# North Bay Water Reuse Program Phase 2 Feasibility Study

**Prepared for** | Sonoma County Water Agency and North Bay Water Reuse Authority

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

Revised May 2021

Brown AND Caldwell

In Association with

BRYANT & ASSOCIATES · Kennedy/Jenks Consultants · GTC · ESA · Data instincts Public Outreach Consultants

FINAL

# North Bay Water Reuse Program
# Phase 2 Feasibility Study

Prepared for

Sonoma County Water Agency
and the North Bay Water Reuse Authority

June 2017

Revised: May 2021

Michael Savage, PE
CA License 32157

Brown AND Caldwell

201 North Civic Drive, Suite 300

Walnut Creek, CA 94596

# Table of Contents

# List of Figures

# List of Tables

# List of Abbreviations

| | |
|---|---|
| ADWF | average dry weather flow |
| AF | acre-feet |
| AFY | acre-feet per year |
| APE(s) | Area of Potential Effect(s) |
| ASA | Area of Sensitivity Assessment |
| ASR | aquifer storage and recovery |
| AWWF | average wet weather flow |
| BAP | Basin Advisory Panel |
| BCDC | San Francisco Bay Conservation and Development Commission |
| BFI | baseflow index |
| BMK | Bel Marin Keys |
| BMP(s) | best management practice(s) |
| CASGEM | California Statewide Groundwater Elevation Monitoring |
| CCI | Construction Cost Index |
| CCA | Critical Coastal Areas |
| CCR | California Code of Regulations |
| CDFW | California Department of Fish and Wildlife |
| CEQA | California Environment Quality Act |
| cfs | cubic feet per second |
| CIP | capital improvement plan |
| CMSA | Central Marin Sanitation Agency |
| Coastal Conservancy | California State Coastal Conservancy |
| CWA | Clean Water Act |
| DAF | dissolved air floatation |
| DBP | disinfection by-product |
| DDW | State Water Resources Control Board Division of Drinking Water |
| DPH | California Department of Public Health |
| DPR | direct potable reuse |
| DWR | California Department of Water Resources |
| ECWRF | Ellis Creek Water Reclamation Facility |
| EIR/EIS | Environmental Impact Report/Environmental Impact Study |
| ENR | Engineering News Record |
| GHG | greenhouse gas |
| GMP | Groundwater Management Plan |
| gpd | gallons per day |
| I&I | inflow and infiltration |
| IPR | indirect potable reuse |
| IRWMP | Integrated Regional Water Management Program |
| ITA | Indian Trust Assets |
| JPA | joint powers authority |
| LCWD | Los Carneros Water District |
| LF | linear foot/linear feet |
| LGVSD | Las Gallinas Valley Sanitary District |
| LID | low impact development |
| MA(s) | Member Agency(ies) |
| MBR | membrane bioreactor |
| MG | million gallons |
| mg/L | milligram per liter |
| mgd | million gallons per day |
| mL (s) | milliliter(s) |
| MMWD | Marin Municipal Water District |
| MOU | Memorandum of Understanding |
| MST | Milliken-Sarco-Tulocay |
| MPN | most probable number |
| Napa SD | Napa Sanitation District |
| NBA | North Bay Aqueduct |
| NBWA | North Bay Watershed Association |
| NBWRA | North Bay Water Reuse Authority |

| | |
|---|---|
| NBWRP | North Bay Water Reuse Program |
| NCFCWCD | Napa County Flood Control & Water Conservation District |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |
| NMWD | North Marin Water District |
| NPDES | National Pollutant Discharge Elimination System |
| Novato SD | Novato Sanitary District |
| O&M | operation(s) and maintenance |
| O&MR | operations, maintenance and replacement |
| Policy | State Water Resources Control Board Policy for Maintaining Instream Flows in Northern California Coastal Streams |
| Program | North Bay Water Reuse Authority Title XVI Program |
| Phase 2 Program | North Bay Water Reuse Authority Phase 2 Program |
| RDI | regulated deficit irrigation |
| RO | reverse osmosis |
| RWQCB | Regional Water Quality Control Board |
| Scoping Study | Phase 2 Project Definition Scoping Study Report |
| SCWA | Sonoma County Water Agency |
| SMART | Sonoma-Marin Area Rail Transit |
| SMR | Self-Monitoring Program Reports |
| SR | State Route |
| SVCSD | Sonoma Valley County Sanitation District |
| SWP | State Water Project |
| SWRCB | State Water Resources Control Board |
| TAC | Technical Advisory Committee |
| TBD | to be determined |
| Title XVI | U.S. Department of the Interior's Bureau of Reclamation Public Law 102-575, Title XVI Reclamation Wastewater and Groundwater Study and Facilities Act of 1992 |
| TMDL | total maximum daily load |
| UC | University of California |
| USACE | U.S. Army Corps of Engineers |
| USBR | U.S. Bureau of Reclamation |
| USEPA | U.S. Environmental Protection Agency |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| UV | ultraviolet |
| UWMP(s) | Urban Water Management Plan(s) |
| VOM | Valley of the Moon |
| VOMWD | Valley of the Moon Water District |
| Water Project | Water Supply, Transmission and Reliability Project |
| WaterSMART | Sustain and Manage America's Resources for Tomorrow Program |
| WRF | Water Recycling Facility |
| WRP | Water Reclamation Plant |
| WTR 11-01 | Reclamation Manual, Directives and Standards, Title XVI Water Reclamation and Reuse Program Feasibility Study Review Process WTR 11-01 |
| WWTP | wastewater treatment plant |

This page intentionally left blank.

# Executive Summary

The North Bay Water Reuse Authority (NBWRA) is comprised of eleven public agencies in the portions of California's Marin, Sonoma and Napa counties that drain into San Pablo Bay – the northern part of the greater San Francisco Bay.

The NBWRA Member Agencies (MAs) include counties, municipalities, flood control and water conservation districts, water and wastewater agencies (See Figure ES-1). These entities are working together as a region to develop, capture and put to beneficial use an estimated 25,000 AFY of highly treated recycled water that is legally discharged into San Pablo Bay.

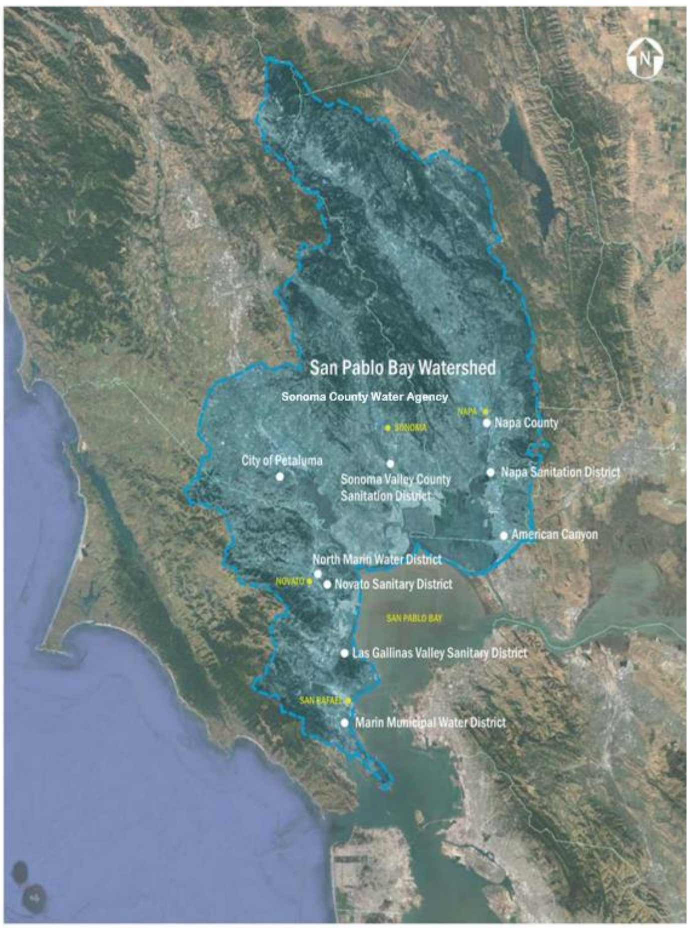



Figure ES-1. NBWRA Study Area

Phase 1 of the North Bay Water Reuse Program (NBWRP) has been under construction for eight years and its $104 million in infrastructure will be completed in 2018. Phase 1 projects are the building blocks of the NBWRP's recycled water system – upgraded wastewater treatment plants, distribution pipelines and small-scale storage reservoirs – all deliver recycled water for urban uses, premium wine grape production and restoration of tidal wetlands and wildlife habitat. Phase 1 is providing 3,800 AFY per year of water for urban and agricultural irrigation and 1,400 for environmental enhancement.

Phase 2 of the NBWRP (Phase 2 Program) – the subject of this Feasibility Study Report – builds upon the Phase 1 technology and infrastructure investments to further develop recycled water as part of the region's water supply portfolio. At the onset of these studies, it was anticipated that recycled water storage projects would be a larger part of the Phase 2 Program in order to capture a greater percentage of the recycled water lost to discharge in the San Pablo Bay. However, both limitations of the Title XVI program and MA's financial ability to construct these projects resulted in several storage facilities being excluded from the final project list. Ultimately, the Phase 2 Program's projects will capture a substantial increment of the available recycled water and deliver an additional yield of 5,364 AFY through expanded treatment, new pipelines and storage projects each contributing toward building resiliency into the region's long-term water supply.

As the NBWRA transitions into its next phase, three of the original Phase 1 members have elected not to include projects in the Phase 2 Program. However, the Phase 2 Program does include the addition of three new agencies so there are seven MA's projects comprising the overall Phase 2 Program.

It should be noted that Associate Members are supporting the NBWRA but do not have projects included this Feasibility Study analysis. Table ES-1 illustrates the agencies roles.

Table ES-1. NBWRA Member Agencies

| Agency | Phase 1 Member | Phase 2 Member | Associate Member |
|---|---|---|---|
| Napa Sanitation District (Napa SD) | ✓ | ✓ | |
| Novato Sanitary District (Novato SD) | ✓ | ✓ | |
| Petaluma (City) | | ✓ | |
| Sonoma County Water Agency (SCWA) | ✓ | ✓ | |
| Sonoma Valley County Sanitation District (SVCSD) | ✓ | ✓ | |
| Las Gallinas Valley Sanitary District (LGVSD) | ✓ | | |
| North Marin Water District (NMWD) | ✓ | | |
| American Canyon (City) | | ✓ | |
| Marin County | | | ✓ |
| Marin Municipal Water District (MMWD) | | ✓ | |
| Napa County | ✓ | | |

### A Regional Approach to Water Supply Reliability

Leadership in the North Bay recognized the growing need for an integrated and regional approach to managing limited water supplies. It was acknowledged that recycled water could be developed as part of the regions supply and provided a catalyst for water and wastewater agencies to forge new partnerships to deliver recycled water for diverse beneficial uses.

It was during the initial appraisal investigations for the NBWRP, that the need and opportunity to develop a substantial amount of recycled water for potable offset across the region was first described. The concept was ambitious, but 25,000 AFY of new recycled supply was identified for urban, agricultural and environmental uses. The U.S. Department of the Interior's Bureau of Reclamation and the Title XVI Program have provided a structured process for technical analysis and decision-making that resulted in the strategic selection of recycled water infrastructure projects, that when implemented, incrementally added to water supply reliability in the North Bay.

The recent drought proved the value of the Program's infrastructure investment, kept the MA's working together and resulted in the Phase 2 Feasibility Study. The drivers that brought them together are the same; the primary solution to addressing water supply imbalances and shortages in the region is through development and distribution of recycled water.

### Water Management Challenges and Need for a Regional Water Recycling Program

From a regional perspective, imported, surface and groundwater water supply is inconsistent between end-users. During times of drought or where supply is constrained, competition for limited resources emerges between urban, rural, agricultural and environmental needs. Water management concerns in study area can be summarized as follows:

- The local agricultural economy is dominated by high-value vineyard culture, which requires a reliable water supply to maintain both production and the secondary economy associated with the industry.
- Land use conversion and urbanization of the greater San Francisco Bay Area, including parts of the NBWRA study area, requires highly reliable sources of water.
- The region's vitally important riparian and estuarine ecosystems support habitat for migratory waterfowl, fisheries and aquatic species. Joint restoration efforts with local, state and federal wildlife management agencies are underway and a reliable water supply is needed to support these efforts.
- Local surface water supplies are becoming less reliable sources due to climate variability and extreme weather events; drought, reduced winter flow, and dry or low summer flows are further exacerbated by impacts associated with multiple diversions on these limited supplies.
- Imported water supplies conveyed from the Russian River are subject to reduced availability during the most severe drought conditions.
- Imported water supplies conveyed from the Sacramento-San Joaquin River Delta are subject to reduced availability in many years and have limited ability to be expanded in the future.
- Groundwater supplies are pumped for agricultural, municipal and rural residential uses and different sub-regions are experiencing declining levels, marginal quality, and salt water intrusion.
- Water is a highly-valued recreation and aesthetic amenity for the outdoor oriented citizens of the North Bay.
- Increasingly stringent conservation mandates, wastewater discharge requirements and water quality standards in San Pablo Bay are increasing the costs of wastewater treatment and disposal.

These water management challenges have resulted in the need for MA's to develop and expand the use of recycled water as part of their supply portfolio in order to meet competing demands and increase regional water supply reliability.

### Formulation and Description of Phase 2 Program and Project Alternatives

The NBWRA applied a stakeholder-driven process to ultimately select the suite of projects which comprise the Phase 2 Title XVI Program. A series of 17 workshops over 3-years provided a stepwise process to select the diverse projects that maximized the NBWRA objectives while concurrently meeting MA needs.

NBWRP objectives and sub-objectives were used to screen and score the projects initially identified and to demonstrate the quantitative and qualitative value each of the projects contributes to meeting the NBWRP objectives. Using this refined list of projects, the process was again applied to include screening and valuation to formulate Program alternatives. The outcomes from this process yielded three diverse alternatives that were formulated for feasibility-level analysis and to ultimately select the Phase 2 Program.

Figure ES-2 below illustrates the process to screen projects and select the Phase 2 Title XVI Program.

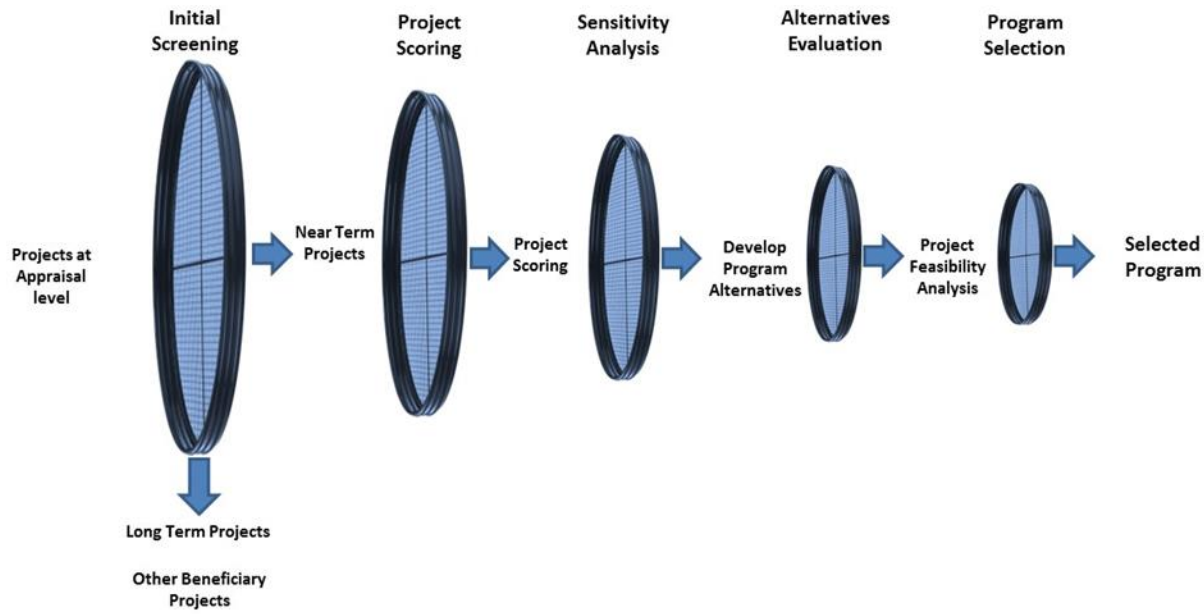



Figure ES-2. NBWRP Phase 2 Program Selection Process

#### Recommended Phase 2 Program Alternative

The Feasibility Study report for the selected Phase 2 Program has been prepared to fulfill the requirements of the U.S. Department of the Interior's Bureau of Reclamation Public Law 102-575, Title XVI (the Reclamation Wastewater and Groundwater Study and Facilities Act of 1992, as amended). Title XVI provides a mechanism for Federal participation and cost-sharing for approved recycled water projects and provides general authority for appraisal and feasibility studies. Specific guidance for Title XVI feasibility studies are provided in Reclamation Manual, Directives and Standards, Title XVI Water Reclamation and Reuse Program Feasibility Study Review Process WTR 11-01 (WTR 11-01).

The Phase 2 Program includes sixteen (16) projects (Table ES-2), with a total capital cost of approximately $83 million. To meet Title XVI requirements, these projects have received full feasibility level analysis, including economic and financial capability and comprise the full Feasibility Study Report. The supporting environmental documentation includes both NEPA and CEQA analysis and it is anticipated the Phase 2 Program's projects would be constructed between 2021 and 2030.

Figure ES-3 provides an overview of the projects included in the Phase 2 Title XVI Program.

| Table ES-2. Proposed Title XVI Program Projects | | | |
|---|---|---|---|
| **Agency** | **Project Type** | **Project Title** | **Capital Cost ($ mil)** |
| Novato SD | Treatment | Novato SD WRP Capacity - 1st Expansion (+0.85 MGD) | $4.8 |
| | Environmental Enhancement | Marin County Lower Novato Creek Project - Distribution | $0.9 |
| | | Turnout to Transitional Wetlands | $0.6 |
| SVCSD | Distribution | 8th Street East and Napa Road Pipelines | $2.4 |
| SCWA | Seasonal Storage | Valley of the Moon Aquifer Storage and Recovery (ASR) | $3.7 |
| | | Sonoma ASR | $3.9 |
| City of Petaluma | Treatment | Increase Ellis Creek Water Reclamation Facility (ECWRF) Capacity | $9.0 |
| | Distribution | Urban Recycled Water Expansion | $14.6 |
| | | Agricultural Recycled Water Expansion Phase 1 | $12.5 |
| | | Agricultural Recycled Water Expansion Phase 2 | $5.9 |
| Napa SD | Treatment | Soscol WRF Increased Filter Capacity | $2.2 |
| | Operational Storage | Additional Soscol WRF Covered Storage | $2.9 |
| MMWD/CMSA | Distribution | Recycled Water Distribution System Expansion to San Quentin Prison | $7.8 |
| City of American Canyon | Distribution | Phase 1 Recycled Water Distribution System Expansion | $3.1 |
| | | Phase 2 Recycled Water Distribution System Expansion | $2.9 |
| | Treatment | American Canyon WRF Phase 2 Treatment Plant Upgrades | $6.0 |
| | | **Total** | **$83.2** |

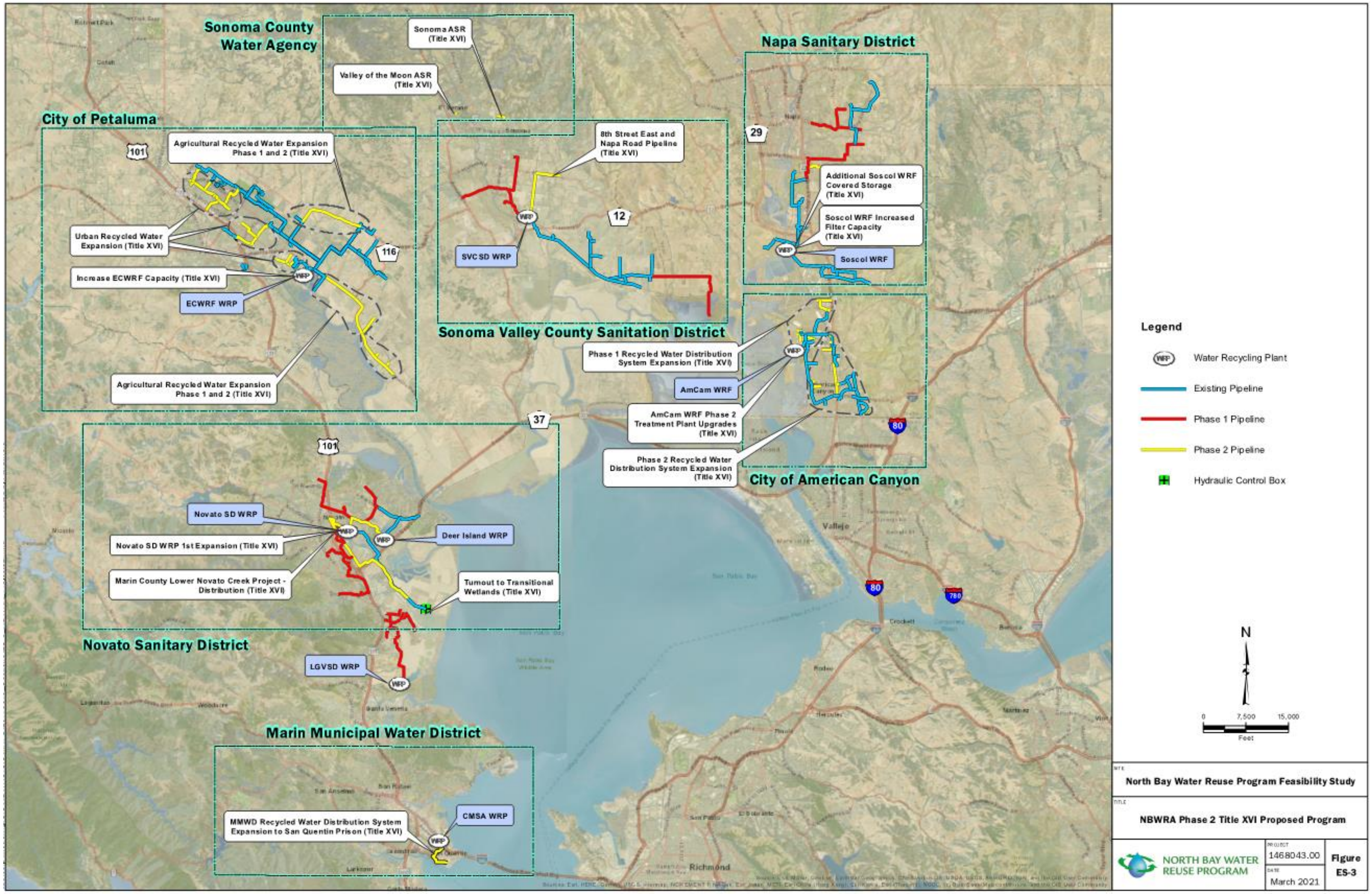



Figure ES-3. Proposed Phase 2 Title XVI Program

# Section 1

# Introduction

This feasibility study report, prepared on behalf of, and in coordination with, the North Bay Water Reuse Authority (NBWRA), presents the North Bay Water Reuse Program's (NBWRP's) engineering evaluation and economic and financial analysis for Phase 2 of the North Bay Water Reuse Program (Phase 2 Program).

## 1.1 Background

The Phase 2 Program builds upon Phase 1 infrastructure investments which included $104 million in treatment, distribution, and storage projects to further develop recycled water as part of the region's water supply portfolio. Building on the Phase 1 technology and infrastructure investments, Phase 2 projects will deliver increased yield through expanded treatment, new pipelines, and additional storage projects while building resiliency into the region's long-term water supply through the use of recycled water.

This report has been prepared in partial fulfillment of the requirements of the U.S. Department of the Interior's Bureau of Reclamation Public Law 102-575, Title XVI (the Reclamation Wastewater and Groundwater Study and Facilities Act of 1992, as amended) which provides general authority for appraisal and feasibility studies and a mechanism for federal participation and cost-sharing for approved recycled water projects.

Preparation of this feasibility study report also followed specific guidance for Title XVI feasibility study requirements as provided in the Reclamation Manual, Directives and Standards, Title XVI Water Reclamation and Reuse Program Feasibility Study Review Process WTR 11-01 (WTR 11-01). WTR 11-01 provides clear direction regarding the U.S. Bureau of Reclamation's (USBR's) review procedures, leading to a more transparent and consistent Title XVI Program.

The NBWRA currently operates under a Memorandum of Understanding (MOU) signed on March 8, 2013 (Third Amendment to the original MOU dated March 2005). NBWRA Member Agencies (MAs) include Sonoma County Water Agency (SCWA), Sonoma Valley County Sanitation District (SVCSD), City of Petaluma, County of Napa, Napa Sanitation District (Napa SD), City of American Canyon, County of Marin, Novato Sanitary District (Novato SD), Las Gallinas Valley Sanitary District (LGVSD), North Marin Water District (NMWD), and Marin Municipal Water District (MMWD).

Under the MOU and its amendments, the NBWRA is exploring "the feasibility of coordinating interagency efforts to expand the beneficial use of recycled water in the North Bay Region thereby promoting the conservation of limited surface water and groundwater resources." The proposed Phase 2 Program, the subject and intended outcome of the NBWRA's work, would reduce the volume of treated wastewater discharged into San Pablo Bay and its tributaries, providing water quality and environmental benefits and redirecting this valuable resource to provide increased recycled water supply for agricultural, urban, and environmental uses.

This feasibility study report describes the proposed Phase 2 Program, comprised of 16 projects, and includes discussion of key water management issues and needs and identifies recycled water opportunities for future consideration (outside the Phase 2 Program). These project opportunities were further developed and analyzed as alternative measures having the potential to address the identified water management issues and needs. Also in support of the Phase 2 Program, an economic and financial analysis was completed and is accompanied by an overview of associated legal and institutional requirements.

## 1.2 Project Purpose

From its inception in 2002, the NBWRA has applied a multiple-benefit approach to recycled water supply planning from both the watershed and sub-regional perspective to determine how best to serve the region's often competing urban, agricultural, and environmental needs. Implementing recycled water projects from this perspective provides community benefits in two fundamental ways; each project reflects the priorities and needs of each agency while concurrently, and incrementally, contributing toward water supply reliability throughout the region.

The region is complex, some sub-regions have a relatively stable urban water supply while in others, reduced and unreliable surface supplies have resulted in urban and surrounding rural residential users looking to groundwater. Groundwater basins can be affected by lack of flows for recharge, conversion of grazing land to high-value irrigated vineyards and rural residential housing. In some areas pumping has resulted in brackish groundwater and water quality degradation while in other areas, pumping ordnances have been implemented in an attempt to manage yield/flow availability. Agriculture and particularly, wineries and their associated tourism, are a multi-billion-dollar economic powerhouse in the region. However, agricultural demands for diversion of stream flow for irrigation and frost protection management has associated impacts to sub-surface groundwater levels and flow to support riparian habitats, fisheries and associated aquatic species.

## 1.3 Participants

Phases 1 and 2 of the Program have a diverse mix of water and wastewater agencies in Marin, Sonoma, and Napa Counties. The table below shows how some agencies completed their projects in Phase 1, others are new to the Phase 2 Program, and some have both Phase 1 and 2 projects in their portfolio.

**Table 1-1. NBWRA Member Agencies**

| Agency | Phase 1 Member | Phase 2 Member | Associate Member |
|---|---|---|---|
| Napa SD | ✓ | ✓ | |
| Novato SD | ✓ | ✓ | |
| Petaluma (City) | | ✓ | |
| SCWA | ✓ | ✓ | |
| SVCSD | ✓ | ✓ | |
| LGVSD | ✓ | | |
| NMWD | ✓ | | |
| American Canyon (City) | | ✓ | |
| Marin County | | | ✓ |
| MMWD | | ✓ | |
| Napa County | ✓ | | |

## 1.4 Study Area

The NBWRA encompasses the North San Pablo Bay Watershed within the counties of Napa, Sonoma, and Marin as shown in in Figure 1-1 below. The Phase 2 Program focuses on areas that are, or could be, served by the Novato SD, City of Petaluma, SCWA, SVCSD, Napa SD, MMWD, Central Marin Sanitation Agency (CMSA) and the City of American Canyon.

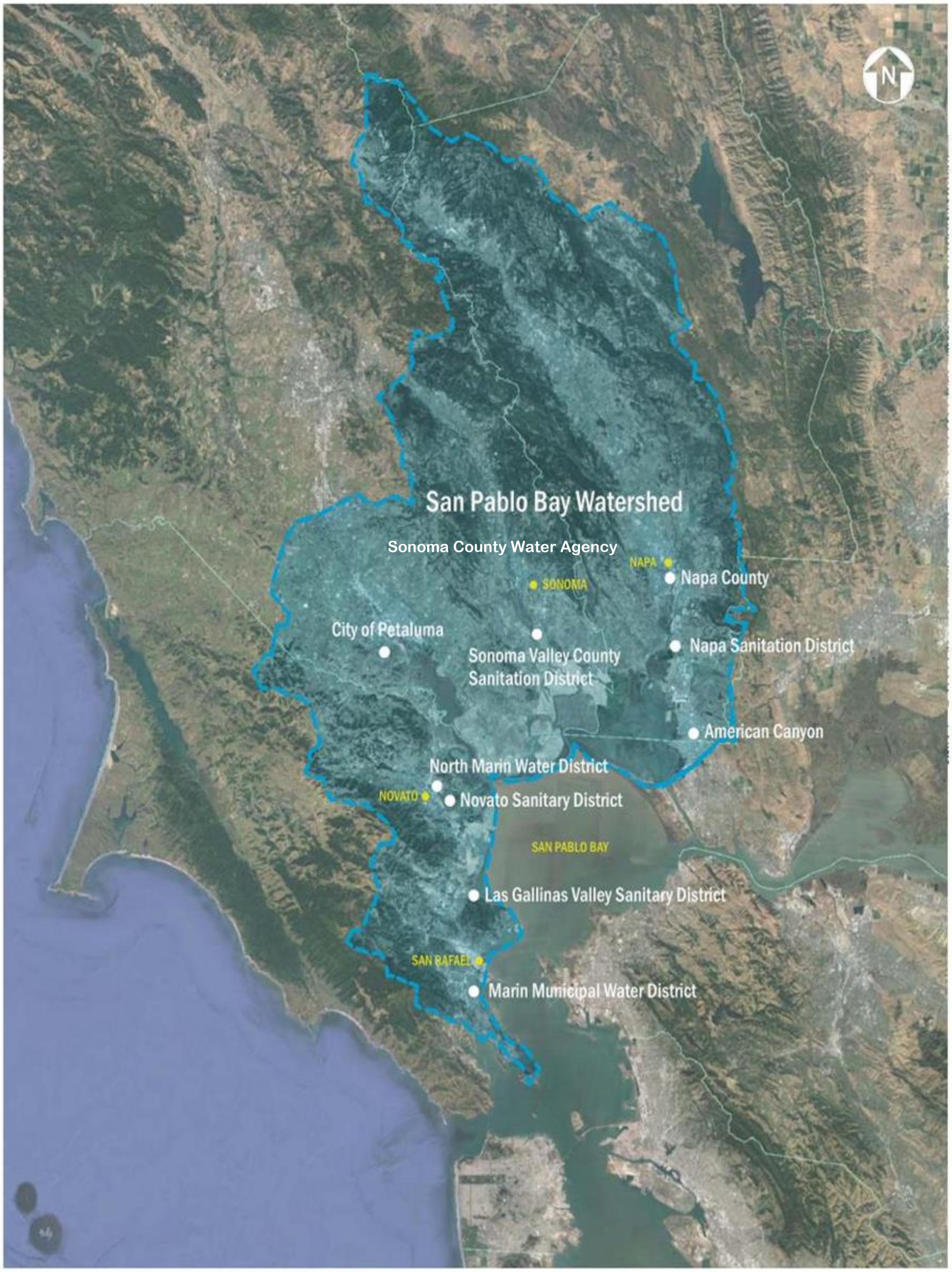



Figure 1-1. NBWRA Study Area

# 1.5 Planning Process

## 1.5.1 Overview

Planning activities for the development of the Phase 2 Program included a series of screening and evaluation processes designed to ensure the NBWRA Program objectives were met. Each MAs' proposed projects were screened for their ability to meet objectives, develop alternatives, and ultimately the selection of the Phase 2 Program. This iterative process allowed the viewpoints and success factors of the MAs to be addressed and incorporated into the Phase 2 Program.

## 1.5.2 Workshops

As part of the planning process, a series of workshops were held to obtain direct input from stakeholders. These technical workshops occurred over a 32-month period and provided a stepwise process to select the diverse projects that maximized the NBWRA objectives while concurrently meeting MA needs. A summary of the workshops held and topics discussed is provided in Table 1-2.

**Table 1-2. Phase 2 Stakeholder Workshops**

| Workshop | Date | Topics Addressed |
|---|---|---|
| 1 | July 2014 | Discussion on planned public involvement activities. |
| 2 | October 2014 | NBWRA approach, schedule, and report topics to be addressed. |
| 3 | January 2015 | Initial project list identification. |
| 4 | April 2015 | Decision process to select Phase 2 Program, review NBWRA objectives, initial weighting of objectives, assignment to weight objectives and submit prior to July meeting. |
| 5 | July 2015 | Results of weighting NBWRA objectives and subobjectives, appraisal level project costs, and preliminary list of projects to be considered in the Program. |
| 6 | September 2015 | Results of detailed analysis of seasonal storage projects issues, opportunities and feasibility level costs. Discussion of three categories of projects: Title XVI, Non-Title XVI, and Programmatic Level. |
| 7 | October 2015 | Process to refine project list for Phase 2 Program, assign MAs to categorize their projects for the Program, and Program expansion discussion. |
| 8 | December 2015 | Discuss project lists and feasibility level costs by MA. Initial categorization of projects into Title XVI, Non-Title XVI and Programmatic Level. |
| 9 | January 2016 | Discussion and approval of Phase 2 Program projects by category. Discussion of activities to complete the study. |
| 10 | March 2016 | Feasibility Study Report review process and schedule. |
| 11 | April 2016 | Draft Feasibility Study Report status. |
| 12 | July 2016 | Revised List of Projects for Phase 2 Environmental Analysis, Discussion of Impacts of Revisions, and Consideration of Approval of a Final List of Projects. |
| 13 | August 2016 | Discussion of Program project list. |
| 14 | September 2016 | Feasibility Study Report comments received by MAs been tabulated and being addressed. Addition of new agencies and projects identified. |
| 15 | December 2016 | Impacts of the addition of new Phase 2 agencies and projects discussed. |
| 16 | January 2017 | Discussion regarding revisions to the draft Feasibility Study Report for additional agencies. Discussion of environmental review schedule. |
| 17 | March 2017 | Board of Directors approval of final Phase 2 projects for inclusion in Feasibility Study Report. |

### 1.5.3 Public Outreach

Concurrent with the technical workshops and feasibility study activities, the NBWRA conducted public outreach efforts to collect and share information on a broad scale within each MAs' service area. Public outreach activities included the following stakeholder relations activities:

- Identifying potential customers, key stakeholders, and special interest groups and their representatives in the NBWRA region, including local governments, sanitation and water districts, agricultural industry, environmental community, local business community, and non-governmental organizations that may have an interest in the Phase 2 Program.
- Providing outreach to stakeholders and providing NBWRA-related information, the potential benefits of the Phase 2 Program, and stakeholder issues of concern related to the Phase 2 Program.
- Gathering/sharing information regarding potential customers, stakeholders, and special interest groups. Planned, prepared and assisted in facilitating meetings with stakeholder groups. Assisted and provided guidance to NBWRA in resolving stakeholder issues of concern. Provided follow-up reporting to public workshop participants and reported on outcomes of public meetings to keep them informed.
- Maintained a NBWRA webpage (www.nbwra.org/) to provide broad sharing of information with the public.

## 1.6 Phase 2 Program

The projects selected by the MAs that provided the most benefit and met their financial constraints exceeded the Title XVI program funding capabilities. Therefore, the projects were separated into the following three categories:

- **NBWRA Phase 2 Title XVI Program:** Approximately $83.2 million in feasible projects that would be constructed between 2021 and 2030 to seek construction funding under Title XVI.
- **Programmatic Level:** There are approximately $41.1 million in projects that are considered future projects to be developed outside Title XVI as needed by the individual MAs.
- **Non-Title XVI Projects:** Approximately $153.2 million in feasible projects that will be funded under other mechanisms.

The Phase 2 Program projects categorized after the feasibility study are shown in Table 1-3.

**Table 1-3. NBWRA Phase 2 Program**

| Agency | Project Type | Project Title | Title XVI Project Level EIR/EIS | Programmatic Level | Non-Title XVI Project Level EIR/EIS |
|---|---|---|---|---|---|
| Novato SD | Treatment | Novato SD WRP Capacity - 1st Expansion (+0.85 mgd) | ✓ | | |
| | | Novato SD WRP Capacity - 2nd Expansion (+0.85 mgd) | | | ✓ |
| | Seasonal Storage | Option 1: Site Near Highway 37 (Tertiary) 150 AF | | ✓ | |
| | | Option 2: Site Near Highway 37 (Secondary) 150 AF | | | ✓ |
| | | Option 3: Hamilton Site (Secondary) 150AF | | | ✓ |
| | Environmental Enhancement | Marin County Lower Novato Creek Project - Distribution | ✓ | | |
| | | Marin County Lower Novato Creek Project - Restoration | | ✓ | |
| | | Turnout to Transitional Wetlands | ✓ | | |
| SVCSD | Seasonal Storage | Option 1: Mulas Site (Tertiary) 49 AF | | | ✓ |
| | | Option 2: Robledo Site (Tertiary) 49 AF | | | ✓ |
| | Distribution | 8th Street East and Napa Road Pipelines | ✓ | | |
| SCWA | Seasonal Storage | Valley of the Moon (VOM) Aquifer Storage and Recovery (ASR) | ✓ | | |
| | | Sonoma ASR | ✓ | | |
| | Groundwater Management | Sonoma Valley Groundwater Management and Recharge Project | | | |
| City of Petaluma | Treatment | Increase Ellis Creek Water Reclamation Facility (ECWRF) Capacity | ✓ | | |
| | Seasonal Storage | Option 1a: Site Southeast of ECWRF (Secondary) 300 AF | | | ✓ |
| | | Option 1b: Site Southeast of ECWRF (Secondary) 150 AF | | | ✓ |
| | Distribution | Urban Recycled Water Expansion | ✓ | | |
| | | Agricultural Recycled Water Expansion Phase 1 | ✓ | | |
| | | Agricultural Recycled Water Expansion Phase 2 | ✓ | | |
| | | Agricultural Recycled Water Expansion Phase 3 | | ✓ | |
| Napa SD | Treatment | Soscol WRF Increased Filter Capacity | ✓ | | |
| | Operational Storage | Additional Soscol WRF Covered Storage | ✓ | | |
| | | Napa State Hospital Storage Tank | | ✓ | |
| | Seasonal Storage | Option 1a: Raise Existing Pond Levees (Secondary) 300 AF | | | ✓ |
| | | Option 1b: Raise Existing Pond Levees (Secondary) 1,100 AF | | | ✓ |
| | | Option 2: Somky Ranch Site (Secondary) 300 AF | | | ✓ |
| | | Option 3a: Jameson Ranch Site (Tertiary) 600 AF (Phase 1) | | | ✓ |
| | | Option 3b: Jameson Ranch Site (Tertiary) 300 AF | | | ✓ |
| | Distribution | Milliken-Sarco-Tulocay (MST) Northern Loop | | | ✓ |
| | | MST Eastern Extension | | | ✓ |

| Table 1-3. NBWRA Phase 2 Program | | | | | |
|---|---|---|---|---|---|
| Agency | Project Type | Project Title | Title XVI Project Level EIR/EIS | Programmatic Level | Non-Title XVI Project Level EIR/EIS |
| MMWD/CMSA | Distribution | Recycled Water Distribution System Expansion to San Quentin Prison | ✓ | | |
| City of American Canyon | Distribution | Phase 1 Recycled Water Distribution System Expansion | ✓ | | |
| | | Phase 2 Recycled Water Distribution System Expansion | ✓ | | |
| | Treatment | American Canyon WRF Phase 2 Treatment Plant Upgrades | ✓ | | |

*AF = acre-feet; CMSA = Central Marin Sanitation Agency; EIR/EIS = Environmental Impact Report/Environmental Impact Study; mgd = million gallons per day; WRP = Water Reclamation Plant.*

## 1.7 Document Organization

The Phase 2 feasibility study report is organized in alignment with the guidance provided by WTR 11-01 to clearly address Title XVI requirements and facilitate USBR review.

| Table 1-4. Phase 2 Feasibility Study Report Organization | |
|---|---|
| Title | Topics |
| Executive Summary | |
| 1. Introduction | • Non-federal project sponsor(s).<br>• Description of the study area |
| 2. Problems and Needs | • Water supply & demand<br>• Water quality<br>• Current disposal activities |
| 3. Water Reclamation and Reuse Opportunities | • Water and wastewater agencies<br>• Current reuse and potential future supplies and use types<br>• Initial list of Phase 2 projects by agency |
| 4. Formulation of Alternatives and Selection of Program | • Overview of alternatives evaluation process<br>• Projects screened using Program objectives<br>• Alternatives that were evaluated to feasibility level to provide better definition to allow the Program selection. |
| 5. Proposed Phase 2 Title XVI Program | Detailed description the projects within each MA that were screened and formulated into a Program |
| 6. Economic Analysis | The economic analysis and projections of the future with, and without, the project. |
| 7. Environmental Consideration and Potential Effects | Sufficient information on each alternative to allow USBR to assess the potential measures and costs that may be necessary to comply with NEPA, and any other applicable federal law. |
| 8. Legal and Institutional Requirements | Legal or institutional requirements or barriers to implementing the proposed Title XVI project. |
| 9. Financial Capability of the Sponsors | Information to determine that the non-federal project sponsor is likely to demonstrate financial capability if the project moves to construction” |

| Table 1-4. Phase 2 Feasibility Study Report Organization | |
|---|---|
| **Title** | **Topics** |
| 10. Research Needs | Description of research needs associated with the proposed water reclamation and reuse project |
| Appendix A: Workshop Meeting Summaries | Stakeholder engagement documentation |
| Appendix B: Existing or Potential Special Studies Species in the Study Area | Update of Phase 1 appendix to focus on Phase 2 projects |
| Appendix C: Hydraulic Studies | • Petaluma system<br>• Napa MST (completed in Phase 1)<br>• SVCSD Napa Road (a single line) |
| Appendix D: Basis for Feasibility Construction Costs Estimates | • Documentation of approach<br>• Costs curves uses<br>• Assumptions |
| Appendix E: Geologic Conditions and geologic Constraints | • Update and expansion of Phase 1<br>• Focus on Phase 2 facility locations and alignments<br>• No field investigations were conducted |

Section 2

# Problems and Needs

The MAs have undertaken this feasibility study to address mounting environmental, regulatory, and water supply challenges. The NBWRA study area is unique with a mix of sensitive environmental resources, growing urban areas, and high-value agricultural land all competing for limited water resources. Each of the individual sub-regions within the NBWRA study area will be exposed to increasing water resource challenges in the future. Water reclamation and reuse is a local, cost-effective solution to some of these water resources challenges.

The challenges facing the MAs are summarized as follows:

- The local agricultural economy is dominated by high-value vineyard culture which requires a highly reliable water supply to maintain production and the secondary economy associated with the industry.
- Continued urbanization of the greater San Francisco Bay Area, including the NBWRA study area, requires highly reliable sources of water.
- The vitally important estuarine ecosystem of the North San Pablo Bay area, which includes endangered species and wetlands, has been under intense stress. Although protective and restorative measures are in place and underway, the habitat requires a reliable water supply to support these efforts.
- The local surface water supplies are becoming less reliable due to climate change impacts such as drought, reduced winter flow, and dry or low summer flows. These shortages are further exacerbated by impacts associated with multiple diversions on these limited supplies.
- Imported water supplies that are conveyed from the Russian River are subject to reduced availability during the most severe drought conditions.
- Imported water supplies that are conveyed from the San Francisco Bay Delta are subject to reduced availability in many years and have only limited ability to be expanded in the future.
- Groundwater supplies are pumped for agricultural and municipal uses and some areas are experiencing declining levels, marginal quality, and salt water intrusion.
- Water is a highly valued recreation and aesthetic amenity for the outdoor oriented citizens of the North Bay.
- Increasingly stringent wastewater discharge requirements are increasing the costs of wastewater treatment and disposal.

These water management challenges have resulted in the need for the MAs to investigate expanding the use of various water supply alternatives to increase water supply and reliability.

While urban growth has been relatively modest in recent years, the local population is projected to continue to grow. Table 2-1 presents the current and projected future population of the urban areas within the NBWRA study area.

**Table 2-1. Population of Urban Areas within the NBWRA Study Area**

| Urban Water Agency | 2010 | 2035 |
|---|---|---|
| Marin Municipal Water District | 190,600 | 206,500 |
| North Marin Water District | 60,423 | 67,808 |
| City of Petaluma | 60,214 | 75,587 |
| City of Sonoma | 11,426 | 14,471 |
| VOM Water District (VOWMD) | 23,478 | 25,943 |
| City of Napa | 86,743 | 93,543 |
| City of American Canyon[a] | 19,392 | 28,903 |
| **Total** | **452,276** | **512,755** |

*Source: 2010 Urban Water Management Plans (UWMPs).*

*a. Population data for the City of American Canyon was taken from their 2015 UWMP.*

This section describes the water resources management problems and needs that could be addressed through the implementation of the Phase 2 Program proposed in this report by increasing water reuse. An overview of water supplies, water demands, water quality concerns, and other wastewater disposal options is provided in this section as well as the region’s vulnerability to climate change and sea level rise.

## 2.1 Current and Projected Water Supplies

Water users in the NBWRA study area rely on a mixture of water supplies from local surface water, imported surface water, groundwater, and existing recycled water produced at several wastewater treatment plants (WWTPs), also termed WRPs and WRFs. This section presents a description of current and projected water supplies, potential sources of additional water other than the proposed Title XVI project, and plans for new facilities. The key water resources features are depicted on Figure 2-1.

### 2.1.1 Local Surface Water

Local surface water is used by urban water suppliers, agricultural users, and some smaller self-supplied domestic users within the region. The main waterways in the study area are the Napa River, Petaluma River, Sonoma Creek, Novato Creek, and many smaller tributaries that feed these waterways, which all flow into San Pablo Bay. Table 2-2 presents the watershed area, outlet location and existing beneficial uses of each of these rivers. The rivers are also shown in Figure 2-1. Table 2-3 summarizes the annual average, median, and minimum river flows, which demonstrate the large reduction from average river flows that occurs in dry years.

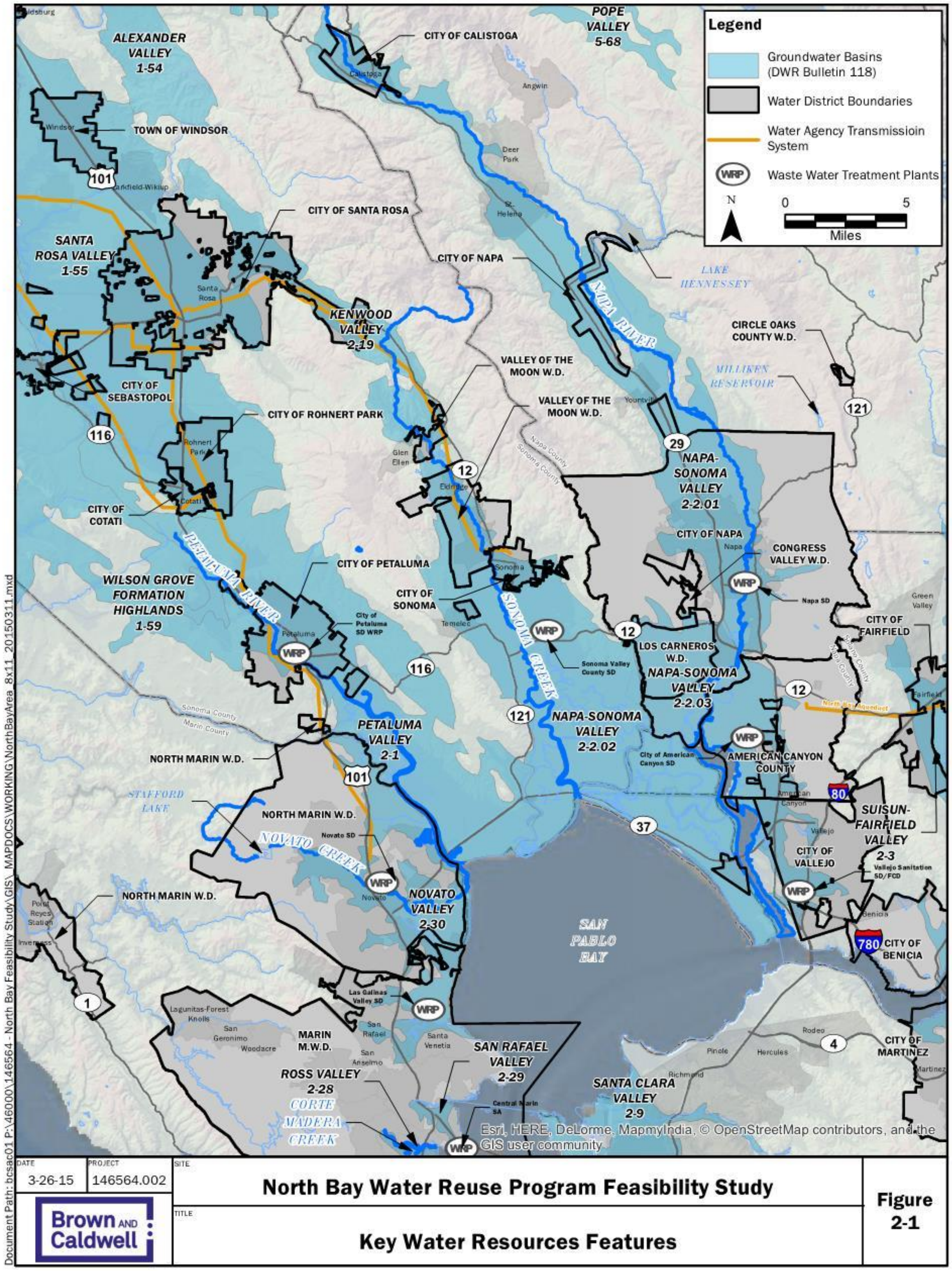



Figure 2-1. Key Water Resources Features

| Table 2-2. Surface Water Watershed Characteristics | | | |
|---|---|---|---|
| Watershed | Area (sq. miles) | Outlet | Existing Beneficial Uses |
| Novato Creek | 45 | San Pablo Bay | Municipal and domestic supply; commercial and sport fishing; cold freshwater habitat; fish migration; preservation of rare and endangered species; fish spawning; warm freshwater habitat; wildlife habitat; water contact recreation; noncontact water recreation |
| Petaluma River | 146 | San Pablo Bay | cold freshwater habitat; estuarine habitat; fish migration; preservation of rare and endangered species; fish spawning; warm freshwater habitat; wildlife habitat; water contact recreation; noncontact water recreation; navigation |
| Sonoma Creek | 170 | North San Pablo Bay | Commercial and sport fishing; cold freshwater habitat; fish migration; preservation of rare and endangered species; fish spawning; warm freshwater habitat; wildlife habitat; water contact recreation; noncontact water recreation |
| Napa River | 426 | North San Pablo Bay | agricultural supply; municipal and domestic supply; groundwater recharge; commercial and sport fishing; cold freshwater habitat; fish migration; preservation of rare and endangered species; fish spawning; warm freshwater habitat; wildlife habitat; water contact recreation; noncontact water recreation; navigation |

*Source of beneficial uses: San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) 2015.*

| Table 2-3. Annual Surface Water Flows (AFY) | | | |
|---|---|---|---|
| Watershed (Period of Record) | Average | Median | Minimum (Water Year) |
| Novato Creek (1947-2013) | 8,900 | 6,200 | 293 (1976) |
| Petaluma River (2011-2014) | 35,500 | 30,400 | NA |
| Sonoma Creek (1956-2014) | 49,900 | 49,900 | 999 (1976) |
| Napa River (1960-2013) | 150,200 | 134,200 | 524 (1977) |

*Source: Calculated from U.S. Geological Survey (USGS) data (USGS, 2016).*

The State Water Resources Control Board (SWRCB) has declared the Sonoma Creek and the Napa River as fully appropriated streams. In addition, the SWRCB's Policy for Maintaining Instream Flows in Northern California Coastal Streams (Policy) is in place for the protection of fishery resources, thus, minimizing water supply impacts on other beneficial uses of water. The geographic scope of the policy encompasses coastal streams from the Mattole River near the border with Oregon to San Francisco, including coastal streams entering northern San Pablo Bay. This encompasses five counties: Marin, Sonoma, and portions of Napa, Mendocino, and Humboldt. The policy applies to applications to appropriate water, small domestic use, small irrigation use, livestock stock pond registrations, water rights registrations, and water rights petitions.

Surface water runoff and groundwater discharge creates the flows within the rivers and streams. The baseflow component is primarily derived from groundwater that seeps into the stream's bed and banks through adjacent shallow aquifers. The baseflow index (BFI) is a measure of the proportion of the stream runoff that comes from groundwater discharge into streams. The BFI for Sonoma Creek during the 1956 through 2013 period was estimated to range from approximately 0.45 to 0.62, with an average of approximately 0.50 (SCWA, 2014). The BFI for the Napa River is estimated for this study as 0.08 based on the estimated contribution of groundwater to the Napa River of 12,700 AF per year (AFY) (California Department of Water Resources [DWR], 2003).

Streamflow in all creeks and rivers varies greatly by season and year depending on precipitation. Many smaller tributaries are naturally dry during the summer while other streams experience varying flows between wet and dry years. Lower flow rates occur in the streams as a result of water being held in reservoirs and directly withdrawn from the streams for both agricultural and domestic uses. Individual agricultural growers divert surface water during winter or spring months from multiple upstream tributaries via on-site ponds, reservoirs, or other surface water diversion facilities for use during the summer irrigation season. Some agricultural users divert water from surface streams that are ephemeral or have very low flows during the summer. Table 2-4 demonstrates the wide seasonal variation in streamflows by presenting the monthly mean streamflows in cubic feet per second (cfs) for the main waterways in the NBWRA study area.

**Table 2-4. Maximum and Minimum Monthly Mean Streamflows**

| Source | High Mean Flow Month | High Mean Flow (cfs) | Low Mean Flow Month | Low Mean Flow (cfs) | Measurement Time Period |
|---|---|---|---|---|---|
| Novato Creek (at Novato) | February | 47.7 | September | 0.3 | 1946-2002 |
| Petaluma River (at Petaluma) | February | 64.2 | July | 0 | 1948-2014 |
| Sonoma Creek (at Agua Caliente)[a] | January | 257 | September | 0.78 | 1955-2002 |
| Napa River (at Napa) | January | 63.4 | September | 0.89 | 1970-1983 |

*Source: SCWA/USBR, 2008.*

*a. 50,836 AFY according to Sonoma Valley Groundwater Management Program 2015 Annual Report (SCWA 2016).*

The urban water suppliers in the NBWRA study area that have local surface water supplies are NMWD, MMWD, and the City of Napa. NMWD diverts water from Novato Creek, MMWD diverts water from Lagunitas Creek, and the City of Napa diverts water from tributaries of the Napa River. Lagunitas Creek flows to the Pacific Ocean and is not located in the San Pablo Bay watershed; therefore, it is not in the NBWRA study area. Table 2-5 presents the projected local surface water supplies for the urban areas during normal climate years. Table 2-6 presents the projected local surface water supplies for single dry years and multiple dry years. The City of Petaluma, City of Sonoma, and VOMWD do not currently have local surface water supplies.

**Table 2-5. Projected Normal Climate Year Local Surface Water Supplies for Urban Areas (AFY)**

| Urban Water Agency | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|---|
| Marin Municipal Water District | 19,077 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 |
| North Marin Water District | 2,456 | 2,500 | 2,500 | 2,167 | 1,684 | 1,000 |
| City of Napa | 18,200 | 18,200 | 18,200 | 18,200 | 18,200 | 18,200 |
| **Total** | **39,733** | **40,700** | **40,700** | **40,367** | **39,884** | **39,200** |

*Source: 2010 UWMPs.*

| Table 2-6. Projected Single Dry Year and Multiple Dry Years Local Surface Water Supplies for Urban Areas (AFY) | | |
|---|---|---|
| Urban Water Agency | Single Dry Year Supply | Multiple Dry Years Supply |
| Marin Municipal Water District | 18,534 | 14,567 |
| North Marin Water District | 2,500 | 1,000 |
| City of Napa | 12,000[a] | 19,458[b] |
| Total | 33,034 | 35,025 |

a. *Includes 6,600 AFY reservoir depletion.*

b. *Includes 6,533 AFY reservoir depletion in year 1 and 1,333 AFY for years 2 to 6.*

Though the amount of local surface water that supplies agricultural users in all of Marin, Sonoma, and Napa Counties is not precisely known, it is estimated to be 85,540 AFY (presented later in Table 2-8). Of this, the amount of surface water used by agriculture in the NBWRA study area is assumed to be approximately 13,000 AFY. The amount of local surface water used by agriculture in the Sonoma Valley groundwater basin is estimated to be 1,200 AFY.

### 2.1.2 Imported Surface Water

Surface water is imported into the NBWRA study area from two sources for urban uses only: the Russian River Project operated by the SCWA and the State Water Project (SWP) owned and operated by the DWR.

SCWA diverts and conveys water from the Russian River Project (including water from Lake Mendocino, Lake Sonoma, and imports from the Eel River via Pacific Gas & Electric Company's Potter Valley Project) in accordance with criteria established by the SWRCB's Decision 1610, which established minimum instream flow requirements for the Russian River. Water is diverted from the Russian River near Forestville and conveyed via the transmission system (including diversion facilities, treatment facilities, aqueducts, pipelines, water storage tanks, and booster pump stations) to NMWD, MMWD, VOMWD, and the Cities of Sonoma and Petaluma, as well as to other cities outside the NBWRA study area. The transmission system consists of over 85 miles of pipelines that range in diameter from 16 to 54 inches. The system has 7 booster pump stations and 18 storage tanks with a combined storage capacity of 129 million gallons (396 AF), as shown in Figure 2-2. The major pipelines segments that comprise the system are known as the Santa Rosa Aqueduct, the Sonoma Aqueduct, the Petaluma Aqueduct, and the Russian River to Cotati Intertie. SCWA owns the northern portion of the North Marin Aqueduct that extends from the terminus of the Petaluma Aqueduct to the Kastania Booster Station, located near the border of Marin County with Sonoma County. The remainder of the North Marin Aqueduct is owned and maintained by the NMWD, which transfers water to its service area and to MMWD to the south.

The Cities of Napa and American Canyon contract with the Napa County Flood Control & Water Conservation District (NCFCWCD) to buy imported surface water from the SWP. The NCFCWCD acts as the SWP contract administrator on behalf of the municipalities in Napa County. The SWP water is diverted from the Sacramento-San Joaquin Delta at the Barker Slough Pumping Plant. The water is then conveyed 21 miles through the North Bay Aqueduct (NBA) to Cordelia Forebay and is then pumped an additional 6 miles to the NBA terminal reservoirs. The water is treated at Napa's Jameson Canyon Water Treatment Plant and the City of American Canyon's Water Treatment Plant. The two facilities are directly adjacent to each other. The City of American Canyon also has an agreement to purchase both treated and raw water from the City of Vallejo.

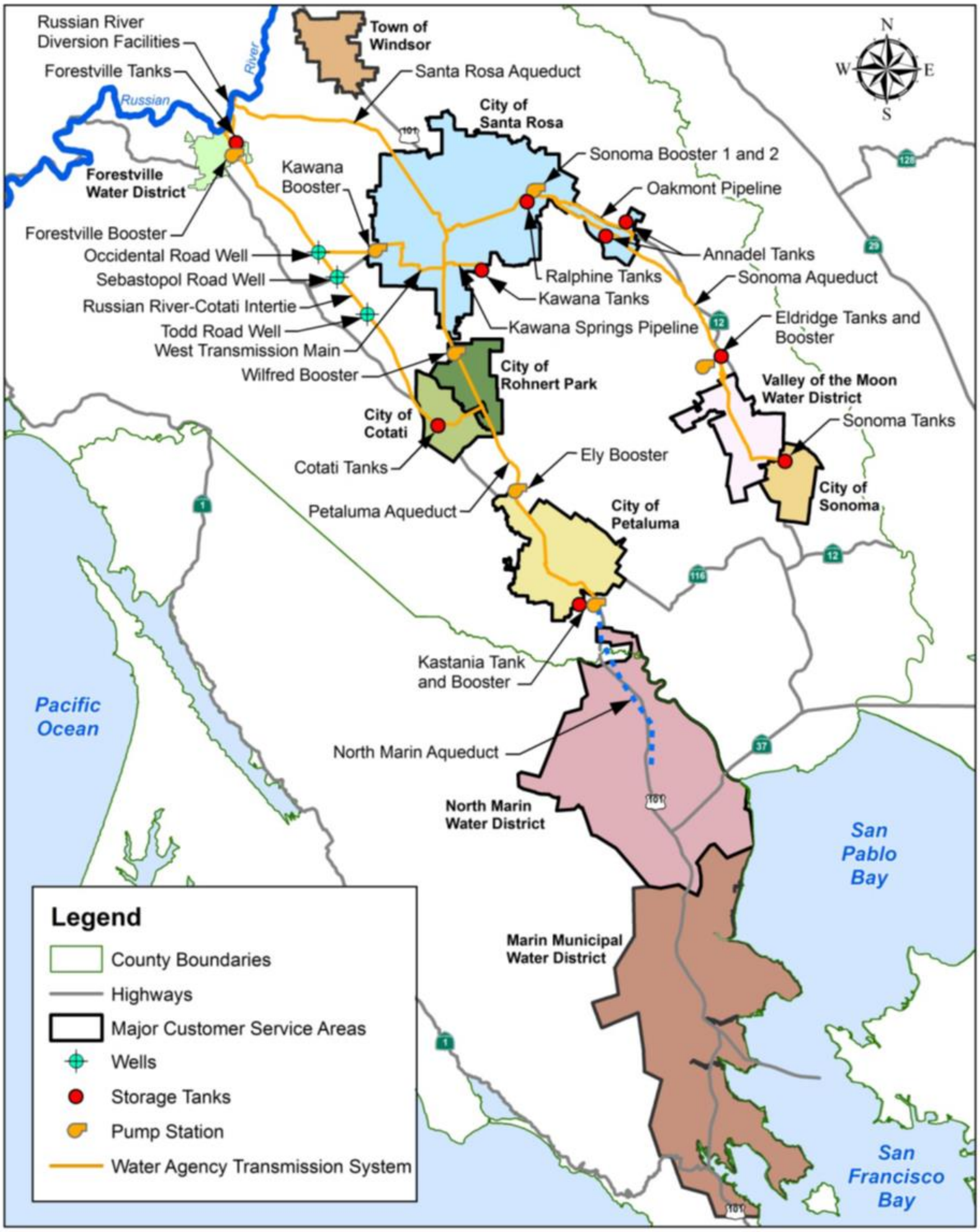



**Figure 2-2 SCWA Transmission System**

The projected imported water supply for each of the urban water agencies for a normal climate year is provided in Table 2-7. While the SWP contract amount for the Cities of Napa and American Canyon is 21,900 AFY and 5,200 AFY, respectively, the NBA conveyance capacity limits the supply to 19,900 AFY. The normal year supply is estimated to be less than the contract amount and conveyance capacity since the SWP typically does not provide 100-percent supply in normal years, as shown in Table 2-7.

**Table 2-7. Projected Normal Year Imported Water Supply for Urban Areas (AFY)**

| Urban Water Agency | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|---|
| Marin Municipal Water District | 6,521 | 8,500 | 8,500 | 8,500 | 8,500 | 8,500 |
| North Marin Water District | 6,198 | 9,182 | 9,291 | 9,831 | 10,372 | 10,912 |
| City of Petaluma | 7,158 | 10,489 | 9,705 | 10,273 | 10,841 | 11,409 |
| City of Sonoma | 1,908 | 2,355 | 2,392 | 2,485 | 2,576 | 2,626 |
| Valley of the Moon Water District | 3,319 | 2,995 | 2,994 | 3,099 | 3,192 | 3,308 |
| City of Napa | 13,140 | 13,140 | 13,140 | 13,140 | 13,140 | 13,140 |
| City of American Canyon | 3,024 | 3,014 | 6,553 | 7,119 | 7,119 | 7,119 |
| Total | 41,268 | 49,675 | 52,575 | 54,447 | 55,740 | 57,014 |

*Source: Sonoma County Water Agency's 2010 UWMP and City of Napa's 2010 UWMP. Does not include transmission system losses. City of American Canyon data is from their 2010 and 2015 UWMPs.*

During dry years, the imported surface water supply is less than the values shown in Table 2-7. The single-dry year supply from the SCWA is projected to vary from 82 to 86 percent of normal year deliveries through 2035. The City of Napa's SWP projected supply of 1,533 AFY in a single-dry year through 2025 (City of Napa, 2011), increasing to 2,409 AFY after 2025, is based on information in the DWR's State Water Project Delivery Reliability Report. For the City of American Canyon, single-dry year supply from the SWP supplies can be substantially curtailed. In 2014, DWR's allocation of SWP water to contractors was 5 percent of the contract amounts. Given the uncertainty surrounding the availability of SWP water, the City of American Canyon supplements its water supply with water purchased from the City of Vallejo, which has a significantly higher reliability (City of American Canyon, 2016).

The estimated use of both local and imported surface water in 2010 for all of Marin, Napa, and Sonoma Counties is presented in Table 2-8. The agricultural use of surface water in Napa and Sonoma Counties is on the same order of magnitude as the urban surface water use.

| Table 2-8. Surface Water Use in 2010 in the Marin-Napa-Sonoma County Area (AFY) | | | | |
|---|---|---|---|---|
| Type | Marin County | Napa County | Sonoma County | Total |
| Public supply | 34,816 | 19,626 | 37,135 | 91,577 |
| Domestic self-supplied | 78 | 224 | 437 | 739 |
| Industrial self-supplied | 0 | 0 | 0 | 0 |
| Irrigation | 2,890 | 22,931 | 59,719 | 85,540 |
| Livestock self-supplied | 650 | 78 | 2,016 | 2,744 |
| Aquaculture self-supplied | 0 | 661 | 6,923 | 7,584 |
| Mining self-supplied | 22 | 269 | 56 | 347 |
| Thermoelectric power, self-supplied | 0 | 0 | 0 | 0 |
| Total | 38,456 | 43,789 | 106,286 | 188,531 |

*Source: Compiled data from water uses (USDI/USGS, 2014).*

### 2.1.3 Groundwater

Groundwater supplies water for agricultural users and is a supplemental supply for some of the urban water agencies in the NBWRA study area. There are eight groundwater basins in the NBWRA study area identified by DWR. These are characterized in Table 2-9, including the basins' identification numbers, names, California Statewide Groundwater Elevation Monitoring (CASGEM) Program prioritization, and CASGEM monitoring entity (DWR, 2014). DWR did not identify "critical conditions of overdraft" in any of these groundwater basins (DWR, 2016). None of these groundwater basins are adjudicated. More detailed basin descriptions included in Bulletin 118 are provided on DWR's website.

| Table 2-9. Groundwater Basins | | | | |
|---|---|---|---|---|
| Basin Number | Basin Name | Surface Area, Acres | CASGEM Groundwater Basin Prioritization | CASGEM Monitoring Entity |
| 2-1 | Petaluma Valley | 46,043 | Medium | City of Petaluma |
| 2-2.01 | Napa-Sonoma Valley, Napa Valley | 45,895 | Medium | Pending |
| 2.02.02 | Napa-Sonoma Valley, Sonoma Valley | 44,626 | Medium | SCWA |
| 2.02.03 | Napa-Sonoma Valley, Napa-Sonoma Lowlands | 40,455 | Very Low | TBD |
| 2.19 | Kenwood Valley | 5,135 | Very Low | SCWA |
| 2.28 | Ross Valley | 1,763 | Very Low | TBD |
| 2.29 | San Rafael Valley | 874 | Very Low | TBD |
| 2.30 | Novato Valley | 20,519 | Very Low | TBD |

*Source: DWR, 2014.*

*TBD = to be determined.*

The principle groundwater-bearing aquifers in these groundwater basins are comprised of alluvial deposits, which cover most of the low-lying areas in the Sonoma, Napa, and Petaluma Valleys. These aquifers are largely continuous, with general flow towards San Pablo Bay. However, local flow has been reversed in the region adjacent to the bay. Groundwater levels in the alluvial deposits vary locally, but are generally 5 to 75 feet below the ground surface. In southern Sonoma County, local variations are observed due to the presence of local impermeable layers, which create small semi-confined aquifers.

Natural recharge into the alluvial aquifers occurs through streambed recharge and direct infiltration of precipitation. The shallow aquifer system receives most of this recharge. Recharge that reaches the deeper aquifer zones is more poorly defined and likely comes from a combination of leakage from overlying shallow aquifers and mountain front recharge along the margins of the valley. Almost 90 percent of the annual inflow into the Sonoma Valley groundwater basin is estimated to be due to recharge from the percolation of precipitation (SCWA, 2014).

Groundwater yields vary depending on location, but yields in the foothills (where many new vineyards are being developed) are low. Additionally, the deteriorating quality of some groundwater sources is a concern. The groundwater aquifers in parts of Sonoma and Napa Counties, for example, have localized concentrations of boron and salinity that make the groundwater unusable for agricultural uses and in some cases for urban uses.

The following sections discuss the basins and uses of groundwater within the NBWRA study area that currently provide supply for uses that could be offset with the Phase 2 Program.

#### 2.1.3.1 Napa-Sonoma Valley, Sonoma Valley Basin

The Napa-Sonoma Valley, Sonoma Valley groundwater basin (Sonoma Valley Basin) is the only basin in the NBWRA study area that has a Groundwater Management Plan (GMP), the Sonoma Valley GMP, which was completed in December 2007 (SCWA, 2007). A collaborative group of 20 stakeholders from several public organizations and private interests have continued their involvement in the GMP through ongoing participation on the Basin Advisory Panel (BAP), which meets quarterly. Guidance on the implementation of the GMP is provided to the BAP through a Technical Advisory Committee (TAC) that meets monthly. The BAP identified four management strategies consisting of increased use of recycled water, increased use of groundwater, implementation of groundwater banking, and stormwater recharge.

Primary observations on groundwater conditions in the Sonoma Valley Basin include the following (SCWA, 2009):

- Groundwater level trends observed in shallow-zone wells (less than 200 feet) are generally stable and are predominantly above sea level;
- The two previously identified pumping depressions are most apparent in the deeper zone; and
- Some deeper zone wells in localized areas have exhibited sustained declining trends of up to 2 feet per year.

One pumping depression located southeast of the City of Sonoma measured groundwater levels within this basin to be as low as 116 feet below sea level. The other pumping depression, located southwest of El Verano, found groundwater levels as low as 45 feet below sea level in deeper zone wells. The water budget estimate presented in the Five-Year Review and Update Report issued in 2014 shows a net loss to groundwater over the last several decades, indicating the persistence of declining groundwater levels previously observed in these deeper aquifers. This feasibility study report also included estimates of the 2012 water demands by supply source and type of use within the Sonoma Valley Basin area, summarized in Table 2-10. As shown in this table, groundwater supplied over half of the demands in the region, with agriculture being the largest user.

**Table 2-10. Sonoma Valley Groundwater Basin 2012 Water Demands by Type of Supply (AFY)**

| User Type | Groundwater | Imported Water | Local Surface Water | Recycled Water | Total |
|---|---|---|---|---|---|
| Irrigation | 5,400 | | 1,200 | 1,200 | 7,800 |
| Rural domestic | 3,000 | | | | 3,000 |
| Municipal and commercial | 1,300 | 4,700 | 300 | | 6,300 |
| Golf courses and parks | 700 | | | | 700 |
| Total | 10,400 | 4,700 | 1,500 | 1,200 | 17,800 |

*Source: SCWA, 2014*

### 2.1.3.2 Napa-Sonoma Valley, Napa Valley Basin

Groundwater storage capacity in the Napa-Sonoma Valley, Napa Valley Basin (Napa Valley Basin) is estimated to be 300,000 AF (DWR 2003). Flow in the Napa River in dry periods is the result of groundwater discharge with an estimated average annual net gain of 12,700 AFY. Groundwater levels are generally stable except of the Milliken–Sarco–Tulucay (MST) area, located east and northeast of the City of Napa, where the groundwater level trend is downward. The MST area covers approximately 11,000 acres or 24 percent of the groundwater basin. The almost doubling of groundwater extraction in the MST area since 1975 has resulted in the general decline of groundwater levels (USGS, 2003). Declining groundwater levels evident over a large part of the MST area indicates that groundwater use exceeds the average rate of groundwater replenishment.

Napa County's groundwater conservation ordinance, Ordinance 1162, prohibits groundwater extraction for wasteful and non-beneficial purposes. Agricultural developments in the groundwater-depleted lower MST area requires a groundwater permit, unless specifically exempt. Permits issued for the MST area require that wells have meters installed and limit the user to 0.30 AFY, calculated as a 3-year average. Groundwater wells serving agricultural areas outside the MST area do not require permitting. Napa County issues groundwater permits to single-family homes (with associated landscaping) with requirements for submittal of well meter readings bi-annually and use is limited to 0.60 AFY (13 Napa County Code).

### 2.1.3.3 Groundwater Use

The total quantity of available groundwater supply that can be sustainably used is usually defined as the annual safe yield of each of the groundwater basins. However, the safe yield of groundwater basins has not been quantified. As the 2014 Sustainable Groundwater Management Act is implemented over the next few years, it is likely that the available groundwater supplies will be defined. It is assumed the groundwater basins are being pumped close to or above the annual yield that can be sustained in the long term.

The projected use of groundwater for the urban water suppliers during a normal climate year in the NBWRA study area is presented in Table 2-11. During a dry year, groundwater use would potentially increase to replace reductions in surface water supplies. The Cities of Petaluma and Sonoma and VOMWD use groundwater to supplement SCWA surface water supplies. The City of Napa, MMWD, and NMWD do not use groundwater for drinking water supplies.

| Table 2-11. Projected Normal Year Groundwater Use by Urban Areas (AFY) | | | | | | |
|---|---|---|---|---|---|---|
| Urban Water Agency | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 |
| Marin Municipal Water District | 0 | 0 | 0 | 0 | 0 | 0 |
| North Marin Water District | 0 | 0 | 0 | 0 | 0 | 0 |
| City of Petaluma | 1,007 | 0 | 0 | 0 | 0 | 0 |
| City of Sonoma | 43 | 250 | 250 | 195 | 143 | 50 |
| Valley of the Moon Water District | 515 | 470 | 450 | 327 | 232 | 100 |
| City of Napa | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 1,565 | 720 | 700 | 522 | 375 | 150 |

*Source: 2010 UWMPs.*

Estimated use of groundwater in 2010 for all of Marin, Napa, and Sonoma Counties is presented in Table 2-12. The largest user of groundwater in this three-county area is agriculture. Agricultural use of groundwater in the NBWRA study area is estimated to be approximately 54,700 AFY (DWR, 2013). The estimated agricultural use of groundwater in the NBWRA study area is significantly less than the three-county total since a significant portion of the agricultural lands included in this value are located to the north, outside the portion of the NBWRA study area that overlays the Russian River watershed.

| Table 2-12. Groundwater Use in 2010 in the Marin-Napa-Sonoma Counties (AFY) | | | | |
|---|---|---|---|---|
| Type | Marin County | Napa County | Sonoma County | Total |
| Public supply | 1,053 | 1,143 | 17,375 | 19,571 |
| Domestic self-supplied | 347 | 1,031 | 6,027 | 7,405 |
| Industrial self-supplied | 314 | 8,458 | 16,546 | 25,318 |
| Irrigation | 7,237 | 54,017 | 106,992 | 168,246 |
| Livestock self-supplied | 504 | 67 | 1,580 | 2,151 |
| Aquaculture self-supplied | 0.00 | 0.00 | 0.00 | 0 |
| Mining self-supplied | 90 | 0 | 336 | 426 |
| Thermoelectric power, self-supplied | 0 | 0 | 35,601 | 35,601 |
| Total | 9,545 | 64,716 | 184,457 | 258,718 |

Currently, the agricultural water users in the NBWRA study area rely on stored runoff from small local streams and local groundwater. It is assumed that the use of groundwater by the agriculture and other categories in the NBWRA study area is approximately 32,000 and 10,000 AFY, respectively. 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 including increased salinity intrusion, potential land subsidence, losses in streamflows, and environmental damages while also increasing costs associated with extraction, well deepening, and well replacement.

### 2.1.4 Recycled Water

Currently, recycled water within the NBWRA area is supplied by Novato SD, the City of Petaluma, SVCSD, Napa SD, CMSA, and the City of American Canyon for wildlife habitat, agricultural, and landscape irrigation uses as discussed in greater detail in Section 3. LGVSD also provides recycled water within the area and was a part of Phase 1. The Cities of Petaluma and American Canyon are the only agencies that provide both potable water and recycled water supplies. The other three recycled water suppliers are wastewater agencies.

The Novato SD provides recycled water for wildlife habitat and agricultural uses and for golf course, school, and landscape irrigation. The City of Petaluma uses recycled water for irrigation of crops, pasture, schools, city parks, and golf courses. The SVCSD provides recycled water for environmental purposes, dairies, and vineyard irrigation. Napa SD provides recycled water for vineyards, public and commercial landscaping, schools, public parks, and golf courses, and to its own reclamation sites during the dry season. CMSA currently provides as needed recycled water to the City of Larkspur to maintain habitat at the Remillard Park Pond and was recently granted State approval for a recycled water truck filling station for licensed commercial haulers using recycled water in MMWD's service area. The City of American Canyon provides recycled water for vineyard, public and commercial landscape, and public park irrigation along with dual plumbed warehouse and apartment toilet flushing.

The recycled water demands and the amount of recycled water supply estimated to be available for future recycled water projects are presented in Table 2-13. The estimated 2025 supply available for Phase 2 assumes that all wastewater inflow is available for recycled water use.

**Table 2-13. Recycled Water Supply (AFY)[a]**

| Wastewater Agency | Wastewater Inflow | | Existing and Phase 1 Demands | 2025 Supply Available for Phase 2 |
|---|---|---|---|---|
| | 2014 | 2025 | | |
| Novato SD | 6,245 | 8,811 | 1,744 | 7,067 |
| City of Petaluma | 6,122 | 6,949 | 2,658 | 4,291 |
| SVCSD | 4,063 | 5,110 | 3,339 | 1,772 |
| Napa SD[b] | 9,513 | 12,107 | 2,911 | 9,197 |
| CMSA | 13,082 | 14,891 | 1,256 | 13,635 |
| City of American Canyon | 1,559[c] | 2,386 | 248 | 2,138 |
| Total | 40,584 | 50,254 | 12,156 | 38,099 |

*Source: Phase 2 Project Definition Scoping Study Report, CMSA numbers were provided by CMSA staff; City of American Canyon wastewater inflow number for "2014" is from their 2015 UWMP, the "2025" projection is from their 2010 UWMP. The City of American Canyon existing recycled water demands are from their May 2016 Recycled Water Master Plan.*

a. *Values have been rounded.*

b. *Napa SD future projections based on 2030 wastewater inflows*

c. *City of American Canyon wastewater inflows for the "2014" column are actually 2015 wastewater inflows.*

The recycled water supplied for agricultural customers and wildlife habitat uses does not offset potable water demands, but does offset some amount of groundwater pumping and local surface water diversions. Recycled water provided for irrigation of landscaping does replace potable water that would otherwise be supplied for this purpose.

Table 2-14 presents the recycled water use projections provided by the urban water suppliers and includes the name of the respective recycled water supplier for each urban water agency. These recycled water values are lower than the quantities in Table 2-13 since they do not include recycled water that is supplied to customers outside of the water system service boundaries. These recycled water supply customers would otherwise likely use potable water.

Table 2-14. Projected Potable Water Offsets from Recycled Water Use (AFY)

| Urban Water Agency | Recycled Water Supplier | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|---|---|
| MMWD | Las Gallinas Valley Sanitary District and others | 514 | 534 | 763 | 765 | 766 | 768 |
| NMWD | Novato Sanitary District | 140 | 436 | 660 | 673 | 673 | 673 |
| City of Petaluma | City of Petaluma | 131 | 670 | 670 | 670 | 670 | 670 |
| City of Napa[a] | Napa SD | 1,671 | 2,173 | 2,794 | 2,794 | 2,794 | 2,794 |
| City of Sonoma | | 0 | 0 | 0 | 0 | 0 | 50 |
| VOMWD | | 0 | 0 | 0 | 0 | 0 | 25 |
| City of American Canyon[b] | City of American Canyon | 73 | 107 | 513 | 552 | 552 | 1,063 |
| | Total | 2,529 | 3,920 | 5,400 | 5,454 | 5,455 | 6,043 |

*Source: 2010 UWMPs.*

a. *The City of Napa offset totals include only recycled water that was used for "Landscape" irrigation. The Landscape irrigation sector within the City of Napa's 2010 UWMP represents dedicated irrigation-only accounts.*

b. *The City of American Canyon "2010" value is from their 2010 UWMP, values for 2015 through 2035 were taken from their 2015 UWMP.*

### 2.1.5 Potential Water Supply Sources and Plans for New Facilities

In normal hydrologic condition years, adequate supplies exist to meet potable water demands on an annual basis. However, supplies are strained on a seasonal basis (e.g., surface water flows are lowest in the summer when demand is highest) and in dry years. Future urban growth will likely exacerbate this situation and additional sources of water supply to meet future demands are limited. Additionally, supplies are strained in dry years.

Potential sources of additional water other than the proposed Title XVI Phase 2 projects include recycled water projects, additional imported water supplies, and groundwater banking. Desalination of ocean or brackish water has been considered; however, there are no current plans to access saline water supplies.

Each of the urban water agencies within the NBWRA study area have future water supply projects identified, as further discussed in Section 4.5. SCWA estimates that it will need to increase its annual diversion from the Russian River. A portion of this additional supply would be conveyed to some of the urban water suppliers in the NBWRA study area. The City of Sonoma, VOMWD, and SCWA have identified a groundwater banking project with estimated completion by 2020. All of the urban water agencies also have plans to expand the use of recycled water; however, these expansions would be reduced in size and pursued at a slower pace without the support of the Title XVI program.

### 2.1.6 Summary of Water Supplies

Table 2-15 presents a summary of the water supplies for the urban areas in the NBWRA. The surface water supplies would be reduced in dry years from the amounts presented.

**Table 2-15. Water Supplies in the NBWRA Study Area for Urban Use (AFY)**

| Supply Source | 2015 | 2035 |
|---|---|---|
| Local surface water [a] | 40,700 | 39,200 |
| Imported surface water [b] | 49,675 | 57,014 |
| Groundwater [c] | 720 | 150 |
| Recycled water [d] | 3,920 | 6,043 |
| Total | 95,015 | 102,407 |

a. *From Table 2-5.*
b. *From Table 2-7.*
c. *From Table 2-11.*
d. *From Table 2-14.*

## 2.2 Current and Projected Water Demands

This section presents a description of current and projected water demands. The urban, agricultural, and environmental demands in the study area are discussed.

### 2.2.1 Urban Demands

The projected water demands through 2035 for the urban water agencies within the NBWRA area is summarized in Table 2-16.

**Table 2-16. Projected Potable Water Use (AFY)**

| Urban Water Agency | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|---|
| MMWD | 26,237 | 28,852 | 28,725 | 28,616 | 28,717 | 28,799 |
| NMWD [a, b] | 8,190 | 11,860 | 12,019 | 12,084 | 12,023 | 11,791 |
| City of Petaluma | 7,963 | 10,627 | 10,112 | 10,580 | 11,047 | 11,515 |
| City of Sonoma [a] | 1,952 | 2,605 | 2,642 | 2,680 | 2,719 | 2,726 |
| VOMWD [a, c] | 2,710 | 3,465 | 3,444 | 3,427 | 3,424 | 3,433 |
| City of Napa | 13,877 | 14,895 | 14,303 | 14,260 | 14,391 | 14,522 |
| City of American Canyon | 3,024 | 2,976 | 3,405 | 3,622 | 3,898 | 4,175 |
| Total | 63,953 | 75,280 | 74,650 | 75,269 | 76,219 | 76,961 |

*Source: 2010 UWMPs. City of American Canyon data is from both their 2010 and 2015 UWMPs.*
a. *Revised from contractor's UWMP to incorporate projected water conservation savings.*
b. *Assume recycled water not included in the presented water deliveries in the contractor's UWMP.*
c. *Plumbing code portion of water conservation savings not included in contractor's UWMP and not included in here.*

### 2.2.2 Agricultural Demands

Agricultural water use has the highest water use of all of the user categories in the NBWRA study area. Metered agricultural water use data is not available because the use is mostly unmetered, unrecorded, or not centrally tabulated. Therefore, agricultural water use must be estimated.

The USGS developed estimates of the 2010 agricultural water use for all of Marin, Napa, and Sonoma Counties, as shown in Table 2-17. Agricultural water use is broken into three categories: irrigation, livestock, and aquaculture. Almost all of the agricultural water use is for irrigation.

**Table 2-17. Agricultural Water Use in 2010 in the Marin-Napa-Sonoma Counties (AFY)**

| Type | Marin County | Napa County | Sonoma County | Total |
|---|---|---|---|---|
| Irrigation | 10,127 | 76,948 | 166,711 | 253,786 |
| Livestock self-supplied | 1,154 | 145 | 3,596 | 4,895 |
| Aquaculture self-supplied | 0 | 661 | 6,923 | 7,584 |
| **Total** | **11,281** | **77,754** | **177,230** | **266,265** |

The DWR generates Detailed Analysis Units for sub-watershed areas within each county that estimate irrigated crop acreages and applied water for 20 crop categories. The Detailed Analysis Units for 2010 for the Napa, South Sonoma, and East Marin sub-watershed areas are shown in Table 2-18. The majority of irrigated crop was, and continues to be, vine crops.

**Table 2-18. Irrigated Crop Area in 2010 (acres)**

| DAU Number | 040 | 391 | 392 | |
|---|---|---|---|---|
| DAU Name | Napa | South Sonoma | East Marin | Total |
| Grain | 108 | 326 | - | 434 |
| Corn | - | 79 | - | 79 |
| Oth Fld[a] | - | 73 | - | 73 |
| Pasture | 543 | 1,288 | 1,071 | 2,902 |
| Oth Trk[b] | 112 | 394 | 3 | 509 |
| Oth Dec[c] | 73 | 51 | - | 124 |
| Subtrop[d] | 214 | 189 | 180 | 583 |
| Vine | 39,251 | 14,498 | 96 | 53,845 |
| **Total** | **40,301** | **16,898** | **1,350** | **58,549** |

*Source: DWR, 2010.*

a. *Includes flax, hops, grain sorghum, sudan, castor beans, miscellaneous fields, sunflowers, hybrid sorghum/sudan, millet and sugar cane.*

b. *Includes artichokes, asparagus, beans (green), carrots, celery, lettuce, peas, spinach, flowers nursery and tree farms, bush berries, strawberries, peppers, broccoli, cabbage, cauliflower and Brussel sprouts.*

c. *Includes apples, apricots, cherries, peaches, nectarines, pears, plums, prunes, figs, walnuts and miscellaneous deciduous.*

d. *Includes grapefruit, lemons, oranges, dates, avocados, olives, kiwis, jojoba, eucalyptus and miscellaneous subtropical fruit.*

The amount of total applied water for each crop category is shown in Table 2-19 using the DWR estimates of applied water per acre for each crop type. The unit applied water factors are developed by DWR considering crop evapotranspiration, evapotranspiration of applied water, effective precipitation, and the consumed fraction of applied water. The estimated agricultural water use developed by DWR for the three Detailed Analysis Units is approximately 20 percent of the total agricultural water use in the three counties developed by USGS.

**Table 2-19. Applied Irrigation Water in 2010 (AFY)**

| DAU number | 040 | 391 | 392 | |
|---|---|---|---|---|
| DAU name | Napa | South Sonoma | East Marin | Total |
| Grain | 192 | 159 | - | 351 |
| Corn | - | 137 | - | 137 |
| Oth Fld[a] | - | 161 | - | 161 |
| Pasture | 1,898 | 5,216 | 4,145 | 11,259 |
| Oth Trk[b] | 191 | 1,061 | 6 | 1,258 |
| Oth Dec[c] | 159 | 113 | - | 272 |
| Subtrop[d] | 398 | 426 | 391 | 1,215 |
| Vine | 27,350 | 11,073 | 90 | 38,513 |
| Total | 30,188 | 18,346 | 4,632 | 53,166 |

*Source: DWR, 2010*

a. *Includes flax, hops, grain sorghum, sudan, castor beans, miscellaneous fields, sunflowers, hybrid sorghum/sudan, millet and sugar cane.*

b. *Includes artichokes, asparagus, beans (green), carrots, celery, lettuce, peas, spinach, flowers nursery and tree farms, bush berries, strawberries, peppers, broccoli, cabbage, cauliflower and Brussel sprouts.*

c. *Includes apples, apricots, cherries, peaches, nectarines, pears, plums, prunes, figs, walnuts and miscellaneous deciduous.*

d. *Includes grapefruit, lemons, oranges, dates, avocados, olives, kiwis, jojoba, eucalyptus and miscellaneous subtropical fruit.*

The Phase 1 Feasibility Study provided an estimate of the monthly demand pattern of vineyard water use, this is presented in Table 2-20. Vineyards exerted the major water use for irrigation in the study area followed by dairies/pastures. For the annual unit demands shown in Table 2-19, DWR estimated that the applied water unit factor in 2010 was 0.70, 0.76, and 0.94 AFY/acres for the Napa, South Sonoma, and East Marin Detailed Analysis Units, respectively. In comparison, the annual unit demands for vineyard water use are 35 percent for Napa County and 65 percent for Sonoma County of the respective the applied water unit factor.

Regional vineyard operators widely practice Regulated Deficit Irrigation (RDI). RDI is an agricultural practice in the wine industry that strategically decreases the quantity of applied water during periods of the growing season to cause the plant to be slightly stressed. This enhances characteristics such as berry size and color. Decreased irrigation causes the plant to use more of the soil moisture, which also allows for more storage of future rainfall in the soil. RDI can significantly reduce demand; therefore, the projections shown in Table 2-20 are representative of the vineyard demands within the NBWRA study area.

| Table 2-20. Monthly Vineyard Unit Water Demand (AF/acre) | | |
|---|---|---|
| Month | Napa County | Sonoma County |
| January | 0.000 | 0.000 |
| February | 0.000 | 0.000 |
| March | 0.000 | 0.000 |
| April | 0.000 | 0.000 |
| May | 0.000 | 0.104 |
| June | 0.088 | 0.153 |
| July | 0.086 | 0.145 |
| August | 0.053 | 0.084 |
| September | 0.023 | 0.014 |
| October | 0.000 | 0.000 |
| November | 0.000 | 0.000 |
| December | 0.000 | 0.000 |
| Total | 0.250 | 0.500 |

*Source: SCWA/USBR, 2008.*

Table 2-21 presents the monthly demand curve for pasture water demand.

| Table 2-21. Monthly Dairy and Pasture Unit Water Demand | |
|---|---|
| Month | Study Area (AF/acre) |
| January | 0.000 |
| February | 0.000 |
| March | 0.000 |
| April | 0.217 |
| May | 0.355 |
| June | 0.476 |
| July | 0.511 |
| August | 0.455 |
| September | 0.330 |
| October | 0.158 |
| November | 0.000 |
| December | 0.000 |
| Total | 2.502 |

*Source: SCWA/USBR, 2008.*

Agricultural water use within the NBWRA study area is dependent on factors that influence the crop composition and is anticipated to change in the future. Urbanization and economic pressure to shift to different crops are the two major factors that are likely to change agricultural land use within the NBWRA study area. Crop prices and productivity are highly sensitive to weather conditions, the world market, and local and national economic conditions. Due to the uncertainty associated with these factors, calculating future agricultural water use is not currently possible.

Growing populations within the NBWRA study area could cause urban areas to expand in the future. There are currently some agricultural land uses within urban growth boundaries. Sonoma, Marin, and Napa Counties have objectives and policies within their respective General Plans to protect conversion of agricultural land to non-agricultural uses. These objectives and policies try to focus urban development on infill, with only small extensions to urban boundaries. This suggests that agricultural water use could may decline slightly if some of those agricultural areas were converted to urban uses.

### 2.2.3 Environmental Demands

Environmental water demands include water for ecological purposes including plant and animal uses throughout the watershed. Environmental water uses within the region benefit multiple habitats: instream aquatic habitat, riparian vegetation, lake and reservoir aquatic habitat, and wetlands. Creeks and rivers within the region provide instream habitat for fish.

The natural populations of Coho and Chinook salmon and steelhead within coastal California, known to be in the watershed tributaries to the San Francisco Estuary, have declined dramatically over the last 50 years. Coho salmon used to inhabit some of the watersheds surrounding the San Francisco Estuary but have not been observed there since the early-to-mid 1980s. There are multiple reasons for the decline that include water diversions and water temperature.

A region-wide analysis was conducted by the Center for Ecosystem Management and Restoration for the California State Coastal Conservancy (Coastal Conservancy) to prioritize expenditures on steelhead restoration in the watersheds tributary to the San Francisco Estuary (Becker, 2007). This work identified the locations with the greatest promise to achieve steelhead conservation and restoration. Bay Area watersheds were assessed using two criteria: 1) the existence of reproducing steelhead populations; and 2) the amount of rearing habitat available. Eight of the Bay Area's 58 watersheds account for about 75 percent of the region's fish habitat resources and are called "anchor watersheds." These watersheds include Corte Madera Creek, Sonoma Creek, and the Napa River. Within these watersheds, "essential streams" were identified to focus restoration efforts.

The SWRCB and California Department of Fish and Wildlife (CDFW) generally find that cumulative diversions of more than 10 percent of total annual discharge may pose a threat to aquatic habitats. CDFW and National Marine Fisheries Service (NMFS) developed "2002 Guidelines for Maintaining InStream Flows to Protect Fisheries Resources Downstream of Water Diversions in Mid-California Coastal Streams (Guidelines)" to protect anadromous salmonids and habitat in mid-California streams (CDFW and NMFS, 2002). The guidelines support environmental water uses by proposing limits on the maximum cumulative water that can be diverted in a watershed.

The SWRCB Policy establishes principles and guidelines for maintaining instream flows for the protection of fishery resources, while minimizing water supply impacts on other beneficial uses of water such as irrigation, municipal use, and domestic use. The geographic scope of the Policy encompasses coastal streams from the Mattole River to San Francisco and coastal streams entering northern San Pablo Bay and extends to five counties: Marin, Sonoma, and portions of Napa, Mendocino, and Humboldt Counties. The Policy applies to applications to appropriate water, small domestic use, small irrigation use, and livestock stockpond registrations, water rights registrations, and water rights petitions.

The Policy does not establish specific instream flow requirements for particular rivers or streams but establishes guidelines for evaluating the potential impacts of water diversion projects on stream hydrology and biological resources. Principles are included in the Policy to ensure that new water appropriations and changes to existing water rights permits and licenses will not affect the instream flows needed for fish spawning, migration and rearing, or the flows needed to maintain natural flow variability and to ensure that migration paths to spawning and rearing habitats are not blocked.

The Napa River has historically supported (and continued to support) the largest run of Steelhead salmon within the San Francisco Estuary. However, on-going water diversions for agricultural uses pose a serious threat to this status. A study to improve streamflow in the Napa River concluded that direct diversions and groundwater pumping from the adjacent shallow aquifer pose the greatest threat to sustaining a stable summer flow pattern to provide adequate summer habitat. While annual water availability is generally adequate, seasonal water use in the summer conflicts with ecological flow needs. This conclusion suggests that efforts to enhance both storage and dry season streamflow are feasible and worth pursuing (Becker, 2007). Recovery strategies for Napa River Steelhead must address instream flow provisions in order to be successful (Leidy, 2005). The Napa River has been identified as an “anchor watershed” with the highest potential for restoring salmon populations in the San Francisco Bay area (Bay Area Integrated Regional Water Management Plan [IRWMP], 2013). Therefore, increases in recycled water use for environmental purposes to promote increase instream flow may be a future possibility.

The Napa-Sonoma River Salt Marsh Restoration Project, included in Phase 1, consists of the restoration of tidal wetlands and enhancement of managed ponds in the Napa-Sonoma Marsh Wildlife Area. It is the primary NBWRA Phase 1 use of recycled water for environmental purposes. The approximately 9,500-acre Napa River Unit consists of 12 former salt evaporation ponds located on the west side of the lower Napa River. The project has several objectives. First, it aims to create a mix of tidal habitat and managed pond habitat that services a broad range of wildlife. Second, it allows restoration of large areas of tidal habitats in a band along the Napa River ensuring connections between the patches of tidal marsh. The project also improves the ability to manage water depths and salinity levels in the managed ponds to maximize feeding and resting habitat for migratory and resident waterfowl.

Calculating environmental demands and projecting future demands requires knowledge of habitats, demands by habitat type, instream flow requirements, and groundwater-surface water interactions for areas with shallow groundwater. Some of this information is not yet available; therefore, rigorous demand calculations are not currently possible. These issues will be studied as a part of environmental documentation development.

### 2.2.4 Summary of Water Demands

Table 2-22 summarizes the total water demand in the NBWRA study area by demand sector. The future agricultural demands are assumed to remain the same as the estimate for 2010.

| Table 2-22. Total Water Use in Marin-Napa-Sonoma Counties, AFY | | |
|---|---|---|
| Demand Sector | 2015 | 2035 |
| Urban[a] | 75,280 | 76,961 |
| Agricultural[b] | 53,166 | 53,166 |
| Domestic and industrial self-supplied[c] | 66,924 | 66,924 |
| Environmental[d] | | |
| Total | 192,394 | 192,876 |

a. *From Table 2-16.*
b. *From Table 2-19.*
c. *From Tables 2-8 and 2-12.*
d. *Not quantified.*

As a comparison, Table 2-23 presents the estimated total water use in 2010 for all of Marin, Napa, and Sonoma Counties.

| Table 2-23. Total Water Use in 2010 in Marin-Napa-Sonoma Counties, AFY | | | | |
|---|---|---|---|---|
| Type | Marin County | Napa County | Sonoma County | Total |
| Public supply | 35,869 | 20,769 | 54,510 | 111,148 |
| Domestic self-supplied | 425 | 1,255 | 6,464 | 8,144 |
| Industrial self-supplied | 314 | 8,458 | 16,546 | 25,318 |
| Irrigation | 10,127 | 76,948 | 166,711 | 253,786 |
| Livestock self-supplied | 1,154 | 145 | 3,596 | 4,895 |
| Aquaculture self-supplied | 0 | 661 | 6,923 | 7,584 |
| Mining self-supplied | 112 | 269 | 392 | 773 |
| Thermoelectric power, self-supplied | 0 | 0 | 35,601 | 35,601 |
| Total | 48,001 | 108,505 | 290,743 | 447,249 |

*Source: USDI/USGS, 2014.*

## 2.3 Water Quality Concerns

This section describes water quality concerns for the current and projected water supply. The urban water agencies have minor to no water quality issues with their surface water and groundwater supplies. The NBA intake has experienced elevated organic matter concentrations from decaying vegetation. Alternate intake locations are currently being evaluated by DWR. Since high turbidity occurs in Napa's reservoirs during the rainy season, the City of Napa is considering upgrading its water treatment plant at Milliken Reservoir so the supply can be used year-round. MMWD has identified salt water intrusion in low lying areas of the sewer collection system and algal blooms in the surface water reservoirs that can cause taste and odor problems.

Surface water quality is an environmental concern. Under Section 303(d) and 305(b) of the 1972 Clean Water Act (CWA), states, territories, and authorized tribes are required to develop a list of waters that do not meet water quality standards for a particular pollutant. States must submit this list every 2 years. States must develop total maximum daily loads (TMDLs) for the constituents that create water quality concerns in each water body. As the name indicates, TMDLs establish limits of each constituent that can enter the waterway every day, from all potential sources. The SWRCB develops the 303(d) List for California. Several of the local surface water sources are considered impaired under the CWA. The current list of impaired waters includes the Napa River, the Petaluma River, Sonoma Creek, and several coastal sites. The presence of nutrients, pathogens, and sediment are the primary causes for water bodies being listed.

The California Coastal Commission has designated several locations in the San Pablo Bay area as Critical Coastal Areas (CCAs). The CCA Program is an innovative program to foster collaboration among local stakeholders and government agencies to better coordinate resources and focus efforts on coastal watersheds in critical need of protection from polluted runoff. The CCA Program relies on existing designations of degraded water quality (i.e., the CWA 303(d) list of impaired and threatened water bodies), and marine or estuarine areas with high resource values (i.e., California Marine Managed Areas, including State Water Quality Protection Areas, and equivalent areas specified in the San Francisco Bay Plan). The CCAs in the San Pablo Bay area are presented in Table 2-24.

**Table 2-24. Critical Coastal Areas in the San Pablo Bay Area**

| Number | Site | Reason |
|---|---|---|
| 89 | Miller Creek | CWA 303(d) and Wildlife Refuge |
| 85 | Gallinas Creek | CWA 303(d) and Wildlife Refuge |
| 98 | San Rafael Creek | CWA 303(d) and Wildlife Refuge |
| 83 | Corte Madera Creek | CWA 303(d) and Wildlife Refuge |
| 90 | Napa River | CWA 303(d) and Wildlife Refuge |
| 91 | Novato Creek | CWA 303(d) and Wildlife Refuge |
| 92 | Petaluma River | CWA 303(d) and Wildlife Refuge |
| 99 | Sonoma Creek | CWA 303(d) and Wildlife Refuge |

*Source: California Coastal Commission.*

To address water quality problems in the waterways, the San Francisco Bay Regional Water Quality Control Board (RWQCB) has imposed limitations on point sources during summer months when the waterways are most seriously impaired. Future implementation of TMDLs, or other regulatory requirements, could impose additional limitations on point sources.

San Pablo Bay was once bordered by more than 50,000 acres of highly-productive tidal wetlands. Those wetlands were an integral ecological complement to the open waters of the San Francisco Bay estuary, serving as a nursery grounds for fisheries, wintering areas for migratory water birds, and nutrient production factories for aquatic species. Over the last century and a half, 75 percent of those wetlands were diked, drained, and disconnected from the estuary ecosystem. This process has decreased water flows and marsh habitat, including habitat for endangered or threatened species such as the California Clapper Rail and the Salt Marsh Harvest Mouse.

The groundwater basins close to the San Francisco Bay have areas of high total dissolved solids and chloride concentrations. Groundwater quality problems include high levels of boron and iron in the Napa and Sonoma Valleys and elevated nitrate concentrations in the shallow aquifer zone in the northwest Petaluma Valley. A recent USGS study has found that saline water intrusion in the southern part of the Sonoma Valley could be occurring in the vicinity of a groundwater depression within and to the southeast of the City of Sonoma's service area. These groundwater quality issues may impact some self-supplied domestic and agricultural users.

SVCSD developed a Salt and Nutrient Management Plan to ensure the underlying groundwater basin (Sonoma Valley Subbasin 2-2.02) is protected as required by SWRCB's Recycled Water Policy. The plan found that groundwater quality in the basin is stable, with low salinity and nutrient levels. It established that recycled water use can be increased while still protecting groundwater quality.

### 2.3.1 Wastewater Treatment Plant Water Quality

Recycled water is used for numerous agricultural applications throughout California and across the U.S. In addition to the filtration and disinfection requirements that recycled water must meet for agricultural use in California, 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 the type of storage facilities used. 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 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 plant's threshold tolerance 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 (U.S. Environmental Protection Agency [USEPA], 2012).

**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, 2012).

**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 limits (USEPA, 2012).

**Chlorine Residual.** Residual free chlorine concentrations of less than 1 milligram per liter (mg/L) usually pose no problems 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, 2012).

**Nutrients.** The most important nutrients for crop growth 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, 2012).

In 2006, the University of California (UC) Division of Agriculture and Natural Resources completed a study that examined the quality of Napa SD's recycled water and its appropriateness for vineyard applications (UC Division of Agriculture and Natural Resources, 2006). 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.

Table 2-25 summarizes water quality data for the participating WWTPs' effluent. The table also presents the water quality guidelines for the use of recycled water by the USEPA, the 2006 study by the UC Division of Agriculture and Natural Resources, and from the North Bay Watershed Association (NBWA).

Based on the data, in almost all cases the effluent of the participating WWTPs meets the recommended water quality levels for each of the constituents listed in Table 3-7 for agricultural application. Only the constituents of chlorine residual, sodium, and specific conductance (as measured at Napa SD for chlorine residual, and SVCSD for sodium and specific conductance) are present at levels higher than those recommended by the NBWA study; however, these constituents have no recommended maximum level by USEPA or the UC Division of Agriculture and Natural Resources.

