	0.012	0.027

(1) Source: University of California Division of Agriculture and Natural Resources 2006.
(2) Source: Guidelines for Water Reuse, USEPA, 2004
(3) North Bay Watershed Association (NBWA) Recycled Water Characterization.
(4) Values are a compilation of sampling data for 2000-2003.
(5) Only one value was reported for arsenic.
(6) Values are a compliation of combined effluent data for July 2000-June 2003.
(7) pH data is a compilation from SVCSD Reclamation Reservoirs taken between 2000 and 2004. All other constituent data is compiled from SVCSD WWTP effluent taken between 2000 and 2002.
(8) Desired range as defined by SVCSD.
(9) All sampling events were non-detect less than the value specified.
(10) Only two samples were taken for Zirconium from 1999-2004. Both results were under laboratory testing limits.
(11) Values are a compilation of sampling data from May 2002 through November 2004.
(12) mmhos/cm = millimhos per centimeter
N/A = Not available

Table 4-4
Summary of WWTP Flow and Beneficial Reuse

	2005 Conditions (AFY)		2020 Conditions (AFY)	
	WWTP Flow	**Beneficial Reuse**	**WWTP Flow**	**Beneficial Reuse**
LGVSD	3,063	613	3,671	902
Novato SD	6,813	269	8,673	1,015
City of Petaluma	6,076	2,389	8,630	3,823
SVCSD	4,076	1,173	5,506	3,000
Napa SD	8,974	1,307	9,800	4,540
Total	29,002	5,753	36,280	13,280

Table 4-5
WWTP Existing and Future Levels of Treatment (mgd)

	LGVSD WWTP	Novato SD WWTP	Petaluma WWTP	SVCSD WWTP	Napa SD WWTP
Existing & (Future) Capacity for Secondary Treatment	8.0 (N/A)	13.0 (N/A)	5.2 (6.7)	11.5 (11.5)	15.4 (15.4)
Existing & (Future) Capacity for Title 22 Tertiary Treatment	2.0 (2.0)	0.5 (0.5)	0.0 (5.2)	16.0 (16.0)	8.8 (8.8)

Notes:
1: Flow rates indicate WWTP potential capacity, which may be higher than either the permitted or normal operating capacities.
2: Future capacity is result of WWTP improvements, assumed complete by 2010.
3: N/A = Information currently not available.

Table 4-6
WWTP Existing and Future Levels of Treatment (AF/day)

	LGVSD WWTP	Novato SD WWTP	Petaluma WWTP	SVCSD WWTP	Napa SD WWTP
Existing & (Future) Capacity for Secondary Treatment	24.5 (N/A)	39.9 (N/A)	16.0 (20.6)	35.3 (35.3)	47.3 (47.3)
Existing & (Future) Capacity for Title 22 Tertiary Treatment	6.1 (6.1)	1.5 (1.5)	0.0 (16.0)	49.1 (49.1)	27.0 (27.0)

Notes:
1: Flow rates indicate WWTP potential capacity, which may be higher than either the permitted or normal operating capacities.
2: Future capacity is result of WWTP improvements, assumed complete by 2010.
3: N/A = Information currently not available.

Section 5
Formulation of Initial Alternatives

Taking into account the complex setting of the North San Pablo Bay Restoration and Reuse Project (Project) area, and the multiple and diverse interests that must be considered in development of a successful plan, the member agencies of the North Bay Water Reuse Authority (Authority) undertook a comprehensive planning process that first identified a wide range of preliminary alternatives for the Project and then screened this array for selection of the most promising alternatives for detailed analysis. This section describes (1) the planning process used to develop the preliminary alternatives, (2) the options and components used to characterize the alternatives, and (3) the rationale used to select three Project action alternatives for further study. The detailed evaluation of the selected Project alternatives is presented in Section 6.

5.1 Development Process

For the initial development of alternatives, the study team and the technical workshop participants worked through a structured planning process, as described in Section 1.5. The development of initial alternatives was a subset of the overall planning process.

The first step was to identify the broad characteristics that could be used to formulate alternatives. These characteristics fell into three categories:

- Recycled water projects – existing, identified, and potential – in the study area
- Extent of the recycled water distribution network – basic, partially connected, fully connected
- Storage options to increase use of recycled water – no new storage, partial storage, and full storage of recycled water supplies

These options were combined to form the initial alternatives.

The next step in the process was to screen the initial alternatives. The study team examined the characteristics to verify that they were technically, environmentally, politically, and legally feasible. The screening of initial alternatives led to the final step in the process: identification of three to four Project action alternatives to move forward for more detailed feasibility analysis.

5.2 Formulation of Initial Project Alternatives

The initial Project alternatives were formed as combinations of options under the following characteristics: recycled water projects in the study area, extent of the recycled water distribution network, and storage options to increase use of recycled water. The 15 identified recycled water projects were grouped in various combinations into six recycled water distribution systems. Each of the six distribution systems was then evaluated under the three different storage options, creating a total of 18 initial alternatives. Each of the alternative characteristics is described below.

5.2.1 Recycled Water Projects

In order to form candidate recycled water projects, the study team reviewed land use data (see Section 3) and the participating agencies' recycled water planning documents. Water and wastewater agencies in the study area have developed several existing recycled water projects and identified recycled water projects for future implementation. The study team identified additional potential recycled water project areas by grouping land uses either in major agricultural or landscaping areas or in areas between existing and proposed projects. These existing, agency-identified, and new potential project areas, summarized in Table 5-1, are described below.

Table 5-1
Recycled Water Projects Considered

Existing Projects	*Agency-Identified Projects*	*New Potential Reuse Areas*
Sonoma Valley County Sanitation District Reuse Area	Peacock Gap Golf Course	Petaluma South
Marin Municipal Water District Reuse Area	North Marin Water District Urban Reuse Project	Southern Sonoma Valley
Stone Tree Golf Course Reuse Area	Sonoma Valley Recycled Water Project	Sears Point
	Carneros East	Central Sonoma Valley
	Milliken-Sarco-Tulocay Creeks Area	North Central Sonoma
	Napa Salt Marsh Restoration	Napa Valley

5.2.1.1 Existing Projects

Each participating agency generates some amount of recycled water for use on its own property or as a small-scale reuse project. These small-scale efforts are not included as part of the Project.

In addition, there are currently four existing recycled water projects underway in the study area, shown in Figure 5-1. Although these projects are outside the scope of planning and construction for this Project, they were taken into account for hydraulic modeling purposes because their facilities and infrastructure could potentially be used in conjunction with the Project. These projects are:

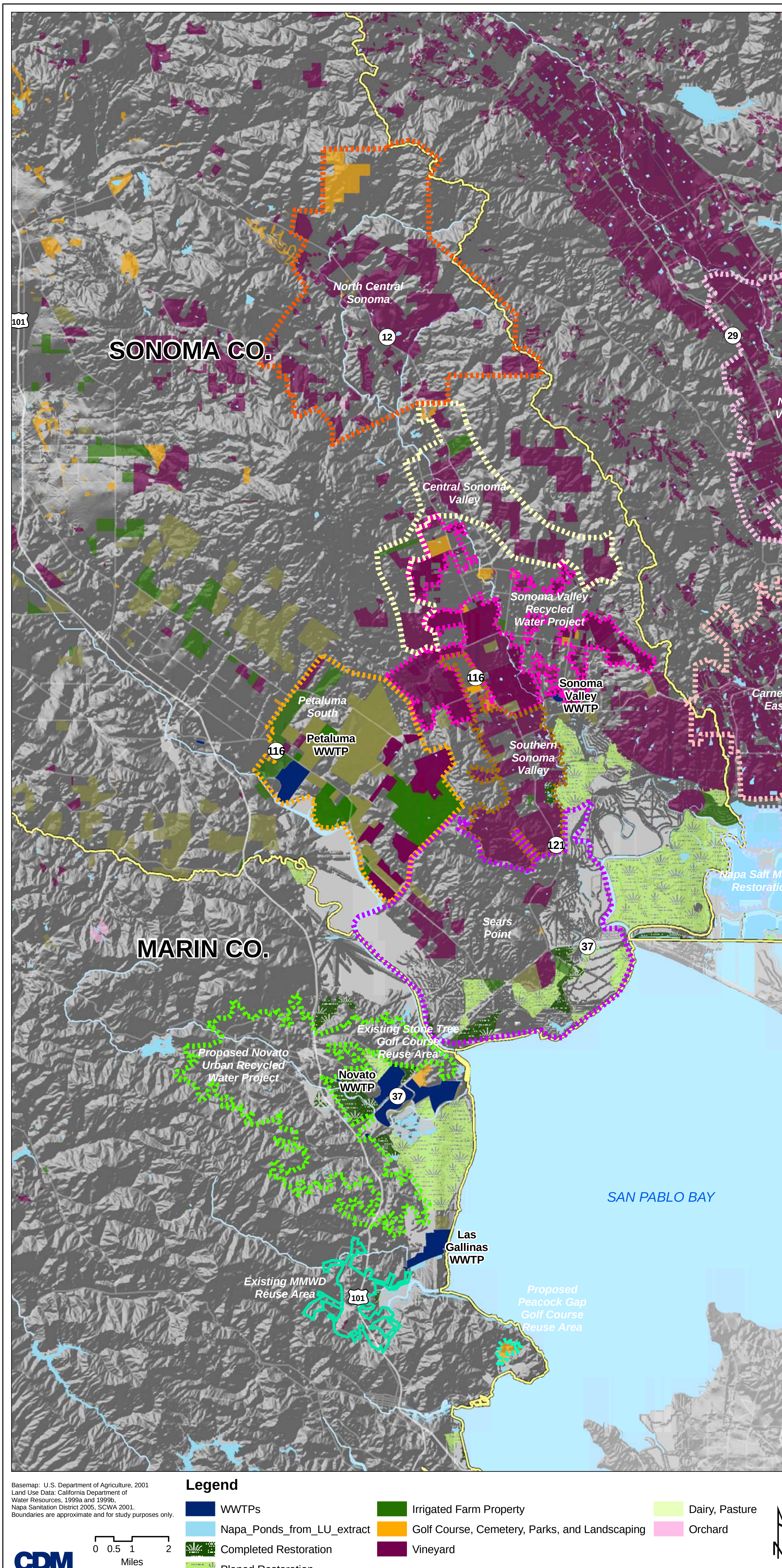

Figure 5-1
Potential Project Recycled Water Use Areas

- ***Existing Sonoma Valley County Sanitation District (SVCSD) Reuse Area*** – SVCSD currently provides about 1,200 acre-feet per year (AFY) of recycled water in the Sonoma County portion of the Los Carneros American Viticultural Area (AVA) (SCWA 2005). To reach more potential users for the purposes of this project, the study team assumed an increase in the size of the existing SVCSD reuse area to a total of 4,470 acres (160 acres of dairy/pasture land, 322 acres of irrigated farm land, and 3,988 acres of vineyard). Based on the water demands developed in Section 2, the maximum estimated water use for the existing SVCSD reuse area is about 2,286 AFY.

- ***Existing Marin Municipal Water District (MMWD) Reuse Area*** – Las Gallinas Valley Sanitary District (LGVSD) provides about 900 AFY of recycled water to MMWD for urban landscaping demands around the City of San Rafael (Castle 2005).

- ***Existing Stone Tree Golf Course Reuse Area*** – The Stone Tree golf course is adjacent to the Novato Sanitary District (Novato SD) wastewater treatment plant (WWTP). The project uses about 270 AFY to irrigate the golf course and a few nearby urban landscaping customers (James 2008).

- ***Existing Napa Reuse Area*** – Existing Napa Sanitation District (Napa SD) recycled water users include Chardonnay Golf Course and Vineyards, Somsky Ranch, Jameson Canyon Reclamation Site, Napa Airport, Hakusan Sake Factory, and Napa Corporate Park (Napa SD 2005). Recycled water users are along the discharge pipeline at Highway 29 and Jameson Canyon Road and further north along the Napa Valley Highway. In 2005, recycled water users received 1,307 AFY (Napa SD 2005).

5.2.1.2 Agency-Identified Projects

There are six recycled water projects currently identified by the participating agencies. These projects are at different phases of development, independent of the planning underway under the Project. Each of these project areas is shown in Figure 5-1. The agency-identified projects are:

- ***Peacock Gap Golf Course*** – LGVSD proposes to serve recycled water to the Peacock Gap Golf Course at the eastern end of San Rafael. In 2006, the golf course and neighboring facilities was estimated to use about 437 AFY (Castle 2006).

- ***North Marin Water District (NMWD) Urban Reuse Project*** – Under the originally proposed NMWD Urban Reuse Project, Novato SD was estimated to provide 1,312 AFY of recycled water for urban landscaping in the City of Novato (NMWD and Novato SD 2004). This recycled water service would be a potable water offset.

- ***Sonoma Valley Recycled Water Project*** – SVCSD is developing the Sonoma Valley Recycled Water Project, which identified about 1,015 acres of dairy/pasture land, 234 acres of urban landscaping, 2 acres of irrigated farm land, and 6,249 acres of vineyards, for a total of about 7,680 acres. Sonoma County Water Agency (SCWA), Valley of the Moon Water District, and the City of Sonoma are partnering with SVCSD for this project. The objectives of the project are to offset potable water demands, reduce discharge, and reduce groundwater pumping associated with increases in vineyard lands (SCWA 2005). Using the acreage listed above and the water demands discussed in Section 2, the Sonoma Valley Recycled Water Project could use a maximum of about 6,520 AFY of recycled water. The potable water offset would be 147 AFY.

- ***Carneros East*** – Napa SD's St*rategic Plan for Recycled Water Use in the Year 2020* develops alternatives for a recycled water system to serve two areas of southern Napa County (Napa SD 2005). Napa SD's goals are to recycle water to augment water supplies, prevent overdraft of groundwater resources, ensure that highest quality water is reserved for potable uses, and increase its ability to comply with summer discharge requirements (Napa SD 2005). According to the land use data developed for the Project, Napa SD's Carneros East reuse area consists of about 6,654 acres of vineyards in the Napa County portion of the Los Carneros AVA. Based on the vineyard demand developed for Napa County in Section 2, the Carneros East area would use a maximum of about 1,663 AFY of recycled water.