**Table 2-25. WWTP Effluent Water Quality**

| Constituent | Units | Water Quality Guidelines: Recommended Maximum Level for Vineyard Water Quality Needs[f] | Water Quality Guidelines: Recommended Constituent Limits in Recycled Water For Irrigation[g] | NBWA Values, Degree of Restrictions on Use[h]: None | NBWA Values, Degree of Restrictions on Use[h]: Slight to Moderate | NBWA Values, Degree of Restrictions on Use[h]: Severe | Petaluma[a] Minimum | Petaluma[a] Average | Petaluma[a] Maximum | Novato SD[a] Minimum | Novato SD[a] Average | Novato SD[a] Maximum | SVCSD[b] Desired Range[i] | SVCSD[b] Minimum | SVCSD[b] Average | SVCSD[b] Maximum | Napa SD[c] Minimum | Napa SD[c] Average | Napa SD[c] Maximum | CMSA[d] Minimum | CMSA[d] Average | CMSA[d] Maximum | City of American Canyon[e] Minimum | City of American Canyon[e] Average | City of American Canyon[e] Maximum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | mg/L | 5.0 | 5.0 | | | | 0.420 | 0.420 | 0.420 | | | | None | <0.05 | 0.05925 | 0.087 | 0.120 | 0.284 | 0.510 | | | | | | |
| Arsenic | mg/L | 0.1 | 0.10 | | | | 0.00067 | 0.001 | 0.0013 | 0.0005 | 0.0005 | 0.0007 | None | | <0.002[j] | | <0.0005 | 0.0085 | 0.011 | 0.00056 | 0.00068 | 0.00081 | <0.00045 | 0.00073 | 0.0012 |
| Beryllium | mg/L | 0.1 | 0.10 | | | | <0.00009 | <0.00009 | <0.00009 | | | | None | | <0.001[j] | | <0.0001 | | <0.0005 | ND | ND | ND | ND | ND | ND |
| Bicarbonate | mg/L | | | <90 | 90-500 | >500 | 200 | 225 | 250 | | | | 75 | 72 | 125 | 210 | | | | | | | | | |
| Boron | mg/L | 1 | 0.75 | <0.7 | 0.7-3.0 | >3.0 | 0.38 | 0.455 | 0.53 | | | | <0.5 | 0.35 | 0.41 | 0.48 | 0.29 | 0.82 | 1.87 | | | | 0.062 | 0.062 | 0.062 |
| Cadmium | mg/L | 0.01 | 0.01 | | | | <0.00002 | 0.00004 | 0.00015 | <0.00005 | 0.00005 | 0.00005 | None | | <0.001[j] | | | <0.1[j] | | ND | 0.00011 | 0.00078 | ND | ND | ND |
| Chloride | mg/L | 262 | | <140 | 140-350 | >350 | 130 | 145 | 160 | | | | 30 | 63 | 76 | 82 | 6- | 160 | 251 | | | | 190 | 190 | 190 |
| Chlorine residual | mg/L | | | <1.0 | 1.0-5.0 | >5.0 | 0.31 | 0.31 | 0.31 | <.01 | <.01 | <.01 | None | | | | 8 | 8.5 | 9.1 | ND | ND | ND | 1.8 | 4.6 | 12.9 |
| Chromium | mg/L | 0.1 | 0.1 | | | | 0.00008 | 0.00043 | 0.00094 | <0.0005 | 0.00005 | 0.00076 | None | | <0.002[j] | | <0.0005 | 0.0008 | 0.0012 | 0.00042 | 0.0006 | 0.00095 | ND | ND | ND |
| Cobalt | mg/L | 0.05 | 0.05 | | | | 0.00026 | 0.00026 | 0.00026 | | | | None | | <0.02[j] | | <0.0005 | | 0.0005 | | | | | | |
| Copper | mg/L | 0.2 | 0.2 | | | | 0.00049 | 0.0036 | 0.007 | 0.0013 | 0.00331 | 0.0054 | None | 0.0050 | 0.0064 | 0.0080 | 0.0020 | 0.0040 | 0.0076 | 0.0036 | 0.0046 | 0.007 | 0.0020 | 0.0040 | 0.0062 |
| Dissolved Solids | mg/L | | | <450 | 450-2000 | >2000 | 560 | 580 | 600 | | | | <500 | 370 | 460 | 520 | | | | | | | 576 | 1213 | 1865 |
| Fluoride | mg/L | 1.0 | 1.0 | | | | 0.13 | 0.13 | 0.13 | | | | None | 0.13 | 0.17 | 0.22 | <0.10 | | 0.18 | | | | | | |
| Iron | mg/L | | 5.0 | <0.1 | 0.1-1.5 | >1.5 | 0.04 | 0.04 | 0.04 | 0.00007 | 0.000145 | 0.00033 | None | <0.05 | | <0.10 | <0.05 | | 0.07 | | | | | | |
| Lead | mg/L | 5.0 | 5.0 | | | | 0.00008 | 0.00025 | 0.00046 | <0.00025 | <0.00025 | <0.00025 | None | | <0.002[j] | | <0.0003 | | <0.0005 | 0.0001 | 0.00016 | 0.00016 | <0.00010 | <0.00015 | <0.00023 |
| Lithium | mg/L | 2.5 | 2.0 | | | | 0.0099 | 0.0099 | 0.0099 | | | | None | | | | 0.0090 | 0.0102 | 0.0120 | | | | | | |
| Manganese | mg/L | 0.2 | 0.2 | <1.0 | 1.0-5.0 | >5.0 | 0.0021 | 0.00755 | 0.013 | | | | None | <0.02 | | 0.021 | 0.0001 | 0.0456 | 0.0930 | | | | | | |
| Molybdenum | mg/L | 0.01 | 0.01 | | | | 0.0014 | 0.0014 | 0.0014 | | | | None | | | | 0.0010 | 0.0020 | 0.0033 | | | | | | |
| Nickel | mg/L | 0.2 | 0.2 | | | | 0.0013 | 0.0026 | 0.012 | 0.002 | 0.00353 | 0.0066 | None | | <0.02[j] | | 0.0036 | 0.0046 | 0.0061 | 0.0035 | 0.0039 | 0.0044 | 0.0035 | 0.0042 | 0.0049 |
| pH | Unitless | | | | 6.5-8.4 | | | | 7.62 | 7.62 | 7.62 | 6.7 | 6.96 | 7.2 | 8.125 | 9.2 | | | | | | | 7.2 | 7.4 | 8.0 |
| Selenium | mg/L | 0.02 | 0.02 | | | | 0.00013 | 0.00023 | 0.00058 | <0.0004 | 0.000463 | 0.00074 | None | | <0.005[j] | | <0.001 | | 0.013 | ND | 0.00032 | 0.00092 | ND | <0.00043 | <0.00085 |
| Sodium | mg/L | | | <3 | 3-9 | >9 | | | | | | | <30 | 52 | 66 | 80 | | | | | | | 180 | 180 | 180 |
| Sodium Adsorption Ratio | mg/L | 3 | | | | | 4.13 | 4.215 | 4.3 | | | | <6.0 | 1.86 | 2.11 | 2.63 | 0.6 | 3.5 | 4.7 | | | | 4.6 | 4.6 | 4.6 |
| Specific Conductance | mmhos/cm[k] | | | <0.7 | 0.7-3.0 | >3.0 | 0.85 | 0.975 | 1.10 | | | | <750 | 0.52 | 0.67 | 0.76 | 0.9 | 1.0 | 1.3 | 0.71 | 2.36 | 4.39 | 1.03 | 2.17 | 2.95 |
| Vanadium | mg/L | 0.1 | 0.1 | | | | 0.002 | 0.002 | 0.002 | | | | None | | <0.1[j] | | <0.002 | | 0.002 | | | | | | |
| Zinc | mg/L | 2.0 | 2.0 | | | | 0.019 | 0.039 | 0.082 | 0.015 | 0.026 | 0.036 | None | 0.035 | 0.049 | 0.058 | 0.001 | 0.017 | 0.024 | 0.015 | 0.026 | 0.034 | 0.038 | 0.051 | 0.062 |

*a. Values are a compilation of sampling data from January 2015 through December 2015.*

*b. Values are a compilation of sampling data for 2000-2003 taken from the North San Pablo Bay Restoration and Reuse Project Draft EIR/EIS, (NBWRA/USBR, 2009).*

*c. Values are a compilation of sampling data from April 2007 through October 2007 taken from the North San Pablo Bay Restoration and Reuse Project Draft EIR/ EIS, NBWRA 2009.*

*d. Results are a compilation of Final Effluent Discharge Data for 2015. CMSA does not currently monitor recycle effluent.*

*e. Data was provided by City of American Canyon staff. If the minimum, maximum, and average values are all the same, then the parameter was likely only tested once during 2015 and may not be a good reflection of actual water quality.*

*f. Source: UC Division of Agriculture and Natural Resources, 2006.*

*g. Source: USEPA, 2012.*

*h. NBWA Recycled Water Characterization.*

*i. Desired range as defined by SVCSD.*

*j. All sampling events were non-detect less than the value specified.*

*k. mmhos/cm = millimhos per centimeter.*

This page intentionally left blank.

## 2.4 Wastewater Facilities and Disposal

This section presents a summary of the current wastewater treatment facilities and flows, wastewater disposal options other than those in the proposed Title XVI Program. Section 3 provides more detailed discussion of the existing wastewater treatment facilities within the NBWRA study area.

The major wastewater treatment facilities, treatment flow capacity, and current and projected wastewater inflow is presented in Table 2-26.

**Table 2-26. Wastewater Treatment Facilities**

| Wastewater Agency | NPDES Permitted Capacity, mgd | Discharge Water Body | Wastewater Inflow, AFY | |
|---|---|---|---|---|
| | | | 2010 | 2025 |
| Napa SD | 15.4 | Napa River | 9,513[a] | 12,107[b] |
| SVCSD | 3.0 | San Pablo Bay via Schell and Hudeman Slough | 4,063[a] | 5,110 |
| Petaluma, City of | 6.7 | Petaluma River | 6,122[a] | 6,949 |
| Novato SD | 7.05 | San Pablo Bay via outfall | 6,245[a] | 8,811 |
| LGVSD | 3 | | 3,365 | 3,271 |
| CMSA | 10 | Central San Francisco Bay | 13,082[a] | 14,891 |
| City of American Canyon | 2.5 | North Slough | 1,957 | 2,386 |
| Total | 47.65 | | 44,347 | 53,525 |

*NPDES = National Pollutant Discharge Elimination System.*

*Source: NBWRA, 2014; CMSA wastewater inflow data was provided by CMSA staff, City of American Canyon wastewater inflow data is from 2010 UWMP.*

*a. Value from 2014 data.*

*b. Value for 2030.*

Wastewater disposal options other than the proposed Title XVI Program include continued discharge at the current discharge locations and other water recycling projects. The wastewater agencies have plans to expand treatment capacity as needed to meet growth and permit discharge requirements. The details of new wastewater treatment projects have not been identified.

## 2.5 Climate Change

The USBR summarizes the impact of climate change on water supplies as follows:

> "The impacts of climate change are being felt across the Western United States. Warming is affecting water supplies by changing the overall annual volume of precipitation and altering the balance of rain versus snowfall. Communities are facing increasing problems with water availability and drought, flooding, and increased risk of forest fires."
>
> *(USBR, 2014)*

A quantitative effects analysis has been performed for the NBWRA Phase 2 Feasibility Study following the USBR Technical Guidance and uses the climate change vulnerability assessment guidance questions listed in the DWR's *Climate Change Handbook for Regional Water Planning*. For the purpose of this feasibility study report, climate change vulnerability is defined as "the extent to which a water resource system with a Reclamation interest could be negatively affected as result of climate change" (USBR, 2014).

Two greenhouse gas (GHG) emissions scenarios have been used in recent planning documents for California:

- Scenario A2 (Medium–High Emissions) assumes higher GHG emissions and high growth in population and represents a more competitive world that lacks cooperation in sustainable development (similar to "business as usual").
- Scenario B1 (Lower Emissions) is a lower GHG emission scenario that represents social consensus and action for sustainable development.

Scenario B1 is generally viewed as an optimistic "best case" or "policy" scenario for emissions that will require fundamental shifts in global policy. Scenario A2 is a status quo scenario reflecting current real-world conditions incorporating incremental improvements and is generally the more realistic choice for decision-makers to use for climate adaptation planning (Bay Area IRWMP, 2013).

Three timeframes are used by the Intergovernmental Panel on Climate Change for climate change analysis: Year 2030, Year 2050; and Year 2100. The vulnerability analysis completed for this study considered projections for Years 2050 and 2100. This is consistent with available modeling approaches to climate change and similar to the Bay Area IRWMP.

### 2.5.1 Climate Change Vulnerabilities Affecting the North Bay Water Reuse Authority Study Area

This section provides a discussion of climate change vulnerabilities by water characteristic that are applicable to the NBWRA study area. Characteristic water vulnerabilities include impacts on water demand, water supply, water quality, sea level rise, flooding, ecological health and habitat, and hydropower.

The projections and analysis for the NBWRA study area are based on information provided in the August 2013 Bay Area IRWMP related to climate change and sea level rise projections.

**Climate Change.** The historical average annual temperature in the San Francisco Bay Area region is 56.8 degrees Fahrenheit (13.8 degrees Celsius). Overall average air temperatures in the San Francisco Bay Area are expected to rise 2.7 degrees Fahrenheit (1.5 degrees Celsius) between 2000 and 2050 regardless of the GHG emissions scenario; however, by the end of the twenty-first century, Scenarios A2 and B1 project increases of 10.8 degrees Fahrenheit (6 degrees Celsius) and 3.6 degrees Fahrenheit (2 degrees Celsius), respectively. The San Francisco Bay Area is likely to continue with a Mediterranean climate of cool wet winters and hot dry summers. The expectation is average conditions may be drier and more intense rain events may occur during somewhat shorter typical rainy seasons. Similar conditions are expected to affect the North Bay region, which is home to the NBWRA study area.

**Sea Level Rise.** Sea level rise is expected to increase the risk of coastal erosion and flooding along the California coast. Impacts to assets from extreme high tides as well as net increases in sea level will likely result in catastrophic flooding and coastal erosion due to increased inundation frequency, extents, and depths. While the NBWRA study area is not located along the coast, San Pablo Bay is the southern boundary of the NBWRA study area, which makes the region, and its infrastructure, vulnerable to sea level rise and flooding. Table 2-27 shows the projected relative sea level rise for San Francisco Bay. This includes the regional influences on sea level such as regional tectonic movement and gravitational influences of ice caps.

**Table 2-27: Relative Sea Level Rise Projections for San Francisco Bay**

| Year | Projection (in) | Range (in) |
|---|---|---|
| 2030 | 6 | 2-12 |
| 2050 | 11 | 5-24 |
| 2100 | 36 | 17-66 |

*Source: Table 16-2, Bay Area IRWMP, 2013; Table 5.3, National Research Council, 2012.*

The areas in blue shading shown on Figure 2-3 illustrate those regions that would be impacted by a projected 69 inches of sea level rise and 100-year flood[1] by 2100. Due to data limitations, a sea level rise of 69 inches is shown in Figure 2-3, instead of the 66 inches listed in Table 2-27.

[1] Sea level rise and 100-year flood data from http://data.prbo.org/apps/ocof/index.php?page=flood-map.

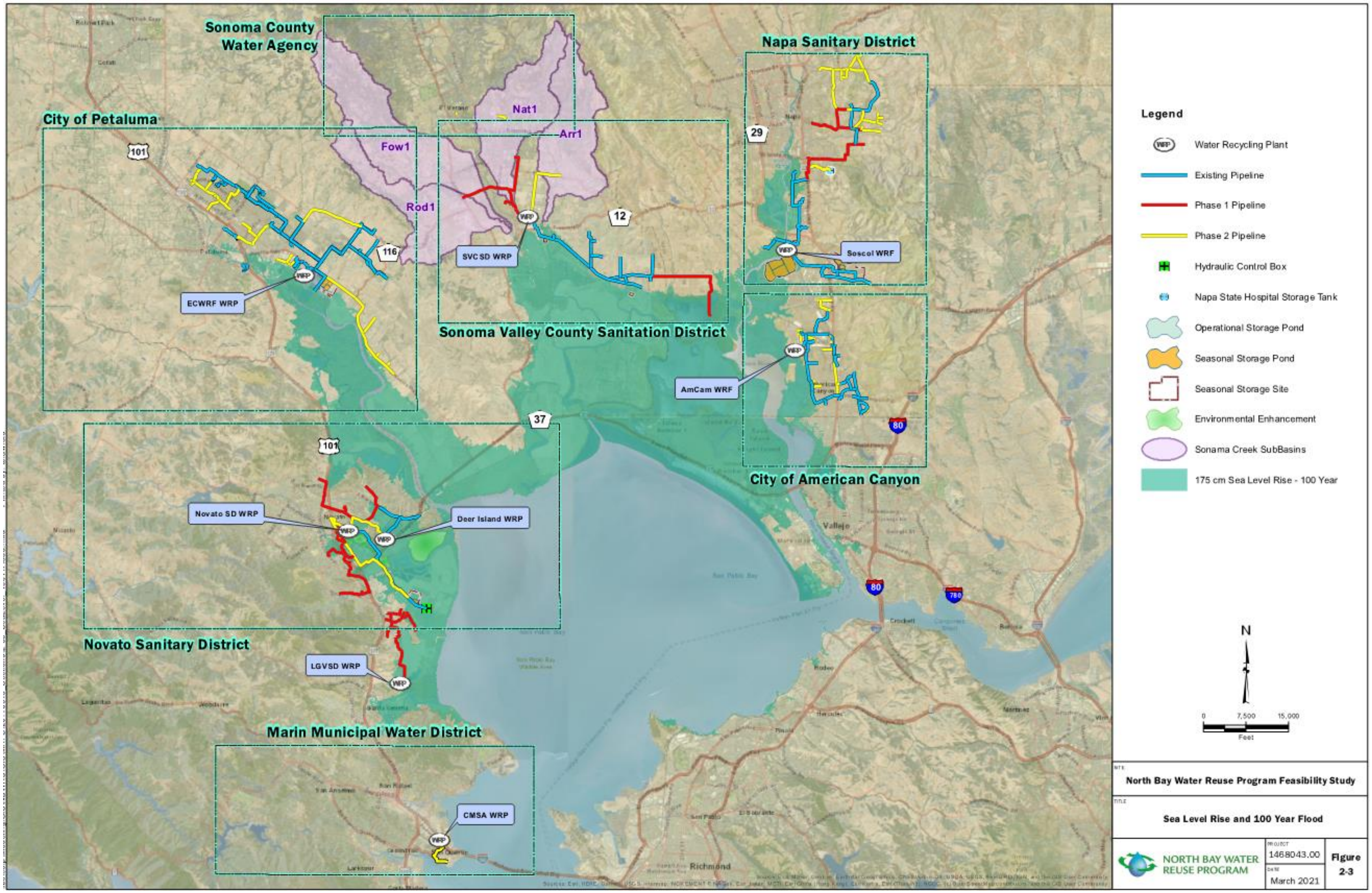



Figure 2-3. NBWRA Phase 1 and 2 Projects – Sea Level Rise – 100-Year Flooding

A general overview of the vulnerability for a range of water characteristics is summarized in Table 2-28. The water characteristics are those identified in the climate change vulnerability checklist assessment as defined in the DWR Climate Change Handbook for Regional Water Planning.

**Table 2-28: Summary of Climate Change Vulnerability Assessment**

| Vulnerability Areas | General Overview of Vulnerabilities |
|---|---|
| Water Demand | Urban and Agricultural Water Demand – Changes to hydrology in the NBWRA study area as a result of climate change could lead to changes in total water demand and use. Increased irrigation demand (outdoor landscape or agricultural) is anticipated to occur as a result of increased evaporative losses and a longer growing season due to warmer temperatures. The North Bay region is not as highly urbanized as the rest of the San Francisco Bay Area and may be particularly vulnerable to increased demands from agriculture in Sonoma, and Napa Counties. There are significant agricultural demands in these counties, primarily for vineyards and forage crops. Increased urban water demands may be experienced primarily as a result of increased outside watering and landscaping during the dry season causing increased demands on all surface, recycled and groundwater sources.<br>Infrastructure - Water treatment and distribution systems are most vulnerable to increases in maximum day demand and may be at or exceed capacity limitations with increased demand. This vulnerability impacts all MAs. |
| Water Supply | Imported Water – Potential impacts on the availability of imported water sources resulting from climate change directly affect the amount of imported water supply delivered to the NBWRA study area. For example, the City of Napa relies on imported NBA water, which is part of the SWP, a water source likely to be negatively impacted by climate change.<br>Surface Water - Although future projections suggest that small changes in total annual precipitation over the North Bay region may be minimal, there may be changes in precipitation patterns (less rainfall in spring, and a shorter intense rainfall season). For example, SCWA draws water from the Russian River and may be vulnerable to extended droughts and more intense rainfall events.<br>Groundwater – Changes in local hydrology could affect natural recharge to the local groundwater aquifers and the quantity of groundwater that could be pumped sustainably over the long-term in some areas. Decreased inflow from more intense runoff, increased evaporative losses, and warmer and shorter rainfall seasons can alter natural recharge of groundwater. Salinity intrusion into coastal groundwater aquifers due to sea level rise could interfere with local groundwater uses. Furthermore, additional reductions in imported water supplies would lead to less water available for managed recharge of local groundwater basins, and potentially more groundwater pumping in lieu of imported water availability. Local groundwater within the NBWRA study area could be affected by climate change. |
| Water Quality | Imported Water – For sources derived from the Delta, sea level rise could result in increases in chloride and bromide concentrations, disinfection by-product (DBP) precursors that are also components of sea water), potentially requiring changes in treatment for drinking water. Increased temperature could result in an increase in algal blooms, taste and odor changes, and a general increase in DBP formation. For example, water withdrawn from the NBA may experience increased levels of DBPs because of increased total organic carbon in the source water.<br>Regional Surface Water – Increased temperature could result in lower dissolved oxygen in streams as well as prolong thermocline stratification in lakes and reservoirs forming anoxic bottom conditions and algal blooms. Decreases in annual precipitation could result in higher concentrations of contaminants in streams during droughts or in association with first rain events. Increased wildfire risk coupled with more intense storms could increase runoff turbidity loads, thereby increasing turbidity experienced at water treatment plants. In the NBWRA study area, both drinking water and wastewater treatment plants could face additional operational challenges from more intense storms as a result of seeing short duration quality decreases and quantity increases. |
| Sea Level Rise | Sea level rise coupled with tidal range, storm surges, streamflows, and wind waves, may increase the potential for higher total water levels, overtopping, and erosion.<br>Much of the North Bay shoreline is comprised of low-lying diked baylands that are already vulnerable to flooding. In addition to rising mean sea level, continued subsidence due to tectonic activity may increase the rate of relative sea level rise.<br>Both the frequency and consequences of coastal storm events and the cost of damage to the built and natural environment may increase as sea levels rise. Existing coastal armoring (e.g., levees, breakwaters, and other structures) is likely to be insufficient to protect against projected sea level rise. Crest elevations of structures may have to be raised or structures relocated to reduce hazards from higher total water levels and larger waves.<br>The NBWRA study area adjacent to San Pablo Bay would be most affected by sea level rise. Projects located within Novato SD, the City of Petaluma, and Napa SD would be vulnerable to an up to 66-inch (by 2100) sea level rise scenario, as shown on Figure 2-3. |

| Table 2-28: Summary of Climate Change Vulnerability Assessment | |
|---|---|
| Vulnerability Areas | General Overview of Vulnerabilities |
| Flooding | Climate change projections are not sensitive enough to assess localized flooding. However, the general expectation is that more intense storms would occur, thereby leading to increased frequency, duration, and flooding depths.<br>Elevated water surface elevations in the San Francisco Bay due to sea level rise would increase backwater effects, further exacerbating the effect of fluvial floods and storm drain backwater flooding (see Figure 2-3). |
| Ecosystem and Habitat | Changes in the seasonal patterns of temperature, precipitation, and fire due to climate change can dramatically alter ecosystems that provide habitats for California's native species. These impacts can result in species loss, increased invasive species ranges, loss of ecosystem functions, and changes in vegetation growing ranges.<br>Reduced precipitation and changes in the seasonal distribution of rainfall may alter timing of low flows in streams and rivers, which in turn would have consequences for aquatic ecosystems. Changes in precipitation patterns and air temperature may affect water temperatures, potentially affecting cold-water aquatic species.<br>San Francisco Bay Area ecosystems and habitat provide important ecosystem services, such as: carbon storage, enhanced water supply and quality, flood protection, food and fiber production. Climate change is expected to substantially change these ecosystem services.<br>The NBWRA study area provides substantial aquatic and habitat-related recreational opportunities, including: fishing, wildlife viewing, and wine industry tourism (a significant asset to the region) that may be at risk due to climate change effects. |
| Hydropower | Hydropower is not applicable for this report because there are no hydropower facilities in the NBWRA study area. Indirect effects such as availability and price of electricity, water supply and water quality may occur from out-of-region hydropower projects. |

*Source: Adapted from Bay Area IRWMP (2013), Table 16-3.*

## 2.5.2 Vulnerability by Type of Project

The Phase 2 projects include infrastructure improvements to produce, store, or convey recycled water to meet increasing water demands to reduce the NBWRA study area's reliance on imported water and surface water. The types of projects being considered include treatment expansions, seasonal storage facilities, operational storage facilities, distribution (pipelines), groundwater management, and environmental enhancement. The vulnerability of each project type, within each of the vulnerability areas considered, is summarized in the following sections.

### 2.5.2.1 Treatment

**Water Demand:** Treatment expansion projects provide additional capacity to treat sources of local supply that can be used to meet increased water demands resulting from climate change; therefore, these projects have low vulnerability to water demand changes due to climate change. Treatment projects would reduce the amount of discharge from a WWTP and subsequently reduce instream flows in cases where wastewater is discharged to the San Francisco Bay, rivers and streams in the winter.

**Water Supply:** Treatment projects would have low vulnerability to changes in water supply due to climate change since these projects generally provide an additional source of local water supply. However, water supply is also subject to water quality vulnerabilities discussed below.

**Water Quality:** Overall, treatment projects have a moderate vulnerability to changes in water quality due to climate change, primarily as a result of recycled water quality being directly related to wastewater quality. Given that recycled water quality is affected by the water quality of the wastewater, increased inflow and infiltration (I&I) in the sewer collection system has a direct impact on recycled water quality. Increases in I&I from sea level rise will increase the salinity in wastewater resulting in reduced quality of recycled water and limit its uses (e.g., salt intolerance of plants and crops). Similarly, as more intense storms are expected with climate change, I&I could result in substantial amounts of freshwater diluting the wastewater stream, which could result in biological upsets at WWTPs. An intense precipitation event in a watershed where a wildfire occurred within the prior year could also result in water quality issues due to extremely high turbidities (i.e., peak turbidities over 80 NTU), and increased fine organic matter loading that could enter the WWTP via I&I (Bay Area IRWMP 2013). This could in turn affect recycled water supply.

**Sea Level Rise:** Vulnerability to sea level rise from climate change depends on the project's proximity to the bay and rivers leading to the bay. Treatment projects can be highly vulnerable to sea level rise from climate change if they are located in areas that could be inundated (e.g., sea level rise of up to 66 inches by 2100) by increasing water surface elevations due to the combined impacts of flooding and sea level rise. The existing WWTPs for Novato SD, the City of Petaluma, and Napa SD are located in areas less than 6 feet above sea level and are, hence, highly vulnerable to sea level rise from climate change. The existing WWTPs for the City of American Canyon and CMSA are located in areas more than 10 feet above sea level and have insignificant vulnerability to sea level rise from climate change.

**Flooding:** The existing WWTPs for Novato SD, the Cities of Petaluma and American Canyon are located adjacent to areas with moderate flood risk area with a significant vulnerability to climate change; therefore, these WWTPs have minor vulnerability. Napa SD's and CMSA's WWTPs are located in a high flood risk area; therefore, have a high vulnerability to climate change induced flooding. Flooding can result in safety issues for plant operators during extreme precipitation events. Flooding can also result in untreated sewage discharges if a treatment plant is unable to operate due to a flood, which could lead to potential public health impacts and monetary fines. Additionally, infrastructure damaged during floods can be expensive to fix and put an economic burden on the impacted agency.

**Ecological Health and Habitat:** The proposed expansions, upgrades, and improvements to the WWTP's for Novato SD, the City of Petaluma, Napa SD, and the City of American Canyon would all occur within the confines of the existing facilities. As such, these projects would not be expected to affect biological resources. Any significant environmental effects primarily relating to the construction impacts associated with new facility instillations are expected to be reduced to less-than-significant levels by implementing established best management practices (BMPs) and applying avoidance and minimization measures.

#### 2.5.2.2 Seasonal Storage

**Water Demand:** Seasonal storage projects have low vulnerability to changes in water demand due to climate change because storage provides more water during the summer months. These storage projects address seasonal shifts in demand and can help to mitigate the impacts of climate change on water demand. Diverting winter effluent to storage may result in reduced discharges to rivers and streams during the winter months, which could influence environmental conditions, particularly in dry years.

**Water Supply:** Seasonal storage projects have low vulnerability to changes in water supply due to climate change because storage provides additional local water supplies in periods when supply is limited (i.e., peak summer months). Water supply is subject to water quality vulnerabilities, as discussed below, as well as increasing temperatures that result in more evaporative losses from storage pond surfaces, which may slightly reduce the overall effectiveness of storage.

**Water Quality:** Since seasonal storage projects receive recycled water from treatment facilities, these projects could experience similar vulnerabilities to changes in water quality due to sea level rise and more intense storms (see Section 2.5.2.1 above). Temperature increases could lead to more frequent and intense algae bloom formation in uncovered storage ponds, which can affect pond filters and clog users' irrigation systems. These factors cause seasonal storage projects to have a moderate vulnerability to changes in water quality due to climate change.

**Sea Level Rise:** Vulnerability to sea level rise from climate change depends on the proximity to the bay and rivers leading to the bay. Those seasonal storage projects within the blue shaded 100-year flood zone with sea level rise shown in Figure 2-3 would have a high vulnerability to sea level rise from climate change.

**Flooding:** Seasonal storage projects' vulnerability to flooding due to climate change depends on the location. Projects that are located within high to moderate flood risk zones would have significant or high vulnerability to climate change. Storage projects which use levees could be of particular concern during flood events as levee safety and potential to breaching could lead to public health and safety concerns. Additionally, any infrastructure damaged during floods could be costly to repair.

**Ecological Health and Habitat:** Seasonal storage sites would either be located within lands currently used for agriculture or in upland areas not anticipated to affect wetland features. However, climate change has the potential to alter the current outlay of these areas. Storage sites with the potential to affect wetland features could be configured to avoid those areas. In the event that avoidance is not feasible, acquisition of regulatory permits from U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), CDFW and RWQCB, including identification of compensatory mitigation as appropriate, would be anticipated. In addition, climate change also has the potential to affect nesting patterns of bird species in the area, and seasonal construction limitations may be applicable to construction activities.

#### 2.5.2.3 Operational Storage

**Water Demand:** Operational storage projects are not significantly vulnerable to changes in water demand due to climate change because day-to-day optimization of the recycled water system, as provided by this type of project, is not subject to seasonal influences.

**Water Supply:** Since operational storage projects are not used to meet seasonal variations in demand, the vulnerability to changes in water supply due to climate change is insignificant. Water conservation efforts that may reduce wastewater flows available for recycled water production is minor and operational storage may help reduce these impacts to water demand.

**Water Quality:** Operational storage projects are typically covered reservoirs and tanks. These types of facilities are not exposed to direct sunlight; therefore, the potential for algae blooms and associated water quality issues are low. The vulnerability of operational storage projects to changes in water quality due to climate change is deemed to be low. Uncovered storage facilities, such as the existing facilities for the City of Petaluma, have a somewhat increased vulnerability since they are exposed to sunlight.

**Sea Level Rise:** Vulnerability to sea level rise from climate change depends on the proximity to the bay and rivers leading to the bay. The operational storage projects located within the shaded 100-year flood zone with sea level rise, shown in Figure 2-4, would have a high vulnerability to sea level rise from climate change.

**Flooding:** Operational storage vulnerability to flooding due to climate change depends on the project location. Projects located within a high risk flood zone would have a significant vulnerability to climate change. Similar to the seasonal storage projects, levee safety could be of concern and any infrastructure damaged during floods could be costly to repair.

**Ecological Health and Habitat:** Operational storage at the Napa SD WWTP would be constructed in upland area and would not be anticipated to affect wetland features. However, climate change has the potential to alter the current outlay of these areas. In addition, the Swainson's hawk nesting occurs within 0.5 miles of the WWTP, climate change has the potential to affect nesting patterns, and seasonal construction limitations may be applicable to construction activities.

#### 2.5.2.4 Distribution

**Water Demand:** Distribution projects have low vulnerability to water demand changes due to climate change. Recycled water distribution systems help mitigate potential increases in potable water demands due to climate change. However, the pipeline projects provide the ability to increase recycled water delivery, resulting in decreased effluent discharge and could subsequently reduce instream flows.

**Water Supply:** Since distribution projects would convey recycled water from the WWTPs, they face similar water supply vulnerabilities to climate change as treatment projects as the result of sea level rise and intense storms (see 2.5.2.1 above).

**Water Quality:** Distribution projects would experience similar water quality vulnerabilities to climate change as those described for treatment and storage projects. However, pipelines are typically buried and not subject to direct sunlight so increased temperature effects would not be experienced. Therefore, vulnerability to changes in water quality due to climate change is deemed to be low for distribution projects.

**Sea Level Rise:** Given that recycled water distribution pipelines are typically buried and pressurized, the vulnerability to sea level rise is generally insignificant. Increased I&I in sewer collection system would have no impact; however, pipeline material selection would need to consider the possibility of corrosion from seawater intrusion. Pump stations and above ground facilities of a distribution project located within the shaded 100-year flood zone with sea level rise, shown in Figure 2-4, would have a high vulnerability to sea level rise from climate change.

**Flooding:** Distribution pipelines would not be vulnerable to flooding as a result of climate change. However, pump stations or above ground features of a distribution project may be vulnerable to flooding due to climate change, depending on their locations. Projects located within a high flood risk zone would have a significant vulnerability to climate change.

**Ecological Health and Habitat:** Distribution project alignments would follow existing roadways and are not anticipated to affect biological resources. Appropriate avoidance methods would be implemented at stream crossings. However, climate change has the potential to alter the current outlay of some of these areas. It is anticipated that the final design alignment would be able to avoid any direct impacts. In the event that avoidance is not feasible, acquisition of regulatory permits from USACE, USFWS, CDFW and RWQCB, including identification of compensatory mitigation as appropriate, would be anticipated.

#### 2.5.2.5 Groundwater Management

**Water Demand:** Groundwater management projects, such as ASR wells, have low vulnerability to climate change induced water demand changes because these projects can take advantage of excess flows during winter months to be stored for later extraction to satisfy increases in summer water demands.

**Water Supply:** Similar to seasonal storage projects, these types of projects help mitigate the vulnerability to changes in water supply due to climate change by using the groundwater aquifer for seasonal storage, which provides additional local water supplies in periods when overall supply is limited (e.g., peak irrigation months).

**Water Quality:** Similar to treatment projects, an intense precipitation event in a watershed where a wildfire occurred within the prior year can result in water quality impacts. Depending on the water quality objectives of the groundwater basin, there could be a moderate vulnerability to changes in water quality due to climate change.

**Sea Level Rise:** Vulnerability to sea level rise depends on the proximity to the bay and rivers leading to the bay. Groundwater management projects, located away from the bay, are not significantly impacted by climate change. Groundwater injection projects have the potential to reduce and mitigate against seawater intrusion by raising groundwater levels in the upper basin or creating a seawater intrusion barrier.

**Flooding:** Above ground facilities associated with groundwater management projects located within moderate to high flood risk zones have a moderate to high vulnerability to climate change. Safety issues would be a concern for the above ground structures, such as a pump station or wellhead treatment facility and infrastructure damage from flooding could result in high repair costs.

**Ecological Health and Habitat:** Above ground facilities associated with groundwater management projects would be within existing paved areas and no impacts are anticipated. However, climate change has the potential to alter the current outlay of some of these areas. It is anticipated that the final design would be able to avoid any direct impacts. In the event that avoidance is not feasible, acquisition of regulatory permits from USACE, USFWS, CDFW and RWQCB, including identification of compensatory mitigation as appropriate, would be anticipated.

#### 2.5.2.6 Environmental Enhancement

**Water Demand:** The irrigation of restoration levees has low vulnerability to climate change induced water demand changes because it allows for the delivery of recycled water for irrigation, which mitigates potable water demands. Similar to the other project types, these types of projects have low vulnerability to climate change induced water demand changes and can mitigate increased potable water demand increases; however, these projects may reduce instream flows to rivers and streams as a result of decreased wastewater effluent discharge.

**Water Supply:** The use of recycled water for irrigation as part of environmental enhancement project would experience similar water supply vulnerabilities as treatment and distribution projects; however, since the scale is usually smaller these projects have a slightly lower vulnerability.

**Water Quality:** Similar vulnerability as treatment and distribution projects would be experienced by environmental enhancement projects; however, these projects have a slightly lower vulnerability since the scale is usually smaller.

**Sea Level Rise:** Vulnerability to climate change induced sea level rise depends on the proximity to the bay and rivers leading to the bay. Environmental enhancement projects located within the shaded 100-year flood zone with sea level rise, shown in Figure 2-4, have a high vulnerability to sea level rise from climate change. However, the nature of these types of project may mitigate against sea level rise by providing a natural buffer to attenuate flows. Facilities constructed to support these projects would need to be appropriately designed to account for increased water levels associated with the anticipated rise in sea levels.

**Flooding:** Vulnerability of environmental enhancement projects to flooding due to climate change depends on the location with these projects. Those located within high risk flood zones having significant or high vulnerability to climate change. Levee safety could be a particular concern during flood events and breaching of the levees could potentially lead to public safety issues. In addition, any infrastructure damaged during floods could be costly to repair.

**Ecological Health and Habitat:** The Lower Novato Creek projects include provision of recycled water irrigation to ecological enhancement areas, providing benefit to Ridgway's rail, California black rail and salt marsh harvest mouse. Proposed facilities would be installed using BMPs and avoidance measures to reduce the potential for temporary impacts. However, climate change has the potential to alter the current outlay of some of these areas which could limit the benefits of irrigating some of these ecologically enhanced areas.

This page intentionally left blank.

Section 3

# Water Reclamation and 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. Water reuse also presents communities with an opportunity to better leverage existing local water resources by treating wastewater to a higher level allowing alternative use rather than discharging.

Water reuse in California is an accepted and growing practice. The SWRCB's Recycled Water Policy, adopted in 2009, and amended in 2013, established statewide goals to increase water reuse above 2002 levels (590,000 AFY) by at least 1 million AFY by 2020 and by at least 2 million AFY by 2030.

Use of recycled water is an already accepted and growing practice in the NBWRP region. When fully implemented, Phases 1 and 2 could yield up to 30,000 AFY of recycled water (NBWRP, 2015).

This section describes the current recycled water supplies and uses as well as the potential for generating and delivering additional recycled water within the NBWRP region as part of Phase 2.

## 3.1 Current and Potential Future Supplies of Recycled Water

Six WWTPs were initially evaluated to determine the viability of each as sources of recycled water for the proposed NBWRA Phase 2 Program. The WWTPs identified currently produce tertiary disinfected recycled water and include the Napa SD WWTP in Napa County, the City of American Canyon WRF in Napa County, the SVCSD in Sonoma County, the City of Petaluma's WWTP in Sonoma County, and the Novato SD and CMSA WWTP's in Marin County.

In order to improve water quality in San Pablo Bay, the San Francisco Bay RWQCB has prohibited the discharge of treated wastewater to receiving water bodies of San Pablo Bay during the dry season.

These WWTP's 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 recycled water demands to holding ponds, wetlands, or rely upon the spreading and evapotranspiration of recycled water on local grassland.

Implementing the Phase 2 Program would allow increased beneficial use of recycled water, resulting in less water discharged to San Pablo Bay and reducing the dependence of new recycled water users on surface or groundwater, thereby, reducing demand on these water resources and potential negative impacts to water quality and declining groundwater levels.

The following sections describe the four wastewater agencies and their wastewater treatment facilities, including existing and future recycled water supplies available for the purposes of implementing this Phase 2 Program.

### 3.1.1 Novato Sanitation District

The Novato SD WWTP provides service to approximately 60,000 residents within the City of Novato and surrounding areas (Novato SD, 2010). The WWTP discharges an average annual flow of

4.53 mgd, and can treat up to 7.05 mgd during the dry season. The San Francisco Bay RWQCB does not permit effluent discharge to San Pablo Bay between June 1 and August 31. Discharge during May, September, and October is also subject to lower limits for biochemical oxygen demand and suspended solids.

As specified in Novato SD's NPDES permit, the Novato SD WWTP treats flows up to 7.0 mgd with influent screening and grit removal, primary clarification, activated sludge, secondary clarification, and ultraviolet disinfection. By design, during wet weather, the WWTP can provide secondary treatment for a sustained 3-hour peak flow of up to 47 mgd.

#### 3.1.1.1 Current Recycled Water System

During the dry season, the Novato SD sends secondary effluent to three Novato SD-owned irrigation sites (totaling approximately 820 acres), two treated water storage ponds, and 15 acres of wildlife habitat. These parcels are along 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 to San Pablo Bay. The current recycling water facility at the Novato SD WWTP is able to provide treatment to meet California Code of Regulations (CCR) Title 22 tertiary filtration and disinfection requirements. The facility is designed for an average flow of 1.4 mgd and a peak flow of 1.7 mgd (Karkal, 2015). Currently, the plant can supply approximately 1.7 mgd or 40 percent of its average annual flow of recycled water to NMWD for landscape irrigation at the local Stone Tree Golf Course and other small users (Karkal, 2015).

#### 3.1.1.2 Current Wastewater Treatment Plant Flows

In 2011, Novato SD completed improvements resulting in consolidated treatment operations from two WWTPs to one. Current and projected influent flows to Novato SD were developed using Self-Monitoring Program Reports (SMR) from Novato SD (Novato SD 2014), the Novato SD Facility Plan (Novato SD, 2004), and the Phase 2 Project Definition Scoping Study Report (Scoping Study) (NBWRA, 2014). The SMR documented the 2014 monthly inflows to Novato SD. The 2004 Facility Plan presented the projected average dry weather flow (ADWF), average wet weather flow (AWWF), and the average annual flow for 2025 (build-out). The projected build-out ADWF, AWWF, and seasonal peak flow patterns for 2025 were developed by using the monthly flow patterns from 2010 flow data that is documented in the Scoping Study.

The existing (i.e., prior to Phase 1) recycled water demands and Phase 1 recycled water demands were developed using information about areas currently receiving recycled water from Novato SD in addition to areas that are proposed to be served by Novato SD or NMWD during Phase 1, as presented in the Scoping Study. Recycled water supplies available for Phase 2 opportunities were developed by reducing the anticipated 2025 recycled water supply by the sum of the existing and expected Phase 1 recycled water demands.

Table 3-1 presents summarizes results of the flow projection calculations performed. Figure 3-1 shows the monthly distribution of 2014 WWTP inflows (blue line), projected 2025 WWTP inflows (green line), existing and Phase 1 total recycled water demands (red line), and the supply available for future Phase 2 opportunities (purple line).

| Table 3-1. Summary of Novato SD Inflows and Projected Phase 2 Recycled Water Supply | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Current WWTP Inflows (2010) | | Projected WWTP Inflows (2025) | | Existing and Phase 1 Demands | | 2025 Supply Available for Phase 2 | |
| Month | MG | AF | MG | AF | MG | AF | MG | AF |
| January | 224 | 688 | 280 | 858 | 0 | 1 | 280 | 857 |
| February | 204 | 627 | 270 | 830 | 0 | 1 | 270 | 829 |
| March | 214 | 657 | 267 | 821 | 2 | 5 | 265 | 816 |
| April | 202 | 621 | 256 | 785 | 14 | 42 | 242 | 743 |
| May | 156 | 480 | 233 | 714 | 20 | 61 | 213 | 653 |
| June | 130 | 399 | 215 | 661 | 157 | 481 | 58 | 180 |
| July | 132 | 406 | 212 | 651 | 162 | 498 | 50 | 153 |
| August | 127 | 391 | 211 | 646 | 162 | 496 | 49 | 150 |
| September | 128 | 393 | 211 | 648 | 27 | 84 | 184 | 564 |
| October | 136 | 417 | 214 | 658 | 21 | 65 | 193 | 593 |
| November | 144 | 441 | 221 | 677 | 3 | 8 | 218 | 669 |
| December | 236 | 725 | 281 | 862 | 1 | 3 | 280 | 859 |
| **Total [a]** | **2,033** | **6,245** | **2,871** | **8,811** | **568** | **1,744** | **2,303** | **7,067** |

a. *Values have been rounded to the nearest million gallons (MG) or AF.*

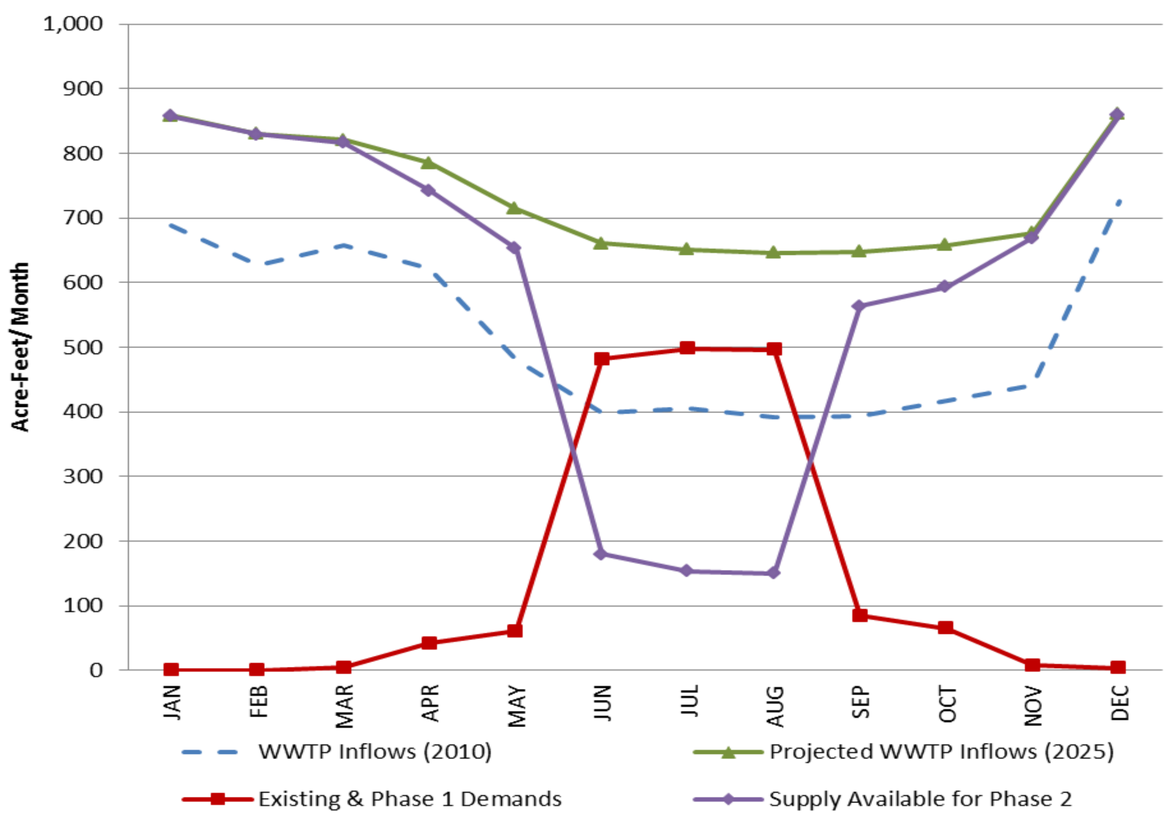



**Figure 3-1. Novato SD Projected WWTP Inflows, Recycled Water Demand, and Available Supply for Phase 2**

#### 3.1.1.3 Potential for Expansion

The Novato SD completed construction of an upgraded treatment plant in Phase 1 of the NBWRP that has a permitted average dry weather capacity of 7.0 mgd and is capable of providing full secondary treatment for wet weather flows up to 47 mgd and CCR Title 22 tertiary filtration and disinfection for flows up to 1.7 mgd. The CCR Title 22 tertiary treatment facilities were designed with the ability to be potentially expanded to produce up to 3.4 mgd of CCR Title 22 tertiary treated water; however, a timeframe for expansion has not yet been set. The main treatment plant upgrade was completed to address aging facilities, nominal growth within the Novato SD service area, new regulatory requirements, more stringent discharge enforcement, and facility upgrades identified in the Strategic Plan completed in 2000.

### 3.1.2 City of Petaluma

The City of Petaluma 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 WWTP has an ADWF design capacity of 6.7 mgd for secondary treatment which includes pretreatment, activated sludge, secondary clarification, oxidation ponds, disinfection and dechlorination. The WWTP is able to achieve tertiary treatment levels for 5.2 mgd which includes treatment of secondary clarification effluent using flocculation, filtration, and ultraviolet (UV) disinfection. The plant presently discharges an ADWF of 4.5 mgd and annual average flow of about 5.2 mgd. During the periods of October 21 through April 30, treated wastewater is discharged to the Petaluma River. Similar to the other WWTPs in the region, the San Francisco Bay 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, tertiary treated wastewater is reused for agricultural irrigation or stored in onsite ponds.

#### 3.1.2.1 Current Recycled Water System

The City of Petaluma operates an extensive recycled water program that currently provides for irrigation of urban parks, schools, greenbelts, and the Adobe Creek and Rooster Run Golf courses to offset potable water use as well as local agricultural and vineyard lands. Until the summer of 2013, the City of Petaluma paid agricultural users to take disinfected secondary effluent produced at the ECWRF during the irrigation season. The City of Petaluma implemented agricultural irrigation to comply with an order from the San Francisco Bay RWQCB that restricts the City's treated wastewater discharges to the Petaluma River between May 1 and October 30. Agricultural users began paying the City of Petaluma a commodity charge in the summer of 2013. The City of Petaluma has replaced deliveries of secondary effluent to agricultural users with tertiary treated effluent.

In 2014, the Petaluma WWTP supplied a total of 651 MG (2,000 AF) of tertiary treated recycled water for all uses (Walker, 2015). Of the total recycled water use in 2014, 206 MG was used for landscape irrigation, 298 MG was used for agriculture, and 147 MG was used for plant process water and trucked water. Depending upon wet weather season precipitation levels and duration, 533 to 822 MG (1,636 to 2,524 AF) is currently applied to approximately 1,180 acres of local pasture land to meet the no-discharge requirement during the summer months.

#### 3.1.2.2 Current Wastewater Treatment Plant Flows

The 2014 influent flows for the City of Petaluma were obtained from the Pretreatment Annual Report (City of Petaluma, 2015). The City of Petaluma provided influent flows for 2010 (Iribarne, 2013) were adjusted to reflect the projected increase in Petaluma's ADWF from 2010 to 2025 as described in the City of Petaluma Water Demand & Supply Analysis Report (City of Petaluma 2006). The expected increase is approximately 0.59 mgd (1.8 AF/day), which was added to the 2010 monthly flows to develop the anticipated 2025 monthly flows.

Supplies available for Phase 2 opportunities were developed by reducing the anticipated 2025 flows by the expected pre-Phase 2 recycled water demands, evaporation at the WWTPs ponds, and on-site usage at the plant.

Table 3-2 presents a summary of the calculations performed. Figure 3-2 shows the monthly distribution of 2014 WWTP inflows (blue line), projected 2025 WWTP inflows (green line), the pre-Phase 2 tertiary recycled water demands (red line), and availability of supply for future Phase 2 opportunities (purple line). As shown in the figure, there is a projected negative available supply in summer months indicating a recycled water demand greater than available supply. Seasonal storage can be used to meet the summer demands through use of stored winter flows.

**Table 3-2. Summary of City of Petaluma Inflows and Projected Phase 2 Recycled Water Supply**

| | WWTP Inflows (2014) | | Projected WWTP Inflows (2025) | | Existing and Phase 1 Demands | | 2025 Supply Available for Phase 2 | |
|---|---|---|---|---|---|---|---|---|
| Month | MG | AF | MG | AF | MG | AF | MG | AF |
| January | 146 | 447 | 256 | 786 | 25 | 77 | 231 | 709 |
| February | 190 | 582 | 201 | 618 | 11 | 34 | 190 | 584 |
| March | 178 | 546 | 209 | 642 | 20 | 63 | 189 | 579 |
| April | 218 | 668 | 208 | 639 | 44 | 136 | 164 | 503 |
| May | 148 | 455 | 180 | 552 | 36 | 110 | 144 | 442 |
| June | 138 | 424 | 163 | 502 | 101 | 309 | 62 | 193 |
| July | 136 | 419 | 149 | 457 | 169 | 518 | -20 | -61 |
| August | 133 | 407 | 152 | 467 | 157 | 481 | -5 | -14 |
| September | 128 | 391 | 149 | 457 | 143 | 438 | 6 | 19 |
| October | 131 | 401 | 164 | 503 | 84 | 257 | 80 | 246 |
| November | 131 | 402 | 166 | 509 | 57 | 176 | 109 | 333 |
| December | 319 | 980 | 266 | 817 | 19 | 60 | 247 | 757 |
| **Total [a]** | **1,995** | **6,122** | **2,263** | **6,949** | **866** | **2,658** | **1,397** | **4,291** |

a. *Values have been rounded.*

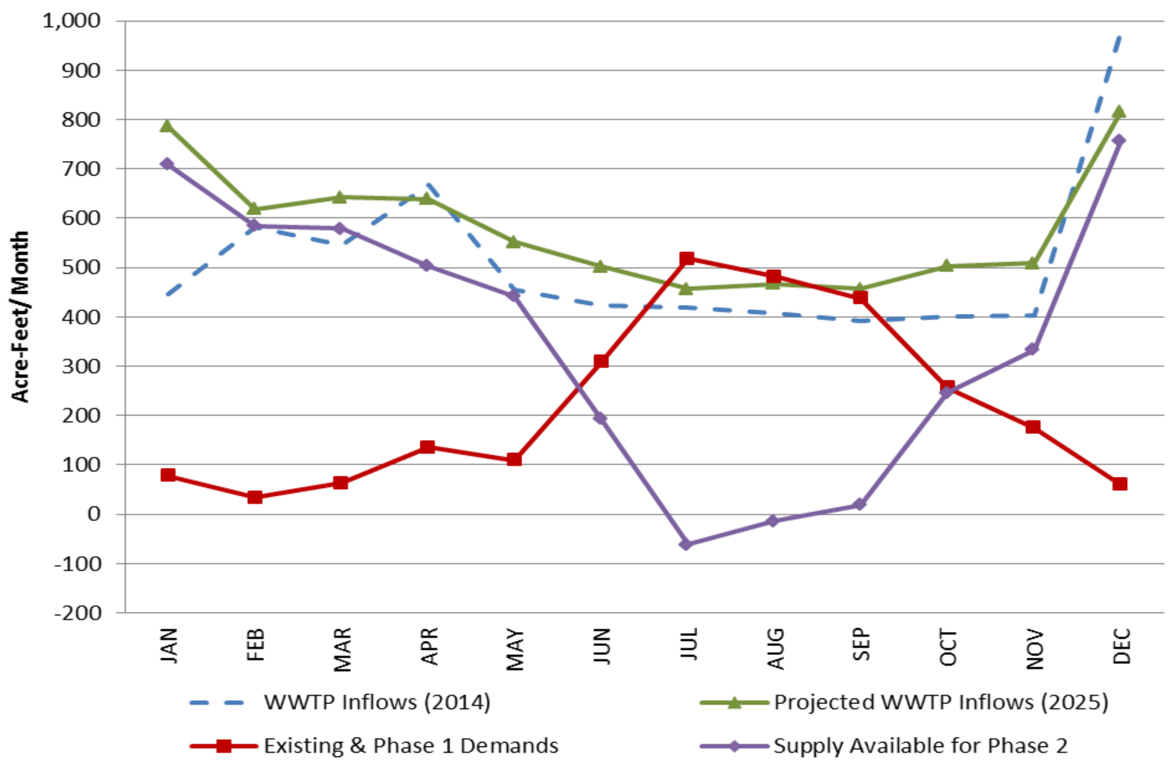



**Figure 3-2. City of Petaluma Projected WWTP Inflows, Recycled Water Demand, and Available Supply for Phase 2**

#### 3.1.2.3 Potential for Expansion

Expansion of tertiary filtration and disinfection treatment is included in the capital improvement plan (CIP) for the City of Petaluma. The planned expansion would increase tertiary capacity to 7.8 mgd. Expanded tertiary filtered and disinfected reclaimed water use within the City of Petaluma's water service area provides financial benefit to the City from the sale of recycled water and from reduced costs of purchasing imported water from SCWA. Expanded water reuse will also meet the goals of providing potable water use offsets and agricultural well pumping offsets and reduces the demand on the regional water supply during the critical summer season.

### 3.1.3 Sonoma Valley County Sanitation District

The SVCSD WWTP began operations in 1953 and provides service to approximately 17,000 equivalent single-family dwellings within a 7-square-mile area (SVCSD, 2015). The service area includes the City of Sonoma and unincorporated areas of Glen Ellen, Boyes Hot Springs, El Verano, and Agua Caliente, which has approximately 36,000 residents. As part of a county government restructure in 1995, the SCWA assumed responsibility for managing the county sanitation zones and districts, including SVCSD.

The existing WWTP has the capacity to treat 16 mgd to a tertiary treatment level (SVCSD, 2014) through pretreatment, aeration, secondary clarification, tertiary filtration, and chlorine disinfection processes. Between May 1 and October 31, the San Francisco Bay RWQCB does permit the WWTP to discharge to local water bodies if certain criteria is met while encouraging the use of recycled water; therefore, SVCSD supplies recycled water for irrigation of vineyards, dairy fodder crops, as well as wetlands. Between November 1 and April 30, SVCSD discharges recycled water into Schell Slough and Hudeman Slough, which ultimately flow into San Pablo Bay.

#### 3.1.3.1 Current 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 delivered approximately 3,350 AF of recycled water to local users in 2014. The remaining recycled water is used for wetlands enhancement on property owned by SVCSD, in addition to supply recycled water to the Napa-Sonoma Salt Marsh, owned by the California Department of Fish and Game.

#### 3.1.3.2 Current Wastewater Treatment Plant Flows

Influent flows to SVCSD were obtained from the *2014 Annual Report for the Sonoma Valley County Sanitation District Treatment Plant* (SVCSD, 2015a). SVCSD is required to submit an annual report to the San Francisco Bay RWQCB covering the previous calendar year. Potential 2030 inflows to SVCSD were based on SVCSD's documented 2010 flows, as described in the Scoping Study. The 2010 base flow was projected to 2030 by equating increased wastewater inflows to increases in the projected water use in the City of Sonoma and in the VOMWD. It was assumed that the percentage increase in wastewater would be approximately equivalent to the percentage increase in water use. Based on SCWA's Urban Water Management Plan (SCWA, 2011), it was estimated that the total water supplied in 2010 to the City of Sonoma and the VOMWD was 4,105 AFY. The 2010 Urban Water Management Plan projected that in 2030 5,768 AFY would be supplied, a 40 percent increase over the 2010 value. This percentage increase was applied to the regional base wastewater flow, resulting in a 26 MG/month (or 80 AF/month) increase for each of the 2010 monthly flows.

Existing and Phase 1 recycled water demands were developed using information about areas currently receiving recycled water from SVCSD in addition to areas that are proposed to be served by SVCSD during Phase 1, as presented in the Scoping Study. Recycled water available for Phase 2 opportunities was developed by reducing the anticipated 2030 recycled water supply by the sum of the existing and expected Phase 1 recycled water demands.

Table 3-3 presents a summary of the flow projection calculations performed. Figure 3-3 shows the monthly distribution of the 2014 WWTP inflows (blue line), projected 2025 WWTP inflows (green line), existing and Phase 1 recycled water demands (red line), and availability of recycled water supply for future Phase 2 opportunities (purple line). Negative flows shown in Figure 3-3 for the available supply in the summer months indicate the demand for recycled water is greater than the available supply for that particular month; however, demands can be met because a seasonal storage reservoir was developed in Phase 1 to store winter flows to meet summer demands.

**Table 3-3. Summary of SVCSD Inflows and Projected Phase 2 Recycled Water Supply**

| | WWTP Inflows (2014) | | Projected WWTP Inflows (2025) | | Existing and Phase 1 Demands | | 2025 Supply Available for Phase 2 | |
|---|---|---|---|---|---|---|---|---|
| Month | MG | AF | MG | AF | MG | AF | MG | AF |
| January | 79 | 244 | 197 | 606 | 106 | 326 | 91 | 280 |
| February | 164 | 504 | 175 | 536 | 106 | 325 | 69 | 211 |
| March | 141 | 433 | 178 | 547 | 107 | 328 | 72 | 220 |
| April | 119 | 366 | 174 | 535 | 116 | 355 | 59 | 180 |
| May | 88 | 269 | 117 | 359 | 81 | 249 | 36 | 110 |
| June | 81 | 250 | 98 | 300 | 122 | 373 | -24 | -73 |
| July | 82 | 250 | 92 | 284 | 120 | 369 | -28 | -85 |
| August | 80 | 244 | 94 | 289 | 81 | 247 | 13 | 41 |
| September | 78 | 238 | 92 | 281 | 29 | 88 | 63 | 193 |
| October | 80 | 246 | 107 | 329 | 9 | 27 | 98 | 302 |
| November | 82 | 252 | 116 | 355 | 106 | 326 | 9 | 29 |
| December | 249 | 765 | 225 | 690 | 106 | 325 | 119 | 365 |
| **Total [a]** | **1,324** | **4,063** | **1,665** | **5,110** | **1,088** | **3,339** | **577** | **1,772** |

a. *Values have been rounded to the nearest MG or AF.*

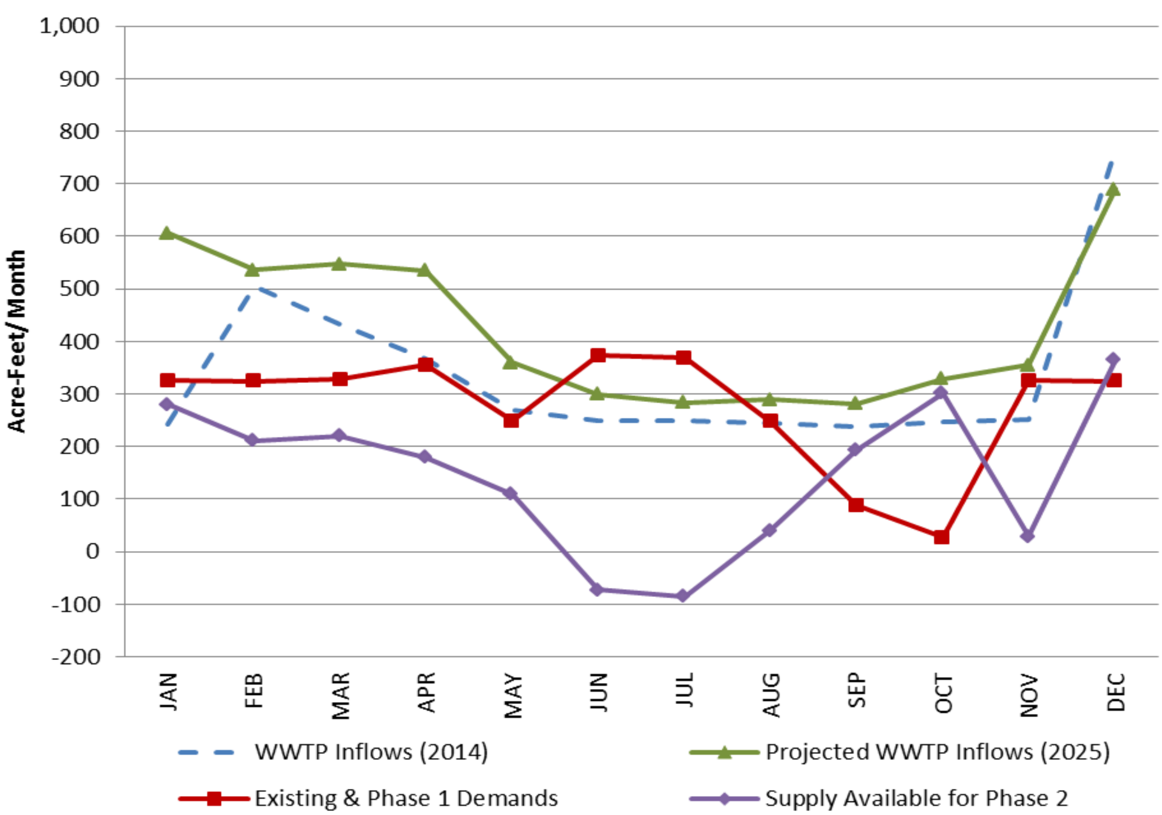



**Figure 3-3. SVCSD Projected WWTP Inflows, Recycled Water Demand, and Available Supply for Phase 2**

#### 3.1.3.3 Potential for Expansion

There are currently no plans for expansions or upgrades at the WWTP.

### 3.1.4 Napa Sanitation District

The Napa SD treats wastewater from the City of Napa and surrounding unincorporated communities, and includes approximately 36,000 service connections (Napa SD, 2015). Napa SD's WWTP has an average annual discharge of 10.5 mgd and a dry weather permitted capacity of 15.4 mgd with the ability to handle 60 mgd. Treatment consists of pretreatment, primary clarification, and secondary treatment through activated sludge and secondary clarification and/or oxidation pond system and chlorine disinfection. Napa SD also utilizes four oxidation ponds, totaling 342 acres, for secondary treatment. All water used for recycled water also goes through sand filtration tertiary treatment prior to disinfection.

Napa SD distributes recycled water for irrigation between May 1 and October 31. The San Francisco Bay RWQCB permits Napa SD to discharge to the Napa River between November 1 and April 30. The treatment plant has completed a series of improvements under the Phase 1 Recycled Water Expansion Project which increased tertiary capacity to 12.2 mgd. These improvements meet peak day production capacity and produce recycled water at a quality that meets the requirements of CCR Title 22 disinfected tertiary levels for unrestricted use (Damron, 2015).

#### 3.1.4.1 Current Recycled Water System

Napa SD currently provides recycled water for irrigating golf courses, vineyards, landscaping, pastureland, parks, playing fields and a cemetery. Napa SD sources water from the activated sludge process and the oxidation ponds for tertiary filtration and chlorine disinfection for recycled water distribution. Additionally, the Napa SD Water Recycling Facility has two 10-AF recycled water reservoirs on site.

Existing Napa SD recycled water users include Chardonnay Golf Course and Vineyards, Eagle Vines Golf Course, Napa Golf Course, Kennedy Municipal Park, Napa Valley College, Somky Ranch, Jameson Canyon Reclamation Site, Napa Airport Industrial Area, Napa Commons, and various smaller agricultural and landscape users (Napa SD, 2005). In 2014, Napa SD distributed recycled water customers received 579 MG per year (1,777 AFY) of recycled water (Napa SD, 2015a). Expansion of the recycled water system, both treatment and distribution, began in 2014 and is further discussed in Section 3.2.4.3 below.

#### 3.1.4.2 Current Wastewater Treatment Plant Flows

Influent 2014 flows for Napa SD were obtained from the Pretreatment Annual Report (Napa SD 2015b). Projected 2030 recycled water supplies for Napa SD were developed using the Napa SD Wastewater Treatment Master Plan (Napa SD, 2011) in combination with historic 2012 flow data provided by Napa SD. The 2030 ADWF was estimated to be 8.55 mgd. The 2012 ADWF was calculated to be 6.59 mgd by averaging the monthly flows of August, September, and October 2012. Projected 2030 monthly influent flows were developed by increasing the 2012 monthly base flow by 1.96 mgd (6 AFY), the difference between the actual 2012 and estimated 2030 ADWF.

Napa SD's recycled water supply available for Phase 2 opportunities was developed by reducing the anticipated 2030 flows by the sum of the existing and anticipated Phase 1 recycled water demands and the demands for two new projects that will be served by Napa SD before the start of Phase 2. Phase 1 demands served by Napa SD were developed using information about areas proposed to receive recycled water by Napa SD presented in the Scoping Study.

Table 3-4 presents a summary of the calculations performed. Figure 3-4 shows the monthly distribution of the 2014 WWTP inflow (blue line), projected 2030 WWTP inflow (green line), existing and Phase 1 recycled water demands (red line), and availability of recycled water supply for future Phase 2 opportunities (purple line).

**Table 3-4. Summary of Napa SD Inflows and Projected Phase 2 Recycled Water Supply**

| | WWTP Inflows (2014) | | Projected WWTP Inflows (2030) | | Existing and Phase 1 Demands | | 2030 Supply Available for Phase 2 | |
|---|---|---|---|---|---|---|---|---|
| Month | MG | AF | MG | AF | MG | AF | MG | AF |
| January | 183 | 563 | 255 | 783 | 3 | 8 | 253 | 775 |
| February | 353 | 1085 | 418 | 1284 | 1 | 2 | 418 | 1282 |
| March | 308 | 945 | 380 | 1165 | 5 | 16 | 374 | 1148 |
| April | 312 | 956 | 381 | 1169 | 32 | 97 | 349 | 1072 |
| May | 222 | 682 | 294 | 903 | 54 | 166 | 240 | 736 |
| June | 204 | 627 | 274 | 840 | 241 | 739 | 33 | 101 |
| July | 200 | 614 | 272 | 835 | 245 | 751 | 27 | 84 |
| August | 196 | 602 | 268 | 822 | 192 | 588 | 76 | 234 |
| September | 187 | 574 | 257 | 788 | 112 | 344 | 145 | 444 |
| October | 190 | 584 | 262 | 804 | 54 | 165 | 208 | 639 |
| November | 201 | 616 | 270 | 829 | 7 | 21 | 263 | 807 |
| December | 543 | 1666 | 615 | 1886 | 4 | 12 | 611 | 1874 |
| Total [a] | 3,100 | 9,513 | 3,945 | 12,107 | 948 | 2,911 | 2,997 | 9,197 |

a. *Values have been rounded.*

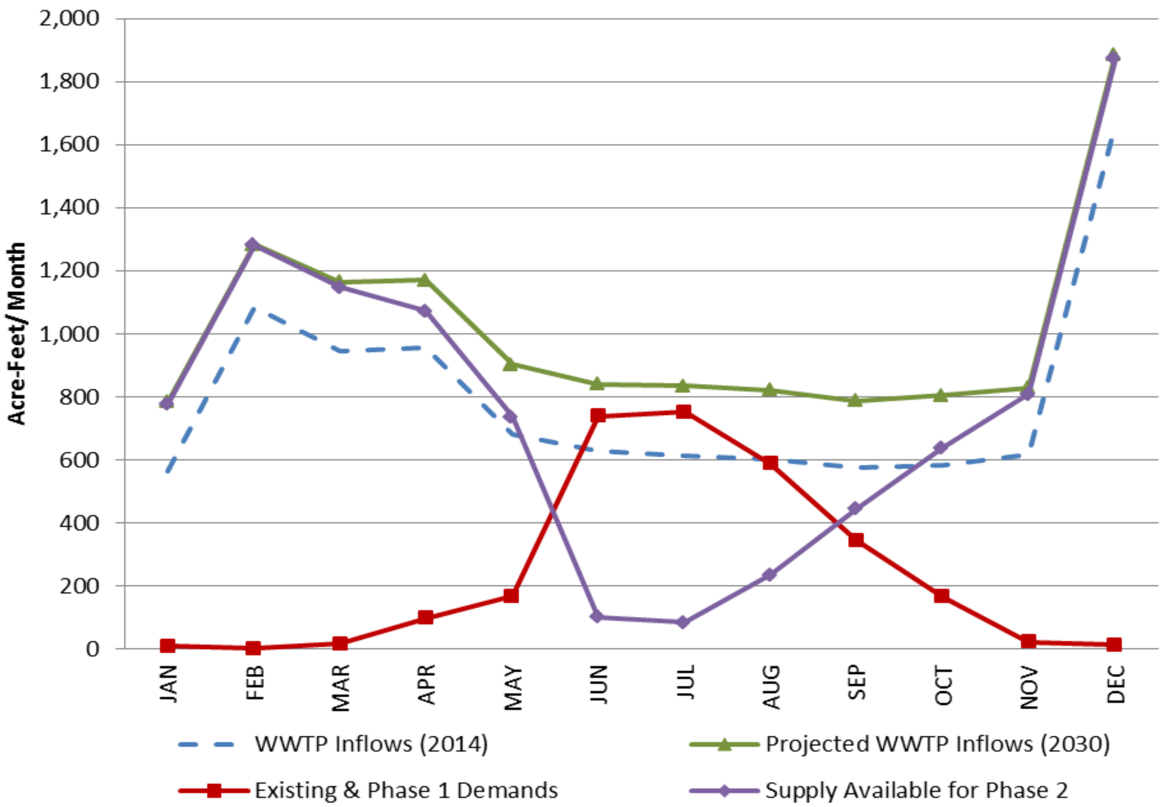



**Figure 3-4. Napa SD Projected WWTP Inflows, Recycled Water Demand, and Available Supply for Phase 2**

### 3.1.4.3 Potential for Expansion

As previously noted, Napa SD recently completed treatment improvements that increased tertiary disinfection and filtration capacity to 12.2 mgd. In 2014, Napa SD began construction on two projects to extend the recycled water distribution system to serve the MST Project in the north and the Stanly Ranch & Los Carneros Water District (LCWD) to the west as part of NBWRP Phase 1. Both projects were completed in 2016. The treatment plant upgrades and recycled water distribution system now has a capacity of 3,700 AF.

With the addition of the MST and LCWD service areas, and as a result of Napa SD experiencing an increased demand for recycled water beyond the available supply, Napa SD developed an allocation policy which provided limits of recycled water the current and potential users within the service area. This resulted in the MST area being allocated 700 AFY and LCWD allocation of 450 AFY. However, total demand for MST is 2,000 AFY and LCWD is 1,200 AFY. Depending on the users that ultimately connect to each system, and other improvements or changes at the treatment plant to produce additional recycled water, these allocations may be revised in the future.

In an effort to address the recycled water shortfall, Napa SD initiated discussions with the San Francisco Bay RWQCB regarding potential changes to the operation of the ponds at the WWTP that would allow for increased recycled water delivery. These changes would be captured in the NPDES permit renewal to be completed in late 2016 and could allow for an additional 228 MG (700 AF) of recycled water.

### 3.1.5 Central Marin Sanitation Agency

CMSA is a Joint Powers Agency that was formed in 1979 to consolidate the wastewater collection, treatment, water reclamation, and disposal needs of about 110,000 residents in Central Marin County as well as San Quentin State Prison (Carollo, 2016). CMSA's WWTP is located in San Rafael, and began operation in 1985. CMSA was originally comprised of four MAs: San Rafael Sanitation District, Sanitary District No. 1, Sanitary District No. 2, and the City of Larkspur (the City of Larkspur was annexed into Ross Valley Sanitary District in 1993). Each MA owns, operates, and maintains their respective sanitary sewer collection system.

The WWTP has an ADWF capacity of 10 mgd and was recently expanded to treat up to 125 mgd at peak wet weather flow conditions (Carollo, 2016). The WWTP treatment process consists of screening, grit removal, primary sedimentation, biological treatment via trickling filters, aeration, secondary clarification, disinfection via chlorination, dechlorination, and effluent storage (Carollo, 2016). The treated and disinfected effluent is discharged to Central San Francisco Bay through a submerged outfall approximately 8,000 feet offshore at a depth of approximately 12 to 28 feet at mean lower low water.

#### 3.1.5.1 Current Recycled Water System

The CMSA WWTP currently produces Disinfected Tertiary-23 recycled water that it provides to the City of Larkspur on an as-needed basis to maintain water level in Remillard Park Pond. The pond provides habitat for an endangered species of turtle. Typically, Remillard Park pond requests water for 2 to 4 weeks during the summer months. Water deliveries range from 216,000 to 400,000 gallons per day (gpd).

Additionally, the State recently approved CMSA for a recycled water truck filling station for licensed commercial haulers using recycled water in MMWD's service area. The filling station is planned to be operational by the end of 2015 (Carollo, 2016).

#### 3.1.5.2 Current Wastewater Treatment Plant Flows

Influent 2014 flows for CMSA were obtained from CMSA staff. CMSA staff also provided an estimate of the projected total amount of wastewater that would be collected and treated in 2025. Using the 2014 monthly influent flows distribution and the total estimated volume of wastewater in 2025, projected 2025 monthly influent flows were developed.

CMSA's recycled water supply available for Phase 2 opportunities was developed by reducing the anticipated 2025 flows by the sum of the existing recycled water demands, CMSA was not part of the Phase 1 Program. The existing recycled water demands were developed using existing recycled water customer information provided by CMSA staff.

Table 3-5 presents a summary of the calculations performed. Figure 3-5 shows the monthly distribution of the 2014 WWTP inflow (blue line), projected 2025 WWTP inflow (green line), existing and Phase 1 recycled water demands (red line), and availability of recycled water supply for future Phase 2 opportunities (purple line).

| Table 3-5. Summary of CMSA Inflows and Projected Phase 2 Recycled Water Supply | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Month | WWTP Inflows (2014) | | Projected WWTP Inflows (2025) | | Existing & Phase 1 Demands | | 2025 Supply Available for Phase 2 | |
| | MG | AF | MG | AF | MG | AF | MG | AF |
| January | 285 | 874 | 324 | 995 | 32 | 97 | 293 | 898 |
| February | 502 | 1,539 | 571 | 1,752 | 30 | 91 | 541 | 1,661 |
| March | 432 | 1,325 | 491 | 1,508 | 31 | 95 | 460 | 1,413 |
| April | 379 | 1,165 | 432 | 1,326 | 32 | 97 | 400 | 1,228 |
| May | 282 | 865 | 321 | 985 | 37 | 114 | 284 | 871 |
| June | 239 | 735 | 273 | 836 | 34 | 103 | 239 | 734 |
| July | 256 | 784 | 291 | 893 | 38 | 117 | 253 | 776 |
| August | 271 | 830 | 308 | 945 | 43 | 132 | 265 | 813 |
| September | 247 | 759 | 281 | 864 | 33 | 102 | 248 | 762 |
| October | 258 | 791 | 294 | 901 | 35 | 107 | 259 | 793 |
| November | 293 | 899 | 333 | 1,023 | 31 | 96 | 302 | 927 |
| December | 820 | 2,516 | 933 | 2,864 | 34 | 105 | 899 | 2,759 |
| Total [a] | 4,263 | 13,082 | 4,852 | 14,891 | 409 | 1,256 | 4,443 | 13,635 |

a. *Values have been rounded.*

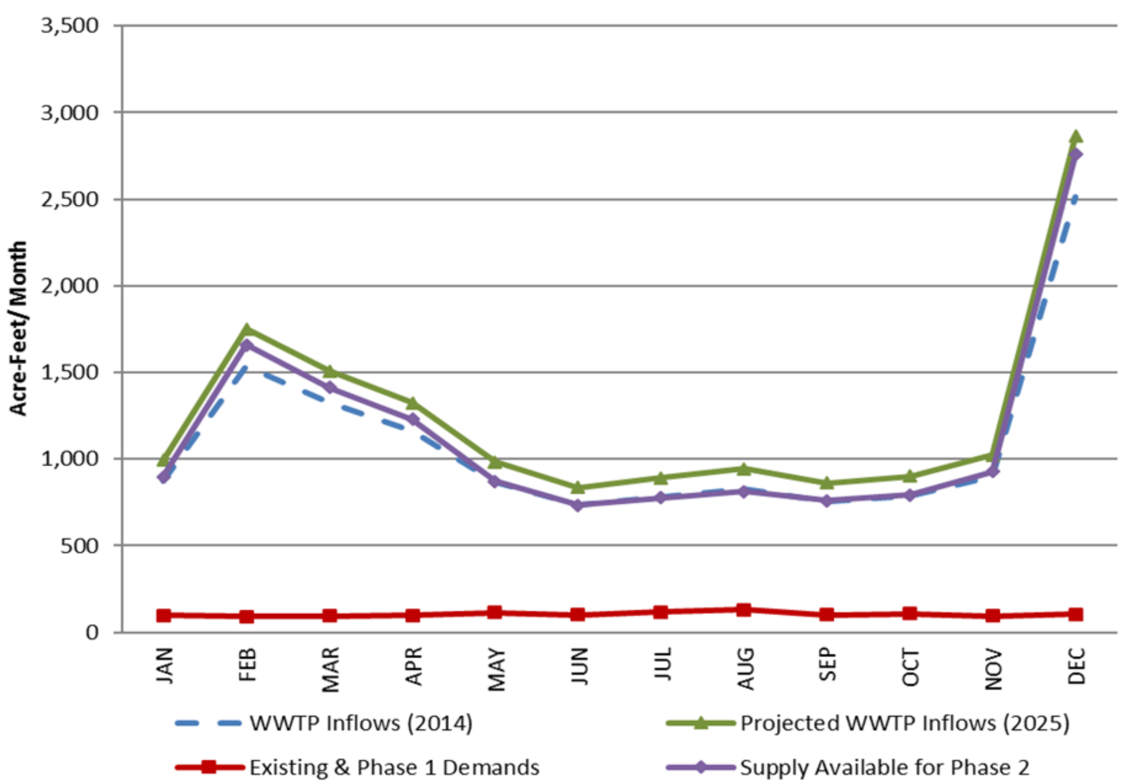



**Figure 3-5. CMSA Projected WWTP Inflows, Recycled Water Demand, and Available Supply for Phase 2**

#### 3.1.5.3 Potential for Expansion

CMSA recently completed their Recycled Water Feasibility Study (Carollo, 2016). The study's primary objective was to identify and analyze potential opportunities to increase recycled water use within the CMSA service area. The study focused on urban uses as the communities CMSA serves are mainly residential and commercial areas with only limited agricultural, process, and industrial uses (Carollo, 2016). Increasing recycled water use in the area would offset some of the potable water demand and provide a beneficial use of the CMSA wastewater effluent.

### 3.1.6 City of American Canyon

The City of American Canyon owns and operates the American Canyon WRF commissioned in 2001. It treats domestic and industrial wastewater flows from customers within the city limits and its sphere of influence. The service area extends east of Highway 29 between Watson Lane to the south and Fagan Creek to the north in unincorporated Napa County. The current area served is approximately 6.3 square miles with an overall potential service area of over 8.5 square miles (GHD, 2016).

The existing WRF has a total wastewater treatment capacity of 2.5 mgd at ADWF conditions and 5.0 mgd at peak wet weather flow conditions. The WWTP facilities include an emergency overflow basin, headworks, four parallel secondary/tertiary treatment trains that use membrane bioreactor technology and a UV disinfection system. The plant also has a chlorine contact basin and pumping system for recycled water production (City of American Canyon, 2016). One of the membrane bioreactor basins is used to treat wastewater from industrial users, which is discharged. The other three membrane bioreactor basins are used to treat the rest of the wastewater, which can be discharged or routed through the chlorine contact basin for delivery as recycled water (City of American Canyon, 2016).

#### 3.1.6.1 Current Recycled Water System

Recycled water forms an integral piece of the City of American Canyon overall water supply portfolio. In the last 15 years, the City has made significant strides in constructing the primary components of a distribution system including a pump station at the WRF, a 1-million-gallon elevated storage tank, and 13 miles of distribution pipelines (GHD, 2016). The City of American Canyon currently has 8 private recycled water customers and 12 public recycled water customers. Demand for the City is currently about 248 AFY (GHD, 2016).

#### 3.1.6.2 Current Water Recycling Facility Flows

Influent 2015 flows for the City of American Canyon were obtained from the SMR reports (City of American Canyon, 2015) for the City's WRF. The City of American Canyon's 2010 UWMP estimated that in 2025 the WRF would collect and treat 2,386 AF of wastewater. The UWMP assumed wastewater volume would increase at 2 percent per year which was consistent with projected population growth at that time. Using the 2015 monthly influent flows distribution and the total estimated volume of wastewater in 2025, projected 2025 monthly influent flows were developed.

The City of American Canyon's recycled water supply available for Phase 2 opportunities was developed by reducing the anticipated 2025 flows by the sum of the existing recycled water demands, the City was not part of the Phase 1 Program. The existing demands served by the City were developed using existing recycled water customer information presented in the City of American Canyon Recycled Water Master Plan (GHD, 2016).

Table 3-6 presents a summary of the calculations performed. Figure 3-6 shows the monthly distribution of the 2015 WRF inflow (blue line), projected 2025 WRF inflow (green line), existing and

Phase 1 recycled water demands (red line), and availability of recycled water supply for future Phase 2 opportunities (purple line).

**Table 3-6. Summary of City of American Canyon Inflows and Projected Phase 2 Recycled Water Supply**

| Month | WRF Inflows (2015) | | Projected WRF Inflows (2025) | | Existing & Phase 1 Demands | | 2025 Supply Available for Phase 2 | |
|---|---|---|---|---|---|---|---|---|
| | MG | AF | MG | AF | MG | AF | MG | AF |
| January | 50 | 155 | 77 | 237 | 1 | 2 | 77 | 235 |
| February | 51 | 157 | 78 | 240 | 1 | 2 | 78 | 238 |
| March | 48 | 147 | 74 | 226 | 1 | 3 | 73 | 223 |
| April | 45 | 138 | 69 | 211 | 4 | 13 | 65 | 198 |
| May | 42 | 130 | 65 | 199 | 5 | 17 | 59 | 182 |
| June | 39 | 121 | 60 | 185 | 18 | 54 | 43 | 131 |
| July | 39 | 121 | 60 | 185 | 18 | 56 | 42 | 129 |
| August | 39 | 119 | 60 | 183 | 15 | 48 | 44 | 135 |
| September | 36 | 111 | 56 | 170 | 10 | 31 | 45 | 139 |
| October | 36 | 111 | 55 | 170 | 5 | 16 | 50 | 153 |
| November | 37 | 114 | 57 | 174 | 1 | 4 | 55 | 170 |
| December | 44 | 136 | 68 | 207 | 1 | 2 | 67 | 205 |
| **Total [a]** | **508** | **1,560** | **777** | **2,386** | **81** | **248** | **697** | **2,138** |

a. *Values have been rounded.*

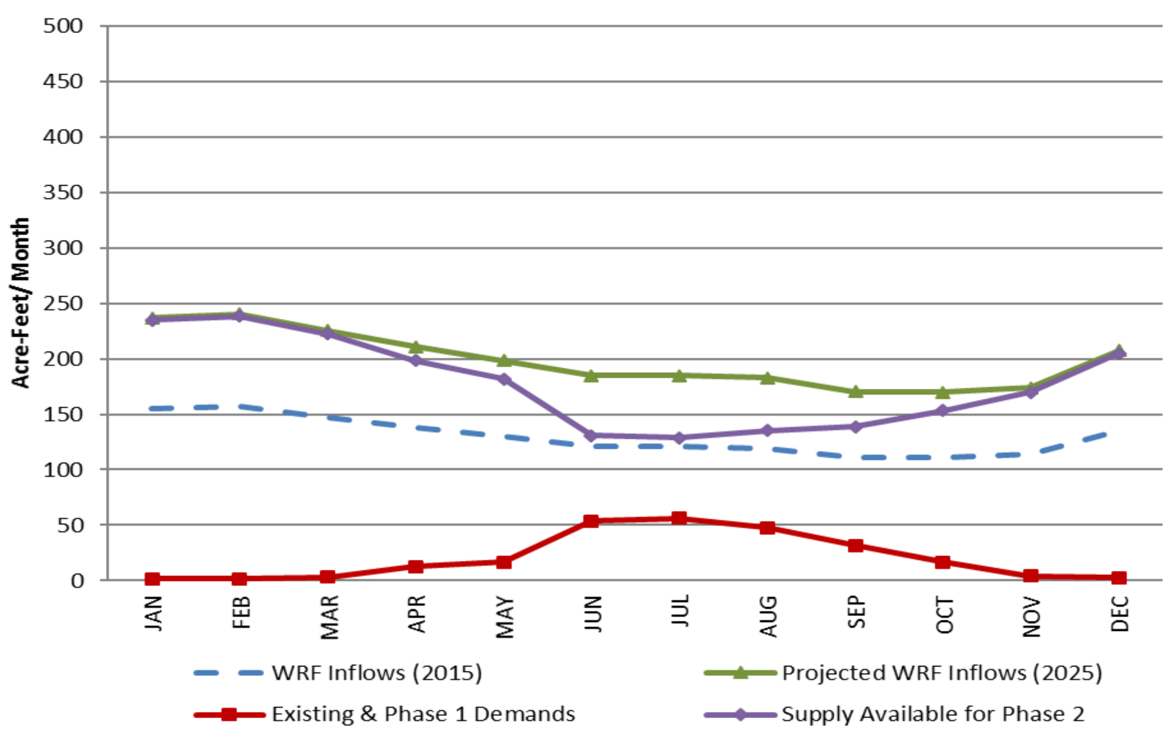



**Figure 3-6. City of American Canyon Projected WRF Inflows, Recycled Water Demand, and Available Supply for Phase 2**

#### 3.1.6.3 Potential for Expansion

The City of American Canyon updated its Recycled Water Master Plan in 2016 (GHD, 2016); it included an analysis of existing and projected recycled water demand. The Recycled Water Master Plan indicated that at build-out, there would be over 1,200 AFY of recycled water demand for landscaping and vineyard irrigation within the City's recycled water service area. Serving additional recycled water customers would require the City of American Canyon to expand its existing distribution system which would incur construction costs. The City is currently reviewing its CIP and exploring potential funding sources to aid in the expansion of the recycled water distribution system (City of American Canyon, 2016).

### 3.1.7 Summary of Existing Wastewater Treatment Plant Conditions, Current and Potential Future Recycled Water Supplies

The capacity and level of both existing and future anticipated treatment (combination of secondary and tertiary) at each of the WWTPs presented in Sections 3.1.1 through 3.1.6 is summarized in Table 3-7.

**Table 3-7. Summary of WWTP Discharge Volumes (mgd)**

| | Novato WWTP[a] | Petaluma WWTP[b] | SVCSD WWTP[c] | Napa SD WWTP[d] | CMSA WWTP[e] | City of American Canyon WRF[f] |
|---|---|---|---|---|---|---|
| Current NPDES Dry Season Discharge Limit | 7.05 | 6.7 | 3.0[g] | 15.4 | 10 | 2.5 |
| ADWF (2014) | 3.37 | 4.5 | 2.6 | 6.5 | 4.7 | 1.15[n] |
| AWWF (2014) | 6.9[h] | 6.6 | 4.0 | 10.5 | 21.7[l] | 1.42[l] |
| ADWF (2025)[i] | 7.0 | 6.2 | 3.0 | 7.95[j] | 6.3[m] | 1.85[o] |
| AWWF (2025)[i] | 10.3 | 7.0 | 5.0 | 10.0[k] | 17.5[l, m] | 2.8[l] |

a. *Source: Karkal 2015.*
b. *Source: Walker 2015.*
c. *Source: Booker 2015a.*
d. *Source: Damron 2015.*
e. *Source: Carollo 2016.*
f. *Source: City of American Canyon 2016.*
g. *Source: Booker 2015.*
h. *Value presented is AWWF in 2002, Source: SCWA/USBR 2008.*
i. *2025 flows are projected.*
j. *Source: Napa SD 2011.*
k. *Value presented is projected AWWF in 2020, Source: SCWA/USBR 2008.*
l. *Value shown is the average day max month, which is the average daily flow occurring during the maximum flow month of the year.*
m. *Values shown are projected 2035 values.*
n. *Source: GHD 2016a.*
o. *2025 flows were taken from City of American Canyon 2010 UWMP, the minimum 90-day average flow occurring between the months of May and October was used for ADWF.*

As shown in Table 3-7, the existing dry weather discharge limit at the SVCSD WWTP is sufficient to accommodate the anticipated ADWFs in 2025. Currently, no plans for expansions or upgrades at the WWTP are in development. Novato SD, Petaluma, Napa SD, CMSA, and the City of American Canyon appear to have ADWF adequate capacity until at least 2025.

The WWTPs in the study area supply recycled water to local customers as previously discussed in Sections 3.1.1 through 3.1.6 for agricultural, urban landscape, and environmental restoration. The Phase 2 Program assumes that the WWTPs will continue to honor these commitments as they each continue to develop local projects for additional recycled water use. The existing and Phase 1 pipelines comprising the distribution systems are shown in Figure 3-7.

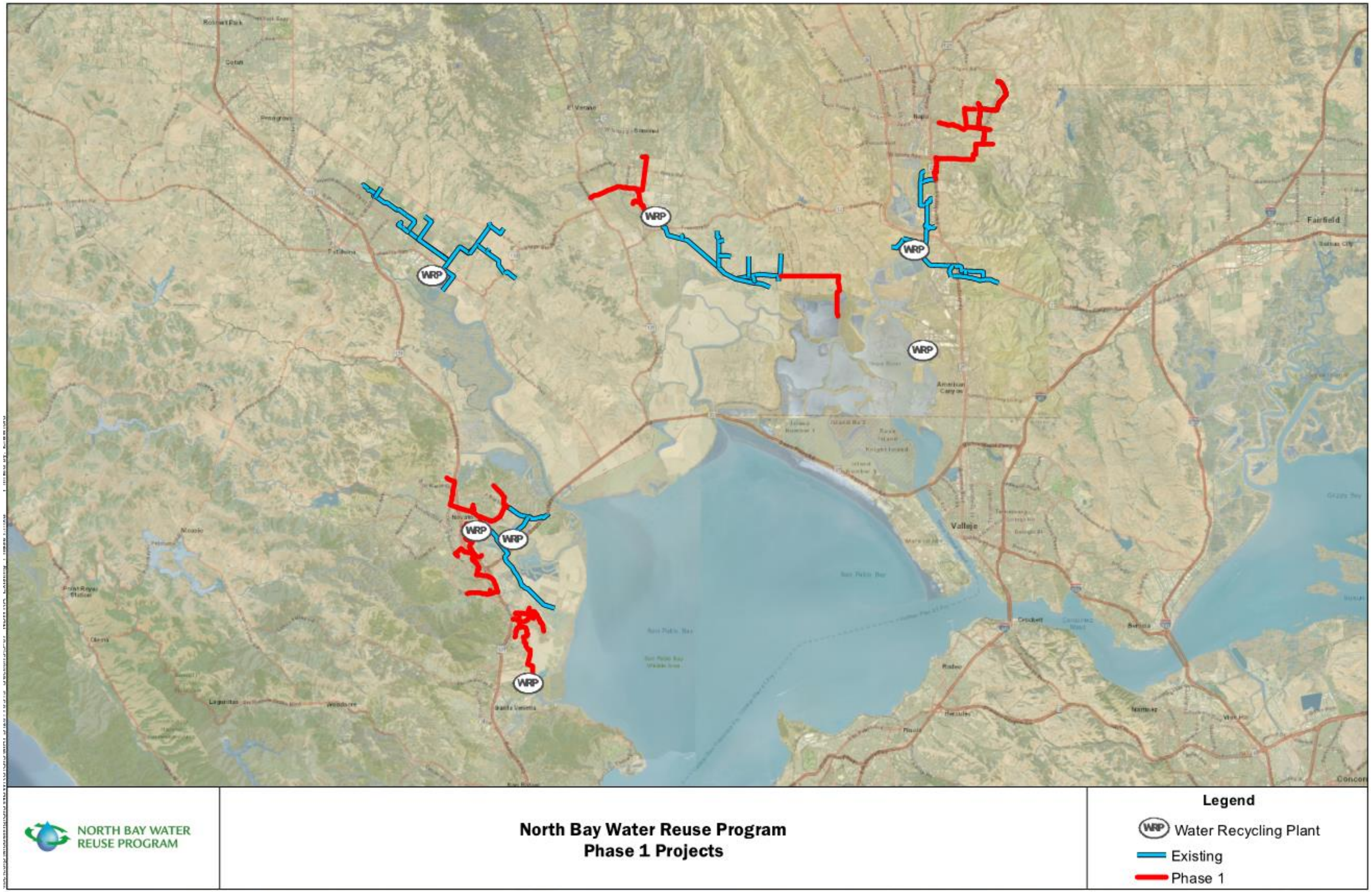



Figure 3-7. Existing and Phase 1 Recycled Water Distribution Systems

The amount of water utilized by each WWTP in 2014 for beneficial reuse (recycled water served to customers) and the projected increase in WWTP flows and beneficial reuse, assuming the full implementation of potential local projects, is summarized in Table 3-8.

**Table 3-8. Summary of WWTP Flow and Beneficial Reuse**

| WWTP | 2014 Conditions (mgd) | | 2025 Conditions (mgd) | |
|---|---|---|---|---|
| | WWTP Flow[a] | Beneficial Reuse | WWTP Flow[a] | Beneficial Reuse |
| Novato SD[b] | 4.53 | 1.8 | 7.86 | 0.91[g] |
| City of Petaluma[c] | 5.2 | 1.78[i] | 6.2 | 6.2 |
| SVCSD[d] | 3.3 | 2.99 | 4.0 | 3.60[d] |
| Napa SD | 8.01[c] | 1.17[c] | 10.34[h] | 4.05[g] |
| CMSA[e] | 11.68 | NA | 13.29 | NA |
| City of American Canyon[f] | 1.39 | 0.16 | 2.13 | 0.58 |
| **Total** | **34.11** | **7.9** | **43.82** | **15.34** |

a. *Flows are average annual flows*
b. *Source: Karkal 2015.*
c. *Source: Walker 2015.*
d. *Source: Booker 2015a.*
e. *Source: Koekemoer 2017.*
f. *Source: "2014 WWTP Flow" value is based on total 2015 WWTP flow and was taken from the 2015 City of American Canyon UWMP. The "2025 WWTP Flow" value is based on total flow projections from the 2010 City of American Canyon UWMP. "Beneficial Reuse" values are from the 2015 City of American Canyon UWMP.*
g. *Existing conditions based on 2005 data not 2014 and future projections are for the year 2020 not 2025. Source: SCWA/USBR 2008.*
h. *Source: Napa SD 2011.*
i. *Tertiary treatment capacity is 5.2 mgd, however, beneficial reuse is 651MG/365days=1.78 mgd equivalent.*

Each of the Phase 2 Program participants agrees that the NBWRP must be able to deliver high-quality water to potential users in order to be an attractive and effective regional solution. As discussed in the Phase 2 Program's Hydraulic Studies Technical Memorandum (see Appendix C), 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 Phase 2 Program to reflect the peak daily dry weather flow demands of the anticipated local users supplied by the WWTP. Tables 3-9 and 3-10 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.

| Table 3-9. WWTP Existing and Future Levels of Treatment (mgd) | | | | | | |
|---|---|---|---|---|---|---|
| | Novato WWTP | Petaluma[a] WWTP | SVCSD WWTP | Napa SD WWTP | CMSA WWTP | City of American Canyon WRF |
| Existing and (Future) Capacity for Secondary Treatment | 8.0 (N/A)[b] | 6.7 (N/A) | 5.2 (6.7)[b] | 11.5 (11.5)[b] | 10 (10)[e] | 2.5 (2.5)[f] |
| Existing and (Future) Capacity for CCR Title 22 Tertiary Treatment | 1.4 (3.4)[c] | 5.2 (7.8) | 2.99 (2.99)[d] | 16.0 (16.0)[b] | 10 (10)[e] | 2.5 (2.5)[f] |

*a. Source: Walker 2015.*

*b. Existing conditions based on 2005 data not 2014 and future capacity is a result of WWTP improvements that were identified in the Phase 1 Feasibility Study and assumed completed by 2010. Source: SCWA/USBR 2008.*

*c. Source: Karkal 2015.*

*d. Source: Booker 2015.*

*e. Source: Carollo 2016*

*f. Source: City of American Canyon 2016.*

| Table 3-10. WWTP Existing and Future Levels of Treatment (AF/day) | | | | | | |
|---|---|---|---|---|---|---|
| | Novato WWTP | Petaluma[a] WWTP | SVCSD WWTP | Napa SD WWTP | CMSA WWTP | City of American Canyon WRF |
| Existing and (Future) Capacity for Secondary Treatment | 39.9 (N/A)[b] | 20.6 (N/A) | 35.3 (35.3)[b] | 47.3 (47.3)[b] | 30.7 (30.7)[e] | 7.7 (7.7)[f] |
| Existing and (Future) Capacity for CCR Title 22 Tertiary Treatment | 4.3(10.4)[c] | 16 (24) | 9.2 (9.2)[d] | 27.0 (27.0)[b] | 30.7 (30.7)[e] | 7.7 (7.7)[f] |

*a. Source: Walker 2015.*

*b. Existing conditions based on 2005 data not 2014 and future capacity is a result of WWTP improvements that were identified in the Phase 1 Feasibility Study and assumed completed by 2010. Source: SCWA/USBR 2008.*

*c. Source: Karkal 2015.*

*d. Source: Booker 2015.*

*e. Source: Carollo 2016.*

*f. Source: City of American Canyon 2016.*

The combined recycled water supply in the NBWRP Region is the sum of all recycled water net supplies for all agencies. Table 3-11 below summarizes the total available supply by month for all the MAs. The total available annual supply is 38,101 AFY (12,413 MG per year) after full implementation of Phase 1 of the NBWRP.

The monthly available supplies are at their lowest during the summer irrigation demand period. The supplies during June, July, and August represent approximately 9 percent of the annual supply; therefore, storage becomes a key element of the Phase 2 Program to meet future summer demands.

**Table 3-11. Projected Monthly and Annual Phase 2 Recycled Water Supplies[a]**

| Month | Available Phase 2 Recycled Water Supplies MG | Available Phase 2 Recycled Water Supplies AF |
|---|---|---|
| January | 1,223 | 3,754 |
| February | 1,565 | 4,805 |
| March | 1,433 | 4,399 |
| April | 1,279 | 3,925 |
| May | 977 | 2,995 |
| June | 411 | 1,266 |
| July | 324 | 996 |
| August | 443 | 1,359 |
| September | 691 | 2,121 |
| October | 888 | 2,727 |
| November | 956 | 2,935 |
| December | 2,222 | 6,819 |
| **Total** | **12,413** | **38,101** |

a. *Values have been rounded.*


**Figure 3-8. Total Available Recycled Water Supplies for Phase 2 by Month for All Member Agencies**

Treatment processes for the production of recycled water within the NBWRP Region include tertiary filtration and disinfection either with UV or chlorine. As a result of the Phase 2 Program building upon existing facilities for the expansion of recycled water within the area, development or implementation of improved technologies for treatment would not be cost effective nor consistent with NBWRP objectives.

## 3.2 Phase 2 Projects

The Scoping Study identified an initial range of conceptual level recycled water projects that builds on the NBWRP's Phase 1 investment in facilities to further develop additional water supplies. Approximately 50 projects were initially identified by the MAs to increase or add recycled water use for agricultural, urban irrigation, environmental restoration, recreation, groundwater management, in lieu stream flow, climate change impacts and sea level rise, and energy efficient treatment and conveyance. These conceptual level projects would expand recycled water use and other water management options within the NBWRP Region as recycled water reduces the reliance on imported water and surface water by being a localized source of water that does not rely on rainfall.

The Scoping Study included a New User Assessment and a Multi-purpose Storage Investigation to provide a multi-dimensional, regional perspective to develop and use recycled water in a manner that best meets community priorities, reflects local values, and significantly contributes toward water supply reliability in the NBWRP region. Analysis was also conducted to identify the broadest range of uses and projects to maximize use of all available recycled water in the NBWRP region.

The conceptual level projects identified to be carried forward in this Phase 2 Feasibility Study build on the projects initially identified in the Scoping Study and include infrastructure improvements to produce, store, or convey recycled water to meet increasing water demands. The six project types identified in the Scoping Study are summarized in Table 3-12 below.

Table 3-12. Type of Project

| Type of Project | Description |
|---|---|
| Treatment | Expansion of existing wastewater/water reclamation treatment plant. |
| Seasonal Storage | Storage facilities used to store winter effluent for summer use. |
| Operational Storage | Storage facilities used to optimize daily recycled water supply. |
| Distribution | Pipelines to convey recycled water to end users. |
| Environmental Enhancement | Irrigation of levees for beneficial reuse, water supply to wetlands. |
| Groundwater Management | Aquifer storage, aquifer recovery, and groundwater basin recharge. |

Recycled water provides a drought-proof source of water which aid in addressing climate change vulnerabilities. By implementing these projects, the NBWRP increases the region's ability to meet water demands with reduced potable water sources. The following sections discuss the process undertaken by the program to support the development of the Feasibility Study to further refine the list of projects identified as part of the Scoping Study and define the Phase 2 Program.

### 3.2.1 Novato Sanitation District

Members of the project team met with Novato SD staff on October 29, 2014, to identify recycled water projects to be considered in the Phase 2 Feasibility Study by Novato SD in conjunction with Marin County, NMWD, and the Coastal Conservancy in the Phase 2 Feasibility Study. Meeting attendees included:

- Novato SD – Sandeep Karkal, General Manager
- NMWD – Drew McIntyre, Chief Engineer
- County of Marin – Liz Lewis, Watershed Planning Manager; and Laurie Williams, Senior Planner
- Consultant Team – Mike Savage, Jenny Gain, Dawn Taffler, and Ginger Bryant

Based on the meeting and follow-up communications, Novato SD indicated interest in exploring the potential projects summarized in Table 3-13 to increase recycled water production abilities and delivery for urban irrigation uses.

**Table 3-13. Novato SD Phase 2 Projects Evaluated**

| Project Type | Timeframe | Project Title | Description |
|---|---|---|---|
| Treatment | Near-Term | Novato SD WRP Capacity | Increase WWTP tertiary capacity to meet demands as they are defined. |
| Storage | Near Term | Seasonal Storage Option 1 - Novato SD Wetland/Storage Project (evaluate 2 storage volumes) | Contingent on the Transitional Brackish Wetland Project being constructed, includes the following:<br>• Construct a Storage Wetlands.<br>  • Initially, for secondary effluent that will be discharged to the Transitional Brackish Wetland Project. Coordinate work with the Coastal Conservancy to breach existing levee, create setback levee to form western boundary, and then build storage reservoir.<br>  • In future, for CCR Title 22 tertiary recycled water.<br>• Construct a new flow splitting structure to the storage wetland (as needed).<br>• Construct pump station to convey stored water to treatment. |
| | | Seasonal Storage Option 2 – Novato SD Pasture north of Highway 37 (evaluate 2 storage volumes) | • Novato SD Pasture north of Highway 37 Pasture Ranch Lease - P-1 through P-8) |
| Distribution | Long-Term | Indian Valley College Pipeline | • Phase 2 or Potential Addition to Phase 1: Expand service area south from the terminus of the Central Service Area from Marin Country Club then west to Indian Valley College. |
| | | Potential Intertie to LGVSD | • If additional flow to southern Marin County is needed, construct a new 20,700-LF, 18-inch diameter pipeline to connect the Novato SD pump station to interconnect with the LGVSD recycled water system. |
| | | NMWD West Service Area Pipelines | • Expand North Service Area to the west (i.e., areas W-1, W-2, W-3, and W-5) to increase supply to NMWD. (Contingent on construction of a Phase 1 pipeline in the central service area that may be deleted from Phase 1.) |

| Table 3-13. Novato SD Phase 2 Projects Evaluated | | | |
|---|---|---|---|
| **Project Type** | **Timeframe** | **Project Title** | **Description** |
| Environmental Enhancement (Other Program Beneficiaries - outside of the NBWRP study area) | Near-Term | Marin County Lower Novato Creek Project | • Relocate Novato SD outfall to increase area available for habitat creation and sediment management. Novato SD pipelines to deliver recycled water.<br>• Recycled water irrigation of ecotone slopes. |
| | | Novato SD Wetland/Storage Project (Discharge to Coastal Conservancy/Novato SD Transitional Brackish Wetland Project) | Contingent on the Transitional Brackish Wetland Project being constructed, includes the following:<br>• Construct a new flow splitting structure in the outfall pipeline to discharge secondary effluent into a newly created Novato SD/Coastal Conservancy Transitional Brackish Wetland Project.<br>• Truncate outfall and abandon pipeline at the flow splitting structure.<br>• Construct pump station to convey stored water to treatment.<br>• Construct a Storage Wetlands.<br>  • Initially, for secondary effluent that will be discharged to the Transitional Brackish Wetland Project. Coordinate work with the Coastal Conservancy to breach existing levee, create setback levee to form western boundary, and then build storage reservoir.<br>  • In future, for CCR Title 22 tertiary filtered and disinfected recycled water. |
| | | Novato SD Irrigation Pasture (existing) | Return leased spray fields to Marin County and use the land to restore tidal prism, enhance habitat, irrigate natural habitat, and address sediment issues in Novato Creek. (Contingent on the construction of Transitional Brackish Wetland/Storage Projects.) |

### 3.2.2 Sonoma Valley County Sanitation District

On October 17, 2014, members of the project team met with SVCSD and SCWA staff to identify water supply projects to be considered in the Phase 2 Feasibility Study. Meeting attendees included:

- SVCSD – Pam Jeane, Assistant General Manager, and Wendy Gjestland, Engineer
- SCWA – Jay Jasperse, Chief Engineer and Director of Groundwater Management, Kevin Booker, Principal Engineer, and Jake Spaulding, Administrative Services Officer
- Consultant Team – Mike Savage, Jenny Gain, Dawn Taffler and Ginger Bryant

Based on the meeting and follow-up communications for clarification, SVCSD staff indicated interest in exploring the potential projects summarized in Table 3-14.

| Table 3-14. SVCSD Phase 2 Projects Evaluated | | | |
|---|---|---|---|
| **Project Type** | **Timeframe** | **Project Title** | **Description** |
| Storage | Near-Term | Sonoma Valley Reuse Storage | Explore locations for storage in Sonoma Valley by others on private lands through potential public, private, or public/private partnerships. |
| Distribution | Near-Term | Napa Road Pipeline | Construct new pipeline to expand the recycled water service area in the unincorporated areas of Sonoma County along Napa Road. |
| | Long-Term | Peru Road Pipeline | Construct new pipeline to expand the recycled water service area for landscaping and agriculture in the City of Sonoma along Peru Road. |

### 3.2.3 Sonoma County Water Agency

The October 17, 2014, meeting with members of the project team, SVCSD, and SCWA staff was used to identify water supply projects to be considered in the Phase 2 Feasibility Study for SCWA. Based on the meeting and numerous follow-up communications for clarification, SCWA staff indicated interest in exploring the potential projects summarized in Table 3-15.

**Table 3-15. SCWA Phase 2 Projects Evaluated**

| Project Type | Timeframe | Project Title | Description |
|---|---|---|---|
| Groundwater Management (Storage) | Near-Term | El Verano Depression Area ASR | Use Russian River winter flows for ASR in a joint project with the Valley of the Moon Water District at the north end of the Phase 1 pipeline and to the west of the Phase 1 pipeline in the El Verano groundwater depression area near Dowdall Creek. |
| | | Southeast Depression Area ASR | Use SCWA Russian River winter flows for ASR north of downtown in the City of Sonoma. |
| | Near-Term | Sonoma Valley Groundwater Management and Recharge | Capture and infiltrate stormwater to recharge aquifer using off-stream stormwater retention basins in lower-slope areas; high-flow diversion/recharge channels; and infiltration galleries. Potential recharge locations include Sonoma Creek and Nathanson Creek. |
| Other Program Beneficiaries (outside of the NBWRP study area) | Near-Term | Agricultural On-Site Storage Ponds | Potential private recycled water storage locations on private sites in Sonoma Valley. |
| | Long-Term | Potential Petaluma-Sonoma Intertie | Potentially partner with Petaluma to import tertiary recycled water to agricultural customers to the east of Petaluma to offset groundwater pumping. This would require additional distribution pipelines and significant pumping for Petaluma to convey recycled water over the hill into Sonoma Valley. (See Petaluma Phase 2 projects list.) |

### 3.2.4 City of Petaluma

Members of the project team met with City of Petaluma staff on October 1, 2014, to identify recycled water projects to be considered in the Phase 2 Feasibility Study. Meeting attendees included:

- City of Petaluma – Dan St. John, Director of Public Works and Utilities, Leah Walker, Environmental Services Manager, Matt Pierce, Operations Supervisor, and Robert Wilson, Environmental Services Supervisor
- Consultant Team – Mike Savage, Jenny Gain, and Dawn Taffler

Based on the meeting and follow-up communications, City of Petaluma staff indicated interest in exploring the potential projects summarized in Table 3-16.

| Table 3-16. Petaluma Phase 2 Projects Evaluated | | | |
|---|---|---|---|
| **Project Type** | **Timeframe** | **Project Title** | **Description** |
| Treatment | Near-Term | Ellis Creek WRF Capacity | Increase the ECWRF's tertiary treatment capacity from 5.2 mgd to 7.8 mgd to meet max day demand. |
| Storage | Near-Term | Seasonal Storage Option 1 – New Ponds Southeast of ECWRF (evaluate 2 storage volumes) | Construct new recycled water storage ponds southeast of the ECWRF with habitat restoration or mitigation in partnership with the Coastal Conservancy. |
| | | Seasonal Storage Option 2 – Raise Oxidation Ponds (evaluate 2 storage volumes) | Expand capacity of oxidation ponds by raising levee height for seasonal storage. Two options include:<br>• Dual use of ponds for wet weather flow, emergency backup and recycled water storage.<br>• Dedicate some of the existing oxidation ponds to recycled water storage. |
| Distribution | Near-Term | Urban Recycled Water Expansion | Expand urban recycled water distribution to serve mostly schools, parks, landscape medians, and golf courses by extending pipelines from an existing 20inch pipeline that runs northwest from the ECWRF. |
| | | Agricultural Recycled Water Expansion | Expand agricultural recycled water distribution along Lakeville Highway. Agricultural customers would be prioritized based on the unit cost per acre foot delivered to identify the most cost-effective distribution system. |
| Other Project Opportunities | Near-Term | Agricultural Groundwater Pumping Offset | Offset agricultural well pumping by serving recycled water for agricultural irrigation in the area northeast of the City's service area. |
| Other Program Beneficiaries (outside of the NBWRP study area) | Near-Term | Storage on Agricultural Properties | Expand private storage on agricultural properties. The City is coordinating with agricultural users to add, expand, or repurpose storage for recycled water as part of delivery agreements. |
| | Long-Term | Potential Petaluma-Sonoma Intertie | Potentially export tertiary recycled water to SCWA agricultural customers to the east of the City to offset groundwater pumping. This would require additional distribution pipelines and significant pumping to convey recycled water over the hill into the Petaluma Basin. (See SCWA Phase 2 projects list.) |

### 3.2.5 Napa Sanitation District

On October 20, 2014, members of the project team met with Napa SD staff to discuss the recycled water projects that would be considered in the Phase 2 Feasibility Study. Meeting attendees included:

- Napa SD – Tim Healy, General Manager, Jeff Tucker, Director of Administrative Services/Chief Financial Officer, and Andrew Damron, Senior Civil Engineer
- Consultant team – Mike Savage, Jenny Gain, Dawn Taffler and Ginger Bryant

Based on the meeting and follow-up communications, Napa SD staff indicated interest in exploring the potential projects summarized in Table 3-17.

**Table 3-17. Napa SD Phase 2 Projects Evaluated**

| Project Type | Timeframe | Project Title | Description |
|---|---|---|---|
| Treatment | Near-Term | Soscol WRF Increased Filter Capacity | Construct additional filters to increase treatment capacity by 1.7 mgd. (The filter basins are being constructed as part of Phase 1 of the NBWRP; Phase 2 work will consist of adding the mechanical parts to the filter basins, and adding associated pumping, piping, and treatment capacity in the plant.) |
| | Long-Term | Soscol WRF Expanded Treatment | Pending expanded storage of seasonal secondary effluent and recycled water demands that exceed the filter limitations, expand treatment for additional secondary clarification (dissolved air floatation [DAF] or flocculation), additional filter capacity, and add another chlorine contact basin. |
| Storage | Near-Term | Additional Soscol WRF Covered Equalization Storage | Construct a 10-AF covered equalization storage pond for tertiary effluent. |
| | | Seasonal Storage Option 1 – Raise Pond Levees | Construct new seasonal storage by raising the existing pond levees (pending findings of geotechnical study in progress). |
| | | Seasonal Storage Option 2 – Somky Ranch Equalization Reservoir (evaluate 2 storage volumes) | Construct seasonal storage reservoir at Somky Ranch. |
| | | Seasonal Storage Option 3 – Jameson Ranch (evaluate two storage volumes) | Construct new seasonal storage as a new off-site pond at Jameson Ranch to serve tertiary effluent using existing conveyance pipelines. |
| | | Napa State Hospital Storage Tank | Construct 5-MG storage tank on Napa State Hospital property to assist with pressure and peak demands in the MST recycled water distribution area. |
| Distribution | Near-Term | MST Pipeline | Construct a 3,200-LF, 12-inch diameter MST pipeline extension for landscape irrigation. |
| | Long-Term | Maximum Distribution System | Increase recycled water distribution to MST and Silverado would require additional seasonal storage and expanded treatment (as described above). |
| Other Program Beneficiaries (inside NBWRP area but not members of NBWRA) | Near-Term | Los Carneros Water District | Provide recycled water to the Los Carneros Water District (LCWD), which is inside the NBWRP area and served by Napa SD. Coordinate with the LCWD to use their private onsite storage. |

### 3.2.6 Central Marin Sanitation Agency and Marin Municipal Water District

Based on the recently completed Recycled Water Feasibility Study, CMSA staff and MMWD staff indicated interest in exploring the potential project summarized in Table 3-18.

**Table 3-18. CMSA and MMWD Phase 2 Projects Evaluated**

| Project Type | Timeframe | Project Title | Description |
|---|---|---|---|
| Distribution | Near-Term | Recycled Water Distribution System Expansion to San Quentin Prison | The proposed project includes treatment of secondary effluent at CMSA using microfiltration and chlorine disinfection then conveying the water to San Quentin Prison for dual plumbing, boiler make-up water, landscape irrigation and use in a car wash; and a truck fill station will also be built at CMSA. |

### 3.2.7 City of American Canyon

Based on the recently completed Recycled Water Master Plan, City of American Canyon staff indicated interest in exploring the potential project summarized in Table 3-19.

Table 3-19. Petaluma Phase 2 Projects Evaluated

| Project Type | Timeframe | Project Title | Description |
|---|---|---|---|
| Treatment | Near-Term | American Canyon WRF Phase 2 Treatment Plant Upgrades | This project would include facility upgrades at the existing American Canyon WRF to increase tertiary treatment process to improve water quality for existing and future recycled water users. |
| Distribution | Near-Term | Phase 1 Recycled Water Distribution System Expansion | Phase 1 expansion includes six (6) recycled water pipeline extensions located within existing built roadways. The customer demands associated with these extensions would be met directly from the WRF during the peak month. No seasonal storage would be needed. |
| | | Phase 2 Recycled Water Distribution System Expansion | Phase 2 expansion includes three (3) recycled water pipeline extensions located within existing built roadways. The customer demands associated with these extensions would be met directly from the WRF during the peak month. No seasonal storage would be needed. These pipelines would be implemented after the Phase 2 treatment plant upgrades. |

### 3.2.8 Implementation Challenges

Typical implementation barriers, such as public acceptance and water quality concerns, are reduced for the Phase 2 Program as a result of the successful implementation of the Phase 1 Program and previous efforts undertaken to support the NBWRP. However, these factors still need to be taken into consideration in addition to project implementation costs. Public acceptance regarding the use of recycled water for irrigation purposes, the primary use within the Phase 2 Program area, has become more favorable in the last decade with many communities viewing recycled water as part of the water supply portfolio. Though recycled water is more favorably viewed, the NBWRA will continue outreach activities to assist MAs in educating potential users and the general public as the Phase 2 Program is implemented.

Recycled water is regulated by the State of California, as discussed in Section 8, and water quality must be suitable for agricultural and urban irrigation use. Based on the analysis completed in support of Phase 1, constituents of concerns for irrigation (e.g., salinity, sodium, trace elements, excessive chlorine residual, and nutrients) where found to be at acceptable levels for the recycled water produced at the WWTPs within the NBWRP area (SCWA/USBR, 2008). Water quality of new agencies added in Phase 2 also demonstrated acceptable levels for the recycled water produced as discussed in Section 2.3.1.

Another implementation challenge for the Phase 2 Program is cost. However, without implementing Phase 2, other water supply projects would have to be developed to increase water supplies and reliability. These other projects will likely be more expensive and challenging to implement, as discussed in Section 4.

## 3.3 Operational Study

As indicated in Section 3.1.7, there is 38,101 AFY of recycled water available for use in Phase 2. However, much of the recycled water is generated during winter months with much less available during the high-demand summer months. The majority of recycled water is allocated through existing and Phase 1 uses during the summer months, resulting in the need to store recycled water during the winter months to meet demands identified for Phase 2. To sufficiently define the storage requirements, an analysis of seasonal and operation storage needs was completed for the NBWRP MAs prior to the evaluation of projects and formulation of alternatives (discussed in Section 4). This analysis aided the MAs in the evaluation and ultimate selection of storage projects to be included in the Phase 2 Program. The following sections describe the supply and demand scenarios analyses completed, the storage options considered, and the final recommendations developed for each agency.

### 3.3.1 Novato Sanitation District

The recycled water storage projects considered were developed to address the ability for Novato SD to meet current and future recycled water demands and are presented in the following sections.

#### 3.3.1.1 Supply and Demand Analysis

Three demand scenarios were developed to identify the amount of storage that would be needed based on two recycled water supply scenarios. The available recycled water supply scenarios addressed two conditions: 1) supply equal to 2010 wastewater flows into the WWTP, and 2) supply equal to projected 2025 wastewater flows into the WWTP. The three demand scenarios are as follows:

- Scenario 1: Storage needs to meet the currently projected NMWD demands plus agriculture demands (600 AFY).
- Scenario 2: Storage needs to meet demands double the current NMWD demands plus agriculture demands (1,200 AFY).
- Scenario 3: Storage needs to meet demands triple the current NMWD demands plus agriculture demands (1,800 AFY).

A summary of the storage needs based on the demand scenarios and available recycled water supply is presented in Table 3-20 and Figure 3-9.

**Table 3-20. Novato SD Demand and Storage Requirements**

| Demand Scenario | Total Demand (AF) | Storage Requirements with 2010 WWTP Inflows (AF) | Storage Requirements with 2025 WWTP Inflows (AF) |
|---|---|---|---|
| 1 | 1,744 | 279 | 0 |
| 2 | 2,346 | 620 | 0 |
| 3 | 2,946 | 960 | 198 |

*Note: Total demands include those originating from Lower Novato Creek (40 AFY) and the agriculture fields (1,104 AFY). However, only NMWD demands were varied from scenario to scenario.*

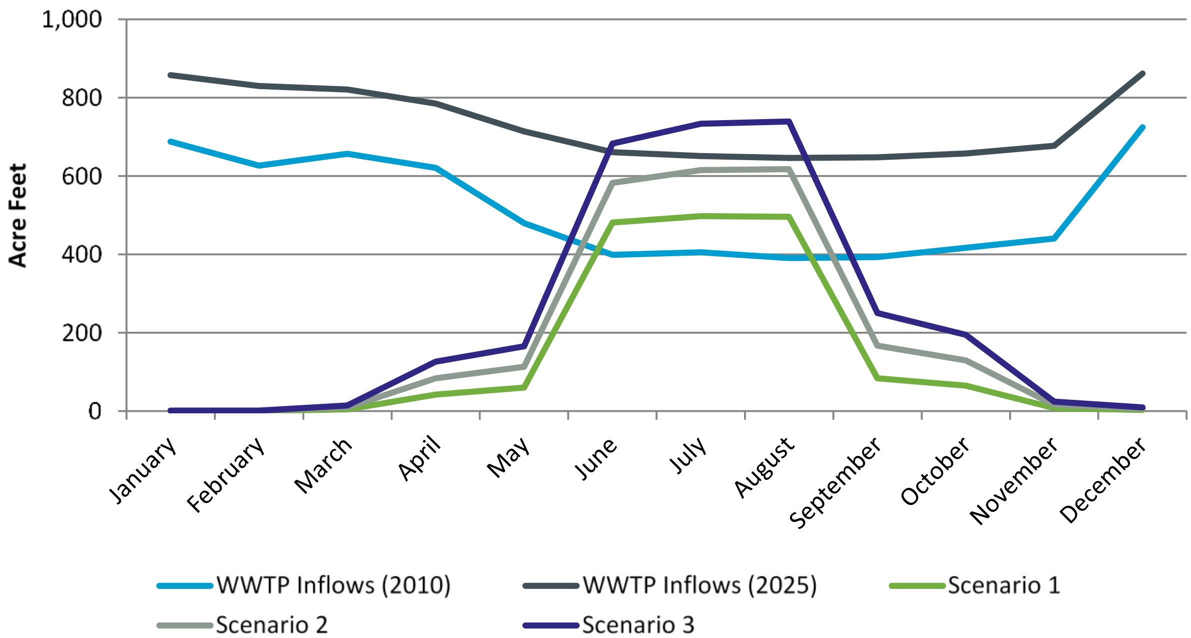



**Figure 3-9. Novato SD Supply and Demand**

Novato SD irrigation demands include irrigating the pasture fields North of Highway 37. The pasture fields demands, which totals 1,104 AFY, has a large influence on the required seasonal storage. With recycled water supply equal to current flows, approximately 300 AF seasonal storage is needed when NMWD demands reach 600 AFY to meet both NMWD and the pasture field demands. However, with an increase of recycled water supply equal to projected 2025 effluent flows, the storage would only be required with NMWD demands of 1,800 AFY. If the fields are not irrigated, then storage is not required under any combination of effluent flow and NMWD demands.

#### 3.3.1.2 Storage Options

Three seasonal storage options were identified and evaluated for Novato SD as part of this Feasibility Study as summarized below and further discussed in Section 5.

- Option 1: Seasonal storage pond on a site near Highway 37 to store 150 AF of tertiary water.
- Option 2: Seasonal storage pond on a site near Highway 37 to store 150 AF secondary treated water.
- Option 3: Seasonal storage pond on a site known as the Hamilton site, located adjacent to the Coastal Conservancy Wetland Project, to store 150 AF secondary treated water.

Based on the evaluation, storage is not needed for Novato SD within the NBWRP Phase 2 timeframe. Storage needs based on the available recycled water supply equal to current wastewater flows is highly dependent on the expansion of NMWD and continued service to the pasture fields. Approximately 200 AF of storage capacity is needed in the future assuming recycled water supply equals that of projected wastewater flows and demands reach 2,946 AFY.

### 3.3.2 City of Petaluma

The following sections summarize the supply and demand analysis which identified storage volume needs for the City of Petaluma and resulted in the development of storage projects for consideration in this Feasibility Study.

#### 3.3.2.1 Supply and Demand Analysis

Petaluma storage volume needs were based on current and future recycled water supply and analyzed for four demand scenarios. Each of the demand scenarios assumed a base demand equal to 2014 deliveries (2,000 AFY). Demands were then varied depending on the inclusion of a new urban system expansion plus a range of agricultural irrigation demands (Agricultural Recycled Water Expansion Project Phases 1, 2, and 3). The demand scenarios included in the analysis are as follows:

- Base Case: Only 2014 Deliveries (2,000 AFY).
- Scenario 1: Storage needs to meet Base demand plus All New Urban Water Demands (2,237 AFY).
- Scenario 2: Storage needs to meet Base demand plus all Agriculture demands from Phase 1 (2,658 AFY).
- Scenario 3: Storage needs to meet Base demand plus all Agriculture demands from Phases 1 and 2 (3,081 AFY).
- Scenario 4: Storage needs to meet Base demand plus all Agriculture demands from Phases 1, 2 and 3 (3,539 AFY).

The current and future recycled water supply was based on current (2014) and projected (2025) wastewater flows into the WWTP, respectively.

The City of Petaluma has a total of 800 AF of existing storage available, which includes City storage ponds and private agricultural reservoirs (currently not used for recycled water storage, but are available for future storage). Currently, the City of Petaluma storage is used to allow the City to meet the summer discharge prohibition. As urban and agricultural demands increase, the summer storage becomes less critical and a transition to winter seasonal storage will be necessary. Based on current recycled water supply, approximately 235 AF of additional storage would be needed to meet summer demands under Scenario 4, the highest demand scenario; lower-demand scenarios would not require any additional storage. In the future, an increase in recycled water supply (equal to projected wastewater flows in 2025) would provide sufficient summer flows to meet Scenario 4 demands with the existing storage. A summary of the demands and required storage based on recycled water supply is presented in Table 3-21.

Table 3-21. City of Petaluma Demand and Additional Storage Requirements

| Scenario | Total Demand (AFY) | Additional Storage Requirements with 2014 WWTP Inflows (AF) | Additional Storage Requirements with 2025 WWTP Inflows (AF) |
|---|---|---|---|
| Base | 2,000 | 0 | 0 |
| 1 | 2,237 | 0 | 0 |
| 2 | 2,658 | 0 | 0 |
| 3 | 3,081 | 0 | 0 |
| 4 | 3,539 | 235 | 0 |

Currently, storage is primarily used in the summer to prevent discharge to the Petaluma River between May 1 and October 22 as required by the NPDES permit. As indicated above, the purpose of existing storage will transition to a winter seasonal storage in the future. However, a sensitivity analysis was conducted to ensure the NPDES summer discharge constraint could be met in a wet year, where larger wastewater inflows and demands are reduced in the winter and spring months as irrigation demands are generally met from rainfall and soil moisture. Additionally, storage ponds receive more direct rainfall and evaporation is typically reduced during wet years. The Demand Scenario 4 in combination with the 2025 recycled water supply was evaluated as this would present the worst case where storage requirements are the greatest and wastewater flows the highest (2025 WWTP inflows). The analysis found that approximately 245 AF of storage would be needed if demands remain unchanged (equal to the Base Case) and WWTP inflows increased to the 2025 projected flows to prevent summer spills in wet years.

#### 3.3.2.2 Storage Options

Two potential seasonal storage options were evaluated for the City of Petaluma to meet the no discharge requirements and future recycled water demands. A summary of the options identified is below and a more detailed description of the storage options is provided in Section 5.

- Option 1: Two seasonal 150 AF ponds located southeast of the ECWRF next to the existing oxidation ponds.
- Option 2: Similar to Option 1, except it includes only one 150 AF pond.

Ultimately, the City of Petaluma may not need additional storage; however, if recycled water demands increase to a Scenario 4 level before supply increases to 2025 projected levels, then approximately 235 AF of additional storage will be needed. Additionally, to prevent a potential summer spill, approximately 245 AF of additional storage is needed if the recycled water demands do not increase while the wastewater flow increases to 2025 projections.

### 3.3.3 Sonoma Valley County Sanitation District

The projects developed to address storage needs for SVCSD to meet current and future recycled water demands did not undergo operational analysis due to the relatively small sizes of the reservoirs as compared to the available winter volume. Local users will be provided tertiary filtered and disinfected recycled water during winter months for summer irrigation use.

Two seasonal storage site options were identified for SVCSD. Each option, summarized below, is further discussed in Section 5.

- Option 1: Seasonal storage pond on a site known as the Mulas Site to store 49 AF of tertiary treated recycled water to serve agriculture demands.
- Option 2: Seasonal storage pond on a site known as the Robledo Site to store 49 AF of tertiary treated recycled water to serve agriculture demands.

### 3.3.4 Napa Sanitation District

The supply and demand analysis completed to identify storage needs for the Napa SD is presented in this section in addition to the projects included identified to satisfy the storage needs.

#### 3.3.4.1 Supply and Demand Analysis

Five demand scenarios, each assuming two recycled water supply quantities were evaluated as described below. The recycled water supply used to assess the demand scenarios were current and projected 2030 wastewater influent flows into the WWTP. The five demand scenarios addressed included:

- Base: Existing and Phase 1 Demands (2,911 AFY).
- Scenario 1: Storage needs to meet Base demand plus Allocated Water Demands[2] (3,698 AFY).
- Scenario 2: Storage needs to meet Base demand plus Allocated Water and Phase 2 LCWD Demands (4,248 AFY).
- Scenario 3: Storage needs to meet Base demand plus Allocated Water and Phase 2 MST Demands (5,148 AFY).
- Scenario 4: Storage needs to meet Base demand plus Allocated Water and all Phase 2 Demands (5,548 AFY).

Napa SD has approximately 1,200 AF of storage existing at the WWTP that currently retains summer flows to prevent discharges during the summer in accordance with the Napa SD NPDES permit. As the demand increases, the need for summer storage is reduced and the need for winter seasonal storage increases. Therefore, the existing storage can transition in purpose to meet future Napa SD needs. Based on the analysis, summarized in Table 3-22, up to approximately 1,920 AF of additional storage would be required to meet the highest demand scenario, assuming recycled water supply equals current amounts. Under the future condition where recycled water supply increases (equal to 2030 WWTP influent flow), approximately 1,113 AF additional storage would be needed to meet Scenario 5 demands.

**Table 3-22. Napa SD Demand and Storage Requirements**

| Scenario | Demand | Storage requirements with 2014 WWTP Inflows (AF) | Storage requirements with 2030 WWTP Inflows (AF) |
|---|---|---|---|
| Base | 2,911 | 0 | 0 |
| 1 | 3,698 | 87 | 0 |
| 2 | 4,248 | 620 | 0 |
| 3 | 5,148 | 1,520 | 750 |
| 4 | 5,548 | 1,920 | 1,113 |

The storage needs vary when considering current and future amounts of recycled water supply as the amount of demand increases, as presented in Figure 3-10. While the increased demands may vary in time, as a result of expansion of the recycled water system, the analysis shows additional storage is needed to accommodate expansion of the recycled water service and increases WWTP flows. Potentially significant storage volumes are needed whether constructed by Napa SD or by the actual users on their own property.

[2] This refers to recycled water demands that have been allocated but were not delivered in 2014. These demands are not included in the Phase 1 Demands.

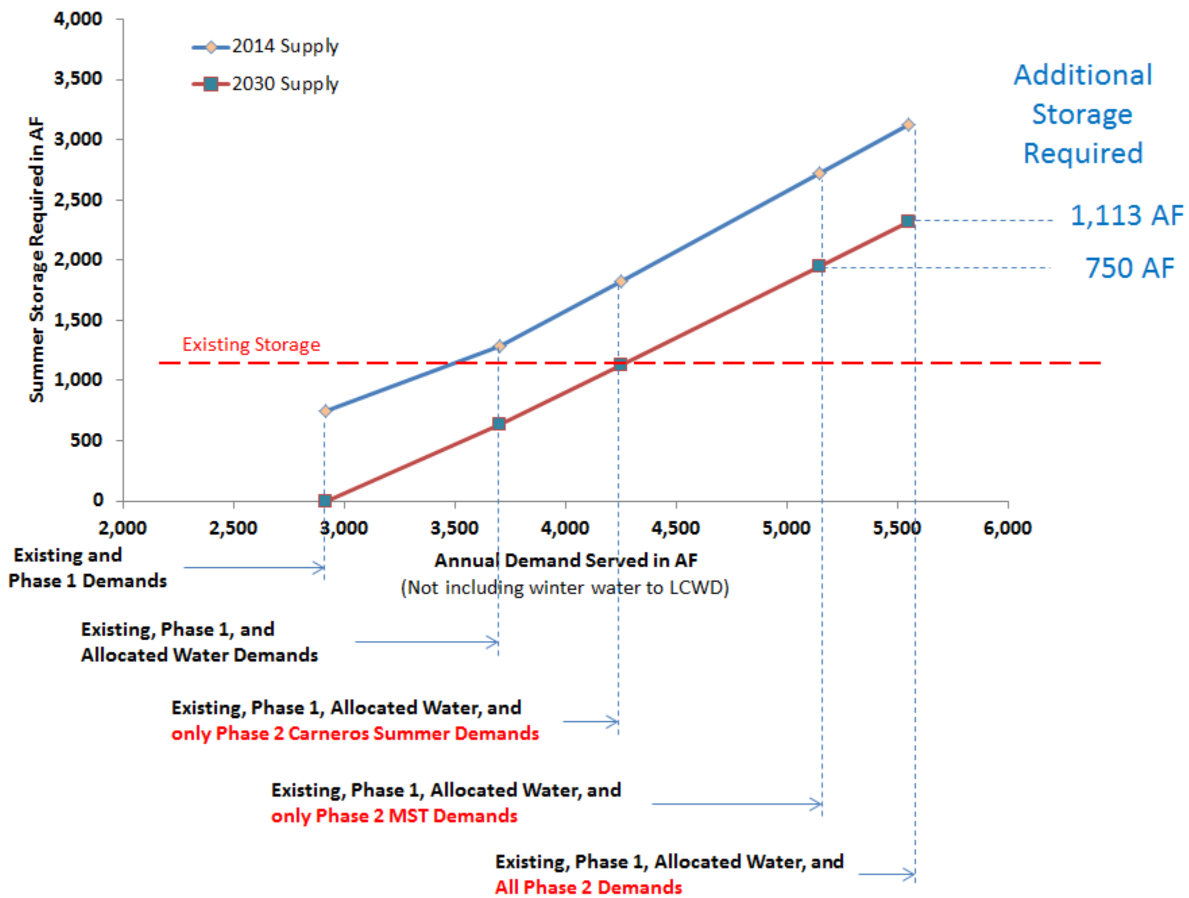



**Figure 3-10. Napa SD Storage Requirements**

### 3.3.4.2 Storage Options

The seasonal storage options were identified and evaluated for Napa SD as part of this Feasibility Study. A detailed description of each is presented in Section 5 and summarized below.

- Option 1a: Raise existing storage Pond 1 3 feet to increase storage by 300 AF.
- Option 1b: Raising all existing storage ponds by 3 feet to increase total storage capacity by 1,100 AF.
- Option 2: Seasonal storage of secondary effluent in two 150 AF ponds at Somky Ranch.
- Option 3a: Two seasonal storage ponds that would yield 600 AF of tertiary filtered and disinfected water storage at the Jamison Ranch Site to serve two local golf courses and other potential future customers.
- Option 3b: Two off-site storage ponds that would yield 300 AF of usable storage at the Jamison Ranch Site to store and serve tertiary treated water to two local golf courses and other potential future customers.

The existing storage capacity is sufficient to meet demand up through Scenario 3 in the future when recycled water supply equals that of 2030 WWTP influent projected flows but can only meet current demands with existing recycled water supply. Given the unknown timing of new users and distribution system expansions, the size of seasonal storage varies significantly. Additionally, opportunities exist for LCWD to develop its own seasonal storage separately,[3] which could then be utilized to provide Napa SD flexibility in meeting other demands, such as in the MST area. For these reasons, only seasonal storage of 600 and 300 AF capacities were considered in the NBWRP Phase 2 Feasibility Study.

### 3.3.5 Central Marin Sanitation Agency

The CMSA and MMWD Recycled Water Feasibility Study showed that the identified recycled water demand can be met from available flows without the need for seasonal storage.

### 3.3.6 City of American Canyon

The City of American Canyon Recycled Water Master Plan showed that the identified recycled water demand can be met from available flows without the need for seasonal storage.

[3] LCWD could pursue seasonal storage projects through either 1) regulatory allowance to use on-stream reservoirs for recycled water, or 2) via outside funding for private reservoirs from grants, loans or public private partnerships.

Section 4

# Formulation of Alternatives and Selection of Program

This section discusses the process used to screen projects, formulate project alternatives, and evaluate Phase 2 Program alternatives to ultimately select the suite of projects which comprise Phase 2 of the proposed NBWRA's Title XVI Program (Program).

Previously developed Program objectives and sub-objectives were used to score the projects, identified in Section 3, to demonstrate the quantitative and qualitative value each of the projects contributes to the Program. From this process, three diverse alternatives were formulated for feasibility-level analysis including a "No Program Alternative." A final selected Title XVI Program is identified for environmental review and implementation.

## 4.1 Program Objectives

Objectives for the Program were developed during the Phase 2 Scoping Study and presented in the Scoping Study Summary Report (NBWRA, 2014) that preceded this Feasibility Study. The identification and selection of objectives was completed through three workshops as part of the Scoping Study which utilized objectives from Phase 1 as well as those of potential funding programs that could assist with Phase 2 project implementation. The results of this activity were a set of Program objectives to satisfy both local needs and broader state and federal requirements. These objectives were then applied to score individual projects, guide the formulation and evaluation of alternatives, and ultimately select the Phase 2 Program.

### 4.1.1 Objectives and Sub-objectives

The Program objectives focus on meeting the criteria of the MAs, the California Environment Quality Act (CEQA), the National Environmental Policy Act (NEPA), and state and federal funding programs. These program-wide and project-specific objectives are built into the foundation of the Program to support both the Feasibility Study and future implementation of the Program.

The objectives are categorized into primary objectives and sub-objectives. Primary objectives are more general, while sub-objectives help define the primary objectives in more specific terms. Program objectives and sub-objectives are listed in Table 4-1.

**Table 4-1. Program Objectives**

| Objective | Sub-objective |
|---|---|
| Improve Regional Water Supply | • Improve local, regional, and state water supply reliability<br>• Address impaired groundwater basins<br>• Offset demands on potable water supplies<br>• Maintain and protect public health and safety<br>• Reduce dependence on the Delta |
| Sustainability | • Incorporate use of renewable energy and promote energy efficiency<br>• Address climate change adaptation<br>• Reduce greenhouse gas emissions |
| Watershed Approach | • Incorporate multiple agencies and stakeholders<br>• Address multiple resource management strategies |
| Economic Feasibility & Financial Viability | • Cost effectiveness<br>• Financially implementable projects |
| Readiness to Proceed | • Ability to start design<br>• Ability to start construction |
| Environmental Enhancement | • Enhance local and regional ecosystems<br>• Improve water quality for habitat<br>• Improve instream flows for aquatic life |
| Social Issues | • Provide benefits to rural or economically disadvantaged communities<br>• Address environmental justice considerations<br>• Enhance recreation and open space opportunities<br>• Maintain agricultural industry and culture |

### 4.1.2 Weighting of Objectives

The objectives were generally not equally important to each of the MAs; i.e., with some objectives being more relevant for some decision-makers than others. For example, sustainability may be more important for a given MA over environmental and social issues. Thus, the Program objectives were weighted to better reflect the values and preferences of NBWRA MAs. This was done using the "forced-paired comparison" method; a method based on the importance of objectives relative to one another when compared in pairs. The results of the paired comparisons are aggregated to determine the overall weight, thus, importance, of each objective. For example, the improved regional water supply reliability objective was found to be of greater importance when compared to the sustainability, the watershed approach, the environmental enhancement, and the social issues objectives and less important than the economic feasibility and financial viability objectives. This results in the improved regional water supply reliability objective getting a score of 5 out a possible 21, thus, a weight of 24 percent.

Using the forced-paired comparison approach, each MA compared each possible pair of objectives and selected which objective in each pair was more important. The results of individual MA evaluations were then averaged in order to get a relative percentage weight of importance for each objective for the overall Program participants. The final weightings of objectives are shown in Figure 4-1.

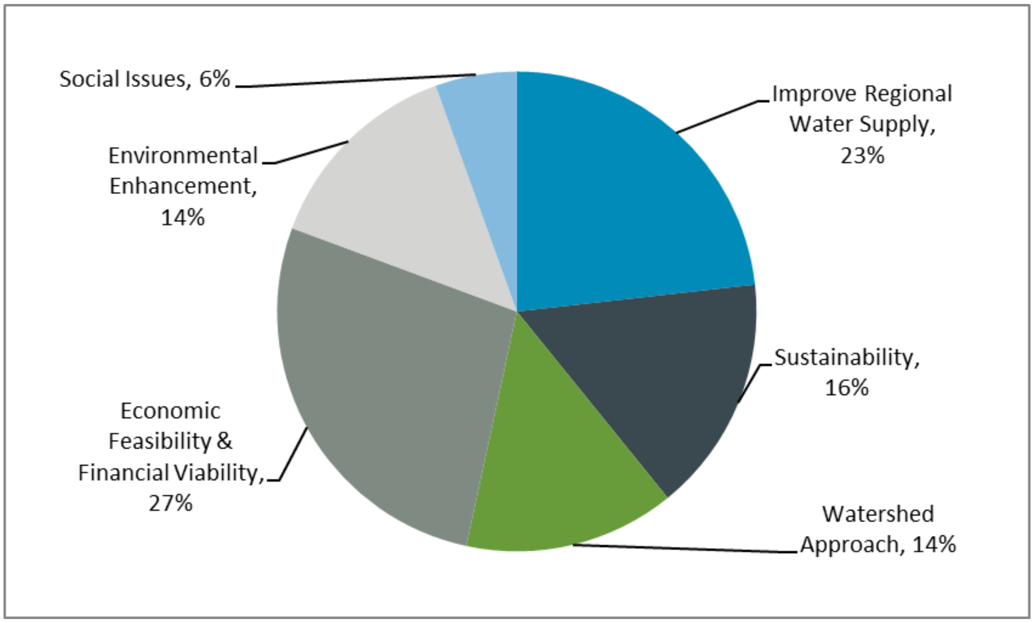



**Figure 4-1. Weighting of Program Objectives**

The “readiness to proceed” objective was not assigned a weight as this parameter was used for initial screening, as further discussed in Section 4.2.1 below, as it was deemed a prequalification factor for inclusion into the Program.

### 4.1.3 Valuation of Sub-objectives

Within each objective the sub-objectives were also ranked relative to each other. The actual weight of each sub-objective was then calculated by multiplying the objective weighting shown in Figure 4-1 by the sub-objective weight to reflect MAs preferences. Similar to weightings of the objective, the sub-objective values from each of the MAs were averaged to give a score used in evaluating projects and alternatives. The weights for each sub-objective are shown in Figure 4-2.

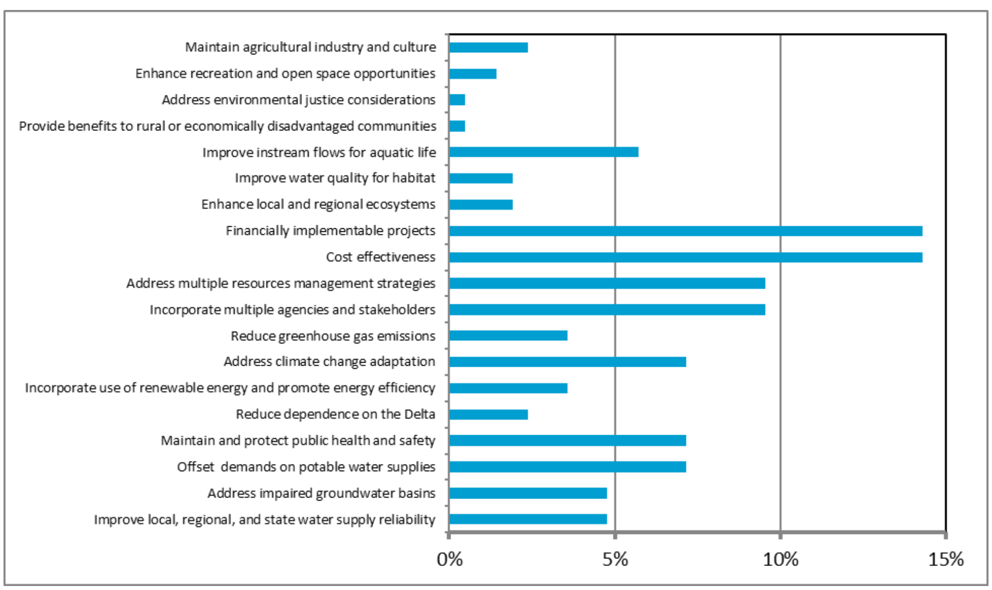



**Figure 4-2. Valuation of Sub-objectives for Scoring**

The weights were used in conjunction with a project or alternative score to develop a weighted score that was used to rank projects, formulate alternatives, and select a final program.

## 4.2 Development of Program Alternatives

The projects identified in Section 3 underwent an evaluation process that included screening and valuation to formulate Program alternatives which were each designed to meet the Program objectives. The process was then applied to the alternatives to select the Phase 2 Program. Figure 4-3 below illustrates the process discussed in this section and indicates the report sections where each topic is addressed.

Initial activity was to develop appraisal-level project layouts and costs for initial screening purposes. The first screening removed projects that would not be implemented in the near-term and projects that were not directly MA projects. The remaining projects were scored against objectives. A sensitivity analysis was then conducted to assess the impact of variations in objectives weightings. The highest-ranking projects were formulated into potential Program alternatives. These alternatives were then scored against the objectives. A potential Program was formulated drawn from higher scoring projects among the alternatives.

Insights from the initial screening process suggested that further project definition with more detail was needed for MAs to select from the highly scored projects to formulate the Phase 2 Program. Therefore, each of the remaining projects was taken from appraisal level to feasibility level layout and costing. In the course of feasibility analysis, some refinements were made to projects or in some cases projects were disaggregated into smaller parts to focus on the most beneficial components of the project. The feasibility level information allowed the MAs to select a proposed program that met the objectives of the USBR's WaterSMART (Sustain and Manage America's Resources for Tomorrow) Title XVI Program and the agency funding constraints. The selected Program is presented in Section 4.4.

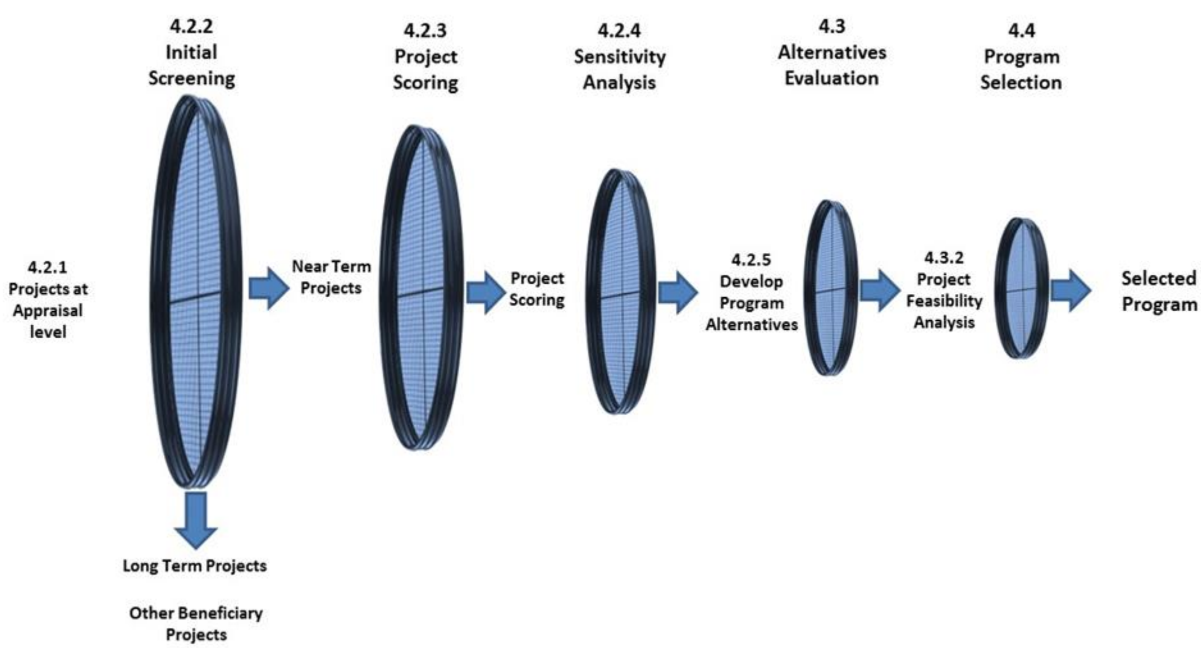



**Figure 4-3. NBWRP Phase 2 Program Selection Process**

### 4.2.1 Projects at Appraisal Level

Appraisal-level estimates of costs were initially developed for all identified projects in Section 3 to support the screening process. Appraisal-level cost estimates represent a very early stage of project development; therefore, have an order-of-magnitude level of accuracy. These cost estimates were developed to assist the MAs in their evaluation and comparison of projects for inclusion in the proposed Program. The estimates were prepared from cost graphs, simple sketches, or rough general designs that used the available site-specific design data. Appendix D includes additional details about the basis for the appraisal-level cost estimates. All cost estimating was based on the following general assumptions:

- Only the major components were incorporated in the cost estimates, including: distribution pipelines; treatment plant improvements; system storage components; and distribution pump stations.
- All present worth costs were based on the Engineering News Record's (ENR) 2016 Construction Cost Index (CCI) for San Francisco.
- Construction bids for Phase 1 projects implemented by the participating agencies were reviewed and integrated as appropriate to update unit cost estimates.

The estimated appraisal-level total construction costs for the projects that could be considered for the Phase 2 Program was $284 million. The Opinions of Probable Total Project Capital Costs were developed in accordance with the Reclamation Directives and Standards (USBR, 2007) and Engineering Research Center guidelines.

1. Based on Phase 2 Feasibility Study - Recon-Level Costing Methods Updated to ENR CCI = 11,555 (July 2016).
2. USBR Allowance/Contingencies (35 percent) includes:
   - Allowance for unlisted Items accounts for additional work that may be identified during additional design phases of the Project (15 percent).
   - Contingencies are considered as funds to be used after construction starts to pay contractors for overruns on quantities, changes site conditions, change orders, etc. (20 percent).
3. Non-Contract Cost (25 percent) includes:
   - Preliminary and final design engineering, preparation of construction plans and specifications (11 percent).
   - Construction services including construction management, construction inspection, engineering support during construction, construction surveying, start-up services, and as-built drawings (13 percent).
   - Project administration, legal support (1 percent).

The appraisal-level cost estimates developed for each of the projects were used to determine whether more detailed investigations of the project would be justified. The projects were then revised to meet MA cost constraints as well as support their evaluation.

### 4.2.2 Initial Screening

The initial screening addressed projects that were not ready to proceed and projects related to MAs but actually would be implemented by other non-MAs. The initial screening separated the projects into three categories described below:

- **Near Term Projects:** "Near Term MA Projects" to be considered for Title XVI feasibility level study were those projects that could be designed and implemented within the 10-year period of 2021 to 2030. WaterSMART Title XVI construction grants can provide up to $4 million per year for projects which must be completed in 2 years from grant award; therefore, it will take approximately 10 years to implement a program within the $20 million grant limit. To successfully work within the Title XVI Program, it is critical that all projects meet the readiness to proceed criteria and are able to be implemented within 10 years of completion of the NEPA document/Record of Decision anticipated in 2021.
- **Long Term Projects:** "Long Term MA Projects" are those with an estimated start of construction after 2027, which is outside the assumed Phase 2 Program Title XVI implementation window. The long-term projects will be described at appraisal level and included in the environmental document at a programmatic level.
- **Other Beneficiary Projects**: Other projects in the study area were identified that could benefit MAs by providing additional recycled water demands, environmental benefits, or on-site agricultural seasonal storage, thereby reducing the need for MAs to provide seasonal storage. These projects are described as "Other Beneficiaries Projects" and were not compared/ranked against the Near-Term MA Projects but could be included in the Phase 2 Program (at a later date with the agreement of the MAs). At a minimum, these projects will be included at an appraisal level in the study and potentially included in the environmental document at a programmatic level.

### 4.2.3 Project Scoring

Program alternatives were formulated by ranking projects based on their total weighted score, which was the sum of project scores within each sub-objective multiplied by the sub-objective weight. The projects were then combined to identify the top scoring projects that could be included based on three different Program total costs. A sensitivity analysis was completed as part of the alternative development to identify projects that address other objectives.

The alternatives formulated using this process are presented in Section 4.2.5.

#### 4.2.3.1 Scoring Process

The Near Term MA Projects were evaluated relative to each sub-objective listed in Table 4-1. Each individual project was scored on a scale of one to five for each sub-objective based on the scoring criteria presented in Table 4-2. Some of the sub-objectives had to be qualitatively scored against a defined criterion (e.g., address environmental justice concerns) and some sub-objectives were quantified relative to projects (e.g., cost effectiveness).

| Table 4-2. Scoring | |
|---|---|
| Scoring Legend | Score |
| Fully Satisfies Requirements or Needs | 5 |
| Mostly Satisfies Requirements or Needs | 4 |
| Partially Satisfies Requirements or Needs | 3 |
| Somewhat Satisfies Requirements or Needs | 2 |
| Unable to Meet Requirements or Needs | 1 |

#### 4.2.3.2 Top Scoring Projects by Cost

Initial preliminary alternatives were developed by ranking the projects based on their total weighted score and grouping based on a range of total appraisal level project costs for a potential program (approximately $80, $90, and $125 million).

### 4.2.4 Sensitivity Analysis

A sensitivity analysis was conducted to address other benefits beyond total Program costs that the inclusion of a project may provide to the Program. Preliminary alternatives were developed that considered a combination of the top ranked projects that would be the most financially viable (i.e., alternatives with a maximum program cost of about $90 million), those that would maximize water supply, or those that would maximize environmental benefit.

The preliminary alternative which maximizes environmental benefit added an “Other Beneficiaries Project” that creates habitat restoration on a joint project between Novato SD and the County of Marin. The Lower Novato Creek Project expands transitional wetlands on the creek with ecotone slopes and levees irrigated with recycled water from the adjacent Novato SD treatment facilities.

### 4.2.5 Develop Program Alternatives

Using the results of the screening, project scoring, the formulation of preliminary alternatives process, and sensitivity analysis, three Program alternatives were developed. Each of the alternatives described below meet the overall Program objectives and are described as follows:

- **Alternative 1:** Represents the highest scoring combination of projects based on weightings and costs of projects that would make up an approximately $90 million program.
- **Alternative 2:** The combination of highest scoring projects that maximizes the Program’s water supply yield.
- **Alternative 3:** Represents the combination of highest scoring projects that maximizes environmental benefits. This alternative adds an “Other Beneficiaries Project,” the Lower Novato Creek Project.

The projects included in each of the three Program alternatives are summarized in Table 4-3. Many appear in more than one alternative.

| Agency | Project Type | Project Title | Alternative 1: Top Ranked Total Cost $90 million | Alternative 2: Maximize Supply | Alternative 3: Maximize Environmental Benefit |
|---|---|---|---|---|---|
| Novato SD | Treatment | Novato SD WRP Capacity | | | ✓ |
| | Transitional (Brackish) Wetlands/Storage | Novato SD Wetland/Storage Project (Discharge to Coastal Conservancy/Novato SD Transitional Brackish Wetland Project) | ✓ | | ✓ |
| | Other beneficiary Project Habitat Restoration | Marin County Lower Novato Creek Project | | | ✓ |
| SVCSD | Distribution | 8th Street East and Napa Road Pipelines | ✓ | ✓ | ✓ |
| SCWA | Storage | El Verano Depression Area ASR | ✓ | ✓ | ✓ |
| | | Southeast Depression Area ASR | ✓ | ✓ | ✓ |
| | Groundwater Management | Sonoma Valley Groundwater Management and Recharge | ✓ | ✓ | ✓ |
| Petaluma | Treatment | ECWRF Capacity | ✓ | ✓ | ✓ |
| | Storage | Seasonal Storage Alternative 1 – New Ponds Southeast of ECWRF | | ✓ | |
| | | Seasonal Storage Alternative 2 – Raise Oxidation Ponds | | | |
| | Distribution | Urban Recycled Water Expansion | ✓ | ✓ | ✓ |
| | | Agricultural Recycled Water Expansion | ✓ | ✓ | ✓ |
| Napa SD | Treatment | Soscol WRF Increased Filter Capacity | ✓ | ✓ | ✓ |
| | Storage | Additional Soscol WRF Covered Equalization Storage | ✓ | ✓ | ✓ |
| | | Napa State Hospital Storage Tank | ✓ | ✓ | |
| | | Seasonal Storage Alterative 1 – Raise Pond Levees | | | |
| | | Seasonal Storage Alterative 2 - Somky Ranch Equalization Reservoir | | | |
| | | Seasonal Storage Alterative 3 – Jameson Ranch | | ✓ | |
| | Distribution | MST Pipeline | ✓ | ✓ | ✓ |

Table 4-3. Program Alternatives Considered

## 4.3 Alternatives Evaluation

The development of the Program alternatives produced a strong list of projects. These were further evaluated and ultimately resulted in an alternative consisting of a combination of the best projects from each of the previously compiled alternatives. This evaluation consisted of the following steps, as further described in this section and illustrated in Figure 4-4:

- **Project Refinement:** The list of highly scored projects in each alternative was further examined, and in some cases disaggregated, to focus on the most successful components.
- **Project Feasibility Analysis:** Analysis of the projects included in the alternatives were evaluated in more detail at feasibility level and updated to meet MA constraints.

- **MA Evaluations:** Each MA worked with their respective Boards of Directors to select projects that provided the most benefit (water supply, environmental, cost effectiveness, etc.) and met their financial constraints.

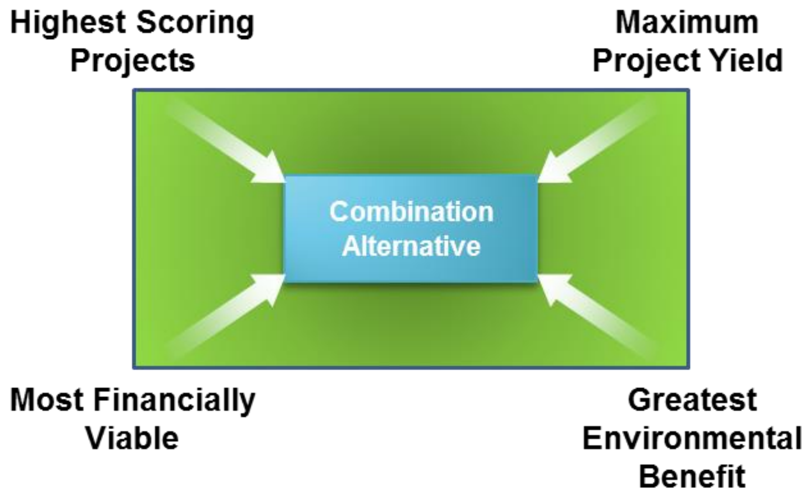



Figure 4-4. Evaluation Process

### 4.3.1 Project Refinements

The projects included in each of the alternatives were further evaluated and refined. A number of changes were made to improve the projects for implementation:

- Projects were disaggregated into smaller components to address cost limitations and phasing issues.
- Projects were dropped from the list as they were now seen as long term projects by the agencies.
- Projects were removed after more detailed review because they did not continue to meet agency needs.
- Projects were renamed to better reflect their purpose.
- One project was moved to implementation under Phase 1 due available funds and updated environmental analysis.

Table 4-4 provides a correlation of the “Original Project Title” and the “Final Project Title.” The description of the change is identified.

**Table 4-4. Project Correlation Mapping**

| Agency | Project Type | Original Project Title | Description of Change | Final Project Title |
|---|---|---|---|---|
| Novato SD | Treatment | Novato SD WRP Capacity | Project disaggregated to phase in expansion | Novato SD WRP Capacity - 1st Expansion (+0.85 mgd) |
| | | | | Novato SD WRP Capacity - 2nd Expansion (+0.85 mgd) |
| | Storage | NA | Project added to investigate potential for storage | Option 1: Site Near Highway 37 (Tertiary) 150 AF |
| | | | Project added to investigate potential for storage | Option 2: Site Near Highway 37 (Secondary) 150 AF |
| | | | Project added to investigate potential for storage | Option 2: Hamilton Site (Secondary) 150 AF |
| | Distribution | Indian Valley College Pipeline[a] | Added to NBWRP Phase 1 | NA |
| | | Potential Intertie to LGVSD | Removed: Long Term project | NA |
| | | NMWD West Service Area Pipelines | Removed: Long Term project | NA |
| | Environmental Enhancement (Other Program Beneficiaries outside of NBWRP study area) | Marin County Lower Novato Creek Project | Project disaggregated into distribution and restoration components. | Marin County Lower Novato Creek Project - Distribution |
| | | | | Marin County Lower Novato Creek Project - Restoration |
| | | Novato SD Wetland/Storage Project (Discharge to Coastal Conservancy/Novato SD Transitional Brackish Wetland Project) | Project name change to reflect what project comprises. Storage deleted here and became Hamilton Site | Turnout to Transitional Wetlands |
| SVCSD | Storage | Sonoma Valley Reuse Storage | Project further developed as part of the operational studies and to support evaluation. | Option 1: Mulas Site (Tertiary) 49 AF |
| | | | | Option 2: Robledo Site (Tertiary) 49 AF |
| | Distribution | Napa Road Pipeline | | 8th Street East and Napa Road Pipelines |
| | | Peru Road Pipeline | Removed: Long Term project | NA |
| SCWA | Groundwater Management (Storage) | El Verano Depression Area ASR | Name changed to better reflect project. | Valley of the Moon ASR |
| | | Southeast Depression Area ASR | Name changed to better reflect project. | Sonoma ASR |
| | | Sonoma Valley Groundwater Management and Recharge Study | No change[b] | Sonoma Valley Groundwater Management and Recharge Study |
| | Other Program Beneficiaries (outside of NBWRP study area) | Agricultural On-Site Storage Ponds | These became 2 specific projects under SVCSD Mulas & Robledo | NA |
| | | Petaluma-Sonoma Intertie | Deleted due to lack of agency interest | NA |

| Table 4-4. Project Correlation Mapping | | | | |
|---|---|---|---|---|
| Agency | Project Type | Original Project Title | Description of Change | Final Project Title |
| City of Petaluma | Treatment | ECWRF Capacity | Name changed to better reflect project. | Increase ECWRF Capacity |
| | Storage | Seasonal Storage Alternative 1 – New Ponds Southeast of ECWRF | Two sub-options evaluated | Option 1a: Site Southeast of ECWRF (Secondary) 300 AF |
| | | | Two sub-options evaluated | Option 1a: Site Southeast of ECWRF (Secondary) 150 AF |
| | | Seasonal Storage Alternative 2 – Raise Oxidation Ponds | Project studied and dropped due to reduced need for storage | NA |
| | Distribution | Urban Recycled Water Expansion | No change[b] | Urban Recycled Water Expansion |
| | | Agricultural Recycled Water Expansion | Project disaggregated into phases for expansion | Agricultural Recycled Water Expansion Phase 1 |
| | | | | Agricultural Recycled Water Expansion Phase 2 |
| | | | | Agricultural Recycled Water Expansion Phase 3 |
| | Other Project Opportunities | Agricultural Groundwater Pumping Offset | Long term project. Ongoing GW studies will take time | NA |
| | Other Program Beneficiaries (outside of NBWRP study area) | Storage on Agricultural Properties | No specific Project initially | NA |
| | | Petaluma-Sonoma Intertie | Deleted due to lack of agency interest | NA |

| Table 4-4. Project Correlation Mapping | | | | |
|---|---|---|---|---|
| Agency | Project Type | Original Project Title | Description of Change | Final Project Title |
| Napa SD | Treatment | Soscol WRF Increased Filter Capacity | No change[b] | Soscol WRF Increased Filter Capacity |
| | | Soscol WRF Expanded Treatment | Removed: Long Term project | NA |
| | Storage | Additional Soscol WRF Covered Equalization Storage | Name changed to better reflect project. | Additional Soscol WRF Covered Storage |
| | | Napa State Hospital Storage Tank | No change[b] | Napa State Hospital Storage Tank |
| | | Seasonal Storage Alterative 1 – Raise Pond Levees | Project further developed as part of the operational studies and to support evaluation. | Option 1a: Raise Existing Pond Levees (Secondary) 300 AF |
| | | | | Option 1b: Raise Existing Pond Levees (Secondary) 1,100 AF |
| | | Seasonal Storage Alterative 2 – Somky Ranch Equalization Reservoir | Project further developed as part of the operational studies and to support evaluation. | Option 2: Somky Ranch Site (Secondary) 300 AF |
| | | Seasonal Storage Alterative 3 – Jameson Ranch | Project further developed as part of the operational studies and to support evaluation. | Option 3a: Jameson Ranch Site (Tertiary) 600 AF |
| | | | | Option 3b: Jameson Ranch Site (Tertiary) 300 AF |
| | Distribution | MST Pipeline | Project disaggregated into components | MST Northern Loop |
| | | | | MST Eastern Extension |
| | | Maximum Distribution System | Removed: Long Term project | NA |
| | Other Program Beneficiaries (outside of NBWRP study area) | American Canyon Partnership - Jameson Ranch Storage | City of American Canyon decided not to join Phase 2 of NBWRP | NA |
| | | Los Carneros Area Agricultural On-Site Storage | Not included in NBWRP - under a separate program | NA |

a. *Though this project was initially identified and associated with Novato SD, it has been implemented by NMWD and removed from the Program. NMWD originally determined it was not feasible to implement the project in the near term due to a lack of local funding available to match the Title XVI funding; however, an opportunity arose where Phase 1 NBWRP funds became available as a result of another MA project cancellation coupled with the ability of NMWD to obtain State of California funds used for the local match.*

b. *The Project Name did not change but through the course of screening and evaluation additional project definition was determined.*

### 4.3.2 Project Feasibility Level Analysis

Feasibility level analyses were completed for each of the projects to aid MAs in the evaluation process. A feasibility level construction cost estimate was generated for the engineering work completed for the Title XVI and Non-Title XVI projects and some of the programmatic-level projects to allow the MAs to make a final decision of projects for each category.

The major components in each project were incorporated in the cost estimates, including: supply pipelines, treatment plant improvements, system storage components, distribution piping, and additional distribution pump station capacity. The estimates also include allowance, contingency, and non-contract costs such as engineering, legal and license fees, and engineering construction services.

Costs are broken down for capital and operation and maintenance (O&M) costs. For this study, the ENR CCI for San Francisco is used. This index is widely used for studies and estimates of construction projects and is published quarterly in the ENR. All costs in this Feasibility Study are based on a July 2016 CCI of 11,555. Costs are based on an evaluation of recent construction cost experience by each of the participating agencies for their region. Where additional cost guidance from national cost indices was considered, these costs were similarly increased to match a CCI of 11,555.

A common set of unit costs was used in developing the construction cost estimate for pipelines, site work, earth work, concrete work, tanks. However, since MAs water treatment processes varied significantly, agency-specific treatment costs were used.

An Opinion of Probable Total Project Capital Costs was estimated based on the Reclamation Directives and Standards and Engineering Research Center guidelines, which prescribe the following allowances, contingencies and non-contract cost percentages to be applied to the total estimated feasibility level total construction contract costs:

- **Allowance for Unlisted Items:** a markup of 15 percent of the Total Construction Contract Cost was added to account for additional work that may be identified during additional design phases of the project.
- **Contingency:** a markup of 20 percent of the total Subtotal Cost was added to pay contractors for overruns on quantities, changed site conditions, change orders, etc. Contingencies are considered as funds to be used after construction starts and not for design changes or changes in project planning.
- **Opinion of Probable Construction Costs:** This reflects an estimate of the capital costs of a feature or project from award to construction closeout. The Opinion of Probable Construction Costs equals the construction contract cost plus contingencies. Contingencies are intended to account for costs resulting from changes in design and/or differing site conditions encountered during construction. The Opinion of Probable Construction Cost is often called the Field Cost by Reclamation.
- **Non-Contract Cost:** This term refers to the costs of work or services provided by consultants/contractors in support of the project. This cost item reflects 25 percent of the Opinion of Probable Construction Costs to cover the following items:
  - Preliminary and final design engineering, preparation of construction plans and specifications (11 percent);
  - Construction services including construction management, construction inspection, engineering support during construction, construction surveying, start-up services, and as-built drawings (13 percent); and

- Project administration, legal support (1 percent).

- **Opinion of Probable Total Project Capital Cost:** The sum of the total Opinion of Probable Construction Costs plus Non-Contract costs. The Opinion of Probable Total Project Capital Cost is often called the Construction Cost by Reclamation.

Appendix D (Basis for Cost Estimates) provides details of the estimate of cost at feasibility level.

### 4.3.3 MA Project Evaluation

The Project Feasibility Analysis resulted in a list of projects with sufficient definition and cost information for evaluation of projects. The evaluation identified projects that provide the most benefit (water supply, environmental, cost effectiveness, etc.) and met the financial constraints of each MA.

## 4.4 Program Selection

Title XVI construction funding will provide up to $20 million or 25 percent of a project cost. This means the Phase 2 Program is limited to $80 million in Title XVI project funding. The projects selected by the MAs that provide the most benefit and met their financial constraints exceeded the Title XVI funding capabilities; therefore, were separated into the following three categories:

- **NBWRA Phase 2 Title XVI Program:** Approximately $83.2 million in feasible projects that would be constructed between 2021 and 2030 to seek Title XVI construction funding. These projects received full feasibility level and environmental analysis and documentation to satisfy CEQA and NEPA requirements.
- **Programmatic Level:** There are approximately $41 million in projects that are considered future projects to be developed as needed by the individual MAs. These projects underwent appraisal level analysis and will only be addressed programmatically under in the environmental analysis and documentation.
- **Non-Title XVI Projects:** Approximately $153 million in feasible projects that will be funded under other mechanisms if the agency decides later to pursue implementation. The projects in this category also underwent full feasibility level analysis.

Section 5 provides detailed descriptions of the projects in each category. The projects in the selected Phase 2 Program are listed in Table 4-5 below with the feasibility level estimates of costs. These feasibility level costs are supported by more detailed analysis than the initial costs used for screening. The feasibility level costs shown in Table 4-5 were used by the MAs to select the Phase 2 Program.

| Table 4-5. NBWRP Phase 2 Program Feasibility Level Estimates of Costs for Program Selection | | | | | | |
|---|---|---|---|---|---|---|
| Agency | Project Type | Project Title | Capital Costs ($ mil) | Title XVI Project Level EIR/EIS | Programmatic Level | Non-Title XVI Project Level EIR/EIS |
| Novato SD | Treatment | Novato SD WRP Capacity - 1st Expansion (+0.85 MGD) | $4.8 | ✓ | | |
| | | Novato SD WRP Capacity - 2nd Expansion (+0.85 MGD) | $4.8 | | | ✓ |
| | Seasonal Storage | Option 1: Site Near Highway 37 (Tertiary) 150 AF | $5.6 | | ✓ | |
| | | Option 2: Site Near Highway 37 (Secondary) 150 AF | $8.0 | | | ✓ |
| | | Option 3: Hamilton Site (Secondary) 150AF | $14.2 | | | ✓ |
| | Environmental Enhancement | Marin County Lower Novato Creek Project - Distribution | $0.9 | ✓ | | |
| | | Marin County Lower Novato Creek Project - Restoration | $21.5 | | ✓ | |
| | | Turnout to Transitional Wetlands | $0.6 | ✓ | | |
| SVCSD | Seasonal Storage | Option 1: Mulas Site (Tertiary) 49 AF | $2.4 | | | ✓ |
| | | Option 2: Robledo Site (Tertiary) 49 AF | $2.6 | | | ✓ |
| | Distribution | 8th Street East and Napa Road Pipelines | $2.4 | ✓ | | |
| SCWA | Seasonal Storage | Valley of the Moon ASR | $3.4 | ✓ | | |
| | | Sonoma ASR | $3.6 | ✓ | | |
| | Groundwater Management | Sonoma Valley Groundwater Management and Recharge Project | TBD | | | |
| City of Petaluma | Treatment | Increase ECWRF Capacity | $9.0 | ✓ | | |
| | Seasonal Storage | Option 1a: Site Southeast of ECWRF (Secondary) 300 AF | $14.3 | | | ✓ |
| | | Option 1b: Site Southeast of ECWRF (Secondary) 150 AF | $7.3 | | | ✓ |
| | Distribution | Urban Recycled Water Expansion | $14.6 | ✓ | | |
| | | Agricultural Recycled Water Expansion Phase 1 | $12.5 | ✓ | | |
| | | Agricultural Recycled Water Expansion Phase 2 | $6.0 | ✓ | | |
| | | Agricultural Recycled Water Expansion Phase 3 | $6.5 | | ✓ | |

| Table 4-5. NBWRP Phase 2 Program Feasibility Level Estimates of Costs for Program Selection | | | | | | |
|---|---|---|---|---|---|---|
| Agency | Project Type | Project Title | Capital Costs ($ mil) | Title XVI Project Level EIR/EIS | Programmatic Level | Non-Title XVI Project Level EIR/EIS |
| Napa SD | Treatment | Soscol WRF Increased Filter Capacity | $2.2 | ✓ | | |
| | Operational Storage | Additional Soscol WRF Covered Storage | $2.9 | ✓ | | |
| | | Napa State Hospital Storage Tank | $7.4 | | ✓ | |
| | Seasonal Storage | Option 1a: Raise Existing Pond Levees (Secondary) 300 AF | $9.9 | | | ✓ |
| | | Option 1b: Raise Existing Pond Levees (Secondary) 1,100 AF | $30.2 | | | ✓ |
| | | Option 2: Somky Ranch Site (Secondary) 300 AF | $15.3 | | | ✓ |
| | | Option 3a: Jameson Ranch Site (Tertiary) 600 AF (Phase 1) | $17.3 | | | ✓ |
| | | Option 3b: Jameson Ranch Site (Tertiary) 300 AF | $11.8 | | | ✓ |
| | Distribution | MST Northern Loop | $6.9 | | | ✓ |
| | | MST Eastern Extension | $3.9 | | | ✓ |
| MMWD/CMSA | Distribution | Recycled Water Distribution System Expansion to San Quentin Prison | $7.8 | ✓ | | |
| City of American Canyon | Distribution | Phase 1 Recycled Water Distribution System Expansion | $3.1 | ✓ | | |
| | | Phase 2 Recycled Water Distribution System Expansion | $2.9 | ✓ | | |
| | Treatment | American Canyon WRF Phase 2 Treatment Plant Upgrades | $6.0 | ✓ | | |

## 4.5 Program Refinement

The "No Program Alternative" assumes that there is no NBWRA Phase 2 Program. It represents the reasonably foreseeable actions taken by MAs and other agencies involved in the study area's water supply in the absence of the Phase 2 Program. There are many variables influencing the regions long-term water supplies but primarily groundwater overdraft and demands on imported surface water could result in water shortages. This uncertainty is significant and the No Program Alternative would require MAs and others to develop additional potable water supplies and limit demand on existing supplies, including those of the region's renowned vineyards and vital urban uses. Attempts to implement other water supply projects to improve reliability and meet future demands would be a regional challenge under the No Program Alternative.

Additional wastewater treatment capacity and water recycling projects may occur strictly from the implementation of local plans for expansion unrelated to water recycling or water supply security needs. However, it is unlikely these plans could be implemented without the Program given local funding constraints.

The future actions taken by individual agencies are summarized in this section which addresses two aspects of the No Program Alternative:

1. New regional non-recycled water supply alternatives; and
2. Individual agency actions with No Program Alternative.

### 4.5.1 Regional Non-Recycled Water Supply Alternatives

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

#### 4.5.1.1 Regional Project for Sonoma and Marin Counties

SCWA previously evaluated the Water Supply, Transmission and Reliability Project (Water Project), which proposes changes to the release and use additional water currently stored in Lake Sonoma and changes to water diversions from the Russian River. Releases from Lake Sonoma currently limit transmission system diversions of 75,000 AFY. Water available under the SCWA's current water supply agreement with its customers would be used to serve Sonoma, City of Petaluma, VOMWD, and NMWD which would comprise a portion of the No Program Alternative for comparison to projects in the Phase 2 Program.

The estimated capital cost of the proposed Water Project is described in Section 6.

As discussed in Section 2, the agricultural users in the study area rely on stored runoff from small local streams as well as local groundwater which has experienced decreased levels. Under the No Project Alternative, agricultural users would rely on current supplies for irrigation as the proposed Project would not serve agricultural users in the Sonoma Valley or in the City of Petaluma.

Implementation of the NBWRP Phase 2 Program in lieu of developing the Water Project would result in the postponement of development of expanded water supplies from the Russian River.

#### 4.5.1.2 Regional Project for Napa County

The future water supply plans in the City of Napa do not include service to the MST agricultural areas that would be served by the Program; therefore, a new water supply would be needed. The No Program Alternative would include additional costs for securing a new water supply. The cost of water in California continues to escalate; on a recent short-term transfer of water in the Central Valley, the transferred water was priced at $700 per AF. It can be assumed that a long-term transfer could be significantly larger. Securing a new water supply under the No Program Alternative would require significant effort to prepare environmental documents and receive regulatory approval, both of which could take several years.

The new imported water supply would likely be wheeled through the NBA, which is currently used at capacity. Therefore, this option would require an increase in the capacity of the NBA. It is possible the City of Napa could use some of its share of the NBA capacity to serve agricultural needs; however, this would need to be negotiated and assumed unlikely under the No Program Alternative. It is assumed Napa County would be responsible for securing the additional water supply to deliver to the agricultural area and a portion of NBA expansion costs based on the share of capacity of new intake, pump stations, and pipelines to serve the MST area. The NBA expansion costs for Napa County and cost associated with new or parallel pipelines is are discussed in Section 6. 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.

Implementation of the NBWRP Phase 2 Program in lieu of developing the expanded NBA would result in the elimination of development of expanded water supplies from the California Delta. In turn, potential impacts to Federal water supply facilities in the California Delta would be prevented.

#### 4.5.1.3 Individual Agency Actions with No Program

Without the Program, and without the regional non-recycled water supply alternatives described above, agency actions would vary as discussed in this section.

Novato SD has identified WRP expansion in anticipation of increased reuse demand in the NMWD. Without the Program, Novato SD would delay the expansion and continue to discharge its effluent, currently not used for recycled water production, to San Pablo Bay.

The City of Petaluma has identified WRP expansion, expansion of the urban landscape distribution system, and creation of an agricultural distribution system with projects included in the Program. Petaluma would continue to expand the urban landscape distribution system to help offset potable demands on Russian River supplies without the Program; however, the expansion would proceed at a slower pace based of the availability of local or potential State of California funding programs. The WRP expansion would not occur; therefore, tertiary recycled water would not be available to serve to agriculture in the Petaluma Gap Wine Region southeast of the city. Vineyards in the area would continue to divert from local stream when flows are available. Use of the local groundwater is limited for vineyards due to water quality constraints. Implementation of the NBWRP Phase 2 Program would therefore reduce or eliminate the use of existing diversions from natural watercourses or withdrawals from aquifers. The City of Petaluma would continue to discharge unused highly treated effluent as allowed under the waste discharge permit.

SVCSD identified distribution system expansion east of Sonoma and local storage for agricultural users. Without the Program, neither the distribution expansion nor the storage would be constructed due to limited local funds. Agricultural irrigation would continue to be limited due to variable local surface supplies and further degradation of the groundwater basin would likely occur due to over pumping and salinity intrusion from San Pablo Bay. Implementation of the NBWRP Phase 2 Program would therefore reduce or eliminate the use of existing diversions from natural watercourses or withdrawals from aquifers.

SCWA identified two opportunities to use available surface water to improve local groundwater conditions through ASR facilities in Sonoma and Valley of the Moon. Without the Program, the ASR facilities would be delayed due to limited local funding. Available winter surface water flows would not be put to beneficial use and the local groundwater conditions would likely continue to deteriorate.

Napa SD has identified treatment expansion, operational storage, distribution system expansion in the MST area, and seasonal storage to allow the use of winter flows for summer irrigation. Distribution system expansion and seasonal storage would not be constructed without the Program due to limited local funding. Agricultural irrigation would continue to be limited due to variable local surface supplies and degradation of the groundwater basin in the MST area. Implementation of the NBWRP Phase 2 Program would therefore reduce or eliminate the use of existing diversions from natural watercourses or withdrawals from aquifers. Napa SD would continue to discharge unused effluent as allowed under the waste discharge permit.

## 4.6 Title XVI Program Recycled Water Customers

The NBWRA Phase 2 Program builds on Phase 1 infrastructure to treat and distribute water to urban and agricultural end-users in the region. As in Phase 1, many MAs have ‘Demand to Serve’ in excess of what current infrastructure can provide. The Phase 2 urban projects can concisely describe the treatment to end user projects however, it is the agricultural end user that is harder to quantify. For example, an agency may build a pipeline to serve a large agricultural user knowing the pipelines will serve smaller operations along the route that may not be fully committed until the proximity of the system makes recycled water use a viable option. The projects in Phase 2 support efforts to broadly distribute recycled water across the region and as each project is implemented we incrementally reduce pressure on surface and groundwater supply.

The Phase 1 Program demonstrated the effectiveness of the NBWRA MAs to fully utilize the recycled water created and distributed. Phase 2 is generally an expansion of Phase 1 facilities for Novato SD, Napa SD, SVCSD, and SCWA. The new MA projects are being undertaken by two cities, Petaluma and American Canyon, that have ongoing and successful recycled water programs. Although no letters of intent are attached here, each of the agencies has or is in the process of securing agreements with customers. Given the limits to new water supplies, implementation of the Sustainable Groundwater Management Act, and the recent drought, the limitation to expanding recycled water use is cost not lack of customer interest. Table 4-6 provides an overview of the customers for Phase 2.

**Table 4-6. Program Alternatives Considered**

| Agency | Project Title | Customers |
|---|---|---|
| Novato SD | Novato SD WRP Capacity - 1st Expansion (+0.85 MGD) | Customers for this project are the NMWD and Marin County. The new facilities are designed to provide recycled water to NMWD using conveyance and distribution facilities constructed by NMWD in Phase 1 of the NBWRP. The treatment capacity expansion improved Novato SD capabilities to meet peak water demands. |
| | Marin County Lower Novato Creek Project - Distribution | The customer for this project is Marin County. The lower Novato Creek project includes conveyance pipelines to the facilities to be constructed by Marin County as the Lower Novato Creek is implemented. Although a relatively small yield, the environmental benefits are important to the region. |
| | Turnout to Transitional Wetlands | The customer for this project is the new tidal marsh environmental enhancement project being developed with the State Coastal Conservancy |

**Table 4-6. Program Alternatives Considered**

| Agency | Project Title | Customers |
|---|---|---|
| SVCSD | 8th Street East and Napa Road Pipelines | Groundwater resources have long played a significant role in the development, growth and sustainability of the Sonoma Valley, with more than half the water demand in a given year met by local groundwater resources. With increasing demand on finite local groundwater supplies, stored groundwater in the Sonoma Valley has been and will continue to be depleted without appropriate actions being taken in the near future. The implementation of the Sustainable Groundwater Management Act has accelerated the need to address groundwater deficiencies in Sonoma Valley.<br><br>SVCSD and SCWA have a successful record of working together to implement recycled water projects in the area under Phase 1 including agricultural, landscape, and residential uses. The agencies consider several factors when determining expansion areas. The current area was identified to be particularly in need of an alternative water source. In 2013 a Salt and Nutrient Management Plan was completed. In addition, the SCWA along with other public agencies and Non-governmental organizations, in Sonoma Valley, have been implementing the Sonoma Valley Groundwater Management Plan, for the past nine years, for maintaining a sustainable, high-quality groundwater resource for the users of the groundwater basin underlying the Sonoma Valley. Data illustrates that the area in Sonoma Valley (near the intersection of 8th Street east and Napa Road) shows a salinity depression area. This depression area is targeted by the Sonoma Valley Groundwater Management Plan as an area that should receive recycled water to offset groundwater pumping, thereby slowing the growth of this depression. As a potential project is years from development, SVCSD is confident, that if the pipelines in Phase 2, along 8th Street East and Napa Road are constructed, users will take advantage of it. The two ASR projects also work to address local groundwater issues. These projects provide water to the Sonoma Aquifer to maintain support the health of the basin. |
| SCWA | Valley of the Moon ASR | |
| | Sonoma ASR | |
| Petaluma | Increase ECWRF Capacity | Customers use recycled water for irrigation of parks, schools, golf courses, pastures and vineyards. Agricultural irrigation includes pasture and vineyards.<br><br>Urban customers within the City of Petaluma limits are provided recycled water under user permits, are metered, and are billed in accordance with the City of Petaluma's water rate ordinance. Urban recycled water users are allowed to irrigate with recycled water at any time. For golf courses, ranches, vineyards and other agricultural customers outside the City of Petaluma limits, the City of Petaluma executes agreements for delivery of recycled water. The City of Petaluma as yet has not had to actively market the recycled water program to potential users outside the City limits. Lack of water availability in the area, the recent drought, and the increased popularity of the viticulture region has prompted property owners to seek recycled water from the City for agriculture in the area. Recycled water agreements with these users are currently being updated. |
| | Urban Recycled Water Expansion | |
| | Agricultural Recycled Water Expansion Phase 1 | |
| | Agricultural Recycled Water Expansion Phase 2 | |
| Napa SD | Soscol WRF Increased Filter Capacity | Napa SD Phase 2 facilities support existing and Phase 1 customers by improving diurnal operations and the ability to meet peak period recycled water demands. Napa SD continues to have long term interest in their recycled water beyond what can be delivered with the Phase 2 Program. |
| | Additional Soscol WRF Covered Storage | |
| MMWD/ CMSA | Recycled Water Distribution System Expansion to San Quentin Prison | MMWD has initiated discussions with San Quentin Prison. They were supportive due to the Governor's order to conserve water applied to the State Office of Prisons. Next to Caltrans, they are the State's largest consumer of water. Also, San Quentin Prison represents the single largest water demand on the MMWD system which makes them a prime candidate for the use of recycled water. |
| American Canyon | Phase 1 Recycled Water Distribution System Expansion | American Canyon currently uses its recycled water to irrigate vineyards, schools, commercial properties, and public urban landscaping. Under the proposed projects recycled water will be used for expanded commercial, industrial, institutional and common area landscapes. The City of American Canyon has a standard Recycled Water Use Application and Agreement. |
| | Phase 2 Recycled Water Distribution System Expansion | |
| | American Canyon WRF Phase 2 Treatment Plant Upgrades | |

Section 5

# Proposed Phase 2 Program

This section provides detailed descriptions for the projects that were screened, formulated into alternatives, and included in the Phase 2 Program. As previously discussed in Section 4, additional effort was put into further developing the projects to the feasibility level, which included development of capital cost and operational costs to assist MAs in the evaluation process to select the suite of projects which meet Program objectives, are financially feasible, and satisfy MA needs.

The proposed Program provides a regional approach to address water management needs through the development and use of recycled water and other water management activities within the NBWRP Region. Based on the screening process described in Section 4, each MA selected and prioritized three categories:

1. NBWRA Phase 2 Title XVI Program: These projects seek to receive Title XVI construction funding with a goal of implementation between 2021 and 2030. A full feasibility level and environmental analysis and documentation are performed for each project in this category to satisfy CEQA and NEPA requirements.
2. Programmatic Level Projects: These projects are considered future projects to be developed as needed by the individual MAs. These projects will only be addressed programmatically under the environmental analysis and documentation.
3. Non-Title XVI Projects: These projects could be funded under other mechanisms if the MA's decides later to pursue implementation. The projects in this category also underwent full feasibility level analysis; however, they will not be addressed in the EIR/EIS.

Sections 5.1, 5.2 and 5.3 describe the projects in the NBWRA Phase 2 Title XVI Program, Programmatic and Non-Title XVI Projects categories, respectively, for each MA. Project descriptions include maps, identification of major structures and facilities, and other project considerations including brief summaries of climate change vulnerabilities that are described in detail in Section 2.5. Feasibility-level estimates of cost are provided for each project, including capital and annual O&M costs. Additional detail about the basis for the cost estimates is provided in Appendix D. Life-cycle costs for the NBWRA Phase 2 Program and additional economic analyses are presented in Section 6.

Figure 5 1 provides an overview of all projects considered by the NBWRA MAs. These projects are also listed in Table 5 1 and are categorized into NBWRA Phase 2 Title XVI, Programmatic and Non-Title XVI projects. Figures 5-2 to 5-8 present individual maps for each MA that similarly show the NBWRA Phase 2 Title XVI, Programmatic and Non-Title XVI projects.

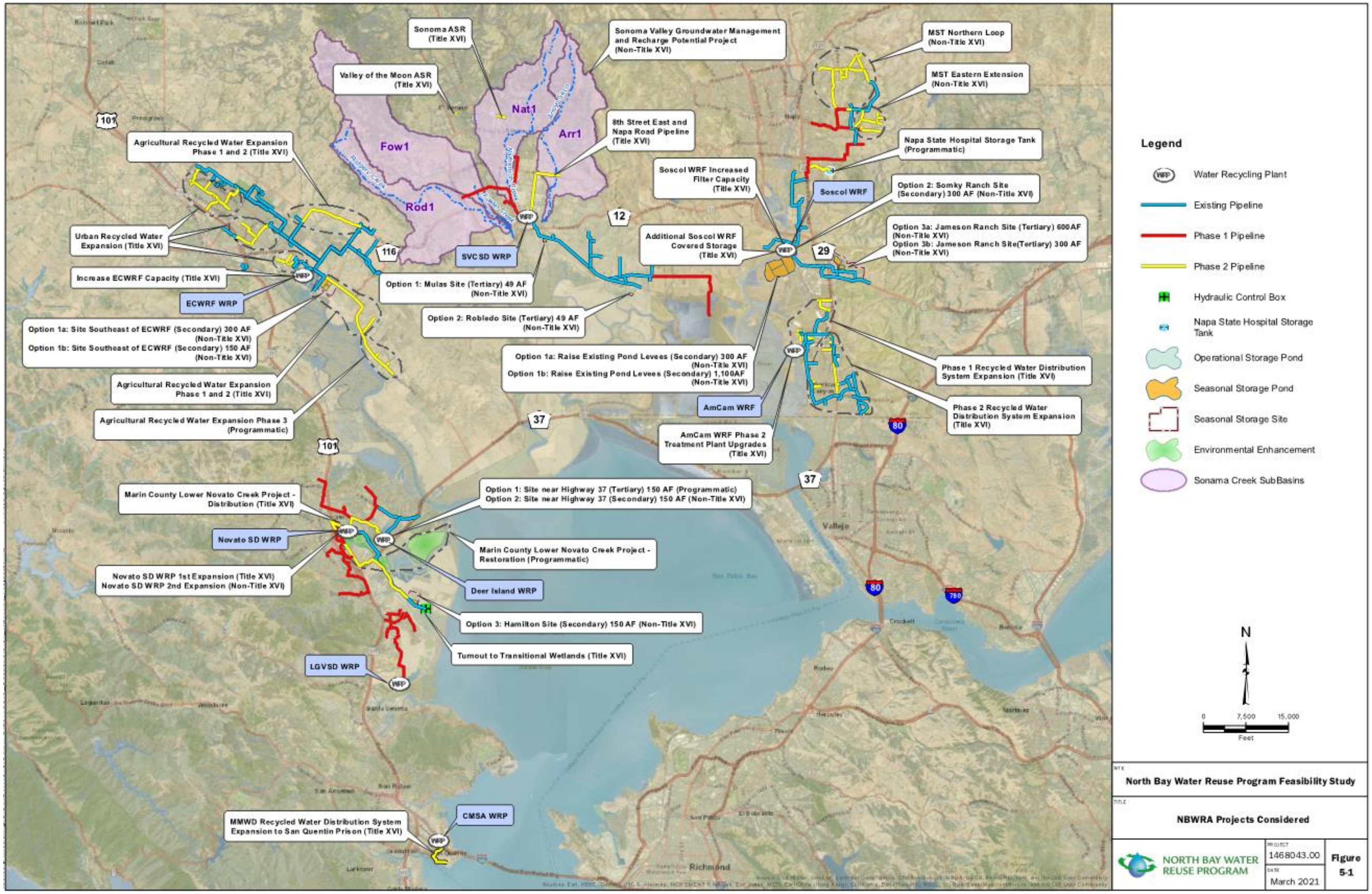



Figure 5-1. NBWRA Projects Considered

**Table 5-1. NBWRA Projects Considered**

| Agency | Project Type | Project Title | Title XVI Project Level EIR/EIS | Programmatic Level | Non-Title XVI Project Level EIR/EIS |
|---|---|---|---|---|---|
| Novato SD | Treatment | Novato SD WRP Capacity - 1st Expansion (+0.85 MGD) | ✓ | | |
| | | Novato SD WRP Capacity - 2nd Expansion (+0.85 MGD) | | | ✓ |
| | Seasonal Storage | Option 1: Site Near Highway 37 (Tertiary) 150 AF | | ✓ | |
| | | Option 2: Site Near Highway 37 (Secondary) 150 AF | | | ✓ |
| | | Option 3: Hamilton Site (Secondary) 150AF | | | ✓ |
| | Environmental Enhancement | Marin County Lower Novato Creek Project - Distribution | ✓ | | |
| | | Marin County Lower Novato Creek Project - Restoration | | ✓ | |
| | | Turnout to Transitional Wetlands | ✓ | | |
| SVCSD | Seasonal Storage | Option 1: Mulas Site (Tertiary) 49 AF | | | ✓ |
| | | Option 2: Robledo Site (Tertiary) 49 AF | | | ✓ |
| | Distribution | 8th Street East and Napa Road Pipelines | ✓ | | |
| SCWA | Seasonal Storage | Valley of the Moon ASR | ✓ | | |
| | | Sonoma ASR | ✓ | | |
| | Groundwater Management | Sonoma Valley Groundwater Management and Recharge Project | | | |
| Petaluma | Treatment | Increase ECWRF Capacity | ✓ | | |
| | Seasonal Storage | Option 1a: Site Southeast of ECWRF (Secondary) 300 AF | | | ✓ |
| | | Option 1b: Site Southeast of ECWRF (Secondary) 150 AF | | | ✓ |
| | Distribution | Urban Recycled Water Expansion | ✓ | | |
| | | Agricultural Recycled Water Expansion Phase 1 | ✓ | | |
| | | Agricultural Recycled Water Expansion Phase 2 | ✓ | | |
| | | Agricultural Recycled Water Expansion Phase 3 | | ✓ | |

**Table 5-1. NBWRA Projects Considered**

| Agency | Project Type | Project Title | Title XVI Project Level EIR/EIS | Programmatic Level | Non-Title XVI Project Level EIR/EIS |
|---|---|---|---|---|---|
| Napa SD | Treatment | Soscol WRF Increased Filter Capacity | ✓ | | |
| | Operational Storage | Additional Soscol WRF Covered Storage | ✓ | | |
| | | Napa State Hospital Storage Tank | | ✓ | |
| | Seasonal Storage | Option 1a: Raise Existing Pond Levees (Secondary) 300 AF | | | ✓ |
| | | Option 1b: Raise Existing Pond Levees (Secondary) 1,100 AF | | | ✓ |
| | | Option 2: Somky Ranch Site (Secondary) 300 AF | | | ✓ |
| | | Option 3a: Jameson Ranch Site (Tertiary) 600 AF (Phase 1) | | | ✓ |
| | | Option 3b: Jameson Ranch Site (Tertiary) 300 AF | | | ✓ |
| | Distribution | MST Northern Loop | | | ✓ |
| | | MST Eastern Extension | | | ✓ |
| MMWD/CMSA | Distribution | Recycled Water Distribution System Expansion to San Quentin Prison | ✓ | | |
| American Canyon | Distribution | Phase 1 Recycled Water Distribution System Expansion | ✓ | | |
| | | Phase 2 Recycled Water Distribution System Expansion | ✓ | | |
| | Treatment | American Canyon WRF Phase 2 Treatment Plant Upgrades | ✓ | | |

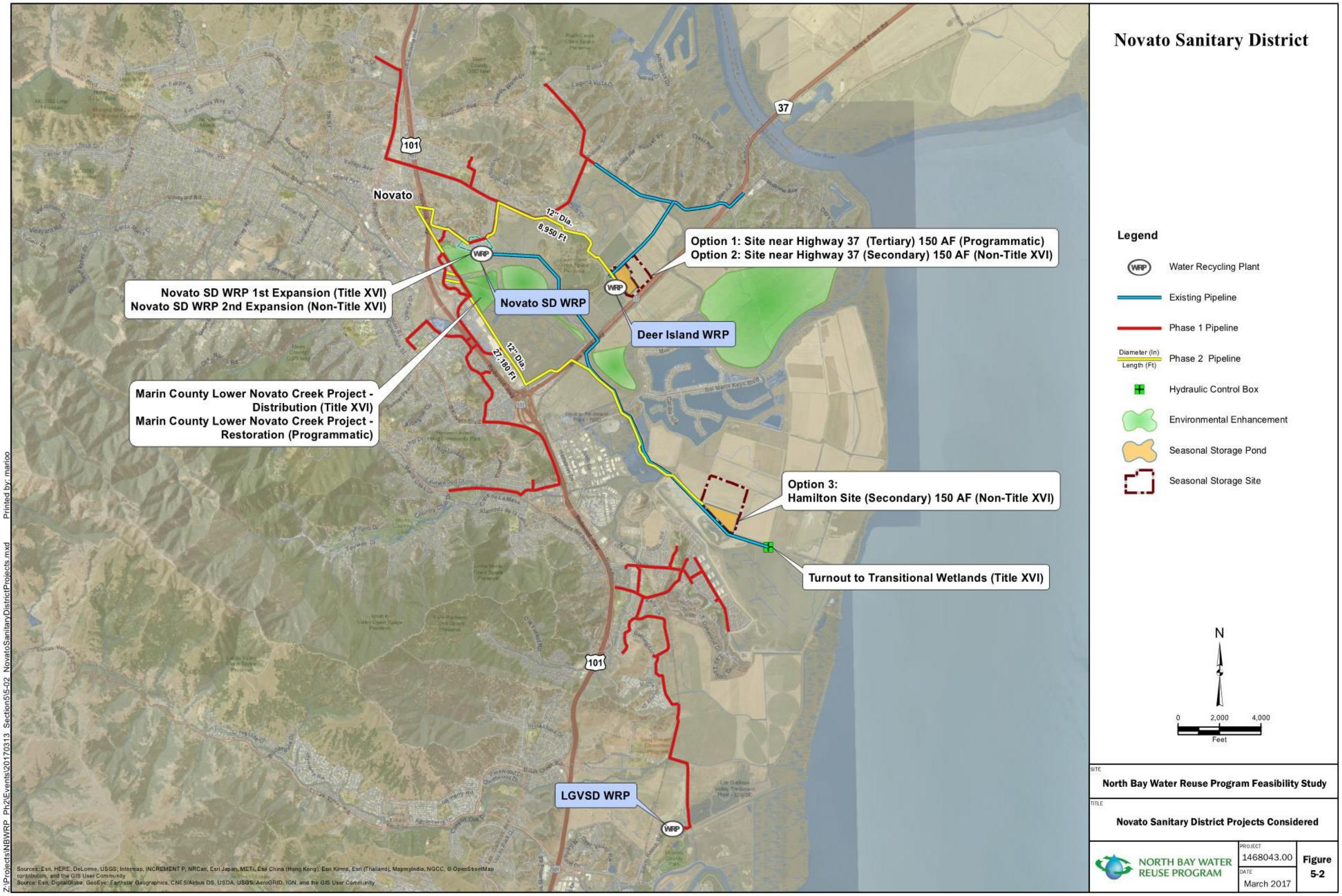



Figure 5-2. Novato Sanitary District Projects Considered

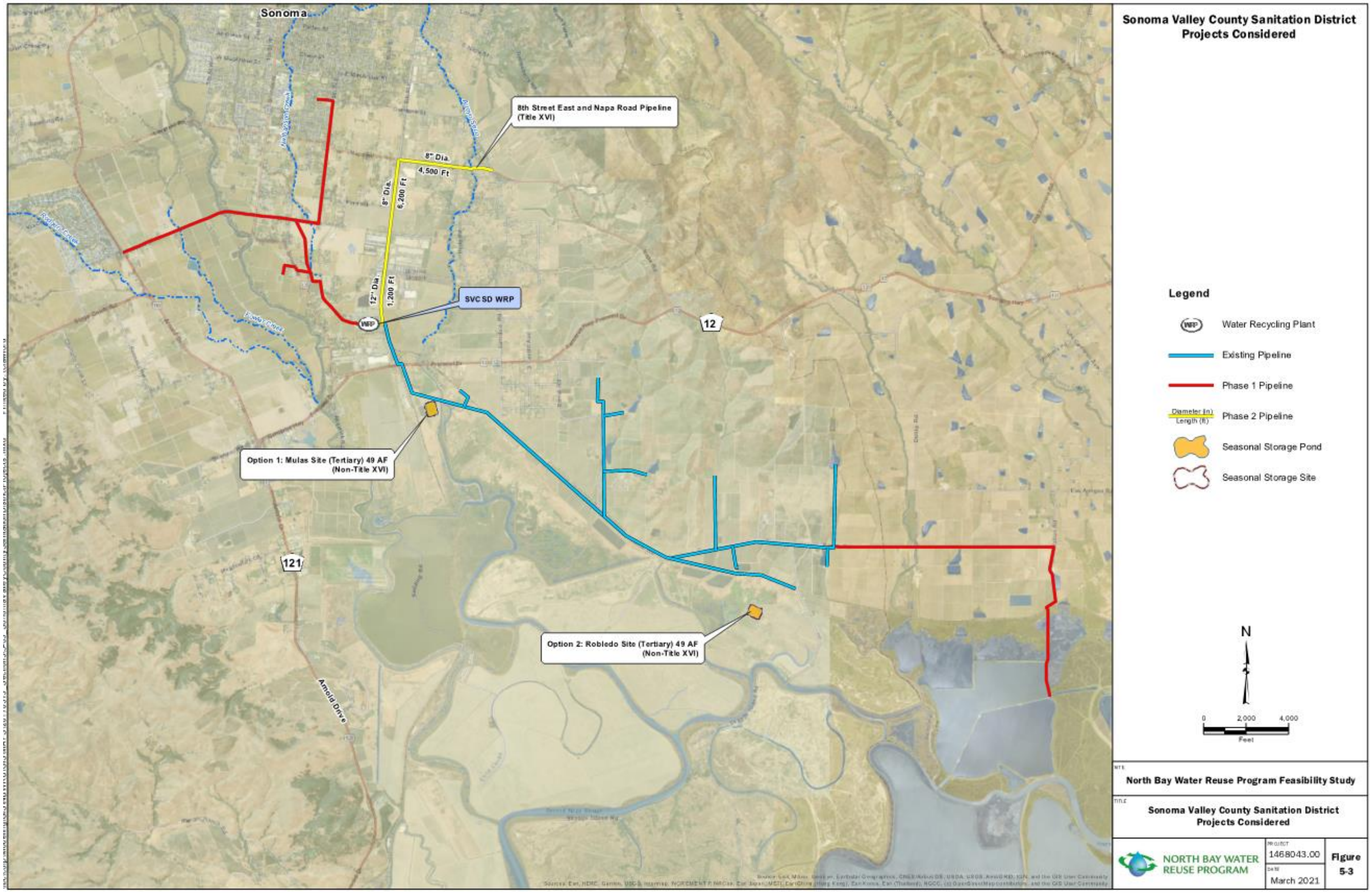



Figure 5-3. Sonoma Valley County Sanitation District Projects Considered

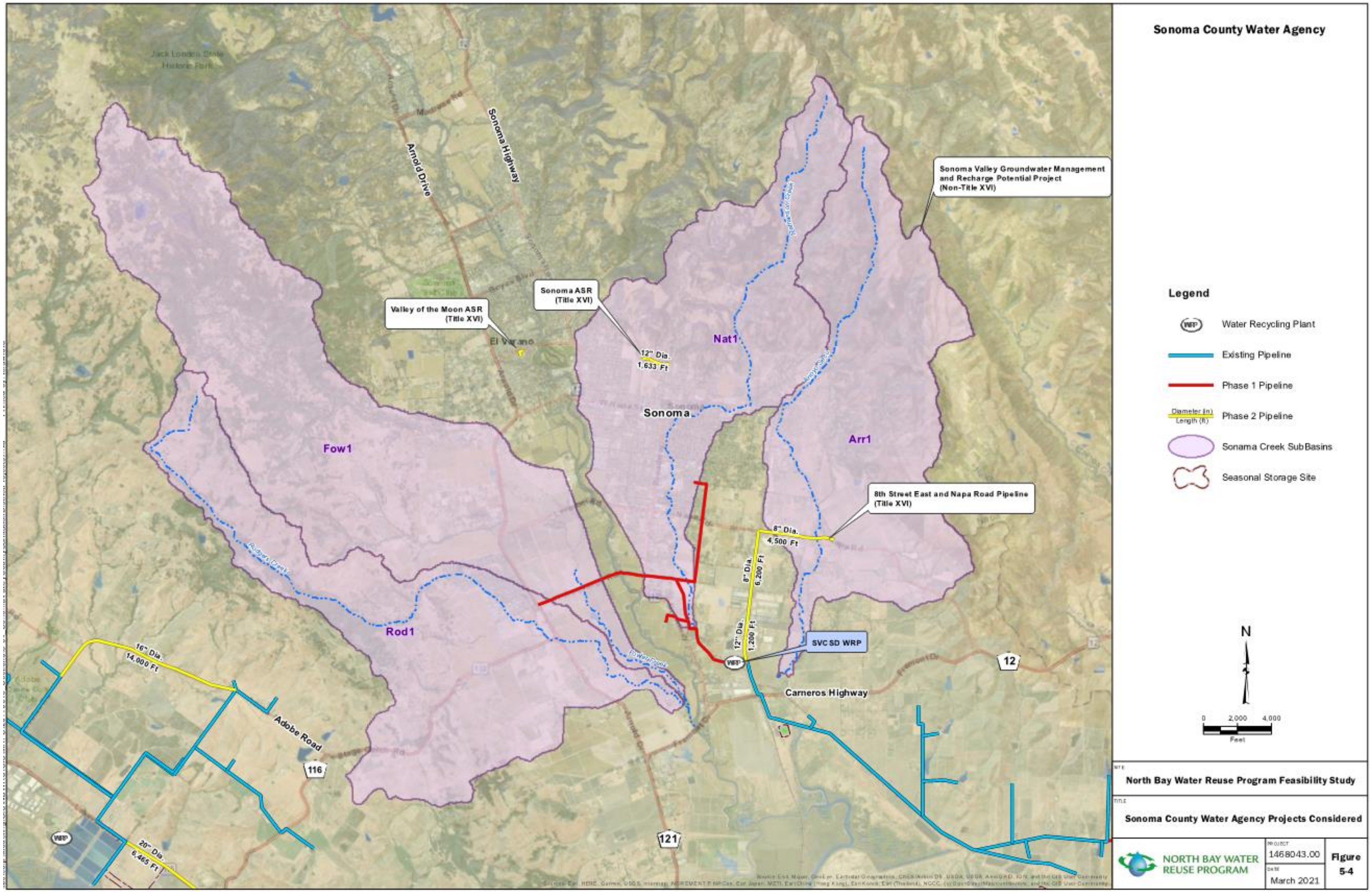



Figure 5-4. Sonoma County Water Agency Projects Considered

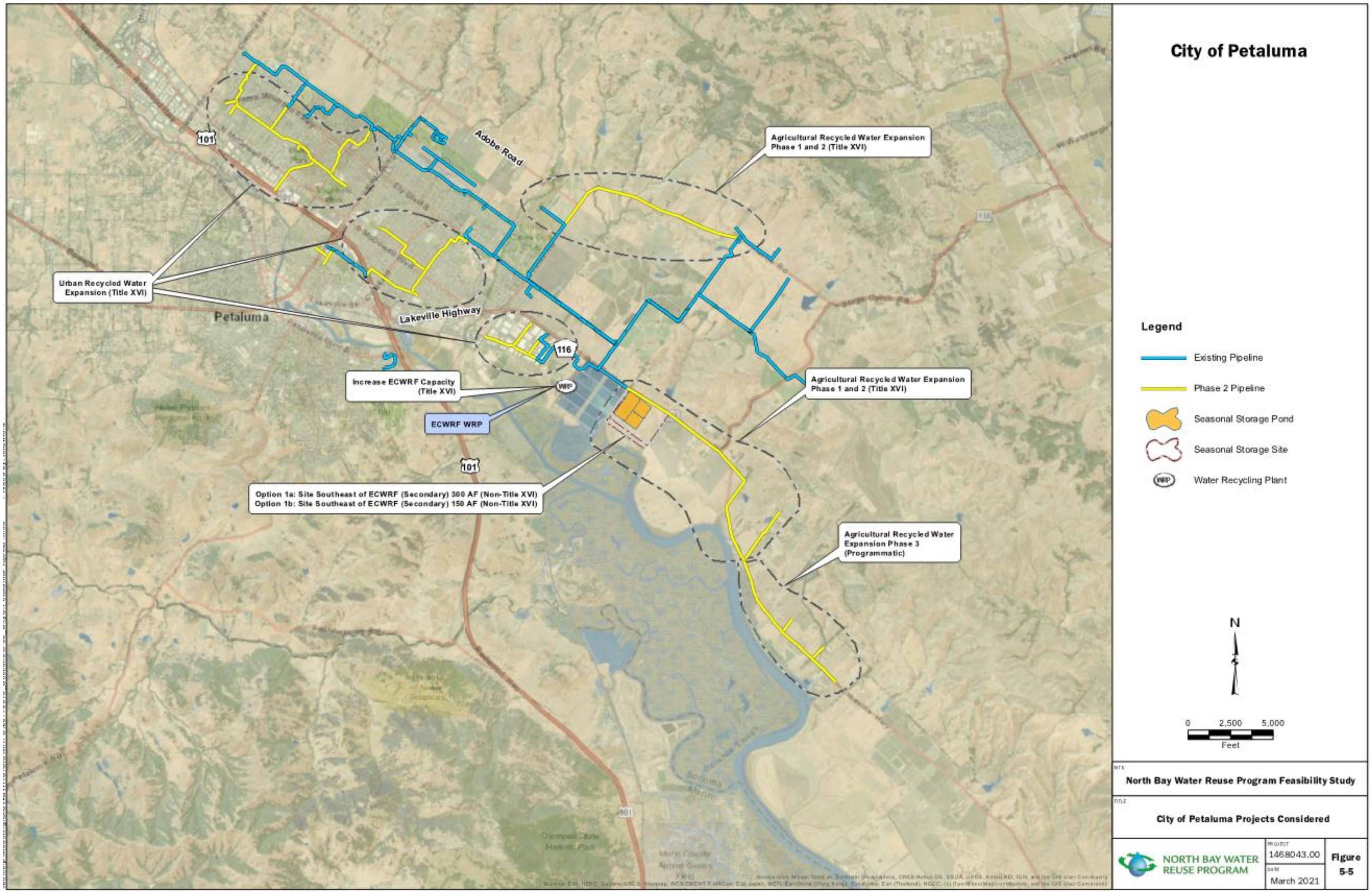



Figure 5-5. City of Petaluma Projects Considered

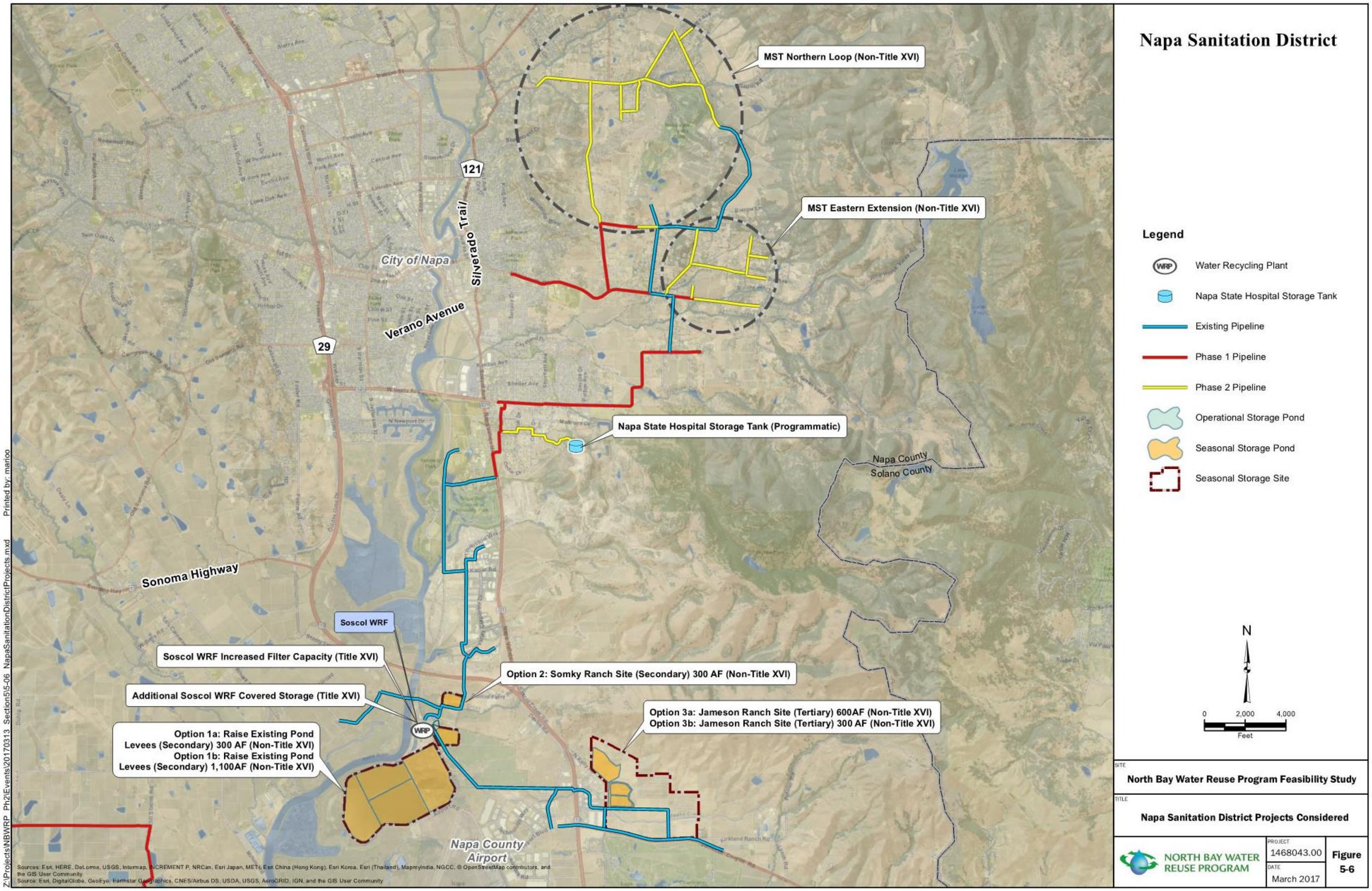



Figure 5-6. Napa Sanitation District Projects Considered

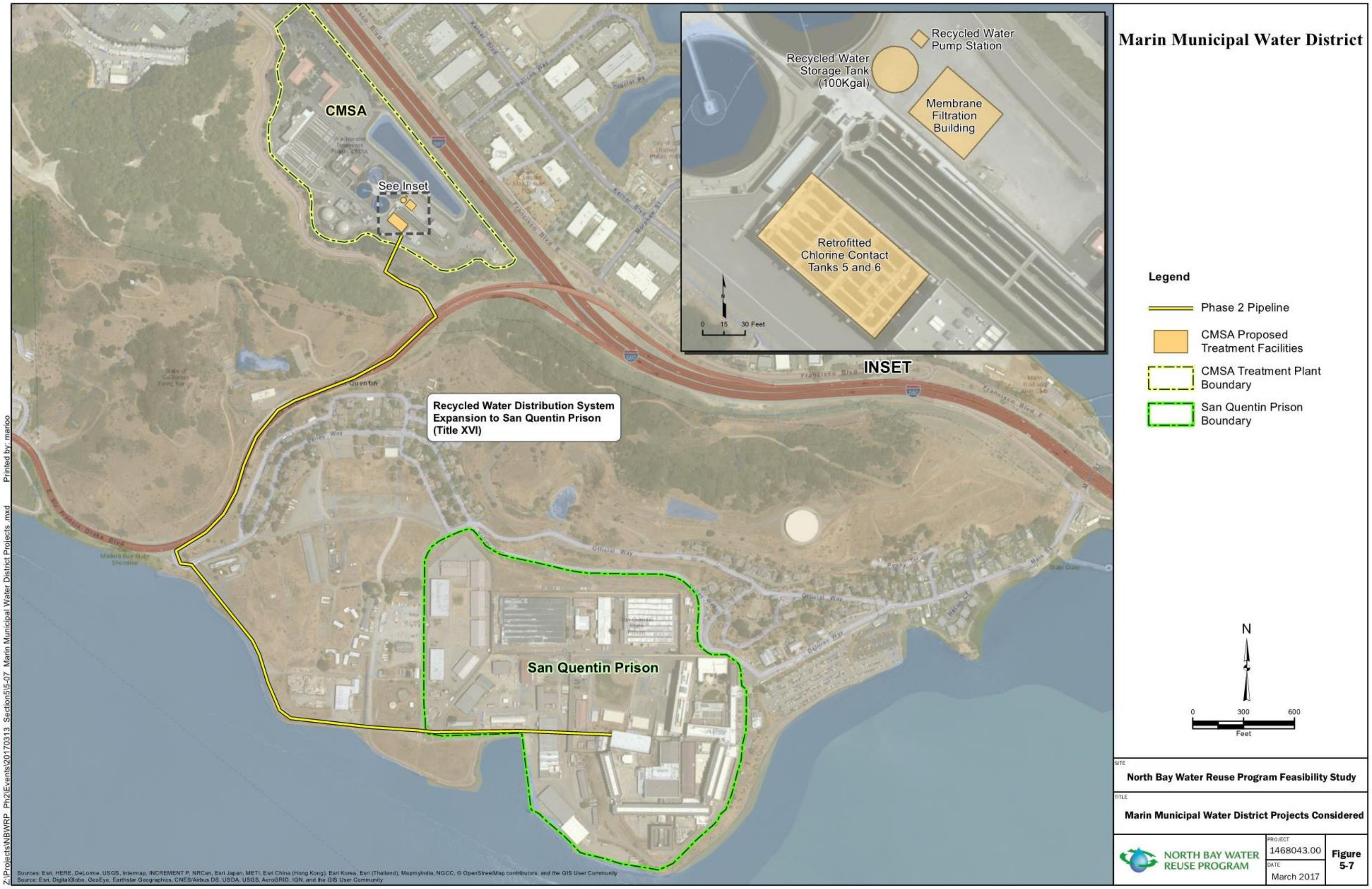



Figure 5-7. Marin Municipal Water District Projects Considered

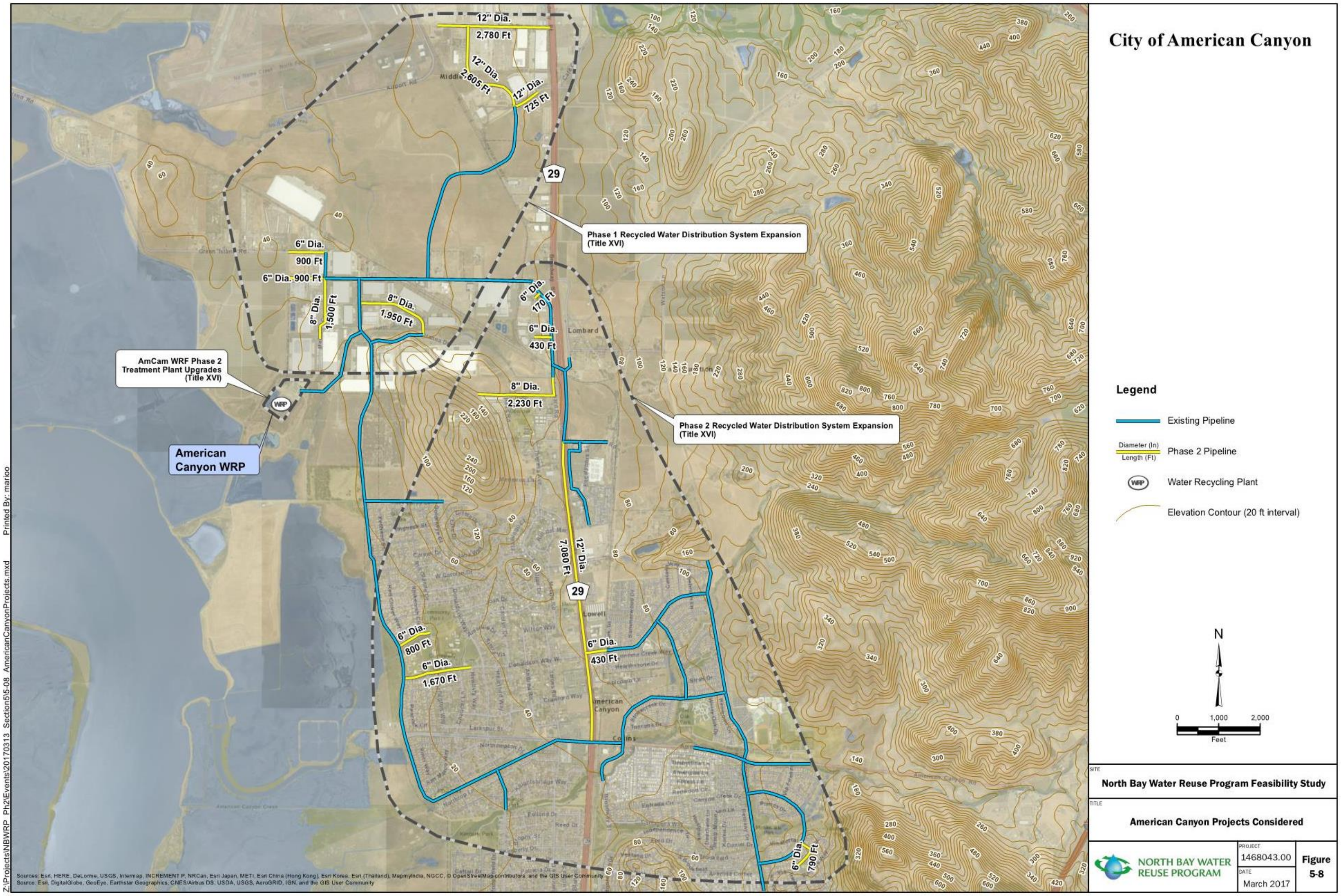



Figure 5-8. American Canyon Projects Considered

## 5.1 NBWRA Phase 2 Title XVI Proposed Program

The Title XVI Program includes sixteen (16) projects (Table 5-2, Figure 5-9), with a total capital cost of approximately $83.2 million. To meet Title XVI funding requirements, these projects have received full feasibility level analysis, environmental documentation and with anticipated construction between 2021 and 2030. A summary of each project, by Agency, is provided in the following sections including project highlights, a map identifying major facilities and place of use, and other considerations for project implementation.