- ***Milliken-Sarco-Tulocay Creeks*** (***MST***) ***Area*** – Napa SD's *Recycled Water Expansion Hydraulic and Preliminary Engineering Analysis: Phase 1 Report – Milliken-Sarco-Tulocay Area* indicates that Napa SD's MST area potentially consists of 4,335 acres (3,856 acres of vineyards, 389 acres of urban landscaping, and 90 acres of golf course/cemeteries) (Napa SD 2007a). Assuming less than full participating in the program, it is anticipated that the MST area would use about 1,937 AFY of recycled water. Additional expansion of the MST area to the north, using the demand data and land use methods developed in Section 3, could develop an additional 690 AFY of use.

- ***Napa Salt Marsh Restoration Project*** – As described in Section 2, the Napa River Salt Marsh Restoration Project consists of restoration of tidal wetlands and enhancement of managed ponds in the Napa Sonoma Marsh Wildlife Area. Two water sources have been evaluated for habitat and flushing operations: river diversions brought about by planned levee breaches, and construction of a recycled water pipeline from the SVCSD WWTP and/or Napa SD WWTP. The use of recycled water for this restoration project continues to be evaluated. The recycled water delivery option calls for 8,000 to 9,000 AFY of recycled water for salinity reduction (flushing) and water level maintenance during the first six to eight years of the project (U.S. Army Corps of Engineers 2004). It is possible that an additional 2,500 to 3,000 acre-feet (AF) of recycled water may be required for pond maintenance, to offset evaporation in the upper ponds, once flushing is complete.

5.2.1.3 New Potential Reuse Areas

Land use maps of the study area and the greater North Bay region were reviewed to develop additional areas where recycled water could be applied. Six new areas were identified, as briefly described below. Each potential project area is shown in Figure 5-1. The new potential reuse areas are:

- ***Petaluma South***[1] – The Petaluma WWTP is surrounded by some large parcels of dairy/pasture land and irrigated farm properties, which would be desirable candidates for recycled water service. The potential Petaluma South project area consists of 3,163 acres of dairy/pasture land, 2,239 acres of irrigated farm land, and 1,569 acres of vineyards, for a total of 6,971 acres, based on land use data developed for this study. Using the water demands developed in Section 2, the Petaluma South area would use up to 11,696 AFY of recycled water.

- ***Southern Sonoma Valley*** – The area south of the City of Sonoma is dedicated predominantly to vineyard uses and is close to the SVCSD WWTP. The Southern Sonoma Valley reuse area includes 55 acres of dairy/pasture land, 48 acres of urban landscaping, and 4,005 acres of vineyards, for a total area of 4,136 acres. Using the water demand estimation developed in Section 2, the total recycled water demand for the Southern Sonoma Valley reuse area could be a maximum of 2,334 AFY.

- ***Sears Point*** – The land in the vicinity of Sears Point lies in between Petaluma WWTP, SVCSD WWTP, and Novato SD WWTP, but is not served with recycled water. This area could act as a convenient link between these treatment plants. The Sears Point reuse area encompasses 326 acres of dairy/pasture land, 76 acres of irrigated farm land, and 1,236 acres of vineyards. The estimated maximum recycled water demand in this area is 1,534 AFY.

- ***Central Sonoma Valley*** – The Central Sonoma Valley reuse area is located north of the proposed Sonoma Valley Recycled Water Project, and includes additional vineyard areas in the valley still relatively close to the SVCSD WWTP. It encompasses 51 acres of urban landscaping, 258 acres of irrigated farm land, and 2,929 acres of vineyards, for a total area of 3,237 acres. Using the water demand estimation developed in Section 2, the estimated maximum recycled water demand in the Central Sonoma Valley reuse area would be 1,974 AFY.

- ***North Central Sonoma*** – The potential North Central Sonoma reuse area is located along the northern stretch of Highway 12, another major grape-growing region for Sonoma County. The reuse project contains 5,616 acres of vineyards and has a total area of 6,388 acres. The maximum water demand for the North Central Sonoma reuse area is estimated to be 5,311 AFY.

- ***Napa Valley*** – The potential Napa Valley reuse area stretches from the Napa city limits north on Highway 29 to the Town of Yountville, along significant grape-growing areas of Napa County. The area contains 7,365 acres of vineyards, with a total area of 7,412 acres. The maximum water demand in the Napa Valley reuse area is estimated to be 1,950 AFY.

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[1] As discussed in Section 1.3, Petaluma was initially evaluated in the Project, but is no longer participating.

5.2.2 Service Area Approaches

Recycled water projects were grouped into alternatives based on different sizes and different connections of the future recycled water system. The distribution system options ranged from virtually independent operation of each WWTP to all WWTPs operating jointly, serving demand throughout the entire study areas. Each of the six potential distribution system approaches is described below.

5.2.2.1 Basic Regional Systems

This approach would put greatest emphasis on recycled water projects near to each WWTP with few interconnections among the facilities. This concept would likely be the least expensive, but would also use the least recycled water.

5.2.2.2 Regional Systems

This approach would link several of the local systems to allow multiple treatment plants to provide and share recycled water to two primary focus areas, Petaluma/Novato and Napa/Sonoma. This strategy would provide partial backup for each plant to balance any changes in recycled water production and would allow distribution to a larger area.

5.2.2.3 Regional Systems with Ponds

This approach would create regional systems that connect several WWTPs and would expand the area served under the Regional Systems alternative by adding the ponds associated with the Napa Salt Marsh Restoration Project as an additional demand point.

5.2.2.4 Expanded Regional Systems without Petaluma

This regional recycled water system approach would provide a larger agricultural area and the Napa Salt Marsh with recycled water. It would emphasize environmental benefits of recycled water for the marsh before the water is fully used for agriculture, in addition to expanding beneficial reuse north into Sonoma and Napa Counties. Petaluma and its associated demand area would not be served.

5.2.2.5 Expanded Regional Systems with Petaluma[2]

This approach is the same as the preceding option, but with addition of the Petaluma WWTP and the Petaluma South reuse area.

5.2.2.6 Interconnected Regional System

The regional system approach would connect all five WWTPs. This alternative would maximize reuse by allowing water from any plant to be delivered to any area that needs recycled water. Because much of the demand is found near Sonoma and Napa, this interconnection is helpful as it allows the other treatment plants to help satisfy the

[2] As discussed in Section 1.3, Petaluma was initially evaluated in the Project, but is no longer participating.

demands in these areas. This alternative would supply the most recycled water, but it would also be the most expensive to implement.

5.2.3 Storage Options

The study team developed three options for water storage for purposes of formulating initial alternatives – No New Storage, Partial Storage, and Full Storage. Each storage concept is described below.

5.2.3.1 No New Storage

Under the No New Storage concept, reuse projects were grouped with WWTPs that would supply recycled water. The only storage available in the recycled water system would be existing storage at the WWTPs and a portion of existing individual landowner storage ponds. This storage option assumed that Novato SD and Petaluma have no storage, LGVSD has 400 AF (320 AF from storage ponds and 80 AF of wildlife marsh), SVCSD has 640 AF, and Napa SD has 1,079 AF of storage available for use by the Project (a portion of the Napa SD's oxidation ponds).

5.2.3.2 Partial Storage

The Partial Storage concept assumed that existing WWTP storage and some existing individual landowner storage ponds would still be available, as well as new, low-impact storage. It was assumed that Novato SD, Petaluma, and SVCSD would not add any storage over the No New Storage option levels. It was further assumed that LGVSD would add 2,310 AF of storage on an adjacent property, bringing LGVSD's total storage up to 2,710 AF, and that Napa SD would have 10,079 AFY available through the addition of 9,000 AF of aquifer storage and recovery (ASR).

ASR is a method used to store recycled water during low-use periods within a local groundwater aquifer. Aquifer storage is typically accomplished by injecting water via multiple wells to the target aquifer zones. ASR operations can be similar to that of a recycled water surface basin with little or no change in its quality or quantity. A separate set of extraction wells withdraw water from the aquifer. Napa SD initiated a study to evaluate the viability of aquifer storage by assessing the potential capacity, benefits, and drawbacks of aquifer storage for local recycled water projects. Groundwater storage typically has fewer disturbances to local land uses and existing habitats than other types of storage, but physical and regulatory constraints can make this a challenging option.

5.2.3.3 Full Storage

Under the Full Storage approach, the recycled water system would include as much storage as needed to reuse all available recycled water supplies. A new surface storage reservoir would be considered if necessary. A surface water storage facility could store recycled water during the wet season (when supply is higher) until the dry season (when demands are higher). Creating a central surface storage facility would allow storage of recycled water from most participating WWTPs, and many of the possible sites for such a facility would allow gravity feed to the potential recycled water users. Implementation of surface storage facilities can be problematic, however, as there are often significant associated land use and environmental effects to mitigate.

5.2.4 Summary of Initial Alternatives

For purposes of screening the initial alternatives, the 15 existing, agency-identified, and new potential project areas were grouped in various combinations of service areas into 6 initial recycled water distribution systems. Table 5-2 presents the 6 initial action alternatives and their associated reuse project areas. Each alternative is described below. The initial alternatives were then evaluated under the three different storage options, bringing the total number of initial alternatives to 18.

Table 5-2
Initial Action Alternatives

Reuse Project Areas	Alternative 1 Basic Regional Systems	Alternative 2 Regional Systems	Alternative 3 Regional Systems with Ponds	Alternative 4 Expanded Regional Systems without Petaluma	Alternative 5 Expanded Regional Systems with Petaluma	Alternative 6 Interconnected Regional System
Existing SVCSD Reuse Area	✓	✓	✓	✓	✓	✓
Existing MMWD Reuse Area	✓	✓	✓	✓	✓	✓
Existing Stone Tree Golf Course Reuse Area	✓	✓	✓	✓	✓	✓
Peacock Gap Golf Course	✓	✓	✓	✓	✓	✓
NMWD Urban Reuse Project	✓	✓	✓	✓	✓	✓
Sonoma Valley Recycled Water Project	✓	✓	✓	✓	✓	✓
Carneros East Area	✓	✓	✓	✓	✓	✓
MST Area	✓	✓	✓	✓	✓	✓
Napa Salt Marsh Restoration			✓	✓	✓	✓
Petaluma South	✓	✓	✓		✓	✓
Southern Sonoma Valley	✓	✓	✓	✓	✓	✓
Sears Point Area	✓	✓	✓	✓	✓	✓
Central Sonoma Valley		✓	✓	✓	✓	✓
Napa Valley Area				✓	✓	✓
North Central Sonoma				✓	✓	✓

5.2.4.1 Alternative 1 – Basic Regional Systems

LGVSD and Novato SD would be connected in this localized alternative, taking advantage of their proximity. Both districts require new treatment facilities to produce tertiary treated recycled water for unrestricted use. Under this initial configuration, LGVSD and Novato SD would jointly treat their wastewater streams and send the recycled water to the Peacock Gap Golf Course area, Novato urban users, and agricultural users in the Sears Point area.

Petaluma would treat its wastewater and send the recycled water to local urban uses, local agricultural uses, and agricultural uses within the Petaluma South area. SVCSD would similarly treat wastewater at its existing plant and distribute recycled water to local uses within the Southern Sonoma Valley reuse project and the Sonoma Valley Recycled Water Project.

Napa SD would treat its wastewater at the existing facility. Napa SD would prioritize delivery of recycled water to the MST area because of the existing groundwater concerns. The increased delivery of recycled water for irrigation would help reduce groundwater pumping in the region. Napa SD would deliver its remaining recycled water to the Carneros East area.

5.2.4.2 Alternative 2 – Regional Systems

LGVSD and Novato SD would have the same facilities as in Alternative 1. Local projects, such as Peacock Gap Golf Course area and Novato urban reuse, would have first priority for recycled water. These facilities would also be linked to Petaluma by a pipeline. The three treatment plants would provide recycled water to the Sears Point area and Petaluma South.

A pipeline would also link SVCSD and Napa SD to deliver recycled water to uses in the Carneros area. SVCSD would prioritize delivering recycled water to the Sonoma Valley Recycled Water Project and would send the remaining recycled water to the Central Sonoma Valley and Carneros East areas. Napa SD would prioritize the delivery of recycled water to the MST area and would send the remaining recycled water to the Carneros East and Southern Sonoma Valley areas.

5.2.4.3 Alternative 3 – Regional Systems with Ponds

This alternative would include joint tertiary treatment facilities for LGVSD and Novato SD. The primary recycled water users would be local users near the plants, including the Peacock Gap Golf Course area and Novato urban users. A pipeline would convey the remaining water north and connect with Petaluma’s recycled water supply. These joint supplies would provide recycled water to agricultural and landscape uses in Petaluma South and Sears Point.

A pipeline would also be constructed to connect SVCSD and Napa SD. SVCSD would prioritize delivering recycled water to the Sonoma Valley Recycled Water Project, and Napa SD would prioritize delivering recycled water to the MST Area. The Napa Salt Marsh would receive any remaining supply during the restoration period (less than 10 years). After the restoration period has been completed, it is possible that additional recycled water may be required for Napa Salt Marsh pond maintenance. The remaining recycled water would be available to agricultural users in the Carneros East, Southern Sonoma Valley, and Central Sonoma Valley.

5.2.4.4 Alternative 4 – Expanded Regional Systems without Petaluma

Similar to Alternative 3, LGVSD and Novato SD would be connected by a pipeline system. Local projects would first receive their supply of recycled water, and the remaining supply would be available to agricultural users in the Sears Point and Southern Sonoma Valley areas. Petaluma and its associated demand area would not be served under this alternative.

Another pipeline system would link SVCSD and Napa SD. These facilities would prioritize delivering recycled water to local projects (Sonoma Valley Recycled Water Project and the MST area). The Napa Salt Marsh would receive any remaining supply during the restoration period (less than 10 years). After the restoration period has been completed, it is possible that additional recycled water may be required for Napa Salt Marsh pond maintenance. The remaining recycled water would be available to agricultural users in the Carneros East, Southern Sonoma Valley, Central Sonoma Valley, Napa Valley, and North Central Sonoma areas.

5.2.4.5 Alternative 5 – Expanded Regional Systems with Petaluma

Similar to Alternative 4, this alternative would include joint tertiary treatment facilities for LGVSD and Novato SD. The primary recycled water uses would be local users near the plants, including the Peacock Gap Golf Course area and Novato urban users. A pipeline would convey the remaining water north and connect with Petaluma's recycled water supply[3]. These joint supplies would provide recycled water to agricultural and landscape uses in Petaluma South, Sears Point, and Southern Sonoma Valley areas.