**Table 5-2. Proposed Title XVI Program Projects**

| Agency | Project Type | Project Title | Capital Cost ($ mil) |
|---|---|---|---|
| Novato SD | Treatment | Novato SD WRP Capacity - 1st Expansion (+0.85 MGD) | $4.8 |
| | Environmental Enhancement | Marin County Lower Novato Creek Project - Distribution | $0.9 |
| | | Turnout to Transitional Wetlands | $0.6 |
| SVCSD | Distribution | 8th Street East and Napa Road Pipelines | $2.4 |
| SCWA | Seasonal Storage | Valley of the Moon ASR | $3.7 |
| | | Sonoma ASR | $3.9 |
| City of Petaluma | Treatment | Increase ECWRF Capacity | $9.0 |
| | Distribution | Urban Recycled Water Expansion | $14.6 |
| | | Agricultural Recycled Water Expansion Phase 1 | $12.5 |
| | | Agricultural Recycled Water Expansion Phase 2 | $5.9 |
| Napa SD | Treatment | Soscol WRF Increased Filter Capacity | $2.2 |
| | Operational Storage | Additional Soscol WRF Covered Storage | $2.9 |
| MMWD/CMSA | Distribution | Recycled Water Distribution System Expansion to San Quentin Prison | $7.8 |
| City of American Canyon | Distribution | Phase 1 Recycled Water Distribution System Expansion | $3.1 |
| | | Phase 2 Recycled Water Distribution System Expansion | $2.9 |
| | Treatment | American Canyon WRF Phase 2 Treatment Plant Upgrades | $6.0 |
| | | Total | $83.2 |

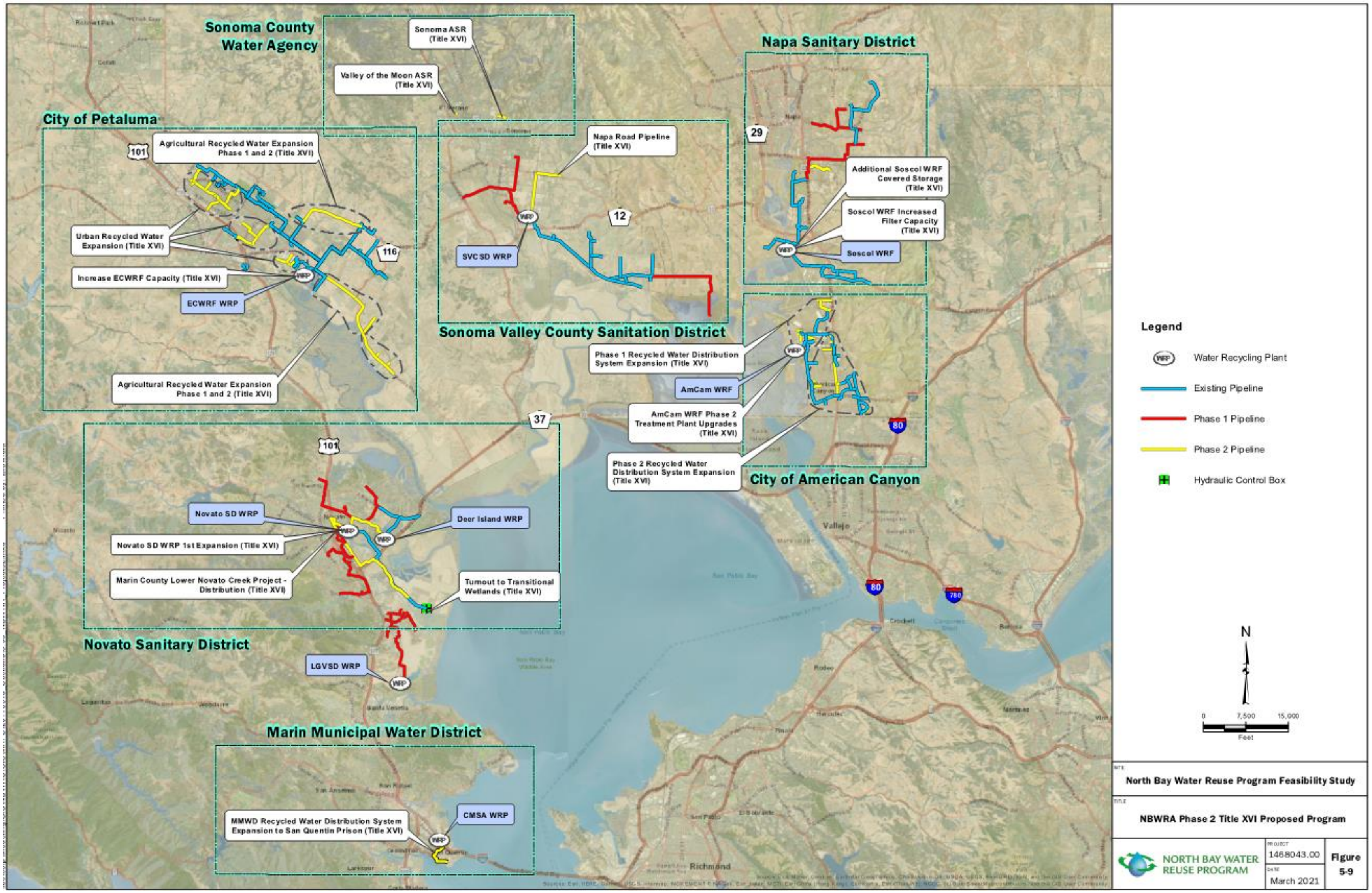



Figure 5-9. NBWRA Phase 2 Title XVI Proposed Program

### 5.1.1 Novato Sanitary District

The proposed Phase 2 Program includes three Title XVI projects for Novato SD, with an estimated total cost of $6.3 million and a project yield of 1,166 AFY.

- Novato SD WRP Capacity – First Expansion (plus 0.85 mgd) ($4.8 million, 286 AFY)
- Marin County Lower Novato Creek Project – Distribution ($0.9 million, 40 AFY)
- Turnout to Transitional Wetlands ($0.6 million, 840 AFY)

#### 5.1.1.1 Novato SD WRP Capacity – First Expansion (plus 0.85 mgd)

This project would include facility upgrades at the existing Novato SD WRP to increase tertiary treatment and disinfection capacity by 0.85 mgd. The existing 1.7 mgd Novato SD WRP was completed in September 2012 under the Phase 1 Program and currently supplies tertiary recycled water to NMWD. The project would construct additional tertiary filters, associated pipelines and mechanical equipment, and an additional chlorine contact tank within the area shown in Figure 5-10.

Title XVI project components include the following:

- **Major Facilities**: 0.85-mgd capacity tertiary filters with associated piping, 250,000-gallon chlorine contact tank.
- **Project Yield**: 286 AFY of additional tertiary recycled water available for reuse based on the additional peak production of 0.85 mgd providing an average annual production of 0.26 mgd.
- **Total Project Capital Cost**: $4.8 million.
- **Annual O&M Cost**: $0.19 million, based on energy, chemical usage and additional labor to operate and maintain the filters.

This project would efficiently utilize existing assets to increase recycled water supply. The project site is located within the already disturbed area at the existing Novato SD owned WRP, thus, requiring minimal construction in undisturbed areas. This diversion of wastewater effluent for recycled water production would reduce the amount of wastewater discharged to rivers and streams in the winter, reducing instream flow. The Novato SD WRP is located within a moderate flood risk area, which makes it vulnerable to the risk of increased flooding and inundation due to climate change (e.g., sea level rise combined with 100-year flood as shown in Figure 2-3). The construction of new facilities should consider design elements to address flood risk and inundation vulnerability. Additionally, water quality into the WRP could be impacted due to an increased I&I in the sewer system as a result of sea level rise and/or more intense rainfall.

A second expansion project to increase tertiary treatment and disinfection capacity at the Novato SD WRP is included in the Non-Title XVI category and discussed in Section 5.3.


**Figure 5-10. Novato SD WRP Capacity – 1st and 2nd Expansion**

#### 5.1.1.2 Marin County Lower Novato Creek Project - Distribution

The Lower Novato Creek Project consists of six related projects located downstream of the Sonoma-Marin Area Rail Transit (SMART) bridge to Highway 37. All the facilities being designed to be adaptive to sea level rise and climate change, and are habitat restoration projects. Additionally, this project supports shifting use of lands from irrigated hayfields to restored tidal marsh and ecotone levees adaptive to sea level rise. The ability to implement this overall project relies on the Novato SD WRP Capacity Projects. The six individual projects included in the Lower Novato Creek Project are undergoing final consideration by Marin County; therefore, they have only been developed to the appraisal level.

Project 1, described below and shown in Figure 5-11, is the only project that is included in the Phase 2 Program. The remaining five projects are categorized as Programmatic Level projects and further described in Section 5.2.1.2. Project 1 would create habitat opportunities and create levees that could utilize recycled water from Novato SD to establish and maintain habitat. The Phase 2 Program includes the distribution facilities necessary to deliver recycled water to the levees.

- **Project 1, to be constructed by Marin County, includes the following:**
  - Flood-flow lateral bypass weir into North Deer Island Detention Basin: Constructing a flood flow weir from Novato Creek into the North Deer Island stormwater detention basin to reduce peak flood water surface elevations and increase upstream flood protection.
  - Installing culverts to provide gravity drainage of floodwaters from the basin back to Novato Creek during low tides.
  - Constructing new eco-tone levees to protect adjacent properties including the newly upgraded treatment plant will be adaptive to sea level rise and provide transitional habitat. The eco-tone levees will be able to accommodate recycled water.

Title XVI Project components include the following:

- **Major Facilities**: 5,443 linear feet (LF) of 6-inch-diameter distribution pipelines and 337 LF of 4-inch-diameter distribution pipelines along the levees.
- **Project Yield**: 40 AFY.
- **Total Project Capital Cost**: $0.9 million.
- **Annual O&M Cost**: Cost of O&M not included in this analysis.

Project 1, the North Deer Island Basin weir, is partially funded through a $1.5 million grant from the DWR IRWMP. The DWR grant will be matched with up to $1 million of Flood Control Zone 1 funds to design and construct the project by 2019.

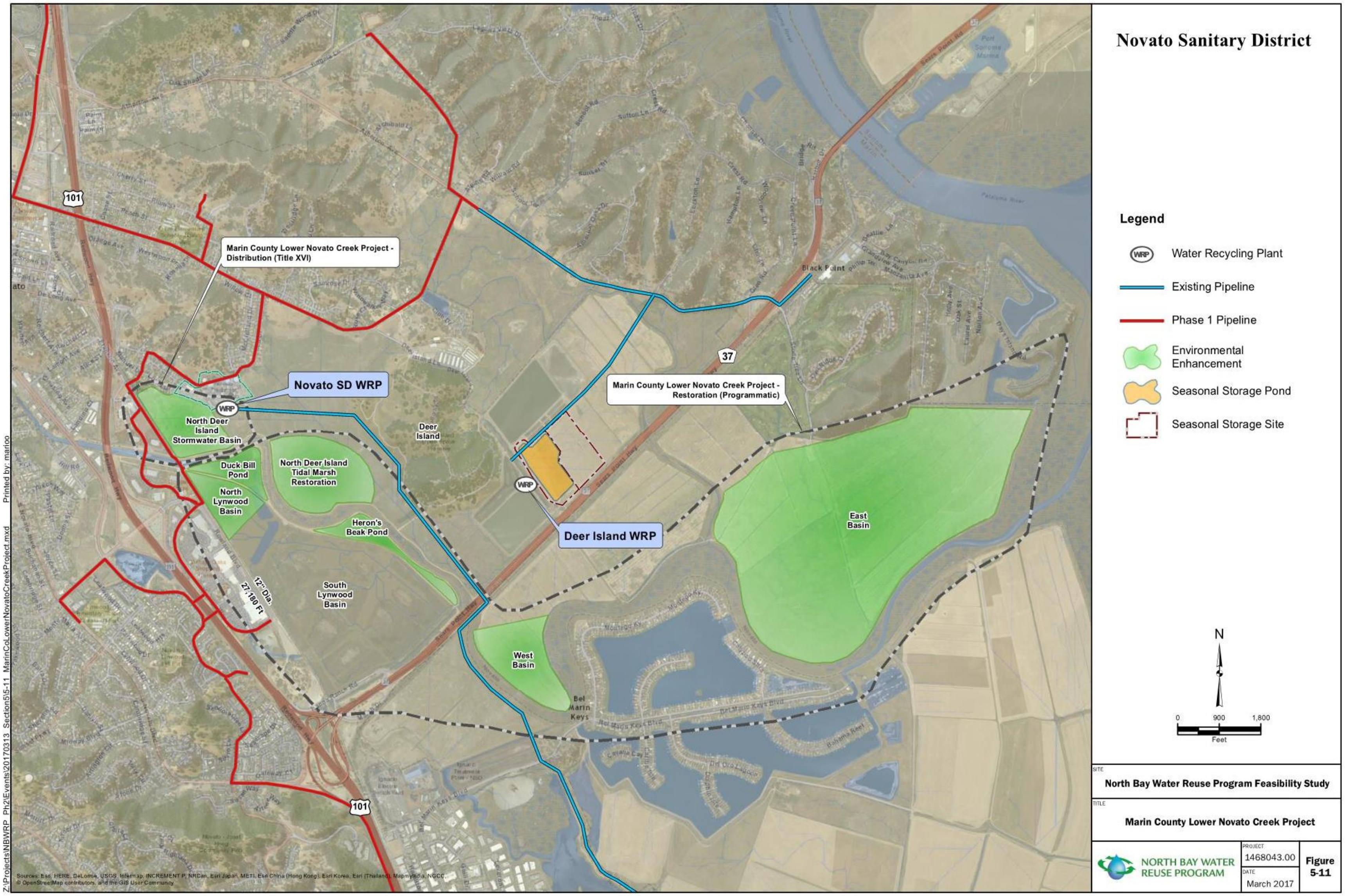



Figure 5-11. Marin County Lower Novato Creek Project

#### 5.1.1.3 Turnout to Transitional Wetlands (Hamilton-Bel Marin Keys Wetland Restoration Project)

Novato SD worked with Coastal Conservancy to gain approval from the RWQCB to include provisions in the new NPDES permit renewal that would allow a turnout form the existing Novato SD outfall for Coastal Conservancy to use the treated wastewater in the next phase of the restoration project. This project would include connecting to the existing outfall pipeline discharging into San Pablo Bay to divert water and discharge into new transitional brackish wetlands created under another project by the Coastal Conservancy, the Hamilton-Bel Marin Keys (BMK) Wetland Restoration Project. Both CEQA and NEPA for the larger BMK Wetland Restoration Project was previously completed in the Bel Marin Keys Unit V Expansion of the Hamilton Wetland Restoration Project Supplemental EIR/EIS and subsequent documentation. Minimal new infrastructure would be required because the existing outfall pipeline would be utilized to convey recycled water for use to restore fresh and brackish marsh habitat along newly constructed shoreline. This project would provide a significant beneficial reuse of water that would otherwise be discharged to the San Pablo Bay. The project would allow for year-round use of wastewater for a direct environmental benefit. Figure 5-12 shows the location of this project.

Title XVI Project components include the following:

- **Major Facilities**: Hydraulic structure to connect to existing outfall pipeline, flow splitting structure to divert flow for beneficial use, 100 LF of 54-inch-diameter pipeline.
- **Project Yield**: 840 AFY.
- **Total Project Capital Cost**: $0.6 million.
- **Annual O&M Cost**: $0.02 million, based on additional labor to operate and maintain the facilities.

This project would utilize existing infrastructure to provide recycled water to an environmental enhancement project. The ecosystem of San Pablo Bay would benefit from a major increase in new tidal marsh, mudflats, and shallow sub-tidal habitat totaling over 1,500 acres. The project will improve water quality in the San Pablo Bay by removing a source of wastewater that is discharged offshore during the wet season. The project will also provide new marsh habitat that will be home to a variety of bird and fish species, thereby improving several beneficial uses of San Pablo Bay. The project would change the management of wastewater to a year-round diversion from bay discharge. This change will have the added benefit of making the spray fields available for other public uses (they are owned by Marin County). The project site is located on soft bay mud which increases risks associated with construction and long term consolidation settlements and is highly vulnerable to climate change induced sea level rise because it is located in an area that could be inundated (e.g., sea level rise combined with 100-year flood as shown in Figure 2-3). Damage to infrastructure due to high water events could lead to increased costs. Additionally, water quality and quantity would be impacted by impacts at the WRP such as increased salinity due to sea level rise or increased I&I.


Figure 5-12. Turnout to Transitional Wetlands

### 5.1.2 Sonoma Valley County Sanitation District

The proposed Phase 2 Program includes one Title XVI project for SCVSD, with a total estimated cost of $2.4 million and a project yield of 225 AFY. The selected project is described in detail in the following section.

#### 5.1.2.1 8th Street East and Napa Road Pipelines

The 8th Street East Pipeline will allow SCVSD to supply recycled water for commercial use at the Sonoma Valley Airport Business Park and supply recycled water to agricultural users along 8th Street East. The pipeline would tie-in into an existing connection from the R5 Reservoir at the SCVSD WWTP and head north up 8th Street East towards Napa Road, then east along Napa Road, as shown in Figure 5-13

The Napa Road Pipeline would expand the recycled water service area in the unincorporated areas of Sonoma County along Napa Road, as shown in Figure 5-13. The pipeline would connect to existing pipelines and extend eastward to serve additional customers. Since the pipeline would be built in an existing road, the project would be within already disturbed areas.

Title XVI Project components include the following:

- **Major Facilities**: 1,200 LF of 12-inch-diameter pipelines and 10,700 LF of 8-inch-diameter pipelines.
- **Project Yield**: 225 AFY.
- **Total Project Capital Cost**: $2.4 million.
- **Annual O&M Cost**: $0.03 million, based on energy used for pumping, and additional labor to maintain and repair the pipelines.

This project would efficiently utilize existing assets to increase the distribution of recycled water. Pipeline projects such as this have low vulnerability to climate change because these projects generally involve constructing buried, pressurized pipelines. Material selection for the pipelines and fittings should take into consideration the possibility of corrosion from seawater as well as other typical and site-specific parameters.


Figure 5-13. 8th Street East and Napa Road Pipelines

### 5.1.3 Sonoma County Water Agency

The proposed Phase 2 Program includes two Title XVI projects for SCWA, with a total estimated cost of $7.6 million and a project yield of 140 AFY. The selected projects are described in detail in the following sections.

- Valley of the Moon ASR ($3.7 million, 80 AFY)
- Sonoma ASR ($3.9 million, 60 AFY)

#### 5.1.3.1 Valley of the Moon Aquifer Storage and Recovery

The purpose of this project is to inject potable water into the VOM aquifer for later recovery and use. The source water would be potable water produced at SCWA's existing Russian River production facilities during winter and spring seasons. Injection wells would introduce the water into the VOM aquifer for later extraction at the same site during dry months or emergency situations. The VOM ASR site is located near an existing SCWA potable water pipeline which would be used to fill the ASR. A new ASR well would be constructed to allow for extraction to capture 80 AFY of injected potable water. Wellheads would be equipped for chlorination/dechlorination. A new pipeline and pump station would be constructed to convey water from the VOM ASR to the existing nearby VOMWD potable water distribution system. Figure 5-14 shows the location of this project.

Title XVI Project components include the following:

- **Major Facilities**: Well equipping to construct one new groundwater well for ASR, two new monitoring wells, and 500 LF of 6-inch-diameter pipelines; One 100 gpm, 1-horsepower pump station.
- **Project Yield**: ASR with 80 AFY of additional water available for use based annual injection rates.
- **Total Project Capital Cost**: $3.7 million.
- **Annual O&M Cost**: $0.13 million, based on energy for pumping, chemical usage for well head chlorination, and additional labor to operate and maintain the ASR system, pump station, and pipelines.

This project would utilize available potable water during winter months to meet demand during summer months. The project site is located within a moderate flood risk area, making it vulnerable to the risk of increased flooding due to climate change. The construction of new facilities should consider design elements to address flood risk vulnerability. This project has low vulnerability to climate change impacts to water demand and supply since the project utilizes potable water produced during winter and spring seasons for aquifer recharge and augmenting water supply during the high demand summer months. While the aquifer would not be impacted by sea level rise since it is located far from the San Pablo Bay, it is located in a moderate flood risk zone and infrastructure damage from flooding is possible.


Figure 5-14. Valley of the Moon ASR

#### 5.1.3.2 Sonoma ASR

Similar to the VOM ASR project, described in Section 5.1.3.1, this project would store potable water produced at SCWA's existing Russian River production facilities during winter and spring seasons in the Sonoma Aquifer for later extraction. Injection wells would introduce potable water into the Sonoma Aquifer with subsequent recovery at the same site during dry months or emergency situations. A new ASR well would be constructed to allow for extraction to capture the 60 AFY of injected potable water. Wellheads would be equipped for chlorination/dechlorination. A new pipeline would be constructed to convey water from the existing SCWA potable water distribution system to the Sonoma ASR during winter. A new pump station would also be constructed to pump the extracted water from the Sonoma ASR through the new pipelines to fill existing SCWA potable water tanks for use during the summer. Figure 5-15 shows the location of this project.

Title XVI Project components include the following:

- **Major Facilities**: Well equipment to construct one new groundwater well for ASR, conversion of existing groundwater well to monitoring well, construction of two new monitoring wells, 1,700 LF of 6-inch diameter pipelines; One 100 gpm, 1-horsepower pump station.
- **Project Yield**: ASR with 60 AFY of additional water available for reuse based annual injection rates.
- **Total Project Capital Cost**: $3.9 million.
- **Annual O&M Cost**: $0.12 million, based on energy for pumping, chemical usage for well head chlorination, and additional labor to operate and maintain the ASR system, pump station, and pipelines.

This project would efficiently utilize available potable water during winter months to meet demand during summer months. The project site is located within a moderate flood risk area, making it vulnerable to the risk of increased flooding due to climate change. The construction of new facilities should consider design elements to address flood risk vulnerability. Similar to the VOM ASR project, this project has low to insignificant vulnerability to water demand, water supply, and sea level rise as a result of climate change; however, it is moderately to highly vulnerable to water quality and infrastructure impacts from flooding.


Figure 5-15. Sonoma Aquifer Storage and Recovery

### 5.1.4 City of Petaluma

The proposed Phase 2 Program includes four Title XVI projects for the City of Petaluma, with a total estimated cost of $37.3 million and a project yield of 2,419 AFY. The selected projects are described in detail in the following sections.

- Increase ECWRF Capacity ($9.0 million, 712 AFY)
- Urban Recycled Water Expansion ($14.6 million, 223 AFY)
- Agricultural Recycled Water Expansion Phase 1 ($10.2 million, 1,113 AFY)
- Agricultural Recycled Water Expansion Phase 2 ($5.9 million, 524 AFY)

#### 5.1.4.1 Increase Ellis Creek Water Reclamation Facility Capacity

This project would include facility upgrades at the existing ECWRF to increase tertiary filtration and disinfection capacity by 2.12 mgd. The existing ECWRF is able to treat 6.8 mgd to secondary treatment standards but only 4.68 mgd to CCR Title 22 tertiary disinfected standards. The existing post-secondary process includes continuous backwash filters and a UV disinfection system. The existing UV system was constructed with a third channel not currently in use to allow for future expansion. This project would install five new filter cells that mirror the existing treatment system and would also install banks of UV lamps in the existing, unused channel. These improvements would allow the City of Petaluma to produce additional tertiary treated recycled water to meet increasing recycled water demands. Figure 5-16 shows the location of this project.

Title XVI Project components include the following:

- **Major Facilities**: 2.12 mgd capacity tertiary filters with associated piping and pumps and UV disinfection lamps.
- **Project Yield**: 712 AFY of additional tertiary recycled water available for reuse based on the additional peak production of 2.12 mgd, providing an average annual production of 0.64 mgd.
- **Total Project Capital Cost**: $9.0 million.
- **Annual O&M Cost**: $0.36 million, based on energy, chemical usage, and additional labor to operate and maintain the filters and UV disinfection system.

This project would efficiently utilize existing assets to increase recycled water supply. The project site is located within the already disturbed area at the existing City of Petaluma-owned ECWRF facility, thus, requiring minimal construction in undisturbed areas. ECWRF is located within a moderate flood risk area, which makes it vulnerable to the risk of increased flooding and inundation due to climate change (e.g., sea level rise combined with 100-year flood as shown in Figure 2-3). The construction of new facilities should consider design elements to address flood risk and inundation vulnerability. This project would reduce the amount of wastewater discharged to rivers and streams in winter by using the wastewater for recycled water production. Water quality into the WRP could be impacted due to increased I&I in the sewer system as a result of sea level rise and/or intense winter rainfall.


Figure 5-16. Increase ECWRF Capacity

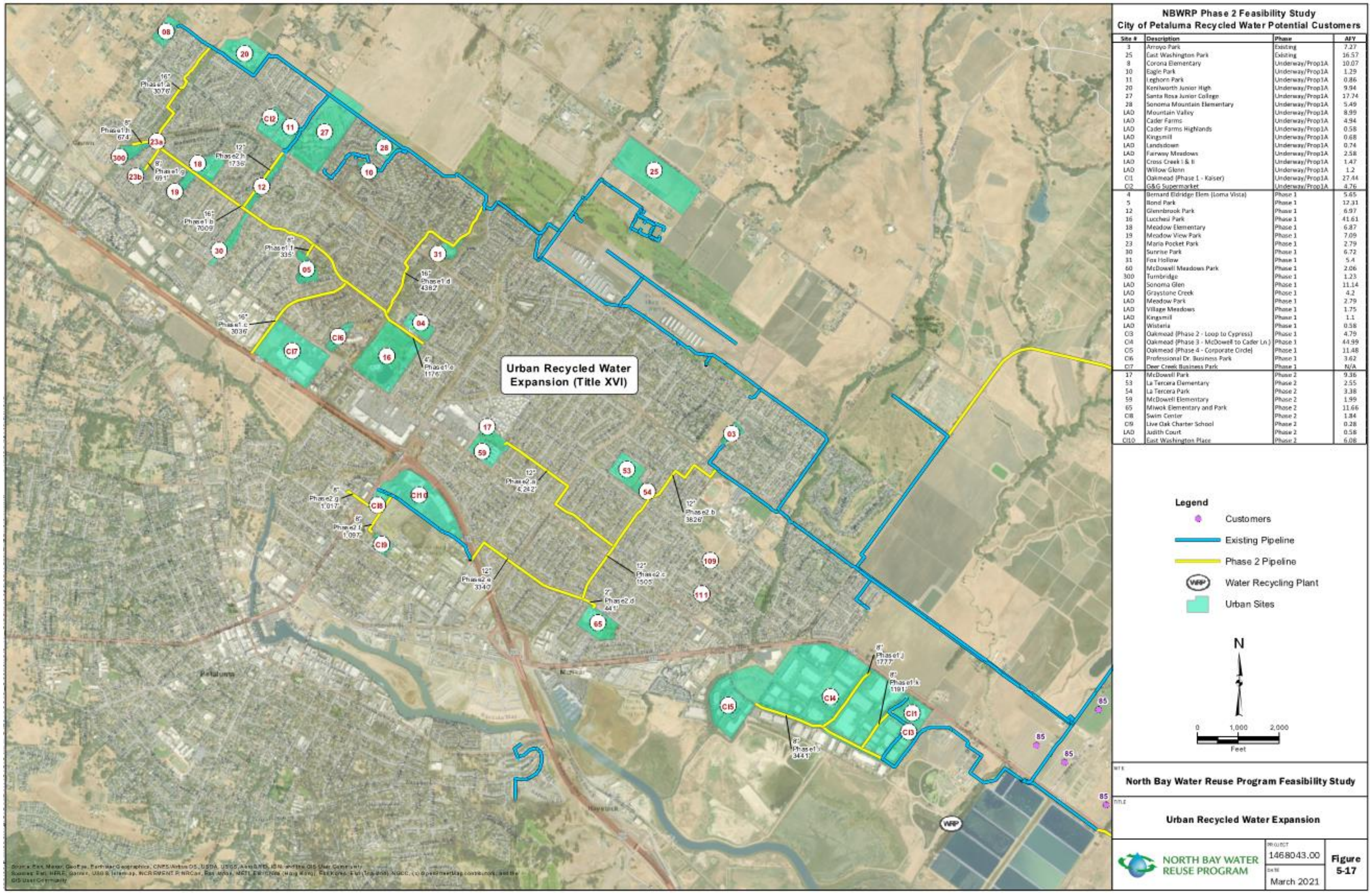
#### 5.1.4.2 Urban Recycled Water Expansion

The Urban Recycled Water Expansion project would extend recycled water pipelines from the end of the existing 20-inch-diameter pipeline that originates from the ECWRF to serve existing landscape customers currently served by the City of Petaluma's potable water system. The project will also extend a pipeline from the existing 8-inch-diameter pipeline near ECWRF to serve the Oakmead cluster. The total project yield is about 223 AFY. Hydraulic modeling was performed to size conveyance facilities, as described in Appendix C. Figure 5-17 shows the location of project pipeline alignments.

Title XVI Project components include the following:

- **Major Facilities**: 17,500 LF of 16-inch-diameter pipelines, 14,900 LF of 12-inch-diameter pipelines, 12,200 LF of 8-inch-diameter pipelines, 1,600 LF of 2- and 4-inch-diameter pipelines, and 60 LF of special pipeline crossings.
- **Project Yield**: 223 AFY.
- **Total Project Capital Cost**: $14.6 million.
- **Annual O&M Cost**: $0.07 million, based on and additional labor to maintain and repair the pipelines.

This project would efficiently utilize existing assets to increase the distribution of recycled water. The proposed pipeline alignment is along roads in the City's right of way, within already disturbed areas. The number of creek crossings would be minimized and green ways would be avoided to minimize construction in undisturbed areas. The vulnerability to climate change is low to insignificant because pipeline distribution projects such as this generally involve constructing buried, pressurized pipelines which reduces exposure to climate change impacts. Material selection for the pipelines and fittings should take into consideration the possibility of corrosion from seawater as well as other typical and site-specific parameters. In addition, the water quality and quantity conveyed by the recycled water distribution system would be impacted by quality changes at the ECWRF.




**NBWRP Phase 2 Feasibility Study**
**City of Petaluma Recycled Water Potential Customers**

| Site # | Description | Phase | AFY |
|---|---|---|---|
| 3 | Arroyo Park | Existing | 7.27 |
| 25 | East Washington Park | Existing | 16.57 |
| 8 | Corona Elementary | Underway/Prop1A | 10.07 |
| 10 | Eagle Park | Underway/Prop1A | 1.29 |
| 11 | Leghorn Park | Underway/Prop1A | 0.86 |
| 20 | Kenilworth Junior High | Underway/Prop1A | 9.94 |
| 27 | Santa Rosa Junior College | Underway/Prop1A | 17.74 |
| 28 | Sonoma Mountain Elementary | Underway/Prop1A | 5.49 |
| LAD | Mountain Valley | Underway/Prop1A | 8.99 |
| LAD | Cader Farms | Underway/Prop1A | 4.94 |
| LAD | Cader Farms Highlands | Underway/Prop1A | 0.58 |
| LAD | Kingsmill | Underway/Prop1A | 0.68 |
| LAD | Landsdown | Underway/Prop1A | 0.74 |
| LAD | Fairway Meadows | Underway/Prop1A | 2.58 |
| LAD | Cross Creek I & II | Underway/Prop1A | 1.47 |
| LAD | Willow Glenn | Underway/Prop1A | 1.2 |
| CI1 | Oakmead (Phase 1 - Kaiser) | Underway/Prop1A | 27.44 |
| CI2 | G&G Supermarket | Underway/Prop1A | 4.76 |
| 4 | Bernard Eldridge Elem (Loma Vista) | Phase 1 | 5.65 |
| 5 | Bond Park | Phase 1 | 12.31 |
| 12 | Glennbrook Park | Phase 1 | 6.97 |
| 16 | Lucchesi Park | Phase 1 | 41.61 |
| 18 | Meadow Elementary | Phase 1 | 6.87 |
| 19 | Meadow View Park | Phase 1 | 7.09 |
| 23 | Maria Pocket Park | Phase 1 | 2.79 |
| 30 | Sunrise Park | Phase 1 | 6.72 |
| 31 | Fox Hollow | Phase 1 | 5.4 |
| 60 | McDowell Meadows Park | Phase 1 | 2.06 |
| 300 | Turnbridge | Phase 1 | 1.23 |
| LAD | Sonoma Glen | Phase 1 | 11.14 |
| LAD | Graystone Creek | Phase 1 | 4.2 |
| LAD | Meadow Park | Phase 1 | 2.79 |
| LAD | Village Meadows | Phase 1 | 1.75 |
| LAD | Kingsmill | Phase 1 | 1.1 |
| LAD | Wisteria | Phase 1 | 0.58 |
| CI3 | Oakmead (Phase 2 - Loop to Cypress) | Phase 1 | 4.79 |
| CI4 | Oakmead (Phase 3 - McDowell to Cader Ln.) | Phase 1 | 44.99 |
| CI5 | Oakmead (Phase 4 - Corporate Circle) | Phase 1 | 11.48 |
| CI6 | Professional Dr. Business Park | Phase 1 | 3.62 |
| CI7 | Deer Creek Business Park | Phase 1 | N/A |
| 17 | McDowell Park | Phase 2 | 9.36 |
| 53 | La Tercera Elementary | Phase 2 | 2.55 |
| 54 | La Tercera Park | Phase 2 | 3.38 |
| 59 | McDowell Elementary | Phase 2 | 1.99 |
| 65 | Miwok Elementary and Park | Phase 2 | 11.66 |
| CI8 | Swim Center | Phase 2 | 1.84 |
| CI9 | Live Oak Charter School | Phase 2 | 0.28 |
| LAD | Judith Court | Phase 2 | 0.58 |
| CI10 | East Washington Place | Phase 2 | 6.08 |

Figure 5-17. Urban Recycled Water Expansion

Brown AND Caldwell

#### 5.1.4.3 Agricultural Recycled Water Expansion – Phase 1 and Phase 2

The City of Petaluma's Agricultural Recycled Water Expansion program would extend recycled water pipelines from the ECWRF eastward to serve agricultural customers along Lakeville Highway. The expansion is divided into three phases, as described below and shown in Figure 5-18.

- **Phase 1**, a Title XVI Project, extends pipelines from ECWRF to Stage Gulch Road to supply 813 AFY. Phase 1 would also construct a pipeline along Adobe Road to supply an additional 300 AFY.
- **Phase 2**, a Title XVI Project, extends pipelines from Stage Gulch Road to Cannon Road to supply 530 AFY of recycled water.
- **Phase 3**, a Programmatic-Level Project, is described in Section 5.2.2.1.

The distribution pipeline along Lakeville Highway for Phase 1 and 2 would be sized to meet future Phase 3 demands. Hydraulic modeling was performed to size conveyance facilities, as described in Appendix C.

Title XVI Project components for Phases 1 and 2 include the following:

- **Major Facilities:** 13,900 LF of 20-inch-diameter pipelines, 14,000 LF of 16-inch-diameter pipelines, 3,600 LF of 12-inch-diameter pipelines, and 450 LF of special pipeline crossings.
- **Project Yield:** 1,113 AFY for Phase 1 and 530 AFY for Phase 2.
- **Total Project Capital Cost:** $18.5 million ($12.5 million Phase 1, $5.9 million Phase 2).
- **Annual O&M Cost:** $0.1 million, based on energy used for pumping, and additional labor to maintain and repair the pipelines.

Project benefits and challenges, and vulnerabilities to climate change are similar to the City of Petaluma's proposed urban recycled water expansion project. This project would efficiently utilize existing assets to increase the distribution of recycled water. The proposed pipeline alignment is along roads in the City's right of way, within already disturbed areas. The number of creek crossings would be minimized and green ways would be avoided to minimize construction in undisturbed areas. The vulnerability to climate change is low to insignificant because pipeline distribution projects such as this generally involve constructing buried, pressurized pipelines, which reduces exposure to climate change impacts. Material selection for the pipelines and fittings should take into consideration the possibility of corrosion from seawater as well as other typical and site-specific parameters. In addition, the water quality and quantity conveyed by the recycled water distribution system would be impacted by quality changes at the ECWRF.

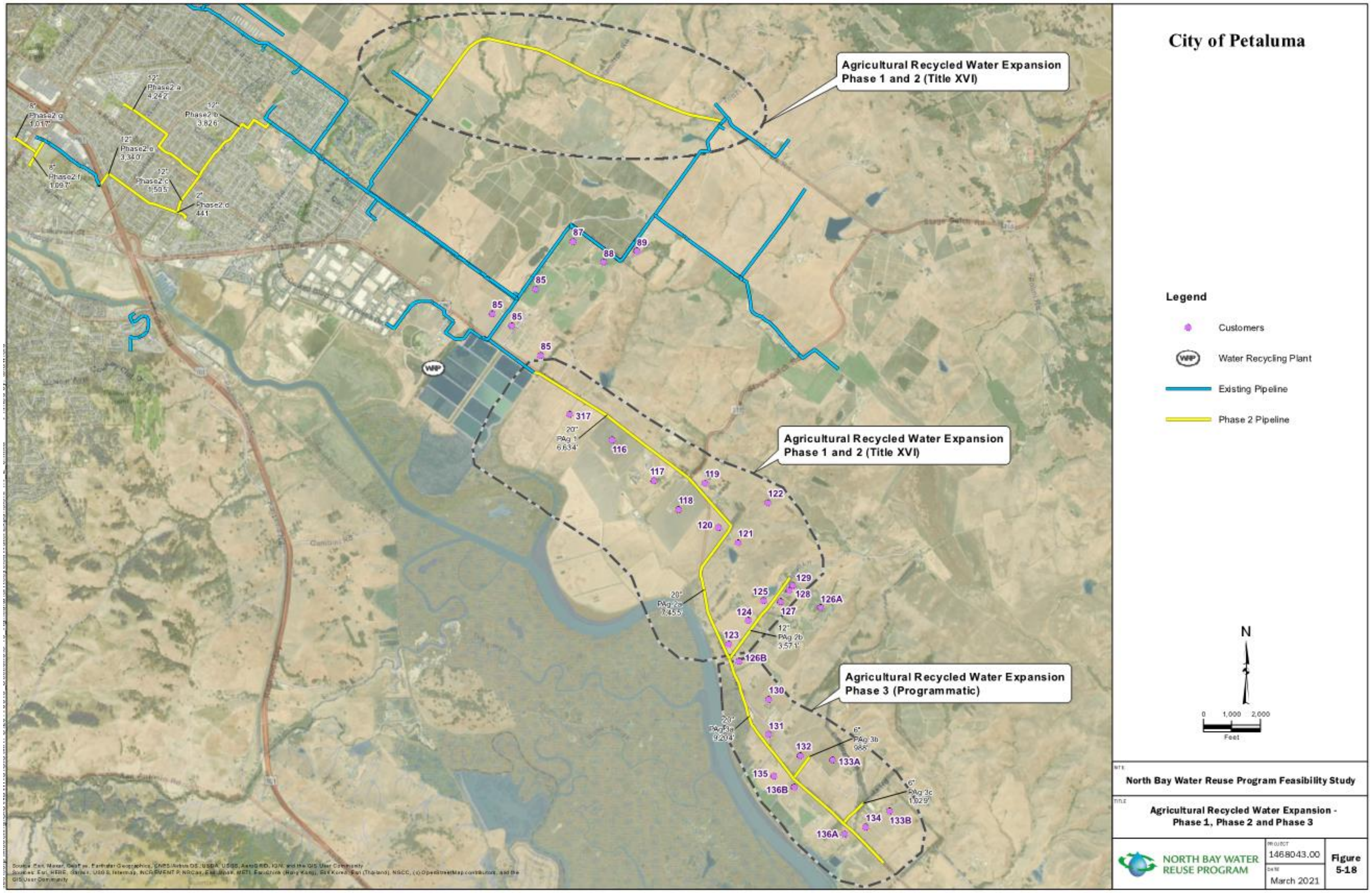



Figure 5-18. Agricultural Recycled Water Expansion – Phases 1, 2 and 3

### 5.1.5 Napa Sanitation District

The proposed Phase 2 Program includes two Title XVI Projects for Napa SD, with a total estimated cost of $5.1 million and a project yield of 811 AFY. The selected projects are described in detail in the following sections.

- Soscol WRF Increased Filter Capacity ($2.2 million, 571 AFY)
- Additional Soscol WRF Covered Storage ($2.9 million, 240 AFY)

#### 5.1.5.1 Soscol WRF Increased Filter Capacity

The Soscol WRF Increased Filter Capacity project would include facility upgrades at the existing Soscol WRF to increase tertiary treatment capacity by 1.7 mgd. Filter basins for 2 filters (comprised of 1,000 square feet of filter area) were constructed as part of the NBWRP Phase 1 Project, but only 1 filter (500 square feet of filter area) was installed at that time. This Phase 2 project consists of installing the remaining filter and associated mechanical components in the existing empty filter basin. Figure 5-19 shows the location of facilities associate with this project.

Title XVI Project components include the following:

- **Major Facilities:** 1.7 mgd capacity tertiary filters with associated mechanical equipment.
- **Project Yield:** 571 AFY of additional tertiary recycled water available for reuse based on the additional peak production of 1.7 mgd providing an average annual production of 0.51 mgd.
- **Total Project Capital Cost:** $2.2 million.
- **Annual O&M Cost:** $0.27 million based on energy, chemical usage, and additional labor to operate and maintain the filters and mechanical parts.

This project would efficiently utilize existing assets to increase recycled water supply. The project site is located within the already disturbed area at the existing Napa SD-owned Soscol WRF facility, thus, requiring only minimal construction in an already disturbed area. Soscol WRF is located within a high flood risk area, which makes it significantly vulnerable to the risk of increased flooding and inundation due to climate change (e.g., sea level rise combined with 100-year flood as shown in Figure 2-3). The construction of new facilities should consider design elements to address the flood and inundation risk vulnerability. This project would reduce the amount of wastewater discharged to rivers and streams in winter, reducing instream flow, by using the wastewater for recycled water production. Additionally, water quality into the WRP could be impacted due to increased I&I in the sewer system resulting from sea level rise and/or intense rainfall.

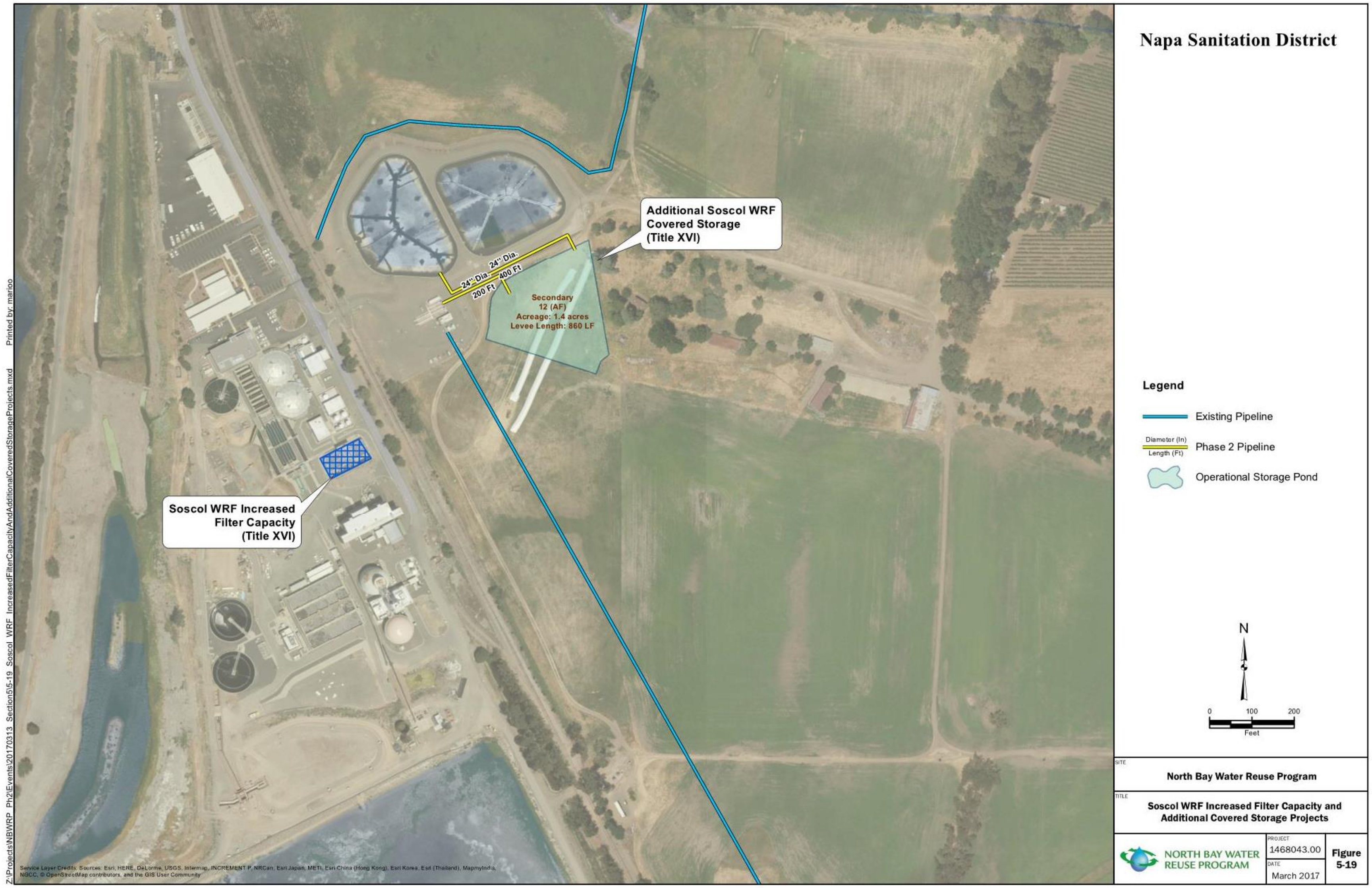



Figure 5-19. Soscol WRF Increased Filter Capacity and Additional Covered Storage Projects

#### 5.1.5.2 Additional Soscol WRF Covered Storage

The project consists of constructing a 10 AF operational storage pond at the Soscol WRF to store tertiary filtered and disinfected recycled water that would be used to meet daily peak customer demands. Similar to the existing recycled water operational storage ponds at the WRF, the new pond would have a lined clay bottom, concrete lined side slopes, and a Hypalon cover. The location of this project is shown in Figure 5-19

Title XVI Project components include the following:

- **Major Facilities:** 10 AF capacity storage pond (0.25 acres) with a membrane liner and floating cover; 600 LF of pipelines to connect to the existing pond.
- **Project Yield:** 240 AFY of additional recycled water available for reuse based on the ability to fill and empty the storage tank at least once a week during the irrigation season.
- **Total Project Capital Cost:** $2.9 million, based on earthwork, facility costs and the use a similar Hypalon cover as the existing ponds.
- **Annual O&M Cost:** $0.04 million, based on additional labor to maintain and repair the pond and cover.

The additional storage provided by this project would increase operational flexibility, thereby increasing the availability of recycled water particularly in the high demand summer irrigation periods. The site is near the existing WRF facility, owned by Napa SD, and would require disturbing an undeveloped area. Soscol WRF is located within a high flood risk area, which makes it vulnerable to the risk of increased flooding and inundation due to climate change. The design of the berms and associated facilities should consider elements to address flood risk and vulnerability.

### 5.1.6 Marin Municipal Water District

The proposed Phase 2 Program includes one Title XVI Project for MMWD, with a total estimated cost of $7.8 million and a project yield of 153 AFY.

#### 5.1.6.1 Recycled Water Distribution System Expansion to San Quentin Prison

A recent Recycled Water Feasibility Study (Carollo, 2016) developed for CMSA and MMWD identified a preferred project to treat effluent from CMSA to CCR Title 22 standards and deliver it to San Quentin Prison. The project, previously shown in Figure 5-7, includes treatment of secondary effluent at CMSA using microfiltration and chlorine disinfection then conveying the water to San Quentin for dual plumbing (121.7 AFY), boiler make-up water (14.3 AFY), landscape irrigation (16.4 AFY) and use in a car wash (0.1 AFY), and a truck fill station at CMSA (0.5 AFY). The project also includes site retrofits for dual plumbing, connection of the partially dual-plumbed North, South, East and West blocks at San Quentin and storage and pumping at CMSA.

Title XVI Project components include the following:

- **Major Facilities:** 5,800 LF of 6-inch-diameter pipelines, dual-plumbing and connection at San Quentin; one 360-gpm, 50-horsepower pump station; 0.08 MG storage tank; 200,000 gpd microfiltration treatment; and a chlorine contact tank retrofit.
- **Project Yield:** 153 AFY.
- **Total Project Capital Cost:** $7.8 million.
- **Annual O&M Cost:** $0.06 million, based on energy used for pumping, and additional labor to maintain and repair the pipelines.

This project would efficiently utilize existing assets to increase the distribution of recycled water. Pipeline projects such as this have low vulnerability to climate change because these projects generally involve constructing buried, pressurized pipelines; however, water quality and quantity conveyed by the pipeline could be impacted by quality changes at the WWTP at CMSA. Material selection for the pipelines and fittings should take into consideration the possibility of corrosion from seawater as well as other typical and site-specific parameters.

### 5.1.7 City of American Canyon

The proposed Phase 2 Program includes three Title XVI Projects for the City of American Canyon with a total estimated cost of $12 million and a project yield of 295 AFY.

- Phase 1 Recycled Water Distribution System Expansion ($3.1 million, 102 AFY)
- Phase 2 Recycled Water Distribution System Expansion ($2.9 million, 25 AFY)
- American Canyon WRF Phase 2 Treatment Plant Upgrades ($6.0 million, 168 AFY)

#### 5.1.7.1 Phase 1 Recycled Water Distribution System Expansion

A recent comprehensive Recycled Water Master Plan (GHD, 2016) developed for the City of American Canyon identified several pipeline extensions of the existing system to deliver recycled water to existing landscaping and industrial users on potable water and convert them to recycled water for non–potable uses. The customer demands associated with these extensions would be met directly from the WRP during the peak month. No seasonal storage would be needed.

Phase 1 expansion includes six recycled water pipeline extensions located within existing built roadways, shown in Figure 5-20 and described below:

- RW1B consists of the construction of approximately 6,110 LF of 12-inch diameter recycled water pipelines to extend the recycled water main north from South Kelly Road along Devlin Road to Tower Road, and then east and west along Tower Road. There will also be an extension east in South Kelly Road up to State Road-29.
- RW2 consists of the construction of approximately 800 LF of 6-inch diameter recycled water pipelines in Spikerush Circle to convert irrigation of American Canyon Community Park from potable water to recycled water.
- RW3 consists of the construction of approximately 1,670 LF of 6-inch diameter recycled water pipelines in Benton Way to convert irrigation demands at the middle school, community services, and park from potable water to recycled water.
- RW5 consists of the construction of approximately 1,800 LF of 6-inch diameter recycled water pipelines in Green Island Road and Jim Oswald Way, and approximately 1,500 LF of recycled water pipeline in Mezzetta Court to serve existing industrial customers.
- RW6 consists of the construction of approximately 1,950 LF of 8-inch diameter recycled water pipelines in Hanna Drive to serve existing industrial customers.
- RW7 consists of the construction of approximately 600 LF of 6-inch diameter recycled water pipelines in Dodd Court and Klamath Court to serve existing industrial customers.

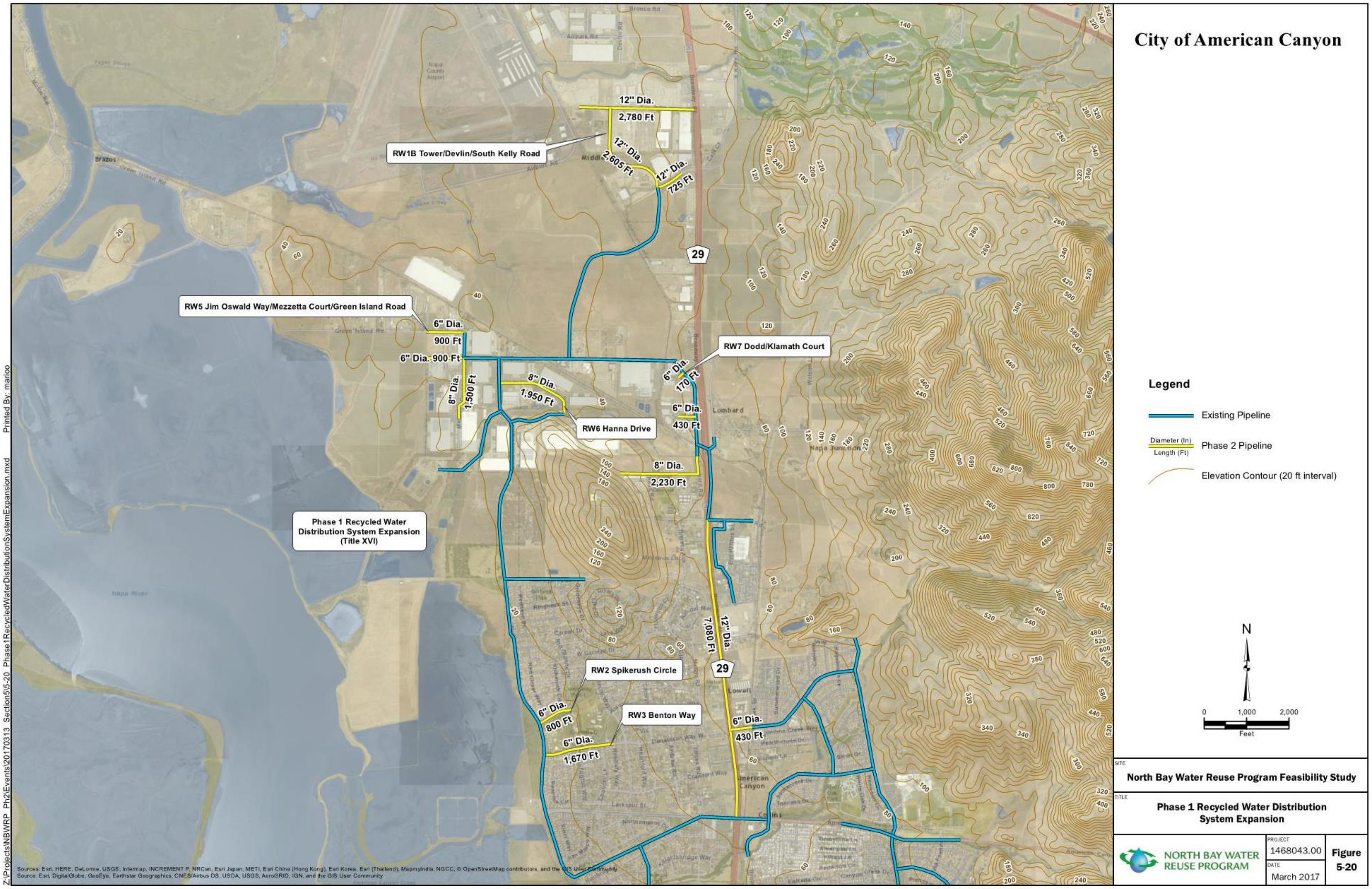



Figure 5-20. Phase 1 Recycled Water Distribution System Expansion

Title XVI Project components for the City of American Canyon's Phase 1 Recycled Water Distribution System Expansion include the following:

- **Major Facilities**: 6,100 LF of 12-inch-diameter pipelines, 2,000 LF of 8-inch-diameter pipelines, and 4,900 LF of 6-inch-diameter pipelines.
- **Project Yield**: 102 AFY.
- **Total Project Capital Cost**: $3.1 million.
- **Annual O&M Cost**: $0.03 million, based on energy used for pumping, and additional labor to maintain and repair the pipelines.

This project would efficiently utilize existing assets to increase the distribution of recycled water. Pipeline projects such as this have low vulnerability to climate change because these projects generally involve constructing buried, pressurized pipelines; however, water quality and quantity conveyed by the pipeline could be impacted by quality changes at the American Canyon WRF. Material selection for the pipelines and fittings should take into consideration the possibility of corrosion from seawater as well as other typical and site-specific parameters.

#### 5.1.7.2 Phase 2 Recycled Water Distribution System Expansion

Like Phase 1, this project includes additional pipeline extensions from the existing recycled water system, as identified in the City of American Canyon's Recycled Water Master Plan. Phase 2 would deliver recycled water to and convert existing landscaping and industrial users to recycled water for non–potable uses. The customer demands associated with these extensions would be met directly from the WRP during the peak month. No seasonal storage would be needed. These pipelines would be implemented after the Phase 2 Treatment Plant Upgrades described in Section 5.1.7.3 are completed. The Phase 2 expansion project includes three recycled water pipeline extensions located within existing built roadways, as shown in Figure 5-21 and described below:

- RW4 consists of the construction of approximately 790 LF of 6-inch diameter recycled water pipelines in Brunello Drive and Pelleria Drive to convert irrigation of La Vigne Community Park from potable water to recycled water.
- RW8 consists of the construction of approximately 2,230 LF of 8-inch diameter recycled water pipelines in Lombard Road and Hess Road to convert existing irrigation demands from potable water to recycled water at the City ball fields and an existing commercial nursery.
- RW15 consists of the construction of approximately 7,080 LF of 12-inch diameter recycled water pipelines in Broadway between Napa Junction Road and American Canyon Road and 430 LF of 6-inch diameter recycled water pipelines in Donaldson Way between Broadway and Tuscan Oak Trail which will increase reliability and balance pressures across the distribution system as buildout is approached.

Title XVI Project components include the following:

- **Major Facilities:** 7,080 LF of 12-inch-diameter pipelines, 2,230 LF of 8-inch-diameter pipelines, and 1,220 LF of 6-inch diameter pipelines.
- **Project Yield:** 25 AFY.
- **Total Project Capital Cost**: $2.9 million.
- **Annual O&M Cost:** $0.03 million, based on energy used for pumping, and additional labor to maintain and repair the pipelines.

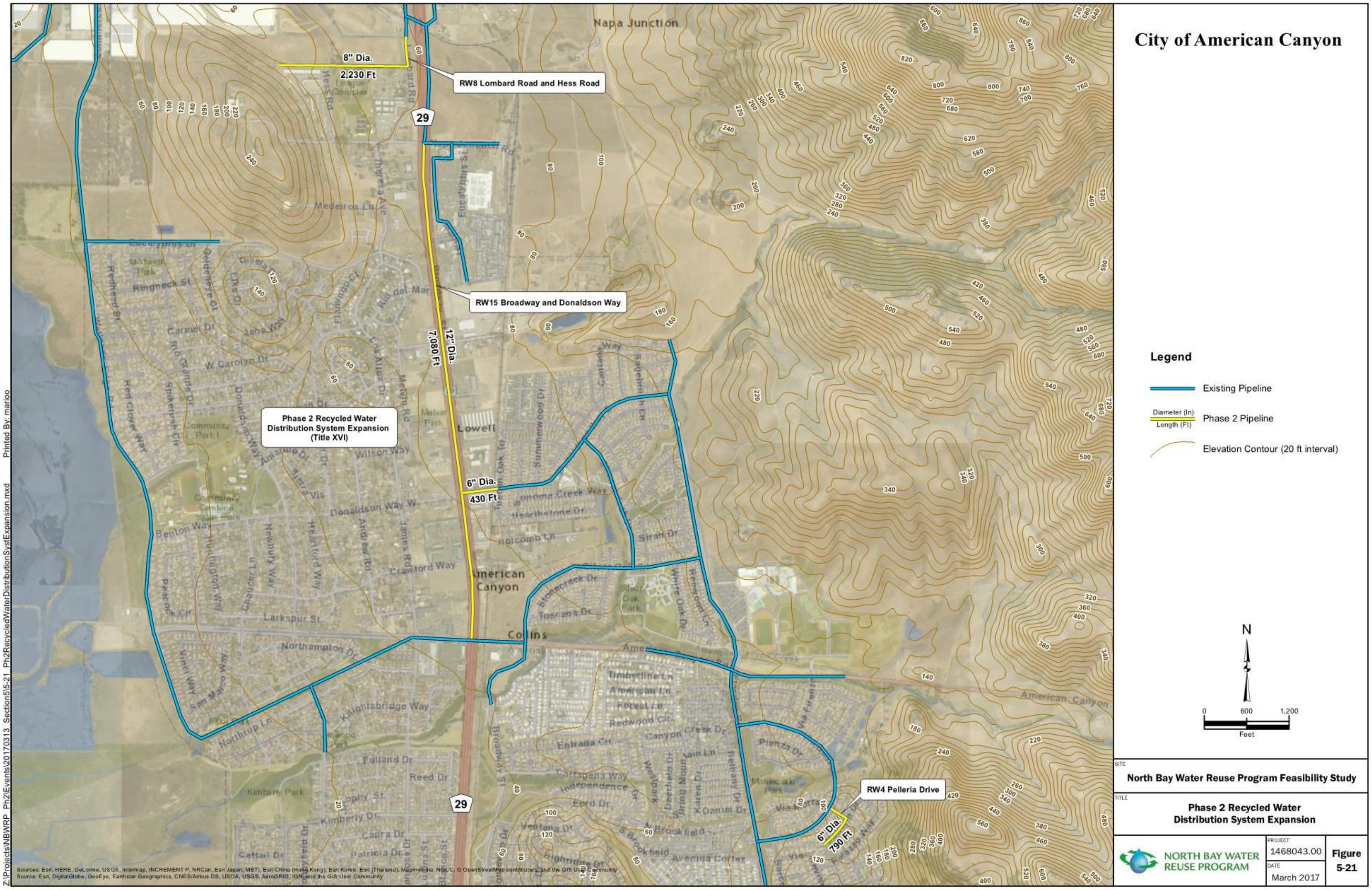



Figure 5-21. Phase 2 Recycled Water Distribution System Expansion

This City of American Canyon Phase 2 Recycled Water Distribution System Expansion project would efficiently utilize existing assets to increase the distribution of recycled water. Pipeline projects such as this have low vulnerability to climate change because these projects generally involve constructing buried, pressurized pipelines; however, water quality and quantity conveyed by the pipeline could be impacted by quality changes at the American Canyon WRF. Material selection for the pipelines and fittings should take into consideration the possibility of corrosion from seawater as well as other typical and site-specific parameters.

#### 5.1.7.3 American Canyon WRF Phase 2 Treatment Plant Upgrades

This project would include facility upgrades at the existing American Canyon WRF to increase tertiary treatment process to improve water quality for existing and future recycled water users. The existing American Canyon WRF consists of a membrane bioreactor (MBR) that could produce 3.75 mgd of tertiary recycled water for non-potable reuse in the City of American Canyon service area. This project would construct a two-stage reverse osmosis (RO) system, modify existing ponds and develop a concentrate disposal system, and install new pipelines to connect the existing MBR system to the RO system and from the RO system to the evaporation pond within the area shown in Figure 5-22. The proposed upgrades would greatly benefit existing and new recycled water customers by reducing the concentration of effluent total dissolved solids and providing the necessary facilities for concentrate disposal through modified evaporation ponds.

Title XVI Project components include the following:

- **Major Facilities:** One two-stage RO system; modifications to ponds and addition of a concentrate disposal system; pipelines between the existing MBR system to the RO system; and pipelines between the RO system and the evaporation pond.
- **Project Yield:** 168 AFY.
- **Total Project Capital Cost:** $6.0 million.
- **Annual O&M Cost:** $0.1 million, based on energy, chemical usage and additional labor to operate and maintain the WRF.

This project would efficiently utilize existing assets to increase recycled water supply. The project site is located within the already disturbed area at the existing City of American Canyon-owned WRF, thus, requiring minimal construction in undisturbed areas. This diversion of wastewater effluent for recycled water production would reduce the amount of wastewater discharged to rivers and streams in the winter, reducing instream flow. The American Canyon WRF is located within a moderate flood risk area. Hence, this project has significant vulnerability to the risk of increased flooding and inundation due to climate change.

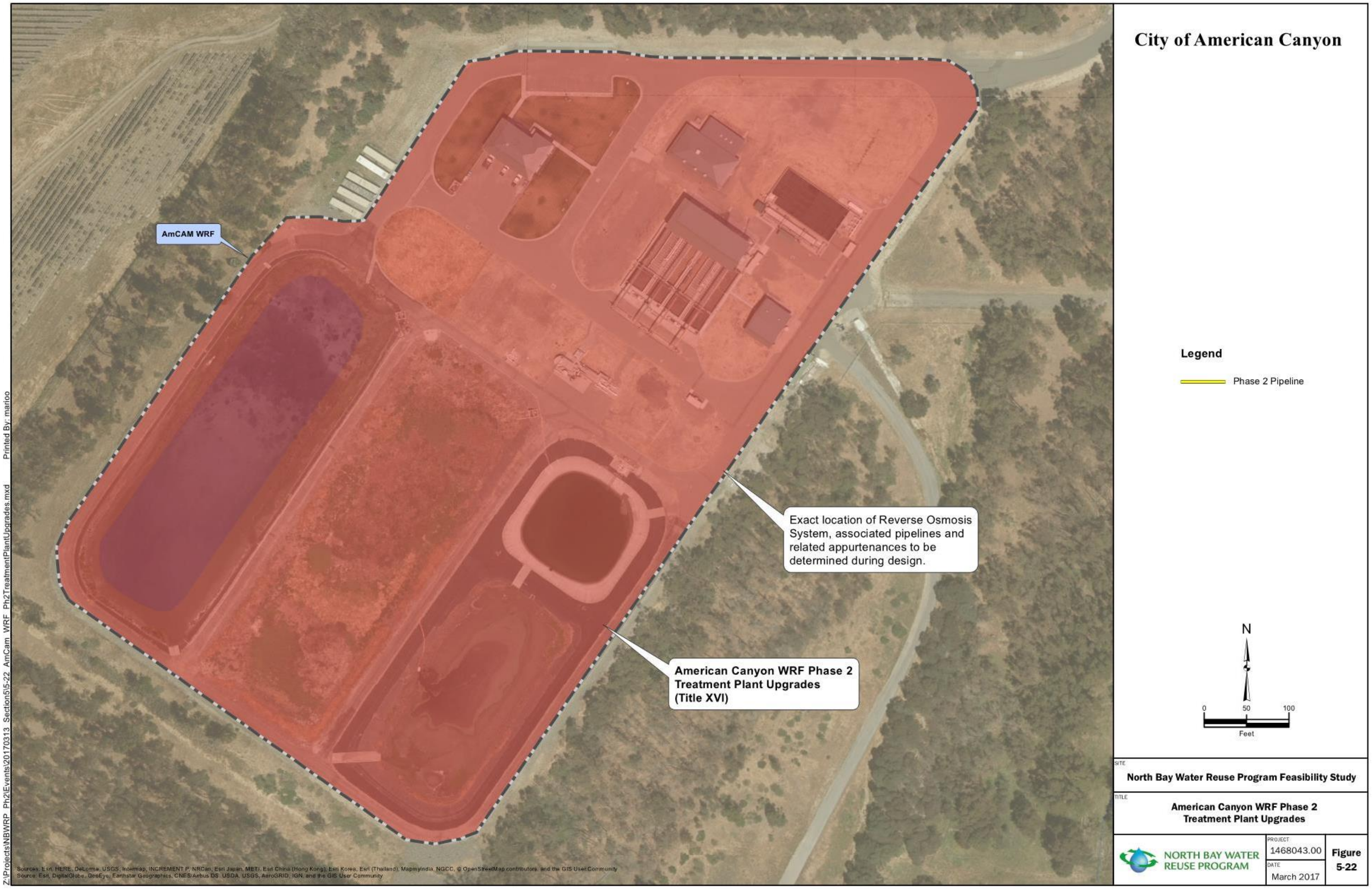



Figure 5-22. American Canyon WRF Phase 2 Treatment Plant Upgrades

## 5.2 Programmatic Level

The Programmatic Level category includes four projects, listed in Table 5-3 and shown in Figure 5-23, with a total capital cost of approximately $41 million. These projects are not part of the Phase 2 Program but are included in the EIR/EIS at a “programmatic level.” The construction dates of these projects are unknown; they are considered to be future projects to be developed as needed by the individual MAs. These projects underwent feasibility or appraisal-level analysis to estimate facility requirements and costs when sufficient information was available. The analysis for the Marin County Lower Novato Creek Project was at an appraisal-level analysis because the facility requirements for this project were being developed by others at the time of this study. All other projects underwent feasibility-level analysis. A summary of each project, by agency, is provided in the following sections including project highlights, a map identifying major facilities and place of use, and other considerations for project implementation.

**Table 5-3. Proposed Title XVI Program Projects**

| Agency | Project Type | Project Title | Capital Cost ($ mil) |
|---|---|---|---|
| Novato SD | Seasonal Storage | Option 1: Site Near Highway 37 (tertiary) 150 AF | $5.7 |
| | Environmental Enhancement | Marin County Lower Novato Creek Project - Restoration | $21.5 |
| City of Petaluma | Distribution | Agricultural Recycled Water Expansion Phase 3 | $6.5 |
| Napa SD | Operational Storage | Napa State Hospital Storage Tank | $7.4 |
| | | Total | $41.1 |

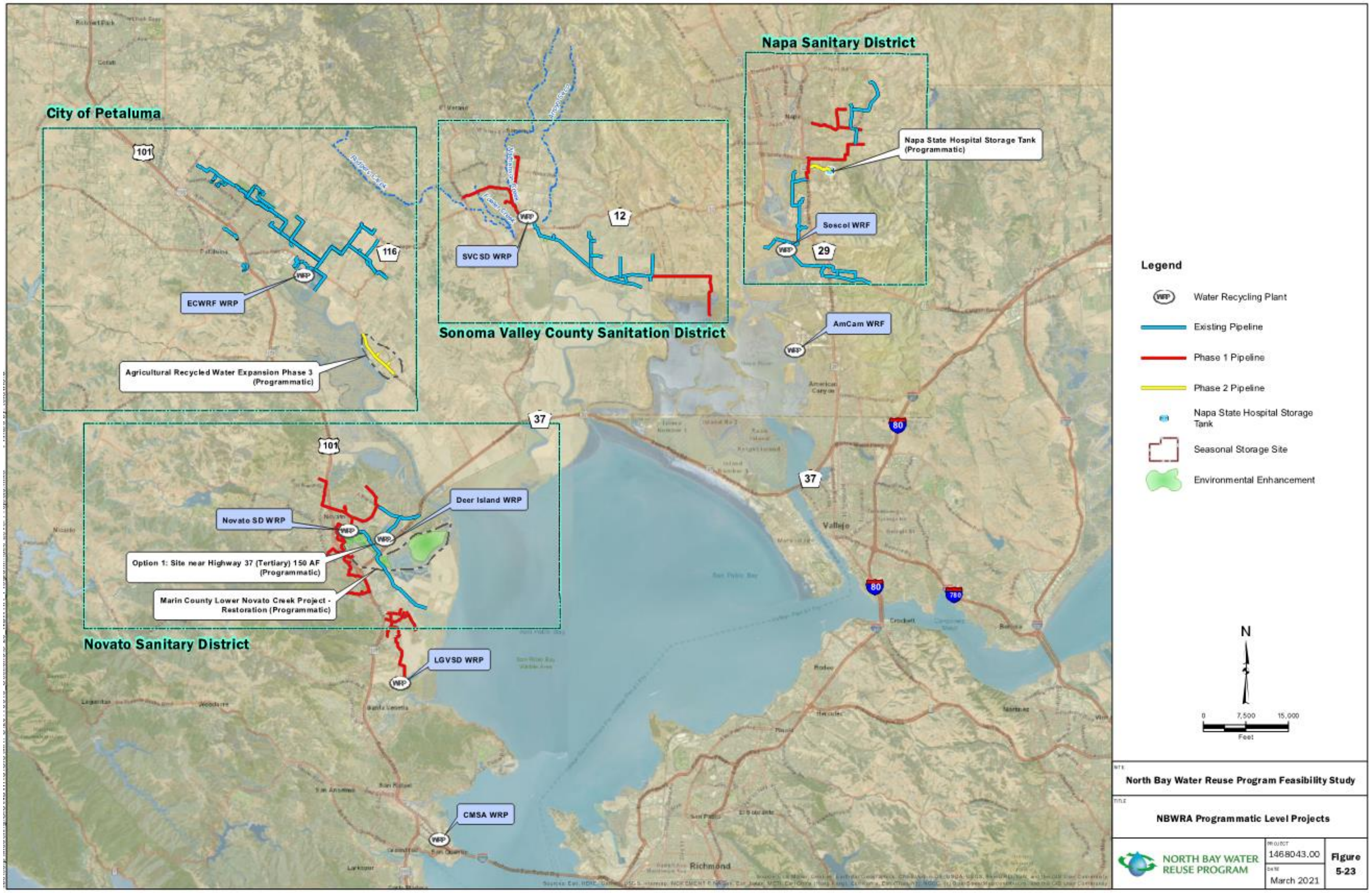



Figure 5-23. NBWRA Programmatic Level Projects

### 5.2.1 Novato Sanitary District

The proposed Phase 2 Program includes two Programmatic Level projects for Novato SD, with a total estimated cost of $27.2 million.

- Option 1: Site Near Highway 37 (Tertiary) 150 AF ($5.7 million, 150 AFY)
- Marin County Lower Novato Creek Project – Restoration ($21.5 million)

#### 5.2.1.1 Option 1: Site Near Highway 37 (Tertiary) 150 AF

This project would include construction of new seasonal tertiary recycled water storage pond at a site near Highway 37 to allow Novato SD to store 150 AF of tertiary effluent during winter months to serve customers during the summer. The proposed storage pond would be filled by tapping off an existing 12-inch-diameter recycled water pipeline that runs by the proposed site.

The storage pond design concept includes the construction of earthen berms using available on-site material from excavation of the berms supplemented by imported fill when needed. Levees would be constructed with three to one horizontal-to-vertical slopes with a 12-foot access road on the top and would not be covered. Hydraulic structures with weirs and/or sluice gates would be constructed to control water levels. Appropriate signage and fencing would be installed to prevent public access to the stored water. The project would include installation of pipelines and a small pump station to convey water to the existing Deer Island WRP where existing pumps would be repurposed to supply recycled water to customers. Figure 5-24 shows the key elements of this project.

Project components include the following:

- **Major Facilities:** 150-AF capacity storage pond (18 acres) with a membrane liner and no cover; 4,000 LF of levee; 250 LF of 12-inch-diameter pipelines; one 700-gpm, 1-horsepower pump station; and two weir boxes.
- **Project Yield:** 150 AFY of additional recycled water available for reuse based on the ability to fill the seasonal storage pond in the winter to provide additional recycled water to meet peak summer demands.
- **Total Project Capital Cost:** $5.7 million.
- **Annual O&M Cost:** $0.07 million, based on additional labor to maintain and repair the storage ponds, pipelines, and pump station.

This project would provide seasonal supply flexibility by increasing the availability of recycled water in the high-demand summer irrigation periods. The project site is located on soft bay mud which increases risks associated with construction and long term consolidation settlements. This site is highly vulnerable to climate change induced sea level rise because it is located in an area that could be inundated (e.g., sea level rise combined with 100-year flood as shown in Figure 2-3). Vulnerability to pond infrastructure damage and potential breaching of levees due to high water events could lead to increased costs and public safety concerns. Additionally, water quality and quantity stored in the pond would be impacted by impacts at the WRP, such as increased salinity due to sea level rise or increased I&I.


Figure 5-24. Option 1: Site Near Highway 37 (Tertiary) 150 AF

### 5.2.1.2 Marin County Lower Novato Creek Project – Restoration

As mentioned in Section 5.1.1.2, the Lower Novato Creek Project consists of six related projects located downstream of the SMART bridge to Highway 37. Projects 2 through 6 are included as Programmatic Level projects. These projects, previously shown in Figure 5-11, are described as follows:

- **Project 2. Enlarge the Novato Creek corridor between SMART tracks and Highway 37:** Remove (right bank) levees along Novato creek adjacent to two small ponds (Heron's Beak and Duckbill) to restore 32 acres of tidal marsh and creek floodplain. Reuse levee fill material to construct new flood protection levees within Lynwood or Deer Island Basin. Removing the levees next to the ponds eliminates a channel constriction and increases the available channel cross section by over 200 percent, improving flood and sediment conveyance. These levees will be able to accommodate recycled water.
- **Project 3. Restore tidal marsh at the northern end of the Lynwood Basin:** The northern end (approximately 75 acres) of Lynwood Basin would be restored to full tidal action by constructing an interior berm dividing Lynwood Basin into two parts, tidal marsh and freshwater, seasonal stormwater storage and a new flood protection levee to protect the SMART tracks within the tidally restored areas. The material from the existing outboard levee would be removed and reused to construct the new interior berm and flood protection levees, which would also be able to accommodate recycled water.
- **Project 4. Set Back North Bank Levees to split Deer Island Basin North:** Set back levees along Novato Creek (North Bank) to expand the Novato Creek floodplain and restore 58 acres of tidal marsh. Place excavated levee, channel cut material, and coarse sediment along the bayward side of the setback levee or along the basin perimeter to build/expand transitional wetland habitat. Maintain a non-tidal portion of North Deer Island Basin to provide Novato Creek flood storage during high tides. Protect existing Novato SD force main and maintain access for inspection. Expanding the Novato Creek floodplain into a portion of the North Deer Island Basin adds flood conveyance, sediment storage capacity and restores estuarine tidal wetlands. The added conveyance capacity improves flood and sediment conveyance from upstream reaches during both peak and annual storm events, reducing the need for dredging upstream. The added tidal exchange in the wetland increases the downstream self-sustaining channel geometry and reduces the need for lower Novato Bayland dredging. Preserving a portion of the basin as non-tidal maintains the opportunity for provide peak flood storage for downtown Novato during high tides. Novato SD currently leases much of the land downstream of Highway 37 from Marin County to use as spray fields. The spray fields are currently an effluent management project to help Novato SD meet their discharge constraints under the NPDES permit. The spray field lands could be returned to Marin County for environmental restoration if Novato SD can either increase recycling with NMWD, on the Lower Novato Creek Project, or discharge flows to the Hamilton-Bel Marin Keys Wetlands Restoration Project. Increased recycling by Novato SD makes the following project sites downstream of Highway 37 available for restoration by Marin County.
- **Project 5. Restore Tidal Marsh to West Basin Oxbow:** Construct new flood protection levee south of Highway 37 and the SMART tracks and restore approximately 50 acres of historic tidal marsh immediately downstream of Highway 37. The new setback levee would be constructed along the western meander bend to protect the Novato SD outfall. Restoring tidal exchange will help deepen the channel cross section for improved flood and sediment conveyance, therefore reducing downstream dredging requirements. A new main stem Novato Creek channel alignment would be excavated to reduce creek sinuosity, direct peak floods/recession flows downstream, and restore tidal wetlands. The excavated channel material would be used to construct berms in the basin interior that concentrate low flows and deflect peak flows downstream. Excavated levee material

would be placed on the bayward side of the new Coastal Flood Protection levee to increase the area and/or connectivity of high marsh/upland transition zone habitat. The floodplain adjacent to the channel would be graded to support peak flood conveyance and habitat complexity.

- **Project 6. Restore East Basin to Tidal Wetlands.** Remove remnant perimeter levees reusing the material as needed for construction of transitional upland, high marsh, setback or horizontal levee and/or lateral effluent discharge facilities. Restoring the full tidal exchange will accelerate sedimentation and increase the tidal prism volume; this will help sustain confluence channel geometry. Integration of East Basin and BMK restoration restores an expansive portion of the San Pablo Bayshore line, creating subtidal habitat and increasing the extent and diversity of seasonally estuarine shoreline ecotones. Removal of remnant flood control levees will promote open circulation of water and sediment across 470 acres of wetlands immediately adjacent to San Pablo Bay. Approximately 15,000 LF (2.8 miles) of existing perimeter levee, which constitutes upland fill in wetlands, is available for removal.

Construction of Project 2 is also partially funded through the IRWMP grant that is also partially funding Project 1. Projects 3 and 4 are considered short-term priorities; funding for these projects is not currently available. Marin County is considering a future special tax measure to leverage grant funds to assist with financing construction of these projects.

The facility requirements for the Lower Novato Creek Project restoration projects are currently being developed; therefore, preliminary cost estimate have not been prepared at this time.

### 5.2.2 City of Petaluma

The proposed Phase 2 Program includes one Programmatic Level project for the City of Petaluma, with an estimated cost of $6.5 million and project yield of 860 AFY.

#### 5.2.2.1 Agricultural Recycled Water Expansion Phase 3

The third phase of the Agricultural Recycled Water Expansion Project, previously described in Section 5.1.4.3 is included as a Programmatic Level project. Phase 3 builds on the Phases 1 and 2 distribution expansions by extending recycled water pipelines eastward from Cannon Road to Old Lakeview Road No. 3. Phase 3 would deliver 860 AFY of recycled water to agricultural customers. Hydraulic modeling was performed to size the conveyance facilities as described in Appendix C. The location of the Phase 3 alignments was previously shown in Figure 5-18.

Project components include the following:

- **Major Facilities:** 9,200 LF of 20-inch-diameter pipelines; 2,000 LF of 6-inch-diameter pipelines; and 100 LF of special pipeline crossings.
- **Project Yield:** 860 AFY.
- **Total Project Capital Cost:** $6.5 million.
- **Annual O&M Cost:** $0.04 million, based on energy used for pumping, and additional labor to maintain and repair the pipelines.

This project would efficiently utilize existing assets to increase the distribution of recycled water. The proposed pipeline alignment is along roads, within already disturbed areas. Vulnerabilities to climate change are similar to the proposed Urban Recycled Water Expansion Project described in Section 5.1.4.2.

### 5.2.3 Napa Sanitation District

The proposed Phase 2 Program includes one Programmatic Level project for the Napa SD, with an estimated cost of $7.4 million and project yield of 429 AFY.

#### 5.2.3.1 Napa State Hospital Storage Tank

The project consists of a new a 5 MG operational storage tank to increase availability of recycled water during high demand periods and improve operation of the existing recycled water distribution system. The storage tank would be located at approximately 270 feet above sea level to assist with pressure and peak demands in the MST recycled water distribution system. Pipelines would be constructed to connect the existing recycled water transmission main to the storage tank located near the Napa State Hospital. The proposed tank site is on volcanic rock, requiring rock bracing at 20-foot intervals for the portion of the pipeline (approximately 1,800 LF) from the base of the hill to the storage tank. Figure 5-25 shows the pipeline alignment and proposed storage tank location for the project.

Project components include the following:

- **Major Facilities:** 5 MG cylindrical, steel above ground storage tank; 4,800 LF of pipeline to connect the tank to the existing recycled water distribution system.
- **Project Yield:** 429 AFY of additional recycled water available for reuse based on the ability to fill and empty the storage tank at least once a week during the irrigation season.
- **Total Project Capital Cost:** $7.4 million, based on pipelines and facility costs.
- **Annual O&M Cost:** $0.07 million, based on additional energy to pump to storage and additional labor to maintain and repair the pipelines and storage tank.

Considerations for implementation include the need for land acquisition and right of way access for pipeline segments and the storage tank which would need to be located on land that is not owned by Napa SD.

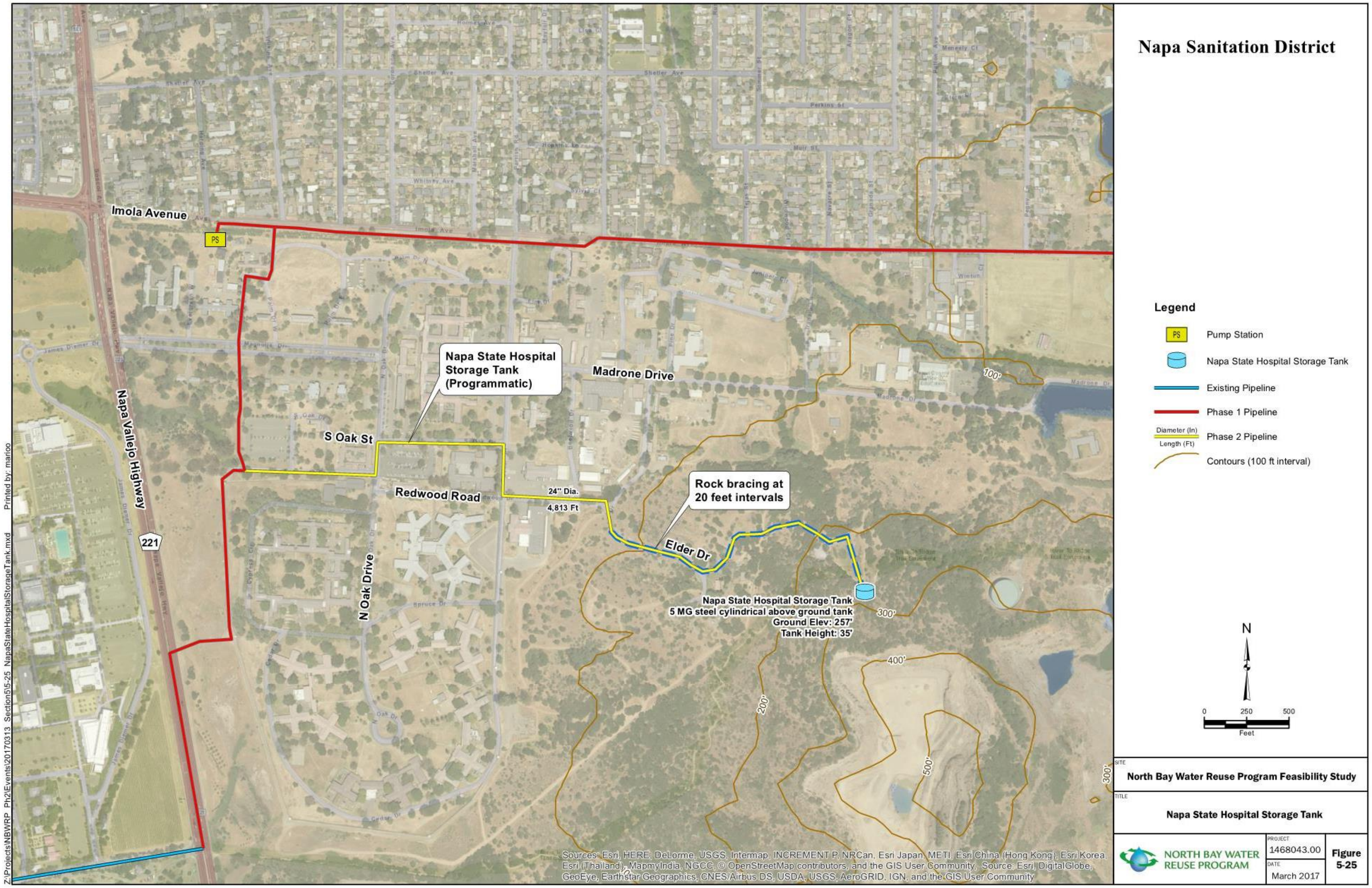



Figure 5-25. Napa State Hospital Storage Tank

## 5.3 Non-Title XVI Projects

The Non-Title XVI Projects includes 14 projects, listed in Table 5-4 and shown in Figure 5-26, with a total capital cost of approximately $153.2 million. These projects would be funded under other mechanisms if the responsible agency decides later to pursue implementation. The projects in this category also underwent full feasibility level analysis; however, they will not be evaluated in the EIR/EIS beyond identification of the footprint of the area studied. The construction date of these projects is unknown. A summary of each project, by agency, is provided in the following sections including project highlights, a map identifying major facilities and place of use, and other considerations for project implementation.

**Table 5-4. Proposed Non-Title XVI Program Projects**

| Agency | Project Type | Project Title | Capital Cost ($ mil) |
|---|---|---|---|
| Novato SD | Treatment | Novato SD WRP Capacity – 2nd Expansion (+0.85 MGD) | $4.8 |
| | Seasonal Storage | Option 2: Site Near Highway 37 (Secondary) 150 AF | $8.0 |
| | | Option 3: Hamilton Site (Secondary) 150 AF | $14.8 |
| SVCSD | Seasonal Storage | Option 1: Mulas Site (Tertiary) 49 AF | $2.4 |
| | | Option 2: Robledo Site (Tertiary) 49 AF | $2.1 |
| SCWA | Groundwater Management | Sonoma Valley Groundwater Management and Recharge Project | TBD |
| City of Petaluma | Seasonal Storage | Option 1a: Site Southeast of ECWRF (Secondary) 300 AF | $14.3 |
| | | Option 1b: Site Southeast of ECWRF (Secondary 150 AF | $7.3 |
| Napa SD | Seasonal Storage | Option 1a: Raise Existing Pond Levees (Secondary) 300 AF | $9.9 |
| | | Option 1b: Raise Existing Pond Levees (Secondary) 1,100 AF | $30.4 |
| | | Option 2: Somky Ranch Site (Secondary) 300 AF | $16.4 |
| | | Option 3a: Jameson Ranch Site (Tertiary) 600 AF | $18.7 |
| | | Option 3b: Jameson Ranch Site (Tertiary) 300 AF | $12.4 |
| | Distribution | MST Northern Loop | $7.6 |
| | | MST Eastern Extension | $4.1 |
| | | **Total** | **$153.2** |

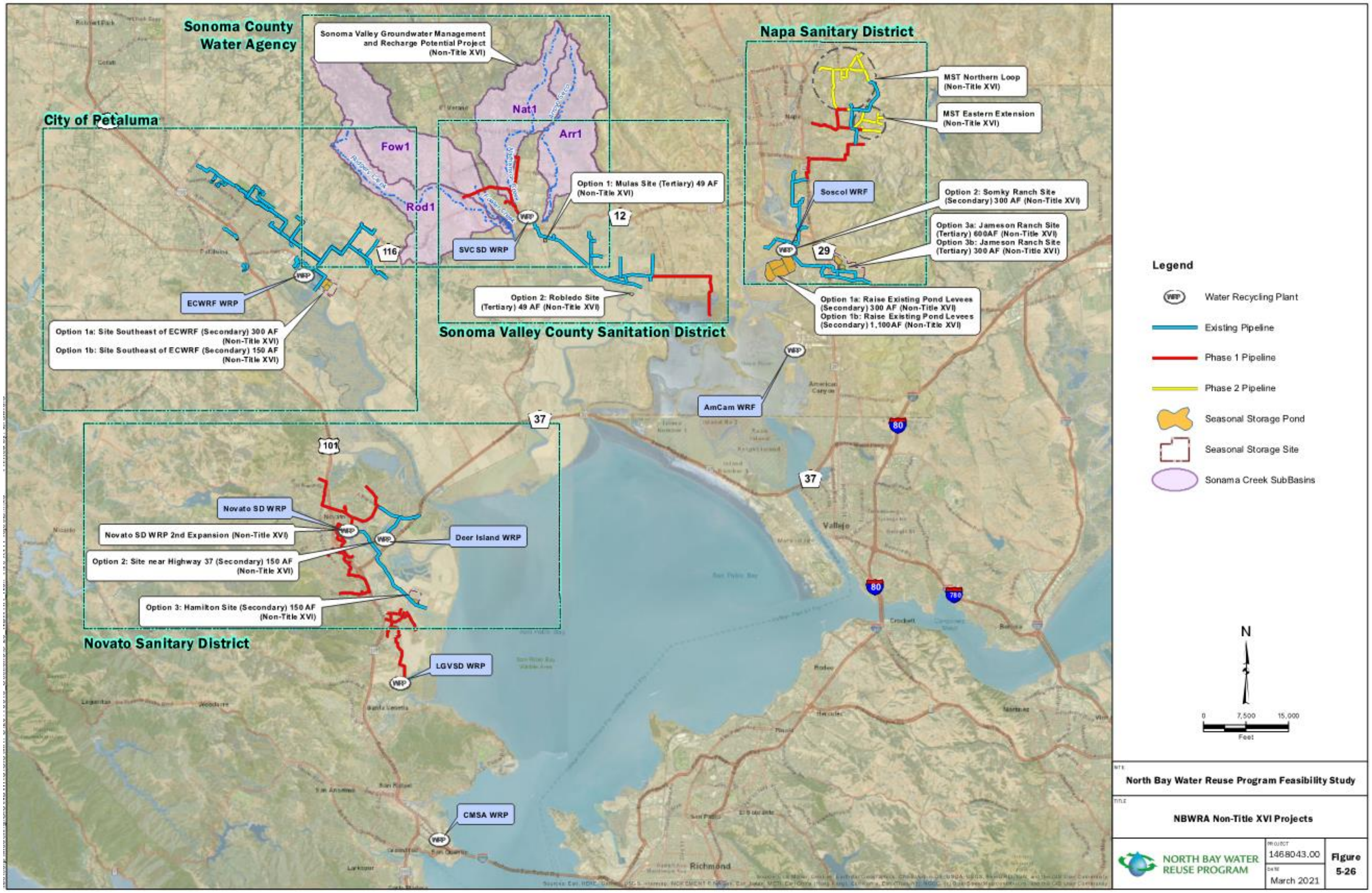



Figure 5-26. NBWRA Non-Title XVI Projects

### 5.3.1 Novato Sanitary District

The proposed Phase 2 Program includes three Non-Title XVI Projects for Novato SD, with a total estimated cost of $27.6 million and a combined project yield of 586 AFY.

- Novato SD WRP Capacity - Second Expansion (plus 0.85 MGD) ($4.8 million, 286 AFY)
- Option 2: Site Near Highway 37 (Secondary) 150 AF ($8.0 million, 150 AFY)
- Option 3: Hamilton Site (Secondary) 150 AF ($14.6 million, 150 AFY)

#### 5.3.1.1 Novato SD WRP Capacity - Second Expansion (plus 0.85 mgd)

This project would include facility upgrades at the existing Novato SD WRP to increase tertiary treatment capacity by an additional 0.85 mgd beyond the proposed first 0.85-mgd expansion, described in Section 5.1.1.1. This project would increase the totally capacity of the Novato SD WRP to 3.4 mgd with the construction of additional tertiary filters, associated pipelines and mechanical equipment, and an additional chlorine contact tank within the area previously shown in Figure 5-10.

Project components include the following:

- **Major Facilities:** 0.85-mgd capacity tertiary filters with associated piping; 250,000-gallon chlorine contact tank.
- **Project Yield:** 286 AFY of additional tertiary recycled water available for reuse based on the additional peak production of 0.85 mgd providing an average annual production of 0.26 mgd.
- **Total Project Capital Cost:** $4.8 million.
- **Annual O&M Cost:** $0.19 million, based on energy, chemical usage and additional labor to operate and maintain the filters and disinfection system.

Project benefits and challenges as well as vulnerabilities to climate change are similar to the proposed first expansion of 0.85 mgd described in Section 5.1.1.1.

#### 5.3.1.2 Option 2: Site Near Highway 37 (Secondary) 150 AF

This project would include construction of a new storage pond to allow Novato SD to store 150 AF of secondary effluent during winter months to later serve customers in summer months. The same site used for the seasonal storage discussed in Section 5.2.1.1, Option 1: Site Near Highway 37 (Tertiary) 150 AF, would be used for this project.

The storage pond construction includes building earthen berms using available on-site material from excavation of the berms supplemented by imported fill when needed. Levees would be constructed with three to one horizontal-to-vertical slopes with a 12-foot access road on the top. Hydraulic structures with weirs and/or sluice gates would be constructed to control water levels. The pond would not be covered. Appropriate signage and fencing would be installed to prevent public access to the stored water. The pond would be filled by hydraulically linking the proposed pond with an adjacent existing effluent storage pond. The project would include the installation of pipelines and a small pump station to convey the secondary recycled water to the existing Deer Island WRP, where existing pumps would be repurposed. Since this pond would store secondary-treated water, 9,500 LF of 12-inch-diameter pipelines would also be needed to convey secondary water back to Novato SD WRP for tertiary treatment before use. Figure 5-27 shows the key elements of this project.

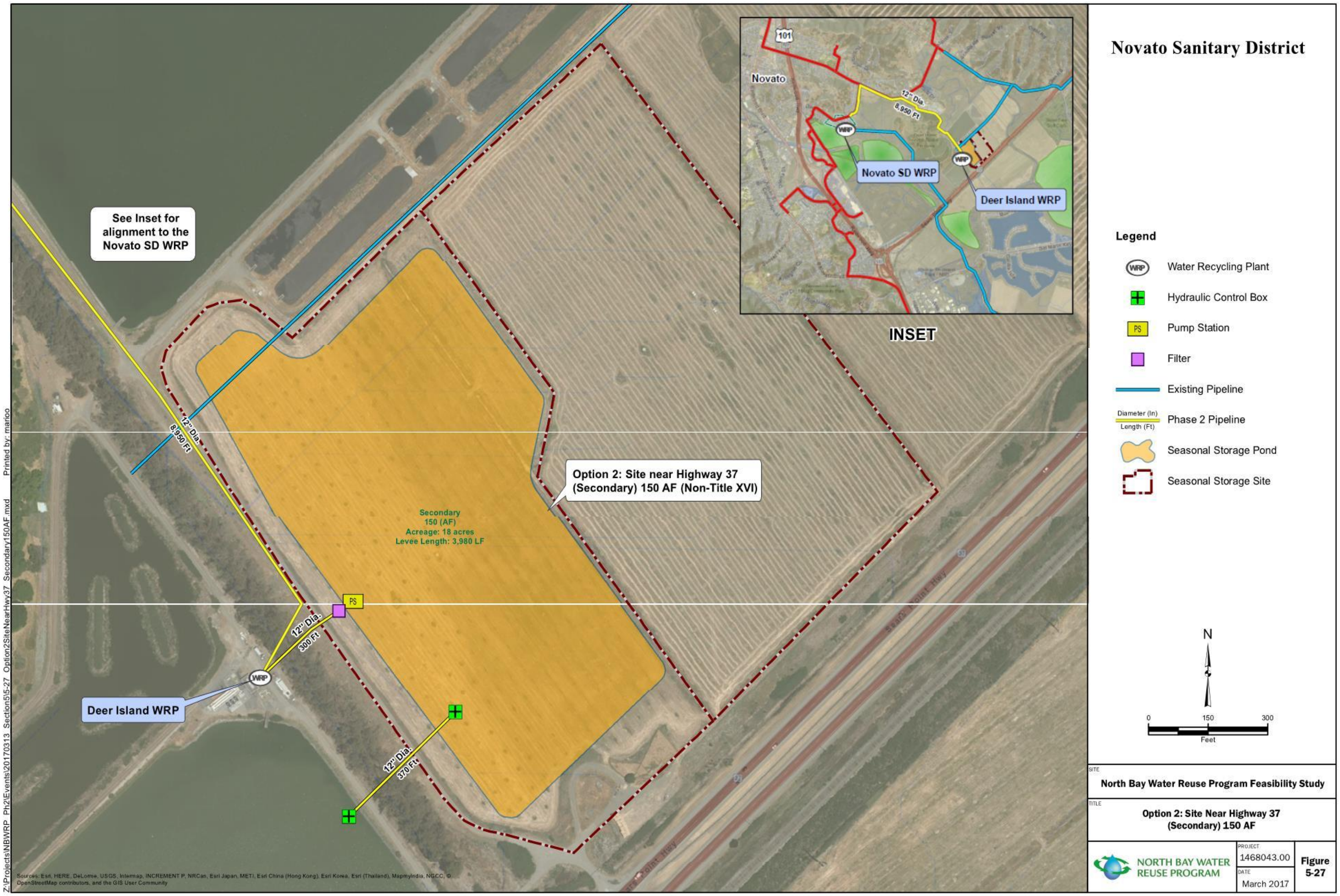



Figure 5-27. Option 2: Site Near Highway 37 (Secondary) 150 AF



Brown AND Caldwell

#### 5.3.1.3 Option 3 Hamilton Site (Secondary) 150 AF

This project would include construction of new seasonal secondary recycled water storage pond at the Hamilton site to allow Novato SD to store 150 AF of secondary effluent during winter months to later serve customer demands in summer months.

The storage pond design concept includes the construction of earth berms using available onsite material from excavation of the berms supplemented by imported fill when needed. Levees would be constructed with three to one horizontal-to-vertical slopes with a 12-foot access road on the top. Hydraulic structures with weirs and/or sluice gates to control water levels would be constructed. The pond would not be covered. Appropriate signage and fencing would be installed to prevent public access to the stored water. Recycled water would be conveyed to the pond by tapping off from an existing 54-inch-diameter outfall pipeline that is routed by the site. The project would include the installation of pipelines and a pump station to convey the stored secondary recycled water back to Novato SD WRP for filtration and disinfection prior to distribution. Figure 5-28 shows the key elements of this project.

Project components include the following:

- **Major Facilities:** 150-AF capacity storage pond (21 acres) with a membrane liner and no cover; 4,600 LF of levee; 28,000 LF of 12-inch-diameter pipelines, 500 LF of special pipeline crossings; one 700 gpm, 105-horsepower pump station; and two weir boxes.
- **Project Yield:** 150 AFY of additional recycled water available for reuse based on the ability to fill the seasonal storage pond in the winter to provide additional recycled water to meet peak summer demands.
- **Total Project Capital Cost:** $14.8 million.
- **Annual O&M Cost:** $0.10 million, based on additional labor to maintain and repair the storage ponds, pipelines and pump station.

This project would increase seasonal supply flexibility by increasing the availability of recycled water in the high demand summer irrigation periods. The site is located on soft bay mud, which increases risks associated with construction and long term settlement. This project is costlier than other storage options due to the need to treat the secondary recycled water again during summer and the longer 28,000 LF 12-inch diameter pipeline needed to convey secondary water back to Novato SD WRP for filtration and disinfection prior to distribution. In addition, similar to the seasonal storage option described in Sections 5.2.1.1 and 5.3.1.2, this site is vulnerable to climate change-induced sea level rise.

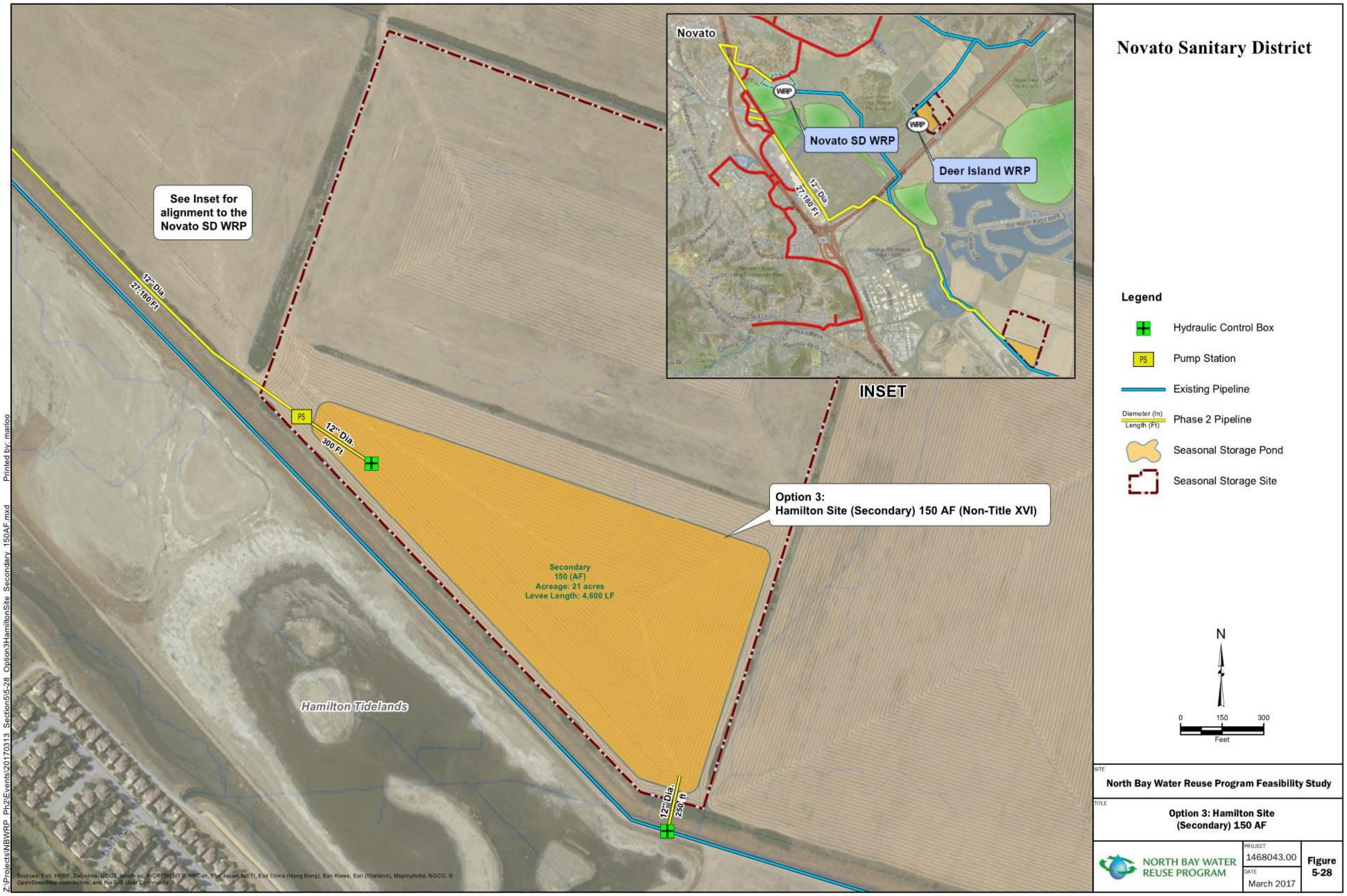



Figure 5-28. Option 3: Hamilton Site (Secondary) 150 AF

### 5.3.2 Sonoma Valley County Sanitation District

The proposed Phase 2 Program includes two Non-Title XVI project for the SCVSD, with a total estimated cost of $4.5 million and a combined project yield of 98 AFY as described in detail in the following section.

- Option 1: Mulas Site (Tertiary) 49 AF ($2.4 million, 49 AFY)
- Option 2: Robledo Site (Tertiary) 49 AF ($2.1 million, 49 AFY)

#### 5.3.2.1 Option 1: Mulas Site (Tertiary) 49 AF

This project would include construction of new seasonal storage pond at the Mulas site to allow SVCSD to store 49 AF of tertiary effluent during winter months to serve nearby agricultural customer demands in summer months.

Similar to other storage ponds constructed for seasonal storage, the pond design concept includes the construction of earth berms using available onsite material from excavation supplemented by imported fill when needed. Levees are constructed with 3:1 horizontal to vertical slopes and a 12-foot access road on the top. The ponds would not be covered. Appropriate signage and fencing would be installed to prevent public access to the stored water. A pump station would be required to serve on-site irrigation demands. Figure 5-29 shows the key elements of this project.

Project components include the following:

- **Major Facilities:** 49-AF capacity storage pond (5 acres) with a membrane liner and no cover; 1,900 LF of levee; 1 pump station.
- **Project Yield:** 49 AFY of additional recycled water available for reuse based on the ability to fill the seasonal storage pond in the winter to provide additional recycled water to meet peak summer demands.
- **Total Project Capital Cost:** $2.4 million.
- **Annual O&M Cost:** $0.03 million, based on additional labor to maintain and repair the storage ponds and pipelines.

This project would include construction of new seasonal storage on private land to increase the availability of recycled water in the high demand summer irrigation periods. The site is located on soft bay mud, which increases risks associated with construction and long term settlement. This site is vulnerable to climate change-induced sea level rise because it is located in an area that could be inundated (see Figure 2-3). Additionally, the water quality and quantity stored in the pond would be negatively impacted by water quality impacts at the WRP associated with climate change, such as increased salinity due to sea level rise and I&I. For storage sites that are vulnerable to sea level rise and flooding; damage to pond infrastructure and potential breaching of levees due to high water events could lead to increased costs and public safety concerns.

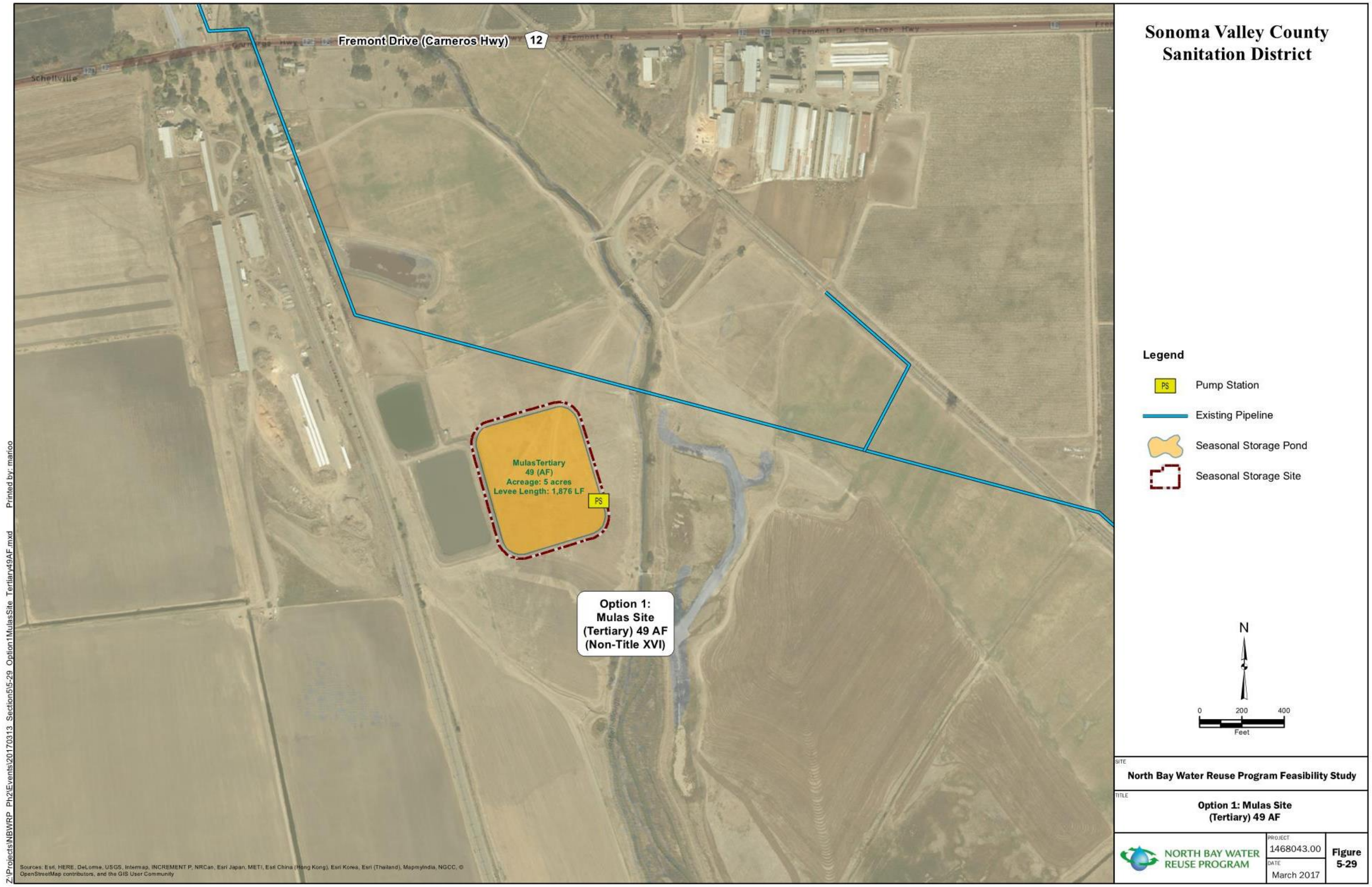



Figure 5-29. Option 1: Mulas Site (Tertiary) 49 AF

#### 5.3.2.2 Option 2: Robledo Site (Tertiary) 49 AF

This project would include construction of new seasonal storage at the Robledo site to allow SVCSD to store 49 AF of tertiary effluent during winter months to serve nearby agricultural customer demands in summer months. Since the capacity of the pond would be less than 50 AF, the pond would be a non-jurisdictional dam and would not be subject to statues and regulations pertaining to the Division of Safety of Dams Supervision of Dams and Reservoirs regulations.

Similar to other storage ponds constructed for seasonal storage, the pond design concept includes the construction of earth berms using available onsite material from excavation for the pond supplemented by imported fill. Levees would be constructed with three to one horizontal-to-vertical slopes and a 12-foot access road on the top. The ponds would not be covered. Appropriate signage and fencing would be installed to prevent public access to the stored water. Figure 5-30 shows the key elements of this project.

Project components include the following:

- **Major Facilities:** 49-AF capacity storage pond (5 acres) with a membrane liner and no cover; 1,900 LF of levee.
- **Project Yield:** 49 AFY of additional recycled water available for reuse based on the ability to fill the seasonal storage pond in the winter to provide additional recycled water to meet peak summer demands.
- **Total Project Capital Cost:** $2.1 million.
- **Annual O&M Cost:** $0.03 million, based on additional labor to maintain and repair the storage ponds and pipelines.

This project includes construction of new seasonal storage on private land to increase the availability of recycled water in the high demand summer irrigation periods. The site is located on soft bay mud which increases risks associated with construction and long-term settlement. In addition, similar to the seasonal storage option described in Section 5.3.2.1, this site is highly vulnerable to sea level rise resulting from climate change because it is located in an area that could be inundated (e.g., sea level rise combined with 100-year flood as shown in Figure 2-3).


Figure 5-30. Option 2: Robledo Site (Tertiary) 49 AF

### 5.3.3 Sonoma County Water Agency

The proposed Phase 2 Program includes one Non-Title XVI Level Project for SCWA as described in detail in the following section. The cost for this project has not been determined as part of this study.

#### 5.3.3.1 Sonoma Valley Groundwater Management and Recharge Project

The proposed Program includes one Non-Title XVI Project for the SCWA. Costs for the projects under consideration have not yet been determined and would vary depending on the size and scope of the project. SCWA's 2010 Water Supply Strategies Action Plan identified projects within SCWA flood control zones that could increase groundwater recharge. An important tool in identifying and improving water resource management in the Sonoma Valley is the 2007 GMP that identified storm water recharge as a key action towards achieving groundwater sustainability.

The GMP identified potential project concepts and determined the feasibility of projects that would provide benefits to Sonoma Valley. This project would provide a yield of about 100 AFY. The benefits include groundwater recharge, water quality improvements, water supply improvements, improved ecosystem functions, preservation of agricultural land use, preservation or enhancement of open spaces, system sustainability, increased recreational opportunities, public access, and education. The GMP utilized technical data and information for the watersheds (Upper Nathanson Creek Watershed, upper Arroyo Seco Creek Watershed, and the western portion of Agua Caliente Creek Watershed) to develop storm water management/groundwater recharge projects that address opportunities for groundwater recharge within the Sonoma Creek watershed. The following are brief descriptions of potential project types or measures that would be considered as part of this project:

- **In-line detention basins:** In-line detention basins increase recharge by providing longer periods or increased inundation area for infiltration by capturing runoff from a drainage area and releasing it slowly over time. An in-line detention basin must have adequate separation from groundwater to allow effective function and to avoid water quality concerns.
- **In-line retention basins:** In-line retention basins increase recharge from runoff by capturing runoff from a drainage area and retaining it, thereby increasing both the inundated area and the time to increase infiltration into the ground. As retention basins have permanent ponding areas that store flow for a much longer duration, retention basins may provide more recharge than is typically provided by detention basins.
- **Infiltration galleries:** In areas where above-ground detention/retention basins are not appropriate, infiltration galleries may be used to achieve groundwater recharge. Infiltration galleries are facilities that intercept and redirect surface water to a porous subsurface zone for infiltration. They typically involve shallow excavation and placement of perforated pipe within a gravel bed that is then backfilled with additional gravel and overlain with topsoil.
- **Self-cleaning infiltration trenches:** Self-cleaning trenches are similar to infiltration galleries but are linear and include an overflow outlet. They have a smaller footprint than detention/retention basins and can be used in location with limited access.
- **Vadose wells:** Vadose wells are wells completed in the vadose zone above unconfined aquifers; these are also known as "dry wells" because they do not intercept saturated aquifer materials. The benefits of vadose wells are they could provide recharge in locations where above ground facilities are not appropriate. These wells are low cost to construct and no maintenance is required.
- **Above-ground or underground storage tank:** Above-ground or underground tanks may be used to store storm water for later use as water supplies in lieu of groundwater pumping.

- **Infiltration-based approaches:** Infiltration-based low impact development (LID) approaches are facilities that rely on filtering storm water through soil (either native soil or an engineered soil mix). Examples of infiltration-based LID approaches are: infiltration basins; bioretention; pervious pavement; infiltration trenches; vegetated swales; and vadose wells (also known as dry wells).

SCWA is evaluating potential project types or measures relative to locations within the sub-watershed. Currently, a screening process is being conducted to identify the locations which appear to be physically feasible for the identified project types. As a result of the project undergoing screening analysis, the risks, benefits, and details of facilities is not fully defined.

Figure 5-31 shows the Sonoma Creek Sub-basins where potential groundwater management and recharge projects may be located in the Sonoma Valley. Since the facility requirements have yet to be designed; preliminary cost estimate have not been prepared at this time.

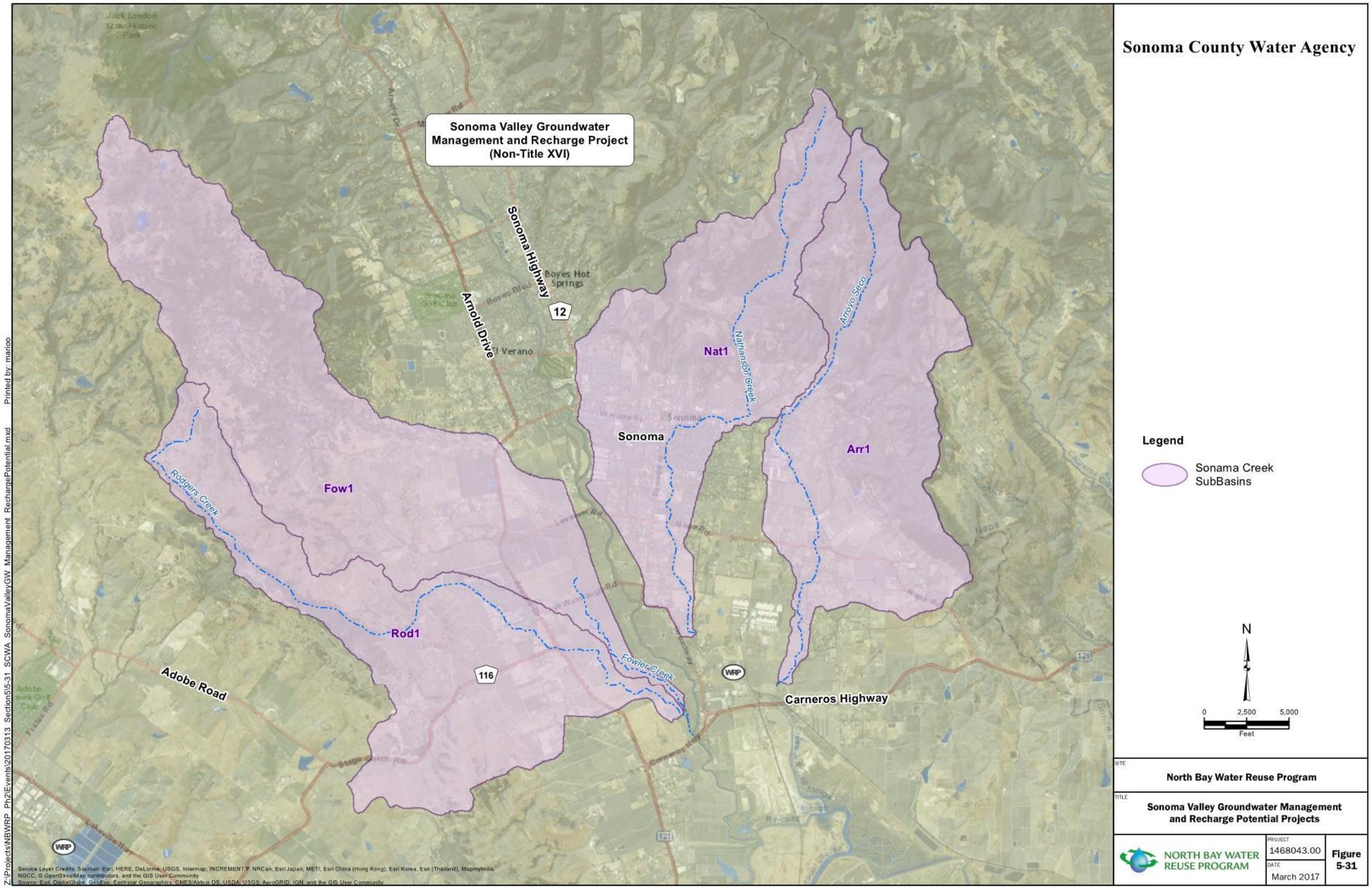



Figure 5-31. Sonoma Valley Groundwater Management and Recharge Potential Projects

### 5.3.4 City of Petaluma

The proposed Phase 2 Program includes two Non-Title XVI Projects for the City of Petaluma, with a total estimated cost of $21.6 million and a combined project yield of 450 AFY. The selected projects are described in detail in the following sections.

- Option 1a: Site Southeast of ECWRF (Secondary) 300 AF ($14.3 million, 300 AFY)
- Option 1b: Site Southeast of ECWRF (Secondary) 150 AF ($7.3 million, 150 AFY)

#### 5.3.4.1 Option 1a: Site Southeast of ECWRF (Secondary) 300 AF

This project would include construction of new seasonal storage pond at a site southeast of the existing ECWRF ponds to allow the City of Petaluma to store 300 AF of secondary effluent during winter months to later serve agricultural customers in summer months. The new ponds would be hydraulically connected with existing storage ponds, Ponds 2 and 3, so no additional pumping would be required.

The storage pond design concept would include the construction of earth berms using available on-site material from excavation of the pond and berms supplemented by imported fill. Similar to the existing ponds, the new pond would be constructed with levees with a three to one horizontal-to-vertical internal slope, a four to one horizontal-to vertical external slope, and a 30-foot access road on the top. The pond would include concrete hydraulic structures with weirs and/or sluice gates to control water levels. The pond would not be covered. Appropriate signage and fencing would be installed to prevent public access to the stored water. Figure 5-32 shows the key elements of this project.

Project components include the following:

- **Major Facilities:** 300-AF capacity storage pond (53 acres) with a membrane liner and no cover; 9,200 LF of levee; 500 LF of 12-inch-diameter pipelines.
- **Project Yield:** 300 AFY of additional recycled water available for reuse based on the ability to fill the seasonal storage pond in the winter to provide additional recycled water to meet peak summer demands.
- **Total Project Capital Cost:** $14.3 million.
- **Annual O&M Cost:** $0.09 million, based on additional labor to maintain and repair the storage ponds and pipelines.

This project would increase seasonal supply flexibility by increasing the availability of recycled water in the high demand summer irrigation periods. However, the site is not owned by the City of Petaluma and would need to be purchased; the cost of the land has not been accounted for in this analysis. The site is also located on soft bay mud, which increases risks associated with construction and long-term settlement. This site has significant vulnerability to climate change induced sea level rise and flooding because it is located in an area that could be inundated (e.g., sea level rise combined with 100-year flood as shown in Figure 2-3). Levee safety and potential public health and safety issues if a levee fails would be of concern. In addition, the water quality and quantity conveyed to the seasonal storage pond would be impacted by what is being produced at the recycled water treatment plants.

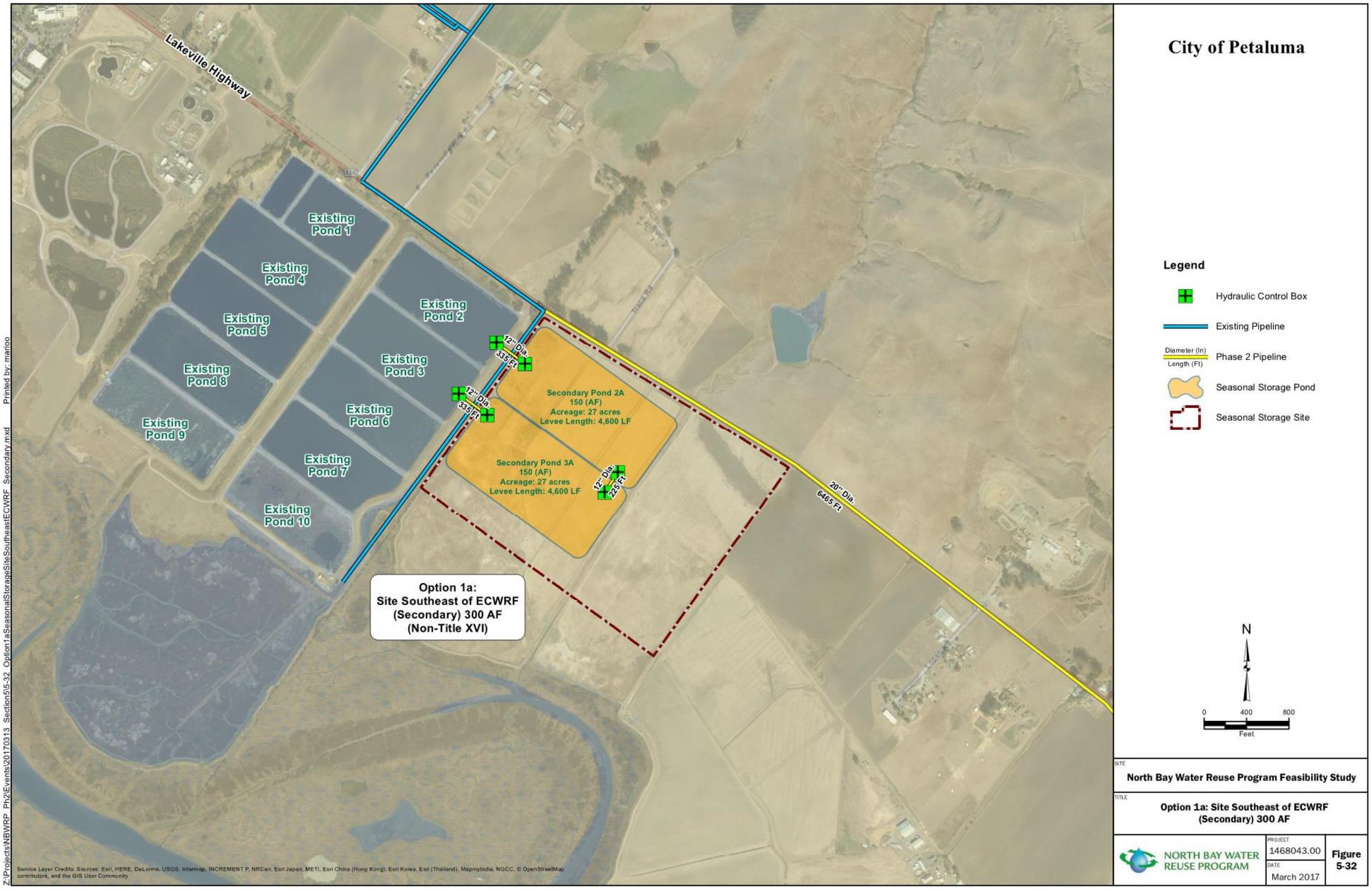



Figure 5-32. Option 1a: Seasonal Storage at Site Southeast of ECWRF (Secondary) 300 AF

### 5.3.4.2 Option 1b: Site Southeast of ECWRF (Secondary) 150 AF

Similar to the 300 AF Secondary Recycled Water Storage project at the site southeast of the ECWRF project described above, this project would include construction of new seasonal storage pond at a site southeast of the existing ECWRF ponds to allow the City of Petaluma to store 150 AF of secondary effluent during winter months to later serve agricultural customers in summer months. The new pond would be hydraulically connected with existing Ponds 2 and 3. As such, no additional pumping is required.

The storage pond design concept would include the same type of construction as the 300 AF Secondary Recycled Water Storage project described above, but be smaller in overall capacity. Figure 5-33 shows the key elements of this project.

Project components include the following:

- **Major Facilities:** 150-AF capacity storage pond (27 acres) with a membrane liner and no cover; 4,600 LF of levee; 500 LF of 12-inch-diameter pipelines.
- **Project Yield:** 150 AFY of additional recycled water available for reuse based on the ability to fill the seasonal storage pond in the winter to provide additional recycled water to meet peak summer demands.
- **Total Project Capital Cost:** $7.3 million.
- **Annual O&M Cost:** $0.06 million, based on additional labor to maintain and repair the storage ponds and pipelines.

This project would increase seasonal supply flexibility by increasing the availability of recycled water in the high-demand summer irrigation periods. However, the site is not owned by the City of Petaluma and would require purchase or leasing of land, which has not been accounted for in this analysis. The site is also located on soft bay mud, which increases risks associated with construction and long-term settlement. Similar to the seasonal storage option described in Section 5.3.4.1, this site has significant vulnerability to sea level rise and flooding from climate change.

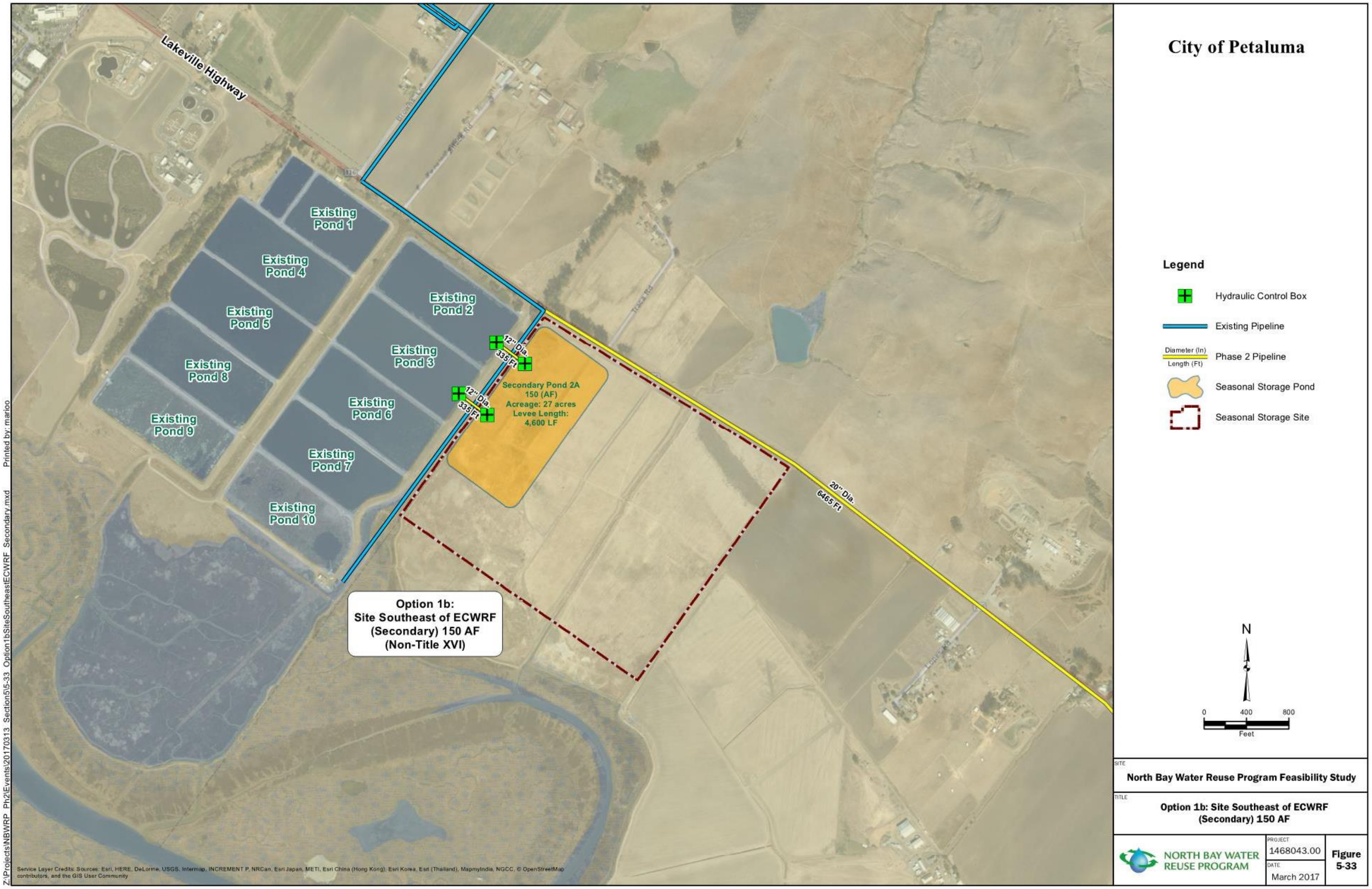



Figure 5-33. Option 1b: Site Southeast of ECWRF (Secondary) 150 AF

### 5.3.5 Napa Sanitation District

The proposed Phase 2 Program includes seven Non-Title XVI Projects for Napa SD, with a total estimated cost of $99.5 million and a combined project yield of 3,100 AFY. The first five projects are potential seasonal storage options explored by Napa SD and the last two are distribution extensions to the existing recycled water system. The selected projects are described in detail in the following sections.

- Option 1a: Raise Existing Pond Levees (Secondary) 300 AF ($9.9 million, 300 AFY)
- Option 1b: Raise Existing Pond Levees (Secondary) 1,100 AF ($30.4 million, 1,100 AFY)
- Option 2: Somky Ranch Site (Secondary) 300 AF ($16.4 million, 300 AFY)
- Option 3a: Jameson Ranch Site (Tertiary) 600 AF ($18.7 million, 600 AFY)
- Option 3b: Jameson Ranch Site (Tertiary) 300 AF ($12.4 million, 300 AFY)
- MST Northern Loop ($7.6 million, 350 AFY)
- MST Eastern Extension ($4.1 million, 100 AFY)

#### 5.3.5.1 Option 1a: Raise Existing Pond Levees (Secondary) 300 AF

This project consists of raising the existing pond levees at Soscol WRF to provide an additional 300 AF of secondary effluent storage from Soscol WRF during the winter to increase the availability of tertiary treated recycled water supply in summer. There are four interconnected existing ponds at the Soscol WRF that store a total of 2,375 AF of secondary effluent. This project would raise the Pond 1 levee by 3 feet to increase storage capacity by 300 AF.

As a result of the increased water surface elevation in Pond 1, flow through the ponds would have to be reversed from the current scheme, which currently routes flow sequentially from Ponds 1 through 4. The change to flow schemes would require secondary effluent to be pumped into Pond 4. Gate valves within the ponds would have to be replaced and a new pump station would be required to lift water from Pond 2 to Pond 1.

The pond design concept would include the construction of earth berms on top of the existing berms using available on-site material from excavation supplemented by imported fill as-needed. The raised levee would be designed similarly to the existing pond levees to achieve a four to one horizontal-to-vertical internal slope, a three to one horizontal-to-vertical external slope, and a 12-foot access road on the top. The ponds would not be covered. Existing signage and security at the WRF would prevent public access to the stored water. Figure 5-34 shows the key elements of this project.

Project components include the following:

- **Major Facilities:** 300-AF capacity additional storage at existing pond with membrane liner and no cover; 1,300 LF of pipelines for operational changes; 800-gpm pump station for operational changes.
- **Project Yield:** 300 AFY of additional secondary effluent available for reuse based on the ability to fill the seasonal storage pond in the winter to provide additional recycled water to meet peak summer demands.
- **Total Project Capital Cost:** $9.9 million, based on earthwork, pump station and pipeline costs.
- **Annual O&M Cost:** $0.09 million, based on energy for pumping and additional labor to maintain and repair the storage ponds, pipelines and pump stations.

The site is within an already disturbed area at Soscol WRF and is located within bay mud soils. The existing pond levees have experienced settlement associated with soil consolidation, particularly for Ponds 2, 3 and 4. Therefore, there are significant geotechnical risks associated with construction and long term settlement would need to be accounted for with any modifications.

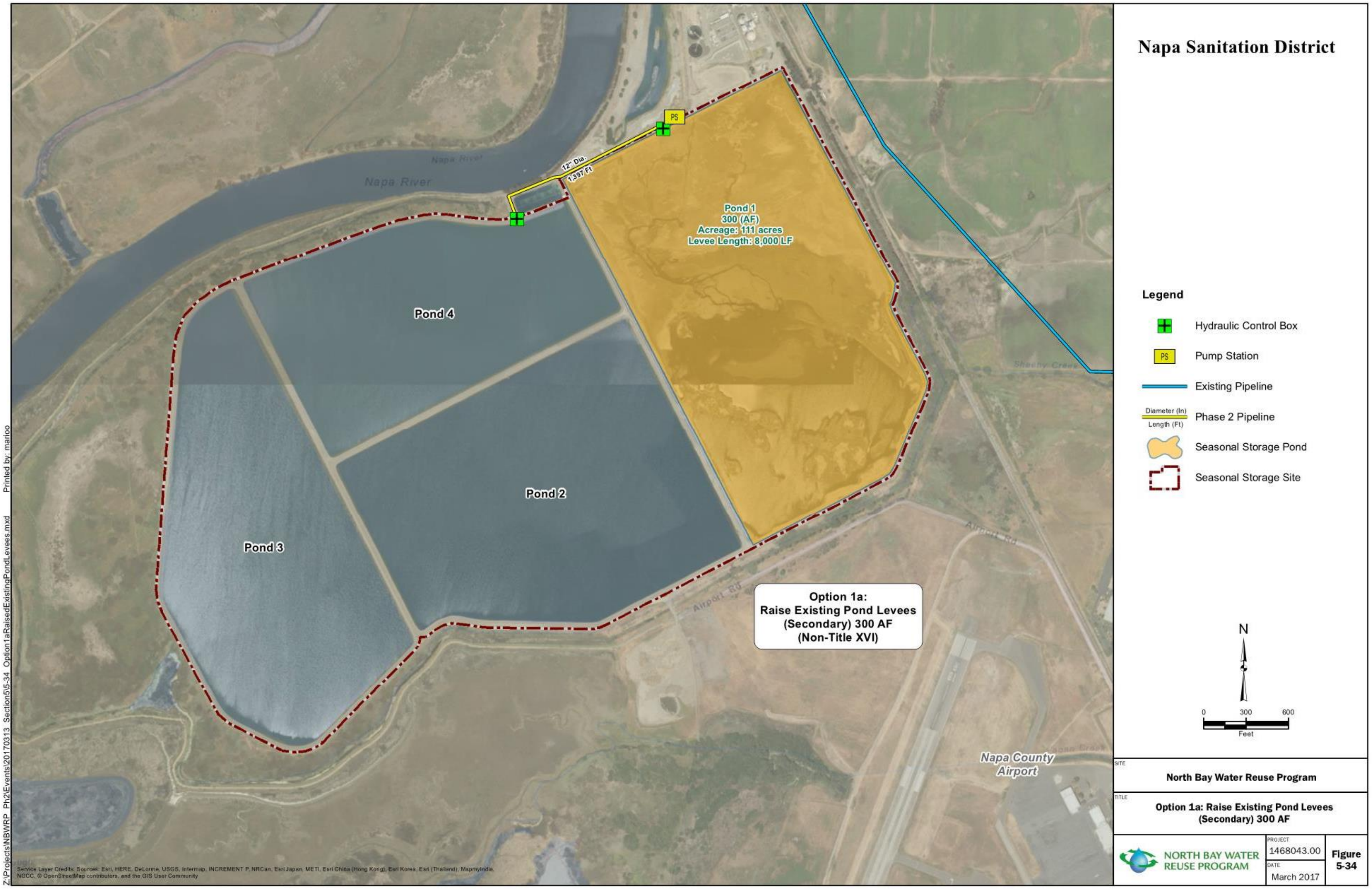



Figure 5-34. Option 1a: Raise Existing Pond Levees (Secondary) 300 AF

The Option 1a project to raise the Pond 1 levee by 3 feet would change the hydraulics between ponds, requiring a new pump station and hydraulic control structures near the ponds. There would be an increased risk of spillage during construction in winter periods due to limited storage and treatment capacity when Pond 1 is fully or partially out of service. The additional 300 AF of stored secondary effluent would have to undergo tertiary treatment prior to delivery to customers.

#### 5.3.5.2 Option 1b: Raise Existing Pond Levees (Secondary) 1,100 AF

This project consists of raising all of the existing pond levees at the Soscol WRF to store an additional 1,100 AF of secondary effluent from Soscol WRF during the winter to increase the availability of tertiary treated recycled water supply in the summer. There are currently four existing ponds hydraulically connected via gate valves that store a total of 2,375 AF of secondary effluent.

This project would include raising the levees for all four ponds to achieve 1,100 AF of new capacity. The Pond 1 levees would be raised by 3 feet. Due to geotechnical conditions and historically observed settlement, Ponds 2, 3, and 4 would have to be raised by 5 feet to achieve a 3-foot rise (allowing for 2 feet of consolidation over time). Gate valves within the ponds would have to be replaced and a new pump station would be required to pump to the increased water surface elevation. The flow sequence between ponds would be maintained, delivering secondary water to the ponds before conveying stored water back to the WRP for tertiary treatment.

The pond design concept would include the construction of earth berms on top of the existing berms using available on-site material from excavation of the ponds supplemented by imported fill as needed. The raised levee would be designed similar to the existing pond levees to achieve a four to one horizontal-to-vertical internal slope, a three to one horizontal-to-vertical external slope, and a 12-foot access road on the top. The ponds would not be covered. Existing signage and security at the WRF would prevent public access to the stored water. Figure 5-35 shows the key elements of this project.

Project components include the following:

- **Major Facilities:** 1,100-AF capacity additional storage at existing pond with a membrane liner and no cover; a 2,500-gpm pump station to pump water to Pond 1; five new concrete box structures to transfer flow between ponds.
- **Project Yield:** 1,100 AFY of additional secondary effluent available for reuse based on the ability to fill the seasonal storage pond in the winter to provide additional recycled water to meet peak summer demands.
- **Total Project Capital Cost:** $30.4 million, based on earthwork and pump station costs.
- **Annual O&M Cost:** $0.23 million, based on energy for pumping and additional labor to maintain and repair the storage ponds, pipelines and pump stations.

This project increases seasonal supply flexibility by increasing the availability of recycled water, particularly in the high demand summer irrigation periods. The site is within the already disturbed Soscol WRF site. The project site is also located on bay mud that has already experienced settlement with the existing ponds. There are significant risks associated with increasing levee height and associated long-term consolidation settlement. There is also the risk of wastewater spills due to limited storage during wintertime construction when any pond is fully or partially out of service. Additionally, the 1,100 AF of stored secondary effluent would have to undergo tertiary treatment prior to delivery to customers.

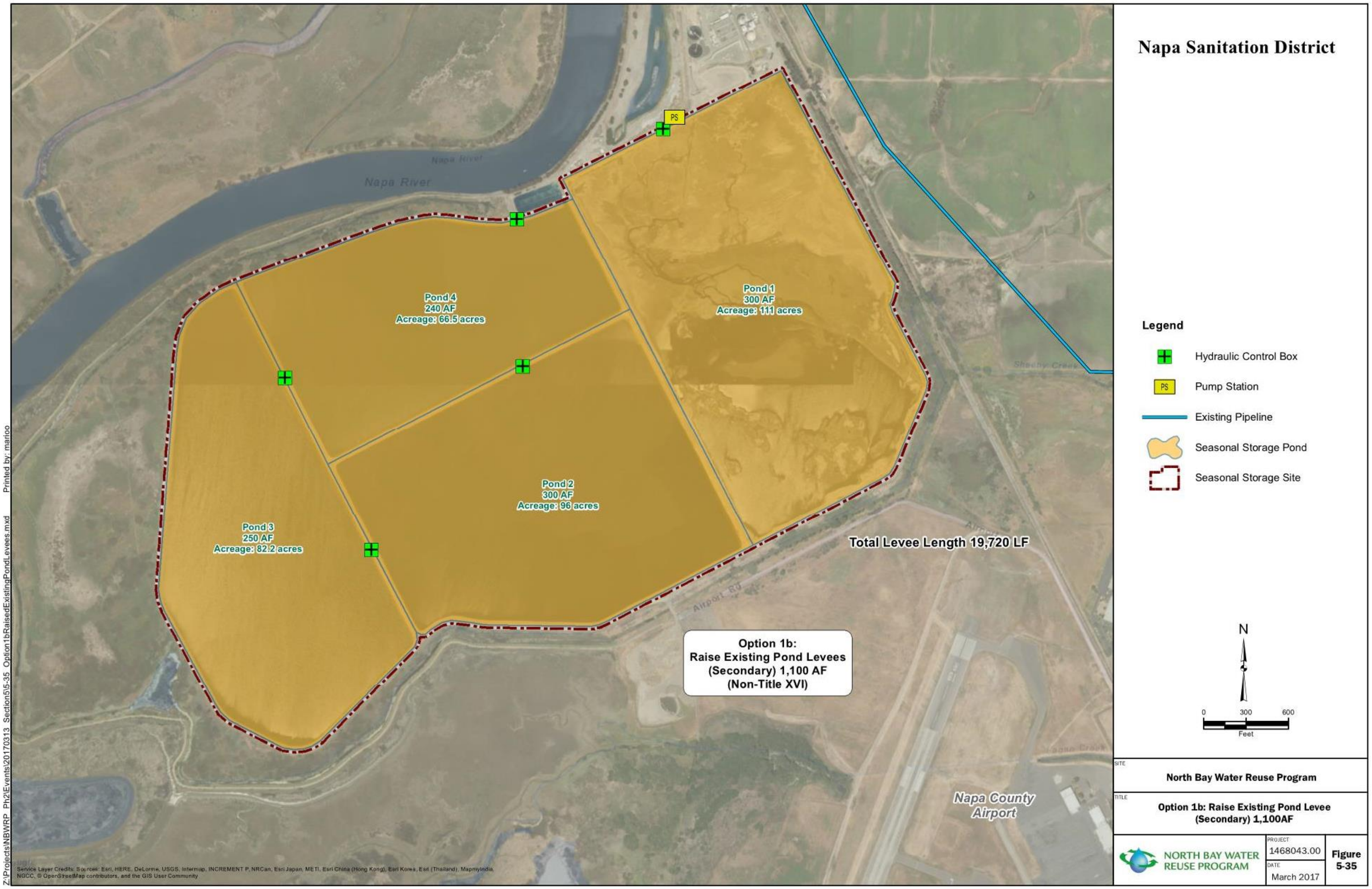



Figure 5-35. Option 1b: Raise Existing Pond Levees (Secondary) 1,100 AF

#### 5.3.5.3 Option 2: Somky Ranch Site (Secondary) 300 AF

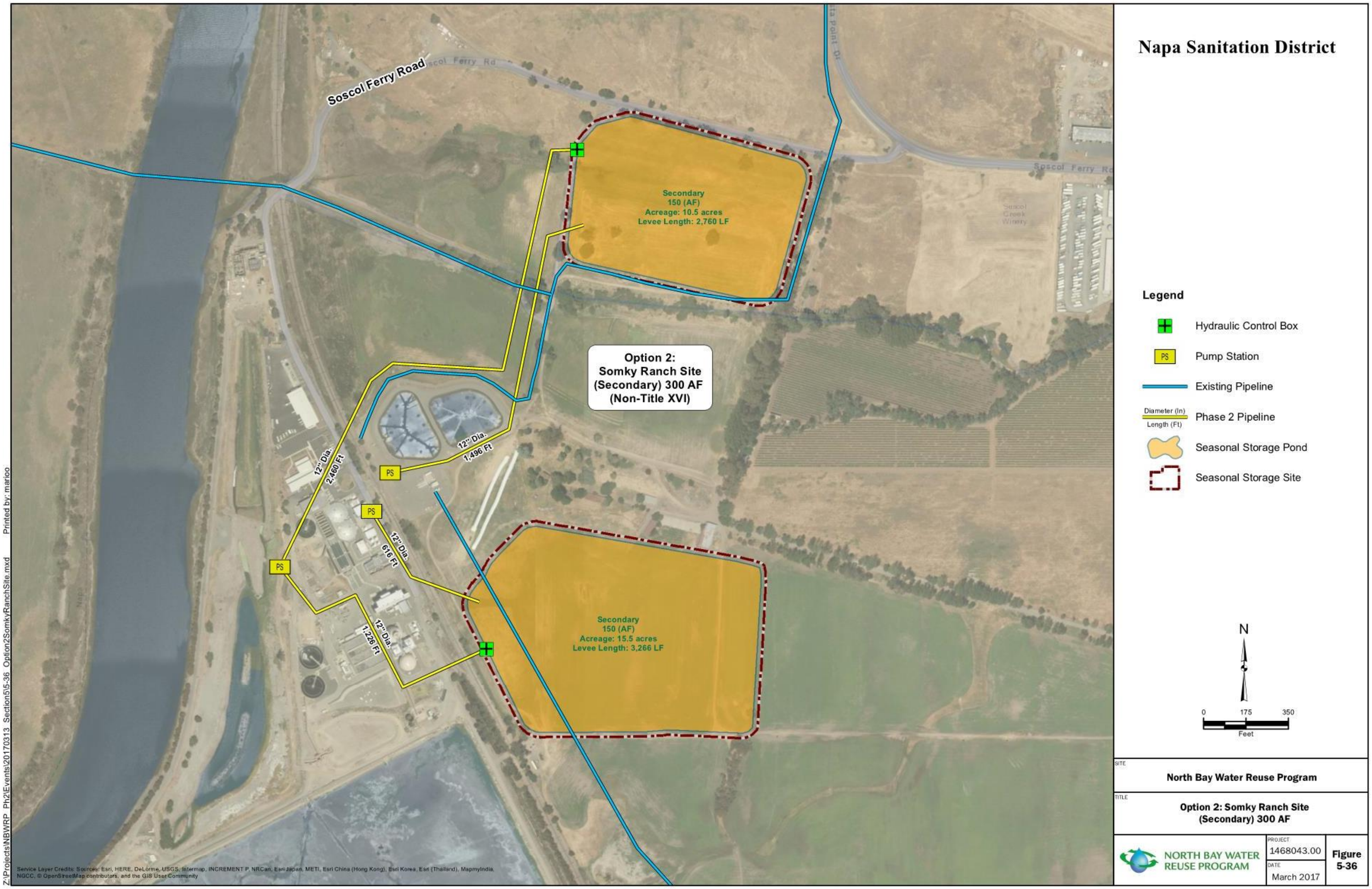
This project consists of new off-site, uncovered, seasonal storage pond to store 300 AF secondary effluent from Soscol WRF during the winter to increase the availability of tertiary treated recycled water supply in summer. Approximately 2 miles of pipelines, ranging in size from 12- to 36-inch-diameter, would be constructed to convey water from Soscol WRF to the two new ponds. Two new pump stations would be required to convey secondary effluent to the north pond and the south pond. Stored water would be conveyed via gravity pipeline to a new DAF facility (a clarifying treatment process through the removal of suspended matter) at the Soscol WRF. A new pump station would also be required to pump DAF effluent to the existing filters.

The pond design concept would include the construction of earth berms using available on-site material from excavation of the ponds and supplemented by imported fill when needed. The pond levee design would include three to one horizontal-to-vertical slope, and a 12-foot access road on the top. The ponds would not be covered. Appropriate signage and fencing would be installed to prevent public access to the stored water. Figure 5-36 shows the key elements of this project.

Project components include the following:

- **Major Facilities:** 300-AF capacity storage pond (26 acres) with a membrane liner and no cover; 6,100 LF of levee; 2,250 LF of 12-inch-diameter pipelines to convey water from Soscol WRF to the ponds and 3,000 LF of 36-inch diameter pipelines to convey stored water from the ponds back to Soscol WRF; two 380-gpm pump stations to pump water from Soscol WRF to each pond and one 9,550-gpm pump station to lift water at Soscol WRF to existing filters; and two concrete box structures to transfer flow in and out of each pond.
- **Project Yield:** 300 AFY of additional secondary effluent available for reuse based on the ability to fill the seasonal storage pond in the winter to provide additional recycled water to meet peak summer demands.
- **Total Project Capital Cost:** $16.4 million, based on earthwork, pipeline, and pump station costs.
- **Annual O&M Cost:** $0.11 million, based on energy for pumping and additional labor to maintain and repair the storage ponds and pump stations.

The project is located close to the Soscol WRF within a moderate flood risk area. There are multiple site constraints related to high groundwater, expansive and compressive soil, and existing utilities (natural gas lines, electrical lines and communication lines) which may need to be relocated to construct the ponds. The site is also in close proximity to the Napa County Airport, which would result in challenging construction constraints due to flight path zones and could increase the potential for bird issues. Additionally, there is a moderate-to-high potential for wetland issues at the south pond. There may also be competing interest in the land for use by vineyards, which translates to a loss of potential revenue if the land were to be leased for grape cultivation.




Z:\Projects\NBWRP_Ph2\Events\20170313_Section5\5-36_Option2SomkyRanchSite.mxd Printed by: marioo

Figure 5-36. Option 2: Somky Ranch Site (Secondary) 300 AF

#### 5.3.5.4 Option 3a: Jameson Ranch Site (Tertiary) 600 AF

This project would include construction of new seasonal storage ponds to store 600 AF recycled water from Soscol WRF during the winter to serve two local golf courses and future customers in summer months. Earthen levees would be constructed to create two adjacent 300-AF ponds hydraulically connected to distribute flow between the ponds. An existing recycled water distribution pipeline routed through the Jameson Ranch site would be used to convey recycled water to the new storage ponds. Stored water would undergo on-site filtration before being supplied to customers to remove algae that might form in the ponds. A new recycled-water pump station and pipeline would be constructed to convey stored recycled water from the ponds into the existing recycled water distribution system to serve the golf courses.

The storage ponds design concept would include the construction of earth berms using available on-site material from excavation for the pond and berms supplemented by imported fill. The pond levee design would be three to one horizontal-to-vertical slope and a 12-foot access road on the top. The ponds would not be covered. Appropriate signage and fencing would be installed to prevent public access to the stored water. Figure 5-37 shows the key elements of this project.

Project components include the following:

- **Major Facilities:** 600-AF capacity storage pond (45 acres) with a membrane liner and no cover; 8,100 LF of levee; 5,000 LF of pipelines; a 2,500 gpm pump station; two concrete box structures to transfer flow in and out of each pond; and a tertiary sand filter system at the pond outlet.
- **Project Yield:** 600 AFY of additional recycled water available for reuse based on the ability to fill the seasonal storage pond in the winter to provide additional recycled water to meet peak summer demands.
- **Total Project Capital Cost:** $18.7 million, based on earthwork and facility costs.
- **Annual O&M Cost:** $0.12 million, based on energy for pumping and additional labor to maintain and repair the storage ponds, pipelines and pump stations.

This project would increase seasonal supply flexibility by increasing the availability of recycled water in the high demand summer irrigation periods. The Jameson Ranch site is owned by Napa SD. The storage site is close to existing pipelines, which minimizes the cost of new pipelines needed. The storage site is also located on higher ground and within a moderate flood risk area.

Should the project be constructed in two phases to gradually meet increases in demand, Phase 1 would involve the construction of the 300 AF South Pond, pump station, 12-inch-diameter pipeline, and filtration unit. Phase 2 would include the construction of the 300 AF North Pond, a pipeline to convey recycled water to the second pond, and a connection pipeline to link the two ponds. This stepwise approach would cost approximately $200,000 more due to additional mobilization costs.

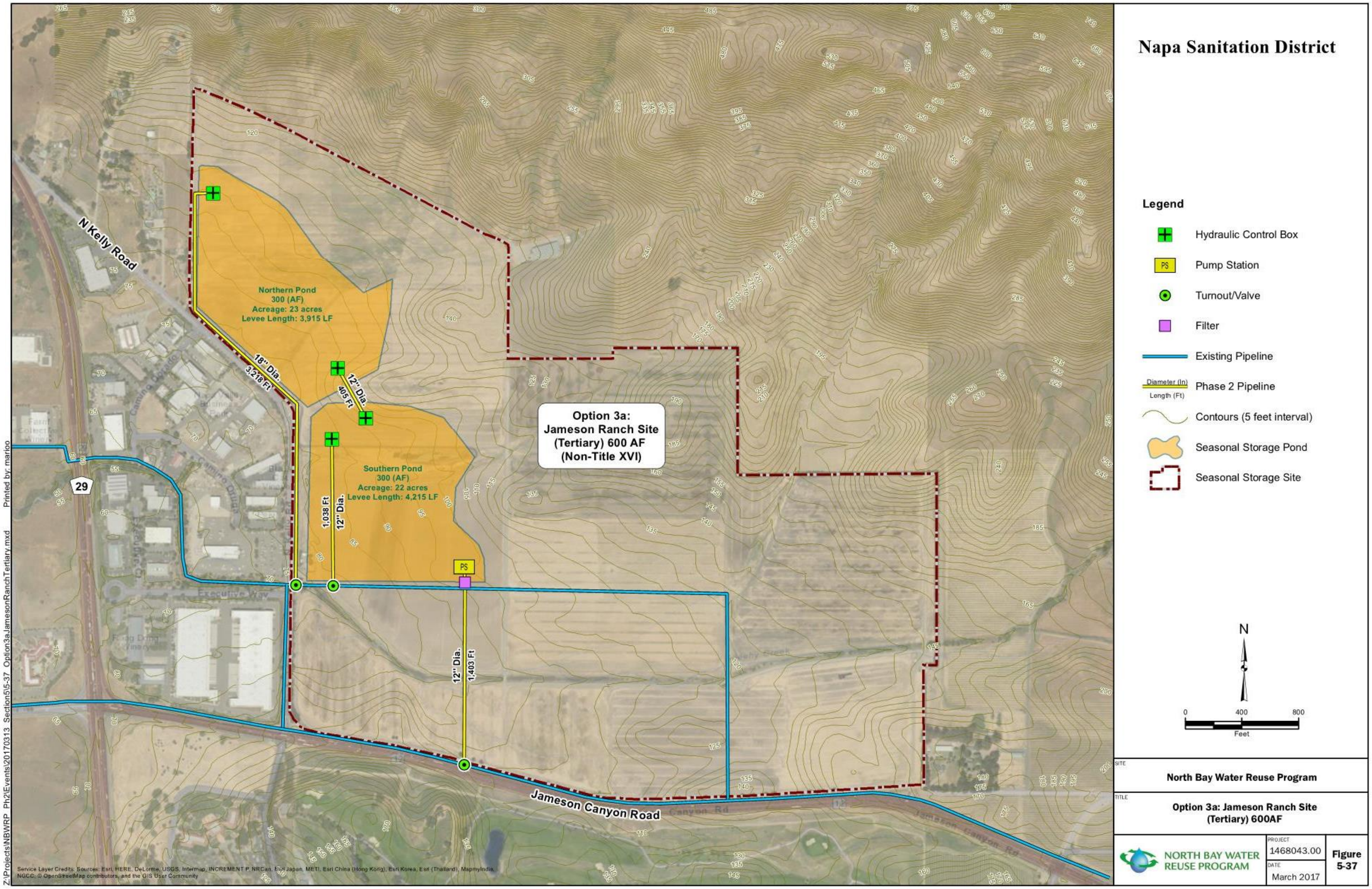



Figure 5-37. Option 3a: Jameson Ranch Site (Tertiary) 600 AF

#### 5.3.5.5 Option 3b: Jameson Ranch Site (Tertiary) 300 AF

This project would construct new off-site, uncovered, seasonal storage ponds to store 300 AF or tertiary treated recycled water from Soscol WRF during the winter to serve two local golf courses and customers in summer. Earthen levees would be constructed to create two 150 AF adjacent ponds connected via a pipeline to distribute flow between the ponds. A new pipeline would be constructed from the existing recycled water pipeline originating at Soscol WRF which passes through the site to fill the new storage ponds. Stored water would undergo on-site filtration, before being delivered to customers to remove algae that might form in the ponds. A new recycled-water pump station and new pipeline would also be needed to convey stored water from the ponds into the existing recycled water distribution system to the golf courses.

The pond design concept would include the construction of earth berms using available onsite material from excavation for the pond and berms supplemented by imported fill when needed. The ponds would be constructed with a three to one horizontal-to-vertical slope and a 12-foot access road on the top. The ponds would not be covered. Appropriate signage and fencing would be installed to prevent public access to the stored water. Figure 5-38 shows the key elements of this project.

Project components include the following:

- **Major Facilities:** 300-AF capacity storage pond (23 acres) with a membrane liner and no cover; 5,200 LF of levee, 5,050 LF of pipelines; a 1,300 gpm pump station; and two concrete box structures to transfer flow in and out of each pond and a tertiary sand filter system at the pond outlet.
- **Project Yield:** 300 AFY of additional recycled water available for reuse based on the ability to fill the seasonal storage pond in the winter to provide additional recycled water to meet peak summer demands.
- **Total Project Capital Cost:** $12.4 million, based on earthwork and facility costs.
- **Annual O&M Cost:** $0.12 million, based on energy for pumping and additional labor to maintain and repair the storage ponds, pipelines and pump stations.

This project would increase seasonal supply flexibility by increasing the availability of recycled water in the high-demand summer irrigation periods. The Jameson Ranch site is owned by Napa SD. The storage site is close to existing pipelines, which minimizes the cost of new pipelines needed. The storage site is also located on higher ground and within a moderate flood risk area.

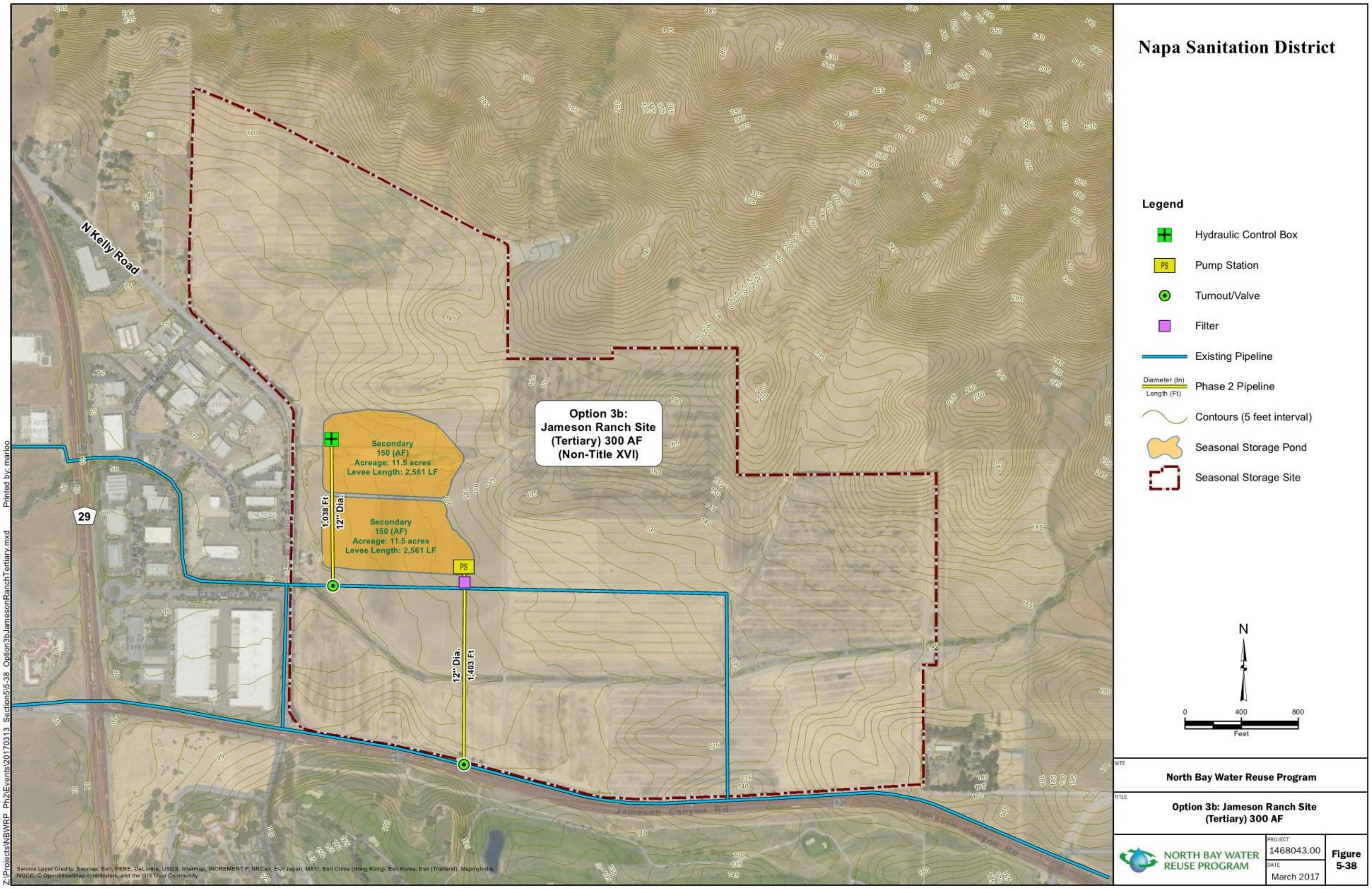



Figure 5-38. Option 3b: Jameson Ranch Site (Tertiary) 300 AF

#### 5.3.5.6 Milliken-Sarco-Tulocay (MST) Northern Loop

Expanding the recycled water distribution system would allow Napa SD to supply recycled water to more customers, thereby reducing reliance on surface water. This project would include constructing 26,100 LF of pipelines, primarily located within existing roads, to expand the existing Napa SD recycled water distribution system. Hydraulic modeling results for the MST system performed in the Phase 1 Feasibility Study were used to size conveyance facilities for the Northern Loop (see Appendix C for hydraulic modeling results). Figure 5-39 shows the location of this project, highlighting the Northern Loop and Eastern Extension (discussed in the following section).

Project components include the following:

- **Major Facilities:** 3,400 LF of 16-inch-diameter pipelines; 6,100 LF of 12-inch-diameter pipelines; and 16,600 LF of 8-inch-diameter pipelines.
- **Project Yield:** 350 AFY of recycled water available for reuse based on the full looped system distributing up to 2,000 AFY.
- **Total Project Capital Cost:** $7.6 million, based on pipeline and installation costs.
- **Annual O&M Cost:** $0.05 million, based on energy for pumping and additional labor to maintain and repair the pipelines.

This project would efficiently utilize existing assets to increase the distribution of recycled water. The proposed pipeline alignment is along roads within already disturbed areas. The vulnerability to climate change is low because pipeline distribution projects such as this generally involve constructing buried, pressurized pipelines, which reduces vulnerability to climate change impacts. The water quality and quantity conveyed by the recycled water distribution system would be impacted by quality changes at the ECWRF.

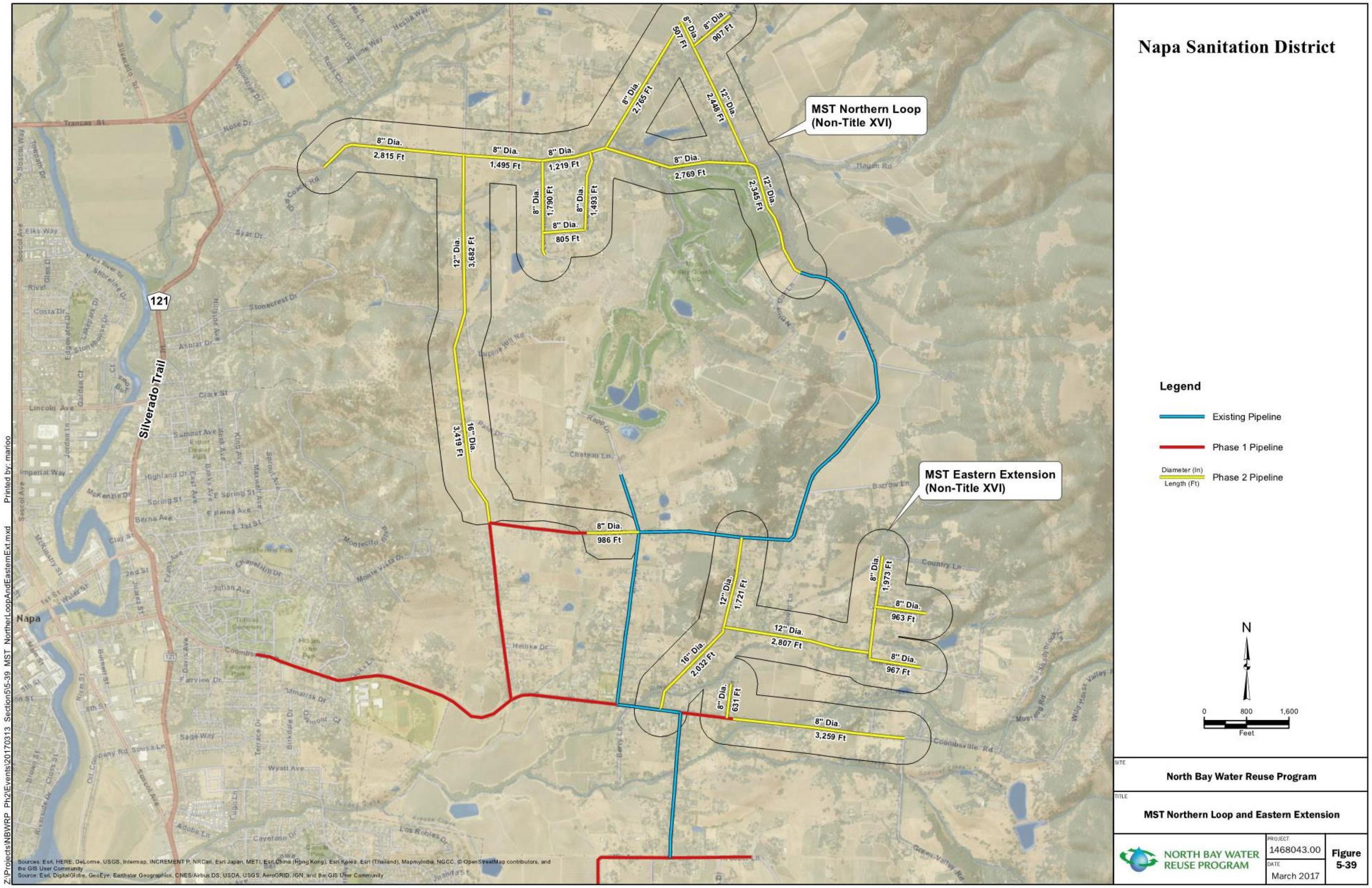



Figure 5-39. MST Northern Loop and Eastern Extension

#### 5.3.5.7 MST Eastern Extension

Similar to the prior project description, this project would expand the recycled water distribution system to allow Napa SD to supply recycled water to additional customers, thereby reducing reliance on surface water. This project consists of constructing 14,500 LF of pipelines to extend the existing Napa SD recycled water distribution system to the east. Pipelines would primarily be located within existing roadways. Hydraulic modeling results for the MST system performed in the Phase 1 Feasibility Study were used to size conveyance facilities for the Eastern Extension (see Appendix C for hydraulic modeling results). Figure 5-39 shows the location of this project.

Project components include the following:

- **Major Facilities:** 2,100 LF of 16-inch-diameter pipelines' 4,500 LF of 12-inch-diameter pipelines; and 7,900 LF of 8-inch-diameter pipelines
- **Project Yield:** 150 AFY of recycled water available for reuse based on the full looped system distributing up to 2,000 AFY.
- **Total Project Capital Cost:** $4.1 million, based on pipeline and installation costs.
- **Annual O&M Cost:** $0.03 million, based on energy for pumping and additional labor to maintain and repair the pipelines.

Project benefits and challenges, and vulnerabilities to climate change are similar to the proposed MST Northern Loop Project described in Section 5.3.5.6.

## 5.4 Alternative Measures

As discussed in Section 3.2, the projects included in the Phase 2 Program aim to expand recycled water use and other water management options within the NBWRA region and build upon investments and projects completed under NBWRP Phase 1. Alternative measures for water reclamation, distribution, and reuse would result in increased project costs and not effectively utilize the previous investments. The treatment projects included in the Phase 2 Program utilize the existing infrastructure already in place to increase recycled water production. Additionally, the distribution projects extend the existing recycled water systems already in existence, many of which were included in Phase 1, to expand service and increase recycled water use.

An operational study, discussed in Section 3.3, was completed to support the MAs in the selection of storage facilities to be included in the Phase 2 Program and met the Phase 2 Program objectives. The alternative storage facilities presented, considered alternative methods to meet the individual MAs needs for operational or seasonal storage. The selected storage options included in the Phase 2 Program were those projects that were more financially feasible for the individual agencies. Those storage projects included in the Programmatic Level remain in the program to provide flexibility should additional storage be needed in the future.

## 5.5 Climate Change Vulnerabilities by Project

An overview of climate change is provided in Section 2.5, which discusses climate change applicable to the NBWRP area, vulnerabilities by water characteristic, and vulnerabilities by type of project. Based on the characteristics, project type, and site-specific considerations, each individual project is qualitatively scored against each water characteristic using the following relative scale:

| Score | Relative Vulnerability |
|---|---|
| 1 | Significant vulnerability to climate change |
| 2 | High vulnerability to climate change |
| 3 | Moderate vulnerability to climate change |
| 4 | Low vulnerability to climate change |
| 5 | Insignificant vulnerability to climate change |

Table 5-5 lists the relative vulnerabilities of each Title XVI and Programmatic Level project in terms of climate change impact to support the environmental analysis and documentation. In general, similar types of projects would have similar vulnerabilities. However, site-specific conditions result in different vulnerabilities. For example, most seasonal storage projects would have low vulnerability to water demand and water supply and moderate vulnerability to water quality as a result of climate change. However, vulnerability to sea level rise or flooding would be highly dependent on site location and project-specific vulnerability scores vary accordingly. Sections 5.1 through 5.3 provide project-specific discussions about the climate change vulnerability parameters that were used as the basis of the scoring presented in Table 5-5. All the NBWRA projects considered (Title XVI, Programmatic Level and Non-Title XVI) are also shown in Figure 5-40.

**Table 5-5. Summary of Climate Change Vulnerabilities**

| Project Type and Title | Agency | Title XVI Project Level EIR/EIS | Programmatic Level | Water Demand (urban, ag, env) | Water Supply | Water Quality | Sea Level Rise | Flooding | Ecological Health and Habitat |
|---|---|---|---|---|---|---|---|---|---|
| **Treatment** | | | | | | | | | |
| Novato SD WRP Capacity - 1st Expansion (+0.85 MGD) | Novato SD | ✓ | | 4 | 4 | 3 | 2 | 2 | 5 |
| Increase ECWRF Capacity | Petaluma | ✓ | | 4 | 4 | 3 | 2 | 2 | 5 |
| Soscol WRF Increased Filter Capacity | Napa SD | ✓ | | 4 | 4 | 3 | 2 | 1 | 5 |
| American Canyon WRF Phase 2 Treatment Plant Upgrades | American Canyon | ✓ | | 4 | 4 | 3 | 5 | 2 | 5 |
| **Seasonal Storage** | | | | | | | | | |
| Option 1: Site Near Highway 37 (Tertiary) 150 AF | Novato SD | | ✓ | 4 | 4 | 3 | 2 | 2 | 5 |
| Valley of the Moon ASR | SCWA | ✓ | | 4 | 4 | 3 | 5 | 4 | 2 |
| Sonoma ASR | SCWA | ✓ | | 4 | 4 | 3 | 5 | 4 | 2 |
| **Operational Storage** | | | | | | | | | |
| Additional Soscol WRF Covered Storage | Napa SD | ✓ | | 5 | 5 | 4 | 2 | 1 | 3 |
| Napa State Hospital Storage Tank | Napa SD | | ✓ | 5 | 5 | 4 | 5 | 2 | 5 |

**Table 5-5. Summary of Climate Change Vulnerabilities**

| Project Type and Title | Agency | Title XVI Project Level EIR/EIS | Programmatic Level | Water Demand (urban, ag, env) | Water Supply | Water Quality | Sea Level Rise | Flooding | Ecological Health and Habitat |
|---|---|---|---|---|---|---|---|---|---|
| **Distribution** | | | | | | | | | |
| 8th Street East and Napa Road Pipelines | SVCSD | ✓ | | 4 | 4 | 4 | 5 | 5 | 5 |
| Urban Recycled Water Expansion | Petaluma | ✓ | | 4 | 4 | 4 | 5 | 5 | 5 |
| Agricultural Recycled Water Expansion Phase 1 | Petaluma | ✓ | | 4 | 4 | 4 | 5 | 5 | 5 |
| Agricultural Recycled Water Expansion Phase 2 | Petaluma | ✓ | | 4 | 4 | 4 | 5 | 5 | 5 |
| Agricultural Recycled Water Expansion Phase 3 | Petaluma | | ✓ | 4 | 4 | 4 | 5 | 5 | 5 |
| Recycled Water Distribution System Expansion to San Quentin Prisona | MMWD/CMSA | ✓ | | 4 | 4 | 4 | 5 | 5 | 5 |
| Phase 1 Recycled Water Distribution System Expansion | American Canyon | ✓ | | 4 | 4 | 4 | 5 | 5 | 5 |
| Phase 2 Recycled Water Distribution System Expansion | American Canyon | ✓ | | 4 | 4 | 4 | 5 | 5 | 5 |
| **Environmental Enhancement** | | | | | | | | | |
| Marin County Lower Novato Creek Project - Distribution | Novato SD | ✓ | | 4 | 5 | 4 | 3 | 5 | 5 |
| Marin County Lower Novato Creek Project - Restoration | Novato SD | | ✓ | 4 | 5 | 4 | 3 | 5 | 5 |
| Turnout to Transitional Wetlands | Novato SD | ✓ | | 5 | 5 | 5 | 4 | 5 | 5 |

a. *CMSA treatment plant upgrades as part of the distribution system expansion to San Quentin Prison would be subject to the following climate change vulnerability scores: Water Demand (4), Water Supply (4), Water Quality (3), Sea Level Rise (5), Flooding (1), and Ecological Health and Habitat (5).*

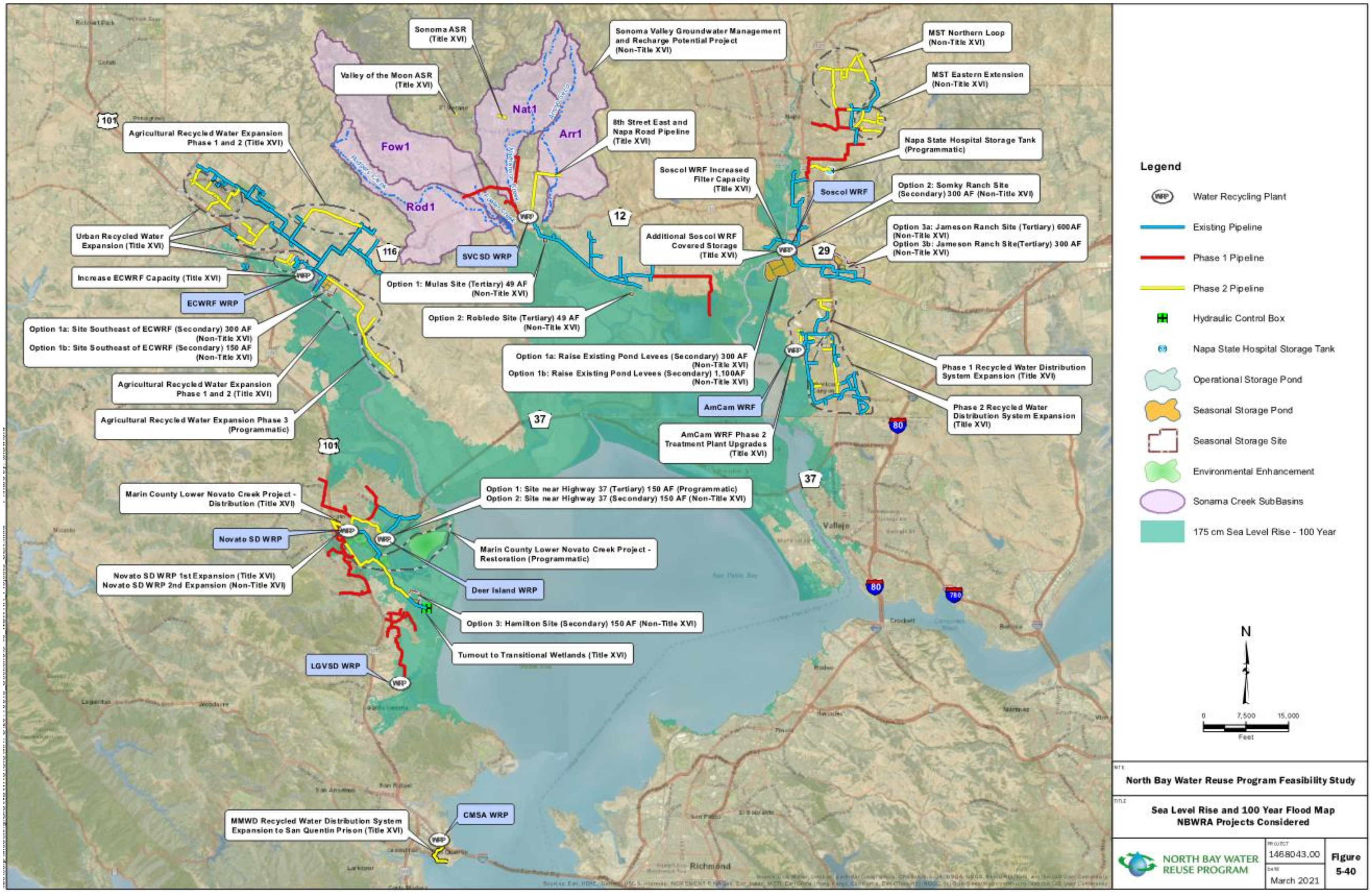



Figure 5-40. Sea Level Rise and 100 Year Flood Map with NBWRA Projects Considered

## 5.6 Summary of Feasibility Level Projects

Tables 5-6, 5-7, and 5-8 summarize the annual yield, capital costs, and O&M costs for projects in the Phase 2 Program, Programmatic, and Non-Title XVI Project categories, respectively. Appendix D includes additional details about the basis for the feasibility-level cost estimates. Life cycle and annualized unit life cycle costs are presented in Section 6.

**Table 5-6. Summary of Proposed Title XVI Program Projects**

| Agency | Project Type | Project Title | Project Yield (AFY) | Capital Cost ($mil) | O&M Cost ($/year) |
|---|---|---|---|---|---|
| Novato SD | Treatment | Novato SD WRP Capacity - 1st Expansion (+0.85 MGD) | 286 | $4.8 | $191,848 |
| | Environmental Enhancement | Marin County Lower Novato Creek Project - Distribution | 40 | $0.9 | $26,450 |
| | | Turnout to Transitional Wetlands | 840 | $0.6 | $24,212 |
| SVCSD | Distribution | 8th Street East and Napa Road Pipelines | 225 | $2.4 | $28,471 |
| SCWA | Seasonal Storage | Valley of the Moon ASR | 80 | $3.7 | $126,083 |
| | | Sonoma ASR | 60 | $3.9 | $124,662 |
| City of Petaluma | Treatment | Increase ECWRF Capacity | 712 | $9.0 | $355,293 |
| | Distribution | Urban Recycled Water Expansion | 223 | $14.6 | $68,298 |
| | | Agricultural Recycled Water Expansion Phase 1 | *1,113* | $12.5 | $61,478 |
| | | Agricultural Recycled Water Expansion Phase 2 | 524 | $5.9 | $39,963 |
| Napa SD | Treatment | Soscol WRF Increased Filter Capacity | 571 | $2.2 | $265,720 |
| | Operational Storage | Additional Soscol WRF Covered Storage | 240 | $2.9 | $39,496 |
| MMWD/CMSA | Distribution | Recycled Water Distribution System Expansion to San Quentin Prison | 154 | $7.8 | $61,216 |
| City of American Canyon | Distribution | Phase 1 Recycled Water Distribution System Expansion | 102 | $3.1 | $30,739 |
| | | Phase 2 Recycled Water Distribution System Expansion | 25 | $2.9 | $30,052 |
| | Treatment | American Canyon WRF Phase 2 Treatment Plant Upgrades | 168 | $6.0 | $99,688 |
| | | Total | 5,364 | $83.2 | $1,573,669 |

**Table 5-7. Summary of Programmatic Level Projects**

| Agency | Project Type | Project Title | Project Yield (AFY) | Capital Cost ($mil) | O&M Cost ($/year) |
|---|---|---|---|---|---|
| Novato SD | Seasonal Storage | Option 1: Site Near Highway 37 (Tertiary) 150 AF | 150 | $5.7 | $66,753 |
| | Environmental Enhancement | Marin County Lower Novato Creek Project - Restoration | 40 | $21.5 | $24,212 |
| Petaluma | Distribution | Agricultural Recycled Water Expansion Phase 3 | 859 | $6.5 | $41,838 |
| Napa SD | Treatment | Napa State Hospital Storage Tank | 429 | $7.4 | $68,602 |
| | | Total | 1,477 | $41.1 | $201,405 |

**Table 5-8. Summary of Non-Title XVI Program Projects**

| Agency | Project Type | Project Title | Project Yield (AFY) | Capital Cost ($mil) | O&M Cost ($/year) |
|---|---|---|---|---|---|
| Novato SD | Treatment | Novato SD WRP Capacity - 2nd Expansion (+0.85 MGD) | 286 | $4.8 | $191,848 |
| | Seasonal Storage | Option 2: Site Near Highway 37 (Secondary) 150 AF | 150 | $8.0 | $66,753 |
| | | Option 3: Hamilton Site (Secondary) 150AF | 150 | $14.8 | $96,191 |
| SVCSD | Seasonal Storage | Option 1: Mulas Site (Tertiary) 49 AF | 49 | $2.4 | $34,533 |
| | | Option 2: Robledo Site (Tertiary) 49 AF | 49 | $2.1 | $25,476 |
| SCWA | Groundwater Management | Sonoma Valley Groundwater Management and Recharge Project | 100 | TBD | TBD |
| Petaluma | Seasonal Storage | Option 1a: Site Southeast of ECWRF (Secondary) 300 AF | 300 | $14.3 | $90,750 |
| | | Option 1b: Site Southeast of ECWRF (Secondary) 150 AF | 150 | $7.3 | $56,100 |
| Napa SD | Seasonal Storage | Option 1a: Raise Existing Pond Levees (Secondary) 300 AF | 300 | $9.9 | $91,127 |
| | | Option 1b: Raise Existing Pond Levees (Secondary) 1,100 AF | 1,100 | $30.4 | $226,523 |
| | | Option 2: Somky Ranch Site (Secondary) 300 AF | 300 | $16.4 | $114,904 |
| | | Option 3a: Jameson Ranch Site (Tertiary) 600 AF (Phase 1) | 600 | $18.7 | $122,971 |
| | | Option 3b: Jameson Ranch Site (Tertiary) 300 AF | 300 | $12.4 | $122,971 |
| | Distribution | MST Northern Loop | 350 | $7.6 | $45,350 |
| | | MST Eastern Extension | 150 | $4.1 | $34,087 |
| | | Total | 4,334 | $153.2 | $1,319,584 |

Section 6

# Economic Analysis

The selected Phase 2 Program described in Section 5 best satisfied the NBWRP objectives, described in Section 4, while also aligning with the funding capabilities of the MAs. This section presents the life cycle costs for the Phase 2 Program. Section 5 described features, total construction cost, and operations, maintenance and replacement (O&MR) costs of the selected Program which was used here for the analysis presented in this section.

## 6.1 Life Cycle Costs of Program

A summary of the Phase 2 Program total, annual, and per AF costs along with the water supply (in AF) is provided in Table 6-1. Life cycle costs are calculated over a 50-year period of analysis using a 3 percent real discount rate. The discount rate reflects the time value of money, indicating that any future costs (or benefits) must be discounted by an appropriate rate for comparing alternatives based on a common point in time. Discount rates used by the utilities are typically the same as the borrowing rates expected over the next several years. While there is no consensus on a single borrowing rate, much of the industry data suggests that a rate of 3 percent would be appropriate and justified. However, to ensure that a change in this important assumption does not affect the conclusions, a sensitivity analysis for the discount rate within a range of 1.5 to 3 percent was performed and found that a discount rate change within this range had no material impact on our analyses and the resulting recommendations.

All Phase 2 facilities are expected to have a service life of at least 50 years with proper maintenance; costs incurred after 50 years would be significantly discounted and were not considered in this analysis. Use of a real discount rate (inflation adjusted) alleviates the need to escalate Phase 2 Program future costs for expected inflation. All Phase 2 Program costs (i.e., capital and O&MR) were combined and brought back to their present value so that the project costs could be represented by a single number, the net present value. The annual costs were developed by including the annualized capital costs, annual O&M costs, and replacement or refurbishment costs for facilities with less than a 50-year life. The annual costs were then divided by the per year water benefits to obtain the Phase 2 Programs cost per AF.

The selected Phase 2 Program would provide water at $901/AF. The life-cycle and per AF costs will be compared to other non-recycling projects in Section 6.2.1 to determine cost-effectiveness of the Phase 2 Program for providing agricultural, urban, and environmental water supplies in the region.

**Table 6-1. Phase 2 Program Life Cycle Costs**

| | |
|---|---|
| Total Capital Costs | $83,228,502 |
| Net Present Value | $124,288,851 |
| Total Annual Costs | $4,830,548 |
| Water Supply (AF) | 5,364 |
| **Program cost per acre-foot** | **$901** |

# 6.2 Economic Analysis

The economic analysis estimates benefits of the Phase 2 Program relative to future conditions if the Phase 2 Program were not implemented. It is expected that the Phase 2 Program would result in direct benefits to urban and agricultural water supply as well as environmental quality.

The Phase 2 Program's water supply benefits would occur by providing recycled water for urban landscape and agricultural uses; thus, relieving demand on future developable potable water supplies. The Phase 2 Program would also provide high quality water to the Lower Novato Creek Restoration Project to sustain habitat for many species, including several that are threatened or endangered. This improved habitat would be an environmental water supply benefit of the Phase 2 Program.

Water supply benefits are measured by comparing the Phase 2 Program costs (Table 6.1) to the costs of a feasible non-recycling project, described in Section 6.2.1, that would provide similar water supplies to the MAs' service areas. If costs are less than the non-recycled water supply, the Phase 2 Program would be considered cost-effective and provide a net economic water supply benefit to the region. Use of alternative costs to compute water supply benefits is a technique frequently used in evaluating federally developed water supplies and is recommended in WTR 11-01 for economic analysis of Title XVI projects (USBR, 2008).

The Phase 2 Program would also result in various indirect benefits to the NBWRP area including water quality improvements, increased groundwater levels, and operational cost reductions. These indirect benefits are described qualitatively in Section 6.2.2.

## 6.2.1 Water Supply Benefits

The Phase 2 Program is expected to provide 5,364 AF of water. Urban landscape would receive approximately 1,670 AF of recycled water, agricultural users would receive approximately 2,813 AF and environmental projects 880 AF. The following analysis estimates the economic benefits of the recycled water supply.

As indicated above, this analysis uses costs of developing and operating non-recycled water supplies to measure water supply benefits of the Phase 2 Program. Section 4.5 described alternative non-recycled water projects under the No Program Condition (no action alternative). Because of the various counties and jurisdictions involved in the Phase 2 Program, several non-recycling projects were identified to serve users in the NBWRP area. These projects are briefly described below; Section 4.5 contains more detailed descriptions.

Similar to the Phase 2 Program costs, the costs of the non-recycling water supply projects are discounted over a 50-year period of analysis using a real discount rate of 3 percent. Costs are then converted to dollars per AF based on the quantity of water the non-recycling project is expected to provide. At this time, all costs for the non-recycling water supply projects are preliminary. This section presents all costs in 2016 dollars.

Dollar per AF costs for the non-recycling water supply projects are compared to the dollar per AF costs of the Phase 2 Program. The lowest cost alternative would be the most cost effective.

### 6.2.1.1 Regional Project for Sonoma and Marin Counties

The SCWA previously identified the potential Water Project that could increase potable water supplies to VOMWD, City of Sonoma, and City of Petaluma in the NBWRP area as well as other SCWA contractors not listed whom are outside the NBWRP area. The project was envisioned to release and use additional water currently stored in Lake Sonoma and divert and re-divert the water from the Russian River. The proposed Water Project concept would expand the existing transmission system and includes a conservation component. The project is currently on hold but provides insights into the avoided costs of additional water supplies (SCWA/USBR, 2008).

The proposed Water Project described here is based on the original studies. Although the projected flows and agency demands have changed due to the current California drought and MAs as well as other SCWA contractors efforts for long-term water conservation, the original concept is used here to illustrate the potential costs for an alternative water supply to the Phase 2 Program. The Water Project is estimated to provide an additional 26,000 AFY of Russian River water to the SCWA contractors. Table 6-2 shows projected deliveries under the Water Project to VOMWD, City of Sonoma, and City of Petaluma under the original project concept.

**Table 6-2. Proposed Water Project Yields**

| Service Area | Projected Increase in Annual Water Supply (AFY) |
|---|---|
| City of Petaluma | 3,537 |
| VOMWD | 629 |
| City of Sonoma | 690 |
| **Total** | **4,856** |

SCWA original cost estimates have been updated to match the date of the Phase 2 Program cost estimates. The total capital costs of the Water Project would be approximately $805 million (2016 dollars). SCWA contractors would share the total costs of the project; therefore, VOMWD, City of Sonoma, and City of Petaluma would be responsible for a portion of the Water Project costs. SCWA did not complete the cost sharing analysis for the Water Project; however, if costs are apportioned based on historical water deliveries, the City of Petaluma, VOMWD, and the City of Sonoma would be responsible for approximately $257 million in capital costs. Table 6-3 summarizes the City of Petaluma, VOMWD, and the City of Sonoma's capital, present value, and per AF costs for the proposed Water Project. O&M costs, which have not been estimated, would add to the project costs. These costs could significantly increase the average cost per AF above $2,057 shown in Table 6-3.

**Table 6-3. Proposed Water Project Preliminary Costs for Petaluma, VOMWD, and Sonoma**

| | |
|---|---|
| Total Capital Costs | $257,045,421 |
| Annual Capital Costs [a] | $9,990,197 |
| Supply (AFY) | 4,856 |
| **$ per acre-foot** | **$2,057** |

a. *The capital costs were discounted based on a 50-year period of analysis using a 3 percent real discount rate.*

Additional costs for treatment, distribution, and delivery that would be experienced by the City of Sonoma, VOMWD, and the City of Petaluma are not included as the project costs are preliminary and not disaggregated by the retail district; therefore, complete comparison to Phase 2 Program costs is not all encompassing. However, since the $2,057 per AF cost for the Water Project is already higher than the Phase 2 Program costs, local treatment and delivery costs were not necessary to show the cost effectiveness.

#### 6.2.1.2 Regional Project for Napa County

This potential water project would serve imported water for potable and agricultural users in the MST area of Napa County who currently rely on groundwater. The groundwater levels in the MST area are decreasing and groundwater would not likely be a reliable supply in the future (see Section 2.1.3.2). There are no other usable local water supplies for the MST area; therefore, importing water appears to be the only alternative to supply users who would be served by the Phase 2 Program. The imported water supplies would likely be wheeled through the Water Project's NBA, which would need to be expanded due to existing capacity limitations to accommodate new water supplies.

Costs for this alternative project include costs for water purchases, the distribution system, and expansion of the NBA. This analysis assumes that Napa County would import 1,937 AF to serve the MST area. The cost of long-term water supply is assumed to be approximately $12.1 million, a new distribution system cost is approximately $49.8 million, and the NBA expansion cost is approximately $47.3 million (SCWA/USBR, 2008 updated to 2016 dollars). Napa County also estimates legal and administrative fees to implement this alternative would be approximately $10 million. Therefore, total costs would be approximately $119.1 million, which does not include annual O&M and maintenance costs. Table 6-4 summarizes the assumed total, annualized, and per AF costs to import potable water to the MST area. The costs to import approximately 1,937 AF of water to the MST area would be $2,389 per AF.

| Table 6-4. Preliminary Costs to Import Water to the MST Area | |
|---|---|
| Total Capital Costs | $119,083,309 |
| Annual Capital Costs [a] | $4,628,232 |
| Supply (AFY) | 1,937 |
| **Dollar per acre-foot** | **$2,389** |

a. *The capital costs were discounted based on a 50-year period of analysis using a 3 percent real discount rate.*

#### 6.2.1.3 Summary Cost Comparison

This section compares the Phase 2 Program costs to the non-recycling project costs to determine the cost-effectiveness of the Phase 2 Program. Table 6-5 summarizes the life-cycle costs and per AF costs of the Phase 2 Program and non-recycling water supply projects. The table also presents the annual quantity of water delivered under each water supply project option.

The Phase 2 Program would cost $901 per AF to serve 5,364 AF to agricultural and urban users in the NBWRP area. Preliminary costs for the Water Project indicate that it would be more expensive than the Phase 2 Program to serve urban users in VOMWD and the Cities of Sonoma and Petaluma. The Water Project would not serve agriculture in the Sonoma Valley; however, this analysis assumes the Water Project's costs are indicative of delivering a new water supply to the region. Planning cost estimates for importing water to the MST area, with increased NBA imported water, are approximately $2,389 per AF, which is also more expensive than the Phase 2 Program costs to provide the same amount of water to the MST area.

Table 6-5. Summary Cost Comparison

| | Phase 2 Program | Water Project (Sonoma County Portion of Project area) | Import Water to MST Area (Napa County portion of Project area) |
|---|---|---|---|
| Total Capital Costs | $83,228,502 | $257,045,421 | $119,083,309 |
| Total Annual Costs | $4,830,548 | $9,990,197[a] | $4,628,232[a] |
| Supply (AF) | 5,364 | 4,856 | 1,937 |
| **Dollar per acre-foot** | **$901** | **$2,057** | **$2,389** |

a. *Total Annual Costs do not include O&M and replacement costs for these projects.*

### 6.2.2 Other Phase 2 Program Benefits

The Phase 2 Program would also result in various indirect benefits to the region, including water quality improvements, increased groundwater levels, and operational cost reductions. These benefits are described qualitatively and would add to the economic justification for pursuing a recycled water project.