Another pipeline system would link SVCSD and Napa SD. These facilities would prioritize delivering recycled water to local projects (Sonoma Valley Recycled Water Project and the MST area). After the restoration period has been completed, it is possible that additional recycled water may be required for Napa Salt Marsh pond maintenance. The remaining recycled water would be available to agricultural users in the Carneros East, Central Sonoma Valley, Napa Valley, and North Central Sonoma areas.

5.2.4.6 Alternative 6 – Interconnected Regional System

A series of pipelines would connect all five treatment plants. Each treatment plant would prioritize the delivery of recycled water to local projects and then send remaining recycled water into the interconnected pipeline system. Local projects include Peacock Gap Golf Course area, Novato urban recycled users, the Sonoma Valley Recycled Water Project, and the MST area. The system would deliver any remaining supply of recycled water to users in the Petaluma South, Sears Point, Southern Sonoma Valley, Central Sonoma Valley, North Central Sonoma, Carneros East, and Napa Valley areas.

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[3] As discussed in Section 1.3, Petaluma was initially evaluated in the Project, but is no longer participating.

5.3 Screening of Initial Alternatives

The goal of alternative screening was to identify three to four alternatives from the 18 initial action alternatives to move forward for more detailed feasibility analysis. This initial screening was based on:

- Quantity of recycled water served,
- Quantity of WWTP discharge reduced,
- Amount of storage required, and
- Planning-level cost estimates.

5.3.1 Screening Factors

For each of the 18 initial alternatives (that is, six system alternatives times 3 possible storage options for each alternative), the study team completed preliminary calculations of recycled water served, wastewater discharged, and planning-level estimated capital costs. To calculate the demand served, the study team first used preliminary data for the acreage of irrigated land uses and initial water demand rates for the different land uses included in the reuse areas to determine the total potential demand of an alternative. If the total potential demand exceeded the supply of recycled water for that alternative, the expected participation rate of the potential reuse areas (the percentage of landowners in the reuse area who agree to use recycled water for their irrigation) was reduced until demand matched supply. The amount of wastewater discharged for an alternative was simply the total recycled water supply for the alternative less the demand served.

The comparison of preliminary opinion of construction costs included preliminary computations of conveyance infrastructure, pumping facilities, required wastewater treatment plant upgrades, and additional storage (improvements to existing diked storage, groundwater storage, and/or surface water storage). The initial costs did not include contingencies, engineering costs, and land costs. These preliminary costs were meant only to compare and select alternatives for further study.

All of these factors have been further refined for the final alternatives presented later in Section 6.

5.3.2 Initial Alternative Comparison

After determining the preliminary estimate of capital costs, demand served, and wastewater discharged for each of the alternatives, the study team compared the 18 initial action alternatives. Figure 5-2 presents the alternatives, grouped by storage option, plotted by the volume rate of discharge to San Pablo Bay (x-axis) and relative capital cost (y-axis).

The participating agencies reviewed Figure 5-2 to screen alternatives for further consideration. As discussed in the following paragraphs (and summarized in Table 5-3), the agencies decided to eliminate some alternatives based upon consideration of:

- storage options
- cost
- regional partnership opportunities, and
- system logistics.

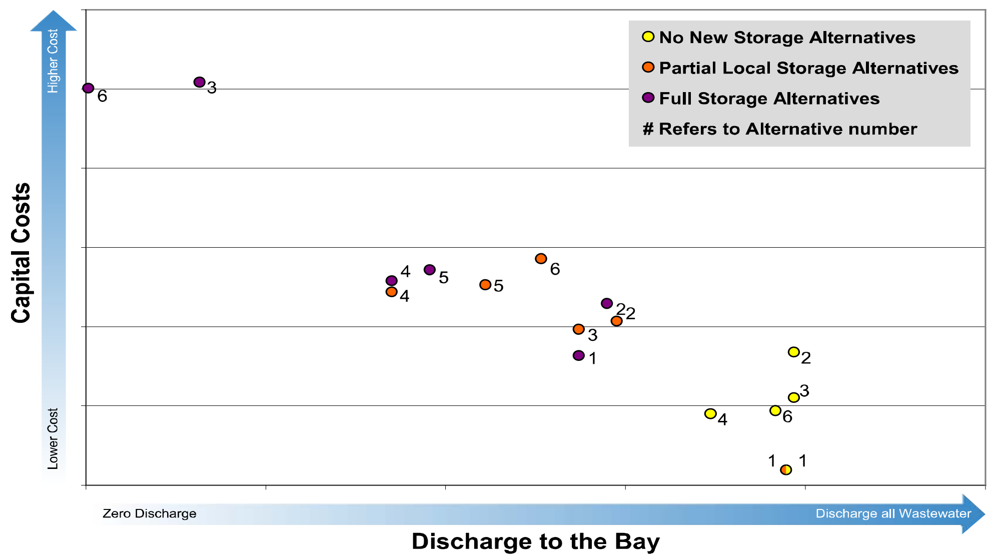


Figure 5-2
Comparison of Initial Action Alternatives

Table 5-3
Summary of Initial Alternative Screening

Storage Option	Alternative Name	Selected	Not Selected	Comments
No New Storage	1 – Basic Regional Systems		✓	Insufficient use of recycled water
	2 – Regional Systems		✓	
	3 – Regional Systems with Ponds		✓	
	4 – Expanded Regional Systems w/out Petaluma		✓	
	5 – Expanded Regional Systems w/Petaluma		✓	
	6 – Interconnected Regional System		✓	
Partial Storage	1 – Basic Regional Systems	✓		Allows for evaluation of smaller distribution systems
	2 – Regional Systems		✓	Too similar to Alternative 3 due to addition of Napa Salt Marsh Restoration
	3 – Regional Systems with Ponds	✓		Balance of WWTP connections with appropriate demand areas
	4 – Expanded Regional Systems w/out Petaluma		✓	Does not include Petaluma
	5 – Expanded Regional Systems w/Petaluma		✓	Includes demand areas that cannot be served without significant storage
	6 – Interconnected Regional System	✓		Allows for evaluation of large regional system
Full Storage	1 – Basic Regional Systems		✓	Prohibitive costs
	2 – Regional Systems		✓	
	3 – Regional Systems with Ponds		✓	
	4 – Expanded Regional Systems w/out Petaluma		✓	
	5 – Expanded Regional Systems w/Petaluma		✓	
	6 – Interconnected Regional System		✓	

5.3.2.1 Storage Options

Figure 5-2 demonstrates that the "No New Storage" options are very limiting. These alternatives use the least amount of recycled water, as shown by their high wastewater discharge rates. Further, as existing system storage is not efficiently located throughout the region, the WWTPs cannot serve much demand when operating independently. For these reasons, the "No New Storage" alternatives were removed from consideration.

The "Partial Storage" alternatives allowed flexibility in the amount of new storage that would be required. This additional storage could be obtained from additional WWTP ponds, landowner ponds, tanks, or ASR facilities.

5.3.2.2 Cost

The "Full Storage" alternatives were removed from consideration due to their substantially higher costs compared to other alternatives. From the preliminary analysis, it appeared that building sufficient storage to facilitate minimal discharge throughout the study area is cost prohibitive.

5.3.2.3 System Logistics

After reviewing preliminary demand and supply calculations for Alternative 5, it was apparent that the Napa Valley and North Central Sonoma potential reuse areas could only be served with the addition of significant storage (under "Full Storage" options). Since Alternative 3 offers the same WWTP connections as Alternative 5 without these inefficient demand areas, Alternative 5 was removed from consideration. Napa Valley and North Central Sonoma were also removed from Alternative 6 for the same reason.

5.3.2.4 Regional Partnership Opportunities

At the time of alternative screening, the participating agencies agreed that it was important to keep the City of Petaluma as a potential partner to demonstrate the region's coordinated efforts at water reuse. Therefore, Alternative 4 was removed from consideration. The agencies also wanted to evaluate an alternative that recognized the possibility of smaller distribution systems, so Alternative 1 was chosen for further study over Alternative 2.

The agencies added the Napa Salt Marsh Restoration project to Alternative 1 so that project area would be included in all alternatives carried forward for further consideration.

5.4 Action Alternatives Carried Forward

Based on the decision-making process outlined above, the participating agencies chose the following initial Project alternatives, with some refinements, to carry forward for further feasibility analysis:

- Alternative 1 – Partial Storage option, with the addition of the Napa Salt Marsh Restoration project and removal of Southern Sonoma Valley.
- Alternative 3 – Partial Storage option, with removal of Central Sonoma Valley
- Alternative 6 – Partial Storage option, with removal of North Central Sonoma and Napa Valley areas.

After this stage of the feasibility study process, the City of Petaluma and MMWD informed the Authority they did not wish to participate further in the Project. At that point, Petaluma WWTP facilities and the Petaluma South service area were removed from all three action alternatives. MMWD is no longer interested is having the Project provide recycled water for an expansion of their current service area. However, the MMWD general manager indicated MMWD will allow the Project to use one of its backbone recycled water pipelines for service from LGVSD to the Peacock Gap Golf Course Reuse Area.

These Project alternatives are further defined and evaluated in Section 6, where they are presented as Alternatives 1, 2, and 3, respectively. The No Action Alternative, a requirement for environmental analysis under the National Environmental Policy Act and the California Environmental Quality Act, is also evaluated in Section 6.

Section 6
Description of Alternatives

From the screening of 18 initial alternatives for the North San Pablo Bay Restoration and Reuse Project (Project), described in Section 5, three preferred Project action alternatives emerged for further development and evaluation, together with the No Action alternative.

In this section, more information is provided on the three action alternatives (which underwent additional refinement and are now re-numbered as Alternatives 1, 2, and 3), plus a phased implementation of each action alternative, and on the No Action alternative. The service area, demand, supply, discharge, storage requirements, and preliminary cost estimates for each action alternative are discussed below.

As part of the additional refinement, detailed hydraulic modeling was performed on each action alternative to provide a quantitative characterization of flows and system requirements.

A geologic review was conducted to identify potential hazards along the proposed pipeline alignments which would result in higher construction costs to avoid or mitigate.

Table 6-1 summarizes the projects incorporated into the three action alternatives, including those that would be part of implementation Phase 1, the counties in which the projects are located, and the wastewater treatment plants (WWTPs) providing service to each local project area.

Table 6-1
Project Reuse Areas (1)

Area Name	County	WWTP Serving Area	Alternatives in which Area Appears (2)
Peacock Gap Golf Course Reuse Area	Marin	LGVSD	Alt 2 & 3
MMWD Reuse Area (existing) (3)	Marin	LGVSD	Phase 1; Alt 1 & 2 & 3
Hamilton Field (in the southern part of the NMWD Urban Recycled Water Project)	Marin	LGVSD	Phase 1, Alt 1 & 2 & 3
NMWD Urban Recycled Water Project, North & Central Areas (4)	Marin	Novato SD	Phase 1, Alt 1 & 2 & 3
NMWD Urban Recycled Water Project, West Area	Marin	Novato SD	Alt 2 & 3
Sears Point Area	Sonoma	Novato SD	Alt 2 & 3
Southern Sonoma Valley	Sonoma	SVCSD/Novato SD (5)	Alt 2 & 3
Central Sonoma Valley	Sonoma	SVCSD	Alt 3 only
Sonoma Valley Recycled Water Project (6)	Sonoma	SVCSD	Phase 1; Alt 1 & 2 & 3
SVCSD Reuse Area (existing)	Sonoma	SVCSD	Phase 1; Alt 1 & 2 & 3
Carneros East	Napa	Napa SD	Alt 1 & 2 & 3
Napa MST Area	Napa	Napa SD	Phase 1; Alt 1 & 2 & 3
Napa Salt Marsh Restoration	Napa	SVCSD/Napa SD (7)	Phase 1; Alt 1 & 2 & 3

(1) LGVSD = Las Gallinas Valley Sanitary District; MMWD = Marin Municipal Water District; NMWD = North Marin Water District; Novato SD = Novato Sanitary District; SVCSD = Sonoma Valley County Sanitation District; MST = Milliken-Sarco-Tulocay Creeks area; Napa SD = Napa Sanitation District
(2) Note that availability of water storage may preclude some areas from being completely developed.
(3) Although not included in the Project alternatives, the MMWD Reuse Area was included in the modeling to account for any capacity and distribution pressure impacts to other areas.
(4) Includes Novato SD WWTP and existing Stone Tree Golf Course reuse area,
(5) Southern Sonoma Valley served by only SVCSD in Alternative 2 and served by only Novato SD and LGVSD in Alternative 3.
(6) Approximately 75% of the Sonoma Valley Recycled Water Project components appear in Phase 1, with full development in Alternatives 1, 2, & 3.
(7) Napa Salt Marsh is served only by SVCSD in implementation Phase 1, and jointly served by SVCSD and Novato SD in fully developed Alternatives 1, 2, & 3.

The action alternatives were designed to provide a balance among four characteristics important to the North Bay Water Reuse Authority (Authority):

- Quantity of recycled water served,
- Quantity of WWTP discharge reduced,
- Amount of storage required, and
- Planning-level cost estimates.

Regional partnership opportunities and system logistics were also factors considered in refining the alternatives. Section 5.3 describes the initial alternatives screening process and why Alternatives 1, 2, and 3 were chosen for further evaluation.

6.1 No Action Alternative

The "No Action Alternative" assumes that there is no joint Project. It represents the reasonably foreseeable actions taken by the members of the Authority, and other agencies involved in the study area's water supply, in absence of the Project. The current water supplies in the region, including groundwater and imported surface water, are not reliable in the long-term, and could result in water shortages to agriculture, including the region's renowned vineyards. Therefore, the agencies would not take "no action," but would implement other water supply projects to improve reliability and meet future demands. Because of the limited water supply options in the region, agencies would have difficulty in meeting all future water needs without the Project. The potential need to develop additional potable water supplies, and limit demand on existing potable supplies, would continue to be a regional challenge under the No Action Alternative.

Additional wastewater treatment capacity and water recycling might occur strictly from the implementation of local plans for expansion. Planned treatment improvements are discussed for each WWTP in Section 4.2, and potential future recycled water production is discussed in Section 2.2.2. However, given local funding constraints, it is unlikely these plans could be implemented without the Project.