As discussed in Section 2, groundwater basins close to the San Francisco Bay, including those in Sonoma and Napa Counties, have areas of high total dissolved solids largely from saline intrusion from the Bay. Saline groundwater is unusable for either urban drinking water needs or for irrigating crops; therefore, the use of groundwater threatens the long-term sustainability of the basin. The Phase 2 Program would offset groundwater pumping by delivering recycled water to agricultural and urban users that currently rely on groundwater. Decreasing groundwater pumping would increase groundwater storage and potentially decrease saline intrusion in these basins.

In addition to improving groundwater quality, the Phase 2 Program could potentially reduce groundwater overdraft, improving the long-term sustainability of the region by providing a consistent annual source of recycled water to agricultural and urban users. The water source provided by the Phase 2 Program could offset groundwater pumping each year and the region would benefit both from a decrease in the need to pump groundwater and the ability of the basins to recover through natural recharge. Increasing groundwater storage would also reduce groundwater pumping costs and may prevent expenses for well deepening or replacement. These groundwater quality and groundwater storage improvements would be indirect benefits of the Phase 2 Program.

The NBWRP area agriculture industry, specifically viticulture, would also benefit from the Phase 2 Program by receiving a consistent supply of water which ensures a consistent annual crop yield as well as supports the labor, product marketing, and tourism associated with this industry. The benefit of the Phase 2 Program to the agriculture industry in the NBWRP area was recognized by Sandy Elles, executive director of the Napa County Farm Bureau, "We are supportive of the development of more sources of tertiary-treated recycled water for ag use. Having access to more recycled water is a sustainable option in times of drought. Growers in Napa see the value of reclaimed water as a supplement to existing groundwater and surface water supplies. As we face greater water scarcity, it will play a bigger role in the future."

Providing a beneficial use for the treated wastewater would also decrease discharges into North San Pablo Bay and reduce operation costs of the sanitation districts during the times of the year when no-discharge is permitted.

Cumulatively, the projects in the Phase 2 Program incrementally contribute toward regional water supply resiliency in the NBWRP area through a portfolio of recycled water projects designed to support all end users, urban, agricultural and environmental, in the watershed and contribute to California's goal of increasing recycled water use by 2 million AFY by 2030.

Section 7

# Environmental Consideration and Potential Effects

This section provides an overview of anticipated potential environmental effects from the Phase 2 Program. Anticipated regulatory requirements and compliance measures are also discussed. Detailed environmental analysis will be completed and available in the EIS/EIR to be developed.

## 7.1 Potential Environmental Effects

Potential environmental impacts from the Phase 2 Program are anticipated to occur during construction and O&M. Construction would involve activities such as site preparation, grading, excavation, and site restoration and would have short-term, temporary impacts. The activities, and thus, the extent of impact, would vary with the project components (e.g., treatment upgrades, pipelines, and storage facilities). Operation of projects included in the Phase 2 Program would involve supply of recycled water for urban, agricultural and environmental uses. Maintenance activities could include periodic inspections, repairs, and replacement of equipment as well as emergency repairs. A brief discussion of the nature of anticipated construction, and operational and maintenance impacts is provided below. Section 7.2 through 7.11 provides a discussion of potential impacts for each of the issue areas identified in WTR 11-01.

### 7.1.1 Project Construction

Project construction impacts are anticipated to include short-term impacts to hydrology, water quality, biological resources, cultural resources, land use, agriculture, transportation, air quality, noise, utilities, and temporary access to recreational facilities. Because the proposed facilities would mostly lie on existing WWTP sites (e.g., pump stations and storage facilities) or primarily along roadways (e.g., pipelines), the impacts associated with construction are anticipated to be short-term and reduced, to the degree feasible, by the implementation of BMPs. These include compliance with existing regulations such as the implementation of Stormwater Pollution Prevention Plans, avoidance and minimization techniques such as the use of trenchless technology to cross stream, and pre-construction surveys for biological and cultural resources.

### 7.1.2 Project Operation

Project operation in the Phase 2 Program would include the distribution and use of recycled water for urban, agricultural, and environmental uses. The project would be consistent with the state, regional, and local policies that encourage recycled water use. The recycled water would be treated at a level stipulated under CCR Title 22 requirements for specific end uses, and would be protective of the environment and public health. Section 8.4 describes California recycled water use regulations. Overall, the Phase 2 Program will increase recycled water use, thereby offsetting potable water use (surface water and groundwater) and reducing the amount of treated wastewater discharged into San Pablo Bay and its tributaries.

### 7.1.3 Project Maintenance

Project maintenance included in the Phase 2 Program would include activities ranging from periodic vehicle trips to inspect facilities and equipment to trenching in order to replace pipeline appurtenances or conduct emergency repairs.

## 7.2 Endangered and Threatened Species

Based on a review of California Natural Diversity Database, USFWS species lists, relevant scientific literature, and field reconnaissance surveys, Appendix B lists the state or federally listed species that are known to occur or may occur in the project area based on suitability of habitat and range of occurrence. However, field reconnaissance of proposed facilities indicates that the potential for sensitive species habitat to occur on existing treatment plant facilities or pipeline routes within existing roadways is low.

Pipeline routes that are located along potential sensitive species habitat would have greater potential to directly or indirectly impact the sensitive species habitat (i.e., the Ridgway's rail, California black rail, California red legged frog, and salt marsh harvest mouse). Any impacts to Ridgway's rail and California black rail would be minimized by avoiding work near salt marsh habitat during the breeding season for these two species. Mitigation measures will be established to avoid or minimize direct and indirect impacts on special-status species that have the potential to occur within the project area. Impacts to the salt marsh harvest mouse would be minimized by avoidance and establishment of barriers around project construction. Direct impacts to salt marsh habitats that cannot be avoided may require restoration or compensatory mitigation.

Rare plants with the potential to occur within the project area may be found in grassland, vernal pools, woodland, coastal salt marsh, chaparral and scrub habitats. Potential impacts to special-status plant species would be minimized through pre-construction surveys to clear pipeline disturbance areas, avoid where feasible, and restore as appropriate. Compensatory mitigation may be required for those locations where impacts cannot be avoided.

Impacts to fish species and California freshwater shrimp would be minimized by using trenchless technology at stream crossings to avoid direct impacts to waters of the U.S. The pipeline projects included in the Phase 2 Program would include approximately 31 stream crossings. Certain impacts may be minimized by restricting work on a seasonal basis. For instance, impacts to conservancy fairy shrimp and vernal pool fairy shrimp could be minimized by scheduling any project activities in the summer months when seasonal wetlands and vernal pools are dry. Impacts to state and federally listed species and locations of potential habitat will be addressed in the Biological Assessment for the proposed Phase 2 Program and consultation with USFWS and CDFW, as appropriate. A discussion of potential impacts for the Phase 2 Program projects within each MA service area is provided below:

- **Novato SD.** Expansion of treatment plant capacity would be at the existing WWTP and would not be anticipated to have direct effects to biological resources. Storage options are located on active agricultural parcels with limited potential for sensitive species or wetland features. The pipeline route to Storage Option 1 includes approximately 1 mile of overland route along an existing dirt trail through oak woodland. The Lower Novato Creek projects include provision of recycled water irrigation to ecological enhancement areas, providing benefit to the Ridgway's rail, California black rail, and salt marsh harvest mouse. Proposed facilities would be installed using BMPs and avoidance measures to reduce the potential for temporary impacts.
- **SVCSD.** Installation of the 8th Street East and Napa Road pipelines would be within the existing roadway and would not be anticipated to affect biological resources. Appropriate avoidance methods would be implemented at stream crossings.

- **SCWA.** Construction of the VOM ASR well facilities and connecting pipelines would be within existing paved areas and no impacts are anticipated. Construction of the Sonoma ASR well facilities would be at an existing well and pump station site; construction of connecting pipelines would be within existing roadways. Potential impacts would likely be limited to disturbance of nesting bird species which could be minimized through construction scheduling.
- **City of Petaluma.** Proposed improvements to increase ECWRF capacity would occur at the existing treatment facility and would not be expected to affect biological resources. Storage sites south of the ECWRF would be located within lands currently used for agricultural production (hay) and could be configured to avoid wetland and drainage features in the vicinity. In the event avoidance is not feasible, acquisition of regulatory permits from USACE, USFWS, CDFW and RWQCB, including identification of compensatory mitigation as appropriate, would be anticipated.
  The proposed distribution pipelines for the Urban Water Recycled Expansion project in the City of Petaluma are generally located with urbanized areas and existing roadways and would not be anticipated to affect biological resources. Proposed distribution pipelines for the Agricultural Recycled Water Expansion project, extending southeast of Petaluma, would be located along the State Route (SR) 116 corridor. Depending upon final alignment of the pipeline within the roadway right of way, construction could have the potential to affect wetland features along the roadway shoulder including potential sensitive species habitat (Phase 3) associated with the Petaluma River marsh. Installation of the Adobe Road pipeline would be within the existing roadway and would not be anticipated to affect biological resources. In both instances, it is anticipated the final design would be able to avoid direct impacts; in the event avoidance is not feasible, acquisition of regulatory permits from USACE, USFWS, CDFW and RWQCB, including identification of compensatory mitigation as appropriate, would be anticipated.
- **Napa SD.** Proposed improvements to increase Soscol WRF filter capacity would occur at the existing treatment facility and would not be anticipated to affect biological resources. Secondary storage at the WWTP is located in upland areas and would not be anticipated to affect wetland features. Swainson's hawk nesting occurs within 0.5 miles of the WWTP and seasonal construction limitations may be applicable to construction activities.
  Construction of the Napa State Hospital Tank would have the potential to affect wetland features at the tank site; in the event avoidance is not feasible, acquisition of regulatory permits from USACE, USFWS, CDFW and RWQCB, including identification of compensatory mitigation as appropriate, would be anticipated.
- **City of American Canyon.** The pipeline extensions for Phases 1 and 2 of the City's Distribution System Expansion would primarily be installed in existing roadways. However, the Phase 1 extensions are located in the Napa Airport and Green Island Road areas in the northern part of the City, which is low-lying with a number of streams. Many development project sites in this area of the City have been found to harbor wetland features or unnamed/unmarked tributaries which require mitigation. A known stream crossing is located on Hanna Drive over North Slough. At this and other stream crossings, the means of installing the extension would determine the type and amount of impact to the resource. Depending upon final alignment of the pipeline extensions within a roadway right of way, construction could have the potential to affect stream and wetland features along the roadway shoulder including potential sensitive species habitat. This would also determine the need for acquisition of regulatory permits from USACE, USFWS, CDFW and RWQCB, including identification of compensatory mitigation as appropriate.
- The Phase 2 upgrades at the WRF would occur within the confines of the WRF and not affect any biological resources on site.

- **MMWD.** The pipeline from the CSMA treatment plant to San Quentin Prison would primarily be in road. The section between Sir Francis Drake Boulevard and the prison fence would be in Levee Road. This roadway is on a levee that parallels the San Pablo Bay shoreline. Although installation within the roadway would be anticipated to avoid direct effects to regulated water, informal consultation with the USACE, USFWS, RWQCB, and the San Francisco Bay Conservation and Development Commission (BCDC) would be necessary to determine the need for permits from these agencies.

## 7.3 Public Health and Safety

Project construction would increase vehicular and truck traffic in the project area. Short-term air emissions and increased noise levels would occur in and around the construction corridors. Construction activities would involve the use of hazardous materials during construction; however implementation of BMPs related to fueling, vehicle washing, and handling, use, and storage of chemicals would minimize any risk to either workers or the public. Project implementation would incrementally increase the use of chemicals commonly used in the treatment of wastewater. All treatment chemicals would be handled and stored in compliance with federal, state, and local requirements.

As noted in Section 8.4, the use of recycled water is highly regulated in California by CCR Title 22. Project operation would include distribution and use of recycled water for urban, agricultural, and environmental uses. The project would be consistent with the state, regional, and local policies that encourage recycled water use. The recycled water would be treated at a level stipulated under CCR Title 22 requirements and will be protective of the environment and public health. Similarly, ASR injection well operations for storage of potable water supplies would be regulated by the SWRCB Division of Drinking Water (DDW).

## 7.4 Regulated Waters

Based on database review and field reconnaissance surveys, pipelines would cross jurisdictional stream features and would occur adjacent to potentially jurisdictional agricultural ponds, freshwater marshes, seasonal wetlands, and brackish marshes. It is anticipated that the entire Phase 2 Program could include approximately 35 stream crossings. Additional impacts to waters of the U.S. could be associated with storage ponds in the SVCSD, City of Petaluma, and Napa SD service areas.

It is anticipated that stream crossings would use trenchless technology to avoid direct impacts to waters of the U.S.; therefore, it is anticipated that these impacts would be largely avoided or minimized. By constraining work to the right-of-way of existing roadways, whenever possible, most wetland and pond features would be avoided. Depending on the methods used, pipeline crossings of streams and wetlands may be subject to the CWA, including the acquisition of appropriate USACE and RWQCB permits and USFWS consultation, as appropriate. Additionally, permits will be required by CDFW for all stream crossings, regardless of crossing method.

## 7.5 Cultural Resources

Based on previous survey efforts, initial current field reconnaissance, and a database review at the Northwest Information Center of the California Historical Resources Information System at Sonoma State University (File No. 15-1817), 40 cultural resources have been previously recorded in the records search radius (1/2-mile radius from the project facilities including pipelines, storage areas, and treatment plant upgrades). Of those, 24 resources are within the Area of Sensitivity Assessment (ASA). The ASA includes the Areas of Direct Impact (pipeline segments and other areas of ground-disturbance) with an additional 300 feet from pipeline centerline or project component. The ASA is useful for determining areas of archaeological sensitivity within the project area. The Area of Potential Effect (APE) will be used for impact analysis and includes all areas of ground-disturbing activity within 25 feet from centerline to account for potential staging areas and spoil piles.

Cultural resources in the ASA are comprised of prehistoric archaeological sites (including, but not limited to, concentrations of obsidian and chert flaked-stone tools [e.g., projectile points, knives, scrapers] or toolmaking debris; culturally darkened soil ["midden"] containing heat-affected rocks, artifacts or shellfish remains; stone milling equipment [e.g., mortars, pestles, handstones or milling slabs]; and battered stone tools [such as hammerstones and pitted stones]), historic-period archaeological resources (including, but not limited to, stone walls; filled wells or privies; deposits of metal, glass, and/or ceramic refuse; and out-of-use transportation features such as railroad berms and roads), and historic-period architectural/structural properties (standing structures, bridges, and in-use railroads or other transportation features).

In general, the nature of this project will not have an adverse impact on architectural resources, with the exception of some structural features such as bridges, which will be addressed appropriately. A clear statement for no adverse impact to architectural properties that exist adjacent to the project areas will be included in the EIR/EIS. A Phase I Cultural Resources Report will be prepared to support Section 106 Consultation. For comparison purposes, a breakdown of the number of sites identified within the ASA, which provides a 300-foot buffer, is provided below. It should be noted that the potential for facilities to directly impact the majority of these sites is considered low.

Nine prehistoric archaeological resources have been recorded within the ASA. Four sites are located in the City of Petaluma along the Agricultural Recycled Water Expansion pipeline alignments extending east of the ECWRF along SR 116 and another near Ely Road. One site is in Novato near Hamilton Field. One site is near the CSMA treatment plant. Two sites are near the pipeline alignments in the City of American Canyon. Based on the criteria used during implementation of the previous NBWRA projects, and developed in coordination with USBR, it is anticipated that an Extended Phase I (subsurface) survey in the APE nearest to these known resources may be required to provide a better presence or absence determination. This would be implemented when more specific facility design information is available.

Avoidance of existing cultural resources would be the first strategy when implementing individual projects. However, construction activities, such as excavation, may cause inadvertent discovery of unknown or unrecorded cultural resources. In the event of such accidental discovery, the project will comply with applicable regulations and implement mitigation measures such as stopping work, creating a buffer area around the discovery, and contacting an archaeologist or a cultural resource expert.

The Phase 2 Program is not anticipated to affect historic architectural properties given the likely locations of the proposed facilities (existing WWTP sites for facilities and roadway rights-of-way for pipelines). Potential resources that could be affected include historic era bridges, and a railroad grade present along SR 116. It is anticipated that these features would not be considered significant; a field analysis and assessment would be required as part of the Phase I Cultural Resources Survey Report.

## 7.6 Significant Environmental Effects

It is possible that potentially significant environmental effects could be identified for specific projects included in the preferred program, primarily relating to construction impacts associated with facility installation. Issue areas where significant short-term impacts and corresponding mitigation relating to construction are anticipated include: geology and soils, water resources, cultural resources, biological resources, land use, aesthetics, traffic, hazardous materials, noise, public services and utilities. It is also anticipated that mitigation measures, including avoidance and minimization measures and implementation of established BMPs, are available to reduce these potentially significant environmental effects to a less-than-significant level.

Long-term operational impacts will relate to the long-term treatment, distribution, and use of recycled water for irrigation and other uses within the service area. These impacts would include increased pumping and corresponding electrical demand for distribution, as well as increased chemical use at WWTPs for treatment.

## 7.7 Unique or Undefined Environmental Risks

Unique or undefined environmental risks of the Phase 2 Program include the potential for spread of pathogens that infect woody plants during the course of construction of pipeline routes. This is common to all construction projects that are located within areas currently infested with these types of pathogens which include Phytophthora cinnamomi and Sudden Oak Death. The Phase 2 Program is anticipated to have minimized impact given the locations of the proposed facilities (existing WWTP sites for facilities and roadway rights-of-way for pipelines). BMPs will be implemented to minimize the projects contribution to the spread of this pathogen.

## 7.8 Status of Compliance Measures or Other Available Information

The combined EIS/EIR would be prepared to comply with CEQA and the NEPA. It is anticipated that the Phase 2 Program would be required to comply with Sections 401 and 404 of the CWA for potential discharges to the waters of the U.S., California Department of Health recycled water requirements (CCR Title 22), Section 7 of the Endangered Species Act, Section 106 of the National Historic Preservation Act, NPDES requirements, Porter-Cologne Water Quality Control Act, and the CDFW Code. Encroachment permits will also be obtained from local and state agencies, as applicable. Other regulatory requirements are discussed in Section 8.

## 7.9 Regional Water Supply and Water Quality

In terms of hydrology, implementation of established BMPs would minimize any potential water quality and hazardous materials impacts to receiving waters and groundwater from the projects. Typical BMPs include scheduling or limiting activities to certain times of the year based on hydrologic considerations, installing sediment barriers such as silt fence and fiber rolls, and maintaining equipment and vehicles used for construction in good condition.

The Phase 2 Program would provide an increased recycled water supply to urban, agricultural, and environmental uses in the study area. The recycled water would increase the reliability of supplies for both urban landscaping irrigation and agricultural irrigation. This reliable water supply would alleviate concerns that surround the potential of future drought conditions. During times of drought, or as area population increases, use of recycled water for irrigation of landscape and crops would help reduce demand on existing potable water supplies and save that potable water for municipal users.

As described in Section 3, the Phase 2 Program would reduce treated wastewater discharge into the San Pablo Bay and its tributaries. The recycled water produced by the MAs will meet CCR Title 22 standards for recycled water. Section 8 discusses some of the regulatory requirements currently in place for managing the design and operation of recycled water systems to safeguard the health and safety of the public and environment. The environmental analysis in the EIS/EIR will analyze these impacts in more detail and will include recommended mitigation measures, as necessary, included identifying if a petition for Water Rights diversion is needed.

## 7.10 Public Involvement

As described in Section 1.5.3, the MAs continued and expanded on public outreach efforts initiated during Phase 1 of the NBWRP to collect end user information at a broad scale within each MAs' service area. Outreach activities were conducted which identified potential customers and key stakeholders, discussed concerns and needs, provided NBWRP benefits, reviewed land use mapping for accuracy, and discussed projected future changes within each service area. The outreach efforts are working towards securing commitments to use recycled water. As the Phase 2 Program activities carry on, potential users will continue to be engaged through use of the NBWRA webpage and invited to attend meetings. An additional round of public outreach meetings will occur during the scoping phase of the EIS/EIR development.

## 7.11 Historic Properties

Because the pipeline alignments would be placed underground mostly along existing roads, no buildings or structures are anticipated to be affected by proposed project facilities, directly or indirectly. Proposed improvements at treatment plants, including treatment and pump stations, are not anticipated to affect historic architectural properties. The APEs for individual facilities associated with the pipelines would be limited to the physical effects of the construction. Any auditory or visual impacts posed by facilities to historic properties will be assessed on a site-by-site basis as part of the Phase I Cultural Resources Survey Report.

This page intentionally left blank.

Section 8

# Legal and Institutional Requirements

In developing the NBWRA Phase 2 Program, the NBWRA considered the legal and institutional requirements the Phase 2 Program would need to meet or satisfy. This section describes the Phase 2 Program's institutional framework, interactions with other agencies, and legal requirements. In addition, the Phase 2 Program's effects on the environment, study area economy, and water rights are also discussed.

## 8.1 Memorandum of Understanding

The NBWRA is comprised of 11 agencies within the North San Pablo Bay watershed that includes portions of Marin, Sonoma, and Napa counties. The participants agreed early in the planning process that they should operate within a jointly established, formal structure. They considered two ways to organize themselves: through a joint powers authority (JPA) or through a MOU.

An MOU can be used to form an organization for any purpose within the authority of a MA through signature of the MOU contract by MAs. Under an MOU, the signatory agencies can adopt an organizational structure that allows them to pursue a common purpose, but limits the entity formed by the MOU from contracting, incurring debt, or employing staff directly.

A Joint Powers Authority (JPA) is a stronger organization structure than an MOU, serving as a coordinating tool for separate parties with common interests as defined under Government Code Section 6500 et seq. Parties administer the purpose and goals of a JPA through a range of powers including, but not limited to: entering into contracts; employing agents and employees; issuing bonds; and acquiring, constructing, managing or operating facilities. Authority available under a JPA is in addition to the power inherent in the individual MAs.

### 8.1.1 Formation Activities

The NBWRA MAs agreed that when the Phase 2 Program becomes operational, they may want to work together under a JPA as the JPA entity would be able to undertake the actions necessary to implement projects under the Phase 2 Program. However, establishing a JPA requires extensive legal and political discussion within each participating agency and could take many months. The MAs determined that an MOU could meet their organizational needs during the planning process by establishing a joint process and effective structure while not yet establishing a formal entity to implement the Phase 2 Program.

The MAs discussed this issue at a series of workshops starting in Fall 2003. As noted in Section 1, the MOU establishing the NBWRA was signed by the five initial MAs (SCWA, Napa SD, SVCSD, Novato SD, and LGVSD) on August 24, 2005. The MOU was amended in January 2008, November 2010, and March 2013. The November 2010 amendment added NMWD and the County of Napa. The March 2013 amendment added the City of Petaluma and MMWD. Subsequent to the execution of the amended MOU, the County of Marin joined as an Associate Member and the City of American Canyon joined as a full member of Phase 2; these two agencies will be signatories to the next version of the MOU. The current MOU is included as Appendix G.

### 8.1.2 Responsibilities

The MOU establishes the NBWRA and outlines the purposes of this group including exploring “the feasibility of coordinating interagency efforts to expand the beneficial use of recycled water in the NBWRP area thereby promoting the conservation of limited surface water and groundwater resources.”

The MOU created a TAC, consisting of one member from each signatory agency, to conduct the business of the NBWRA. The MOU also identifies that the MOU participants shall designate an “Administrative Agency,” currently the SCWA, to enter contracts and perform administrative duties on behalf of the NBWRA. Phase 2 MAs split the costs of the Feasibility Study based on the number of projects studied for each agency and the costs of environmental studies based on value of their projects in the final selected Title XVI Program. Administrative costs of the Phase 2 Program are shared equally between the agencies.

## 8.2 Agency Consultation Activities

The MAs have begun informal discussions with several federal, state, and other local agencies, as required by laws and regulations, to keep them informed of the Program’s progress and to seek their assistance in moving it forward. The formal consultation process is largely related to the environmental documentation effort; the MAs will complete this consultation as part of the EIS/EIR process in 2017 and 2018. Formal consultation will include the USFWS, the NMFS, and the CDFW as required by the federal and state Endangered Species Acts, the Fish and Wildlife Conservation Act, and the Natural Community Conservation Planning Act.

## 8.3 Effects of Recycled Water Use

The Phase 2 Program would increase recycled water supply to agricultural, urban, and environmental uses, thereby reducing potable water use and wastewater discharge into North San Pablo Bay and its tributaries. This shift results in economic and environmental changes within the NBWRA area. Environmental considerations of the alternatives are discussed in Section 7; more detailed information will be available in the EIS/EIR. The costs and benefits of the Phase 2 Program were discussed in Section 6. The sections below briefly summarize the basis for each analysis.

### 8.3.1 Economic Effects

The increased reliability of water supply within the NBWRA area is the main economic benefit of the Phase 2 Program. The recycled water would increase the reliability of supplies for urban landscaping irrigation, agricultural irrigation, and environmental enhancement for restoration of wetlands. Agricultural water supply would be primarily delivered for high-value vineyard production. Reliable water supplies for these uses are more cost-efficient to purchase than intermittent supplies; therefore, any project that increases the reliability of water supplies has a real and quantifiable economic benefit to users.

An additional reliable water supply in the area would alleviate concerns that surround the potential of future drought conditions and impacts from climate change. During times of drought, or as area population increases, use of recycled water for irrigation of landscape and crops would help reduce demand on existing potable water supplies.

### 8.3.2 Environmental Effects

The Phase 2 Program would reduce discharges of treated wastewater effluent to San Pablo Bay and its tributaries by providing recycled water for use in urban and agricultural irrigation and as a supply for environmental enhancement. As discussed in Section 3, the recycled water currently produced meets and will continue to meet CCR Title 22 standards for unrestricted use. However, some members of the public may have concerns about the use of recycled water on parks or other high-use public areas. Section 8.4 discusses some of the regulatory requirements currently in place for the design and operation of recycled water systems in order to safeguard the health and safety of the public and environment. The environmental analysis of alternatives in the EIS/EIR will analyze these impacts in more detail and will include recommended mitigation measures, as necessary.

As discussed in Section 3.2.6, public acceptance for use of recycled water for irrigation has become more favorable in the last decade. Outreach activities will be continued by NBWRA to educate potential users and the general public to assist the MAs during the implementation of the Phase 2 Program. As found during the Phase 1 planning and implementation, early and continued public engagement helped build a solid foundation for public acceptance and later endorsement of the projects included in the Phase 2 Program.

The EIS/EIR will also include consideration of the other impacts associated with construction and operation of the treatment, pipelines, pump stations, and storage facilities included in each alternative.

### 8.3.3 Water Rights Effects

In some recycled water programs, decreased discharge of effluent to waterways has the potential to affect the water rights of downstream users. The Phase 2 Program has little likelihood of such an impact, as the water downstream of the MAs discharges is generally brackish and there are no known domestic or municipal users of the water.

Some potential recipients of recycled water may be concerned that decreasing use of their existing surface water supplies may jeopardize their surface water rights. However, legal investigation into this issue has shown that shifting from surface water to recycled water will not create the potential to lose the initial surface water right. California Water Code Section 1010 asserts that no claim of water right (riparian, pre-1914 appropriative, post-1914 appropriative) will be reduced or lost as a result of the use of recycled water. The use of recycled water in lieu of surface water is equivalent to maintaining that right as it will be a beneficial use. Section 1010 states,

> "(a)(1) The cessation of, or reduction in, the use of water under any existing right regardless of the basis of right, as the result of the use of recycled water, desalinated water, or water polluted by waste to a degree which unreasonably affects the water for other beneficial uses, is deemed equivalent to, and for purposes of maintaining any right shall be construed to constitute, a reasonable beneficial use of water to the extent and in the amount that the recycled, desalinated, or polluted water is being used not exceeding, however, the amount of such reduction.
>
> (2) No lapse, reduction, or loss of any existing right shall occur under a cessation of, or reduction in, the use of water pursuant to this subdivision, and, to the extent and in the amount that recycled, desalinated, or polluted water is used in lieu of water appropriated by a permittee pursuant to Chapter 6 (commencing with Section 1375) of Part 2, the board shall not reduce the appropriation authorized in the user's permit."
>
> *(California Water Code §1010(a))*

California Water Code Section 13551 establishes that potable water shall not be used for nonpotable uses if suitable recycled water is available. The use of recycled water constitutes beneficial use under any existing water right. Section 13551 states:

> "A person or public agency, including a state agency, city, county, city and county, district, or any other political subdivision of the state, shall not use water from any source of quality suitable for potable domestic use for nonpotable uses, including cemeteries, golf courses, parks, highway landscaped areas, and industrial and irrigation uses if suitable recycled water is available as provided in Section 13550; however, any use of recycled water in lieu of water suitable for potable domestic use shall, to the extent of the recycled water so used, be deemed to constitute a reasonable beneficial use of that water and the use of recycled water shall not cause any loss or diminution of any existing water right."

## 8.4 Regulatory Requirements

Several state and federal agencies have regulatory power over projects that affect water quality and sources of supply. Implementation of the Phase 2 Program will require coordination with such agencies, as well as with a number of county, city, municipal, and private agencies. Table 8-1 lists the federal, state, local, and private agencies that may need to be contacted for permits or special coordination in order for the Phase 2 Program to progress.

**Table 8-1. Jurisdictional and Stakeholder Agencies**

| Agency Name | Permits or Special Coordination |
|---|---|
| **Federal Agencies** | |
| USBR | • Title XVI Funding for Recycled Water Project |
| USACE | • Nationwide 12 and 18 Pre-construction Notification<br>• State Historic Preservation Office – Programmatic Agreement<br>• Section 404 of Clean Water Act<br>• Section 10 of Rivers and Harbor Act |
| USFWS | • Section 7 Consultation – Endangered Species Act |
| NMFS | • Endangered Species Act Consultation |
| **State Agencies** | |
| CDFW | • Lake or Streambed Alteration Agreement |
| California Department of Transportation | • Encroachment Permit |
| San Francisco Bay RWQCB | • 401 Certification or Waiver<br>• Water Reclamation Permit<br>• Modification to Basin Plan |
| State Lands Commission | • California Planning, Zoning, & Development Law |
| SWRCB | • Water Rights Permit<br>• Place of Use Approval<br>• CCR Title 22 – Recycled Water Regulations<br>• Drinking Water Monitoring and Regulations |

| Table 8-1. Jurisdictional and Stakeholder Agencies | |
|---|---|
| **Agency Name** | **Permits or Special Coordination** |
| **Local Agencies** | |
| Association of Bay Area Governments | • Consistency Determination |
| City of Napa | • Development Permit |
| City of Novato | • Development Permit |
| City of Petaluma | • Development Permit |
| City of Sonoma | • Development Permit |
| Marin County | • Encroachment Permit<br>• Grading/Riparian/Building Permits |
| Napa County | • Encroachment Permit<br>• Grading/Riparian/Building Permits |
| Sonoma County | • Encroachment Permit<br>• Grading/Riparian/Building Permits |
| **Private Agencies [a]** | |
| Pacific Gas & Electric | • Infrastructure Review |
| Cable providers | • Infrastructure Review |
| Telephone providers | • Infrastructure Review |
| Railroad | • Infrastructure Review |

*a. It is recommended that a USA North Design Inquiry be performed on all projects to identify other private utility owners that may be in the area of the project so the utility owner can provide a review.*

The EIS/EIR will evaluate which projects within the Phase 2 Program will require permits from the agencies listed above.

### 8.4.1 Recycled Water Use Regulations in California

The production, discharge, distribution, and use of recycled water are subject to federal, state, and local regulations—the primary objectives of which are to protect public health. In the State of California, recycled water requirements are administered by the SWRCB DDW, formerly under California Department of Public Health (DPH), and individual RWQCBs. The regulatory requirements for recycled water projects in California are contained in the following sources[4]:

- CCR – Title 22 and Title 17
- California Health and Safety Code
- California Water Code

Regulatory requirements apply for non-potable and potable uses of recycled water.

[4]State requirements for production, discharge, distribution, and use of recycled water are contained in the California Water Code, Division 7-Water Quality, Sections 1300 through 13999.16 (Water Code); the California Administrative Code, Title 22-Social Security, Division 4 Environmental Health, Chapter 3-Reclamation Criteria, Sections 60301 through 60475 (Title 22); and the California Administrative Code, Title 17-Public Health, Chapter 5, Subchapter 1, Group 4-Drinking Water Supplies, Sections 7583 through 7630 (Title 17).

**Non-potable reuse** refers to the use of treated municipal wastewater for specific purposes other than drinking such as landscape irrigation, industrial uses, and agriculture or for environmental benefits. Non-potable reuse usually requires an independent "purple pipe" distribution system for conveying recycled water to customers separate from the potable water supply. In California, non-potable reuse has been occurring for the last century and regulations for non-potable reuse have been in place since the 1970s.

**Potable reuse** refers to the intended use of highly treated or purified municipal wastewater to augment a water supply that is used for drinking and all other purposes. Unplanned potable reuse, where one community draws raw water supplies downstream from discharges from wastewater treatment plants, is regulated by federal discharge requirements. Planned potable reuse involves a more formal public process and regulatory consultation program to implement and the regulations in California for the indirect and direct potable reuse are at varying stages of development.

**Indirect potable reuse (IPR)** is the purposeful introduction of highly purified recycled water into an untreated drinking water supply source, such as groundwater in an aquifer or surface water in a large reservoir. Regulations for groundwater replenishment using recycled water became effective on June 18, 2014, and the adoption of water recycling criteria for surface water reservoir augmentation are anticipated by December 31, 2016. Groundwater IPR and anticipated surface water augmentation IPR rules center around concepts of nondegradation of the receiving water, blending ratio, retention time, and distance between the point of addition and eventual extraction for treatment at a drinking water treatment plant.

**Direct potable reuse (DPR)** is the purposeful introduction of highly purified recycled water into a drinking water supply; immediately upstream of a drinking water treatment plant or directly into the potable water supply distribution system downstream of a water treatment plant. DPR is not yet included as an allowable use in California, although a report on the feasibility of developing uniform water recycling criteria for DPR had been anticipated by December 31, 2016.

Based on the uncertainties and costs associated with potable reuse options, IPR and DPR are not considered for the Phase 2 Program.

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;
- 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 (DPH 2001).

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

According to CCR Title 22, nonpotable 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.

CCR Title 22 establishes quality and treatment standards for the beneficial use of nonpotable recycled water. The four nonpotable 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 7 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 7 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 8-2 summarizes the water quality standards set by CCR 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 8-2. CCR 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<br>• Parks and playgrounds<br>• School yards<br>• Residential landscaping<br>• Unrestricted access golf courses<br>• 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<br>• Freeway landscaping<br>• Restricted access golf courses<br>• Ornamental nursery stock and sod farms where access by the general public is not restricted<br>• Pasture for animals producing milk for human consumption<br>• 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<br>• Vineyards where the recycled water does not come into contact with the edible portion of the crop<br>• Non-food-bearing trees<br>• Fodder and fiber crops and pasture for animals not producing milk for human consumption<br>• Seed crops not eaten by humans<br>• Food crops that must undergo commercial pathogen-destroying processing before being consumed by humans<br>• 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: California Code of Regulations Title 22*

The Phase 2 Program is proposing to use recycled water for agricultural irrigation, urban landscaping, and environmental restoration in the study area. Therefore, all the water used in the Phase 2 Program will be treated to meet the required recycled water standards as shown in Table 8-2 above. The potential demands for these uses were discussed in Section 2.

### 8.4.2 California Fish and Game Code

Sections 1601-1616 of the California Fish and Game Code (also known as the Lake or Streambed Alteration Agreement Program) refer to any projects that affect the flow, channel, or banks of rivers, streams, and lakes. Section 1602 states that public agencies and private individuals must notify the CDFW before construction begins for any projects that will have the following elements and effects:

- Substantially divert or obstruct the natural flow of any river, stream, or lake;
- Substantially change or use any material from the bed, channel, or bank of any river, stream, or lake; or

- Result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement that can pass into any river, stream, or lake designated by the department.

If any effects to waterways are determined during the environmental analysis phase, these projects would require a streambed alteration agreement. The pipeline projects included within the Phase 2 Program may require an agreement; however, in many instances waterways can be avoided with the use of a construction method that does not result in the disturbance of a waterway.

## 8.5 Other Obligations and Constraints

It is the intent of NBWRA and its MAs that the Phase 2 Program not adversely affect any of the MA's contractual water supply obligations for recycled water. The MA's existing recycled water customers would continue to be served as they are now and existing customers have been accounted for in the calculations of future recycled water supplies. Implementation of the Phase 2 Program would increase the reliability of drinking water supplies in the NBWRP area because recycled water would be provided to meet a portion of the nonpotable demand, thus, freeing more potable supply for potable uses and emergency situations.

Indian Trust Assets (ITAs) are legal interests in property held in trust by the U.S. for federally-recognized Indian tribes or individual Indians. ITAs can include land, minerals, federally-reserved hunting and fishing rights, federally-reserved water rights, and instream flows associated with a reservation or rancheria. Beneficiaries of the Indian trust relationship are federally-recognized Indian tribes with trust land. There are no federal or state-recognized Indian reservations or rancherias in the NBWRP area. Indian lands and ITAs will be analyzed as appropriate in the environmental documentation.

This page intentionally left blank.

Section 9

# Financial Capability of the Sponsors

The following section presents information on the financial status of the seven MAs with projects included in the Phase 2 Program, provides a preliminary cost allocation of Phase 2 Program construction and operation costs among the U.S. and the MAs, and describes potential ways the MAs may fund and repay their respective share of costs. A final cost-sharing plan and a more thorough analysis of financial capability will be developed before a construction funding agreement with the U.S. is executed. It is anticipated that construction will begin in late 2018.

## 9.1 Financial Status of the Agencies

Table 9-1 displays selected financial data obtained from the most recent audited MA statements, dated June 30, 2016 (except for the City of Petaluma; their values are from their June 2015 audited financial statements). This information is provided for background purposes and general comparison to the costs to be incurred for the Phase 2 Program.

For all MAs, the largest component of asset value is their existing capital assets, mainly the wastewater collection, treatment, and disposal systems. Capital assets range from 71 to 97 percent of total assets, depending on the MA. All MAs had recently completed capital improvements and/or had construction in progress as of June 30, 2016. The remaining asset values for all MAs primarily consist of cash, cash equivalents, and investments.

**Table 9-1. Selected Financial Parameters, by MAs, as of June 30, 2016**

| Item | City of Petaluma[a] | Novato SD[b] | SCWA[c] | SVCSD[c] | Napa SD[d] | MMWD[e] | City of American Canyon[f] |
|---|---|---|---|---|---|---|---|
| Total Assets | $234,263,341 | $202,248,847 | $197,468,044 | $94,464,176 | $242,800,837 | $460,030,200 | $339,899,049 |
| --Capital Assets | $193,020,946 | $180,012,797 | $139,263,475 | $73,543,602 | $217,579,622 | $383,536,225 | $331,278,806 |
| Total Liabilities | $126,602,537 | $93,701,392 | $50,965,828 | $26,499,922 | $78,188,911 | $221,908,118 | $31,234,487 |
| --Long-Term Debt | $118,368,736 | $85,878,494 | $ 45,259,386 | $25,208,221 | $55,526,716 | $129,856,253 | $16,312,516 |
| Unrestricted Net Assets | $33,140,058 | $12,312,293 | $41,224,208 | $15,240,129 | $5,782,378 | $23,333,804 | $9,069,833 |
| Revenues | $26,205,550 | $19,299,289 | $33,054,297 | $15,314,719 | $23,855,083 | $60,100,547 | $44,402,801 |
| --Sewer Svc Fees | $26,032,141 | $16,222,876 | n/a | $13,016,675 | $19,887,172 | n/a | |
| Expenses | $18,450,168 | $16,587,829 | $36,100,026 | $14,440,165 | $18,676,791 | $65,125,618 | $39,893,603 |

a. *City of Petaluma June 30, 2015, audited financial statements for FY 2014-15, Wastewater Enterprise Fund and Wastewater Rate Stabilization Fund.*

b. *Source: Brown, 2017.*

c. *Source: Spaulding, 2017.*

d. *Source: Tucker, 2017.*

e. *Source: Sellier, 2017.*

f. *Source: Hartwig, 2017.*

Long-term debt comprises between 52 and 95 percent of total liabilities. The long-term debt of SVCSD is split between State Revolving Fund loans and revenue bonds issued to develop their wastewater facilities and replace portions of their sewer collection system. The long-term debt of Novato SD reflects a 2008 State Revolving Fund loan to fund its Wastewater Facilities Upgrade Projects and 2011 Certificates of Participation issued to help fund their share of costs for their NBWRA Phase 1 Recycled Water Facility. Napa SD's largest long-term debts are 2009 and 2012 Certificates of Participation.

As of June 30, 2016, the financial statements of all districts reflected unrestricted net assets between 2 and 21 percent of total asset value. Unrestricted net assets are those assets in excess of liabilities which can be utilized to pay for operating expenses and capital improvements.

Customer sewer service fees represent the largest revenue source for all districts, between 83 and 99 percent. Most of the additional revenues for Novato SD were property tax receipts; SVCSD reported insignificant property tax revenues and Napa SD did not report any. Most of Napa SD's revenues aside from sewer charges were capacity charges from developers and the sale of recycled water.

Although not separately disclosed in Table 9-1, the major operating expenses for all MAs were salaries and benefits, materials and supplies, and depreciation.

## 9.2 Preliminary Cost Allocation and Federal Cost-Share

A preliminary allocation of Phase 2 Program project construction costs among the MAs is presented in Table 9-2. Each project included in the Phase 2 Program cost estimate relates solely to one of the MA; therefore, there was no need to allocate costs of any single project among the MAs. The line item costs and percentage add-ons in Table 9-2 are derived from the Phase 2 cost estimate included in Appendix D Basis for Feasibility Construction Costs Estimate, which may be referenced for additional detail.

Title XVI provides authority for USBR to provide up to 25 percent of the cost of planning, designing, and constructing specific water recycling projects up to the federal appropriations ceiling of $20 million. Therefore, with a program cost of $83,228,502, it is expected the federal cost-share for the Phase 2 Program will be $20,000,000. In 2015, the USBR awarded the NBWRA $450,000 in grant assistance toward completion of the Phase 2 Feasibility Study under FOA R15AS00015 and Cooperative Agreement No. R15AP00143. It anticipated that USBR's contribution in construction grant assistance will be $19,550,000.

The federal and non-federal cost share tentatively allocated among the five MAs in proportion to their respective total project cost is also presented in Table 9-2. The table shows each agency's preliminary portion of the Phase 2 Program infrastructure costs, including pump stations, storage, and pipelines. Contingencies were added based on USBR's cost estimating guidance. For this preliminary allocation, Novato SD would be responsible for $4.6 million, SVCSD would pay $1.8 million, SCWA would pay $5.6 million, the City of Petaluma would pay $35.9 million, Napa SD would pay $3.8 million, MMWD would pay $5.9 million, and the City of American Canyon would pay $5.9 million after the federal funding share is allocated.

The estimated annual O&M expenses among the seven MAs is provided in Table 9-3. Total O&M for each of five categories, including contingency (energy costs, labor costs, chemicals, maintenance, and lab/regulatory compliance), was calculated per project and the total sum for each MA is displayed in Table 9-3. In accordance with the legislation, no federal cost-sharing is provided for O&M expenses.



Brown AND Caldwell

| Table 9-2. Summary of Construction Costs by MA for Phase 2 Program[a] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Agency | Distribution Pipelines | Pump Stations | Storage | WWTP Upgrades | Other Construction Costs | Subtotal | Plus Allowances and Contingencies (15%+20%) | Total Field Cost | Plus Non-Contract Costs (25%) | Total Construction Costs | Less Federal Share | Non-Federal Share |
| Novato SD | $855,600 | $0 | $0 | $2,816,400 | $0 | $3,672,000 | $1,285,200 | $4,957,200 | $1,239,300 | $6,196,500 | $1,549,125 | $4,647,375 |
| SVCSD | $1,426,589 | $0 | $0 | $0 | $0 | $1,426,589 | $499,306 | $1,925,895 | $481,474 | $2,407,369 | $601,842 | $1,805,527 |
| SCWA | $196,000 | $445,500 | $0 | $0 | $3,820,750 | $4,462,250 | $1,561,787 | $6,024,037 | $1,506,009 | $7,530,046 | $1,882,512 | $5,647,535 |
| City of Petaluma | $19,611,602 | $0 | $0 | $5,346,400 | $0 | $24,958,002 | $8,735,300 | $33,693,302 | $8,423,325 | $42,116,627 | $6,141,699 | $35,974,928 |
| Napa SD | $986,671 | $0 | $728,910 | $1,310,000 | $0 | $3,025,581 | $1,058,953 | $4,084,534 | $1,021,133 | $5,105,667 | $1,276,417 | $3,829,250 |
| MMWD/ CMSA | $1,757,418 | $515,000 | $75,700 | $2,290,000 | $0 | $4,638,118 | $1,623,341 | $6,261,459 | $1,565,365 | $7,826,824 | $1,956,706 | $5,870,118 |
| City of American Canyon | $3,655,655 | $0 | $0 | $3,482,400 | $0 | $7,138,055 | $2,498,320 | $9,636,375 | $2,409,094 | $12,045,469 | $6,141,699 | $5,903,770 |
| Total | $28,489,535 | $960,500 | $804,610 | $15,245,200 | $3,820,750 | $49,320,595 | $17,262,207 | $66,582,802 | $16,645,700 | $83,228,502 | $19,550,000 | $63,678,502 |

a. *Total values may not add correctly due to rounding.*

| Agency | Energy Costs | Labor Costs | Chemicals | Maintenance | Lab/ Regulatory Compliance | Contingency | Total O&M Costs | Total O&M Costs (rounded) |
|---|---|---|---|---|---|---|---|---|
| Novato SD | $32,000 | $122,500 | $3,315 | $41,876 | $20,772 | $22,047 | $242,510 | $243,000 |
| SVCSD | $0 | $18,750 | $0 | $7,133 | $0 | $2,588 | $28,471 | $28,000 |
| SCWA | $14,639 | $75,000 | $22,311 | $116,000 | $0 | $22,795 | $250,745 | $251,000 |
| City of Petaluma | $118,400 | $186,250 | $14,919 | $142,814 | $14,919 | $47,730 | $525,032 | $525,000 |
| Napa SD | $62,400 | $148,750 | $6,630 | $43,356 | $16,333 | $27,747 | $305,216 | $305,000 |
| MMWD/ CMSA | $13,710 | $18,750 | $0 | $23,191 | $0 | $5,565 | $61,216 | $61,000 |
| City of American Canyon | $35,200 | $75,000 | $0 | $35,690 | $0 | $14,589 | $160,479 | $160,000 |
| Total | $276,349 | $645,000 | $47,175 | $410,060 | $52,024 | $143,061 | $1,573,669 | $1,573,000 |

Table 9-3. Summary of Local Projects for Phase 2 Program - Annual O&M Costs by MA (March 2017)[a]

a. *Total values may not add correctly due to rounding.*

## 9.3 Preliminary Non-Federal Funding Plan

A firm plan for funding the non-federal share of the Phase 2 Program construction costs has not yet been developed among the MAs and their potential partners. A complete detailed financial capability analysis will be provided to USBR prior to construction, in advance of the federal cost share.

There are several possible funding sources being considered by the MAs for their non-federal share of construction costs. Some level of cash contribution from MAs' reserves could be made, although this would likely be a low percentage of the total required. Various state or local grants are currently being sought. In addition, loans may be taken, notably in the form of Certificates of Participation or the State Revolving Fund, which have been used by some agencies for past projects. Finally, any construction funds not covered by district reserves, grants, or loans will probably be raised through issuance of revenue bonds. It is likely that the final funding plan will include some combination of the above measures.

It is expected that any debt instruments (loans and bonds) acquired to fund construction would be repaid primarily through user fees, both for wastewater service and for recycled water supply deliveries. It is possible that rates for all users in the wastewater and water agencies, not just the users receiving the recycled water supply, could be raised for debt service of this project. In addition, tax assessments could be used to retire project debt, although assessments are not now a large portion of district revenues. The annual O&M expenses for the Phase 2 Program will probably be collected in the same manner as the annual debt service.

## 9.4 Willingness to Pay

Although formal resolutions to pay for their share of the construction costs will not be made by the MAs and their local partners until the cost-sharing plan is finalized prior to construction, all entities support the Phase 2 Program. The MOU to create the NBWRA (included as Appendix G), the legislative collaboration on HR236 and S1472, and the local funding for the feasibility analyses are all indicative of continuing the Phase 2 Program support by the MAs and their partners.

## 9.5 Project Schedule

A preliminary schedule of the Phase 2 project sequencing has been developed to estimate costs, benefits and financing needs. However, the final schedule for project implementation will be dependent on several factors and can only be estimated at this time.

During Phase 1, MAs worked in a coordinated manner to implement projects based on their physical needs for improvements and ability to complete their projects within the required time frame. The same coordinated effort for Phase 2 is anticipated and full utilization of annual grant application capacity will be sought so that implementation opportunities are available to all agencies who are ready to proceed. The two newest MAs will likely seek the first funding requests under the Title XVI WaterSMART Implementation Grant Program.

The proposed schedule below (Table 9-4) indicates projects by agency, project costs, total Phase 2 Program costs, and anticipated grant funds that will be applied for annually. This aggressive schedule assumes that no more than $4 million per year could be available through WaterSMART grants and that each project must be completed in a 2-year time frame.

**Table 9-4. Project Schedule by MA for Phase 2 Program[a]**

| Agency | Project Type | Project Title | Total Project Capital Costs | Year 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|
| Novato SD | Treatment | Novato SD WRP Capacity - 1st Expansion (+0.85 MGD) | $4,752,675 | | | | | | |
| | Environmental Enhancement | Marin County Lower Novato Creek Project - Distribution | $893,531 | | | | | | |
| | | Turnout to Transitional Wetlands | $550,294 | | | | | | |
| SVCSD | Distribution | 8th Street East and Napa Road Pipelines | $2,407,369 | | | | | | |
| SCWA | Seasonal Storage | Valley of the Moon ASR | $3,674,320 | | | | | | |
| | | Sonoma ASR | $3,855,727 | | | | | | |
| City of Petaluma | Treatment | Increase ECWRF Capacity | $9,022,050 | | | | | | |
| | Distribution | Urban Recycled Water Expansion | $14,626,830 | | | | | | |
| | | Agricultural Recycled Water Expansion Phase 1 | $12,534,502 | | | | | | |
| | | Agricultural Recycled Water Expansion Phase 2 | $5,933,246 | | | | | | |
| Napa SD | Treatment | Soscol WRF Increased Filter Capacity | $2,210,625 | | | | | | |
| | Operational Storage | Additional Soscol WRF Covered Storage | $2,895,042 | | | | | | |
| MMWD/ CMSA | Distribution | Recycled Water Distribution System Expansion to San Quentin Prison | $7,826,824 | | | | | | |
| City of American Canyon | Distribution | Phase 1 Recycled Water Distribution System Expansion | $3,103,108 | | | | | | |
| | | Phase 2 Recycled Water Distribution System Expansion | $2,892,451 | | | | | | |
| | Treatment | AmCam WRF Phase 2 Treatment Plant Upgrades | $6,049,908 | | | | | | |
| **Total** | | | $83,228,502 | $16,458,880 | $16,172,819 | $17,156,563 | $16,566,213 | $16,874,027 | -- |
| **Anticipated Grant Funding** | | | $19,550,000 | $3,866,117 | $3,798,922 | $4,029,999 | $3,891,329 | $3,963,633 | -- |

a. *Total values may not add correctly due to rounding.*

## Section 10

# Research Needs

The NBWRP Phase 2 Program will not require additional research to proceed with planning, design, construction, and implementation for the treatment, storage, and distribution projects since these projects expand on existing facilities. The Phase 2 Program projects will use proven tertiary treatment technologies and conventional system components, which are in use for other recycled water projects within the Phase 2 Program area and in other parts of California and the U.S.

Additional research may be necessary for the Sonoma Valley Groundwater Management and Recharge Study depending on the projects selected and how recycled water will be used to meet the specific project objectives. This research would be completed by SCWA to support the development of the project.

This page intentionally left blank.

Section 11

# Limitations

This document was prepared solely for Sonoma County Water Agency in accordance with professional standards at the time the services were performed and in accordance with the contract between Sonoma County Water Agency and Brown and Caldwell dated September 4, 2014. This document is governed by the specific scope of work authorized by Sonoma County Water Agency; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Sonoma County Water Agency and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Further, Brown and Caldwell makes no warranties, express or implied, with respect to this document, except for those, if any, contained in the agreement pursuant to which the document was prepared.

All data, drawings, documents, or information contained this feasibility study report have been prepared exclusively for the person or entity to whom it was addressed and may not be relied upon by any other person or entity without the prior written consent of Brown and Caldwell unless otherwise provided by the Agreement pursuant to which these services were provided.

This page intentionally left blank.

# Section 12

# References

Becker, Gordon S. Isabelle J Reining, David A. Asbury, Andrew Gunther, Ph. D, San Francisco Estuary Watersheds Evaluation: *Identifying Promising Locations for Steelhead Restoration in Tributaries of the San Francisco Estuary,* Center for Ecosystem Management and Restoration for California State Coastal Conservancy, August 2007. (Becker 2007)

Booker, Kevin. 2015. (Sonoma Valley County Sanitation District). E-mail communication with Jill Chamberlain of Brown and Caldwell. Walnut Creek, CA. April 17, 2015.

Booker, Kevin. 2015a. (Sonoma Valley County Sanitation District). E-mail communication with Jill Chamberlain of Brown and Caldwell. Walnut Creek, CA. April 17, 2015.

Brown, Erik. 2017. (Novato Sanitary District). E-mail communication with Mike Savage of Brown and Caldwell. Walnut Creek, CA. April 7, 2017.

California Coastal Commission. California's Critical Coastal Areas: North San Francisco Bay, https://www.coastal.ca.gov/nps/Web/cca_sfbay_n1.htm

California Department of Fish and Game and National Marine Fisheries Service. 2002. Guidelines for Maintaining Instream Flows to Protect Fisheries Resources Downstream of Water Diversions in Mid-California Coastal Streams. June 17, 2012.

California Department of Water Resources (DWR). 2010. "Agricultural Land and Water Use Estimates", California Department of Water Resources: Land and Water Use, http://www.water.ca.gov/landwateruse/docs/annualdata/2010/Ag_DAU_2010.xls, May 2014.

California Regional Water Quality Control Board San Francisco Bay Region. 2015. San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan). March 20, 2015.

Carollo. 2016. Central Marin Sanitation Agency/Marin Municipal Water District - Recycled Water Feasibility Study. January 2016.

City of American Canyon. 2011. Final Urban Water Management Plan 2010. Prepared by Winzler & Kelly. September 2011.

City of American Canyon. 2015. January through December 2015 Self-Monitoring Reports for the City of American Canyon Water Reclamation Facility. January through December 2015.

City of American Canyon. 2016. 2015 Urban Water Management Plan for City of American Canyon. Prepared by Kennedy Jenks Consultants. June 2016.

City of Napa. 2011. Urban Water Management Plan 2010 Update. June 2011.

City of Petaluma, 2015. 2014 City of Petaluma Industrial Pretreatment Semi & Annual Report. February 2015.

City of Petaluma. 2006. Water Demand & Supply Analysis Report. Prepared by Dodson Engineers. June 2006.

City of Petaluma. 2011. 2010 Urban Water Management Plan. Prepared by J. Crowley Group. June 2011.

City of Sonoma. 2011. Final Urban Water Management Plan 2010. Prepared by Winzler & Kelly. June 2011.

Damron, Andrew. 2015. (Napa Sanitation District). E-mail communication with Jill Chamberlain of Brown and Caldwell. Walnut Creek, CA. April 13, 2015.

DWR. 2003. California's Groundwater Bulletin 118-Update 2003, October 2003.

DWR. 2014. "Final CASGEM Basin Prioritization Results – June 2014", California Department of Water Resources Groundwater Basin Prioritization, http://www.water.ca.gov/groundwater/casgem/basin_prioritization.cfm, June 2016.

DWR. 2016. "Critically Overdrafted Basins", California Department of Water Resources Critically Overdrafted Basins, http://www.water.ca.gov/groundwater/sgm/pdfs/COD_BasinsTable.pdf, June 2016.

GHD. 2016. City of American Canyon – Recycled Water Master Plan. May 2016.

GHD. 2016a. City of American Canyon – Sewer Master Plan. May 2016.

Hartwig, Steve. 2017. (City of American Canyon). E-mail communication with Mike Savage of Brown and Caldwell. Walnut Creek, CA. April 7, 2017.

Iribarne, David. 2013. (City of Petaluma). Personal communication with A. Loutsch of CDM Smith. Walnut Creek, CA. April 17, 2013.

Karkal, Sandeep. 2015. (Novato Sanitary District). E-mail communication with Jill Chamberlain of Brown and Caldwell. Walnut Creek, CA. April 8, 2015.

Koekemoer, Mark. 2017. (Central Marin Sanitation Agency). E-mail communication with Rene Guillen of Brown and Caldwell. Walnut Creek, CA. April 13, 2017

Leidy, R.A., G.S. Becker, B.N. Harvey, Historical distribution and current status of steelhead/rainbow trout (Oncorhynchus mykiss) in streams of the San Francisco Estuary, California. Center for Ecosystem Management and Restoration, 2005 (Leidy, 2005).

Marin Municipal Water District. 2011. 2010 Urban Water Management Plan. Prepared by HDR. June 2011.

Napa Sanitation District (Napa SD). 2005. Strategic Plan for Recycled Water Use in the Year 2020, Final Draft. Prepared by Larry Walker Associates. August 2005.

Napa SD. 2011. Wastewater Treatment Plant Master Plan. Prepared by Brown and Caldwell. April 2011.

Napa SD. 2015. "Napa Sanitation District: Service Area and Statistics", Napa Sanitation District: About Us, http://www.napasan.com/Pages/Section.aspx?id=76. Accessed on: April 1, 2015.

Napa SD. 2015a. 2014 Recycled Water Annual Report. April 2015.

Napa SD. 2015b. 2014 Annual Pretreatment Program Report. February 2015.

National Research Council. 2012. Sea level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future. Washington, DC: The National Academies Press. https://doi.org/10.17226/13389.

NBWRA. 2014. North Bay Water Reuse Program Phase 2 Scoping Study Summary Report. Prepared by Brown and Caldwell. May 2014.

North Bay Water Reuse Authority (NBWRA) and U.S. Bureau of Reclamation (USBR). 2009. North San Pablo Bay Restoration and Reuse Project Environmental Impact Report/ Environmental Impact Statement. May 2009.

North Bay Water Reuse Program (NBWRP). 2015. "North Bay Water Reuse Program: Background", North Bay Water Reuse Program: About Us, http://www.nbwra.org/. Accessed on: April 2015.

North Marin Water District. 2011. 2010 Urban Water Management Plan. June 2011.

Novato Sanitary District. 2004. Novato Sanitary District Facility Plan.

Novato Sanitary District. 2010. California Regional Water Quality Control Board National Pollution Discharge Elimination System for Novato Sanitary District. May 2010.

Novato Sanitary District. 2014. January through December 2014 Self-Monitoring Reports for the Novato Wastewater Treatment Plant. January through December 2014.

San Francisco Bay Area Integrated Regional Water Management Plan (Bay Area IRWMP). 2013. Prepared by Kennedy Jenks Consultants. September 2013.

SCWA and USBR. 2008. Phase 3 Engineering and Economic/ Financial Analysis Report for the North San Pablo Bay Restoration and Reuse Project. Prepared by CDM Smith. June 2008.

SCWA. 2009. Sonoma Valley Groundwater Management Program 2009 Annual Report. June 22, 2010.

SCWA. 2011. 2010 Urban Water Management Plan. Prepared by Brown and Caldwell. June 2011.

SCWA. 2014. Sonoma Valley Groundwater Management Program: Five-Year Review and Update Final Report. March 2014.

SCWA. 2016. Sonoma Valley Groundwater Management Program 2015 Annual Report. April 2016.

Sellier, Paul. 2017. (Marin Municipal Water District). E-mail communication with Mike Savage of Brown and Caldwell. Walnut Creek, CA. April 4, 2017.

Sonoma County Water Agency (SCWA). 2007. Sonoma Valley Groundwater Management Plan. December 2007.

Sonoma Valley County Sanitation District (SVCSD). 2014. California Regional Water Quality Control Board National Pollution Discharge Elimination System for Sonoma Valley County Sanitation District. May 2014.

Spaulding, Jake. 2017. (Sonoma County Water Agency). E-mail communication with Mike Savage of Brown and Caldwell. Walnut Creek, CA. April 7, 2017.

SVCSD. 2015. "About the Sonoma Valley County Sanitation District", Sonoma County Water Agency: Sanitation, http://www.scwa.ca.gov/svcsd/. Accessed: April 1, 2015.

SVCSD. 2015a. SVCSD Daily Influent Flow Summary Report 2014.

Tucker, Jeffery. 2017. (Napa Sanitation District). E-mail communication with Mike Savage of Brown and Caldwell. Walnut Creek, CA. April 7, 2017.

U.S. Department of the Interior (USDI) and U.S. Geological Survey (USGS). 2014. Estimated Use of Water in the United States in 2010: U.S. Geological Survey Circular 1405. 2014.

U.S. Environmental Protection Agency (USEPA). 2012. Guidelines for Water Reuse. Prepared by CDM Smith. September 2012.

University of California Division of Agriculture and Natural Resources, Napa Sanitation District, "Suitability Study of Napa Sanitation District Recycled Water for Vineyard Irrigation", March 6, 2006.

USBR. 2007. Reclamation Manual, Directives and Standards, FAC 09-01, Cost Estimating. October 15, 2007.

USBR. 2008. Reclamation Manual, Directives and Standards, WTR 11-01, Title XVI Water Reclamation and Reuse Program Feasibility Study Review Process. March 17, 2008.

USBR. 2014. Technical Guidance for Incorporating Climate Change Information into Water Resources Planning Studies. September 2014

USGS. 2003. Ground-Water Resources in the Lower Milliken–Sarco–Tulucay Creeks Area, Southeastern Napa County, California, 2000–2002: Water-Resources Investigations Report 03-4229. Prepared in cooperation with the Napa County Department of Public Works. 2003

USGS. 2016. "USGS Water Resources: USGS Surface-Water Annual Statistics", USGS National Water Information System: Web Interface, http://waterdata.usgs.gov/nwis/annual. Accessed: February, 2016.

Valley of the Moon Water District. 2011. Final Urban Water Management Plan 2010. Prepared by Winzler & Kelly. June 2011.

Walker, Leah. 2015. (City of Petaluma). E-mail communication with Jill Chamberlain of Brown and Caldwell. Walnut Creek, CA. April 8, 2015.

This page intentionally left blank.

# Appendix A: Technical Workshop Meeting Summaries

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**July 28, 2014**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:36 a.m. on Monday, July 28, 2014 at the Novato City Hall Council Chambers, 901 Sherman Street, Novato, CA 94945. Consultants who were unable to attend participated via telephone, 1-866-906-7447, passcode 2428170#.

## 2. Roll Call

| | |
|---|---|
| **PRESENT:** | David Rabbitt, Chair, Sonoma County Water Agency |
| | Bill Long, Vice-Chair, Novato Sanitary District |
| | Megan Clark, Las Gallinas Valley Sanitary District |
| | Jack Gibson, Marin Municipal Water District |
| | Susan Gorin, Sonoma Valley County Sanitation District |
| | Steve Kinsey, Marin County |
| | Kathy Miller, City of Petaluma |
| | Keith Caldwell, Napa County |
| | Jill Techel, Napa Sanitation District |
| | John Schoonover, North Marin Water District |
| **ABSENT**: | None |

| | | |
|---|---|---|
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Jack Baker | North Marin Water District |
| | Kevin Booker | Sonoma County Water Agency |
| | Gary Butler | Novato Sanitary District |
| | Ginger Bryant | Bryant & Associates |
| | Grant Davis | Sonoma County Water Agency |
| | Barry Dugan | Data Instincts |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | Jenny Gain | Brown & Caldwell (via telephone) |
| | Ryan Grisso | North Marin Water District |
| | Pam Jeane | Sonoma Valley County Sanitation Agency |
| | Andria Loutsch | CDM Smith (via telephone) |
| | Mark Millan | Data Instincts |
| | Phillip Miller | Napa County |
| | Pilar Oñate-Quintana | The Oñate Group |
| | Larry Russell | Marin Municipal Water District |
| | Jake Spaulding | Sonoma County Water Agency |
| | Dan St. John | City of Petaluma |
| | Dawn Taffler | Kennedy Jenks Consultants (via telephone) |
| | Jeff Tucker | Napa Sanitation District |

| | |
|---|---|
| Leah Walker | City of Petaluma |
| Mark Williams | Las Gallinas Valley Sanitary District |

**3. Public Comments**
There were no comments from the public

**4. Introductions**
Participants introduced themselves for the benefit of new attendees.

**5. Board Meeting Minutes of May 19, 2014.**
A motion by Director Schoonover, seconded by Director Long to approve the May 19, 2014 minutes was unanimously approved.

**6. Report from the Program Manager**
**a. Consultant Progress Reports**
The Board reviewed the consultant progress reports for June 2014. The Program Manager highlighted the remaining agenda items.

**7. Financial Report for the Period Ending June 30, 3014**
The Board reviewed the Financial Report and noted that all items were on track.

**8. Status of Consultant Agreement Approval Process**
The Program Manager and Kevin Booker reported on the status of the consultant agreement approval process. They are scheduled to go to the SCWA Board on August 19, 2014.

**9. Program Development – Federal Advocacy Update**
Ginger Bryant provided an update for the Board on federal activities in support of Phase 1 and 2. She discussed Senator Boxer's RIFIA Bill which was to be introduced in the Senate on July 29, 2014. She has requested an endorsement letter from NBWRA. As an action item, the Board agreed to send an endorsement letter. Bryant also discussed the following: future WaterSMART grant levels, EPA's WIFIA regional activities, Phase 2 Feasibility Study funding options, and State funding options. Chair Rabbitt, Grant Davis, and other participants thanked Ginger Bryant and her team for their efforts on behalf of NBWRA.

**10. State Advocacy Update**
Pilar Oñate Quintana updated the Board on the following items: Governor Brown's indicated maximum support for a Water Bond of $6 billion; Senator Wolk's version contains $500 million for recycled water; and that WateReuse is seeking $1 billion. She also noted that the CEQA exemption bill for recycled water pipelines failed due to amendments gutting the intent. Grant Davis thanked Pilar for her efforts on behalf of NBWRA to keep the $500 million for recycled water in Senator Wolk's bill.

**11. Proposition 84 Funding Activities**
Andria Loutsch gave an update on the Bay Area Clean Water Agencies selection process for projects to submit to the state for Proposition 84 funding.

**12. Outreach Program Update**
Mark Millan noted that they have received three recent telephone calls for the following items: a film crew from Germany wants to visit some sites in late August, the Golden Gate National Recreational Area is looking for recycled water, and a fifth grade class has requested a tour. Las Gallinas will respond to the class tour request.

**13. Adjournment**
Chair Rabbitt adjourned the meeting at 10:40 a.m. The next meeting will be October 27, 2014 at 9:30 a.m. at the Novato City Hall Council Chambers.

Minutes approved by the Board October 27, 2014.

Original signed by

Charles V. Weir
Program Manager

C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2014\2014-07\2014-07-28_NBWRA_Board_Minutes.docx

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**October 27, 2014**

## 1. Call to Order

Vice Chair Long called the meeting to order at 9:35 a.m. on Monday, October 27, 2014 at the Novato City Hall Council Chambers, 901 Sherman Street, Novato, CA 94945. Consultants who were unable to attend participated via telephone, 1-866-906-7447, passcode 2428170#.

## 2. Roll Call

**PRESENT:** Bill Long, Vice-Chair, Novato Sanitary District
Keith Caldwell, Napa County
Megan Clark, Las Gallinas Valley Sanitary District
Liza Crosse, Marin County
Susan Gorin, Sonoma Valley County Sanitation District
Mike Healy, City of Petaluma (left at 10:37 a.m.)
Dan St. John, City of Petaluma (took over for Director Healy at 10:37 a.m.)
John Schoonover, North Marin Water District
Jill Techel, Napa Sanitation District

**ABSENT**: Jack Gibson, Marin Municipal Water District

**OTHERS PRESENT:**

| | |
|---|---|
| Chuck Weir, Program Manager | Weir Technical Services |
| Jack Baker | North Marin Water District |
| Kevin Booker | Sonoma County Water Agency |
| Ginger Bryant | Bryant & Associates |
| Grant Davis | Sonoma County Water Agency |
| Barry Dugan | Data Instincts |
| Jenny Gain | Brown & Caldwell |
| Tim Healy | Napa Sanitation District |
| Pam Jeane | Sonoma Valley County Sanitation Agency |
| Sandeep Karkal | Novato Sanitary District |
| Drew McIntyre | North Marin Water District |
| Mark Millan | Data Instincts |
| Phillip Miller | Napa County |
| Pilar Oñate-Quintana | The Oñate Group |
| Mike Savage | Brown & Caldwell |
| Jake Spaulding | Sonoma County Water Agency |
| Dawn Taffler | Kennedy Jenks Consultants (via telephone) |
| Jeff Tucker | Napa Sanitation District |
| Leah Walker | City of Petaluma |

## 3. Public Comments

There were no comments from the public

**4. Introductions**

Introductions were skipped.

**5. Board Meeting Minutes of May 19, 2014.**

A motion by Director Schoonover, seconded by Director Gorin to approve the July 28, 2014 minutes was unanimously approved.

**6. Report from the Program Manager**

**a. Consultant Progress Reports**

The Board reviewed the consultant progress reports for September 2014. The Program Manager highlighted the remaining agenda items.

**7. Financial Report for the Fiscal Year Ending June 30, 2014**

The Board reviewed the Financial Report and noted that the year ended with a small surplus that will be carried over and remain in the trust account.

**8. Financial Report for the Period Ending September 30, 2014**

The Board reviewed the Financial Report. The Program Manager described the new layout of the consultant tracking spreadsheet and SCWA's reports.

**9. Phase 1 Projects Status Report**

The Board reviewed the status of the Phase 1 projects and noted that they are approximately 73% completed. Vice Chair Long requested regular reports on the volume of recycled water delivered as a result of the Phase 1 projects. The TAC will discuss and develop a regular reporting system for the Board and TAC. The Board also requested a summary of the total cost of the various Phase 1 projects at the January 26, 2015 Board meeting.

**10. Phase 2 Overview**

Mike Savage, Brown & Caldwell provided an overview of the plans and schedule for Phase 2 for the coming year. The goal is for the TAC to finalize the list of projects at their December meeting and have the Board approve at the January 26, 2015 meeting.

**11. Outreach Program Update**

Mark Millan, Data Instincts gave an update for the Board. He discussed a Webinar that has been scheduled to educate water and wastewater agencies about Ebola virus transmission. He also discussed plans for developing five videos that will be used for education and marketing purposes.

**12. Program Development, Federal, and State Advocacy Update**

Ginger Bryant provided an update for the Board on federal activities in support of Phase 1 and 2. She discussed W21, Water in the 21st Century Act that has incorporated RIFIA as Title II of the Act. She also discussed WaterSMART funding for 2015, Appropriations Bills for 2015, and the status of ongoing activities. There were several questions regarding funding and she indicated that it might be possible to get 100% funding for construction projects through a combination of grants, loans, and Title XVI. She noted that the next trip to Washington D.C. will be scheduled for early February 2015.

Pilar Oñate Quintana updated the Board on the efforts that led to the passage of the Water Bond and it becoming Proposition 1 on the November 4, 2014 ballot. She asked that the Board take a support position on Proposition 1. This item will be considered separately under Agenda Item No. 13. She discussed the funding provisions of Proposition 1 and how they might apply to NBWRA. She also provided an update on various ongoing activities and initial plans for NBWRA Day in Sacramento in 2015. Lastly she noted that Irvine Ranch Water District is pushing for an understanding that recycled water is not subject to drought restrictions for use.

Vice Chair Long thanked Ginger Bryant and Pilar Oñate-Quintana for all their efforts on behalf of NBWRA.

**13. Resolution in Support of Proposition 1, Water Bond, Funding for Water Quality, Supply, Treatment, and Storage Projects.**

A motion by Director Techel, seconded by Director Schoonover to approve the Resolution in Support of Proposition 1, Water Bond, Funding for Water Quality, Supply, Treatment, and Storage Projects was unanimously approved. Data Instincts will use the resolution in a press release and also note the member agencies that have also supported Proposition 1.

**14. Adjournment**

Vice Chair Long adjourned the meeting at 10:55 a.m. The next meeting will be Monday, January 26, 2015 at 9:30 a.m. at the Novato City Hall Council Chambers.

Minutes approved by the Board January 26, 2015.

Original signed by

Charles V. Weir
Program Manager

C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2014\2014-10\2014-10-27_NBWRA_Board_Minutes.docx

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**January 26, 2015**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:34 a.m. on Monday, January 26, 2015 at the Sonoma County Water Agency, 404 Aviation Boulevard, Santa Rosa, CA 95403. Consultants and others who were unable to attend participated via telephone, 1-866-906-7447, passcode 2428170#.

## 2. Roll Call

**PRESENT:** David Rabbitt, Chair, Sonoma County Water Agency
Bill Long, Vice-Chair, Novato Sanitary District
Keith Caldwell, Napa County
Rabi Elias, Las Gallinas Valley Sanitary District
Jack Gibson, Marin Municipal Water District
Susan Gorin, Sonoma Valley County Sanitation District
Mike Healy, City of Petaluma
Tim Healy, Napa Sanitation District
John Schoonover, North Marin Water District

**ABSENT**: Steve Kinsey, Marin County

**OTHERS PRESENT:**

| | |
|---|---|
| Chuck Weir, Program Manager | Weir Technical Services |
| Kevin Booker | Sonoma County Water Agency |
| Ginger Bryant | Bryant & Associates |
| Grant Davis | Sonoma County Water Agency |
| Jenny Gain | Brown & Caldwell |
| Jason Holley | City of American Canyon (via telephone) |
| Pam Jeane | Sonoma Valley County Sanitation Agency |
| Sandeep Karkal | Novato Sanitary District |
| Drew McIntyre | North Marin Water District |
| Mark Millan | Data Instincts |
| Phillip Miller | Napa County |
| Larry Russell | Marin Municipal Water District |
| Dan St. John | City of Petaluma |
| Mike Savage | Brown & Caldwell |
| Brad Sherwood | Sonoma County Water Agency |
| Jake Spaulding | Sonoma County Water Agency |
| Dawn Taffler | Kennedy Jenks Consultants |
| Jeff Tucker | Napa Sanitation District |
| Leah Walker | City of Petaluma |

**3. Public Comments**
There were no comments from the public

**4. Introductions**
Introductions were skipped.

**5. Board Meeting Minutes of October 27, 2014.**
A motion by Director Schoonover, seconded by Director Caldwell to approve the October 27, 2014 minutes was unanimously approved. Director Baker abstained.

**6. Report from the Program Manager**
**a. Consultant Progress Reports**
The Board reviewed the consultant progress reports for December 2014. The Program Manager highlighted the remaining agenda items.

**7. Financial Report for the Period Ending December 31, 2014**
The Board reviewed the Financial Report.

**8. 2014 Recycled Water Report**
The Board reviewed the 2014 Recycled Water Report and was very pleased with the progress being made in recycled water delivery. Director Long asked if flows discharged to receiving waters could be added to the report as that represents "lost water" that could be recycled.

**9. Outreach Program Update.**
This item was taken out of order and was discussed after Item No. 6 because videotaping that involved some Board members was occurring concurrent with the Board meeting. Mark Millan explained the videotaping process and schedule. He also showed the first video that has been produced that featured Chair Rabbitt. Board members expressed their appreciation for the progress and content of the videos that are being produced.

**10. Program Development, Federal, and State Advocacy Update**
Ginger Bryant provided an update for the Board on federal and state activities in support of Phase 1 and 2. She discussed a $450,000 grant application in support of the Phase 2 Feasibility Study and noted that USBR has requested that the application not include the Triple Bottom Line Analysis (TBL) or Environmental Documents at this time. With this modification the total cost is $1,793,200. The TBL and Environmental Documents still need to be completed and can be done so with additional grant applications. She discussed the CRomnibus bill and noted that it has $50 million in drought funding. Bryant also provided an update on the Water Infrastructure Finance and Innovation Authority (WIFIA) and the Water Resources Reform and Development Act of 2014 (WRRDA). WRRDA has been passed and is expected to be signed into law by the President shortly.

Bryant noted that the Phase 2 language fix has been approved, but it is not in the CRomnibus bill. That may be handled legislatively and/or administratively. Her team continues working on RIFIA and Water 21 and efforts to develop bipartisan support.

Lastly Bryant discussed state issues including the Governor's plans for funding the Water Bond in 2015/16 and the planned March 4, 2015 NBWRA Day in Sacramento. The Governor plans on providing $132.7 million for recycled water and $5.2 million for desalination projects.

**11. Workshop – North Bay Water Reuse Program Phase 2**
Mike Savage and Jenny Gain discussed the following topics: Feasibility Study Report, Project Schedule, Summary of Phase 1 Grant Application, Discussion of Phase 1 Funding Reallocation, and Discussion of TBL. They described the various projects by agency using descriptions and maps. Participants noted a few minor changes that will be incorporated into the final list of Phase 2 projects for the Feasibility Study.

The Program Manager noted that a FY2015/16 Budget would be presented to the Board at the next meeting on April 27, 2015.

**12. Adjournment**
Chair Rabbitt adjourned the meeting at 11:03 a.m. The next meeting will be Monday, April 27, 2015 at 9:30 a.m. at the Novato City Hall Council Chambers.

Minutes approved by the Board April 27, 2015.

Orignal signed by

Charles V. Weir
Program Manager

C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2014\2014-10\2014-10-27_NBWRA_Board_Minutes.docx

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**April 27, 2015**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:34 a.m. on Monday, April 27, 2015 at the Novato City Hall Council Chambers, 901 Sherman Drive, Novato, CA 94945. Consultants and others who were unable to attend participated via telephone, 1-866-906-7447, passcode 2428170#.

## 2. Roll Call

| | |
|---|---|
| **PRESENT:** | David Rabbitt, Chair, Sonoma County Water Agency |
| | Brent Miller, Novato Sanitary District |
| | Keith Caldwell, Napa County |
| | Rabi Elias, Las Gallinas Valley Sanitary District |
| | Jack Gibson, Marin Municipal Water District |
| | Pam Jeane, Sonoma Valley County Sanitation District |
| | Mike Healy, City of Petaluma |
| | Jill Techel, Napa Sanitation District |
| | John Schoonover, North Marin Water District |
| **ABSENT**: | Steve Kinsey, Marin County |

| | | |
|---|---|---|
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Kevin Booker | Sonoma County Water Agency |
| | Ginger Bryant | Bryant & Associates |
| | Grant Davis | Sonoma County Water Agency |
| | Jenny Gain | Brown & Caldwell |
| | Robin Gordon | Data Instincts |
| | Jim Graydon | Kennedy Jenks Consultants |
| | Jason Holley | City of American Canyon |
| | Susan Huang | Kennedy Jenks Consultants |
| | Pam Jeane | Sonoma Valley County Sanitation Agency |
| | Craig Lichty | Kennedy Jenks Consultants |
| | Susan McGuire | Las Gallinas Valley Sanitary District |
| | Drew McIntyre | North Marin Water District |
| | Mark Millan | Data Instincts |
| | Phillip Miller | Napa County |
| | Pilar Oñate-Quintana | The Oñate Group (via telephone) |
| | Dan St. John | City of Petaluma |
| | Mike Savage | Brown & Caldwell |
| | Paul Sellier | Marin Municipal Water District |
| | Jake Spaulding | Sonoma County Water Agency |
| | Dawn Taffler | Kennedy Jenks Consultants |
| | Jeff Tucker | Napa Sanitation District |
| | Leah Walker | City of Petaluma |

**3. Public Comments**

There were no comments from the public

**4. Introductions**

Introductions were made as there were several new people in attendance.

**5. Board Meeting Minutes of January 26, 2015.**

A motion by Director Schoonover, seconded by Director Caldwell to approve the January 26, 2015 minutes was unanimously approved.

**6. Report from the Program Manager**

**a. Consultant Progress Reports**

The Board reviewed the consultant progress reports for March 2015. The Program Manager highlighted the remaining agenda items.

**7. Financial Report for the Period Ending March 31, 2105**

The Board reviewed the Financial Report.

**8. Budgets, Member Agency Cost Allocations, and Scopes and Costs for FY2014/15, FY2015/16, and FY2016/17**

The Board reviewed the proposed budget and noted that there are no recommended changes from the three-year budget that was approved last year. A motion by Director Schoonover, seconded by Director Healy to approve the Budgets, Member Agency Cost Allocation's, and Scopes and Costs for FY2014/15, FY2015/16, and FY2016/17, with approval of funding for FY2015/16 was unanimously approved.

**9. Consideration of Adding City of American Canyon as Associate Member**

The Program Manager provided a brief overview of City of American Canyon's request to participate in NBWRA. A motion by Director Techel, seconded by Director Schoonover to approve Associate Membership for City of American Canyon was unanimously approved.

**10. Outreach Program Update.**

Mark Millan provided an overview of the upgrades to the NBWRA website and also showed three new videos: North Bay Water Reuse Overview, Phase 1: What was Accomplished, and Phase 2: Maximizing Infrastructure Investments.

**11. Program Development, Federal, and State Advocacy Update**

Ginger Bryant provided an update for the Board on federal activities in support of Phase 1 and 2. She discussed the following items: Title XVI Funding, New USBR/USDA Grant Funding, RRIFIA bill has been renamed RE-Act (The Reclamation Efficiency Act of 2015 as described in a handout that was distributed), and Phase 2 construction authority in the President's budget.

Pilar Oñate-Quintana discussed state issues including the State Board's Recycled Water Guidelines. NBWRA and member agencies have sent letters commenting on the draft guidelines. She also discussed Prop 1 funding and legislation of interest including: AB606 (Levine), SB553 (Wold), and AB725 (Wagner).

**12. Workshop – North Bay Water Reuse Program Phase 2**
Mike Savage and Dawn Taffler discussed the following topics: Program Selection Process, Project Screening, Alternative Formulation, Next Steps, and Feasibility Study Report. Participants were asked to fill out two forms. The first was a forced pairwise comparison of objectives, and the second was to rank the subobjectives within each objective. This information will be used to prioritize the list of projects leading to a recommended alternative. The consultant team will distribute the forms to the TAC members so they may use the forms to discuss priorities for each agency. This information will be further discussed by the TAC on May 11, 2015, and the Board/TAC at the June 22, 2015 meeting.

**13. Adjournment**
Chair Rabbitt adjourned the meeting at 11:18 a.m. The next meeting will be Monday, June 22, 2015 at 9:30 a.m. at Novato Sanitary District.

Minutes approved by the Board July 27, 2015.

Original signed by

Charles V. Weir
Program Manager

C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2015\2015-04\2015-04-27_NBWRA_Board_Minutes.docx

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**July 27, 2015**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:36 a.m. on Monday, July 27, 2015 at the Novato City Hall Council Chambers, 901 Sherman Drive, Novato, CA 94945. Consultants and others who were unable to attend participated via telephone, 1-866-906-7447, passcode 2428170#.

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Keith Caldwell | Napa County |
| | Grant Davis | Sonoma Valley County Sanitation District |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | Jack Gibson | Marin Municipal Water District |
| | Mike Healy | City of Petaluma |
| | John Schoonover | North Marin Water District |
| | Jill Techel | Napa Sanitation District |

**ABSENT**: Steve Kinsey, Marin County
Jason Holley, City of American Canyon

| | | |
|---|---|---|
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Jack Baker | North Marin Water District |
| | Kevin Booker | Sonoma County Water Agency |
| | Chris DeGabriele | North Marin Water District |
| | Jenny Gain | Brown & Caldwell |
| | Robin Gordon | Data Instincts |
| | Jim Graydon | Brown & Caldwell |
| | Tim Healy | Napa Sanitation District |
| | Pam Jeane | Sonoma Valley County Sanitation Agency |
| | Craig Lichty | Kennedy Jenks Consultants |
| | Phillip Miller | Napa County |
| | Pilar Oñate-Quintana | The Oñate Group (via telephone) |
| | Larry Russell | Marin Municipal Water District |
| | Dan St. John | City of Petaluma |
| | Mike Savage | Brown & Caldwell |
| | Brad Sherwood | Sonoma County Water Agency |
| | Jake Spaulding | Sonoma County Water Agency |
| | Dawn Taffler | Kennedy Jenks Consultants |
| | Jeff Tucker | Napa Sanitation District |
| | Leah Walker | City of Petaluma |

**3. Public Comments**

There were no comments from the public

**4. Introductions**

Introductions were made as there were several new people in attendance.

**5. Board Meeting Minutes of April 27, 2015.**

A motion by Director Long, seconded by Director Caldwell to approve the April 27, 2015 minutes was unanimously approved.

**6. Report from the Program Manager**

**a. Consultant Progress Reports**

The Board reviewed the consultant progress reports for June 2015. The Program Manager highlighted the remaining agenda items.

**7. Financial Report for the Period Ending June 30, 2105**

The Board reviewed the Financial Report and noted that all expenses were well within budget for the fiscal year. The report is essentially completed with possibly a few minor items still to be added. A final report will be presented at the October 26, 2015 meeting.

**8. Outreach Program Update.**

Robin Gordon provided an update for the Board. They have been working with the Program Development consultant to update items for use in Washington D.C.

**9. Program Development, Federal, and State Advocacy Update**

The Program Manager, on behalf of Ginger Bryant, provided an update for the Board on RE-ACT, Washington D.C. activities and a planned tour for North Bay Congressional representatives on August 20, 2015.

Pilar Oñate-Quintana discussed state issues including the State Board's Recycled Water Funding Guidelines, and an updated CEQA exemption for recycled water projects. She also discussed current legislation, including AB606 (Levine) and SB 471 (Pavley). She is also working on a potential state tour in the fall.

**10. Workshop – North Bay Water Reuse Program Phase 2**

Mike Savage and Dawn Taffler discussed the following topics: Screening Projects for Feasibility Study, Formulating Alternatives, Recommended Program for Feasibility Study, and Schedule. The list of projects has continued to evolve and most recently a range of storage projects was added to the recommended program to allow further evaluation and analysis before selecting one storage project for those agencies needing seasonal storage. The recommended projects include treatment plant capacity increases, seasonal storage, habitat restoration, distribution, and groundwater management. The total costs range from $140 - $205 Million depending on the range of storage projects. Costs will be reduced as storage projects are selected and as the size of projects are modified. Currently $80 Million in projects can be funded through Title XVI. Non-Title XVI projects will also receive full EIR/EIS analysis and be eligible for other federal and state funding.

**11. Approval of Recommended Phase 2 Program for Feasibility Study**

The Board was asked to approve the list of projects as recommended for the Phase 2 Program for Feasibility Study. There was considerable discussion on the process of approving the projects. The Board was concerned that there had not been adequate information in the packet to allow them to properly consider the projects. The consultant team agreed to send information on the list of projects, seasonal storage, and costs to the Board for their information. A motion by Director Healy, seconded by Director Long to approve the Recommended Phase 2 Program for Feasibility Study was approved with two abstentions.

The Board also discussed methods for keeping the Board better informed and getting additional agencies to participate in order to better serve the region. Chair Rabbitt was asked to lead a group to examine issues and report back at a future Board meeting.

**12. Adjournment**

Chair Rabbitt adjourned the meeting at 11:23 a.m. The next meeting will be Monday, October 26, 2015 at 9:30 a.m. at Novato City Hall Council Chambers.

Minutes approved by the Board September 21, 2015.

Original signed by

Charles V. Weir
Program Manager

C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2015\2015-07\2015-07-27_Board_TAC\2015-07-27_NBWRA_Board_Minutes.docx

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**September 21, 2015**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:37 a.m. on Monday, September 21, 2015 at the Novato Sanitary District, 500 Davidson Street, Novato, CA 94945. Consultants and others who were unable to attend participated via telephone, 1-866-906-7447, passcode 2428170#.

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Keith Caldwell | Napa County |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | Jack Gibson | Marin Municipal Water District |
| | Mike Healy | City of Petaluma |
| | Tim Healy | Napa Sanitation District |
| | Jason Holley | City of American Canyon (by telephone) |
| | Pam Jeane | Sonoma Valley County Sanitation District |
| | John Schoonover | North Marin Water District |

**ABSENT**: Steve Kinsey, Marin County

| | | |
|---|---|---|
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Kevin Booker | Sonoma County Water Agency |
| | Erik Brown | Novato Sanitary District |
| | Ginger Bryant | Bryant & Associates |
| | Grant Davis | Sonoma County Water District |
| | Sandeep Karkal | Novato Sanitary District |
| | Drew McIntyre | North Marin Water District |
| | Mark Millan | Data Instincts |
| | Phillip Miller | Napa County |
| | Pilar Oñate-Quintana | The Oñate Group |
| | Larry Russell | Marin Municipal Water District |
| | Mike Savage | Brown & Caldwell |
| | Jake Spaulding | Sonoma County Water Agency |
| | Dawn Taffler | Kennedy Jenks Consultants |
| | Leah Walker | City of Petaluma |
| | Mark Williams | Las Gallinas Valley Sanitary District |

## 3. Public Comments

There were no comments from the public

## 4. Introductions

Introductions were made as there were several new people in attendance.

**5. Board Meeting Minutes of July 27, 2015.**

A motion by Director Schoonover, seconded by Director Caldwell to approve the July 27, 2015 minutes was unanimously approved.

**6. Report from the Program Manager**

**a. Consultant Progress Reports**

The Board reviewed the consultant progress reports for June 2015. The Program Manager highlighted the remaining agenda items.

**7. Financial Reports for the Period Ending June 30, 2105 and August 31, 2015**

The Board reviewed the Financial Reports and noted that all expenses for Fiscal Year 2014/15 were well within budget. Expenses for Fiscal Year 2015/16 are also tracking within budget.

**8. Program Development, Federal, and State Advocacy Update**

Pilar Oñate-Quintana discussed state issues including a summary of this session's bills approved and supported by NBWRA. She discussed a possible emerging issue that environmental non-governmental organizations in southern California seem to be supporting Direct Potable Reuse projects over purple pipe projects and that could, if this issue gains momentum, have a negative impact on future state funding for some NBWRA projects. She also discussed plans for a tour for state legislative staff.

Ginger Bryant discussed program development and federal issues, including the very successful Congressional tour, Phase 2 authorization issues, Re-Act legislation, and new outreach efforts. Outreach efforts including a new website, www.westernwaterpriorities.org, and social media presences on Facebook and Twitter. The outreach efforts are to all western states and are intended to support the provisions in Re-Act: RIFIA loans, expanded WaterSMART grants for storage, water recycling and management projects and Transfer of Title provisions. In addition the outreach efforts support Title XVI reform to allow non-authorized projects to compete for grants. She also discussed plans for the next trip to Washington D.C. in the fall.

**9. Outreach Program Update.**

Mark Millan provided an update for the Board. He provided a demonstration of the new westernwaterpriorities.org website and distributed flyers and business cards that can be used to publicize the efforts. Chair Rabbitt noted that this is a new effort that he discussed with other Board members and approved. A total of $25,000 was added to Data Instincts budget from unused triple bottom line funding and although this increases Data Instincts budget by $25,000, this is a reallocation of existing financial resources and resulted in no changes to the total budget or member agency costs.

**10. Workshop – North Bay Water Reuse Program Phase 2**

Mike Savage and Dawn Taffler discussed the following topics: Extended storage study scope and approach; overview of findings for Napa Sanitation District, Sonoma Valley County Sanitation District, City of Petaluma, and Novato Sanitary District; and insights gained through the process. They discusses the creation of specific fact sheets for each agency that summarize their options and are intended to be used to assist their boards in finalizing projects for the EIR/EIS. It was noted that some projects will be eligible for Title XVI funding and others will need to be funded through other sources that are currently in development.

**11. Direction from Board Regarding Communication, Regional Participation and Related Issues**
Chair Rabbitt let a discussion on these issues. The goal would be a unified approach for water management and recycling projects for the North Bay Region in order to capitalize on both the strength of the organization, be inclusive of new members, and position for future funding opportunities. Vice Chair Long suggested a workshop to discuss these issues, in addition to how to incorporate current and future projects in studies and potential impacts on the budget for the Phase 2 EIR/EIS. Director Elias asked how agencies not currently participating in Phase 2 could ultimately participate. That topic would also be included in the workshop discussion.

There was also discussion regarding increasing communications and the possibility of holding Board meetings concurrent with TAC meetings. Currently, the Board meets four times per year in January, April, July, and October. The TAC meets immediately after the Board meetings to summarize action items. The TAC also meets the month before Board meetings to develop items for action by the Board. Following discussion, the Board members supported the idea of holding joint Board/TAC meetings for planning purposes in the months prior to the four regular Board meetings. The Program Manager noted that adding these additional meetings for the Board would not have any impact on the budget.

It was agreed that the consultants would develop framework alternatives in support of the direction provided by the Board and be prepared to discuss them at the October 26, 2015 Board meeting. It was also agreed that the December 14, 2015 TAC meeting would be modified to include the Board.

As action items, for the October 26, 2015 meeting the consultant team will develop alternatives for consideration in a possible workshop to be held before the end of 2015; and the December 14 meeting will be a combined Board/TAC meeting.

**12. Adjournment**
Chair Rabbitt adjourned the meeting at 12:10 p.m. The next meeting will be Monday, October 26, 2015 at 9:30 a.m. at Novato City Hall Council Chambers.

Minutes approved by the Board October 26, 2015.

Original signed by

Charles V. Weir
Program Manager

C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2015\2015-09\2015-09-21_NBWRA_Board_Minutes.docx

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**October 26, 2015**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:43 a.m. on Monday, October 26, 2015 at the Novato City Hall Council Chambers, 901 Sherman Avenue, Novato, CA 94945. Consultants and others who were unable to attend participated via telephone, 1 (602) 567-4030, passcode 1980; https://conferencing.brwncald.com/conference/1980.

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Keith Caldwell | Napa County |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | Jack Gibson | Marin Municipal Water District |
| | Susan Gorin | Sonoma Valley County Sanitation District |
| | Mike Healy | City of Petaluma |
| | Jason Holley | City of American Canyon (by telephone) |
| | Liz Lewis | Marin County |
| | John Schoonover | North Marin Water District |
| | Jill Techel | Napa Sanitation District |
| **ABSENT**: | None | |
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Kevin Booker | Sonoma County Water Agency |
| | Ginger Bryant | Bryant & Associates |
| | Grant Davis | Sonoma County Water District |
| | Chris DeGabrielle | North Marin Water District |
| | Tim Healy | Napa Sanitation District |
| | Pam Jeane | Sonoma Valley County Sanitation District |
| | Sandeep Karkal | Novato Sanitary District |
| | Mark Millan | Data Instincts |
| | Pilar Oñate-Quintana | The Oñate Group (by telephone) |
| | Jim O’Toole | ESA |
| | Larry Russell | Marin Municipal Water District |
| | Mike Savage | Brown & Caldwell |
| | Paul Sellier | Marin Municipal Water District |
| | Brad Sherwood | Sonoma County Water Agency |
| | Dan St. John | City of Petaluma |
| | Dawn Taffler | Kennedy Jenks Consultants |
| | Jeff Tucker | Napa Sanitation District |
| | Leah Walker | City of Petaluma |
| | Mark Williams | Las Gallinas Valley Sanitary District |

**3. Public Comments**

There were no comments from the public

**4. Introductions**

Introductions were not made.

**5. Board Meeting Minutes of September 21, 2015.**

A motion by Director Long, seconded by Director Caldwell to approve the September 21, 2015 minutes was unanimously approved.

**6. Report from the Program Manager**

The program Manager described an item that came in too late to be included in the agenda and requested that the Board add it to the agenda as an action item per the emergency provisions of the Brown Act. A motion by Director Schoonover, seconded by Director Long to add Item 6.b, to the agenda, Approval of Reallocation of Phase 1 Construction Funds was unanimously approved.

**a. Consultant Progress Reports**

The Board reviewed the consultant progress reports for June 2015. The Program Manager highlighted the remaining agenda items.

**b. Approval of Reallocation of Phase 1 Construction Funds**

The Board reviewed the proposal to reallocate Phase 1 construction funds and administrative funds from SCWA to other Phase 1 participating agencies. A motion by Director Schoonover, seconded by Director Elias was unanimously approved.

**7. Financial Report for the Period Ending September 30, 2015**

The Board reviewed the Financial Report and noted expenses for Fiscal Year 2015/16 are tracking within budget.

**8. Program Development, Federal, and State Advocacy Update**

Pilar Oñate-Quintana discussed state issues including bills of interest to NBWRA, a summary of the October 8, 2015 State staff tour, and plans for a new Water Bond. The bond has a value of $4.895 billion with $400 million for recycled water and habitat related projects.

Ginger Bryant discussed program development and federal issues, including the 2016 Omnibus Appropriations Bill, the 2016 Authorizations Bill, and Senate Bill 1894, Feinstein, California Emergency Drought Relief Act of 2015. The Feinstein bill includes the provisions of RE-Act.

**9. Outreach Program Update.**

Mark Millan provided an update for the Board. He provided a demonstration of the new www.westernwaterpriorities.org website and distributed business cards that can be used to publicize the efforts. He encouraged everyone to sign up for the email list as well as to connect via Facebook and Twitter.

**10. Status Report – North Bay Water Reuse Program Phase 2 and Related Issues**
The Program Manager, Mike Savage, and Ginger Bryant discussed the following topics:

Phase 2

- Meeting Schedule
- Phase 2 Feasibility Study Status Report
- Phase 2 Program Expansion and Budget Impacts
- Other Potential Budget Impacts

Related Issues

- NBWRA Beyond Phase 2
- Plans for Work Study Session

The Board was particularly interested in future meeting schedules and wanted to ensure that the TAC would still be responsible for day to day operations of the program and that the Board would focus on policy issues. Board members were supportive of the workshop concepts discussed and looked forward to the first workshop at the next meeting on December 14, 2015. That workshop will focus on a review of the program's goals and objectives and the pros and cons of expanding the program beyond Phase 2 and adding additional members. As an action item, the Board will review and consider the proposed joint Board and TAC meetings and workshops through the remainder of FY2015/16 at the December 14, 2015 Board meeting.

**11. Approve a modification to the Brown and Caldwell Agreement to use the remaining $40,931 from Triple Bottom Line in Task 2.4 for other expanded efforts in Task 2.4 and move $25,000 from Task 5, Grants to Task 1.1, Workshops**
Several Board members expressed a desire that this item be reviewed and approved by the TAC as has been the practice in the past. As a result, the Board took no action on this item and requested that the TAC consider it at their meeting which will follow the Board meeting.

**12. Adjournment**
Chair Rabbitt adjourned the meeting at 12:05 p.m. The next meeting will be Monday, December 14, 2015 at 9:30 a.m. at Novato City Hall Council Chambers.

Minutes approved by the Board December 14, 2015.

Original signed by

Charles V. Weir
Program Manager

C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2015\2015-10\2015-10-26_NBWRA_Board_Minutes.docx

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**December 14, 2015**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:37 a.m. on Monday, December 14, 2015 at the Novato City Hall Council Chambers, 901 Sherman Avenue, Novato, CA 94945. Consultants and others who were unable to attend participated via telephone, 1 (602) 567-4030, passcode 1980; https://conferencing.brwncald.com/conference/1980.

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Keith Caldwell | Napa County |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | Jack Gibson | Marin Municipal Water District |
| | Susan Gorin | Sonoma Valley County Sanitation District |
| | Mike Healy | City of Petaluma |
| | Jason Holley | City of American Canyon (by telephone) |
| | John Schoonover | North Marin Water District |
| | Jill Techel | Napa Sanitation District |
| **ABSENT**: | Marin County | |
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Kevin Booker | Sonoma County Water Agency |
| | Ginger Bryant | Bryant & Associates |
| | Jennifer Burke | City of Santa Rosa |
| | Grant Davis | Sonoma County Water District |
| | Tim Healy | Napa Sanitation District |
| | Sandeep Karkal | Novato Sanitary District |
| | Susan McGuire | Las Gallinas Valley Sanitary District |
| | Drew McIntyre | North Marin Water District |
| | Mark Millan | Data Instincts |
| | Phillip Miller | Napa County |
| | Jim O'Toole | ESA |
| | Larry Russell | Marin Municipal Water District (by telephone) |
| | Mike Savage | Brown & Caldwell |
| | Paul Sellier | Marin Municipal Water District |
| | Brad Sherwood | Sonoma County Water Agency |
| | Jake Spaulding | Sonoma County Water Agency |
| | Dan St. John | City of Petaluma |
| | Dawn Taffler | Kennedy Jenks Consultants (by telephone) |
| | Melanie Tan | Kennedy Jenks Consultants |
| | Jeff Tucker | Napa Sanitation District |

| | |
|---|---|
| Leah Walker | City of Petaluma |
| Robert Wilson | City of Petaluma |

**3. Public Comments**
There were no comments from the public

**4. Introductions**
Introductions were made for the benefit of those on the telephone.

**5. Board Meeting Minutes of October 26, 2015.**
A motion by Director Schoonover, seconded by Director Techel to approve the October 26, 2015 minutes was unanimously approved.

**6. Report from the Program Manager**
The Board reviewed the consultant progress reports for October and November 2015. The Program Manager highlighted the remaining agenda items.

**a. Consultant Progress Reports**
The Board reviewed the consultant progress reports for October and November 2015.

**7. Financial Report for the Period Ending November 30, 2015**
The Board reviewed the Financial Report and noted expenses for Fiscal Year 2015/16 are tracking within budget.

**8. Program Development, Federal, and State Advocacy Update**
On Behalf of Pilar Oñate-Quintana, Ginger Bryant discussed state issues including bills of interest to NBWRA. She is working with WateReuse on a comment letter for SB 163 (Hertzberg), which would prohibit wastewater discharges to the ocean and likely to San Francisco Bay.

Ginger Bryant discussed program development and federal issues: Construction Funding, Feasibility Studies, Phase 2 Construction Authorization, RE-Act Legislative Activities, and RE-Act Outreach Efforts. NBWRA received a $450,000 grant from USBR in May 2015 toward the feasibility study. Huffman and Feinstein both have bills that include funding programs.

**9. Outreach Program Update.**
Mark Millan provided an update for the Board. He also discussed the upcoming WateReuse conference in Santa Rosa, March 13-15, 2016 and that he would be asking the TAC to support NBWRA's sponsorship of the conference in the amount of $500.

**10. NBWRP Engineering Report**
Mike Savage discussed the following topics:

- Status Update
- Project Lists
- Cost Summary
- Agency Allocation of Projects
- Expanded Phase 2

The list of projects appears to be finalized and is scheduled to be approved by the Board at the January 25, 2016 meeting. There was discussion as to the evolution of the program from Title XVI only projects to non-Title XVI projects and additional funding opportunities. There are now three categories of Phase 2 projects: Title XVI Project Level EIR/EIS, Non-Title XVI Project Level EIR/EIS, and Programmatic Level. There was also discussion regarding the possibility of projects moving from Programmatic and/or non-Title XVI to Title XVI is the EIR/EIS analysis shows some projects to be more suitable than others.

**11. Approve Changes to Program to Include Feasibility Analysis of Non-title XVI Projects and Pursuit of Non-Title XVI Funding**

The Program Manager reviewed the evolution of the program and the need for the Board to approve the changes as they are policy related. A motion by Chair Rabbitt, seconded by Director Long to approve changes to the Program to include feasibility analysis of non-Title XVI Projects and Pursuit of non-Title XVI Funding was unanimously approved. This action also directed the consultant team to provide possible budget impacts for FY2016/17 and beyond at the January 25, 2015 meeting.

**12. Joint Board and TAC Work Session: NBWRA Beyond Phase 2**

Ginger Bryant led the Board and TAC in a discussion of the Program's Goals and Objectives and the pros and cons of expanding the program beyond Phase 2. Following discussion, Bryant presented possible changes to the Memorandum of Understanding Purpose Statement and the Objectives. Director Long suggested the possibility of including a goal of zero discharge to San Pablo Bay in the Purpose Statement. Director Gorin expressed a desire to make sure changes to not lead to projects that are contrary to the Program's intent. She also wants to continue to focus on a regional approach. Director Gorin and others expressed a desire to keep recycled water in the objectives or provide a definition of "total water management" that includes water recycling. Director Elias suggested adding public education to the objectives. Director Techel requested additional information on non-Title XVI state and federal funding opportunities at the January 25, 2016 meeting.

Lastly, Bryant indicated that the January 25, 2016 Work Session will focus on Alternatives for Engagement and Participation.

**13. Consider the Continuation of Joint Board and TAC Meetings and Workshops through the Remainder of FY2015/16**

The Program Manager reviewed the current schedule and the plans for upcoming work sessions and indicated the at this time only the March 28, 2016 meeting needs to be changed from TAC-only to both Board and TAC meetings. The June 27, 2016 TAC meeting does not need to be changed at this time. Board members concurred that the joint work sessions were useful and should be continued. A motion by Director Long, seconded by Chair Rabbitt to change the March 28, 2016 TAC meeting to Board and TAC meetings was unanimously approved.

**14. Adjournment**
Chair Rabbitt adjourned the meeting at 11:23 a.m. The next meeting will be Monday, January 25, 2016 at 9:30 a.m. at Novato City Hall Council Chambers.

Minutes approved by the Board January 25, 2016.

Original signed by

Charles V. Weir
Program Manager

C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2015\2015-12\2015-12-14_NBWRA_Board_Minutes.docx

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**January 25, 2016**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:41 a.m. on Monday, January 25, 2016 at the Novato City Hall Council Chambers, 901 Sherman Avenue, Novato, CA 94945. Consultants and others who were unable to attend participated via telephone, 1 (602) 567-4030, passcode 1980; https://conferencing.brwncald.com/conference/1980.

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Keith Caldwell | Napa County |
| | Jack Gibson | Marin Municipal Water District |
| | Susan Gorin | Sonoma Valley County Sanitation District |
| | Tim Healy | Napa Sanitation District |
| | Susan McGuire | Las Gallinas Valley Sanitary District |
| | John Schoonover | North Marin Water District |
| | Leah Walker | City of Petaluma |

**ABSENT**: Marin County, City of American Canyon

| | | |
|---|---|---|
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Jack Baker | North Marin Water District |
| | Kevin Booker | Sonoma County Water Agency |
| | Ginger Bryant | Bryant & Associates |
| | Grant Davis | Sonoma County Water District |
| | Robin Gordon | Data Instincts |
| | Pam Jeane | Sonoma County Valley Sanitation District |
| | Sandeep Karkal | Novato Sanitary District |
| | Drew McIntyre | North Marin Water District |
| | Mark Millan | Data Instincts |
| | Phillip Miller | Napa County |
| | Pilar Oñate-Quintana | The Oñate Group |
| | Jim O'Toole | ESA |
| | Larry Russell | Marin Municipal Water District (by telephone) |
| | Mike Savage | Brown & Caldwell (by telephone) |
| | Jake Spaulding | Sonoma County Water Agency |
| | Jeff Tucker | Napa Sanitation District |

## 3. Public Comments

There were no comments from the public

**4. Introductions**
Introductions were not made.

**5. Board Meeting Minutes of December 14, 2015.**
A motion by Director Schoonover, seconded by Director Gorin to approve the December 14, 2015 minutes was unanimously approved.

**6. Report from the Program Manager**
The Board reviewed the consultant progress reports for December 2015. The Program Manager highlighted the remaining agenda items.

**a. Consultant Progress Reports**
The Board reviewed the consultant progress reports for December 2015.

**7. Financial Report for the Period Ending December 31, 2015**
The Board reviewed the Financial Report and noted expenses for Fiscal Year 2015/16 are tracking within budget. Drew McIntyre inquired about the percent remaining column and the Program Manager indicated he would check and bring and updated version to the next meeting.

**8. Program Development, Federal, and State Advocacy Update**
Pilar Oñate-Quintana, discussed state issues. She highlighted activities in 2015, including: NBWRA Day in Sacramento 2015, draft guidelines for recycled water funding, activities with WateReuse, state legislative staff tour, state dynamics as related to federal efforts, and legislative efforts including SB163. She highlighted planned activities for 2016, including: March 9, 2016 NBWRA Day in Sacramento, NBWRA's letter on SB163, monitoring the introduction on new bills, budget negotiations, the Governor's efforts on the Delta tunnels, stormwater management funding, and possible changes in the Legislature as a result of the November election.

Ginger Bryant discussed program development and federal issues, including: how the Phase 2 list of projects has evolved from "purple pipe" projects to treatment, storage, environmental enhancement, distribution, groundwater management, and stormwater management; Phase 2 construction authorization; plans for Washington D.C. meetings; RE-Act activities; and RE-Act outreach to other western states.

Pilar Oñate-Quintana and Ginger Bryant gave an update on state and federal funding opportunities for Phase 2 projects, including: a possible State constitutional amendment to ease Proposition 218 restrictions; the Meral Bond; greenhouse gas funding; Title XVI and various WaterSMART grant programs; RIFIA loans through RE-ACT; WIFIA loans; and other loan programs through federal agencies such as EPA, USDA, FEMA, and the Economic Development Administration.

Chair Rabbitt discussed the White House Water Summit that is being planned as part of World Water Day.

**9. Outreach Program Update.**
Mark Millan provided an update for the Board. He also discussed the upcoming WateReuse conference in Santa Rosa, March 13-15. NBWRA is a sponsor and there will be a booth featuring NBWRA's projects. NBWRA presentations will be on March 14, 2016.

**10. NBWRP Engineering Report**
Mike Savage discussed the final list of Phase 2 Projects that are to be considered by the Board for approval in Agenda Item No. 11 as well as the next activities.

**11. Approve Final List of Phase 2 Projects**
Director Caldwell noted that the MST projects would likely not be built as there were insufficient users. He wanted to make sure that cost sharing would be adjusted accordingly. Once the EIR/EIS is issued the cost sharing will be adjusted based on the final estimated costs of each agency's projects. Deletion of the MST projects from the Title XVI list would also allow other projects shown as non-Title XVI or Programmatic Level could be moved to the Title XVI list. A motion by Director Long, Seconded by Director Gorin to approve the Final List of Phase 2 Projects was unanimously approved.

**12. Joint Board and TAC Work Session: NBWRA Beyond Phase 2**
Ginger Bryant led the Board and TAC in a discussion of Alternatives for Engagement and Participation. She provided a summary from the December 14, 2015 Work Session, including possible changes to the Purpose and Objectives from the Memorandum of Understanding (MOU). There was discussion about the concept of not discharging to rivers or San Pablo Bay and how to accommodate that goal in the MOU without creating an opportunity for that becoming a mandate.

She then led a discussion of possible different levels of membership based on services received. She listed the various services, including: program development, technical support, public information support, grant support, technical analysis of projects, environmental support, program management, and lead agency administration. There was discussion regarding engaging other organizations not yet part of NBWRA. These could include water and wastewater agencies, counties, cities, non-profit organizations, and resource conservation districts, among others. It was agreed that changes to membership and cost sharing would require modifications to the MOU and that would be the primary topic of the March 28, 2016 meeting.

**13. Consider the Continuation of Joint Board and TAC Meetings and Work Sessions through the Remainder of FY2015/16**
At the December 14, 2015 meeting, the Board approved holding joint Board and TAC meetings and a Work Session at the March 28, 2016 meeting. The Board was asked to affirm that decision. A motion by Director Gorin, seconded by Director Long to hold joint Board and TAC meetings and a Work Session at the March 28, 2016 meeting was unanimously approved.

**14. Adjournment**
Chair Rabbitt adjourned the meeting at 11:32 a.m. The next meeting will be Monday, March 28, 2016 at 9:30 a.m. at Novato City Hall Council Chambers.

Minutes approved by the Board March 28, 2016.

Original signed by

Charles V. Weir
Program Manager
C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2016\2016-01\2016-01-25_NBWRA_Board_Minutes.docx

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**March 28, 2016**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:44 a.m. on Monday, March 28, 2016 at the Novato City Hall Council Chambers, 901 Sherman Avenue, Novato, CA 94945. Consultants and others who were unable to attend participated via telephone, 1 (602) 567-4030, passcode 1980; https://conferencing.brwncald.com/conference/1980.

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Keith Caldwell | Napa County |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | David Glass | City of Petaluma |
| | Susan Gorin | Sonoma Valley County Sanitation District |
| | Liz Lewis | Marin County |
| | John Schoonover | North Marin Water District |
| | Paul Sellier | Marin Municipal Water District |
| | Jill Techel | Napa Sanitation District |
| **ABSENT**: | City of American Canyon | |
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Jack Baker | North Marin Water District |
| | Kevin Booker | Sonoma County Water Agency |
| | Ginger Bryant | Bryant & Associates |
| | Jennifer Burke | City of Santa Rosa |
| | Jill Chamberlain | Brown and Caldwell |
| | Robin Gordon | Data Instincts |
| | David Graves | Napa Sanitation District |
| | Tim Healy | Napa Sanitation District |
| | Pam Jeane | Sonoma Valley County Sanitation District |
| | Sandeep Karkal | Novato Sanitary District |
| | Susan McGuire | Las Gallinas Valley Sanitary District |
| | Drew McIntyre | North Marin Water District |
| | Phillip Miller | Napa County |
| | Pilar Oñate-Quintana | The Oñate Group (by telephone) |
| | Larry Russell | Marin Municipal Water District |
| | Mike Savage | Brown and Caldwell |
| | Dan St. John | City of Petaluma |
| | Dawn Taffler | Kennedy Jenks Consultants (by telephone) |
| | Melanie Tan | Kennedy Jenks Consultants (by telephone) |

| | |
|---|---|
| Jeff Tucker | Napa Sanitation District |
| Leah Walker | City of Petaluma |

**3. Public Comments**
There were no comments from the public

**4. Introductions**
Introductions were made for the benefit of new participants.

**5. Board Meeting Minutes of January 25, 2016.**
A motion by Director Schoonover, seconded by Director Gorin to approve the January 25, 2016 minutes was unanimously approved.

**6. Report from the Program Manager**
The Board reviewed the consultant progress reports for January and February 2016. The Program Manager highlighted the remaining agenda items.

**a. Consultant Progress Reports**
The Board reviewed the consultant progress reports for January and February 2016.

**7. Financial Report for the Period Ending February 29, 2016**
The Board reviewed the Financial Report and noted expenses for Fiscal Year 2015/16 are tracking within budget.

**8. Program Development, Federal, and State Advocacy Update**
The following items were discussed: State Advocacy, Program Development and Federal Advocacy, and the White House Water Summit.

Pilar Oñate-Quintana discussed State Advocacy and covered the following topics: leadership changes in the Assembly, an estimated $3.6 billion State budget surplus, summary of the March 9, 2016 NBWRA Day in Sacramento, possible constitutional amendment (ACA 8) to assist local water and wastewater agencies, SB 163 (Hertzberg) banning ocean discharges, and AB 2022 (Gordon) allowing agencies to bottle and distribute advanced purified recycled water for educational purposes.

Ginger Bryant provided an update on federal and state advocacy including: Phase 2 Construction Authorization, S.2533 and other Legislation, Western Water Priorities outreach and the White House Water Summit. The language issue for Phase 2 construction authorization had been resolved to NBWRA's satisfaction. S.2533 includes all key provisions of RE-Act that NBWRA has advocated. Efforts continue with Western Waters Priorities and other states and organizations in the support of other legislation. A possible late spring trip to Washington D.C. is in the planning stages. The White House Water Summit's goals and commitments were also discussed. A total $250 million has been identified for the North Bay Water Reuse Program. Bryant thanked Chair Rabbitt for his efforts at the Water Summit. Lastly Chair Rabbitt discussed the White House Water Summit that he attended.

**9. Outreach Program Update.**
Robin Gordon provided an update for the Board. She discussed their efforts to update materials and present the Program at an Exhibitor Booth at the California WateReuse Conference, updated materials for Salt Marsh Tour, Western Water Priorities social media updates in support of S.2533, White House Water Summit press release and distribution, and updated packet materials for the USBR Tour on March 30, 2016.

**10. Engineering, Environmental, and Public Involvement Services Report**
Mike Savage and Lisa Chamberlain discussed the Feasibility Report status and the report schedule challenges. There are ten chapters to the report in various stages of completion. The schedule anticipates completion of the report by early July 2016. Up to three sections will be distributed to the member agencies for review in staggered 3-4 week periods to allow adequate time for member agency review. They asked that each agency submit one set of combined comments.

**11. Joint Board and TAC Work Session: NBWRA Beyond Phase 2**
Chair Rabbitt gave a presentation on Beyond Phase 2 Summary and Moving Forward. He provided a summary of NBWRA accomplishments to date. Since its inception NBWRA has received $34.75 Million in state and federal funding and the agencies have invested $9.85 Million in supporting the program and studies. NBWRA has had numerous positive impacts on federal and state policy and funding. The program is viewed as a model by federal and state agencies.

Chair Rabbitt provided a brief summary of the past work sessions including the Program's purpose and objectives and alternatives for engagement and participation. He discussed the value that the Program has added to the region including a regional identity, providing a forum for collaboration, and economies of scale for participation.

He then noted limitations with the current governance structure and cited examples. A different structure is likely needed to better obtain funding outside of Title XVI. He discussed two concurrent tasks. The first is to continue the ongoing Title XVI program and the second is a Restructuring Governance Task Force. The Task Force would include NBWRA Board members who would investigate options and provide guidance on restructuring NBWRA.

Board members thanked Chair Rabbit for the presentation and asked if the program would continue to focus on the North Bay. Chair Rabbitt indicated that was likely the case.

**12. Adjournment**
Chair Rabbitt adjourned the meeting at 10:54 a.m. The next meeting will be Monday, April 25, 2016 at 9:30 a.m. at Novato City Hall Council Chambers.

Minutes approved by the Board April 25, 2016.

Original signed by

Charles V. Weir
Program Manager
C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2016\2016-03\2016-03-28_NBWRA_Board_Minutes.docx

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**April 25, 2016**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:42 a.m. on Monday, April 25, 2016 at the Novato City Hall Council Chambers, 901 Sherman Avenue, Novato, CA 94945. Consultants and others who were unable to attend participated via telephone, 1 (602) 567-4030, passcode 1980; https://conferencing.brwncald.com/conference/1980.

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Keith Caldwell | Napa County |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | Jack Gibson | Marin Municipal Water District |
| | David Glass | City of Petaluma |
| | Susan Gorin | Sonoma Valley County Sanitation District |
| | John Schoonover | North Marin Water District |
| | Jill Techel | Napa Sanitation District |

**ABSENT**: City of American Canyon, Marin County

| | | |
|---|---|---|
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Kevin Booker | Sonoma County Water Agency |
| | Ginger Bryant | Bryant & Associates |
| | Grant Davis | Sonoma County Water Agency |
| | Ryan Grisso | North Marin Water District |
| | Tim Healy | Napa Sanitation District |
| | Pam Jeane | Sonoma Valley County Sanitation District |
| | Sandeep Karkal | Novato Sanitary District |
| | Susan McGuire | Las Gallinas Valley Sanitary District |
| | Mark Millan | Data Instincts |
| | Phillip Miller | Napa County |
| | Pilar Oñate-Quintana | The Oñate Group (by telephone) |
| | Larry Russell | Marin Municipal Water District |
| | Mike Savage | Brown and Caldwell |
| | Brad Sherwood | Sonoma County Water Agency |
| | Jake Spaulding | Sonoma County Water Agency |
| | Dawn Taffler | Kennedy Jenks Consultants (by telephone) |
| | Leah Walker | City of Petaluma |

## 3. Public Comments

There were no comments from the public

**4. Introductions**
Introductions were not made.

**5. Board Meeting Minutes of March 28, 2016.**
A motion by Director Schoonover, seconded by Director Gorin to approve the March 28, 2016 minutes was unanimously approved.

**6. Report from the Program Manager**
The Board reviewed the consultant progress reports for March 2016. The Program Manager highlighted the remaining agenda items.

**a. Consultant Progress Reports**
The Board reviewed the consultant progress reports for March 2016.

**7. Financial Report for the Period Ending March 31, 2016**
The Board reviewed the Financial Report and noted expenses for Fiscal Year 2015/16 are tracking within budget.

**8. Budgets, Member Agency Cost Allocations, and Scopes and Costs for FY2014/15, FY2015/16, and FY2016/17**
The Program Manager provided an overview of the budget process and noted that since the Phase 2 list of projects has not yet been finalized the Board is being asked to approve the FY2016/17 Budget that has been presented to them the past two years. Once the Phase 2 project list is finalized scopes and costs can be also be finalized for a two-year budget that will be presented to the Board at the October 24, 2016 Board meeting

The recommendation to the Board for approving the budget and funding for FY2016/17 is based on the following items:

a. An amended two-year budget for FY2016/17 and FY2017/18 will be presented to the Board for approval at the October 24, 2016 Board meeting.
b. Work on the environmental review process will not begin on July 1, 2016. Based on TAC direction the process will be delayed until after Board approval of a revised two year budget at the October 24, 2016 Board meeting. The EIR/EIS level of effort and scope of work will be based on the selected projects.
c. The level of effort for Bryant and Associates includes increased monthly fees for The Ferguson Group and The Oñate Group.
d. SCWA will invoice for 50% of the costs shown for FY2016/17. As a disclaimer, SCWA will not make payments to consultants if the funds are not available in the Trust (i.e. if we start spending the budget very quickly we may need to either hold payment to consultants (or consultants may delay work) or accelerate the 2nd invoice). This should not be an issue as there is a sizable balance in the trust at the current time. Full invoicing for FY2016/17 will occur after Board approval of the two year budget.

A motion by director Elias, seconded by Director Long to approve the recommendation noted above was unanimously approved.

**9. Program Development, Federal, and State Advocacy Update**
The following items were discussed: State Advocacy, Program Development and Federal Advocacy, outreach efforts.

Ginger Bryant provided an update on Program Development and Federal Advocacy, including efforts to include RIFIA loans and WaterSMART grants in a Western Water Bill.

Pilar Oñate-Quintana discussed State Advocacy noted water and wastewater agency opposition to SB163, Hertzberg, which would require 50% of treated wastewater to be used for beneficial reuse by 2026 and 100% by 2036. She recommended that NBWRA send a letter of opposition that will support the points made by CASA and WateReuse. Director Caldwell asked where local legislators stood on SB163 and was informed that they were not yet fully aware of the issues. She also noted that in terms of the State budget that it was likely the remaining Prop 1 water recycling funds will be appropriated to the State Water Board this year.

**10. Outreach Program Update.**

Mark Millan discussed the following: Coordination with the team on Chair Rabbitt's presentation for the NBWA Conference April 22, 2016, Coordination with the team and Napa SD regarding press information for their Recycled Water Expansion Ribbon Cutting Celebration May 2, 2016, and preparation of materials for this week's Washington D.C. meetings.

**11. Engineering, Environmental, and Public Involvement Services Report**

Mike Savage gave an update on the production and comment schedule for the chapters in the Feasibility Study Report.

**12. Comments from Chair and Board Members**

Chair Rabbitt thanked everyone for their efforts to date. He discussed the Governance Task force and noted they were looking at an outside facilitator to assist in the process. He noted that money is available and that they would try to keep costs low. He mentioned David Gardiner as a possible facilitator.

**13. Adjournment**

Chair Rabbitt adjourned the meeting at 10:44 a.m. The next meeting will be Monday, July 25, 2016 at 9:30 a.m. at Novato City Hall Council Chambers.

Minutes approved by the Board ______________________________.

Charles V. Weir
Program Manager
C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2016\2016-04\2016-04-25_NBWRA_Board_Minutes.docx

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**July 26, 2016**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 1:39 p.m. on Tuesday, July 26, 2016 at the City of Petaluma Ellis Creek Water Recycling Facility. 3890 Cypress Drive, CA 94954. Consultants and others who were unable to attend participated via telephone, 1 (602) 567-4030, passcode 1980; https://conferencing.brwncald.com/conference/1980.

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Jack Baker | North Marin Water District |
| | Keith Caldwell | Napa County |
| | Grant Davis | Sonoma Valley County Sanitation District |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | David Glass | City of Petaluma |
| | Larry Russell | Marin Municipal Water District (by telephone) |
| | Jill Techel | Napa Sanitation District |

**ABSENT**: City of American Canyon, Marin County

| | | |
|---|---|---|
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Kevin Booker | Sonoma County Water Agency |
| | Ginger Bryant | Bryant & Associates |
| | Chris DeGabriele | North Marin Water District |
| | David Graves | Napa Sanitation District |
| | Tim Healy | Napa Sanitation District |
| | Pam Jeane | Sonoma Valley County Sanitation District |
| | Susan McGuire | Las Gallinas Valley Sanitary District |
| | Mark Millan | Data Instincts |
| | Pilar Oñate-Quintana | The Oñate Group (by telephone) |
| | Dan St. John | City of Petaluma |
| | Mike Savage | Brown and Caldwell |
| | Brad Sherwood | Sonoma County Water Agency |
| | Jake Spaulding | Sonoma County Water Agency |
| | Dawn Taffler | Kennedy Jenks Consultants (by telephone) |
| | Jeff Tucker | Napa Sanitation District |
| | Leah Walker | City of Petaluma |

## 3. Public Comments

There were no comments from the public

**4. Introductions**
Introductions were not made.

**5. Board Meeting Minutes of April 25, 2016.**
A motion by Director Techel, seconded by Director Baker to approve the April 25, 2016 minutes was unanimously approved.

**6. Report from the Program Manager**
The Board reviewed the consultant progress reports for June 2016. The Program Manager highlighted the remaining agenda items.

**a. Consultant Progress Reports**
The Board reviewed the consultant progress reports for June 2016.

**7. Financial Report for the Period Ending June 30, 2016**
The Board reviewed the Financial Report for the period ending June 30, 2016 and noted expenses for Fiscal Year 2015/16 are tracking within budget. The Board was informed of a needed correction of $24,000 for The Ferguson Group should be charged to Phase 2 and not split 30%/70% between Phase 1 and Phase 2. A final corrected Financial Report for FY2015/16 will be presented at the next meeting.

**8. Program Development, Federal, and State Advocacy Update**
The following items were discussed: State Advocacy, Program Development and Federal Advocacy and related outreach efforts.

Pilar Oñate-Quintana discussed State Advocacy and noted that SB163 Hertzberg has been pulled from this session due to water and wastewater agency opposition to SB163. She also noted that Senator Hertzberg will reintroduce a similar bill next year. The Board requested a copy of the CASA letter. She also noted that the remaining Prop. 1 funds, $320,000,000, will be appropriated to the State Water Board per the State budget as passed in June.

Ginger Bryant provided an update on Program Development and Federal Advocacy, including $21,500,000 for Title XVI projects through the Senate energy and Water Appropriations bill. The bill includes an additional $100,000,000 for drought relief projects in the West. She also discussed Western Water Drought Bill will include expansion of WaterSMART Grants, Title XVI reform, and the RIFIA program. She also described NBWRA efforts related to Phase 2 authorization language. Lastly she noted there are three pages of support letters for the Feinstein Bill on the Western Water Priorities website, http://westernwaterpriorities.org/.

**9. Outreach Program Update.**
Mark Millan gave an update on the Western Water Priorities and NBWRA websites and that they were preparing for the next trip to Washington D.C. in September.

**10. Engineering, Environmental, and Public Involvement Services Report**
Mike Savage gave an update on the production and comment schedule for the chapters in the Feasibility Study Report.

**11. Phase 2 Agencies Present Revised List of Projects for Phase 2 Environmental Analysis, Discussion of Impacts of Revisions, and Consideration of approval of a Final List of Projects**

Representatives from the Phase 2 member agencies provided updates on their projects as follows:

- Novato Sanitary District – Leave Options 1 & 2 in the Programmatic Column.
- City of Petaluma – Their projects are okay as listed and there is no need for analysis on storage.
- Napa Sanitation District – They have two small projects in the EIR/EIS and no Programmatic projects
- Sonoma County Water Agency and Sonoma Valley County Sanitation District – Their projects are okay as listed.

Mike Savage made note of the changes. Chair Rabbitt noted that the list would be revisited in August pending approval of changes recommended in Item No. 12.

**12. Update and Recommendations from Governance Task Force**

Chair Rabbitt gave a presentation on issues related to the Phase 2 Project list, communication, decision making, and governance flaws. He stressed that NBWRA is a very successful program that is lauded by USBR and the Obama Administration. He expressed concern that the current list of Phase 2 projects will not utilize the full $80,000,000 available and that efforts should be made to include additional projects to better spread costs and make the program as competitive for federal funding as possible. He described recommendations to address the identified issues, including not having separate Board and TAC meetings, revisions to the meeting schedule, and placing a hold on the EIR/EIS process for six months while additional projects and or members were sought.

Director Techel noted that agencies were encouraged to add lots of projects at the beginning of the Feasibility Study and that her agency has eliminated those projects that will not work. She also suggested that a flow chart detailing how the recommended changes would work would be helpful for the Board to better understand the recommendations. Director Long inquired about possible additional projects and requested a list of organizations and possible projects at the next meeting. He also noted that the Board would be best at bringing in additional agencies and managing consultant expenses. Grant Davis spoke in support of the TAC having properly represented their agencies and that NBWRA needs to support Title XVI and develop a better spread of operating costs. Directors Elias and Glass spoke in support of improving how NBWRA functions. Director Caldwell stated that the recommendations are consistent with the Governance Task Force discussions.

Following additional discussion, on a motion by Director Glass, seconded by Director Elias, to approve Chair Rabbitt's recommendations was approved by a vote of 8 – 1, with Director Techel voting no. The approved recommendations are:

Changes in Board/TAC meeting process

- 6 joint Board/TAC meetings a year (January, March, May, July, September, and October)
- Alternating months off for individual agency work
- Items will be presented for Discussion and scheduled for Action at the following meeting
- Board Member's report agency preferences at meetings
- New Meeting Dates to accommodate NBWRA Business through 2016:

August 22, 2016 (new meeting date)
September 19, 2016 (current TAC only changed to new Joint Board/TAC)
October 24, 2016 (regularly scheduled Board meeting, now joint Board/TAC)
December 19, 2016 (current TAC only changed to new Joint Board/TAC)

Actions on Phase 2 Studies

- Freeze initiation of the EIR/EIS at this time for six months
- Investigate options for moving forward with an expanded Phase 2 Program
- Report back on options at the October 24, 2016 meeting

It was also agreed to develop a list of organizations and projects and a flow chart outlining the decision making process for the August 22, 2016 meeting.

**13. Comments from Chair and Board Members**

Chair Rabbitt described his participation in two panel discussions at the recent National Association of Counties meeting. State Water Board Chair Felicia Marcus and representatives from USBR were also included. David Graves noted that Los Carneros Water District's recycled water project had its ribbon cutting ceremony and that the system was now in operation using recycled water from Napa Sanitation District.

**14. Adjournment**

Chair Rabbitt adjourned the meeting at 3:30 p.m. The next meeting will be Monday, August 22, 2016 at 9:30 a.m. at a location to be determined.

Minutes approved by the Board August 22, 2016.

Charles V. Weir

Charles V. Weir
Program Manager
C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2016\2016-07\2016-07-26_NBWRA_Board_Minutes.docx

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**August 22, 2016**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:42 a.m. on Monday, August 22, 2016 at the Novato City Hall Council Chambers. Consultants and others who were unable to attend participated via telephone, 1 (602) 567-4030, passcode 2231; https://conferencing.brwncald.com/conference/2231.

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Jack Baker | North Marin Water District |
| | Keith Caldwell | Napa County |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | Susan Gorin | Sonoma Valley County Sanitation District |
| | Larry Russell | Marin Municipal Water District (by telephone) |
| | Dan St. John (TAC) | City of Petaluma |
| | Jeff Tucker (TAC) | Napa Sanitation District |

**ABSENT**: City of American Canyon, Marin County

| | | |
|---|---|---|
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Kevin Booker | Sonoma County Water Agency |
| | Ginger Bryant | Bryant & Associates |
| | Jill Chamberlain | Brown and Caldwell |
| | Grant Davis | Sonoma County Water Agency |
| | Pam Jeane | Sonoma Valley County Sanitation District |
| | Sandeep Karkal | Novato Sanitary District |
| | Susan McGuire | Las Gallinas Valley Sanitary District |
| | Drew McIntyre | North Marin Water District |
| | Mark Millan | Data Instincts |
| | Phil Miller | Napa County |
| | Pilar Oñate-Quintana | The Oñate Group (by telephone) |
| | Mike Savage | Brown and Caldwell (by telephone) |
| | Paul Sellier | Marin Municipal Water District |
| | Brad Sherwood | Sonoma County Water Agency |
| | Jake Spaulding | Sonoma County Water Agency |
| | Dawn Taffler | Kennedy Jenks Consultants (by telephone) |
| | Leah Walker | City of Petaluma |

## 3. Public Comments

There were no comments from the public

**4. Introductions**
Introductions were not made.

**5. Board Meeting Minutes of July 26, 2016.**
A motion by Director Long, seconded by Director Baker to approve the July 26, 2016 minutes was unanimously approved.

**6. Report from the Program Manager**
The Board reviewed the consultant progress reports for July 2016. The Program Manager highlighted the remaining agenda items.

**a. Consultant Progress Reports**
The Board reviewed the consultant progress reports for July 2016.

**7. Financial Reports for the Period Ending June 30, 2016 and July 31, 2016**
Sonoma County is still in the process of completing all financial tasks for FY2015/16. As a consequence the usual financial reports were not available and will be presented at the next meeting. The Board reviewed the consultant cost tracking for the period ending July 31, 2016.

**8. FY2016/17 Budget Update**
This item was combined with Agenda Item No. 12.

**9. Program Development, Federal, and State Advocacy Update**
The following items were discussed: State Advocacy, Program Development and Federal Advocacy and related outreach efforts.

Pilar Oñate-Quintana discussed State Advocacy and noted that SB163 Hertzberg has been pulled from this session due to water and wastewater agency opposition. The author has indicated that it will be reintroduced in the next session. Since many agencies appear to be able to meet the 50% reduction requirement, opposition may not be as united as in the past. She also discussed SB1328, which is related to stormwater and greenhouse gases. There is potential grant funding in this legislation for water projects including water recycling.

Ginger Bryant provided an update on Program Development and Federal Advocacy, including the status of water related legislation that will include funding through Title XVI and other venues. She noted that the next trip to Washington D.C. will be in September.

**10. Outreach Program Update.**
Mark Millan noted the new set up for the room, which has the Board members sitting at the head of the room. He also noted that the WateReuse report on Direct Potable Reuse will be presented on September 29, 2016 at Santa Clara Valley Water District in San Jose. The report is at the request of the Legislature and has been managed by the State Water Resources Control Board.

**11. Engineering, Environmental, and Public Involvement Services Report**
There was no specific report on this item as it is currently on hold. There will be a report at the October meeting.

**12. Follow Up on Recommendations from Governance Task Force**
Chair Rabbitt gave a report based on the information in the Agenda packet. The goal of the recommendations is to improve the decision making process. He outlined how consultant agreements are currently and will continue to be managed and how the revised meeting structure would work. Beginning in 2017, the Board will meet every other month. Information will be presented at one meeting and decisions will be made at the next meeting. The time in between is to allow Board members and their staffs to discuss issues with their individual Boards and Councils.

Jake Spaulding provided an overview of the current budget, consultant funding status, and amendments that will be requested for FY2016/17. There are a total of $84,272 in proposed amendments for federal lobbying, state lobbying, and engineering services. A revised budget will be presented at the September 19, 2016 meeting for discussion and the Board will consider approval at the October 24, 2016 meeting. Until such time as cost sharing modifications are resolved, the current cost sharing will be used.

Directors Long and Gorin requested information on the grant funding that has been received from all sources by fiscal year to assist in showing the benefit of participating in the program. Director Long suggested that the Board consider forming a joint powers agency with a General Manager with executive authority.

**13. Comments from Chair and Board Members**
There were no additional comments from the Chair and Board Members.

**14. Adjournment**
Chair Rabbitt adjourned the meeting at 10:53 a.m. The next meeting will be Monday, September 19, 2016 at 9:30 a.m. at Novato Sanitary District.

Minutes approved by the Board September 19, 2016.

Charles V. Weir

Charles V. Weir
Program Manager

C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2016\2016-08\2016-08-22_NBWRA_Board_Minutes.docx

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**September 19, 2016**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:38 a.m. on Monday, September 19, 2016 at the Novato Sanitary District, 500 Davidson Street, Novato, CA. Consultants and others who were unable to attend participated via telephone, 1 (602) 567-4030, access code 2231; https://Conferencing.brwncald.com/conference/2231

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Keith Caldwell | Napa County |
| | Grant Davis (TAC) | Sonoma Valley County Sanitation District |
| | David Glass | City of Petaluma |
| | Jack Gibson | Marin Municipal Water District |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | Tim Healy (TAC) | Napa Sanitation District |
| | Jason Holley (TAC) | City of American Canyon |
| | John Schoonover | North Marin Water District |
| **ABSENT**: | Marin County | |
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Jack Baker | North Marin Water District |
| | Kevin Booker | Sonoma County Water Agency |
| | Ginger Bryant | Bryant & Associates |
| | Jill Chamberlain | Brown and Caldwell |
| | Pam Jeane | Sonoma Valley County Sanitation District |
| | Sandeep Karkal | Novato Sanitary District |
| | Susan McGuire | Las Gallinas Valley Sanitary District |
| | Drew McIntyre | North Marin Water District |
| | Mark Millan | Data Instincts |
| | Phil Miller | Napa County |
| | Pilar Oñate-Quintana | The Oñate Group (by telephone) |
| | Larry Russell | Marin Municipal Water District |
| | Dan St. John | City of Petaluma |
| | Mike Savage | Brown and Caldwell (by telephone) |
| | Paul Sellier | Marin Municipal Water District |
| | Brad Sherwood | Sonoma County Water Agency |
| | Jake Spaulding | Sonoma County Water Agency |
| | Dawn Taffler | Kennedy Jenks Consultants (by telephone) |

**3. Public Comments**

There were no comments from the public

**4. Introductions**

Introductions were not made.

**5. Board Meeting Minutes of August 22, 2016.**

The Program Manager noted an error in Item No. 12 regarding the total proposed budget amendment for FY2016/17. A motion by Director Davis, seconded by Director Gibson to approve the August 22, 2016 minutes as amended was unanimously approved.

**6. Report from the Chair**

- **a. FY2016/17 Management Structure**
  Chair Rabbitt reviewed the FY2016/17 Management Structure that was previously presented.
- **b. Consultant Progress Reports**
  The Board reviewed the consultant progress reports for August 2016.
- **c. Financial Reports**
  The Board reviewed the Financial Reports for the periods ending June 30, 2016 and August 31, 2016.

**7. Board Information Requests**

Chair Rabbitt reviewed the status of the request to develop a membership outreach brochure and information related to the return on investment for participating in NBWRA.

**8. Proposed FY2016/17 Budget Amendments**

Mike Savage provided a summary of proposed budget amendments that include a total increase of $84,272. He then discussed a proposed reallocation of Phase 2 Study and Program Costs. Phase 2 Feasibility Study engineering costs would be shared on the basis of each agency's percentage of the number of projects out of the total studied at the feasibility level. Environmental and Financial Capability Analysis costs would be shared on the basis of each agency's percentage of total project costs in the final EIR/EIS. All program costs would be shared equally between the member agencies. This would include Phase 2 Feasibility Study meetings, public involvement, grant administration, program management, program development, federal advocacy, state advocacy, and program administration. The proposed reallocation would be retroactive to FY2014/15.

The Board discussed the merits of the proposal and was supportive of it as a way of better sharing costs among the agencies. Following additional discussion, the Board directed the consultants to bring a three year budget for FY14/15, FY15/15, and FY16/17 based on the proposed reallocation to the October 24, 2016 meeting for Board approval.

**9. Program Development, Federal, and State Advocacy Update**

Ginger Bryant discussed plans for the upcoming trip to Washington, D.C. September 20 – 22, 2016. Pilar Oñate-Quintana discussed various legislative items, including some related to greenhouse gasses. She also discussed the upcoming election in November.

## 10. Engineering, Environmental, and Public Involvement Services Report

Mark Millan discussed plans for preparing a one-page information sheet for potential new members. He noted that the State Water Board has released the draft feasibility report on Direct Potable Reuse and that there is a 45-day comment period. Lastly he noted that there will be an informational forum at the Santa Clara Valley Water District on September 29, 2016 and that it would likely be a webinar.

Jill Chamberlain noted that all comments on the Phase 2 Feasibility Study have been received as of August 31, 2106. B&C is in the process of addressing all the comments and the final report is expected to be completed on October 7, 2016.

Mike Savage provided a summary of potential new Phase 2 projects from City of American Canyon, Marin Municipal Water District, Las Gallinas Valley Sanitary District, and Novato Sanitary District. He also discussed next steps in terms of potential budget impacts and administrative issues to bring new agencies and projects into the program.

## 11. Items for Future Discussion and Action

Chair Rabbitt gave a brief summary of future discussion and actions, including approval of the FY2016/17 Budget and revised cost allocations, program changes, future budgets, and revisions to the MOU to coincide with the direction established by the Board.

## 12. Comments from Chair and Board Members

There were no additional comments from the Chair and Board Members.

## 13. Adjournment

Chair Rabbitt adjourned the meeting at 11:12 a.m. The next meeting will be Monday, October 24, 2016 at 9:30 a.m. at Novato City Hall Council Chambers.

Minutes approved by the Board ___________________________.

Charles V. Weir
Program Manager

C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2016\2016-09\2016-09-19_NBWRA_Board_Minutes.docx

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**October 24, 2016**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:38 a.m. on Monday, October 24, 2016 at the Novato City Hall Council Chambers, 901 Sherman Avenue, Novato, CA. Consultants and others who were unable to attend participated via telephone, 1 (602) 567-4030, or 1 (888) 227-0011, access code 2231; https://Conferencing.brwncald.com/conference/2231

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Keith Caldwell | Napa County |
| | Susan Gorin | Sonoma Valley County Sanitation District |
| | Jack Gibson | Marin Municipal Water District |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | Dan St. John | City of Petaluma |
| | John Schoonover | North Marin Water District |

**ABSENT**: Marin County, Napa Sanitation District

| | | |
|---|---|---|
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Jack Baker | North Marin Water District |
| | Kevin Booker | Sonoma County Water Agency |
| | Ginger Bryant | Bryant & Associates |
| | Jill Chamberlain | Brown and Caldwell |
| | Anne Crealock | Sonoma County Water Agency |
| | Grant Davis | Sonoma County Water Agency |
| | David Graves | Napa Sanitation District |
| | Ryan Grisso | North Marin Water District |
| | Steve Hartwig | City of American Canyon |
| | Pam Jeane | Sonoma Valley County Sanitation District |
| | Sandeep Karkal | Novato Sanitary District |
| | Susan McGuire | Las Gallinas Valley Sanitary District |
| | Mark Millan | Data Instincts |
| | Phil Miller | Napa County |
| | Pilar Oñate-Quintana | The Oñate Group |
| | Larry Russell | Marin Municipal Water District |
| | Mike Savage | Brown and Caldwell |
| | Brad Sherwood | Sonoma County Water Agency |
| | Jake Spaulding | Sonoma County Water Agency |
| | Leah Walker | City of Petaluma |

## 3. Public Comments

There were no comments from the public

## 4. Introductions

Introductions were not made.

## 5. Board Meeting Minutes of September 19, 2016.

A motion by Director Schoonover, seconded by Director Caldwell to approve the September 19, 2016 minutes as amended was approved with one abstention.

## 6. Report from the Chair

### a. Consultant Progress Reports

The Board reviewed the consultant progress reports for September 2016.

### b. Financial Reports

The Board reviewed the Financial Reports for the period ending September 30, 2016.

### c. Future NBWRA Meeting Dates

The Board reviewed the proposed meeting dates for 2017.

## 7. Board Information Requests

Chair Rabbitt provided an update to the Membership Brochure development. It is intended to include: program information, costs on general membership, study and project funding. A draft is expected by the end of the year.

## 8. FY2016/17 Budget Amendments

Chair Rabbitt provided a summary. He indicated that there an audit of the funding received and final projects built for Phase 1. Susan McGuire asked about the revised costs since some funds were reallocated among agencies. Jake Spaulding indicated that the revised costs would be available at the next meeting.

Director Elias asked for an explanation of the cost sharing changes. He also expressed concerns with costs moving forward to FY17/18 and beyond. Mike Savage gave a summary of the proposed changes to cost sharing for Phase 2. He explained the changes in engineering cost sharing as well as general cost sharing as outlined in the packet. The proposal includes the September 2016 cost sharing method for FY14/15 and FY15/16, and new cost sharing method for FY16/17, which is more consistent with project costs. Director Caldwell expressed concern with the revised cost sharing. The return to Napa Sanitation District is approximately equal to their costs. He indicated that their staff would need to analyze the new proposal. He also expressed concern that there is no longer an opportunity for the Technical Advisory Committee (TAC) to resolve these issues prior to bring them to the Board. He suggested that the TAC meet to resolve the cost sharing issues. He also noted that his last meeting would be in December. Other Directors also expressed concerns with costs and agreed that the TAC should develop a recommendation for the Board. Director Gorin stressed the need to continue to work in a collaborative manner. Grant Davis thanked Director Caldwell for his long service to the region and NBWRA. Chair Rabbitt agreed that the TAC needs to discuss the cost sharing issues.

A motion by Director Schoonover, seconded by Director Gorin, to continue the FY2016/17 Budget Amendments to the December 19, 2016 meeting with review and recommendation by the TAC was unanimously approved.

**9. Program Development, Federal, and State Advocacy Update**

Ginger Bryant provided a summary of Program Development and Federal Advocacy, including a summary of the September 20-22, 2016 trip to Washington D.C., impact of the election on legislation, and that Reclamation is seeking comments on the new WaterSMART Grant Program Criteria.

Pilar Oñate-Quintana provided a summary of State Advocacy activities, including the veto of SB1328 (Greenhouse Gas Reduction Fund). Approval of AB2022 (allows bottling of advanced purified water for educational purposes), and the anticipated reintroduction of Hertzberg's Bill to reduce wastewater discharges to the ocean and bays. She also discussed State Water Board funding opportunities.

**10. Engineering, Environmental, and Public Involvement Services Report**

Mark Millan discussed progress on updating 4 page overview and preparing a one-sheet brochure for potential new members. They are also working on a presentation for U.S. Mayors Water Council being held in Napa on Nov 2 & 3, 2016. He also noted State Water Board public comment period on draft feasibility report on Direct Potable Reuse ends October 25, 2016. Lastly he listed dates for several upcoming conferences that may be of interest to NBWRA participants.

Mike Savage provided a summary of the efforts to develop additional projects for the Phase 2 Feasibility Study. They have identified $19.8M in projects. Three are in American Canyon and one is through Marin Municipal water District. They are developing costs for the agencies to participate in Phase 2 and plan on having an update at the December 19, 2016 meeting. He also updated the study schedule and budget process.

**11. Items for Future Discussion and Action**

Chair Rabbitt gave a brief summary of ongoing budget discussions, the consulting team's General Membership tasks and budgets are being reviewed, these include: Meetings and Communications, Public Involvement, Program Manager, Program Development, Federal and State Advocacy, and Program Administration *(SCWA)*. The outcomes from this review will be discussed at the December and January meetings.

**12. Comments from Chair and Board Members**

Director Long inquired about the involvement of other contractors with Sonoma County Water Agency.

**13. Adjournment**

Chair Rabbitt adjourned the meeting at 11:41 a.m. The next meeting will be Monday, December 19, 2016 at 9:30 a.m. at Novato City Hall Council Chambers.

Minutes approved by the Board December 19, 2016.

Charles V. Weir
Program Manager

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**December 19, 2016**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:35 a.m. on Monday, December 19, 2016 at the Novato Sanitary District, 500 Davidson Street, Novato, CA. Consultants and others who were unable to attend participated via telephone, 1 (602) 567-4030, access code 2231; https://Conferencing.brwncald.com/conference/2231

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Keith Caldwell | Napa County |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | Jack Gibson | Marin Municipal Water District |
| | Jason Holley | City of American Canyon |
| | Pam Jeane | Sonoma Valley County Sanitation District |
| | Drew McIntyre | North Marin Water District |
| | Dan St. John | City of Petaluma |
| | Jill Techel | Napa Sanitation District |
| **ABSENT**: | Marin County | |
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Kevin Booker | Sonoma County Water Agency |
| | Ginger Bryant | Bryant & Associates |
| | Jill Chamberlain | Brown and Caldwell |
| | Anne Crealock | Sonoma County Water Agency |
| | David Graves | Napa Sanitation District |
| | Sandeep Karkal | Novato Sanitary District |
| | Mark Millan | Data Instincts |
| | Phil Miller | Napa County |
| | Pilar Oñate-Quintana | The Oñate Group (by telephone) |
| | Mike Savage | Brown and Caldwell |
| | Brad Sherwood | Sonoma County Water Agency |
| | Jake Spaulding | Sonoma County Water Agency |
| | Dawn Taffler | Kennedy Jenks Consultants (by telephone) |
| | Leah Walker | City of Petaluma |
| | Mark Williams | Las Gallinas Valley Sanitary District |

## 3. Public Comments

There were no comments from the public

**4. Introductions**

Introductions were not made.

**5. Board Meeting Minutes of October 24, 2016.**

A motion by Director Caldwell, seconded by Director Long to approve the October 24, 2016 minutes as presented was approved with one abstention.

**6. Report from the Chair**

**a. Consultant Progress Reports**

The Board reviewed the consultant progress reports for October and November 2016.

**b. Financial Reports**

The Board reviewed the Financial Reports for the period ending November 30, 2016.

**c. Recognize Supervisor Keith Caldwell's Contributions**

The Chair and the Board recognized Supervisor Keith Caldwell for his many years of service to the region, Napa County, and NBWRA. Chair Rabbitt presented Supervisor Caldwell with a plaque. Vice Chair Long noted that Supervisor Caldwell participated in NBWRA before he was elected to the Board of Supervisors and appointed to the NBWRA Board. Supervisor Caldwell noted that it has been an honor and a privilege to work with NBWRA and NBWA. He cited the quality of the organizations and projects.

**7. Board Information Requests**

Chair Rabbitt provided an update to the Membership Brochure development. The brochure will be finalized after decisions are made on new members at the January 2017 meeting.

**8. FY2016/17 Budget Amendments**

Chair Rabbitt and Mike Savage provided a summary. Chair Rabbitt noted that the budget for the rest of FY16/17 needs to be approved to continue business through the end of the fiscal year. Savage noted that the cost sharing may change if additional agencies join NBWRA in January 2017. Jake Spaulding discussed the status of the reconciliation of Phase 1 costs and that a detailed report would be presented at the January 23, 2017 meeting.

A motion by Director Elias, seconded by Director Caldwell, to approve the FY2016/17 Budget Amendments was unanimously approved.

**9. Program Development, Federal, and State Advocacy Update**

Ginger Bryant provided a summary of Program Development and Federal Advocacy, including a summary of The Water Infrastructure Improvements for the Nation Act (WIIN). Included in this legislation was the California Drought Bill Rider that was sponsored by Senator Feinstein. The Act includes increase in funding for WaterSMART grants and Title XVI reforms that created a new program for unauthorized projects. She also noted that Ryan Zinke (R-MT) has been nominated to head the Department of Interior and that they are tracking other appointment in the new administration.

Pilar Oñate-Quintana provided a summary of State Advocacy activities, including the fact that the Democrats now have a 2/3 supermajority in both houses. SB 5 (DeLeon) and AB 18 (Garcia) have been introduced as major water related bonds. Both are multi-billion dollar items and are likely to be combined at some point. She also described the likelihood that Senator Hertzberg will reintroduce his ocean discharge reduction mandate legislation. She has also been working with WateReuse in the development of legislation for direct potable reuse (DPR). Lastly she noted that they are working of possible dates for the next NBWRA Day in the Capitol and the possibility of organizing a tour for newly elected Assemblywoman Cecilia Aguilar-Curry and her staff.

**10. Engineering, Environmental, and Public Involvement Services Report**
Mark Millan discussed progress on updating the 4 page overview and preparing a one-sheet brochure for potential new members. Jill Chamberlain provided an update on the status of the Feasibility Study Report as well as the future schedule for the EIR/EIS analysis.

**11. Items for Future Discussion and Action**
Chair Rabbitt gave a brief summary of items for the January 23, 2017 meeting, including State legislative issues, Federal administration, Federal legislation and funding opportunities, and a discussion on the FY 17/18 Budget. Ginger Bryant noted that the schedule for meetings in 2017 will also need to be discussed.

**12. Comments from Chair and Board Members**
Dan St. John indicated that the City of Petaluma is conducting a rate study that will include NBWRA costs. .

**13. Adjournment**
Chair Rabbitt adjourned the meeting at 10:45 a.m. The next meeting will be Monday, January 23, 2017 at 9:30 a.m. at Novato City Hall Council Chambers.

Minutes approved by the Board March 27, 2017.

Charles V. Weir
Program Manager

C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2016\2016-12\2016-12-19_NBWRA_Board_Minutes.docx

This page intentionally left blank.

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**January 23, 2017**

## 1. Call to Order

Note: Due to extreme weather conditions and road closures, this meeting was changed to a web meeting only. As a consequence, no action was taken on any items on the agenda. Items needing action will be continued to the March 27, 2017 meeting. Chair Rabbitt called the meeting to order at 9:35 a.m. on Monday, January 23, 2017. As noted previously, all attendees participated via telephone, 1 (602) 567-4030, access code 2231; and the internet at: https://Conferencing.brwncald.com/conference/2231

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | Susan Gorin | Sonoma Valley County Sanitation District |
| | Tim Healy | Napa Sanitation District |
| | Jason Holley | City of American Canyon |
| | Belia Ramos | Napa County |
| | John Schoonover | North Marin Water District |
| | Paul Sellier | Marin Municipal Water District |
| | Robert Wilson | City of Petaluma |
| **ABSENT**: | Marin County | |
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Jack Baker | North Marin Water District |
| | Kevin Booker | Sonoma County Water Agency |
| | Ginger Bryant | Bryant & Associates |
| | Anne Crealock | Sonoma County Water Agency |
| | Grant Davis | Sonoma County Water Agency |
| | Chris DeGabrielle | North Marin Water District |
| | Brad Elliott | Sonoma County Water Agency |
| | Pam Jeane | Sonoma Valley County Sanitation District |
| | Sandeep Karkal | Novato Sanitary District |
| | Susan McGuire | Las Gallinas Valley Sanitary District |
| | Drew McIntyre | North Marin Water District |
| | Mark Millan | Data Instincts |
| | Phil Miller | Napa County |
| | Pilar Oñate-Quintana | The Oñate Group |
| | Larry Russell | Marin Municipal Water District |
| | Mike Savage | Brown and Caldwell |
| | Brad Sherwood | Sonoma County Water Agency |

| | |
|---|---|
| Jake Spaulding | Sonoma County Water Agency |
| Dawn Taffler | Kennedy Jenks Consultants |
| Jeff Tucker | Napa Sanitation District |
| Rocky Vogler | North Marin Water District |
| Mark Williams | Las Gallinas Valley Sanitary District |

**3. Public Comments**
There were no comments from the public

**4. Introductions**
Introductions were not made.

**5. Board Meeting Minutes of December 19, 2016.**
This item will be continued to the March 27, 2017 meeting.

**6. Election of Officers**
This item will be continued to the March 27, 2017 meeting

**7. Report from the Chair**

a. **Consultant Progress Reports**
The Board reviewed the consultant progress reports for December 2016.

b. **Financial Reports**
The Board reviewed the Financial Reports for the period ending December 31, 2016.

c. **2017 Meeting Dates**
Meeting dates for 2017 include: January 23, March 27, May 22, August 28, October 23, and December 28. The last three dates are subject to approval of an FY2017/18 Budget. Outlook appointments will be sent for the March 27 and May 22 meetings.

**8. Board Information Requests**
Chair Rabbitt provided an update to the Membership Brochure development. The brochure will include: program information, costs on general membership and study and project funding. Its status is pending a resolution on Phase 2 participation and budget issues.

**9. FY2016/17 – Amend to Include New Member Projects**
This item will be continued to the March 27, 2017 meeting

**10. Program Development, Federal, and State Advocacy Update**
Ginger Bryant provided a summary of Program Development and Federal Advocacy, including Title XVI issues, new WaterSMART grant criteria, a summary of The Water Infrastructure Improvements for the Nation Act (WIIN). She also discussed the California Water Action Plan, which integrates innovations in conservation; storm water capture; recycling; desalination; and water transfers, diversions, conveyance, and storage. She also noted that next Washington D.C. trip is February 28 – March 2, 2017.

Pilar Oñate-Quintana provided a summary of State Advocacy activities. She noted that the State could face a $1.6 billion budget deficit, although the Legislative Analyst's Office projected a

$2.8 billion surplus. She also noted that the Governor has warned of potential cuts in federal funding. She highlighted the proposed 2017/18 State Budget as related to items of interest to NBWRA. The membership of key Senate and Assembly Committees was discussed. Key legislative issues for 2017 include: 2018 Water Bond or Water/Parks hybrid, WateReuse efforts to modify statutory definitions for Direct Potable Reuse, State Board conservation plan efforts, and that Senator Herzberg will not pursue a bill on ocean discharge reduction. Instead, he plans on incentivizing recycled water development. Lastly she discussed plans for NBWRA Day at the State Capitol, currently scheduled for March 22, 2017.

**11. Engineering, Environmental, and Public Involvement Services Report**
Mike Savage reported that the Feasibility Study Report has been completed for current members and projects and the report has been uploaded to SharePoint. If new members opt to participate in Phase 2, the Feasibility Study Report will need to be updated and the scope of the EIR/EIS will need to be modified. Mark Millan discussed preparation of materials for the upcoming D.C. trip and the NBWRA brochure update.

**12. NBWRA Alternatives and Moving Forward**
Ginger Bryant, Mike Savage, and Jake Spaulding discussed alternatives and moving forward. Alternative 1 is a basic Title XVI program and would discontinue program development, federal and state advocacy, and public outreach associated with advocacy. Alternative 2 is similar to Alternative 1, but would maintain limited Title XVI services for program development, federal and state advocacy, and public outreach to support advocacy. Impacts on the FY2017/18 budget were discussed for each alternative. In each case, the September 2016 cost allocation method would be applied. Member agencies were asked to discuss this information with their boards and be prepared to select Alternative 1 or 2 at the March 27, 2017 meeting for final budget preparation. The FY2017/18 Budget will be considered for approval at the May 22, 2017 meeting.

In terms of moving forward, an outline for a New Water Management Program was discussed. This program would continue the regional approach, seek project funding, continue the current economies of scale, and would support agencies in implementing their own projects. The program would transition to a "one water" approach in state and federal policy and funding. Features of the new program would include: maximizing use of recycled water; surface, storage, and groundwater projects; stormwater capture management; drought and climate issues; watersheds basin studies; and drought contingency plans. A proposed budget for the Water Management Program was also discussed. Next steps would include: development of a membership outreach brochure, further development of budget information and outreach to new members, and working with SCWA on basin study and drought contingency plans. Additional information will be presented at the March 27, 2017 meeting.

Meeting participants were interested in the discussion, asked pertinent questions, and requested information that could be used in discussions with their Boards and Councils.

**13. Items for Future Discussion and Action**
All continued items from this meeting will be considered at the March 27, 2017 meeting. This will include a selection of the preferred Title XVI program for the FY2017/18 Budget. Discussion on the Water Management Program will continue.

**14. Comments from Chair and Board Members**
There were no additional comments.

**15. Adjournment**
Chair Rabbitt adjourned the meeting at 10:59 a.m. The next meeting will be Monday, March 27, 2017 at 9:30 a.m. at Novato City Hall Council Chambers.

Minutes approved by the Board March 27, 2017.

Charles V. Weir
Program Manager

C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2017\2017-01\2017-01-23_NBWRA_Board_Minutes.docx

**North Bay Water Reuse Authority**
**Board of Directors Meeting**
**Minutes**
**March 27, 2017**

## 1. Call to Order

Chair Rabbitt called the meeting to order at 9:45 a.m. on Monday, March 27, 2017. Consultants and others who were unable to attend participated via telephone, 1 (602) 567-4030, access code 2231; and the internet at: https://Conferencing.brwncald.com/conference/2231

## 2. Roll Call

| | | |
|---|---|---|
| **PRESENT:** | David Rabbitt, Chair | Sonoma County Water Agency |
| | Bill Long, Vice Chair | Novato Sanitary District |
| | Rabi Elias | Las Gallinas Valley Sanitary District |
| | Jack Gibson | Marin Municipal Water District |
| | David Glass | City of Petaluma |
| | Susan Gorin | Sonoma Valley County Sanitation District |
| | Steve Hartwig | City of American Canyon |
| | Belia Ramos | Napa County |
| | John Schoonover | North Marin Water District |
| | Jill Techel | Napa Sanitation District |
| **ABSENT:** | Marin County | |
| **OTHERS PRESENT:** | Chuck Weir, Program Manager | Weir Technical Services |
| | Jack Baker | North Marin Water District |
| | Kevin Booker | Sonoma County Water Agency |
| | Ginger Bryant | Bryant & Associates |
| | Anne Crealock | Sonoma County Water Agency |
| | Grant Davis | Sonoma County Water Agency |
| | Brad Elliott | Sonoma County Water Agency |
| | Rene Guillen | Brown and Caldwell |
| | Tim Healy | Napa Sanitation District |
| | Pam Jeane | Sonoma Valley County Sanitation District |
| | Sandeep Karkal | Novato Sanitary District |
| | Susan McGuire | Las Gallinas Valley Sanitary District |
| | Drew McIntyre | North Marin Water District |
| | Mark Millan | Data Instincts |
| | Phil Miller | Napa County |
| | Jim O'Toole | ESA |
| | Pilar Oñate-Quintana | The Oñate Group (by phone) |
| | Larry Russell | Marin Municipal Water District (by phone) |
| | Dan St. John | City of Petaluma |
| | Mike Savage | Brown and Caldwell |
| | Brad Sherwood | Sonoma County Water Agency |

| | |
|---|---|
| Jake Spaulding | Sonoma County Water Agency |
| Paul Sellier | Marin Municipal Water District |
| Dawn Taffler | Kennedy Jenks Consultants (by phone) |
| Jeff Tucker | Napa Sanitation District |
| Rocky Vogler | North Marin Water District |
| Leah Walker | City of Petaluma |

**3. Public Comments**
There were no comments from the public

**4. Introductions**
For the benefit of new Director Belia Ramos, Napa County, Board members introduced themselves. .

**5. Board Meeting Minutes of December 19, 2016 and January 23, 2017.**
A motion by Director Schoonover, seconded by Director Techel, to approve the minutes of the December 19, 2016 and January 23, 2017 meetings was unanimously passed with director Ramos abstaining.

**6. Election of Officers**
A motion by director Long, seconded by Director Glass, to nominate David Rabbitt as Chair and Jill Techel as Vice Chair for 2017 was passed unanimously.

**7. Report from the Chair**

**a. Consultant Progress Reports**
The Board reviewed the consultant progress reports for January and February 2017.

**b. Financial Reports**
The Board reviewed the Financial Reports for the period ending February 28, 2017.

**8. Board Information Requests**
Chair Rabbitt provided an update to the Membership Brochure development. The brochure will include: program information, costs on general membership and study and project funding. Its status is pending a resolution on Phase 2 participation and budget issues.

**9. Approval of City of American Canyon as a Title XVI Phase 2 Member Agency**
Chair Rabbitt summarized City of American Canyon's request to become a Title XVI Phase 2 Member Agency. On February 21, 2017 the City Council agreed to participate in Phase 2 for FY2016/17. A motion by Director Ramos, Seconded by Director Techel to approve City of American Canyon as a Title XVI Phase 2 member was unanimously approved.

**10. FY2016/17 Budget – Amend to Include New Member Projects**
The FY2016/17 Budget has been modified to include projects for City of American Canyon and Marin Municipal Water District. This includes an increase in costs for engineering to modify the Phase 2 Feasibility Study and a redistribution of cost sharing based on two additional agencies. A motion by director Glass, seconded by Director Gorin, to approve an amendment to the FY2016/17 Budget was unanimously approved.

**11. Consideration of Approval of the Phase 1 reconciliation and Reassessment**
Jake Spaulding summarized the changes in assessments for Phase 1 based on redistribution of federal funds for project support. A motion by Director Long, seconded by Director Gorin, to approve the Phase 1 Reconciliation and Reassessment was unanimously approved.

**12. Program Development, Federal, and State Advocacy Update**
Ginger Bryant provided a summary of Program Development and Federal Advocacy, including funding for Title XVI, Title XVI Phase 2 authorization, Title XVI Phase 2 construction grants and NBWRA activities to support Title XVI. She also discussed proposed reductions for the Department of Interior and EPA in the President's FY18/19 budget. She also provided a summary of recent meetings in Washington D.C.

Pilar Oñate-Quintana provided a summary of State Advocacy activities. There are two $3 billion bonds in the Legislature. One is parks focused and the other is a parks/water hybrid that included $25 million for recycled water. She discussed efforts by the governor's office to develop long-term statewide water conservation plans and mandates. She has been working with ACWA and WateReuse to develop legislative language to recycled water separately from conservation mandates on potable water. She also discussed AB574 (Quirk) which is intended to better define recycled water use. Lastly she summarized NBWRA Day in Sacramento on March 22, 2017.

**13. Engineering, Environmental, and Public Involvement Services Report**
Mike Savage discussed the status of the Feasibility Study and which sections would be revised based on the addition of projects for City of American Canyon and Marin Municipal Water District. The next section to be drafted is the Financial Capability section. He also discussed the schedule. Jim O'Toole provided an update on the EIR/EIS process and schedule, with a goal of having the Record of Decision issued by July 2018. Mark Millan summarized outreach activities including assistance with recent trips to Washington D.C. and Sacramento, as well as updates to the brochure and website. There have been major redesigns of the website.

**14. Review of NBWRA Title XVI Program Alternatives 1 and 2**
Ginger Bryant summarized the differences between Alternatives 1 and 2, including the level of effort for program development, state advocacy, and federal advocacy. She discussed the differences in the budgets for each alternative. Following discussion she requested guidance from the Board for development of the FY2107/18 Budget. Board members all expressed support for Alternative 2, which will be the basis of the FY2017/18 Budget that will be considered at the May 22, 2017 Board meeting. With the program focusing on Title XVI, quarterly meetings will be adequate. Proposed dates for FY17/18 include: July 24, 2017, October 23, 2017, January 22, 2018, and April 23, 2018. Director Gorin noted a potential conflict with the July 24, 2017 meeting. Directors Techel and Glass requested that the Board packets be distributed at least one week before the meetings.

Chair Rabbitt noted that with the approval of new members and finalization of Phase 2's list of projects, that it is time to revise the Memorandum of Understanding (MOU). He directed staff (Weir, Savage, Booker, and Spaulding) to draft revisions for the May 22, 2016 meeting that reflects: completion of Phase 1, addition of new Phase 2 members, and cost sharing for Phase 2.

**15. Review of NBWRA Title XVI Program Alternatives 1 and 2**
Ginger Bryant discussed the New Water Management Program. The program would be separate from Title XVI activities and would focus on regional water issues such as surface water supplies, storage, groundwater, stormwater, and habitat enhancement. Activities could include similar activities such as Sonoma County Water Agency's (SCWA) efforts on the North Bay Basin Study and Drought Contingency Plans. Efforts to obtain state and federal funding for projects and studies would be key to the program. She further described potential federal and state funding opportunities. Lastly she discussed next steps, including development of a membership brochure, drafting budget and new member materials, and continuing work with SCWA and the Bureau of Reclamation. She noted that additional information will be presented at the May 22, 2017 meeting.

Mike Savage noted that the Drought Contingency Plan application is due April 19, 2017 and that member agencies could participate by providing a list of in-kind services. He will be contacting them soon on this matter.

**16. Items for Future Discussion and Action**
Items for the next meeting on May 22, 2017 include the following: regular reports, discussion and approval of the FY2017/18 Title XVI Budget, discussion of MOU revisions, and continued discussion on the Water Management Program.

**17. Comments from Chair and Board Members**
There were no additional comments.

**18. Adjournment**
Chair Rabbitt adjourned the meeting at 11:41 a.m. The next meeting will be Monday, May 22, 2017 at 9:30 a.m. at Novato City Hall Council Chambers.

Minutes approved by the Board ___________________________.

Charles V. Weir
Program Manager

C:\Users\Chuck\Documents\Weir Technical Services\NBWRA\Agendas\2017\2017-03\2017-03-27_NBWRA_Board_Minutes.docx

# Appendix B: Existing or Potential Special Studies Species in the Study Area

This page intentionally left blank.

# Appendix B
# Plant and Animal Species with Potential to Occur in the Study Area

| Common and Scientific Name | Legal Status[1] Federal/State/CNPS | Common and Scientific Name | Legal Status[1] Federal/State/CNPS |
|---|---|---|---|
| **Plants** | | | |
| Adobe sanicle<br>*Sanicula maritima* | --/CR/1B.1 | Beach layia<br>*Layia carnosa* | FE/SE/1B.1 |
| Franciscan onion<br>*Allium peninsulare* var. *franciscanum* | --/--/1B.2 | Contra Costa goldfields<br>*Lasthenia conjugens* | FE/--/1B.1 |
| Bent-flowered fiddleneck<br>*Amsinckia lunaris* | --/--/1B.2 | Blue coast gilia<br>*Gilia capitata* ssp. *chamissonis* | --/--/1B.1 |
| Bristly sedge<br>*Carex comosa* | --/--/2B.1 | California seablite<br>*Suaeda californica* | FE/--/1B.1 |
| Chaparral ragwort<br>*Senecio aphanactis* | --/--/2B.2 | Choris' popcornflower<br>*Plagiobothrys chorisianus* var. *chorisianus* | --/--/1B.2 |
| Coastal bluff morning-glory<br>*Calystegia purpurata* ssp. *saxicola* | --/--/1B.2 | Coastal triquetrella<br>*Triquetrella californica* | --/--/1B.2 |
| Dark-eyed gilia<br>*Gilia millefoliata* | --/--/1B.2 | Diablo helianthella<br>*Helianthella castanea* | --/--/1B.2 |
| Franciscan manzanita<br>*Arctostaphylos franciscana* | FE/--/1B.1 | Franciscan thistle<br>*Cirsium andrewsii* | --/--/1B.2 |
| Hairless popcornflower<br>*Plagiobothrys glaber* | --/--/1A | Kellogg's horkelia<br>*Horkelia cuneata var. sericea* | --/--/1B.1 |
| Loma Prieta hoita<br>*Hoita strobilina* | --/--/1B.1 | Marin checker lily<br>*Fritillaria lanceolata* var. *tristulis* | --/--/1B.1 |
| Marin checkerbloom<br>*Sidalcea hickmanii ssp. viridis* | --/--/1B.1 | Marin County navarretia<br>*Navarretia rosulata* | --/--/1B.2 |
| Marin manzanita<br>*Arctostaphylos virgata* | --/--/1B.2 | Marin western flax<br>*Hesperolinon congestum* | FT/ST/1B.1 |
| Brewer's western flax<br>*Hesperolinon breweri* | --/--/1B.2 | Bolander's water-hemlock<br>*Cicuta maculata* var. *bolanderi* | --/--/2B.1 |
| Minute pocket moss<br>*Fissidens pauperculus* | --/--/1B.2 | Mt. Tamalpais thistle<br>*Cirsium hydrophilum* var. *vaseyi* | --/--/1B.2 |
| Mt. Tamalpais manzanita<br>*Arctostaphylos hookeri* ssp. *montana* | --/--/1B.3 | Northern meadow sedge<br>*Carex praticola* | --/--/2B.2 |
| Pallid manzanita<br>*Arctostaphylos pallida* | FT/SE/1B.1 | Point Reyes horkelia<br>*Horkelia marinensis* | --/--/1B.2 |
| Presidio clarkia<br>*Clarkia franciscana* | FE/SE/1B.1 | Presidio manzanita<br>*Arctostaphylos montana* ssp. *ravenii* | FE/SE/1B.1 |
| Robust spineflower<br>*Chorizanthe robusta* var. *robusta* | FE/--/1B.1 | Rose leptosiphon<br>*Leptosiphon rosaceus* | --/--/1B.1 |
| Round-headed Chinese-houses<br>*Collinsia corymbosa* | --/--/1B.2 | San Francisco Bay spineflower<br>*Chorizanthe cuspidate* var. *cuspidata* | --/--/1B.2 |
| San Francisco campion<br>*Silene verecunda* ssp. *verecunda* | --/--/1B.2 | San Francisco collinsia<br>*Collinsia multicolor* | --/--/1B.2 |
| San Francisco gumplant<br>*Grindelia hirsutula* var. *maritima* | --/--/3.2 | San Francisco lessingia<br>*Lessingia germanorum* | FE/SE/1B.1 |

| ***Common and Scientific Name*** | ***Legal Status[1] Federal/State/CNPS*** | ***Common and Scientific Name*** | ***Legal Status[1] Federal/State/CNPS*** |
|---|---|---|---|
| San Francisco owl's-clover *Triphysaria floribunda* | --/--/1B.2 | San Francisco popcornflower *Plagiobothrys diffusus* | --/SE/1B.1 |
| Santa Cruz microseris *Stebbinsoseris decipiens* | --/--/1B.2 | Santa Cruz tarplant *Holocarpha macradenia* | FT/SE/1B.1 |
| small groundcone *Kopsiopsis hookeri* | --/--/2B.3 | Tamalpais jewelflower *Streptanthus batrachopus* | --/--/1B.3 |
| Tamalpais lessingia *Lessingia micradenia* var. *micradenia* | --/--/1B.2 | Tamalpais oak *Quercus parvula* var. *tamalpaisensis* | --/--/1B.3 |
| Thurber's reed grass *Calamagrostis crassiglumis* | --/--/2B.1 | Tiburon jewelflower *Streptanthus glandulosus* ssp. *niger* | FE/SE/1B.1 |
| Tiburon Mariposa Lily *Calochortus tiburonensis* | FT/ST/1B.1 | Water star-grass *Heteranthera dubia* | --/--/2B.2 |
| Western leatherwood *Dirca occidentalis* | --/--/1B.2 | White-rayed pentachaeta *Pentachaeta bellidiflora* | FE/SE/1B.1 |
| Showy Indian clover *Trifolium amoenum* | FE/--/-- | Oregon polemonium *Polemonium carneum* | --/--/2B.2 |
| Mt. Diablo fairy-lantern *Calochortus pulchellus* | --/--/1B.2 | Delta Tule Pea *Lathyrus jepsonii* var. *jepsonii* | --/--/1B.2 |
| Suisun Marsh aster *Symphyotrichum lentum* | --/--/1B.2 | Legenere *Legenere limosa* | --/--/1B.1 |
| Alkali Milk Vetch *Astragalus tener* var. *tener* | --/--/1B.2 | Mason's lilaeopsis *Lilaeopsis masonii* | --/SR/1B.1 |
| San Joaquin spearscale *Atriplex joaquiniana* | --/--/1B.2 | Sebastopol meadowfoam *Limnanthes vinculans* | FE/SE/1B |
| Big-scale balsamroot *Balsamorhiza macrolepis* var. *macrolepis* | --/--/1B.2 | Marsh microseris *Microseris paludosa* | --/--/1B.2 |
| Sonoma sunshine *Blennosperma bakeri* | FE/SE/1B.1 | Baker's navarretia *Navarretia leucocephala* ssp. *bakeri* | --/--/1B.1 |
| Tiburon Indian Paintbrush *Castilleja affinis* ssp. *neglecta* | FE/ST/1B.2 | Pitkin Marsh lily *Lilium pardalinum* ssp. *pitkinense* | FE/SE/1B.1 |
| Suisun thistle *Cirsium hydrophyllum* | FE/--/1B | North Coast semaphore grass *Pleuropogon hooverianus* | --/ST/1B.1 |
| Point Reyes bird's-beak *Cordylanthus maritimus* ssp. *palustris* | --/--/1B.2 | Marin knotweed *Polygorum marinense* | --/--/3.1 |
| Dwarf downingia *Downingia pusilla* | --/--/2B.2 | Point Reyes checkerbloom *Sidalcea calycosa* ssp. *rhizomata* | --/--/1B.2 |
| Fragrant fritillary *Fritillaria lilacea* | --/--/1B.2 | Henderson's bent grass *Agrostis hendersonii* | --/--/3.2 |
| Marin dwarf flax *Hesperolinon congestum* | FT/ST/1B.1 | Saline clover *Trifolium depauperatum* var. *hydrophilum* | --/--/1B.2 |
| Sonoma spineflower *Chorizanthe valida* | FE/SE/1B.1 | Golden larkspur *Delphinium luteum* | FE/CR/1B.1 |
| Greene's narrow-leaved daisy *Erigeron greenei* | --/--/1B.2 | Congested-headed hayfield tarplant *Hemizonia congesta* ssp. *congesta* | --/--/1B.2 |
| Pappose tarplant *Centromadia parryi ssp. parryi* | --/--/1B.2 | Carquinez goldenbush *Isocoma argute* | --/--/1B.1 |



A

| ***Common and Scientific Name*** | ***Legal Status[1] Federal/State/CNPS*** | ***Common and Scientific Name*** | ***Legal Status[1] Federal/State/CNPS*** |
|---|---|---|---|
| Congdon's tarplant *Centromadia parryi* ssp. *congdonii* | --/--/1B.1 | Big tarplant *Blepharizonia plumosa* | --/--/1B.1 |
| Petaluma popcornflower *Plagiobothrys mollis* var. *vestitus* | --/--/1A | Mt. Tamalpais bristly jewelflower *Streptanthus glandulosus,* ssp. *pulchellus* | --/--/1B.2 |
| Oval-leaved viburnum *Viburnum ellipticum* | --/--/2B.3 | Napa false indigo *Amorpha californica* var. *napensis* | --/--/1B.2 |
| Two-fork clover *Trifolium amoenum* | FE/--/1B.1 | Round-leaved filaree *California macrophylla* | --/--/1B.2 |
| Northern California black walnut *Juglans hidsii* | --/--/1B.1 | Napa bluecurls *Trichostema ruygtii* | --/--/1B.2 |
| Napa checkerbloom *Sidalcea hickmanii* ssp. *napensis* | --/--/1B.1 | Tiburon buckwheat *Erigonum luteolum* var. *vaninum* | --/--/1B.2 |
| Jepson's leptosiphon *Leptosiphon jepsonii* | --/--/1B.2 | Holly-leaved ceanothus *Ceanothus purpureus* | --/--/1B.2 |
| Rincon Ridge ceanothus *Ceanothus confuses* | --/--/1B.1 | Sonoma ceanothus *Ceanothus sonomensis* | --/--/1B.2 |
| Thin-lobed horkelia *Horkelia tenuiloba* | --/--/1B.2 | Point Reyes salty bird's-beak *Chloropyron maritimum* ssp. *palustre* | --/--/1B.2 |
| Soft [salty] bird's-beak *Chloropyron molle* ssp. *molle* | FE/CR-1B.2 | Lyngbye's sedge *Carex lyngbyei* | --/--/2B.2 |
| California beaked-rush *Rhynchospora californica* | --/--/1B.1 | Narrow-anthered brodiaea *Brodiaea leptandra* | --/--/1B.2 |
| Cobb Mountain lupine *Lupinus sericatus* | --/--/1B.2 | Marsh sandwort *Arenaria paludicola* | FE/FE/1B.1 |
| **Invertebrates** | | | |
| Conservancy fairy shrimp *Branchinecta conservatio* | FE/-- | Monarch butterfly (wintering sites) *Danaus plexippus* | --/-- |
| Vernal pool fairy shrimp *Branchinecta lynchi* | FT/-- | Valley elderberry longhorn beetle *Desmocerus californicus dimorphus* | FT/-- |
| Vernal pool tadpole shrimp *Lepidurus packardi* | FE/-- | Callippee silverspot butterfly *Speyeria callippe callippe* | FE/-- |
| California Freshwater Shrimp *Syncaris pacifica* | FE/SE | Myrtle's silverspot butterfly *Satyrium auretorum fumosoum* | FE/-- |
| Blennosperma vernal pool andrenid bee *Andrena blennospermatis* | --/-- | Obscure bumble bee Bombus caliginosus | --/-- |
| Opler's longhorn moth *Adela oplerella* | --/-- | Sonoma zerene fritillary *Speyeria zerene sonomensis* | --/-- |
| Western bumble bee *Bombus occidentalis* | --/-- | Bay checkerspot butterfly *Euphydryas editha bayensis* | FT/-- |
| Mission blue butterfly *Plebejus icarioides missionensis* | --/-- | San Bruno elfin butterfly *Callophrys mossii bayensis* | FE/-- |
| Bumblebee scarab beetle *Lichnanthe ursina* | --/-- | Marin blind harvestman *Calicina diminua* | --/-- |
| Lee's micro-blind harvestman *Microcina leei* | --/-- | Tiburon micro-blind harvestman *Microcina tiburona* | --/-- |

| Common and Scientific Name | Legal Status[1] Federal/State/CNPS | Common and Scientific Name | Legal Status[1] Federal/State/CNPS |
|---|---|---|---|
| San Francisco Bay Area leaf-cutter bee *Trachusa gummifera* | --/-- | Sandy beach tiger beetle *Cicindela hirticollis gravida* | --/-- |
| Ubick's gnaphosid spider *Talanites ubicki* | --/-- | Marin hesperian *Vespericola marinensis* | --/-- |
| Robust walker *Pomatiopsis binneyi* | --/-- | | |
| **Amphibians** | | | |
| California red-legged frog *Rana aurora draytoni* | FT/SSC | California tiger salamander *Ambystoma californiense* | FT/ST |
| Foothill yellow-legged frog *Rana boylii* | --/SSC | Red-bellied newt *Taricha rivularis* | --/SSC |
| Bridges' coast range shoulderband *Helminthoglypta nickliniana bridgesi* | --/-- | Rimic tryonia (California brackishwater snail) *Tryonia imitator* | --/-- |
| **Reptiles** | | | |
| Western Pond Turtle *Emys marmorata* | --/SSC | Giant garter snake *Thamnophis gigas* | FT/ST |
| Alameda whipsnake *Masticophis lateralis euryxanthus* | FT/ST | | |
| **Fish** | | | |
| Tidewater goby *Eucyclogobius newberryi* | FE/-- | Steelhead – Northern & Central California Coast DPS *Oncorhynchus mykiss irideus* | FT/-- |
| Delta smelt *Hypomesus transpacificus* | FT/SE | California coastal chinook salmon *Oncorhynchus tshawytscha* | FT/-- |
| Coho salmon central coast *Oncorhynchus kisutch* | FE/SE | Sacramento winter-run Chinook salmon *Oncorhynchus tshawytscha* | FE/SE |
| Sacramento splittail *Pogonichthys macrolepidotus* | --/SSC | Central Valley spring-run Chinook salmon *Oncorhynchus tshawytscha* | FT/FT |
| Longfin smelt *Spirinchus thaleichthys* | FC/ST | Eulachon *Thaleichthys pacificus* | FT/-- |
| Sacramento perch *Archoplites interruptus* | --/SSC | | |
| **Birds** | | | |
| Double-crested cormorant (nesting colony) *Phalacrocorax auritus* | --/SSC | Western snowy plover (coastal populations) *Charadrius alexandrinus nivosus* (nesting) | FT/SSC |
| California brown pelican *Pelecanus occidentalis californicus* | FE/SE, SFP | Long-billed curlew *Numenius americanus* | --/SSC |
| American bittern *Botaurus lentiginosus* | --/-- | California least tern *Sterna antillarum browni* | FE/SE,SFP |
| Great egret (rookery) *Ardea alba* | --/-- | Caspian tern (nesting colony) *Sterna caspia* | --/-- |
| Snowy Egret (rookery) *Egretta thula* | --/-- | Short-eared owl *Asio flammeus* | --/SSC |
| Black-crowned night heron (rookery) *Nycticorax nycticorax* | --/-- | Western burrowing owl *Athene cunicularia hypugea* | --/SSC |
| Great blue heron (rookery) *Ardea herodias* | --/-- | Vaux's swift *Chaetura vauxi* | --/SSC |

| ***Common and Scientific Name*** | ***Legal Status[1] Federal/State/CNPS*** | ***Common and Scientific Name*** | ***Legal Status[1] Federal/State/CNPS*** |
|---|---|---|---|
| White-tailed kite<br>*Elanus leucurus* | --/SFP | Willow flycatcher<br>*Empidonax traillii* | FE/SE |
| Ferruginous hawk<br>*Buteo regalis* | --/WL | Salt marsh common yellowthroat<br>*Geothylpis trichas sinuosa* | --/SSC |
| Northern harrier<br>*Circus cyaneus* | --/SSC | San Pablo song sparrow<br>*Melospiza melodia samuelis* | --/SSC |
| Merlin<br>*Falco columbarius* | --/SSC | Suisun song sparrow<br>*Melospiza melodia maxillaries* | SC/SSC |
| Bald Eagle<br>*Haliaeetus leucocephalus* | FT/SE, SFP | Tricolored blackbird<br>*Agelaius tricolor* | --/SSC |
| California black rail<br>*Laterallus jamaicensis coturniculus* | --/ST | California horned lark<br>*Eremophila alepstris* | --/WL |
| California clapper rail<br>*Rallus longirostris obsoletus* | FE/SE | Western yellow-billed cuckoo<br>*Coccyzus americanus occidentalis* | FT/SE |
| Swainson's hawk<br>*Buteo swainsoni* | --/ST | Golden eagle<br>*Aquila chrysaetos* | --/SFP |
| American peregrine falcon<br>*Falco peregrinus anatum* | --/SFP | Bank swallow<br>*Riparia riparia* | --/ST |
| Grasshopper sparrow<br>*Ammodramus savannarum* | --/SSC | Black swift<br>*Cypseloides niger* | --/SSC |
| Burrowing owl<br>*Athene cunicularia* | --/SSC | Northern spotted owl<br>*Strix occidentalis caurina* | FT/-- |
| Osprey<br>*Pandion haliaetus* | --/WL | Cooper's hawk<br>*Accipiter cooperii* | --/WL |
| Alameda song sparrow<br>*Melospiza melodia pusillula* | --/SSC | Yellow-headed blackbird<br>*Xanthocephalus xanthocephalus* | --/SSC |
| **Mammals** | | | |
| Townsend's big-eared bat<br>*Corynorhinus townsendii* | --/SCT | Greater western mastiff bat<br>*Eumops perotis californicus* | SC/SSC |
| Big free-tailed bat<br>*Nyctinomops macrotis* | --/SSC | Suisun ornate shrew<br>*Sorex ornatus sinuosus* | --/SSC |
| Yuma myotis<br>*Myotis yumanensis* | --/-- | Salt marsh harvest mouse<br>*Reithrodontomys raviventris* | FE/SFP |
| Pallid bat<br>*Antrozous pallidus* | --/SSC | Big free-tailed bat<br>*Nyctinomops macrotis* | --/SSC |
| Hoary bat<br>*Lasiurus cinereus* | --/-- | Bilver-haired bat<br>*Lasionycteris noctivagans* | --/-- |
| Western red bat<br>*Lasiurus blossevillii* | --/SSC | Alameda Island mole<br>*Scapanus latimanus parvus* | --/SSC |
| Angel Island mole<br>*Scapanus latimanus insularis* | --/-- | Salt-marsh wandering shrew<br>*Sorex vagrans halicoetes* | --/SSC |
| San Pablo vole<br>*Microtus californicus sanpabloensis* | --/SSC | Point Reyes jumping mouse<br>*Zapus trinotatus orarius* | --/SSC |
| Southern sea otter<br>*Enhydra lutris nereis* | FT/SFP | American badger<br>*Taxidea taxus* | --/SSC |

Key:

**Federal**
FE = Listed as endangered under the federal Endangered Species Act

FT = Listed as threatened under the federal Endangered Species Act

FC = Federal Candidate

-- = No listing

**State**

SE = Listed as endangered under the California Endangered Species Act

ST = Listed as threatened under the California Endangered Species Act

SCT = Candidate for listing as threatened under the California Endangered Species Act

CR = Listed as rare under the California Native Plant Protection Act. This category is no longer used for newly listed plants, but some plants previously listed as rare retain this designation.

SFP = State fully protected

SSC = State species of special concern

WL = Watch List

-- = No listing

**California Native Plant Society (CNPS)**

1A = Rank 1A species: presumed extirpated in California and either rare or extinct elsewhere.

1B = Rank 1B species: rare, threatened, or endangered in California and elsewhere.

2B = Rank 2B species: rare, threatened, or endangered in California but more common elsewhere.

3 = Rank 3 species: plants about which more information is needed to determine their status.

0.1 = Seriously threatened in California (over 80% of occurrences threatened/high degree and immediacy of threat)

0.2 = Moderately threatened in California (20%-80% occurrences threatened/ moderate degree and immediacy of threat)

Sources: CDFW 2016, CNPS 2016, CDFW 2017, USFWS 2017.

# Appendix C: Hydraulic Studies

This page intentionally left blank.

Appendix C

# Hydraulic Studies

Distribution system components are sized to meet hydraulic requirements based on the demand for the recycled water deliveries, operational considerations for storage, and input from each agency regarding the potential future build-out of their system. This document describes the hydraulic evaluations performed to size distribution facilities. General assumptions and industry standards were applied for sizing pipelines and pump stations for most distribution systems. Where appropriate, detailed hydraulic models were employed to analyze more complex conveyance networks.

## C.1 Basis for Appraisal-Level Cost Estimate

New pipelines are located to convey recycled water between the treatment facility, storage site, existing pipelines and/or use areas. Pipeline routes follow those previously developed and/or approved by agencies during the project development process.

New pipelines are sized using velocity and head loss criteria under peak instantaneous flow conditions to meet defined urban and agricultural demands or storage requirements. General assumptions include:

- Conveyance facilities to use areas are sized to meet the peak hour demand;
- Conveyance facilities to storage sites are sized based on the design flow (typically 150 percent of the average flow);
- New pipelines: 6- to 20-inch-diameter buried “purple” high-pressure polyvinyl chloride;
- New pipelines: greater than 20-inch-diameter buried steep or ductile iron;
- Maximum design velocity: 6 feet per second (fps);
- Maximum system pressure: 215 pounds per square inch (psi);
- Minimum delivery pressure: 55 psi;
- Optimum delivery pressure: 55 to 150 psi; and
- Elevation contour data is obtained from GIS mapping data.

New pipelines are sized to minimize pipe scouring, maximize service life of the piping and valves, manage system headlosses, and maintain a consistent (flat) hydraulic grade line. The calculated required diameter is rounded to the nearest nominal pipe size for costing (see North Bay Water Reuse Program [NBWRP] Phase 2 Feasibility Study Appendix D, section D.2.1.2, for pipeline cost details). Minimum pipeline size is assumed to be 6-inch diameter. In some cases, backbone pipelines are upsized to provide flexibility for system expansion, customer demand variability, and peaking factor variations.

Prior hydraulic models developed in Phase 1 or by the agencies were used when available. Additional hydraulic modeling was conducted for the City of Petaluma distribution projects, as described in Section C.3.

## C.2 General Pump Station Hydraulics

New pump stations are included in projects, where needed, to deliver recycled water to higher elevations or to boost pressures to higher pressure zones. Distribution pump stations are sized to meet customer design flow and pressure service requirements. Pump station total dynamic head is estimated based on change in elevation plus frictional headloss (calculated using the Hazen-Williams equation with a roughness factor of 130) and accounting for other minor losses (at 5 percent). New pump stations are assumed to include one to two operating pumps capable of delivering the required combined capacity, and one additional pump operating as a standby unit. The calculated motor horsepower (based on 80 percent efficiency) for the pump station is rounded to the nearest compatible motor size for pump station costing (see NBWRP Phase 2 Feasibility Study Appendix D, section D.2.1.3, for pumping cost details).

## C.3 General Storage Hydraulics and Operations

Five types of storage facilities are included in the projects. The general hydraulic assumptions are summarized below.

1. **Secondary Seasonal Storage Ponds:** modeled as open basin to store secondary effluent for additional on-demand tertiary treatment. New ponds adjacent to existing storage ponds are assumed to be hydraulically connected, operating at the same water surface elevation. Existing pump stations are used to deliver stored water for additional treatment where possible. Depending on site conditions, pumping may be required to convey secondary effluent from the treatment facility to the new storage pond; pumping may also be required to deliver stored water for additional treatment.
2. **Tertiary Seasonal Storage Ponds:** modeled as open basin to store tertiary water for delivery to the recycled water distribution system. New ponds adjacent to existing storage ponds are assumed to be hydraulically connected, operating at the same water surface elevation. Existing pump stations are used to deliver stored water to use areas where possible. Otherwise, new pump stations would be required.
3. **User Storage Ponds:** small ponds developed on private land to store tertiary water for on-site use. The volume of storage was conservatively capped at 49 acre-feet (AF) due to a California Division of Safety of Dams requirement that all ponds over 50 AF be permitted. It is assumed that a small pump station is required for each of these ponds.
4. **Operational Storage Tanks:** modeled as a closed tank located at high elevations within a pressure zone. Operational storage provides system storage for delivery of recycled water to use areas, while providing points that help stabilize local system pressures. Model assumes each system reservoir refills as recycled water is available.
5. **Covered Operational Storage Ponds:** modeled as a covered reservoir to lessen the impact of isolated peak wastewater treatment plant (WWTP) flows on the system as well as diurnal fluctuations in recycled water demand.

Storage operations modeling is described in greater detail in Section 3.3 of the NBWRP Phase 2 Feasibility Study.

## C.4 Wastewater Treatment Plant Hydraulics and Operations

The study 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 be increased to reflect the peak daily dry weather flow demands of the anticipated local users supplied by the WWTP. Tertiary treatment expansion and phasing for each project were confirmed based on discussions with each agency. No additional WWTP modeling or hydraulic evaluations were performed.

## C.5 Hydraulic Modeling

Independent hydraulic models were developed for the Milliken-Sarco-Tulocay (MST) area and for the City of Petaluma.

### C.5.1 MST Area – Phase 1 Hydraulic Model

The NBWRP Phase 1 Feasibility Study included a hydraulic model to evaluated the transmission system expansion for the MST Area. Based on discussions with Napa Sanitation District, the modeled diameters from this prior study were used to size pipelines for the Northern and Eastern Loops.

### C.5.2 City of American Canyon Hydraulic Model

A hydraulic model was developed for the City of American Canyon as part of their 2016 Recycled Water Master Plan and was used to evaluate the City's entire distribution system at build out. The Title XVI projects included in NBWRP Phase 2 Feasibility Study are a subset of that evaluation.

The model used data from 2015 which included approximately 13 miles of water mains ranging in size from 4 to 20 inches in diameter; approximately 13,800 linear feet of these existing pipelines were not in operation when the model was developed. The distribution system also includes 4 fire hydrants, 50 valves, a pump station (two 50 horsepower pumps each at 650 gallons per minute [gpm], 226 feet of head) located at the American Canyon Water Reclamation Facility (WRF) and a 1.0 million gallon storage tank located in the hills east of Newell Drive. The model concluded that existing facilities can meet existing pumping and storage requirements. However, there will be a pumping capacity shortfall at buildout which would require replacement of the WRF pump station. The model is shown in Figure C-1. The pressures and velocities within the entire buildout distribution meet the standards of the following evaluation criteria:

- Minimum dynamic pressure in system: 10 psi
- Minimum dynamic pressure at meter: 40 psi
- Maximum dynamic pressure in system: 115 psi
- Maximum dynamic pressure at meter: 125 psi
- Maximum flow velocity in pipelines: 7 fps
- Typical flow velocities: 2 to 5 fps
- Design Hazen-Williams "C" Value: 130

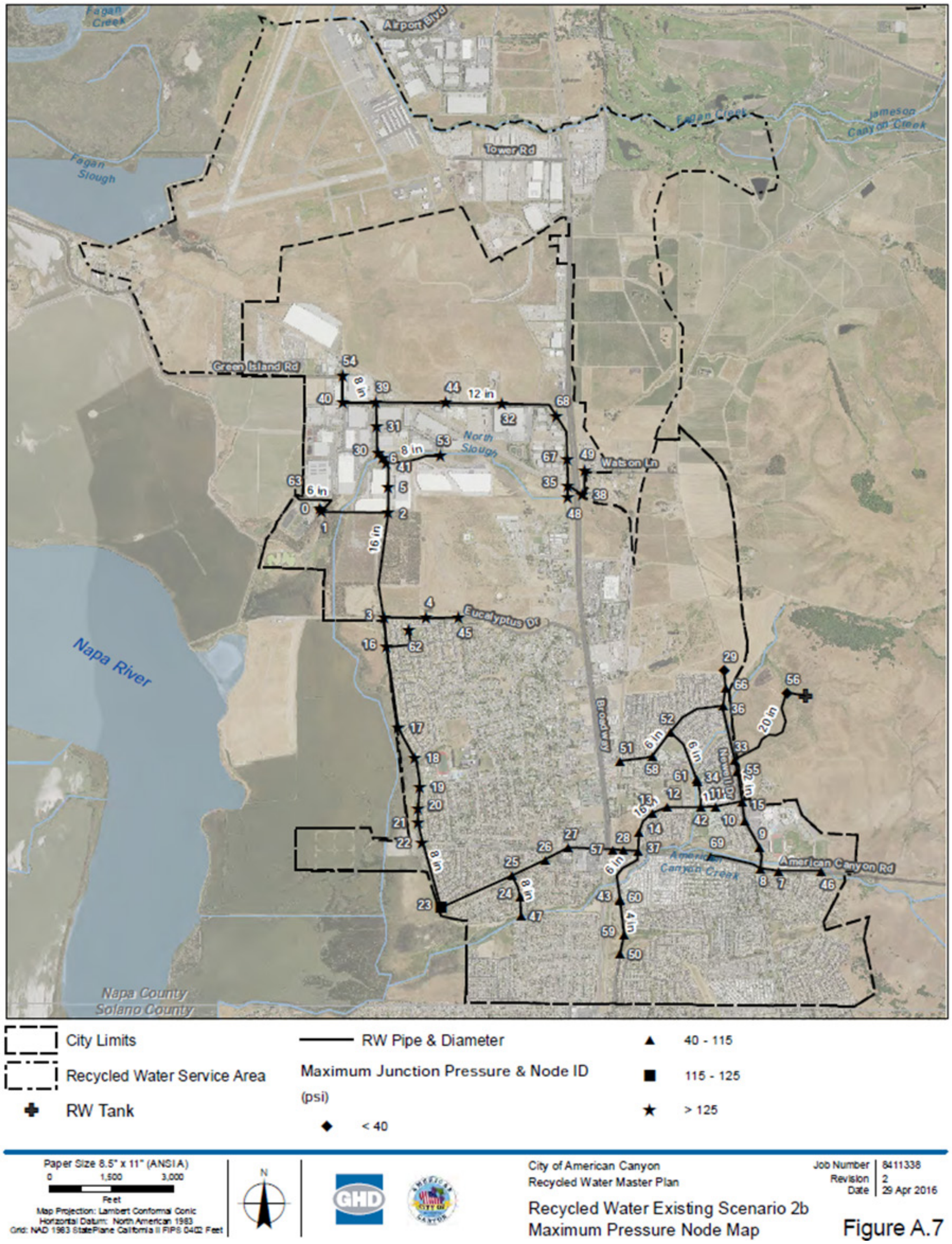



**Figure C-1. City of American Canyon Water Distribution System Water Model**

*Source: GHD 2016*

### C.5.3 City of Petaluma Hydraulic Model

A hydraulic model of the City of Petaluma's recycled water distribution system was developed using InfoWater® using information on existing and projected water demand, existing recycled water mains and existing pump stations provided by the City. Phase 2 pipelines were added into the model based on proposed pipeline sizes provided by the City. The following sections describe background data used for modeling development, model components, demand, and model results.

#### C.5.3.1 Background Data

The following files and information were used for the model development:

- Shapefile of the existing recycled water mains;
- Shapefile of the existing pump station location;
- Urban Recycled Water (URW) Master Plan Map (November 2015);
- Petaluma Phase 2 Projects Map (November 2015);
- URW Pump Station (URWPS) Pump Curves (July 2008);
- Booster Pump Station No. 2 Pump Curve (BPS2); and
- City of Petaluma demands from 'Petaluma Distribution Costs 20160309.xlsx' spreadsheet.

#### C.5.3.2 Model Components

The model data sets are comprised of the following components: pipelines, junctions, reservoirs, pumps, tanks and valves. The following sections described how these model components were developed. The model is shown in Figure C-2.

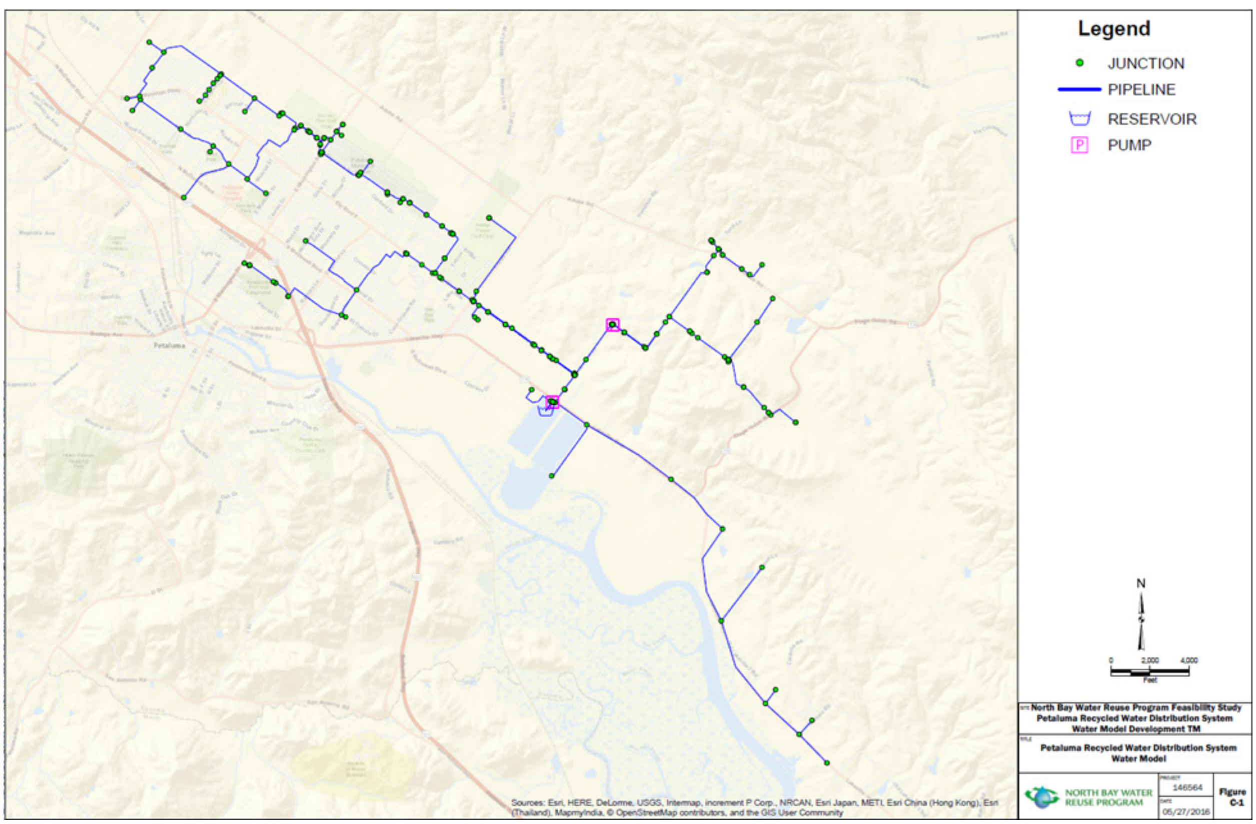



**Figure C-2. City of Petaluma Recycled Water Distribution System Water Model**

**Pipeline.** Using the GIS Gateway tool in InfoWater, existing pipelines 6 inches in diameter and larger were imported into the model from the recycled water mains shapefile. Pipeline data, including pipe length, diameter, and material, were included in the import. The Phase 2 and potential Phase 2 pipelines were manually added into the model based on the alignment shown on the City of Petaluma Phase 2 projects map. The roughness factor for all pipelines was set to 110. This value was selected to provide a conservative basis for hydraulic performance of the City's recycled water distribution system and is not based on actual information. Flow test are needed to calibrate the model and determine actual pipe roughness factors.

**Junctions.** Junctions were automatically added to the ends and intersections of the existing pipeline segments, and the network was reviewed for connectivity errors. Junctions for the Phase 2 and potential Phase 2 pipelines were added manually. The modeled junction elevations represent ground elevations that were obtained using a digital elevation model with 10-meter resolution. The digital elevation model is based on the North American Vertical Datum of 1988 (NAVD 88) vertical coordinate system. A surface was created from the model and elevations were extracted from the surface and assigned to the junctions. Demands were added to the demand data fields for junctions with demands. Demands are discussed further in the following section.

**Reservoir.** A fixed head reservoir was added to simulate the Recycled Water Storage Pond at the water recycling plant. The water surface elevation in the basin is at 16 feet on the National Geodetic Vertical Datum of 1929. The elevation converted to the NAVD 88 datum is 18.71 feet and was used as the reservoir hydraulic grade line (HGL) in the model.

**Pump Stations.** There are two pump stations in the existing recycled water distribution system, the URWPS and the BPS2. The URWPS is located at the water recycling plant. Three pumps were added to the model at the URWPS. Figure C-3 shows the individual pump curve, the pump curves for two and three pumps operating in parallel, and the system curve. The system curve was developed based on providing a minimum pressure of 20 psi at the most challenging node in the system. The individual pump curve was inputted into the model and applied to each pump.

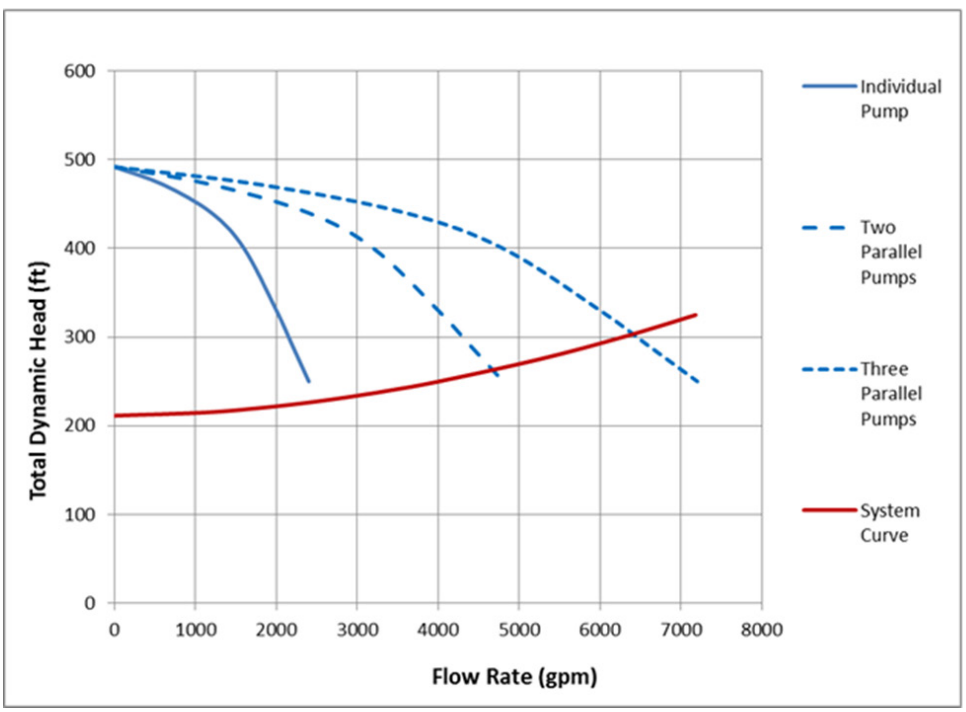



**Figure C-3. URWPS Pump Curves**

BPS2 is located on the corner of Periera Road and Gregory Road. Four pumps were added to the model at the BPS2—three standard pumps and one jockey pump. Figure C-4 shows the pump curves for an individual standard pump, two standard pumps operating in parallel, three standard pumps operating in parallel, and the jockey pump. Figure C-4 also shows the system curve which was developed based on a system pressure of 20 psi on the suction side of the pump station and providing a minimum pressure of 20 psi at the most challenging node in the system that BPS2 serves. The pump curves were inputted into the model and applied to the appropriate pumps.

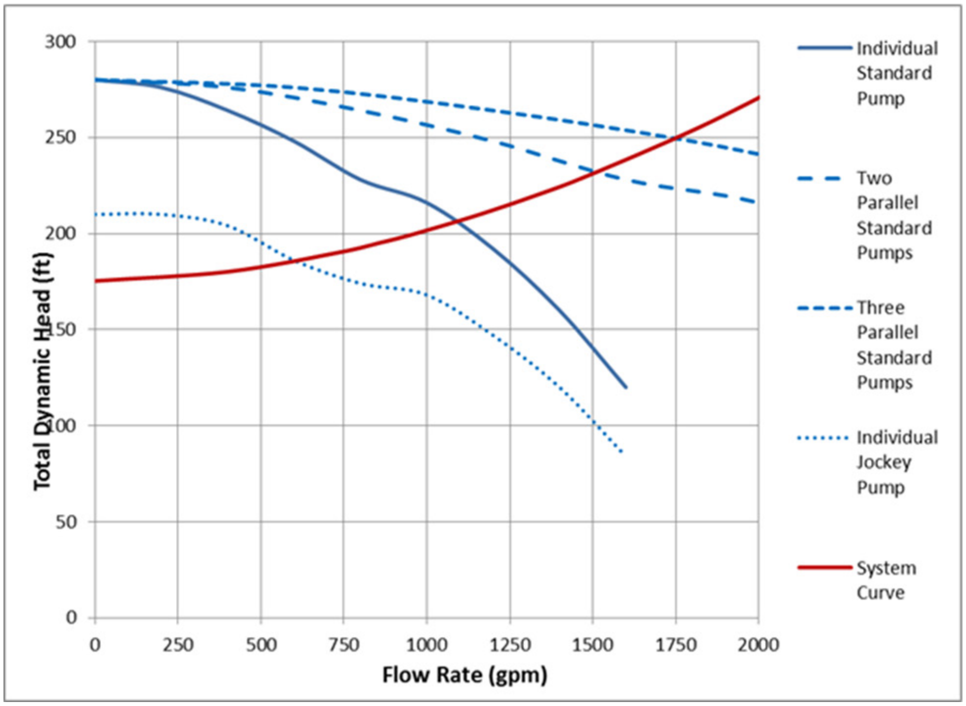



**Figure C-4. BPS2 Pump Curves**

**Tanks.** There are hydropneumatic tanks connected to the discharge header at each pump station to provide a continuous pressure to the system while minimizing pump on/off cycles. The current model does not include hydropneumatic tanks with pump controls. Hydropneumatic tanks can be simulated using small diameter tanks with artificial levels and controls can be added to start and stop pump operation if the ability to perform extended period simulation is desired. There are no tanks in the existing system and, presently, no planned tanks in the future system. Therefore, there are no tanks in the model.