This section addresses non-recycled water supply projects which are options in absence of the proposed Project. The Project would generally serve urban landscape areas in Marin County and urban and agricultural users in Sonoma and Napa Counties. A number of previous and ongoing water supply studies were reviewed to develop these non-recycled water options to the proposed Project. These projects had been developed for primarily municipal and industrial users and have not focused on agricultural users. Few options have been formulated in the study area to directly serve the demands that would be met by the Project. The sections below summarize the non-recycled water projects.

6.1.1 Sonoma and Marin County Projects

Under the No Action Alternative, potable water customers in the Sonoma and Marin Counties portion of the Project's service area (including the City of Sonoma, Valley of the Moon Water District [VOMWD], and NMWD), would receive water from Sonoma County Water Agency's (SCWA's) Water Supply, Transmission, and Reliability Project (Water Project). Agricultural water users in Sonoma Valley would continue to use local surface waters and pump groundwater under the No Action Alternative.

6.1.1.1 Potable Water Users

SCWA is currently evaluating the Water Project, which proposes to release and use additional water currently stored in Lake Sonoma and divert and re-divert the water from the Russian River. Releases from Lake Sonoma would be increased by up to 26,000 acre-feet per year (AFY) as necessary so that the total authorized amount of diversions and re-diversions would increase from the current limit on transmission system diversions of 75,000 AFY to a maximum of 101,000 AFY (Booker 2008b). The proposed Water Project would also expand the existing transmission system to alleviate system constraints, meet existing and future demands, and improve existing and future system reliability. The Water Project would serve SCWA water contractors, including the Cities of Santa Rosa, Sonoma, Rohnert Park, Cotati, and Petaluma, the Town of Windsor, VOMWD, and NMWD. The project is currently in the environmental review stage.

The current estimated capital costs of the proposed Water Project are $647 million, in 2008 dollars. Depending on the project components, only a portion of this cost would apply to providing water to users in Sonoma, VOMWD, and NMWD. The incremental cost per acre-foot to expand the Water Project can be used for comparison to the components of this feasibility study that would offset the need for additional SCWA potable water in Sonoma and Marin Counties. Section 9 describes preliminary costs allocated to the three districts for purposes of this report; these allocations will change as SCWA refines project cost estimates. The proposed Water Project is anticipated to provide incremental increases of 2,294 AFY to NMWD, 629 AFY to VOMWD, and 690 AFY to Sonoma over 2005-2006 Russian River deliveries. After Water Project implementation, Russian River water supplies from SCWA would total 13,000 AFY for NMWD, 3,730 AFY for VOMWD, and 3,000 AFY for Sonoma. (Booker 2008b)

The Water Project delivers water supply to these contractors, which would then need to deliver the water to customers at additional costs. These additional costs are described in Section 9.

Although no ocean desalination plants are currently being planned by water agencies in the Authority, MMWD which adjoins the study area, is considering such a plant. Given the uncertainties associated with other developable water supplies, it is possible that desalination may become an option in the study area. The MMWD Bay Water Desalination Project would treat diversions from San Rafael Bay to drinking water standards to increase MMWD's water supply reliability. The proposed project is a 5 million gallon per day (mgd) plant that could ultimately supply up to 15 mgd. The first phase, a 5 mgd facility, would provide supplemental water supply, particularly during drought years. The estimated project capital cost of the expandable 5 mgd desalination plant in 2008 dollars is $121 million. Operation and maintenance (O&M) costs range from $4.3 million in average conditions to $7.1 million in drought conditions (MMWD 2007). MMWD assumes the plant will initially produce 5,300 AF per year (Kennedy/Jenks Consultants 2007).

6.1.1.2 Agricultural Water Users

Currently, the agricultural users in the Project's service area rely on stored runoff from small local streams and local groundwater. The proposed Water Project would not serve agricultural users in the Sonoma Valley. Under the No Action Alternative, agricultural users would rely on current supplies for irrigation. Groundwater pumping in Sonoma Valley groundwater basins is increasing. It was estimated that from 1975 to 2000, 17,300 AF were lost from total groundwater storage. Projected increases in demands are estimated to result in a further reduction of approximately 16,000 to 22,000 AF from storage in the groundwater basin (SCWA 2007). Declining groundwater levels could result in potential adverse effects of increased salinity intrusion, potential land subsidence, losses in stream flows, environmental damages, and increasing extraction, well deepening, and replacement costs.

The Sonoma Valley Groundwater Management Plan identifies potential activities to increase groundwater sustainability, including storm water recharge, groundwater banking, recycled water use, and conservation/demand reduction (SCWA 2007). Under the No Action Alternative, the Stormwater Capture Project and Groundwater Banking Project could be implemented to sustain groundwater levels for irrigation. Stormwater captured could be used for direct irrigation or groundwater recharge. Additional agricultural conservation measure would also be implemented, though the majority of grape growers employ intense conservation practices. Costs for these projects have not yet been identified.

Many agencies in California are implementing similar groundwater recharge and banking projects. San Joaquin County has estimated capital costs for groundwater banking projects range from $53 to $65 million and conjunctive use projects with surface water diversion and recharge range from $86 to $250 million, depending on the size of diversion and/or recharge (Northeastern San Joaquin Groundwater Basin Authority 2007). These prices are likely indicative of the costs of a groundwater banking or recharge project in the Sonoma Valley.

6.1.2 Napa County Projects

The Project would serve recycled water to the MST area, which is an unincorporated portion of Napa County due east of the City of Napa named after the three creeks that run through the area. The area consists of a mix of rural residential, vineyard, a golf course, and unimproved open space. Current water supplies consist of groundwater and small surface water diversions. Continuing current groundwater pumping patterns would severely affect the sustainability of the MST groundwater basin, which is in a current state of groundwater overdraft (Farrar and Metzger 2003).

No alternative water supplies have been defined in previous studies for bringing water to the MST area of Napa County. Several options have been identified and are listed below; however, several of these have significant implementation issues. The most feasible new water supply alternative, other than bringing recycled water into the area, is to import potable water to the area.

- <u>Direct recharge to aquifers</u> – The MST groundwater basin has a low hydraulic conductivity throughout most of its area, which greatly restricts the feasibility of artificial recharge through wells or from surface water retention facilities (Farrar and Metzger 2003). USGS notes that "encouraging reductions in groundwater pumping by supplying imported water or reclaimed water to users in and near the pumping depressions might hold the greatest promise of reducing groundwater level declines" (Farrar and Metzger 2003).

- Divert water from Napa River – Napa River water rights are fully allocated and it is unlikely there is additional supply for the MST area.

- Construct new surface storage – New surface storage would be costly and could have significant environmental concerns. The implementation timeframe could also take many years.

- Wheeling agreements – Wheeling agreements are typically short-term and must be negotiated on an annual basis, which does not represent a reliable water supply. Long-term wheeling agreements are difficult to obtain because of current water shortage concerns and environmental issues in the Delta. If negotiated, water would be expensive and the North Bay Aqueduct (NBA) would need to be expanded. New infrastructure would be necessary to deliver water to the MST area.

- Import potable water to the MST area – This is the most feasible water supply option and was chosen as the alternate water supply under the No Action Alternative. However, this option also has implementation concerns, as discussed below.

- Recycled water to the MST area – This is the proposed Project.

The No Action Alternative assumes that, in absence of the Project, imported water would be brought to the MST area for potable water users and some conjunctive use would occur for agricultural users to maintain groundwater levels. This option is a potential alternative to recycled water; however, it would be extremely expensive and there would be substantial legal, environmental, regulatory and political hurdles to overcome.

It is assumed that 1,937 AF of imported potable water would be needed annually, which is the same amount of recycled water the Project would provide to the MST area. This amount is thought to be enough to provide sufficient groundwater offset to help improve the groundwater table in the basin. The City of Napa's Water Master Plan and General Plan do not identify plans to provide water service to this unincorporated area of the County and their existing supplies and estimated demands do not show excess available water supplies during future dry year conditions. Therefore, the water supplies needed to provide potable water for the MST area would need to be imported.

Importing water to the MST area has several costs associated with it, including distribution infrastructure, new water supply costs, legal costs, and a possible NBA expansion. The infrastructure construction costs for a potable water system designed to deliver 1,937 AF of potable water annually to the MST area would be about $40 million, similar to the recycled water distribution infrastructure costs for the MST area. The overall pipeline lengths may be less relative to recycled water pipelines due to closer proximity of tie-ins to existing City of Napa water mains, but the City of

Napa specifies ductile iron pipelines, which cost more than the polyvinyl chloride system proposed for the recycled water system. There may also be a need to install a storage tank somewhere in the area to provide adequate pressure and flow conditions. Napa County estimates an additional $8 million in legal and bonding fees would be required to fund the new infrastructure.

The City of Napa's future water supply plans do not include the MST area; therefore, a new water supply would be needed at additional costs. A recent long-term transfer of water in the Central Valley was priced at $4,000 per AF. The price of water in California continues to escalate, so it is assumed for this discussion that by the time a long-term water deal could be worked out, the price would be $5,000 per AF. Therefore, the cost to obtain 1,937 AF is estimated to be about $9.7 million. It should also be noted that there would be a substantial effort required to prepare environmental documents and receive regulatory approval, which could take several years. Litigation would also be a very real possibility, which would drive up costs further.

These imported water supplies would likely be wheeled through the NBA, which is currently used at capacity. It is possible the City of Napa could use some of its share of the pipeline capacity to serve the MST area, but this would have to be negotiated. Therefore, this option would likely require an increase in the capacity of the NBA. Preliminary costs for an NBA expansion to serve all NBA customers are estimated to be about $269 million. This discussion assumes Napa County would be responsible for the portion of NBA expansion costs based on the share of capacity of new intake, pump stations, and pipelines needed to serve the MST area. Under this alternative, Napa County would receive 1,937 AF from the NBA for the purposes of delivering water to the MST area. The NBA expansion costs for Napa County would be approximately $38 million – the majority would be new or parallel pipelines, about $36 million. The NBA expansion costs would be in addition to the new potable water distribution system to the MST area and the long-term water supply costs. Based on the above preliminary estimates, total costs to import water to the MST area would be about $96 million.

6.2 Alternative 1

Alternative 1 is the most basic regional system of the three Action alternatives. It places greatest emphasis on the implementation of recycled water projects close to each wastewater treatment plant. Under this alternative, no WWTPs are connected for joint treatment, storage, or distribution of combined recycled water. Alternative 1 is estimated to be the least expensive of the Action alternatives, in terms of implementation costs, but it would also provide the least amount of recycled water.

6.2.1 Description

This section describes the service area, projects, supply, demand, and infrastructure required for Alternative 1. Also discussed are the recycled water system's effect on existing water supplies and potential barriers to recycled water use in the study area.

6.2.1.1 Service Area and Projects

Figure 6-1 illustrates the proposed sharing of recycled water, resources, and delivery areas among the participating WWTPs in Alternative 1. The defining features of Alternative 1 are:

- Each treatment plant would put first priority on the delivery of recycled water to its local projects. Local projects include the NMWD Urban Recycled Water Project (URWP), the Sonoma Valley Recycled Water Project, Napa MST, and the Carneros East areas.

- All WWTP treatment and distribution systems would be sized and designed to serve their respective local users. Interconnectivity between WWTPs would only occur between SVCSD and Napa SD to serve the Napa Salt Marsh Restoration Area during the restoration period (less than 10 years); however, the two WWTPs do not plan to size or coordinate their facilities to share recycled water in other areas. After the restoration period has been completed, it is possible that additional recycled water may be required for Napa Salt Marsh pond maintenance.

- LGVSD would require either new or expanded treatment facilities to produce tertiary treated recycled water for unrestricted use, since the existing tertiary facility at the WWTP is currently operating at maximum capacity to meet existing MMWD user demands. Recycled water from LGVSD would be supplied to users at Hamilton Field, in the southern portion of the NMWD URWP Area. Existing available storage at the WWTP would be used, and one 0.5-million gallon (MG) drinking water reservoir near Hamilton Field would be rehabilitated for recycled water use.

- Novato SD would require either new or expanded treatment facilities to produce additional tertiary treated recycled water for unrestricted use. Recycled water from Novato SD would be supplied to users in the northern and central portions of the NMWD URWP Area, which includes the existing Stone Creek Golf Course. Existing available storage at the WWTP would be used, and one 0.5-MG drinking water reservoir in the northern portion of the NMWD URWP area would be rehabilitated for recycled water use.

- SVCSD would treat wastewater at its existing plant and distribute recycled water to local users within its existing SVCSD Reuse Area (Carneros West) in addition to the Sonoma Valley Recycled Water Project and Napa Salt Marsh Restoration Areas. This alternative would include construction of a new recycled water storage pond near the SVCSD WWTP, and assumes potential user ponds in the Carneros West

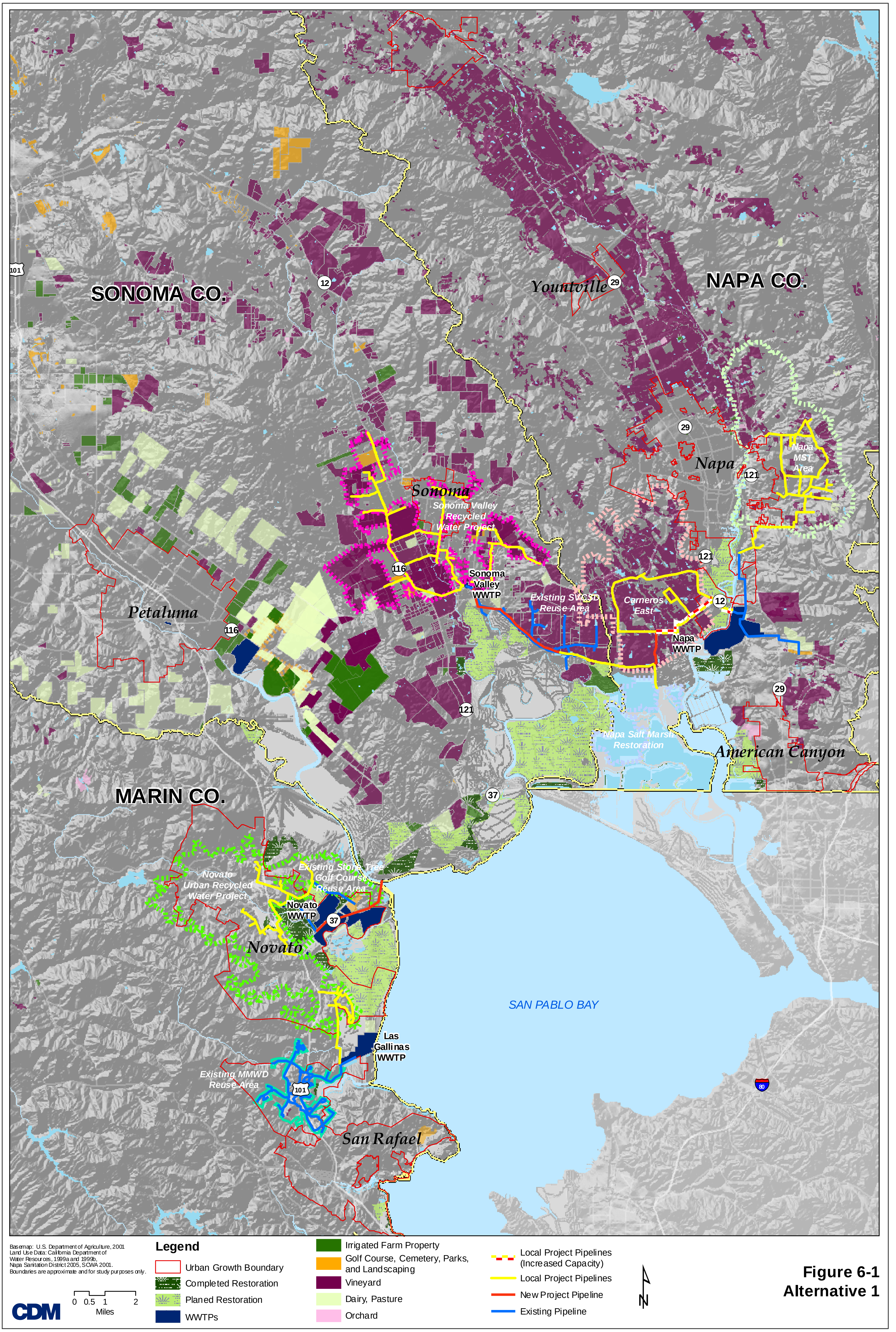


Figure 6-1
Alternative 1

and Sonoma Valley Recycled Water Project Areas would also be used for recycled water storage prior to local use.

- Napa SD would treat wastewater at its existing reclamation facility and focus on delivering recycled water to the Napa MST and Carneros East Areas. Napa SD would deliver any remaining recycled water to the Napa Salt Marsh Restoration Area. It is assumed existing ponds at the WWTP would be reconfigured for recycled water storage and potential user ponds in the Napa MST and Carneros East Areas would be used for recycled water storage prior to local use. Napa SD performed an operational analysis and determined their ponds could be used to provide peak storage for the delivery of 4,540 AF to recycled water users over the course of a year (Napa SD 2005). All Napa SD recycled water demand above 4,540 AFY is assumed to require user ponds for storage.

6.2.1.2 Recycled Water Supply, Demand, and Discharge

Table 6-2 summarizes the recycled water demand, supply, and discharge to San Pablo Bay for each treatment plant service area under Alternative 1 in 2020. Each of the WWTPs currently serves some recycled water customers. Table 6-2 presents this existing demand for each service area, the additional demand created by Alternative 1, and the total recycled water demand in the study area with the addition of Alternative 1.

Table 6-2
Recycled Water Supply, Demand, and Discharge for Alternative 1

WWTP Service Area	*2020 WWTP Inflow (AFY)*	*Existing Recycled Water Demand (AFY)*	*New Recycled Water Demand (Beneficial Reuse) Developed for Alternative 1 (AFY)*	*Total Recycled Water Demand in Project Area (AFY)*	*Discharge to San Pablo Bay (AFY)*
LGVSD WWTP	3,670	902	202	1,104	2,566
Novato SD WWTP	8,677	270	542	812	7,865
SVCSD WWTP	5,508	1,174	2,719	3,893	1,615
Napa WWTP	9,800	2,598	2,992	5,590	4,210
Total	**27,655**	**4,944**	**6,455**	**11,399**	**16,256**

The Alternative 1 demand shown in Table 6-2 represents recycled water use by customers (beneficial reuse). Urban landscaping uses would receive approximately 2,345 AF and agricultural uses would receive approximately 4,110 AF of recycled water. SVCSD and Napa SD could provide additional recycled water to the Napa Salt Marsh Restoration Area during non-peak irrigation periods. This area’s demand was considered secondary to customer demands during the peak irrigation season. The Napa Salt Marsh Restoration Area may require up to 3,000 AFY during its maintenance period, depending upon the service agreement reached with California Department of Fish and Game (CDFG). The total discharge to San Pablo Bay under

Alternative 1 (16,256 AFY) would be reduced by any deliveries of recycled water to the Napa Salt Marsh.

6.2.1.3 System Requirements

Table 6-3 summarizes the pipeline requirements for Alternative 1. Pipeline diameters, pipeline length by diameter, and total pipeline length are presented.

Table 6-3
Summary of Pipeline Sizes and Lengths for Alternative 1

Pipeline Diameter	Length (Miles)
4”	5
6”	16
8”	15
10”	9
12”	11
14”	2
16”	2
18”	11
20”	0
24”	5
30”	5
36”	4
Total	83

Table 6-4 presents figures on treatment upgrades required to implement Alternative 1. All WWTPs currently have some tertiary treatment capability; however, all but SVCSD would need to increase their treatment capacity to meet the demands of Alternative 1.

Table 6-4
Treatment Improvement Requirements for Alternative 1

Facility	Tertiary Treatment Capacity without the Project (mgd)	Tertiary Treatment Capacity Required for Alternative 1 (mgd)	Tertiary Treatment Capacity Increase (mgd)
LGVSD	2.0	2.3	0.3
Novato SD	0.5	1.7	1.2
SVCSD	16.0	9.9	0.0
Napa SD	8.8	14.3	5.5
Total	**27.3**	**28.2**	**7.0**

Table 6-5 summarizes the additional recycled water storage needs (i.e., the volume in excess of existing available storage), which would be required under Alternative 1. The local project areas being served separately by LGVSD and Novato SD would require less water during all months than would be treated at the two WWTPs; therefore, no storage of water is required to accommodate peak month demands, only as necessary for operational interests and system pressure management. The local project areas being served by SVCSD and Napa SD would require more water during the peak summer months than each of the WWTPs would be treating; additional water storage at the WWTPs, as anticipated by these Agencies’ local project reports, would be required to accommodate peak month demands. SVCSD would require additional new storage at the WWTP, and Napa SD would need to modify existing water storage basins for recycled water system use. Individual landowner ponds would be used throughout the project areas to help offset the system storage required to serve users during peak-use periods.

Table 6-5
Additional Storage Requirements for Alternative 1

Type	Location	Volume (AF)	Comments
WWTP Storage	LGVSD WWTP	0	
	Novato WWTP	0	
	SVCSD WWTP	1,020	Requires land purchase
	Napa WWTP	950	Existing storage ponds to be used
	Total	*1,970*	
System Storage Ponds	SVCSD Reuse Area	625	Existing storage ponds
	SVCSD Reuse Area	0	
	Total	*625*	
Reservoir Storage	Hamilton Field (LGVSD)	1.5	Rehabilitate existing reservoir
	NMWD Project Areas	1.5	Rehabilitate existing reservoir
	Novato WWTP	0	
	Peacock Gap	0	
	Total	*3.0*	
Total		**2,598**	

Pump stations would be needed throughout the system for distribution and to boost pressures to higher pressure zones. Alternative 1 would make use of some existing pumps at the WWTPs or project areas, and would require additional pump stations. The locations of these pump stations are summarized below in Table 6-6.

Table 6-6
Pump Stations Required for Alternative 1

Location (WWTP or Reuse Area)	Horsepower (HP)	Comments
LGVSD WWTP	71	
Novato WWTP	258	
SVCSD WWTP	872	
Napa WWTP	663	New Pump
Napa WWTP	1,989	Existing Pumps
Carneros East	0	
Central Sonoma Valley	0	
Existing SVCSD Reuse Area (Carneros West)	0	New Pumps
Existing SVCSD Reuse Area (Carneros West)	218	Existing Pumps
Napa MST Area	244	
Peacock Gap Golf Course	0	
Southern Sonoma Valley	0	
Sonoma Valley Recycled Water Project	238	
Total	**4,553**	

6.2.1.4 Effect on Existing Water Supplies

Alternative 1 would provide 893 AF of Russian River water offset in the study area: 147 AF in the Sonoma Valley Recycled Water Project and 746 AF in the NMWD URWP Area. This represents drinking water that would no longer be used for non-potable uses, thus ensuring the highest quality water is reserved for potable uses. This potable offset reduces the need for new supplies to be developed to serve the study area, which is discussed above regarding the No Action Alternative (Section 6.1).

6.2.1.5 Barriers to Recycled Water Use

Public acceptance, water quality, and cost are potential barriers to implementing recycled water use under Alternative 1. In other parts of the San Francisco Bay Area, public concerns about the use of recycled water have included potential unknown health impacts, potential negative impact on property values, and citizen choice versus public mandate on infrastructure when recycled water systems were approved without sufficient public information. The Authority is continuing outreach activities to educate the public and potential users about recycled water use in order to help facilitate more effective implementation.

As described in Section 4.3, recycled water quality must be reviewed for potential chemical constituents related to agricultural irrigation, such as salinity, sodium, trace elements, excessive chlorine residual, and nutrients. Recycled water produced by the member agencies' WWTPs was compared to water quality guidelines for the use of recycled water by the U.S. Environmental Protection Agency (US EPA), a 2006 study by the University of California (UC) Division of Agriculture, and from the North Bay Watershed Association (NBWA). Based on the data presented in Table 4-3, the member agencies' recycled water meets the water quality recommendations for agricultural application.

Cost is another potential barrier to recycled water use in the study area. Without recycled water, other water supplies would have to be developed, likely with similar costs as the construction of a recycled water system. Outreach activities to educate the public and potential users about these avoided potable water development costs will help facilitate more effective implementation.

6.2.2 Costs

Table 6-7 summarizes the opinion of probable total project capital costs for Alternative 1 in 2008 dollars. O&M costs are estimated to be about $1.8 million per year.

Table 6-7
Opinion of Probable Total Project Capital Costs for Alternative 1

Major Project Component	***Cost ($ Million)***
Pipelines	$129.6
Treatment Improvements	$29.6
Storage	$40.6
Pumping	$10.1
Probable Total Project Capital Costs	***$209.9***

6.3 Alternative 2

Alternative 2 involves development of a larger regional recycled water system, taking advantage of increased storage capacity and additional pipelines to distribute recycled water more extensively throughout the study area than could be achieved under Alternative 1.

6.3.1 Description

This section describes the service area, projects, supply, demand, and infrastructure required for Alternative 2. Also discussed are the recycled water system's effect on existing water supplies, and potential barriers to recycled water use in the study area.

6.3.1.1 Service Area and Projects

Figure 6-2 illustrates the proposed sharing of recycled water, resources, and delivery areas among the participating WWTPs in Alternative 2. The defining features of Alternative 2 are:

- Each treatment plant would put first priority on the delivery of recycled water to its local projects. Local projects include the Peacock Gap Golf Course area, NMWD URWP, the Sonoma Valley Recycled Water Project, Napa MST, and the Carneros East areas.

- Interconnectivity between WWTPs would occur between SVCSD and Napa SD to serve the Napa Salt Marsh Restoration Area during the restoration period (less than 10 years), and between Novato SD and LGVSD to serve the Sears Point Area.

- LGVSD would require either new or expanded treatment facilities to produce tertiary treated recycled water for unrestricted use, since the existing tertiary facility at the WWTP is currently operating at maximum capacity to meet existing MMWD user demands. Recycled water from LGVSD would be supplied to users at Hamilton Field, in the southern portion of the NMWD URWP Area, and to the Peacock Gap Golf Course Area. The distribution to the Peacock Gap Golf Course Area would require both a new pipeline and use of additional conveyance capacity in the existing MMWD recycled water distribution system, and rehabilitation of an

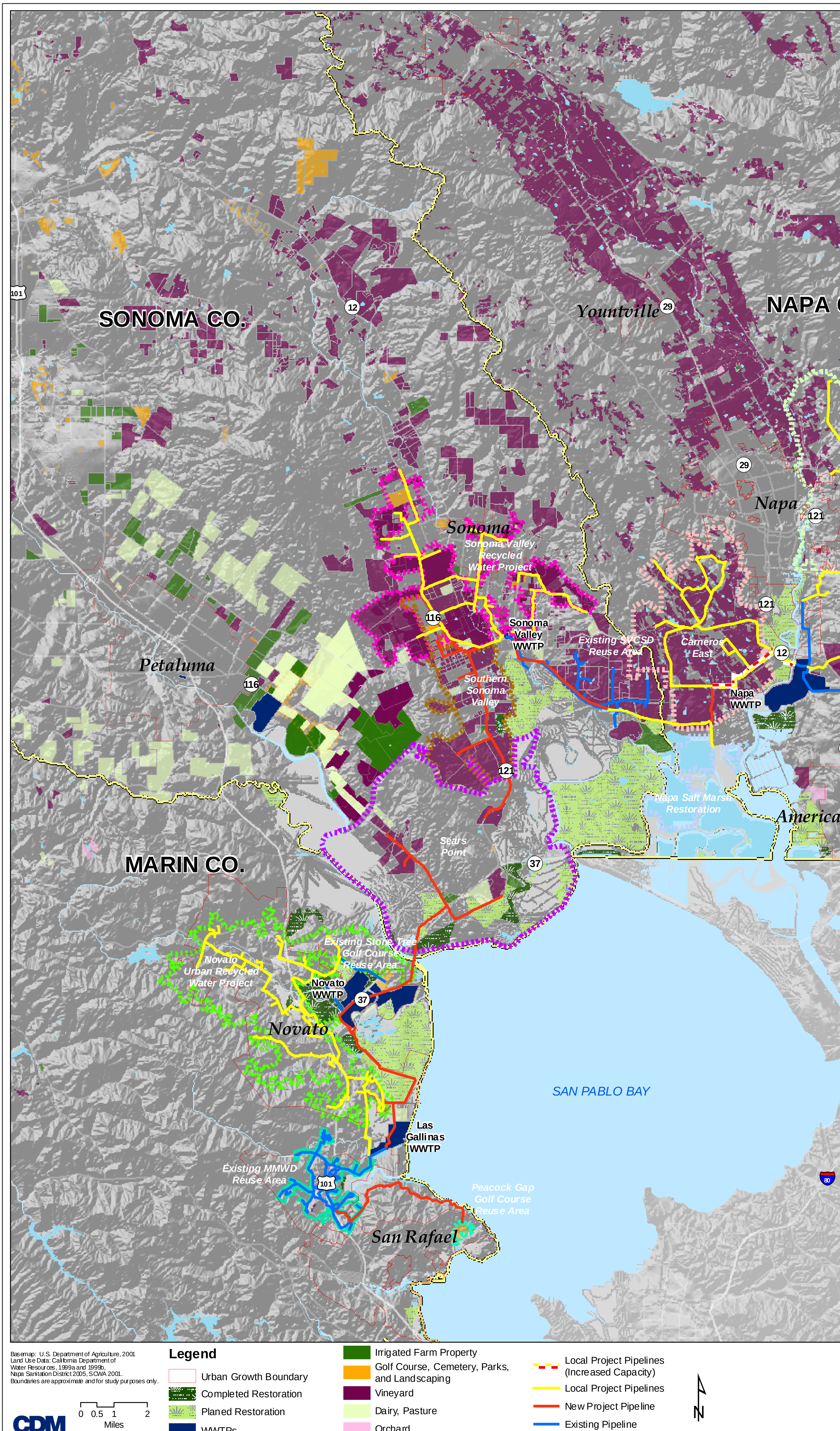


Figure 6-2
Alternative 2

existing 0.5-MG drinking water reservoir near the Peacock Gap Golf Course. Existing available storage at the WWTP would be used, and one 0.5-MG drinking water reservoir near Hamilton Field would be rehabilitated for recycled water use.

- Novato SD would require either new or expanded treatment facilities to produce additional tertiary treated recycled water for unrestricted use. Recycled water from Novato SD would be supplied to users in the northern, western, and central portions of the NMWD URWP Area, which includes the existing Stone Creek Golf Course. An added recycled water pipeline from LGVSD would extend north to join a recycled water pipeline from Novato SD; the combined flow would continue east to jointly serve the Sears Point Area, although most of this flow is anticipated to originate from Novato SD. Existing available storage at the WWTP would be used, and two 0.5-MG drinking water reservoirs in each of the northern and western portions of the NMWD URWP area would be rehabilitated for recycled water use.

- SVCSD would treat wastewater at its existing plant and distribute recycled water to local uses within its existing recycled water service area (Carneros West) in addition to the Sonoma Valley Recycled Water Project, Southern Sonoma Valley Service Area, and Napa Salt Marsh Restoration Area. This alternative would include construction of a new recycled water storage pond near the SVCSD WWTP and additional system storage in the Carneros West Area. In addition, this alternative assumes potential user ponds in the Carneros West, Sonoma Valley Recycled Water Project, and Southern Sonoma Valley Service Areas would also be used for recycled water storage prior to local use.

- Napa SD would treat wastewater at its existing reclamation facility and focus on delivering recycled water to an expanded Napa MST Area (compared to Alternative 1), an expanded Carneros East Area (compared to Alternative 1), and potential new recycled water users in southeast Napa. Napa SD would deliver any remaining recycled water to the Napa Salt Marsh Restoration Area. It is assumed that existing ponds at the WWTP would be reconfigured for recycled water storage and potential user ponds in the Napa MST and Carneros East Areas would be used for recycled water storage prior to local use. Napa SD performed an operational analysis and determined their ponds could be used to provide peak storage for the delivery of 4,540 AF to recycled water users over the course of a year (Napa SD 2005). All Napa SD recycled water demand above 4,540 AFY is assumed to require user ponds for storage.

- Aquifer Storage and Recovery (ASR) Basins, previously reviewed during development of the initial alternatives for recycled water storage, are no longer considered necessary in Alternative 2. All anticipated storage for Alternative 2 would occur in surface storage ponds or reservoirs.

6.3.1.2 Recycled Water Supply, Demand, and Discharge

Table 6-8 summarizes the recycled water demand, supply, and 2020 discharge to San Pablo Bay for each treatment plant service area that would be achieved under Alternative 2. Each of the WWTPs currently serves some recycled water customers. Table 6-8 presents this existing demand for each service area, the additional demand created by Alternative 2, and the total recycled water demand in the study area with the addition of Alternative 2.

Table 6-8
Recycled Water Supply, Demand, and Discharge for Alternative 2

WWTP Service Area	*2020 WWTP Inflow (AFY)*	*Existing Recycled Water Demand (AFY)*	*New Recycled Water Demand (Beneficial Reuse) Developed for Alternative 2 (AFY)*	*Total Recycled Water Demand in the Project Area (AFY)*	*Discharge to San Pablo Bay (AFY)*
LGVSD WWTP	3,670	902	574	1,476	2,194
Novato SD WWTP	8,677	270	2,114	2,384	6,293
SVCSD WWTP	5,508	1,174	4,306	5,480	28
Napa WWTP	9,800	2,598	4,221	6,819	2,981
Total	**27,655**	**4,944**	**11,215**	**16,159**	**11,496**

The Alternative 2 demand shown in Table 6-8 represents recycled water use by customers (beneficial reuse). Urban landscaping uses would receive approximately 3,966 AF and agricultural uses would receive approximately 7,249 AF of recycled water. SVCSD and Napa SD could provide additional recycled water to the Napa Salt Marsh Restoration Area during non-peak irrigation periods. This area's demand was considered secondary to customer demands during the peak irrigation season. The Napa Salt Marsh Restoration Area may require up to 3,000 AFY during its maintenance period, depending upon the service agreement reached with CDFG. The total discharge to San Pablo Bay under Alternative 2 (11,496 AFY) would be reduced by any deliveries of recycled water to the Napa Salt Marsh.

6.3.1.3 System Requirements

Table 6-9 summarizes the pipeline requirements for Alternative 2. Pipeline diameters, pipeline length by diameter, and total pipeline length are presented.

Table 6-10 presents figures on treatment upgrades required to implement Alternative 2. All WWTPs currently have some tertiary treatment capability; however, all but SVCSD would need to increase their treatment capacity to meet the demands of Alternative 2. These treatment upgrades are the same as are required under Alternative 1.

Table 6-9
Summary of Pipeline Sizes and Lengths for Alternative 2

Pipeline Diameter	Length (Miles)
4”	5
6”	31
8”	26
10”	13
12”	22
14”	3
16”	7
18”	19
20”	1
24”	5
30”	5
36”	4
Total	140

Table 6-10
Treatment Improvement Requirements for Alternative 2

Facility	Tertiary Treatment Capacity without the Project (mgd)	Tertiary Treatment Capacity Required for Alternative 2 (mgd)	Tertiary Treatment Capacity Increase (mgd)
LGVSD	2.0	3.1	1.1
Novato SD	0.5	5.6	5.1
SVCSD	16.0	15.9	0.0
Napa SD	8.8	17.9	9.1
Total	**27.3**	**42.5**	**15.3**

Table 6-11 summarizes the additional recycled water storage needs required under Alternative 2. The addition of the Peacock Gap Golf Course to the areas served by LGVSD, compared to Alternative 1, would increase the summer water demand to slightly above the flow treated at the WWTP during this season; therefore, LGVSD would need to use existing water storage basins at the WWTP for recycled water system use during the summer.

The local project areas being served separately by Novato SD would require less water during all months than would be treated at the WWTP; therefore, no storage of water would be required to accommodate peak month demands, only as necessary for operational interests and system pressure management.

The local project areas being served by SVCSD and Napa SD would require more water during the peak summer months than each of the WWTPs is treating; additional water storage at the WWTPs, as anticipated by these Agencies’ local project reports, would be required to accommodate peak month demands. SVCSD would require additional new storage at the WWTP, as well as additional pond storage within the system to accommodate users added in the Southern Sonoma Valley Area.

It is anticipated this additional pond storage would occur either at the WWTP or in the Carneros West area. Napa SD would need to modify existing storage ponds at the WWTP for recycled water system use.

Table 6-11
Additional Storage Requirements for Alternative 2

Type	Location	Volume (AF)	Comments
WWTP Storage	LGVSD WWTP	200	Existing storage ponds to be used
	Novato WWTP	0	
	SVCSD WWTP	1,020	Requires land purchase
	Napa WWTP	950	Existing storage ponds to be used
	Total	*2,170*	
System Storage Ponds	SVCSD Reuse Area	625	Existing storage ponds
	SVCSD Reuse Area	1,200	New storage ponds. Requires land purchase.
	Total	*1,825*	
Reservoir Storage	Hamilton Field	1.5	Rehabilitate existing reservoir
	NMWD Project Areas	3.1	Rehabilitate existing reservoirs
	Novato WWTP	3.1	Locate at existing WWTP
	Peacock Gap	1.5	Rehabilitate existing reservoir
	Total	*9.2*	
Total		**4,004**	

Individual landowner ponds would be used throughout the project areas.

Pump stations would be needed throughout the system for distribution and to boost pressures to higher pressure zones. Alternative 2 would make use of some existing pumps at the WWTPs or project areas, and would require additional pump stations. The locations of these pump stations are summarized below in Table 6-12.

6.3.1.4 Effect on Existing Water Supplies

Alternative 2 would provide 1,085 AF of Russian River water offset in the study area: 147 AF in the Sonoma Valley Recycled Water Project and 938 AF in the NMWD URWP Area. This represents drinking water that would no longer be used for non-potable uses, thus ensuring the highest quality water is reserved for potable uses. This potable offset reduces the need for new supplies to be developed to serve the study area, which is discussed above regarding the No Action Alternative (Section 6.1).

Table 6-12
Pump Stations Required for Alternative 2

Location (WWTP or Reuse Area)	Horsepower (HP)	Comments
LGVSD WWTP	91	
Novato WWTP	584	
SVCSD WWTP	1,315	
Napa WWTP	673	New Pump
Napa WWTP	2,020	Existing Pumps
Carneros East	105	
Central Sonoma Valley	0	
Existing SVCSD Reuse Area (Carneros West)	52	New Pumps
Existing SVCSD Reuse Area (Carneros West)	218	Existing Pumps
Napa MST Area	382	
Peacock Gap Golf Course	246	Existing MMWD Pumps
Sonoma Valley Recycled Water Project	192	
Southern Sonoma Valley	260	
Total	**6,138**	

6.3.1.5 Barriers to Recycled Water Use

The potential barriers for recycled water implementation under Alternative 2 are the same as Alternative 1: public acceptance, water quality, and cost. In other parts of the San Francisco Bay Area, public concerns about the use of recycled water have included potential unknown health impacts, potential negative impact on property values, and citizen choice versus public mandate on infrastructure when recycled water systems were approved without sufficient public information. The Authority is continuing outreach activities to educate the public and potential users about recycled water use in order to help facilitate more effective implementation.

As described in Section 4.3, recycled water quality must be reviewed for potential chemical constituents related to agricultural irrigation, such as salinity, sodium, trace elements, excessive chlorine residual, and nutrients. Recycled water produced by the member agencies' WWTPs was compared to water quality guidelines for the use of recycled water by the US EPA, a 2006 study by the UC Division of Agriculture, and from the NBWA. Based on the data presented in Table 4-3, member agencies' recycled water meets the water quality recommendations for agricultural application.

Cost is another potential barrier to recycled water use in the study area. Without recycled water, other water supplies would have to be developed, likely with similar costs as the construction of a recycled water system. Outreach activities to educate the public and potential users about these avoided potable water development costs will help facilitate more effective implementation.

6.3.2 Costs

Table 6-13 summarizes the opinion of probable total project capital costs for Alternative 2. O&M costs are estimated to be about $2.8 million per year.

Table 6-13
Opinion of Probable Total Project Capital Costs for Alternative 2

Major Project Component	*Cost ($ million)*
Pipelines	$198.0
Treatment Improvements	$64.7
Storage	$98.6
Pumping	$16.2
Probable Total Project Capital Costs	***$377.5***

6.4 Alternative 3

Alternative 3 creates an interconnected regional system that links all four wastewater treatment facilities in the study area. This alternative maximizes water reuse by allowing recycled water from any WWTP to be delivered to any area that needs recycled water. With much of the demand for recycled water coming from the area near Sonoma and Napa, the regional interconnection achieved under Alternative 3 is helpful as it allows the other treatment plants to help satisfy the demand in this area. This alternative would provide the greatest use of recycled water, but it would also have the highest implementation costs.

6.4.1 Description

This section describes the service area, projects, supply, demand, and infrastructure required for Alternative 3. Also discussed are the recycled water system's effect on existing water supplies and potential barriers to recycled water use in the study area.

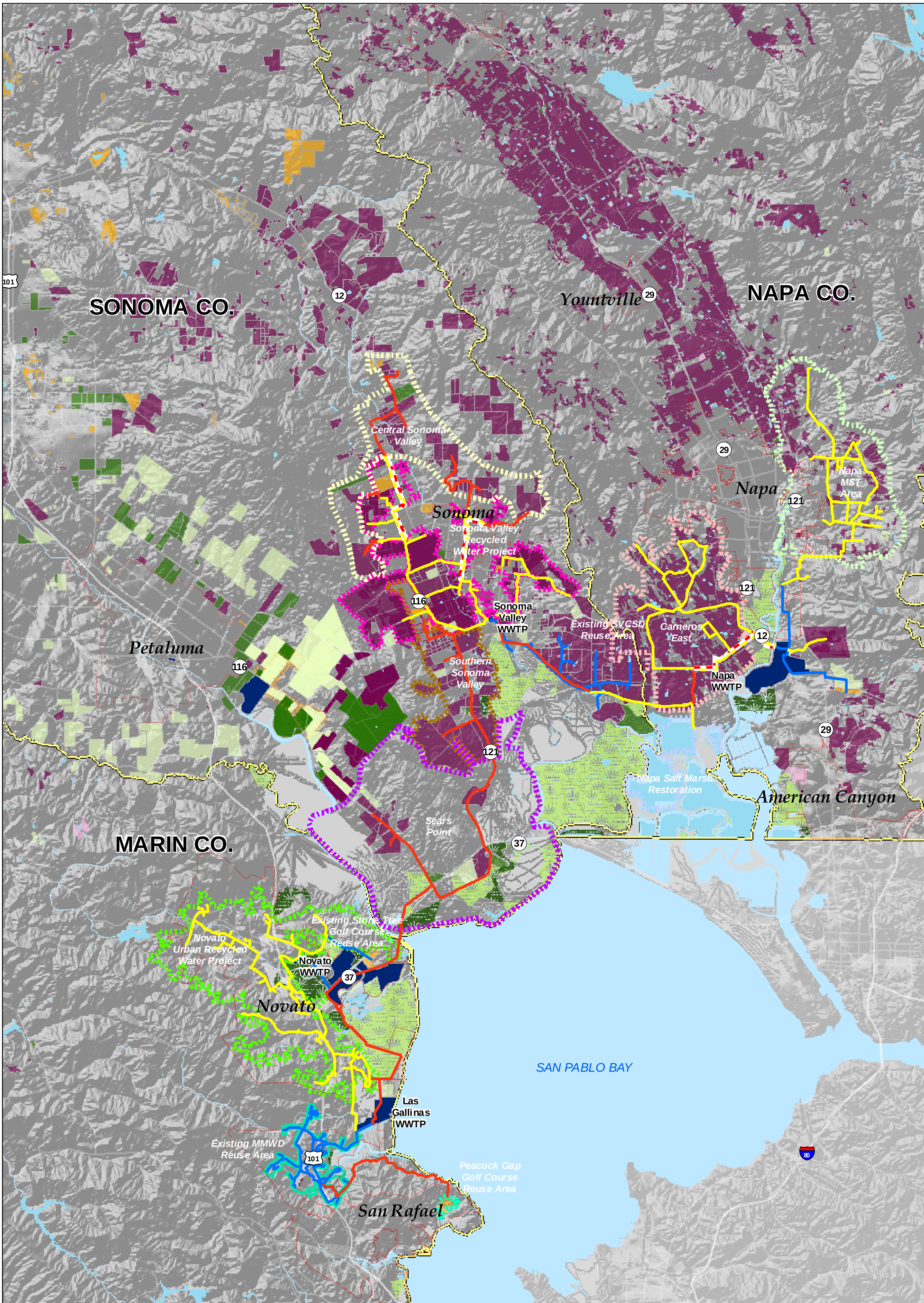
6.4.1.1 Service Area and Projects

Figure 6-3 illustrates the proposed sharing of recycled water, resources, and delivery areas among the participating WWTPs in Alternative 3. The defining features of Alternative 3 are:

- A series of pipelines would connect all four treatment plants to allow for potential maximum distribution and use of recycled water.

- Each treatment plant would put first priority on the delivery of recycled water to its local projects. Local projects include the Peacock Gap Golf Course area, NMWD URWP, the Sonoma Valley Recycled Water Project, Napa MST, and the Carneros East areas.

- LGVSD would require either new or expanded treatment facilities to produce tertiary treated recycled water for unrestricted use, since the existing tertiary facility at the WWTP is currently operating at maximum capacity to meet existing MMWD user demands. Recycled water from LGVSD would be supplied to users at



Basemap: U.S. Department of Agriculture, 2001
Land Use Data: California Department of Water Resources, 1999a and 1999b, Napa Sanitation District 2005, SCWA 2001.
Boundaries are approximate and for study purposes only.

0 0.5 1 2
Miles

CDM

Legend

- Urban Growth Boundary
- Completed Restoration
- Planed Restoration
- WWTPs
- Irrigated Farm Property
- Golf Course, Cemetery, Parks, and Landscaping
- Vineyard
- Dairy, Pasture
- Orchard
- Local Project Pipelines (Increased Capacity)
- Local Project Pipelines
- New Project Pipeline
- Existing Pipeline

N

Figure 6-3
Alternative 3

Hamilton Field, in the southern portion of the NMWD URWP Area, and to the Peacock Gap Golf Course Area. The distribution to the Peacock Gap Golf Course Area would require both a new pipeline and use of additional conveyance capacity in the existing MMWD recycled water distribution system, and rehabilitation of an existing 0.5-MG drinking water reservoir near the Peacock Gap Golf Course. Existing available storage at the WWTP would be used, and one 0.5-MG drinking water reservoir near Hamilton Field would be rehabilitated for recycled water use.

- Novato SD would require either new or expanded treatment facilities to produce additional tertiary treated recycled water for unrestricted use. Recycled water from Novato SD would be supplied to users in the northern, western, and central portions of the NMWD URWP Area, which includes the existing Stone Creek Golf Course. An added recycled water pipeline from LGVSD would extend north to join a recycled water pipeline from Novato SD; the combined flow would continue east to jointly serve the Sears Point Area and the Southern Sonoma Valley Area, although most of this flow is anticipated to originate from Novato SD. Existing available storage at the WWTP would be used, and two 0.5-MG drinking water reservoirs in each of the northern and western portions of the NMWD URWP area would be rehabilitated for recycled water use.

- SVCSD would treat wastewater at its existing plant and distribute recycled water to local uses within its existing recycled water service area (Carneros West) in addition to the Sonoma Valley Recycled Water Project, Central Sonoma Valley Area, and Napa Salt Marsh Restoration Area. This alternative would include construction of a new recycled water storage pond near the SVCSD WWTP and additional surface reservoir system storage in the Carneros West Area. In addition, this alternative assumes potential user ponds in the Carneros West, Sonoma Valley Recycled Water Project, and Central Sonoma Valley Service Areas would also be used for recycled water storage prior to local use.

- Napa SD would treat wastewater at its existing reclamation facility and focus on delivering recycled water to an expanded Napa MST Area (compared to Alternative 1), an expanded Carneros East Area (compared to Alternative 1), and new potential recycled water users in southeast Napa. Napa SD would deliver any remaining recycled water the Napa Salt Marsh Restoration Area. It is assumed existing ponds at the WWTP would be reconfigured for recycled water storage and potential user ponds in the Napa MST and Carneros East Areas would be used for recycled water storage prior to local use. Napa SD performed an operational analysis and determined their ponds could be used to provide peak storage for the delivery of 4,540 AF to recycled water users over the course of a year (Napa SD 2005). All Napa SD recycled water demand above 4,540 AFY is assumed to require user ponds for storage.

- ASR basins, previously reviewed during development of the initial alternatives for recycled water storage, are no longer considered necessary in Alternative 3. All anticipated storage for Alternative 3 would occur in surface storage ponds or reservoirs.

6.4.1.2 Recycled Water Supply, Demand, and Discharge

Table 6-14 summarizes the recycled water demand, supply, and discharge to San Pablo Bay for each treatment plant service area under Alternative 3 in 2020. Each of the WWTPs currently serves some recycled water customers. Table 6-14 presents this existing demand for each service area, the additional demand created by Alternative 3, and the total recycled water demand in the study area with the addition of Alternative 3.

Table 6-14
Recycled Water Supply, Demand, and Discharge for Alternative 3

WWTP Service Area	*2020 WWTP Inflow (AFY)*	*Existing Recycled Water Demand (AFY)*	*New Recycled Water Demand (Beneficial Reuse) Developed for Alternative 3 (AFY)*	*Total Recycled Water Demand in the Project Area (AFY)*	*Discharge to San Pablo Bay (AFY)*
LGVSD WWTP	3,670	902	574	1,476	2,194
Novato SD WWTP	8,677	270	3,701	3,971	4,706
SVCSD WWTP	5,508	1,174	4,229	5,403	105
Napa WWTP	9,800	2,598	4,221	6,819	2,981
Total	**27,655**	**4,944**	**12,725**	**17,669**	**9,986**

The Alternative 3 demand shown in Table 6-14 represents recycled water use by customers (beneficial reuse). Urban landscaping uses would receive approximately 4,092 AF and agricultural uses would receive approximately 8,633 AF of recycled water. SVCSD and Napa SD could provide additional recycled water to the Napa Salt Marsh Restoration Area during non-peak irrigation periods. This area's demand was considered secondary to customer demands during the peak irrigation season. The Napa Salt Marsh Restoration Area may require up to 3,000 AFY during its maintenance period, depending upon the service agreement reached with CDFG. The total discharge to San Pablo Bay under Alternative 3 (9,986 AFY) would be reduced by any deliveries of recycled water to the Napa Salt Marsh.

6.4.1.3 System Requirements

Table 6-15 summarizes the pipeline requirements for Alternative 3. Pipeline diameters, pipeline length by diameter, and total pipeline length are presented.

Table 6-15
Summary of Pipeline Sizes and Lengths for Alternative 3

Pipeline Diameter	***Length (Miles)***
4”	4
6”	32
8”	24
10”	13
12”	34
14”	5
16”	8
18”	20
20”	1
24”	5
30”	5
36”	4
Total	155

Table 6-16 presents figures on treatment upgrades required to implement Alternative 3. All WWTPs currently have some tertiary treatment capability; however, all but SVCSD would need to increase their treatment capacity to meet the demands of Alternative 3.

Table 6-16
Treatment Improvement Requirements for Alternative 3

Facility	***Tertiary Treatment Capacity without the Project (mgd)***	***Tertiary Treatment Capacity Required for Alternative 3 (mgd)***	***Tertiary Treatment Capacity Increase (mgd)***
LGVSD	2.0	3.1	1.1
Novato SD	0.5	10.4	9.9
SVCSD	16.0	15.5	0.0
Napa SD	8.8	17.9	9.1
Total	**27.3**	**46.9**	**20.1**

The increased recycled water demands reflected in Alternative 3 require that all WWTPs provide some amount of secondary effluent storage for treatment and use during the peak summer period. Table 6-17 summarizes the additional recycled water storage needs (i.e., the volume in excess of existing available storage), which would be required under Alternative 3.

The addition of the Peacock Gap Golf Course to the areas served by LGVSD, compared to Alternative 1, would increase the summer water demand to slightly above the flow treated at the WWTP during this season; therefore, LGVSD would need to use existing water storage basins at the WWTP for recycled water system use during the summer.

Table 6-17
Additional Storage Requirements for Alternative 3

Type	Location	Volume (AF)	Comments
WWTP Storage	LGVSD WWTP	200	Existing storage ponds to be used
	Novato WWTP	437	Existing storage ponds to be used
	SVCSD WWTP	1,020	Requires land purchase
	Napa WWTP	950	Existing storage ponds to be used
	Total	*2,607*	
System Storage Ponds	SVCSD Reuse Area	625	Existing storage ponds
	SVCSD Reuse Area	1,200	New storage ponds. Requires land purchase
	Total	*1,825*	
Reservoir Storage	Hamilton Field	1.5	Rehabilitate existing reservoir
	NMWD Project Areas	3.1	Rehabilitate existing reservoirs
	Novato WWTP	3.1	Locate at existing WWTP
	Peacock Gap	1.5	Rehabilitate existing reservoir
	Total	*9.2*	
Total		**4,441**	

The addition of the Sears Point and Southern Sonoma Valley Areas, compared to Alternatives 1 & 2, would increase the summer water demand above the flow treated at the WWTP during this season; therefore, Novato SD would need to use existing water storage basins for recycled water system use during the summer.

The local project areas being served by SVCSD and Napa SD would require more water during the peak summer months than each of the WWTPs is treating; additional water storage at the WWTPs, as anticipated by these Agencies' local project reports, would be required to accommodate peak month demands. SVCSD would require additional new storage at the WWTP, as well as additional pond storage within the system to accommodate users added in the Central Sonoma Valley Area. It is anticipated this additional pond storage would occur either at the WWTP or in the Carneros West area. Napa SD would need to modify existing water storage basins for recycled water system use.

Individual landowner ponds would be used throughout the project areas.

Pump stations would be needed throughout the recycled water system for distribution and to boost pressures to higher pressure zones. Alternative 3 would make use of some existing pumps at the WWTPs or project areas, and would require additional pump stations. The locations of these pump stations are summarized below in Table 6-18.

Table 6-18 Pump Stations Required for Alternative 3		
Location (WWTP or Reuse Area)	**Horsepower (HP)**	**Comments**
LGVSD WWTP	203	
Novato WWTP	704	
SVCSD WWTP	1,649	
Napa WWTP	672	New Pump
Napa WWTP	2,016	Existing Pumps
Carneros East	105	
Central Sonoma Valley	409	
Existing SVCSD Reuse Area (Carneros West)	61	New Pumps
Existing SVCSD Reuse Area (Carneros West)	218	Existing Pumps
Napa MST Area	382	
Peacock Gap Golf Course	246	Existing MMWD Pumps
Sonoma Valley Recycled Water Project	575	
Southern Sonoma Valley	260	
Total	**7,500**	

6.4.1.4 Effect on Existing Water Supplies

Alternative 3 provides 1,085 AF of Russian River water offset in the study area: 147 AF in the Sonoma Valley Recycled Water Project and 938 AF in the NMWD URWP Area. This represents drinking water that would no longer be used for nonpotable uses, thus ensuring the highest quality water is reserved for potable uses. This potable offset reduces the need for new supplies to be developed to serve the study area, which is discussed above regarding the No Action Alternative (Section 6.1).

6.4.1.5 Barriers to Recycled Water Use

The potential barriers for recycled water implementation under Alternative 3 are the same as Alternatives 1 and 2: public acceptance, water quality, and cost. In other parts of the San Francisco Bay Area, public concerns about the use of recycled water have included potential unknown health impacts, potential negative impact on property values, and citizen choice versus public mandate on infrastructure when recycled water systems were approved without sufficient public information. The Authority is continuing outreach activities to educate the public and potential users about recycled water use in order to help facilitate more effective implementation.

As described in Section 4.3, recycled water quality must be reviewed for potential chemical constituents related to agricultural irrigation, such as salinity, sodium, trace elements, excessive chlorine residual, and nutrients. Recycled water produced by the member agencies' WWTPs was compared to water quality guidelines for the use of recycled water by the US EPA, a 2006 study by the UC Division of Agriculture, and from the NBWA. Based on the data presented in Table 4-3, the member agencies' recycled water meets the water quality recommendations for agricultural application.

Cost is another potential barrier to recycled water use in the study area. Without recycled water, other water supplies would have to be developed, likely with similar costs as the construction of a recycled water system. Outreach activities to educate the public and potential users about these avoided potable water development costs will help facilitate more effective implementation.

6.4.2 Costs

Table 6-19 summarizes the opinion of probable total project capital costs for Alternative 3 in 2008 dollars. O&M costs are estimated to be about $3.1 million per year.

Table 6-19
Opinion of Probable Total Project Capital Costs for Alternative 3

Major Project Component	***Cost ($ millions)***
Pipelines	$216.7
Treatment Improvements	$85.2
Storage	$90.7
Pumping	$21.4
Probable Total Project Capital Costs	***$414.0***

6.5 Alternative Implementation – Phase 1

Within the Alternatives described above, the Authority members have collectively prioritized the projects within their individual service areas to identify a phased implementation plan under any of the alternatives being considered. The first phase (Phase 1) of alternative implementation includes projects that each member agency has defined to a level of detail that allows both for project-level environmental review in other sections of the feasibility study, and short-term readiness for design, funding, and construction.

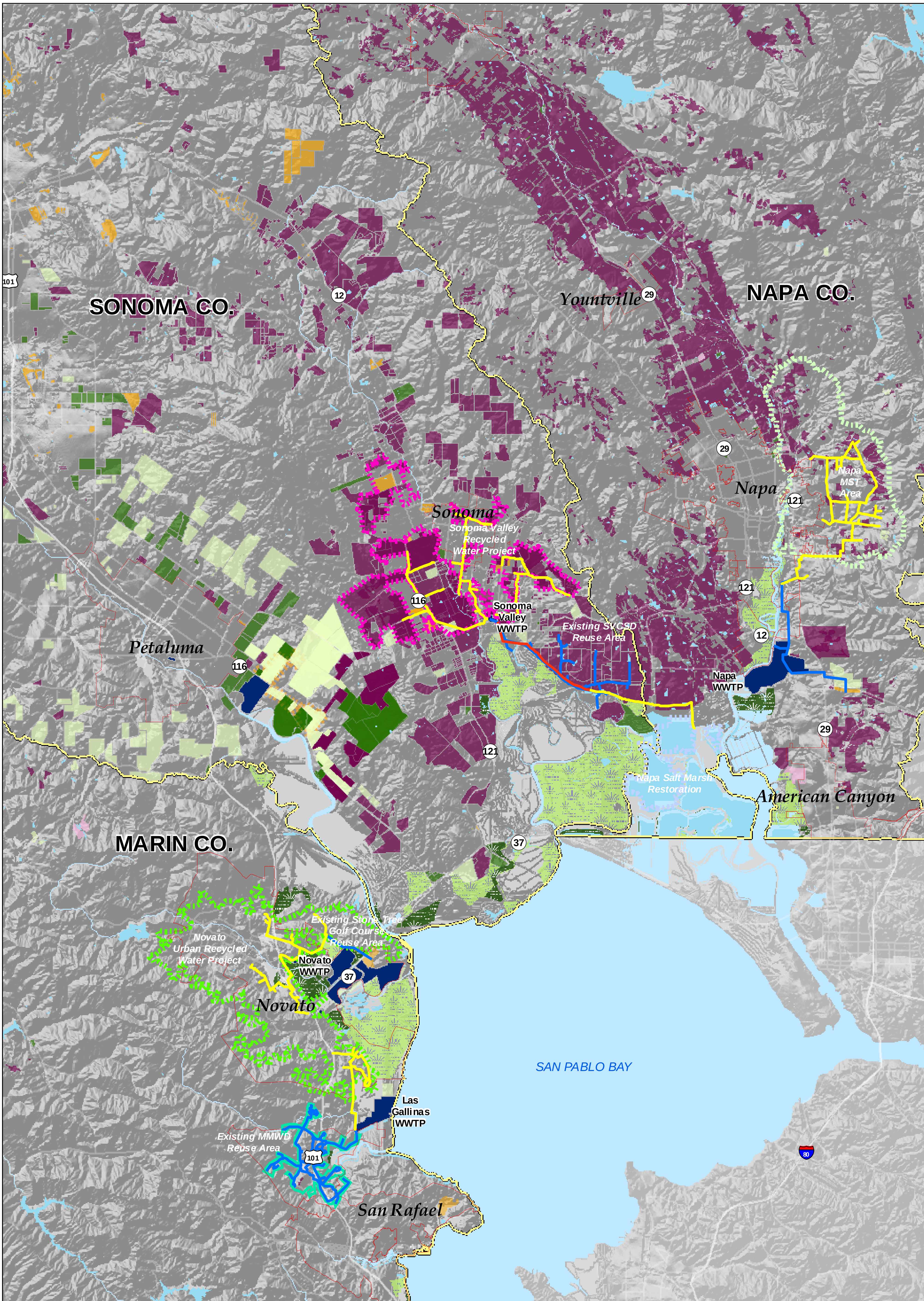
The modular nature of the design and construction of the primary project components (e.g., WWTP treatment improvements, pump stations, storage basins) results in the Phase 1 elements of larger components appearing similar under any alternative. Only the project pipelines installed under Phase 1 would need to be sized to anticipate the future full development of the preferred project alternative.

6.5.1 Description

This section describes the service area, projects, supply, demand, and infrastructure included in implementation Phase 1.

6.5.1.1 Service Area and Projects

Figure 6-4 illustrates the anticipated construction components and delivery areas associated with implementation Phase 1 under any of Alternatives 1, 2, or 3. The defining features of Phase 1 are:



Basemap: U.S. Department of Agriculture, 2001
Land Use Data: California Department of Water Resources, 1999a and 1999b, Napa Sanitation District 2005, SCWA 2001.
Boundaries are approximate and for study purposes only.

0 0.5 1 2
Miles

CDM

Legend

- Urban Growth Boundary
- Completed Restoration
- Planed Restoration
- WWTPs
- Irrigated Farm Property
- Golf Course, Cemetery, Parks, and Landscaping
- Vineyard
- Dairy, Pasture
- Orchard
- Local Project Pipelines (Increased Capacity)
- Local Project Pipelines
- New Project Pipeline
- Existing Pipeline

N

Figure 6-4
Phase 1

- Each treatment plant would put first priority on the delivery of recycled water to its local projects. Local projects include the NMWD URWP, the Sonoma Valley Recycled Water Project, and the Napa MST areas.

- LGVSD would require either new or expanded treatment facilities to produce tertiary treated recycled water for unrestricted use, since the existing tertiary facility at the WWTP is currently operating at maximum capacity to meet existing MMWD user demands. Recycled water from LGVSD would be supplied to users at Hamilton Field, in the southern portion of the NMWD URWP Area. Existing available storage at the WWTP would be used, and one 0.5-MG drinking water reservoir near Hamilton Field would be rehabilitated for recycled water use.

- Novato SD would require either new or expanded treatment facilities to produce additional tertiary treated recycled water for unrestricted use. Recycled water from Novato SD would be supplied to users in the northern and central portions of the NMWD URWP Area, which includes the existing Stone Creek Golf Course. Existing available storage at the WWTP would be used, and one 0.5-MG drinking water reservoir in the northern portion of the NMWD URWP area would be rehabilitated for recycled water use.

- SVCSD would treat wastewater at its existing plant and distribute recycled water to local users within its existing SVCSD Reuse Area (in Carneros West) in addition to the Sonoma Valley Recycled Water Project and Napa Salt Marsh Restoration Areas. This alternative includes construction of a new recycled water storage pond near the SVCSD WWTP, and assumes potential user ponds in the Carneros West and Sonoma Valley Recycled Water Project Areas would also be used for recycled water storage prior to local use.

- Napa SD would treat wastewater at its existing reclamation facility and focus on delivering recycled water to the Napa MST Area. The increased delivery of recycled water for irrigation would help reduce groundwater pumping in the MST region. It is assumed that existing ponds at the WWTP would be reconfigured for recycled water storage and potential user ponds in the Napa MST Area would be used for recycled water storage prior to local use.

6.5.1.2 Recycled Water Supply, Demand, and Discharge

Table 6-20 summarizes the recycled water demand, supply, and discharge to San Pablo Bay for each treatment plant service area under implementation Phase 1 in 2020. Each of the WWTPs currently serves some recycled water customers. Table 6-20 presents this existing demand for each service area, the additional demand created by implementation Phase 1, and the total recycled water demand included in the Phase 1 use areas.

Table 6-20
Recycled Water Supply, Demand, and Discharge for Implementation Phase 1

WWTP Service Area	2020 WWTP Inflow (AFY)	Existing Recycled Water Demand (AFY)	New Recycled Water Demand (Beneficial Reuse) Developed for Implementation Phase 1 (AFY)	Total Recycled Water Demand in the Project Area (AFY)	Discharge to San Pablo Bay (AFY)
LGVSD WWTP	3,670	902	202	1,104	2,566
Novato SD WWTP	8,677	270	542	812	7,865
SVCSD WWTP	5,508	1,174	1,972	3,146	2,362
Napa WWTP	9,800	2,598	1.937	4,535	5,265
Total	**27,655**	**4,944**	**4,653**	**9,597**	**18,058**

The Phase 1 demand shown in Table 6-20 represents recycled water use by customers (beneficial reuse). Urban landscaping uses would receive approximately 2,021 AF and agricultural uses would receive approximately 2,633 AF of recycled water. SVCSD and Napa SD could provide additional recycled water to the Napa Salt Marsh Restoration Area during non-peak irrigation periods. This area's demand was considered secondary to customer demands during the peak irrigation season. The Napa Salt Marsh Restoration Area may require up to 3,000 AFY during its maintenance period, depending upon the service agreement reached with CDFG. The total discharge to San Pablo Bay under Phase 1 (18,058 AFY) would be reduced by any deliveries of recycled water to the Napa Salt Marsh.

6.5.1.3 System Requirements

Table 6-21 summarizes the pipeline requirements for implementation Phase 1. Pipeline diameters, pipeline length by diameter supporting each full Alternative, and total pipeline length are presented.

Table 6-21
Summary of Pipeline Sizes and Lengths for Implementation Phase 1

Pipeline Diameter	Length (Miles) Under Alternative 1	Length (Miles) Under Alternative 2	Length (Miles) Under Alternative 3
4”	4	4	3
6”	8	8	7
8”	12	12	12
10”	6	6	6
12”	9	9	9
14”	2	1	2
16”	2	2	4
18”	8	8	8
20”	0	1	1
24”	5	5	5
30”	0	0	0
36”	4	4	4
Total	**59**	**59**	**59**

Table 6-22 presents figures on treatment upgrades required for implementation Phase 1. All WWTPs currently have some tertiary treatment capability; however, all but SVCSD would need to increase their treatment capacity to meet Phase 1 demands.

Table 6-22
Treatment Improvement Requirements for Implementation Phase 1

Facility	*Tertiary Treatment Capacity without the Project (mgd)*	*Tertiary Treatment Capacity Required for Implementation Phase 1 (mgd)*	*Tertiary Treatment Capacity Increase (mgd)*
LGVSD	2.0	2.3	0.3
Novato SD	0.5	1.7	1.2
SVCSD	16.0	9.5	0.0
Napa SD	8.8	10.8	2.0
Total	**27.3**	**24.3**	**3.5**

Table 6-23 summarizes the existing and additional recycled water storage needs (i.e., the volume in excess of existing available storage), which would be required under implementation Phase 1. The local project areas being served separately by LGVSD and Novato SD would require less water during all months than would be treated at the two WWTPs; therefore, no storage of water would be required to accommodate peak month demands, only as necessary for operational interests and system pressure management. The local project areas being served by SVCSD and Napa SD would require more water during the peak summer months than each of the WWTPs is treating; additional water storage at the WWTPs, as anticipated by these Agencies' local project reports, would be required to accommodate peak month demands. SVCSD would require additional new storage at the WWTP, and Napa SD would need to modify existing water storage basins for recycled water system use. Individual landowner ponds would be used throughout the project areas to help offset the system storage required to serve users during peak-use periods.

Table 6-23
Additional Storage Requirements for Implementation Phase 1

Type	*Location*	*Volume (AF)*	*Comments*
WWTP Storage	LGVSD WWTP	0.0	
	Novato WWTP	0.0	
	SVCSD WWTP	195	Requires land purchase
	Napa WWTP	950	Existing storage ponds to be used
	Total	*1,145*	
System Storage Ponds	SVCSD Reuse Area	625	Existing storage ponds
	SVCSD Reuse Area	0	
	Total	*625*	
Reservoir Storage	Hamilton Field	1.5	Rehabilitated reservoir
	NMWD Project Areas	1.5	Rehabilitated reservoir
	Novato WWTP	0	
	Peacock Gap	0	
	Total	*3.0*	
Total		**1,773**	

Additional pump stations would be needed throughout the system for distribution and to boost pressures to higher pressure zones. The locations of these pump stations are summarized below in Table 6-24.

Table 6-24
Pump Stations Required for Implementation Phase 1

Location (WWTP or Reuse Area)	***Horsepower (HP)***	***Comments***
LGVSD WWTP	72	
Novato WWTP	259	
SVCSD WWTP	662	
Napa WWTP	636	New Pump
Napa WWTP	1,907	Existing Pumps
Carneros East	0	
Central Sonoma Valley	0	
Existing SVCSD Reuse Area (Carneros West)	0	New Pumps
Existing SVCSD Reuse Area (Carneros West)	218	Existing Pumps
Napa MST Area	244	
Peacock Gap	0	
Southern Sonoma Valley	0	
Sonoma Valley Recycled Water Project	96	
Total	**4,094**	

6.5.1.4 Effect on Existing Water Supplies

Implementation Phase 1 provides 833 AF of Russian River water offset in the study area: 87 AF in the Sonoma Valley Recycled Water Project and 746 AF in the NMWD URWP Area. This represents drinking water that would no longer be used for non-potable uses, thus ensuring the highest quality water is reserved for potable uses. This potable offset reduces the need for new supplies to be developed to serve the study area, which is discussed above regarding the No Action Alternative (Section 6.1).

6.5.2 Costs

Table 6-25 summarizes the opinion of probable total project capital costs for implementation Phase 1 in 2008 dollars. O&M costs are estimated to be about $1.4 million per year.

Table 6-25
Opinion of Probable Total Project Capital Costs for Implementation Phase 1

Major Project Component	***Cost ($ million) under Alternative 1***	***Cost ($ million) under Alternative 2***	***Cost ($ million) under Alternative 3***
Pipelines	$89.3	$90.0	$92.4
Treatment Improvements	$14.9	$14.9	$14.9
Storage	$8.3	$8.3	$8.3
Pumping	$8.5	$8.5	$8.5
Probable Total Project Capital Costs	***$121.0***	***$121.7***	***$124.1***