**Valves.** No information was provided on hydraulic valves in the recycled water system; therefore, no valves are included in the model. If there are hydraulic valves in the system, such as pressure reducing valves, the valves and valve settings should be added to the model to create a more accurate representation of the system. Isolation valves do not need to be added to the model as they can be simulated by closing or opening a pipe.

### C.5.3.3 Demands

The demands, given by the City of Petaluma in AF per year (AFY) for each customer, were assumed to be evenly distributed throughout the year to get the average day demand (ADD). These include Agricultural Phase 1, Phase 2, and Phase 3 Demands, and Urban Phase 1B, 2A, 2B, 2C, and 2D demands. Using the maps provided, the demands were assigned to the nearest junction. Three distribution projects were studied under NBWRP Phase 2: (i) Agricultural Phase 1 and Phase 2; (ii) Agricultural Phase 3; and (iii) URW Expansion (Urban Phases 2B and 2C). Urban Phases 1B and 2A are being developed under California Proposition 1 funding. Urban Phase 2D is a potential project that the City of Petaluma is exploring for the future and is not covered under the NBWRP Phase 2 Feasibility Study.

Individual customer information was not available for the existing demands. Total existing demands separated by demand type were provided by the City of Petaluma and are summarized in Table C-1 below. Existing urban demands were assigned to a junction on the west end of the existing distribution system. Existing agricultural/vineyard demands were assigned to a junction on the east end of the existing distribution system.

**Table C-1. Existing Demands**

| Recycled Water Use | Demand Type | Demand (AFY) |
|---|---|---|
| Urban Use | Parks/Schools/Airport | 68 |
| | Greenbelts/Landscape Application Disposal (LAD) | 0 |
| | Golf courses | 22 |
| | Commercial irrigation | 0 |
| | Other | 25 |
| Agricultural Use | Ranchers/Vineyards | 915 |
| | Golf courses | 765 |

Demand type information was retained in the model by using separate demand fields for each demand type. Table C-2 lists the demand field for each demand type:

**Table C-2. Demand Field Type**

| Demand Field | Demand Type |
|---|---|
| Demand 1 | Commercial Irrigation |
| Demand 2 | Golf Course |
| Demand 3 | LAD |
| Demand 4 | Park |
| Demand 5 | School |
| Demand 6 | Agriculture |
| Demand 7 | Vineyard |
| Demand 8 | Other |

Maximum day demands (MDD) and peak hour demands were estimated by applying factors to the ADD. Table C-3 below summarizes the peaking factors used and the basis for the peaking factors.

| Table C-3. Maximum Day and Peak Hour Peaking Factors | | |
|---|---|---|
| Demand | Peaking Factor | Basics |
| MDD | 2.3 | Determined from ratio of maximum monthly demand (occurs in July) to the average monthly demands. |
| Peak Hour Demand – Urban | 6.9 | Urban demands were assumed to occur over an 8-hour period each day, yielding a factor of 3 (24 hours ÷ 8 hours); the peak hour factor was determined by multiplying the maximum day peaking factor of 2.3 by 3. |
| Peak Hour Demand – Agricultural | 2.3 | Agricultural demands were assumed to be even throughout the 24-hour period each day and is equivalent to the maximum day peaking factor of 2.3. |

The total demands are summarized in Table C-4 below.

| Table C-4. System Demands | |
|---|---|
| Demand Condition | Demand (gpm) |
| ADD | 2,725 |
| MDD | 6,268 |
| Peak Hour Demand (PHD) | 9,931 |

The demands related to the projects studied under NBWRP Phase 2 are summarized below in Table C-5.

| Table C-5. URW Expansion and Agricultural Phase 1, 2, and 3 Demands | | | |
|---|---|---|---|
| Demands | ADD | MDD | Peak Hour Demand |
| URW Expansion | 169.71 | 390.33 | 1,171.00 |
| Agricultural Phase 1 | 504.30 | 1,159.89 | 1,159.89 |
| Agricultural Phase 2 | 324.82 | 747.08 | 747.08 |
| Agricultural Phase 3 | 532.53 | 1,224.83 | 1,224.83 |

### C.5.3.4 Evaluation and Model Results

The hydraulic model was used to evaluate whether the City of Petaluma's existing and planned recycled water distribution system facilities have the capacity to meet the following typical criteria:

- Velocity in pipelines less than 10 fps under PHD conditions;
- Minimum pressure in system greater than 20 psi under PHD conditions; and
- Adequate distribution system capacity to supply PHD.

Modeled pipeline velocities were used as the primary criteria for evaluating the proposed project for the Phase 2 Feasibility Study. Figure C-5 shows the velocities in the system under PHD conditions. The modeled velocities in the existing pipelines do not exceed 10 fps. The modeled velocities in the Phase 2 pipelines are low and, along many alignments, less than 2 fps. These results are expected because the pipelines were intentionally upsized by the City of Petaluma to support future expansion. Hydraulic considerations will require detailed review during the design stage to minimize stagnant water in the pipeline. Pressure and pump station capacity would also need to be optimized during the design stage.

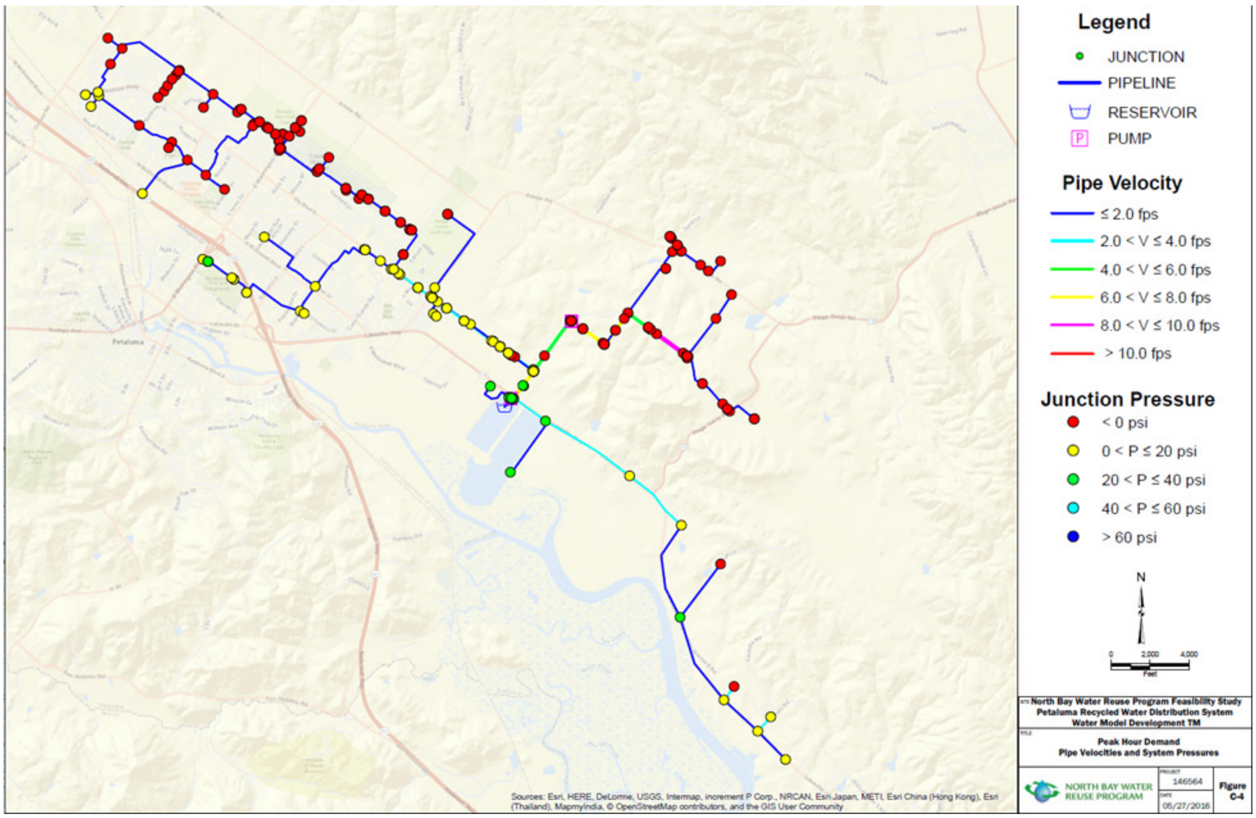



**Figure C-5. Petaluma Proposed Pipeline Velocities under Peak Hour Demand**



Brown AND Caldwell

# References

GHD. 2016. *City of American Canyon – Recycled Water Master Plan.* May 2016.

This page intentionally left blank.

# Appendix D: Basis for Feasibility Construction Cost Estimate

This page intentionally left blank.

## Appendix D

# Basis for Cost Estimates

The U.S. Bureau of Reclamation (USBR) policy requires the preparation of an estimate of the construction and project costs from the time of the initial preliminary investigation through feasibility, final design, and construction until all construction is complete (USBR 2007).

USBR standards utilized for estimating project costs consist of the following:

- FAC TRMR-8, Policy - Cost Estimating (USBR 2006)
- FAC TRMR-9, Directives & Standards - Cost Estimating (USBR 2006a)
- FAC 09-01, Directives & Standards - Cost Estimating (USBR 2007)
- FAC 09-02, Directives & Standards - Construction Cost Estimates and Project Cost Estimates (USBR 2007a)
- BGT 01-04, Directives & Standards - Instructions on Budgeting for Construction – Estimates, Schedules, and Supporting Documents (USBR 1995)
- BGT 01-05, Directives & Standards - Instructions on Budgeting for Operation and Maintenance – Estimates, Schedules, and Supporting Documents (USBR 1995a)

This document describes the basis for the appraisal-level cost estimates for all projects considered for Phase 2 (as described in Section 4 of the North Bay Water Reuse Program (NBWRP) Phase 2 Feasibility Study [Feasibility Study]) and the basis for the feasibility-level cost estimates for the selected Phase 2 Program (as described in Section 5 of the Feasibility Study).

## D.1 Basis for Appraisal-Level Cost Estimate

The appraisal cost estimates used herein determine whether more detailed investigations of a potential project are justified. These estimates are prepared from cost graphs, simple sketches, or rough general designs which use the available site-specific design data. These estimates are intended to be used as an aid by comparing alternative projects for inclusion in the proposed Phase 2 Program. Appraisal cost estimates are not suitable for requesting project authorization or construction fund appropriations from the U.S. Congress due to the early stage of project development.

The appraisal level cost approach is based on the following general assumptions:

- Only major components were incorporated in the cost estimates including distribution pipelines, treatment plant improvements, system storage components, and distribution pump stations.
- All present worth costs are based on cost indices that are measures of the average change in process over time. For this study, the Engineering News Record’s (ENR) Construction Cost Index (CCI) for San Francisco was used.
- Construction bids for Phase 1 projects implemented by participating agencies were reviewed and integrated as appropriate to update unit cost estimates.

Additional assumptions were applied to estimate facility construction contract costs:

- **Distribution Pipelines.** Pipeline costs were based on a unit cost for each pipe size (i.e., dollar per inch-diameter linear foot) using conventional dry trenching techniques. A percent increase for constructability was applied to reflect site-specific geotechnical complexity or currently unknown conditions that could increase construction costs.
- **Pump Stations.** Pumping costs were estimated based on brake horsepower requirements, assuming a redundancy factor, and outside pumps with an enclosed control building. Land acquisition costs for pump stations were not included in the cost estimate.
- **Storage.** The unit cost for constructing earthen storage reservoirs was estimated at approximately $30,000 per acre-feet (AF) of storage created, based on the recently constructed 100-AF storage pond for Sonoma Valley County Sanitation District's (SVCSD) Phase 1 project. The storage tank (concrete and steel) unit cost is based on cost curves for recently constructed projects in the Bay Area and professional experience.
- **Wastewater Treatment Upgrades.** Cost estimates for individual treatment upgrade projects were based on information provided by the applicable member agency, equipment providers or professional experience.
- **Lump Sum or Other Construction Cost.** This includes costs for aquifer storage recovery (ASR) wells and monitoring wells based on recently constructed projects in the Bay Area and professional experience.

The total estimated appraisal level total construction contract costs for the potential Phase 2 projects were presented in Section 4.2.1 of the Feasibility Study. An opinion of probable total project capital costs was estimated based on the USBR Directives and Standards and Engineering Research Center Guidelines which prescribe the following allowances, contingencies, and non-contract cost percentages to be applied:

- **Allowance for Unlisted Items**: a markup of 15 percent of the total construction contract cost was added to account for additional work that may be identified during additional design phases of the project.
- **Contingency**: a markup of 20 percent of the subtotal cost was added to pay contractors for overruns on quantities, changed site conditions, change orders, etc. Contingencies are considered as funds to be used after construction starts and not for design changes or changes in project planning.
- **Opinion of Probable Construction Costs:** reflects an estimate of the capital costs of a feature or project from award to construction closeout. The opinion of probable construction costs equals the construction contract cost plus contingencies. Contingencies are intended to account for costs resulting from changes in design and/or differing site conditions encountered during construction. The opinion of probable construction cost is often called the 'Field Cost' by USBR.
- **Non-Contract Cost:** refers to the costs of work or services provided by consultants/contractors in support of the project. This cost item reflects 25 percent of the opinion of probable construction costs to cover the following items:
  - Preliminary and final design engineering, preparation of construction plans and specifications (11 percent);
  - Construction services including construction management, construction inspection, engineering support during construction, construction surveying, start-up services, and as-built drawings (13 percent); and
  - Project administration, legal support (1 percent).

- **Opinion of Probable Total Project Capital Cost:** the sum of the total opinion of probable construction costs plus non-contract costs. The opinion of probable total project capital cost is often called the 'Construction Cost' by USBR.

The opinion of probable total project capital costs for the proposed list of Phase 2 projects is presented in Section 4.4 of the Feasibility Study.

# D.2 Basis for Feasibility Level Construction Cost Estimate

A feasibility level construction cost estimate was generated for the engineering work completed for the Title XVI, Non-Title XVI, and programmatic-level projects to allow for an economic and financial analysis of the Proposed Program. The resulting construction cost estimates were presented in Section 5 of the Feasibility study. The financial analysis, performed in accordance with Title XVI guidelines, was presented in Section 6 of the Feasibility Study.

This document contains cost criteria and assumptions. Only the major components common to each project were incorporated into the cost estimates including supply pipelines, treatment plant improvements, system storage components, distribution piping, and additional distribution pump station capacity. The estimates also include allowance, contingency, and non-contract costs such as engineering, legal and license fees, and engineering construction services.

Costs are broken down for capital and operation and maintenance (O&M) costs. As discussed in Section 6 of the Feasibility Study, the annual O&M costs are used in conjunction with the anticipated life cycle of project components to evaluate the project economic feasibility.

All present worth costs are based on cost indices that are measures of the average change in process over time. For this study, ENR's CCI for San Francisco is used. This index is widely used for studies and estimates of construction projects and is published quarterly in ENR. All costs in this study are based on a July 2016 CCI of 11,555. Costs are based on an evaluation of recent construction cost experience by each of the participating agencies for their region. Where additional cost guidance from national cost indices was considered, these costs were similarly increased to match a CCI of 11,555.

## D.2.1 Feasibility Level Capital Cost Estimate

A common set of unit costs was used in developing the construction cost estimate for pipelines, site work, earth work, concrete work, and tanks. However, since member agencies' water treatment processes varied significantly, agency-specific treatment costs were used.

The unit costs associated with the project components are described by each project type in the following sections.

### D.2.1.1 Treatment Costs

A common set of unit costs was used in developing the construction cost estimate for pipelines, site work, earth work, concrete work, tanks. However, since member agencies water treatment processes varied significantly, agency-specific treatment costs were used.

The unit costs associated with the project components are described by each project type in the following sections. The treatment plant upgrade projects involve increasing treatment capacity at existing recycled water treatment plants. The treatment processes at each facility differs. Hence, agency-specific treatment costs were used for Novato Sanitation District (SD), Napa SD, the City of Petaluma, the City of American Canyon, and Marin Municipal Water District (MMWD)/ Central Marin Sanitation Agency (CMSA). Treatment upgrades range from $0.8 million per million gallons per day (mgd) (for Napa SD) to $3.3 million per mgd (for Novato SD).

An itemized list of treatment unit costs is shown in Table D-1 below.

**Table D-1. Treatment Unit Costs**

| Treatment Cost Items | Life (years) | Unit Cost ($) | Unit |
|---|---|---|---|
| Novato SD Site Work and Structural | 50 | 1,574,000 | mgd |
| Novato SD Filters | 30 | 194,000 | mgd |
| Novato SD Mechanical and Media | 25 | 660,000 | mgd |
| Novato SD Electrical and Controls | 25 | 500,000 | mgd |
| Novato SD Chlorine Contact Tank | 50 | 386,000 | mgd |
| Napa SD Filters | 30 | 142,000 | mgd |
| Napa SD Mechanical, Pumping and Piping | 25 | 629,000 | mgd |
| Petaluma UV Equipment | 20 | 546,000 | LS |
| Petaluma UV Installation | 20 | 273,000 | LS |
| Petaluma Tertiary Filters | 30 | 4,377,000 | LS |
| Petaluma Polishing Wetland Strainers | 25 | 50,000 | LS |
| Petaluma Tertiary Pumps | 25 | 100,000 | LS |
| City of American Canyon 1st and 2nd Stage RO | 25[1] | 2,277,000 | LS |
| City of American Canyon Modifications to Ponds and Brine Disposal System | 25 | 750,000 | LS |
| City of American Canyon Electrical/I&C | 25 | 455,400 | LS |
| MMWD/CMSA Microfiltration Treatment | 30 | 9,000,000 | mgd |
| MMWD/CMSA Chlorine Contact Tank Retrofit | 50 | 460,000 | LS |

*I&C = Instrumentation and Controls; LS = lump sum; RO = reverse osmosis; UV = ultraviolet.*

### D.2.1.2 Pipeline Costs

The base pipeline cost condition assumes construction through rural land, with conventional cut and cover dry trenching techniques. A pipeline constructability factor was then applied, depending on whether the pipelines are along existing roads or within bay mud.

Costs for pipe sizes, ranging from 4 to 54 inches in diameter, were developed for use in this study. Pipes 18 inches in diameter and smaller were assumed to have the same $13.5 per inch-foot diameter construction unit cost and pipes 20 inches in diameter and larger were assumed to have the same $15.6 per inch-foot diameter construction unit cost. Trenchless crossings costs of $165 per inch-foot unit were assumed for river crossings and miscellaneous crossings (culverts, bridges, etc.). Crossings at major intersections were assumed at $40 per inch-foot diameter unit costs. Pumping costs are accounted for separately.

Aboveground pipeline costs were only developed for the Napa SD State Hospital operational storage project that requires a 24-inch-diameter pipeline.

[1] Cost of Reverse Osmosis (RO) membranes comprise about 40% of this cost and will need to be replaced every 7 years

An itemized list of pipeline unit costs is shown in Table D-2 below.

**Table D-2. Pipeline Unit Costs**

| Pipeline Cost Items | Life (years) | Unit Cost ($) | Unit |
|---|---|---|---|
| 54-inch-diameter | 50 | 841 | LF |
| 36-inch-diameter | 50 | 560 | LF |
| 30-inch-diameter | 50 | 467 | LF |
| 24-inch-diameter | 50 | 374 | LF |
| 20-inch-diameter | 50 | 311 | LF |
| 18-inch-diameter | 50 | 244 | LF |
| 16-inch-diameter | 50 | 217 | LF |
| 12-inch-diameter | 50 | 162 | LF |
| 8-inch-diameter | 50 | 108 | LF |
| 6-inch-diameter | 50 | 81 | LF |
| Miscellaneous Crossing (Trenchless) | 50 | 165 | $/inch-diameter/LF |
| River Crossing (Trenchless) | 50 | 165 | $/inch-diameter/LF |
| Major Intersections | 50 | 40 | $/inch-diameter/LF |
| 24-inch-diameter (above) | 50 | 348 | LF |
| Rock Bracing | 50 | 500 | each |

*LF = linear feet*

### D.2.1.3 Pumping Costs

The following pump station cost model was used to estimate the cost of the pump station:

$$Cost\ of\ Pump\ Station = c\left(a + P^{b}\right) * E * D * W$$

Where,

c = Cost Factor based on actual construction projects, assumed at $3,800

a = Empiral coefficient based on pump station design experience, assumed at 20

b = Empiral coefficient based on pump station design experience, assumed at 0.9

P = Total installed horsepower (HP) of pumps, rounded to nearest compatible pump station motor size

E = Enclosure factor, assumed at 1.00 for pumps with MCCs located outside

D = Drive factor, assumed at 1.10 for variable speed pumps

W = Wet-well factor, assumed at 1.20 for pumps with wet-wells

Land acquisition costs for pump stations are not included in the cost estimate.

For pump stations with 5 HP or less, a lump cost of $50,000 was used. These small pump stations would typically be located near proposed storage ponds.

### D.2.1.4 Storage Costs

Five types of storage facilities are included in the projects. The general storage cost assumptions are summarized below.

- **Secondary Seasonal Storage Ponds, Tertiary Seasonal Storage Ponds and User Storage Ponds.** The storage pond design concept includes the construction of earth berms using available on-site material from excavation of the berms supplemented by imported fill when needed. The ponds are designed to minimize the amount of fill required. Storage ponds are assumed to be open, lined basins.
- Site-specific horizontal to vertical slopes were used (see Appendix F of the Feasibility Study for typical levee cross sections). Cut and fill volumes were estimated based on site-specific topography.
- Lump sum costs were assumed for mobilization, survey and layout, erosion control, and underdrain piping. For earth work, per acre costs for clearing and grubbing, and rough and fine grading were applied; per cubic yard costs for excavation cut, haul, and fill were applied.
- **Operational Storage Tanks.** A steel ground tank is assumed. Storage tank costs do not include foundation costs, which are assumed to be covered by contingencies (see Appendix D.2.1.5). For MMWD/CMSA, agency-specific storage costs of $1,000,000 per million gallons (MG) were provided and used.
- **Covered Operational Storage Ponds.** The storage pond design concept includes the construction of earth berms using available on-site material from excavation of the berms supplemented by imported fill when needed. The ponds are designed to minimize the amount of fill required. Storage ponds are assumed to be covered, lined reservoirs.

  Lump sum costs were assumed for mobilization, survey and layout, erosion control, and underdrain piping. For earth work, per acre costs for clearing and grubbing, and rough and fine grading were applied; per cubic yard costs for excavation cut, haul and fill were applied.

  The operational storage pond cover is assumed to be similar to the floating cover used at the two existing storage ponds at Napa SD.

An itemized list of storage unit costs is shown in Table D-3 below.

**Table D-3. Storage Unit Costs**

| Pipeline Cost Items | Life (years) | Unit Cost ($) | Unit |
|---|---|---|---|
| **Site Work** | | | |
| Mobilization | 50 | 75,000 | LS |
| Survey & Layout | 50 | 25,000 | LS |
| Erosion Controls | 50 | 50,000 | LS |
| Dewatering | 50 | 25,000 | MO |
| Underdrain Piping | 50 | 150,000 | LS |
| Site Work General | 50 | 5% | - |

| Table D-3. Storage Unit Costs | | | |
|---|---|---|---|
| **Pipeline Cost Items** | **Life (years)** | **Unit Cost ($)** | **Unit** |
| **Earthwork** | | | |
| Clear & Grub | 50 | 1,500 | Acre |
| Rough Grading | 50 | 2,500 | Acre |
| Fine Grading | 50 | 3,500 | Acre |
| Excavation Cut + Haul (Clay/Loam) | 50 | 5.3 | CY |
| Excavation Cut and Haul (clay) | 50 | 7.6 | CY |
| Excavation Fill | 50 | 5 | CY |
| Import Material | 50 | 5 | CY |
| **Other Elements** | | | |
| Membrane Liner | 20 | 5 | SY |
| Napa SD Floating Cover | 20 | 561,000 | LS |
| **Treatment at Storage Pond Outlet** | | | |
| Novato SD Filter at all tertiary Storage Pond Outlet | 30 | 312,000 | LS |
| Napa SD Filter at Jameson Site Storage Pond Outlet | 30 | 410,000 | LS |
| **Storage Tank** | | | |
| Steel Ground Tank | 50 | 350,000 | MG |
| **General** | | | |
| Yard Piping | 50 | 5% | - |
| Electrical/I&C and Other | 25 | 20% | - |
| Mobilization/Demobilization | 50 | 5% | - |
| Pipeline Constructability (Bay Mud) | 50 | 30% | - |
| Pipeline Constructability (Along Roads) | 50 | 10% | - |
| Pipeline Constructability (Regular) | 50 | 0% | - |
| Site Development/Foundation | 50 | 5% | - |

*CY = cubic yard; MO = month.*

### D.2.1.5 Allowance, Contingencies, and Non-Contract Costs

The opinion of probable total project capital costs was estimated based on the USBR Directives and Standards and Engineering Research Center Guidelines which prescribe the following allowances, contingencies, and non-contract cost percentages to be applied to the total estimated feasibility level total construction contract costs:

- **Allowance for Unlisted Items:** a markup of 15 percent of the total construction contract cost was added to account for additional work that may be identified during additional design phases of the project.
- **Contingency:** a markup of 20 percent of the subtotal cost was added to pay contractors for overruns on quantities, changed site conditions, change orders, etc. Contingencies are

considered as funds to be used after construction starts and not for design changes or changes in project planning.

- **Opinion of Probable Construction Costs:** reflects an estimate of the capital costs of a feature or project from award to construction closeout. The opinion of probable construction costs equals the construction contract cost plus contingencies. Contingencies are intended to account for costs resulting from changes in design and/or differing site conditions encountered during construction. The opinion of probable construction cost is often called the 'Field Cost' by USBR.
- **Non-Contract Cost:** refers to the costs of work or services provided by consultants/contractors in support of the project. This cost item reflects 25 percent of the opinion of probable construction costs to cover the following items:
  - Preliminary and final design engineering, preparation of construction plans and specifications (11 percent);
  - Construction services including construction management, construction inspection, engineering support during construction, construction surveying, start-up services, and as-built drawings (13 percent); and
  - Project administration, legal support (1 percent).
- **Opinion of Probable Total Project Capital Cost:** the sum of the total opinion of probable construction costs plus non-contract costs. The opinion of probable total project capital cost is often called the 'Construction Cost' by USBR.

### D.2.2 Feasibility-Level O&M Cost Estimate

For the NBWRP Phase 2 Title XVI and Non-Title XVI projects, the O&M costs are estimated to include the following items:

- Energy costs for conveyance and treatment;
- Labor costs for treatment and other maintenance activities (including conveyance and storage facility);
- Chemical costs;
- Miscellaneous maintenance, repair, and replacement costs for pumping, pipelines, and storage facilities;
- Laboratory/regulatory compliance (only for treatment projects); and
- Contingency.

The unit costs associated with the project components are described by each O&M cost category in the following sections.

#### D.2.2.1 Energy Costs

A common energy unit cost of $0.16 per kilowatt-hour (kWh) is used for all projects.

Pumping energy costs are estimated based on the number of hours each pump runs. For seasonal storage projects, pumps are assumed to operate for 3 months per year, 12 hours per day. For ASR projects, pumps are assumed to operate for 6 months per year, 8 hours per day.

Treatment energy costs were estimated based on proposed treatment used at the facility. An energy consumption of 3 kWh per 1,000 gallons and 2 kWh per 1,000 gallons was assumed for treatment with UV and without UV, respectively.

A 5 percent contingency is applied to the sum of treatment and pumping energy requirements. Itemized O&M energy costs are summarized in Table D-4.

| Table D-4. O&M Energy Costs | | |
|---|---|---|
| O&M Energy Cost Items | Unit Cost ($) | Unit |
| Energy Cost | 0.16 | $/kWh |
| Treatment – RO without UV | 4.00 | kWh/1,000 gallons |
| Treatment - without UV | 3.00 | kWh/1,000 gallons |
| Treatment - with UV | 2.00 | kWh/1,000 gallons |
| Energy (other) | 5% | % |

### D.2.2.2 Labor Costs

For Sonoma County Water Agency (SCWA), SVCSD, City of Petaluma and Napa SD, labor costs are estimated based on annual pay (retrieved from publicpay.ca.gov) in March 2016. The annual Sonoma Valley Water Agency Senior Plant Operator pay was used to as the basis for treatment plant labor costs. The annual Sonoma Valley Water Agency Engineering Technician III annual pay was used as the basis for general labor costs.

Novato SD labor costs are based on a composite cost of $85 per hour as provided by Novato SD. The labor cost estimates take into the following consideration the differing levels of labor needed to address the complexity of each project, such as:

- Operational complexity of treatment (filtration, disinfection, UV).
- Maintenance and repair for mechanical components (including I&C) and other infrastructure (pipelines, levees, storage, etc.).
- The labor estimate assumes that the existing full time recycled water program manager(s), administration, and operations staff would be available to perform some of the duties for the new facilities; thus, part-time allocation for tasks is assumed.

Itemized O&M labor costs and assumptions are summarized in Table D-5 below.

| Table D-5. O&M Labor Costs | | |
|---|---|---|
| O&M Energy Cost Items | Unit Cost ($) | Unit |
| Energy Cost | 0.16 | $/kWh |
| Treatment – RO without UV | 4.00 | kWh/1,000 gallons |
| Treatment - without UV | 3.00 | kWh/1,000 gallons |
| Treatment - with UV | 2.00 | kWh/1,000 gallons |
| Energy (other) | 5% | % |
| **Project Type** | | |
| Seasonal storage > 50 AF | 0.50 | FTE |
| Seasonal storage <50 AF | 0.25 | FTE |
| Operational storage | 0.25 | FTE |
| Treatment | 1.00 | FTE |
| Distribution | 0.25 | FTE |
| Groundwater Management – ASR | 0.50 | FTE |
| Groundwater Management – Sonoma Valley Groundwater management & Recharge | 0.25 | FTE |

*FTE = full time employee*

### D.2.2.3 Chemical Costs

For ASR projects, well head chlorination costs are assumed at 0.5 percent of capital costs. For tertiary treatment projects, chemical costs are assumed at $13,000 per mgd per year.

Itemized O&M chemicals costs are summarized in Table D-6 below.

| Table D-6. O&M Chemical Costs | | |
|---|---|---|
| O&M Chemical Cost Items | Unit Cost ($) | Unit |
| Energy Cost | 0.16 | $/kWh |
| Treatment - without UV | 3.00 | kWh/1,000 gallons |
| Treatment - with UV | 2.00 | kWh/1,000 gallons |
| Energy (other) | 5% | % |

### D.2.2.4 General Maintenance Costs

O&M costs to account for general maintenance are also included in the cost estimate.

For treatment and pipeline projects, maintenance costs are estimated at 2 percent and 0.5 percent of project capital costs, respectively. For operational storage tank, environmental enhancement, groundwater management, and recharge and covered operational storage projects, a general maintenance cost of 1 percent of project capital costs is used.

For ASR projects, an annual maintenance cost of $58,000 is assumed. This includes bi-annual well redevelopment and twice a week disposal of backflush water.

For seasonal storage pond projects, unit costs of $90/AF and $150/AF are used for storage ponds smaller than 150 AF and larger than 150 AF, respectively. These costs cover seasonal weed erosion control, periodic groundwater and leakage monitoring, periodic liner repairs, and cleaning of hydraulic structures associated with the ponds.

Itemized O&M maintenance, repair, and replacement costs are summarized in Table D-7 below.

| Table D-7. O&M General Maintenance Costs | | |
|---|---|---|
| O&M General Maintenance Cost Items | Unit Cost ($) | Unit |
| Maintenance - Treatment | 2.0% | % |
| Maintenance - General | 1.0% | % |
| Maintenance - Pipelines | 0.5% | % |
| Maintenance - ASR | 58,000 | $/year |
| Storage Pond (<150 AF) Maintenance | 90 | AF |
| Storage Pond (>150 AF) Maintenance | 150 | AF |

### D.2.2.5 Laboratory/ Regulatory Compliance Costs

Laboratory and regulatory compliance costs will be incurred for treatment projects. This includes additional laboratory sampling and testing, data collection and reporting.

For Napa SD and the City of Petaluma treatment projects, it is assumed that laboratory/regulatory compliance costs will be about 1.25 percent of direct facility costs.

The direct facility costs at Novato SD are higher than Napa SD and the City of Petaluma because a new chlorine contact tank has to be built. Hence, it is assumed that Novato SD's laboratory/regulatory compliance cost will be about 1.25 percent of direct facility costs, excluding the cost of site work, structural work and chlorine contact tank.

#### D.2.2.6 Contingency

A 10 percent contingency is applied to the O&M subtotal costs.

### D.2.3 Feasibility-Level Cycle Cost Estimate

Life-cycle costs are calculated over a 50-year period of analysis using a 3 percent real discount rate. The discount rate reflects the time value of money, indicating that any future costs (or benefits) must be discounted by an appropriate rate for comparing alternatives based on a common point in time. Discount rates used by the utilities are typically the same as the borrowing rates expected over the next several years. While there is no consensus on a single borrowing rate, much of the industry data suggests that a rate of 3 percent would be appropriate and justified.

All Phase 2 Program costs (i.e., capital and O&M and replacement) were combined and brought back to their present value so that the project costs could be represented by a single number, the net present value. The annual costs were developed by including the annualized capital costs, annual O&M costs, and replacement or refurbishment costs for facilities with less than a 50-year life. The annual costs were then divided by the per year water benefits to obtain the Phase 2 Program's cost per AF.

### D.2.4 Capital and O&M Cost Tables

Detailed opinions of probable costs for each Phase 2 project, by agency, are included herein.

# References


USBR. 1995. *Reclamation Manual, Directives and Standards, BGT 01-04, Instructions on Budgeting for Construction – Estimates, Schedules, and Supporting Documents.* September 22, 1995.

USBR. 1995a. *Reclamation Manual, Directives and Standards, BGT 01-05, Instructions on Budgeting for Operation and Maintenance – Estimates, Schedules, and Supporting Documents.* September 22, 1995.

USBR. 2006. *Reclamation Manual, Directives and Standards, FAC TRMR-8, Cost Estimating – Policy.* October 30, 2006.

USBR. 2006a. *Reclamation Manual, Directives and Standards, FAC TRMR-9, Cost Estimating – Directive and Standard.* October 31, 2006.

USBR. 2007. *Reclamation Manual, Directives and Standards, FAC 09-01, Cost Estimating.* October 15, 2007.

USBR. 2007a. *Reclamation Manual, Directives and Standards, FAC 09-02, Construction Cost Estimates and Project Cost Estimates.* October 15, 2007.

SCWA and USBR. 2008. P*hase 3 Engineering and Economic/ Financial Analysis Report for the North San Pablo Bay Restoration and Reuse Project*. Prepared by CDM Smith. June 2008.

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

**Agency:** Novato SD
**Project Type:** Treatment
**Project Title:** Novato SD WRP Capacity - 1st Expansion (+0.85 MGD)

**Prepared By:** DTT, MT
**Date Prepared:** Sep-2016
**K/J Proj. No.** 1468043.00

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| **1.0** | **Pipelines** | | | | **0** | |
| **2.0** | **Pump Stations** | | | | **0** | |
| **3.0** | **North and South Pond** | | | | **0** | |
| **4.0** | **Treatment** | | | | **2,816,400** | |
| 4.1 | Site Work and Structural | 0.85 | MGD | 1,574,000 | 1,337,900 | Based on Novato SD 2011 Phase 1 Recycled Water Facility Constuction Costs with ENRCCI adjustments |
| 4.2 | Filters | 0.85 | MGD | 193,588 | 164,600 | Based on Novato SD 2011 Phase 1 Recycled Water Facility Constuction Costs with ENRCCI adjustments |
| 4.3 | Mechanical and Media | 0.85 | MGD | 659,941 | 561,000 | Based on Novato SD 2011 Phase 1 Recycled Water Facility Constuction Costs with ENRCCI adjustments |
| 4.4 | Electrical and Controls | 0.85 | MGD | 499,706 | 424,800 | Based on Novato SD 2011 Phase 1 Recycled Water Facility Constuction Costs with ENRCCI adjustments |
| 4.5 | Chlorine Contact Tank | 0.85 | MGD | 385,941 | 328,100 | Based on Novato SD 2011 Phase 1 Recycled Water Facility Constuction Costs with ENRCCI adjustments |
| | | | | **Subtotal Direct Facility Costs** | **2,816,400** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $0 | $0 | $0 | $2,816,400 | $0 | **$2,816,400** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $985,740 | **$3,802,140** | $950,535 | **$4,752,675** | **$4.8** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Operational Hours (hr/yr) = | 8760 |
| | | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| | | | | | | Peak Flow Capacity (mgd) = | 0.85 |
| 1.1 | Energy (Treatment) | 190,000 | KWh | 0.16 | 30,400 | Est Ave Annual Flow (mgd) = | 0.26 |
| | | | | | | Assume treament (kwh/1000 gal) = | 2.00 |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | N/A | |
| 1.3 | Energy (other) | 10,000 | KWh | 0.16 | 1,600 | 5% of sum of treatment + pumping energy requirements | |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Novato Labor | 0.5 | No. of Staff | 170,000 | 85,000 | Based on annual salary for full time staff per year including benefits and overhead. | |
| **3.0** | **Chemicals - Tertiary Treatment** | 0.26 | mgd | 13,000 | 3,315 | Based on data from similar projects | |
| **4.0** | **Maintenance - Treatment** | @ | % | 2.0% | 33,320 | % of Direct Facility Costs, excluding site work and structural and chlorine contact tank | |
| **6.0** | **Lab / Regulatory Compliance** | @ | % | 1.25% | 20,772 | % of Direct Facility Costs, excluding site work and structural and chlorine contact tank | |
| **7.0** | **Contingency** | @ | % | 10.0% | 17,441 | % of above O&M costs | |
| | | | | **Annual O&M Costs ($/year)** | **$191,848** | | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$672** | Based on Product Flow (AFY) = | 286 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$2.06** | | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $32,000 | $85,000 | $3,315 | $33,320 | $20,772 | $17,441 | $191,848 |

Engineers Opinion of Probable Costs

## NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | |
|---|---|---|---|
| **Agency:** | Novato SD | **Prepared By:** | DTT, MT |
| **Project Type:** | Treatment | **Date Prepared:** | Sep-2016 |
| **Project Title:** | Novato SD WRP Capacity - 2nd Expansion (+0.85 MGD) | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| **1.0** | **Pipelines** | | | | **0** | |
| **2.0** | **Pump Stations** | | | | **0** | |
| **3.0** | **North and South Pond** | | | | **0** | |
| **4.0** | **Treatment** | | | | **2,816,400** | |
| 4.1 | Site Work and Structural | 0.85 | MGD | 1,574,000 | 1,337,900 | Based on Novato SD 2011 Phase 1 Recycled Water Facility Constuction Costs with ENRCCI adjustments |
| 4.2 | Filters | 0.85 | MGD | 193,588 | 164,600 | Based on Novato SD 2011 Phase 1 Recycled Water Facility Constuction Costs with ENRCCI adjustments |
| 4.3 | Mechanical and Media | 0.85 | MGD | 659,941 | 561,000 | Based on Novato SD 2011 Phase 1 Recycled Water Facility Constuction Costs with ENRCCI adjustments |
| 4.4 | Electrical and Controls | 0.85 | MGD | 499,706 | 424,800 | Based on Novato SD 2011 Phase 1 Recycled Water Facility Constuction Costs with ENRCCI adjustments |
| 4.5 | Chlorine Contact Tank | 0.85 | MGD | 385,941 | 328,100 | Based on Novato SD 2011 Phase 1 Recycled Water Facility Constuction Costs with ENRCCI adjustments |
| | | | | **Subtotal Direct Facility Costs** | **2,816,400** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $0 | $0 | $0 | $2,816,400 | $0 | **$2,816,400** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $985,740 | **$3,802,140** | $950,535 | **$4,752,675** | **$4.8** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Operational Hours (hr/yr) = | 8760 |
| | | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| | | | | | | Peak Flow Capacity (mgd) = | 0.85 |
| 1.1 | Energy (Treatment) | 190,000 | KWh | 0.16 | 30,400 | Est Ave Annual Flow (mgd) = | 0.26 |
| | | | | | | Assume treament (kwh/1000 gal) = | 2.00 |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | N/A | |
| 1.3 | Energy (other) | 10,000 | KWh | 0.16 | 1,600 | 5% | of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Novato Labor | 0.5 | No. of Staff | 170,000 | 85,000 | Based on annual salary for full time staff per year including benefits and overhead. | |
| **3.0** | **Chemicals - Tertiary Treatment** | 0.26 | mgd | 13,000 | 3,315 | Based on data from similar projects | |
| **4.0** | **Maintenance - Treatment** | @ | % | 2.0% | 33,320 | % of Direct Facility Costs, excluding site work and structural and chlorine contact tank | |
| **6.0** | **Lab / Regulatory Compliance** | @ | % | 1.25% | 20,772 | % of Direct Facility Costs, excluding site work and structural and chlorine contact tank | |
| **7.0** | **Contingency** | @ | % | 10.0% | 17,441 | % of above O&M costs | |
| | | | | **Annual O&M Costs ($/year)** | **$191,848** | | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$672** | Based on Product Flow (AFY) = | 286 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$2.06** | | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $32,000 | $85,000 | $3,315 | $33,320 | $20,772 | $17,441 | $191,848 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
Water Supply Reliability through Regional Reuse

**KENNEDY/JENKS CONSULTANTS**

**Prepared By:** DTT, MT
**Date Prepared:** Sep-2016
**K/J Proj. No.** 1468043.00

**Agency:** Novato SD
**Project Type:** Environmental Enhancement
**Project Title:** Marin County Lower Novato Creek Project - Distribution

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **529,500** | |
| 1.1 | WRP effluent to Deer Island | 1,500 | LF | 81 | 121,900 | 6 in-diameter |
| | | | | | | |
| 1.2 | Deer Island ecotone levee | 3,943 | LF | 81 | 320,300 | 6 in-diameter |
| | | | | | | |
| 1.3 | Deer Island cross levee | 337 | LF | 54 | 18,300 | 4 in-diameter |
| | | | | | | |
| 1.4 | Pipelines General | | | | | |
| | *Pipeline Constructability (Along Roads)* | | @ | 10% | 46,000 | Apply % to all pipeline costs to reflect site specific geotechnical complexity with pipeline installation in levee or currently unknown conditions that could increase construction costs |
| | *Mob/demob* | | @ | 5% | 23,000 | |
| | | | | | | |
| | **Subtotal Direct Facility Costs** | | | | **529,500** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $529,500 | $0 | $0 | $0 | $0 | **$529,500** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $185,325 | **$714,825** | $178,706 | **$893,531** | **$0.9** |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

KENNEDY/JENKS CONSULTANTS

**Prepared By:** DTT, MT
**Date Prepared:** Sep-2016
**K/J Proj. No.** 1468043.00

**Agency:** Novato SD
**Project Type:** Environmental Enhancement
**Project Title:** Turnout to Transitional Wetlands

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **326,100** | |
| 1.1 | Stage 1 Truncate Outfall Pipeline | 1 | LS | 100,000 | 100,000 | Per CC study Alt E.1, maintain outfall for emergcy discharges when storage capacity is exceeded, add line item cost to account for hydraulic structure (i.e. sluice gate) to manually activate in emergency |
| | | | | | | |
| 1.2 | Stage 1 Secondary Eff Pipeline to Wetland | 100 | LF | 841 | 84,100 | 54 **in-diameter** |
| | | | | | | |
| 1.3 | Flow Splitting Structure | 1 | LS | 100,000 | 100,000 | |
| | | | | | | |
| 1.4 | Pipelines General | | | | | |
| | *Pipeline Constructability (Along Roads)* | | @ | 10% | 28,000 | |
| | *Mob/demob* | | @ | 5% | 14,000 | |
| | | | | | | |
| | **Subtotal Direct Facility Costs** | | | | **326,100** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $326,100 | $0 | $0 | $0 | $0 | **$326,100** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $114,135 | **$440,235** | $110,059 | **$550,294** | **$0.6** |

**Note: O&M costs not provided for this project**

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | | |
|---|---|---|---|---|
| **Agency:** | Novato SD | | **Prepared By:** | DTT, MT |
| **Project Type:** | Seasonal Storage | | **Date Prepared:** | Sep-2016 |
| **Project Title:** | Option 1: Site Near Highway 37 (Tertiary) 150 AF | | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **54,817** | |
| 1.1 | Pipeline from new pond to Deer Island WRP | 250 | LF | 162 | 40,605 | 12 in-diameter |
| | | | | | | |
| 1.2 | Pipelines General | | | | | |
| | *Pipeline Constructability (Bay Mud)* | 250 | LF @ | 30% | 12,182 | Apply to length of pipeline affected. Bay mud / Alluvium |
| | *Mob/demob* | 0 | LF @ | 5% | 2,030 | Apply to direct costs |
| | | | | | | |
| **2.0** | **Pump Stations** | | | | **50,000** | |
| 2.1 | New pump station from pond to existing 400 HP pump at Deer Island WRP | | | | | 1 duty, 0 standby |
| | Pump Station | 1 | LS | 50,000 | 50,000 | 1,042 gpm |
| | | | | | | 5 hp |
| 2.2 | Pump Station General | | | | | Assume included in lump sum cost above |
| | *Yard Piping* | | @ | 5% | | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | | @ | 20% | | Includes communication to existing system |
| | *Site Work General* | | @ | 5% | | applies to PS facility costs (Includes grading, erosion control, cut/fill, etc.) |
| | *Mob/demob* | | @ | 5% | | apply to direct costs |
| | | | | | | |
| **3.0** | **Storage Pond 1** | | | | **2,939,668** | |
| | Storage Volume | 153 | AF | | | |
| | Depth | 9 | LF | | | |
| | Surface Area | 18 | Acre | | | |
| | Perimeter | 3,980 | LF | | | |
| | Approx Wetted Area | 805,415 | SF | | | |
| 3.1 | Site work | | | | | Includes survey, dewatering, liner, etc |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | MO | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 3.2 | Earthwork | | | | | |
| | *Clear & Grub* | 17.7 | Acre | 1,500 | 26,550 | |
| | *Rough Grading* | 17.7 | Acre | 2,500 | 44,250 | |
| | *Fine Grading* | 17.7 | Acre | 3,500 | 61,950 | |
| | *Excavation Cut + Haul (Clay)* | 128,300.0 | CY | 8 | 975,080 | |
| | *Excavation Fill* | 30,100.0 | CY | 5 | 150,500 | |
| | *Import Material* | 30,100.0 | CY | 5 | 150,500 | |
| 3.3 | Concrete | | | | | |
| | *Weir Box* | 2.0 | LS | 40,000 | 80,000 | |
| 3.4 | Mechanical | | | | | |
| | | | | | | |
| 3.5 | Other Elements | | | | | |
| | *Membrane Liner* | 89,490.6 | SY | 5 | 447,453 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0 | SF | 5 | 0 | |
| 3.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | - | 5% | 113,064 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | - | 20% | 452,257 | Includes communication to existing system |
| | *Mob/demob* | 1 | - | 5% | 113,064 | apply to direct costs |
| | | | | | | |
| **4.0** | **Treatment** | | | | **312,000** | |
| 4.1 | Filter at Storage Pond Oulet | | | | | |
| | Novato Filter at Storage Pond Outlet | 1 | LS | 312,000 | 312,000 | |
| | | | | | | |
| | | | | **Subtotal Direct Facility Costs** | **3,356,485** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $54,817 | $50,000 | $2,939,668 | $312,000 | $0 | **$3,356,485** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $1,174,770 | **$4,531,254** | $1,132,814 | **$5,664,068** | **$5.7** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A | |
| 1.2 | Energy (Pumping) | 4,080 | KWh | 0.16 | 653 | Operational Hours (hr/yr) = | 1095 |
| | | | | | | Operational Hours (months/yr) = | 3 |
| | | | | | | Operational Hours (hours/day) = | 12 |
| | | | | | | Total Horsepower (HP) = | 5 |
| 1.3 | Energy (other) | 200 | KWh | 0.16 | 32 | 5% | of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Labor - General | 0.50 | No. of Staff | 75,000 | 37,500 | Based on annual salary for full time staff per year including benefits and overhead. | |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A | |
| **4.0** | **Maintenance** | | | | | | |
| | Storage Pond (>150 AF) Maintenance | 150 | AF | 150 | 22,500 | Based on seasonal weed and erosion control, periodic groundwater and leakage monitoring, and periodic liner repairs (and cleaning hydraulic structures) | |
| **5.0** | **Contingency** | @ | % | 10.0% | 6,068 | % of above O&M costs | |
| | | | | **Annual O&M Costs ($/year)** | **$66,753** | | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$445** | Based on Storage (AFY) = | 150 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$1.37** | | |

| Summary of O&M Costs ($) | | | | | | |
|---|---|---|---|---|---|---|
| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
| $685 | $37,500 | $0 | $22,500 | $0 | $6,068 | $66,753 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | |
|---|---|
| **Agency:** | Novato SD |
| **Project Type:** | Seasonal Storage |
| **Project Title:** | Option 2: Site Near Highway 37 (Secondary) 150 AF |

| | |
|---|---|
| **Prepared By:** | DTT, MT |
| **Date Prepared:** | Sep-2016 |
| **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **1,699,319** | |
| 1.1 | Pipeline between existing effluent storage pond #1 to new pond | 350 | LF | 162 | 56,847 | 12 in-diameter |
| | | | | | | |
| 1.2 | Pipeline between pond back to Novato WRP | 9,000 | LF | 162 | 1,461,780 | 12 in-diameter |
| | | | | | | Assume no special crossings since mostly along ROW and small section of Ag land |
| 1.3 | Pipelines General | | | | | |
| | *Pipeline Constructability (Bay Mud)* | 2,150 | LF @ | 30% | 104,761 | Apply to pipeline linking new pond to effluent storage pond. And to 20% of 1.7 mile pipeline. Bay mud / Alluvium |
| | *Mob/demob* | | LF @ | 5% | 75,931 | Apply to direct costs |
| | | | | | | |
| **2.0** | **Pump Stations** | | | | **50,000** | |
| 2.1 | New pump station from pond to existing 400 HP pump at Deer Island WRP | | | | | 1 duty, 0 standby |
| | Pump Station | 1 | LS | 50,000 | 50,000 | 1,042 gpm |
| | | | | | | 200 hp |
| 2.2 | Pump Station General | | | | | Apply % to all pump station costs |
| | *Yard Piping* | | @ | 5% | | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | | @ | 20% | | Includes communication to existing system |
| | *Site Work General* | | @ | 5% | | applies to PS facility costs (Includes grading, erosion control, cut/fill, etc.) |
| | *Mob/demob* | | @ | 5% | | apply to direct costs |
| | | | | | | |
| **3.0** | **Storage Pond 1** | | | | **2,991,668** | |
| | Storage Volume | 153 | AF | | | |
| | Depth | 9 | LF | | | |
| | Surface Area | 18 | Acre | | | |
| | Perimeter | 3,980 | LF | | | |
| | Approx Wetted Area | 805,415 | SF | | | |
| 3.1 | Site work | | | | | Includes survey, dewatering, liner, etc. - see storage tab |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | MO | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 3.2 | Earthwork | | | | | |
| | *Clear & Grub* | 17.7 | Acre | 1,500 | 26,550 | |
| | *Rough Grading* | 17.7 | Acre | 2,500 | 44,250 | |
| | *Fine Grading* | 17.7 | Acre | 3,500 | 61,950 | |
| | *Excavation Cut + Haul (Clay)* | 128,300.0 | CY | 8 | 975,080 | |
| | *Excavation Fill* | 30,100.0 | CY | 5 | 150,500 | |
| | *Import Material* | 30,100.0 | CY | 5 | 150,500 | |
| 3.3 | Concrete | | | | | |
| | *Weir Box* | 3.0 | LS | 40,000 | 120,000 | |
| 3.4 | Mechanical | | | | | |
| | | | | | | |
| 3.5 | Other Elements | | | | | |
| | *Membrane Liner* | 89,490.6 | SY | 5 | 447,453 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0.0 | SF | 5 | 0 | |
| 3.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | - | 5% | 115,064 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | - | 20% | 460,257 | Includes communication to existing system |
| | *Mob/demob* | 1 | - | 5% | 115,064 | apply to direct costs |
| | | | | | | |
| **4.0** | **Treatment** | | | | **0** | |
| 4.1 | Filter at Storage Pond Oulet | | | | | |
| | Novato Filter at Storage Pond Outlet | 0 | LS | 312,000 | 0 | |
| | | | | | | |
| | | | | **Subtotal Direct Facility Costs** | **4,740,987** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $1,699,319 | $50,000 | $2,991,668 | $0 | $0 | **$4,740,987** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $1,659,345 | **$6,400,333** | $1,600,083 | **$8,000,416** | **$8.0** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A | |
| 1.2 | Energy (Pumping) | 4,080 | KWh | 0.16 | 653 | Operational Hours (hr/yr) = | 1095 |
| | | | | | | Operational Hours (months/yr) = | 3 |
| | | | | | | Operational Hours (hours/day) = | 12 |
| | | | | | | Total Horsepower (HP) = | 5 |
| 1.3 | Energy (other) | 200 | KWh | 0.16 | 32 | 5% of sum of treatment + pumping energy requirements | |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Labor - General | 0.50 | No. of Staff | 75,000 | 37,500 | Based on annual salary for full time staff per year including benefits and overhead. | |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A | |
| **4.0** | **Maintenance** | | | | | | |
| | Storage Pond (>150 AF) Maintenance | 150 | AF | 150 | 22,500 | Based on seasonal weed and erosion control, periodic groundwater and leakage monitoring, and periodic liner repairs (and cleaning hydraulic structures) | |
| **5.0** | **Contingency** | @ | % | 10.0% | 6,068 | % of above O&M costs | |
| | | | | **Annual O&M Costs ($/year)** | **$66,753** | | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$445** | Based on Storage (AFY) = | 150 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$1.37** | | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $685 | $37,500 | $0 | $22,500 | $0 | $6,068 | $66,753 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | |
|---|---|---|---|
| **Agency:** | Novato SD | **Prepared By:** | DTT, MT |
| **Project Type:** | Seasonal Storage | **Date Prepared:** | Sep-2016 |
| **Project Title:** | Option 3: Hamilton Site (Secondary) 150AF | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **5,032,486** | |
| 1.1 | Pipeline between existing 54" outfall pipe to new pond | | | | | |
| | 12 | 250 | LF | 162 | 40,605 | |
| 1.2 | Pipeline between pond back to Novato WRP | | | | | |
| | 12 | 27,500 | LF | 162 | 4,466,550 | |
| 1.3 | Pipelines General | | | | | |
| | *Pipeline Constructability (Bay Mud)* | | LF @ | 30% | 280,175 | Apply to pipeline linking existing 54" outfall to new pond. And to 20% of 5.2 mile pipeline. Bay mud / Alluvium |
| | *Mob/demob* | 27,500 | LF @ | 5% | 225,358 | Apply to direct costs |
| | *Major Intersections* | 500 | LF @ | 40 | 19,799 | Assume 5 special nos of 100 ft special crossings (highways) |
| | | | | | | |
| **2.0** | **Pump Stations** | | | | **945,000** | |
| 2.1 | New pump station from pond back to Novato WRP | | | | | 1 duty, 1 standby |
| | Pump Station | 1 | LS | 700,000 | 700,000 | 1,042 gpm |
| | | | | | | 200 hp |
| 2.2 | Pump Station General | | | | | Apply % to all pump station costs |
| | *Yard Piping* | | @ | 5% | 35,000 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | | @ | 20% | 140,000 | Includes communication to existing system |
| | *Site Work General* | | @ | 5% | 35,000 | applies to PS facility costs (Includes grading, erosion control, cut/fill, etc.) |
| | *Mob/demob* | | @ | 5% | 35,000 | apply to direct costs |
| | | | | | | |
| **3.0** | **Storage Pond 1** | | | | **2,765,371** | |
| | Storage Volume | 155 | AF | | | |
| | Depth | 8 | LF | | | |
| | Surface Area | 21 | Acre | | | |
| | Perimeter | 4,600 | LF | | | |
| | Approx Wetted Area | 931,948 | SF | | | |
| 3.1 | Site work | | | | | Includes survey, dewatering, liner, etc. |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | MO | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 3.2 | Earthwork | | | | | |
| | *Clear & Grub* | 20.6 | Acre | 1,500 | 30,900 | |
| | *Rough Grading* | 20.6 | Acre | 2,500 | 51,500 | |
| | *Fine Grading* | 20.6 | Acre | 3,500 | 72,100 | |
| | *Excavation Cut + Haul (Clay)* | 59,600.0 | CY | 8 | 452,960 | |
| | *Excavation Fill* | 59,700.0 | CY | 5 | 298,500 | |
| | *Import Material* | 59,700.0 | CY | 5 | 298,500 | |
| 3.3 | Concrete | | | | | |
| | *Weir Box* | 2.0 | LS | 40,000 | 80,000 | |
| 3.4 | Mechanical | | | | | |
| | | | | | | |
| 3.5 | Other Elements | | | | | |
| | *Membrane Liner* | 103,549.7 | SY | 5 | 517,749 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0.0 | SF | 5 | 0 | |
| 3.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | - | 5% | 106,360 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | - | 20% | 425,442 | Includes communication to existing system |
| | *Mob/demob* | 1 | - | 5% | 106,360 | apply to direct costs |
| | | | | | | |
| **4.0** | **Treatment** | | | | **0** | |
| 4.1 | Filter at Storage Pond Oulet | | | | | |
| | Filter at Storage Pond Outlet | 0 | LS | 361,000 | 0 | |
| | | | | | | |
| | | | | **Subtotal Direct Facility Costs** | **8,742,857** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $5,032,486 | $945,000 | $2,765,371 | $0 | $0 | **$8,742,857** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $3,060,000 | **$11,802,857** | $2,950,714 | **$14,753,572** | **$14.8** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 163,370 | KWh | 0.16 | 26,139 | Operational Hours (hr/yr) = 1095<br>Operational Hours (months/yr) = 3<br>Operational Hours (hours/day) = 12<br>Total Horsepower (HP) = 200 |
| 1.3 | Energy (other) | 8,170 | KWh | 0.16 | 1,307 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.50 | No. of Staff | 75,000 | 37,500 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance**<br>Storage Pond (>150 AF) Maintenance | 150 | AF | 150 | 22,500 | Based on seasonal weed and erosion control, periodic groundwater and leakage monitoring, and periodic liner repairs (and cleaning hydraulic structures) |
| **5.0** | **Contingency** | @ | % | 10.0% | 8,745 | % of above O&M costs |
| | | | | **Annual O&M Costs ($/year)** | **$96,191** | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$641** | Based on Storage (AFY) = 150 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$1.97** | |

| Summary of O&M Costs ($) | | | | | | |
|---|---|---|---|---|---|---|
| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
| $27,446 | $37,500 | $0 | $22,500 | $0 | $8,745 | $96,191 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | |
|---|---|
| **Agency:** | SVCSD |
| **Project Type:** | Distribution |
| **Project Title:** | 8th Street East and Napa Road Pipelines |
| **Prepared By:** | DTT, MT |
| **Date Prepared:** | Sep-2016 |
| **K/J Proj. No.** | 1468043.00 |
| **Updated By:** | **RG, MS** |
| **Date Updated:** | **Mar-2021** |

| **Item No.** | **Description** | **Qty** | **Units** | **Total Costs $/Unit** | **Total Capital Cost** | **Notes/Source** |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **1,426,589** | |
| 1.1 | Napa Road Pipeline | 4,500 | LF | 108 | 487,260 | 8 **in-diameter** |
| 1.2 | 8th Street East Pipeline (12") | 1,200 | LF | 162 | 194,904 | 12 **in-diameter** |
| 1.3 | 8th Street East Pipeline (8") | 6,200 | LF | 108 | 671,336 | 8 **in-diameter** |
| | | | | | | |
| 1.2 | Pipelines General | | | | | |
| | *Pipeline Constructability (Along Roads)* | | | 10% | 48,726 | Apply % to all pipeline costs to reflect site specific geotechnical complexity with pipeline installation in levee or currently unknown conditions that could increase construction costs |
| | *Mob/Demob* | | | 5% | 24,363 | |
| | | | | | | |
| | **Subtotal Direct Facility Costs** | | | | **1,426,589** | |

| **Summary of Feasibility Level Facility Costs ($)** | | | | | |
|---|---|---|---|---|---|
| **Pipelines** | **Pump Stations** | **Storage** | **Treatment** | **Lump Sum or Other Construction Cost** | **Total Construction Contract Costs** |
| $1,426,589 | $0 | $0 | $0 | $0 | **$1,426,589** |

| **USBR Contingencies ($)** | | | | |
|---|---|---|---|---|
| ***USBR Allowance/ Contingencies (35%)*** | ***Opinion of Probable Const. Costs*** | ***USBR Non-Contract Costs (25%)*** | ***Opinion of Probable Total Project Capital Costs*** | ***Total Project Capital Costs*** |
| *$499,306* | ***$1,925,895*** | *$481,474* | ***$2,407,369*** | ***$2.4*** |

| ***Item No.*** | ***Description*** | ***Qty*** | ***Units*** | ***Total O&M Costs ($/year) $/Unit*** | ***Total O&M Cost*** | ***Notes/Source*** |
|---|---|---|---|---|---|---|
| | ***Annual Operations and Maintenance Costs*** | | | | | |
| ***1.0*** | ***Energy Costs*** | | | | | *N/A* |
| *1.1* | *Energy (Treatment)* | *0* | *KWh* | *0.16* | *0* | *Composite Energy Cost ($/kwh) = 0.16*<br>*N/A* |
| *1.2* | *Energy (Pumping)* | *0* | *KWh* | *0.16* | *0* | *Cost of additional pumping not included in analysis* |
| *1.3* | *Energy (other)* | *0* | *KWh* | *0.16* | *0* | *5% of sum of treatment + pumping energy requirements* |
| ***2.0*** | ***Labor Costs*** | | | | | |
| *2.1* | *Labor - General* | *0.25* | *No. of Staff* | *75,000* | *18,750* | *Based on annual salary for full time staff per year including benefits and overhead.* |
| ***3.0*** | ***Chemicals*** | *0* | *0* | *0* | *0* | *N/A* |
| ***4.0*** | ***Maintenance - Pipelines*** | *@* | *%* | *0.5%* | *7,133* | *% of Direct Facility Costs* |
| ***5.0*** | ***Contingency*** | *@* | *%* | *10.0%* | *2,588* | *% of above O&M costs* |
| | | | | ***Annual O&M Costs ($/year)*** | ***$28,471*** | |
| | | | | ***Annual Unit O&M Costs ($/AF)*** | ***$127*** | *Based on Product Flow (AFY) = 225* |
| | | | | ***Annual Unit O&M Costs ($/1000 gal)*** | ***$0.39*** | |

| ***Summary of O&M Costs ($)*** | | | | | | |
|---|---|---|---|---|---|---|
| ***Energy Costs*** | ***Labor Costs*** | ***Chemicals*** | ***Maintanence*** | ***Lab / Regulatory Compliance*** | ***Contingency*** | ***Total O&M Costs*** |
| *$0* | *$18,750* | *$0* | *$7,133* | *$0* | *$2,588* | *$28,471* |

Engineers Opinion of Probable Costs

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
Water Supply Reliability through Regional Reuse
KENNEDY/JENKS CONSULTANTS

**Prepared By:** DTT, MT
**Date Prepared:** Sep-2016
**K/J Proj. No.** 1468043.00

**Agency:** SVCSD
**Project Type:** Seasonal Storage
**Project Title:** Option 1: Mulas Site (Tertiary) 49 AF

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| **1.0** | **Pipelines** | | | | **0** | |
| 1.1 | Pipelines | | | | | |
| | 12 | 0 | LF | 162 | 0 | Assume existing 12" RW pipeline pass through site is sufficient to fill pond |
| **2.0** | **Storage Pond** | | | | **300,000** | |
| 2.1 | New pump station at pond outlet to serve irrigation needs on site | | | | | |
| | Pump Station | 1 | LS | 300,000 | 300,000 | |
| **3.0** | **Pond** | | | | **1,146,719** | |
| | Storage Volume | 49 | AF | | | |
| | Depth | 10 | LF | | | |
| | Surface Area | 5 | Acre | | | |
| | Perimeter | 1,876 | LF | | | |
| | Approx Wetted Area | 228,239 | SF | | | |
| 3.1 | Site work | | | | | Includes survey, dewatering, liner, etc. |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | MO | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 3.2 | Earthwork | | | | | |
| | *Clear & Grub* | 4.8 | Acre | 1,500 | 7,200 | |
| | *Rough Grading* | 4.8 | Acre | 2,500 | 12,000 | |
| | *Fine Grading* | 4.8 | Acre | 3,500 | 16,800 | |
| | *Excavation Cut + Haul (Clay)* | 20,170.0 | CY | 8 | 153,292 | |
| | *Excavation Fill* | 24,100.0 | CY | 5 | 120,500 | |
| | *Import Material* | 24,100.0 | CY | 5 | 120,500 | |
| 3.3 | Concrete | | | | | |
| | *Weir Box* | 0.0 | LS | 40,000 | 0 | |
| 3.4 | Mechanical | | | | | |
| 3.5 | Other Elements | | | | | |
| | *Membrane Liner* | 25,359.9 | SY | 5 | 126,799 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0.0 | SF | 5 | 0 | |
| 3.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | @ | 5% | 44,105 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | @ | 20% | 176,418 | Includes communication to existing system |
| | *Mob/demob* | 1 | @ | 5% | 44,105 | apply to direct costs |
| **4.0** | **Treatment** | | | | **0** | |
| 4.1 | Filter at Storage Pond Oulet | | | | | |
| | Filter at Storage Pond Outlet | 0 | LS | 361,000 | 0 | |
| | | | | **Subtotal Direct Facility Costs** | **1,446,719** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $0 | $300,000 | $1,146,719 | $0 | $0 | **$1,446,719** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $506,352 | **$1,953,070** | $488,268 | **$2,441,338** | **$2.4** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 49,010 | KWh | 0.16 | 7,842 | Operational Hours (hr/yr) = 1095<br>Operational Hours (months/yr) = 3<br>Operational Hours (hours/day) = 12<br>Total Horsepower (HP) = 60 |
| 1.3 | Energy (other) | 2,450 | KWh | 0.16 | 392 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance** | | | | | |
| | Storage Pond (<=150 AF) Maintenance | 49 | AF | 90 | 4,410 | Based on seasonal weed and erosion control, periodic groundwater and leakage monitoring, and periodic liner repairs (and cleaning hydraulic structures) |
| **5.0** | **Contingency** | @ | % | 10.0% | 3,139 | % of above O&M costs |
| | | | | **Annual O&M Costs ($/year)** | **$34,533** | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$705** | Based on Storage (AFY) = 49 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$2.16** | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $8,234 | $18,750 | $0 | $4,410 | $0 | $3,139 | $34,533 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*
KENNEDY/JENKS CONSULTANTS

**Prepared By:** DTT, MT
**Date Prepared:** Sep-2016
**K/J Proj. No.** 1468043.00

**Agency:** SVCSD
**Project Type:** Seasonal Storage
**Project Title:** Option 2: Robledo Site (Tertiary) 49 AF

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **0** | |
| 1.1 | Pipelines | | | | | |
| | 12 | 0 | LF | 162 | 0 | |
| | | | | | | |
| | | | | | | |
| **2.0** | **Pump Stations** | | | | **0** | |
| | | | | | | |
| 2.1 | Pump Station | 0 | LS | 300,000 | 0 | **A new pump station at pond outlet to serve irrigation needs on site is not included in project cost** |
| | | | | | | |
| **3.0** | **Storage Pond** | | | | **1,258,634** | |
| | Storage Volume | 49 | AF | | | |
| | Depth | 10 | LF | | | |
| | Surface Area | 5 | Acre | | | |
| | Perimeter | 1,876 | LF | | | |
| | Approx Wetted Area | 228,239 | SF | | | |
| 3.1 | Site work | | | | | Includes survey, dewatering, liner, etc. |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | MO | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 3.2 | Earthwork | | | | | |
| | *Clear & Grub* | 4.8 | Acre | 1,500 | 7,200 | |
| | *Rough Grading* | 4.8 | Acre | 2,500 | 12,000 | |
| | *Fine Grading* | 4.8 | Acre | 3,500 | 16,800 | |
| | *Excavation Cut + Haul (Clay)* | 25,508.0 | CY | 8 | 193,861 | |
| | *Excavation Fill* | 28,652.0 | CY | 5 | 143,260 | |
| | *Import Material* | 28,652.0 | CY | 5 | 143,260 | |
| 3.3 | Concrete | | | | | |
| | *Weir Box* | 0.0 | LS | 40,000 | 0 | |
| 3.4 | Mechanical | | | | | |
| | | | | | | |
| 3.5 | Other Elements | | | | | |
| | *Membrane Liner* | 25,359.9 | SY | 5 | 126,799 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0.0 | SF | 5 | 0 | |
| 3.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | @ | 5% | 48,409 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | @ | 20% | 193,636 | Includes communication to existing system |
| | *Mob/demob* | 1 | @ | 5% | 48,409 | apply to direct costs |
| | | | | | | |
| **4.0** | **Treatment** | | | | **0** | |
| 4.1 | Filter at Storage Pond Oulet | | | | | |
| | Filter at Storage Pond Outlet | 0 | LS | 361,000 | 0 | |
| | | | | | | |
| | | | | **Subtotal Direct Facility Costs** | **1,258,634** | |

| Summary of Feasibility Level Facility Costs ($) | | | | | |
|---|---|---|---|---|---|
| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
| $0 | $0 | $1,258,634 | $0 | $0 | **$1,258,634** |

| USBR Contingencies ($) | | | | |
|---|---|---|---|---|
| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
| $440,522 | **$1,699,156** | $424,789 | **$2,123,945** | **$2.1** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | Assume there is sufficient residual pressure in the conveyance system to fill pond |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance** | | | | | |
| | Storage Pond (<=150 AF) Maintenance | 49 | AF | 90 | 4,410 | Based on seasonal weed and erosion control, periodic groundwater and leakage monitoring, and periodic liner repairs (and cleaning hydraulic structures) |
| **5.0** | **Contingency** | @ | % | 10.0% | 2,316 | % of above O&M costs |
| | | | | **Annual O&M Costs ($/year)** | **$25,476** | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$520** | Based on Storage (AFY) = 49 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$1.60** | |

| Summary of O&M Costs ($) | | | | | | |
|---|---|---|---|---|---|---|
| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
| $0 | $18,750 | $0 | $4,410 | $0 | $2,316 | $25,476 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
Water Supply Reliability through Regional Reuse

KENNEDY/JENKS CONSULTANTS

**Agency:** SCWA
**Project Type:** Seasonal Storage
**Project Title:** Valley of the Moon ASR

**Prepared By:** DTT, MT
**Date Prepared:** Sep-2016
**K/J Proj. No.** 1468043.00

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| **1.0** | **Pipelines** | | | | **46,000** | |
| 1.1 | Pipeline A | 468 | LF | 81 | 40,000 | 6 in-diameter |
| 1.2 | Constructability | | | | | |
| | *Pipeline Constructability (Along Roads)* | | @ | 10% | 4,000 | Apply % to all pipeline costs to reflect site specific geotechnical complexity or currently unknown conditions that could increase construction costs |
| | *Mob/demob* | | @ | 5% | 2,000 | |
| **2.0** | **Pump Stations** | | | | **243,000** | |
| 2.3 | Pump station to send water from ASR back into existing VOMWD system (at 150 psi) | | | | | 1 duty, 1 standby |
| | Small Pump Station | 1 | LS | 180,000 | 180,000 | 150 gpm |
| | | | | | | 20 hp |
| 2.4 | Pump Station General | | | | | |
| | *Yard Piping* | | @ | 5% | 9,000 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | | @ | 20% | 36,000 | Includes communication to existing system |
| | *Site Work General* | | @ | 5% | 9,000 | applies to PS facility costs (Includes grading, erosion control, cut/fill, etc.) |
| | *Mob/demob* | | @ | 5% | 9,000 | apply to direct costs |
| **3.0** | **ASR** | | | | **1,888,375** | |
| 3.1 | Well Drilling | 1 | each | 577,991 | 578,000 | |
| 3.2 | Well Equipping | 1 | each | 310,218 | 310,300 | Assumes 1 newly constructed well to be converted to 1 ASR. Uses conceptual level well equipping costs for Sonoma ASR |
| 3.3 | Monitoring Wells | 2 | each | 160,000 | 320,000 | Includes well casing materials and installation. Should consult Hydrogeologist for number of monitoring wells needed. |
| 3.4 | Well head chlorination/dechlorination | 1 | LS | | | Included in Equipping |
| 3.5 | Wells General | | | | | Apply % to all well costs |
| | *Yard Piping* | | @ | 5% | 60,415 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | | @ | 20% | 241,660 | Includes communication to existing system |
| 3.6 | Constructability | | | | | |
| | *Well Constructability* | | @ | 20% | 302,000 | Apply % to all costs to reflect site specific geotechnical complexity or currently unknown conditions that could increase construction costs |
| | *Mob/demob* | | @ | 5% | 76,000 | |
| | | | | **Subtotal Direct Facility Costs** | **2,177,375** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $46,000 | $243,000 | $0 | $0 | $1,888,375 | **$2,177,375** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $762,081 | **$2,939,456** | $734,864 | **$3,674,320** | **$3.7** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A. Only chemical costs | |
| 1.2 | Energy (Pumping) | 49,010 | KWh | 0.16 | 7,842 | Operational Hours (hr/yr) = | 1460 |
| | | | | | | Operational Hours (months/yr) = | 6 |
| | | | | | | Operational Hours (hours/day) = | 8 |
| | | | | | | Total Horsepower (HP) = | 45 |
| 1.3 | Energy (other) | 2,450 | KWh | 0.16 | 392 | 5% | of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Labor - General | 0.50 | No. of Staff | 75,000 | 37,500 | Based on annual salary for full time staff per year including benefits and overhead. | |
| **3.0** | **Chemicals - Wellhead Chlorination** | @ | % | 0.5% | 10,887 | % of Direct Facility Costs | |
| **4.0** | **Maintenance - ASR** | | $/year | 58,000 | 58,000 | Includes bi-annual well redevelopment, twice weekly disposal of backflush water | |
| **5.0** | **Contingency** | @ | % | 10.0% | 11,462 | % of above O&M costs | |
| | | | | **Annual O&M Costs ($/year)** | **$126,083** | | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$1,576** | Based on Est Recharge (AFY) = | 80 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$4.84** | | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $8,234 | $37,500 | $10,887 | $58,000 | $0 | $11,462 | $126,083 |

Engineers Opinion of Probable Costs

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
Water Supply Reliability through Regional Reuse

**Agency:** SCWA
**Project Type:** Seasonal Storage
**Project Title:** Sonoma ASR

**KENNEDY/JENKS CONSULTANTS**
**Prepared By:** DTT, MT
**Date Prepared:** Sep-2016
**K/J Proj. No.** 1468043.00

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **150,000** | |
| 1.1 | Pipeline A | 1,633 | LF | 81 | 130,000 | 6 in-diameter |
| 1.2 | Constructability | | | | | |
| | *Pipeline Constructability (Along Roads)* | | @ | 10% | 13,000 | Apply % to all pipeline costs to reflect site specific geotechnical complexity or currently unknown conditions that could increase construction costs |
| | *Mob/demob* | | @ | 5% | 7,000 | |
| | | | | | | |
| **2.0** | **Pump Stations** | | | | **202,500** | |
| 2.1 | Pump station to send water from ASR back into potable water tank (260 ft) | | | | | 1 duty, 1 standby |
| | Small Pump Station | 1 | each | 50,000 | 150,000 | 113 gpm |
| | | | | | | 10 hp |
| 2.2 | Pump Station General | | | | | |
| | *Yard Piping* | | @ | 5% | 7,500 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | | @ | 20% | 30,000 | Includes communication to existing system |
| | *Site Work General* | | @ | 5% | 7,500 | applies to PS facility costs (Includes grading, erosion control, cut/fill, etc.) |
| | *Mob/demob* | | @ | 5% | 7,500 | apply to direct costs |
| | | | | | | |
| **3.0** | **ASR Wells** | | | | **1,932,375** | |
| 3.1 | Well Conversion to Monitoring Well | 1 | each | 30,000 | 30,000 | Cost for site clearing, pump removal, new sounder, new data logger. |
| 3.2 | Well Drilling | 1 | each | 577,991 | 578,000 | Cost of drilling |
| 2.3 | Well Equipping | 1 | each | 310,218 | 310,300 | Assumes 1 newly constructed well to be converted to 1 ASR. Uses conceptual level well equipping costs for Sonoma ASR |
| 2.4 | Monitoring Wells | 2 | each | 160,000 | 320,000 | Includes well casing materials and installation. Should consult Hydrogeologist for number of monitoring wells needed. |
| 2.5 | Well head chlorination | 1 | LS | | | Included in Equipping |
| 2.6 | Wells General | | | | | Apply % to all well costs |
| | *Yard Piping* | | @ | 5% | 60,415 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | | @ | 20% | 247,660 | Includes communication to existing system |
| 2.7 | Constructability | | | | | Apply % to all costs to reflect site specific geotechnical complexity or currently unknown conditions that could increase construction costs |
| | *Well Constructability* | | @ | 20% | 309,000 | Apply % to all costs to reflect site specific geotechnical complexity or currently unknown conditions that could increase construction costs |
| | *Mob/demob* | | @ | 5% | 77,000 | |
| | **Subtotal Direct Facility Costs** | | | | **2,284,875** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $150,000 | $202,500 | $0 | $0 | $1,932,375 | **$2,284,875** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $799,706 | **$3,084,581** | $771,145 | **$3,855,727** | **$3.9** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A. Only chemical costs |
| 1.2 | Energy (Pumping) | 38,120 | KWh | 0.16 | 6,099 | Operational Hours (hr/yr) = 1460<br>Operational Hours (months/yr) = 6<br>Operational Hours (hours/day) = 8<br>Total Horsepower (HP) = 35 |
| 1.3 | Energy (other) | 1,910 | KWh | 0.16 | 306 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.50 | No. of Staff | 75,000 | 37,500 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals - Wellhead Chlorination** | @ | % | 0.5% | 11,424 | % of Direct Facility Costs |
| **4.0** | **Maintenance - ASR** | | $/year | 58,000 | 58,000 | Includes bi-annual well redevelopment, twice weekly disposal of backflush water |
| **5.0** | **Contingency** | @ | % | 10.0% | 11,333 | % of above O&M costs |
| | | | | **Annual O&M Costs ($/year)** | **$124,662** | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$2,078** | Based on Est Recharge (AFY) = 60 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$6.38** | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $6,405 | $37,500 | $11,424 | $58,000 | $0 | $11,333 | $124,662 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

**Agency:** Petaluma
**Project Type:** Treatment
**Project Title:** Increase ECWRF Capacity

**Prepared By:** DTT, MT
**Date Prepared:** Sep-2016
**K/J Proj. No.** 1468043.00

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **0** | |
| | | | | | | |
| **2.0** | **Pump Stations** | | | | **0** | |
| | | | | | | |
| **3.0** | **Storage** | | | | **0** | |
| | | | | | | |
| **4.0** | **Treatment** | | | | **5,346,400** | |
| 4.1 | Petaluma Tertiary Filters | 1 | LS | $ 4,377,070 | 4,377,100 | Ellis Creek WRF Tertiary Upgrade Project (Carollo, 25 June 2015) |
| 4.2 | Petaluma UV | | | | | |
| | *Petaluma UV Equipment* | 1 | LS | $ 546,132 | 546,200 | Ellis Creek WRF Tertiary Upgrade Project (Carollo, 25 June 2015) |
| | *Petaluma UV Installation* | 1 | LS | $ 273,066 | 273,100 | Ellis Creek WRF Tertiary Upgrade Project (Carollo, 25 June 2015) |
| 4.3 | Petaluma Polishing Wetland Strainers | 1 | LS | $ 50,000 | 50,000 | Ellis Creek WRF Tertiary Upgrade Project (Carollo, 25 June 2015) |
| 4.4 | Petaluma Tertiary Pumps | 1 | LS | $ 100,000 | 100,000 | 2 pumps assumed |
| | **Subtotal Direct Facility Capital Costs** | | | | **5,346,400** | |

*OK*

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $0 | $0 | $0 | $5,346,400 | $0 | **$5,346,400** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $1,871,240 | **$7,217,640** | $1,804,410 | **$9,022,050** | **$9.0** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Operational Hours (hr/yr) = 8760<br>Composite Energy Cost ($/kwh) = 0.16<br>Peak Flow Capacity (mgd) = 2.12 |
| 1.1 | Energy (Treatment) | 700,000 | KWh | 0.16 | 112,000 | Est Ave Annual Flow (mgd) = 0.64<br>Assume treament (kwh/1000 gal) = 3.00 |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | N/A |
| 1.3 | Energy (other) | 40,000 | KWh | 0.16 | 6,400 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - Treatment | 1.0 | No. of Staff | 130,000 | 130,000 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | | $/year | | 14,919 | Based on Petaluma's inputs. Assume 20% of non-energy and non-labor O&M costs for chemicals |
| **4.0** | **Maintenance - Treatment** | | $/year | | 44,756 | Based on Petaluma's inputs. Assume 60% of non-energy and non-labor O&M costs for chemicals |
| **5.0** | **Lab / Regulatory Compliance** | | $/year | | 14,919 | Based on Petaluma's inputs. Assume 20% of non-labor and non-energy O&M costs for to maintenance |
| **6.0** | **Contingency** | @ | % | 10.0% | 32,299 | % of above O&M costs |
| | **Annual O&M Costs ($/year)** | | | | **$355,293** | |
| | **Annual Unit O&M Costs ($/AF)** | | | | **$499** | Based on Product Flow (AFY) = 712 |
| | **Annual Unit O&M Costs ($/1000 gal)** | | | | **$1.53** | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $118,400 | $130,000 | $14,919 | $44,756 | $14,919 | $32,299 | $355,293 |

*Engineers Opinion of Probable Costs*

## *NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis*

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

***KENNEDY/JENKS CONSULTANTS***

| | | | |
|---|---|---|---|
| ***Agency:*** | *Petaluma* | ***Prepared By:*** | *DTT, MT* |
| ***Project Type:*** | *Distribution* | ***Date Prepared:*** | *Sep-2016* |
| ***Project Title:*** | *Urban and Agricultural Pipelines* | ***K/J Proj. No.*** | *1468043.00* |
| | | ***Updated By:*** | ***RG, MS*** |
| | | ***Date Updated:*** | ***Mar-2021*** |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | ***Direct Facility Capital Costs*** | | | | | |
| ***1.0*** | ***Urban Phase 1 Pipelines*** | | | | ***5,978,764*** | |
| *1.1* | *Pipelines* | | | | | |
| | *Phase1.a* | *3,046* | *LF* | *217* | *659,592* | *16 in-diameter* |
| | *Phase1.b* | *6,979* | *LF* | *217* | *1,511,404* | *16 in-diameter* |
| | *Phase1.c* | *3,036* | *LF* | *217* | *657,461* | *16 in-diameter* |
| | *Phase1.d* | *4,382* | *LF* | *217* | *948,943* | *16 in-diameter* |
| | *Phase1.e* | *1,176* | *LF* | *54* | *63,686* | *4 in-diameter* |
| | *Phase1.f* | *335* | *LF* | *108* | *36,271* | *8 in-diameter* |
| | *Phase1.g* | *691* | *LF* | *108* | *74,875* | *8 in-diameter* |
| | *Phase1.h* | *674* | *LF* | *108* | *72,961* | *8 in-diameter* |
| | *Phase1.i* | *3,441* | *LF* | *108* | *372,561* | *8 in-diameter* |
| | *Phase1.j* | *1,777* | *LF* | *108* | *192,414* | *8 in-diameter* |
| | *Phase1.k* | *1,191* | *LF* | *108* | *128,961* | *8 in-diameter* |
| | *Phase1.l* | *2,000* | *LF* | *162* | *324,840* | *12 in-diameter* |
| | *River Crossing (Trenchless)* | *60* | *$/in-dia/LF* | *165* | *178,200* | *18 in-diameter* |
| *1.2* | *Pipelines General* | | | | | |
| | *Pipeline Constructability (Along Roads)* | | | *10%* | *504,397* | |
| | *Mob/demob* | | | *5%* | *252,198* | |
| ***2.0*** | ***Urban Phase 2 Pipelines*** | | | | ***2,688,987*** | |
| *2.1* | *Pipelines* | | | | | |
| | *Phase2.a* | *4,242* | *LF* | *162* | *688,989* | *12 in-diameter* |
| | *Phase2.b* | *3,826* | *LF* | *162* | *621,447* | *12 in-diameter* |
| | *Phase2.c* | *1,505* | *LF* | *162* | *244,450* | *12 in-diameter* |
| | *Phase2.d* | *441* | *LF* | *27* | *11,936* | *2 in-diameter* |
| | *Phase2.e* | *3,340* | *LF* | *162* | *542,540* | *12 in-diameter* |
| | *Phase2.f* | *1,097* | *LF* | *108* | *118,748* | *8 in-diameter* |
| | *Phase2.g* | *1,017* | *LF* | *108* | *110,139* | *8 in-diameter* |
| *2.2* | *Pipelines General* | | | | | |
| | *Pipeline Constructability (Along Roads)* | | | *10%* | *233,825* | |
| | *Mob/demob* | | | *5%* | *116,912* | |
| ***3.0*** | ***Agricultural Pipelines*** | | | | ***14,800,700*** | |
| *3.1* | *Ag Phase 1* | | | | *7,427,853* | |
| *3.1.1* | *Pipelines* | | | | | |
| | *PAg.1* | *6,584* | *LF* | *311* | *2,049,771* | *20 in-diameter* |
| | *Adobe Road Pipeline* | *14,000* | *LF* | *217* | *3,031,840* | *16 in-diameter* |
| | *Miscellaneous Crossing (Trenchless)* | *400* | *$/in-dia/LF* | *165* | *1,584,000* | *24 in-diameter* |
| *3.1.2* | *Pipelines General* | | | | | |
| | *Pipeline Constructability (Along Roads)* | | | *10%* | *508,161* | |
| | *Mob/demob* | | | *5%* | *254,081* | |
| *3.2* | *Ag Phase 2* | | | | *3,515,998* | |
| *3.2.1* | *Pipelines* | | | | | |
| | *PAg.2a* | *7,405* | *LF* | *311* | *2,305,213* | *20 in-diameter* |
| | *PAg.2b* | *3,571* | *LF* | *162* | *580,002* | *12 in-diameter* |
| | *Miscellaneous Crossing (Trenchless)* | *50* | *$/in-dia/LF* | *165* | *198,000* | *24 in-diameter* |
| *3.2.2* | *Pipelines General* | | | | | |
| | *Pipeline Constructability (Along Roads)* | | | *10%* | *288,522* | |
| | *Mob/demob* | | | *5%* | *144,261* | |
| 3.3 | Ag Phase 3 | | | | 3,856,849 | |
| 3.3.1 | Pipelines | | | | | |
| | PAg.3a | 9,154 | LF | 311 | 2,849,686 | 20 in-diameter |
| | PAg.3b | 938 | LF | 81 | 76,175 | 6 in-diameter |
| | PAg.3c | 1,029 | LF | 81 | 83,573 | 6 in-diameter |
| | Miscellaneous Crossing (Trenchless) | 100 | $/in-dia/LF | 165 | 396,000 | 24 in-diameter |
| 3.3.2 | Pipelines General | | | | | |
| | *Pipeline Constructability (Along Roads)* | | @ | 10% | 300,943 | |
| | *Mob/demob* | | @ | 5% | 150,472 | |
| **3.0** | **Storage** | | | | **0** | |
| **4.0** | **Treatment** | | | | **0** | |
| | | | **Subtotal Direct Facility Capital Costs** | | **23,468,451** | |

| | Summary of Feasibility Level Facility Costs ($) | | | | | |
|---|---|---|---|---|---|---|
| | Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
| **TOTAL Urban + Ag Pipelines** | $23,468,451 | $0 | $0 | $0 | $0 | **$23,468,451** |
| **Urban Phase 1** | $5,978,764 | $0 | $0 | $0 | $0 | **$5,978,764** |
| **Urban Phase 2** | $2,688,987 | $0 | $0 | $0 | $0 | **$2,688,987** |
| **Ag Phase 1** | $7,427,853 | $0 | $0 | $0 | $0 | **$7,427,853** |
| **Ag Phase 2** | $3,515,998 | $0 | $0 | $0 | $0 | **$3,515,998** |
| **Ag Phase 3** | $3,856,849 | $0 | $0 | $0 | $0 | **$3,856,849** |

| | USBR Contingencies ($) | | | | |
|---|---|---|---|---|---|
| | USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
| **TOTAL Urban + Ag Pipelines** | $8,213,958 | **$31,682,409** | $7,920,602 | **$39,603,011** | **$39.6** |
| **Urban Phase 1** | $2,092,567 | **$8,071,331** | $2,017,833 | **$10,089,164** | **$10.1** |
| **Urban Phase 2** | $941,146 | **$3,630,133** | $907,533 | **$4,537,666** | **$4.5** |
| **Ag Phase 1** | $2,599,748 | **$10,027,601** | $2,506,900 | **$12,534,502** | **$12.5** |
| **Ag Phase 2** | $1,230,599 | **$4,746,597** | $1,186,649 | **$5,933,246** | **$5.9** |
| **Ag Phase 3** | $1,349,897 | **$5,206,747** | $1,301,687 | **$6,508,434** | **$6.5** |

## Urban Recycled Water Expansion

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | Cost of additional pumping not included in analysis |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance - Pipelines** | @ | % | 0.5% | 43,339 | % of Direct Facility Costs |
| **5.0** | **Contingency** | @ | % | 10.0% | 6,209 | % of above O&M costs |
| | | | | **Annual O&M Costs ($/year)** | **$68,298** | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$306** | Based on Flow (AFY) = 223 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$0.94** | |

| Summary of O&M Costs ($) | | | | | | |
|---|---|---|---|---|---|---|
| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
| $0 | $18,750 | $0 | $43,339 | $0 | $6,209 | $68,298 |

## Agricultural Recycled Water Expansion Phase 1

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | Cost of additional pumping not included in analysis |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance - Pipelines** | @ | % | 0.5% | 37,139 | % of Direct Facility Costs |
| **5.0** | **Contingency** | @ | % | 10.0% | 5,589 | % of above O&M costs |
| | | | | **Annual O&M Costs ($/year)** | **$61,478** | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$55** | Based on Flow (AFY) = 1,113 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$0.17** | |

| Summary of O&M Costs ($) | | | | | | |
|---|---|---|---|---|---|---|
| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
| $0 | $18,750 | $0 | $37,139 | $0 | $5,589 | $61,478 |

## Agricultural Recycled Water Expansion Phase 2

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | Cost of additional pumping not included in analysis |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance - Pipelines** | @ | % | 0.5% | 17,580 | % of Direct Facility Costs |
| **5.0** | **Contingency** | @ | % | 10.0% | 3,633 | % of above O&M costs |
| | | | | **Annual O&M Costs ($/year)** | **$39,963** | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$76** | Based on Flow (AFY) = 524 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$0.23** | |

| Summary of O&M Costs ($) | | | | | | |
|---|---|---|---|---|---|---|
| **Energy Costs** | **Labor Costs** | **Chemicals** | **Maintanence** | **Lab / Regulatory Compliance** | **Contingency** | **Total O&M Costs** |
| $0 | $18,750 | $0 | $17,580 | $0 | $3,633 | $39,963 |

## Agricultural Recycled Water Expansion Phase 3

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | Cost of additional pumping not included in analysis |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance - Pipelines** | @ | % | 0.5% | 19,284 | % of Direct Facility Costs |
| **5.0** | **Contingency** | @ | % | 10.0% | 3,803 | % of above O&M costs |
| | | | | **Annual O&M Costs ($/year)** | **$41,838** | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$49** | Based on Flow (AFY) = 859 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$0.15** | |

| Summary of O&M Costs ($) | | | | | | |
|---|---|---|---|---|---|---|
| **Energy Costs** | **Labor Costs** | **Chemicals** | **Maintanence** | **Lab / Regulatory Compliance** | **Contingency** | **Total O&M Costs** |
| $0 | $18,750 | | $19,284 | $0 | $3,803 | $41,838 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | |
|---|---|---|---|
| **Agency:** | Petaluma | **Prepared By:** | DTT, MT |
| **Project Type:** | Seasonal Storage | **Date Prepared:** | Sep-2016 |
| **Project Title:** | Option 1a: Site Southeast of ECWRF (Secondary) 300 AF | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **109,634** | |
| 1.1 | Pipeline between Pond 2 / 2A | 250 | LF | 162 | 40,605 | 12 in-diameter |
| | | | | | | |
| 1.2 | Pipeline between Pond 3 / 3A | 250 | LF | 162 | 40,605 | 12 in-diameter |
| | | | | | | |
| 1.3 | Pipelines General | | | | | |
| | *Pipeline Constructability (Bay Mud)* | 500 | LF @ | 30% | 24,363 | Apply to length of pipeline affected. Bay mud / Alluvium |
| | *Mob/demob* | | LF @ | 5% | 4,061 | Apply to direct costs |
| | | | | | | |
| **2.0** | **Pump Stations** | | | | **0** | |
| 2.1 | Pump Station | 0 | LS | 0 | 0 | |
| 2.2 | Pump Station General | | | | | Apply % to all pump station costs |
| | *Yard Piping* | | @ | 5% | 0 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | | @ | 20% | 0 | Includes communication to existing system |
| | *Site Work General* | | @ | 5% | 0 | applies to PS facility costs (Includes grading, erosion control, cut/fill, etc.) |
| | *Mob/demob* | | @ | 5% | 0 | apply to direct costs |
| | | | | | | |
| **3.0** | **Storage Pond 1** | | | | **4,186,437** | |
| | Storage Volume | 152 | AF | | | |
| | Depth | 6 | LF | | | |
| | Surface Area | 27 | Acre | | | |
| | Perimeter | 4,600 | LF | | | |
| | Approx Wetted Area | 1,188,361 | SF | | | |
| 3.1 | Site work | | | | | Includes survey, dewatering, liner, etc. - see storage tab |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | LS | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 3.2 | Earthwork | | | | | |
| | *Clear & Grub* | 26.7 | Acre | 1,500 | 40,019 | |
| | *Rough Grading* | 26.7 | Acre | 2,500 | 66,698 | |
| | *Fine Grading* | 26.7 | Acre | 3,500 | 93,378 | |
| | *Excavation Cut + Haul (Clay)* | 225,400.0 | CY | 8 | 1,713,040 | |
| | *Excavation Fill* | 20,200.0 | CY | 5 | 101,000 | |
| | *Import Material* | 20,200.0 | CY | 5 | 101,000 | |
| 3.3 | Concrete | | | | | |
| | *Weir Box* | 3.0 | LS | 40,000 | 120,000 | |
| 3.4 | Mechanical | | | | | |
| | | | | | | |
| 3.5 | Other Elements | | | | | |
| | *Membrane Liner* | 132,040.1 | SY | 5 | 660,201 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0 | SF | 5 | 0 | |
| 3.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | - | 5% | 161,017 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | - | 20% | 644,067 | Includes communication to existing system |
| | *Mob/demob* | 1 | - | 5% | 161,017 | apply to direct costs |
| | | | | | | |
| **4.0** | **Storage Pond 2** | | | | **4,186,437** | |
| | Storage Volume | 152 | AF | | | |
| | Depth | 6 | LF | | | |
| | Surface Area | 27 | Acre | | | |
| | Perimeter | 4,600 | LF | | | |
| | Approx Wetted Area | 1,188,361 | SF | | | |
| 4.1 | Site work | | | | | Includes survey, dewatering, liner, etc. - see storage tab |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | LS | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 4.2 | Earthwork | | | | | |
| | *Clear & Grub* | 26.7 | Acre | 1,500 | 40,019 | |
| | *Rough Grading* | 26.7 | Acre | 2,500 | 66,698 | |
| | *Fine Grading* | 26.7 | Acre | 3,500 | 93,378 | |
| | *Excavation Cut + Haul (Clay)* | 225,400.0 | CY | 8 | 1,713,040 | |
| | *Excavation Fill* | 20,200.0 | CY | 5 | 101,000 | |
| | *Import Material* | 20,200.0 | CY | 5 | 101,000 | |
| 4.3 | Concrete | | | | | |
| | *Weir Box* | 3.0 | LS | 40,000 | 120,000 | |
| 4.4 | Mechanical | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4.5 | Other Elements | | | | | |
| | *Membrane Liner* | 132,040.1 | SY | 5 | 660,201 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0 | SF | 5 | 0 | |
| 4.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | - | 5% | 161,017 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | - | 20% | 644,067 | Includes communication to existing system |
| | *Mob/demob* | 1 | - | 5% | 161,017 | apply to direct costs |
| | **Subtotal Direct Facility Capital Costs** | | | | **8,482,507** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $109,634 | $0 | $8,372,873 | $0 | $0 | **$8,482,507** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $2,968,877 | **$11,451,384** | $2,862,846 | **$14,314,230** | **$14.3** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | N/A - Hydraulically connected with existing ponds, no additional pumping required. |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | N/A |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.50 | No. of Staff | 75,000 | 37,500 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance** | | | | | |
| | Storage Pond (>150 AF) Maintenance | 300 | AF | 150 | 45,000 | Based on seasonal weed and erosion control, periodic groundwater and leakage monitoring, and periodic liner repairs (and cleaning hydraulic structures) |
| **5.0** | **Contingency** | @ | % | 10.0% | 8,250 | % of above O&M costs |
| | **Annual O&M Costs ($/year)** | | | | **$90,750** | |
| | **Annual Unit O&M Costs ($/AF)** | | | | **$303** | Based on Storage (AFY) = 300 |
| | **Annual Unit O&M Costs ($/1000 gal)** | | | | **$0.93** | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $0 | $37,500 | $0 | $45,000 | $0 | $8,250 | $90,750 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | |
|---|---|---|---|
| **Agency:** | Petaluma | **Prepared By:** | DTT, MT |
| **Project Type:** | Seasonal Storage | **Date Prepared:** | Sep-2016 |
| **Project Title:** | Option 1b: Site Southeast of ECWRF (Secondary) 150 AF | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **109,634** | |
| 1.1 | Pipeline between Pond 2 / 2A | 250 | LF | 162 | 40,605 | 12 **in-diameter** |
| | | | | | | |
| 1.2 | Pipeline between Pond 3 / 2A | 250 | LF | 162 | 40,605 | 12 **in-diameter** |
| | | | | | | |
| 1.3 | Pipelines General | | | | | |
| | *Pipeline Constructability (Bay Mud)* | 500 | LF @ | 30% | 24,363 | Apply to length of pipeline affected. Bay mud / Alluvium |
| | *Mob/demob* | | LF @ | 5% | 4,061 | Apply to direct costs |
| | | | | | | |
| **2.0** | **Pump Stations** | | | | **0** | |
| 2.1 | Pump Station | 0 | LS | 0 | 0 | |
| 2.2 | Pump Station General | | | | | Apply % to all pump station costs |
| | *Yard Piping* | | @ | 5% | 0 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | | @ | 20% | 0 | Includes communication to existing system |
| | *Site Work General* | | @ | 5% | 0 | applies to PS facility costs (Includes grading, erosion control, cut/fill, etc.) |
| | *Mob/demob* | | @ | 5% | 0 | apply to direct costs |
| | | | | | | |
| **3.0** | **Storage Pond 1** | | | | **4,238,437** | |
| | Storage Volume | 152 | AF | | | |
| | Depth | 6 | LF | | | |
| | Surface Area | 27 | Acre | | | |
| | Perimeter | 4,600 | LF | | | |
| | Approx Wetted Area | 1,188,361 | SF | | | |
| 3.1 | Site work | | | | | Includes survey, dewatering, liner, etc. - see storage tab |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | LS | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 3.2 | Earthwork | | | | | |
| | *Clear & Grub* | 26.7 | Acre | 1,500 | 40,019 | |
| | *Rough Grading* | 26.7 | Acre | 2,500 | 66,698 | |
| | *Fine Grading* | 26.7 | Acre | 3,500 | 93,378 | |
| | *Excavation Cut + Haul (Clay)* | 225,400.0 | CY | 8 | 1,713,040 | |
| | *Excavation Fill* | 20,200.0 | CY | 5 | 101,000 | |
| | *Import Material* | 20,200.0 | CY | 5 | 101,000 | |
| 3.3 | Concrete | | | | | |
| | *Weir Box* | 4.0 | LS | 40,000 | 160,000 | |
| 3.4 | Mechanical | | | | | |
| | | | | | | |
| 3.5 | Other Elements | | | | | |
| | *Membrane Liner* | 132,040.1 | SY | 5 | 660,201 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0 | SF | 5 | 0 | |
| 3.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | - | 5% | 163,017 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | - | 20% | 652,067 | Includes communication to existing system |
| | *Mob/demob* | 1 | - | 5% | 163,017 | apply to direct costs |
| | | | | | | |
| | | | **Subtotal Direct Facility Capital Costs** | | **4,348,070** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $109,634 | $0 | $4,238,437 | $0 | $0 | **$4,348,070** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $1,521,825 | **$5,869,895** | $1,467,474 | **$7,337,368** | **$7.3** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh)= 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | N/A - Hydraulically connected with existing ponds, no additional pumping required. |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | N/A |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.50 | No. of Staff | 75,000 | 37,500 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance** | | | | | |
| | Storage Pond (<=150 AF) Maintenance | 150 | AF | 90 | 13,500 | Based on seasonal weed and erosion control, periodic groundwater and leakage monitoring, and periodic liner repairs (and cleaning hydraulic structures) |
| **5.0** | **Contingency** | @ | % | 10.0% | 5,100 | % of above O&M costs |
| | | | | **Annual O&M Costs ($/year)** | **$56,100** | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$374** | Based on Storage (AFY) = 150 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$1.15** | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $0 | $37,500 | $0 | $13,500 | $0 | $5,100 | $56,100 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | |
|---|---|---|---|
| **Agency:** | Napa SD | **Prepared By:** | DTT, MT |
| **Project Type:** | Treatment | **Date Prepared:** | Sep-2016 |
| **Project Title:** | Soscol WRF Increased Filter Capacity | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Capital Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **0** | |
| | | | | | | |
| **2.0** | **Pump Stations** | | | | **0** | |
| | | | | | | |
| **3.0** | **Storage** | | | | **0** | |
| | | | | | | |
| **4.0** | **Treatment** | | | | **1,310,000** | Based on NSD WRF Phase 1 Recycled Water Expansion Project |
| 4.1 | Filters | 1.7 | MGD | 141,176 | **240,000** | (CIP #13714) Schedule of Values (not including construction contingencies) |
| 4.2 | Mechanical, Pumping and Piping | 1.7 | MGD | 629,412 | **1,070,000** | |
| | | | | | | |
| | **Subtotal Direct Facility Capital Costs** | | | | **1,310,000** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $0 | $0 | $0 | $1,310,000 | $0 | **$1,310,000** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $458,500 | **$1,768,500** | $442,125 | **$2,210,625** | **$2.2** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Operational Hours (hr/yr) = | 8760 |
| | | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| | | | | | | Peak Flow Capacity (mgd) = | 1.70 |
| 1.1 | Energy (Treatment) | 370,000 | KWh | 0.16 | 59,200 | Est Ave Annual Flow (mgd) = | 0.51 |
| | | | | | | Assume treament (kwh/1000 gal) = | 2.00 |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | N/A | |
| 1.3 | Energy (other) | 20,000 | KWh | 0.16 | 3,200 | 5% | of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Labor - Treatment | 1.0 | No. of Staff | 130,000 | 130,000 | Based on annual salary for full time staff including benefits & overhead | |
| **3.0** | **Chemicals - Tertiary Treatment** | 0.51 | mgd | 13,000 | 6,630 | Based on data from similar projects | |
| **4.0** | **Maintenance - Treatment** | @ | % | 2.0% | 26,200 | % of Direct Facility Costs | |
| **6.0** | **Lab / Regulatory Compliance** | | % | 1.25% | 16,333 | % of Direct Facility Costs | |
| **7.0** | **Contingency** | @ | % | 10.0% | 24,156 | % of above O&M costs | |
| | | | | **Annual O&M Costs ($/year)** | **$265,720** | | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$465** | Based on Project Flow (AFY) = | 571 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$1.43** | | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $62,400 | $130,000 | $6,630 | $26,200 | $16,333 | $24,156 | $265,720 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Level Cost-Analysis

**Agency:** Napa Sanitation District
**Project Type:** Distribution
**Project Title:** MST Northern Loop

**KENNEDY/JENKS CONSULTANTS**
**Prepared By:** DTT, MT
**Date Prepared:** Sep-2016
**K/J Proj. No.** 1468043.00

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Napa MST Pipelines** | | | | **4,495,426** | |
| 1.1 | Pipeline ID | | | | | |
| | 131 | 3,411 | LF | 217 | 738,763 | 16 in-diameter |
| | 151 | 3,682 | LF | 162 | 597,961 | 12 in-diameter |
| | 141 | 2,815 | LF | 108 | 304,855 | 8 in-diameter |
| | 129 | 1,495 | LF | 108 | 161,912 | 8 in-diameter |
| | 139 | 1,790 | LF | 108 | 193,822 | 8 in-diameter |
| | 140 | 805 | LF | 108 | 87,178 | 8 in-diameter |
| | 164 | 1,493 | LF | 108 | 161,704 | 8 in-diameter |
| | 146 | 1,219 | LF | 108 | 132,013 | 8 in-diameter |
| | 142 | 2,765 | LF | 108 | 299,419 | 8 in-diameter |
| | 143 | 2,448 | LF | 162 | 397,573 | 12 in-diameter |
| | 187 | 507 | LF | 108 | 54,917 | 8 in-diameter |
| | 148 | 2,769 | LF | 108 | 299,851 | 8 in-diameter |
| | 144 | 907 | LF | 108 | 98,237 | 8 in-diameter |
| | 210 | 2,345 | LF | 162 | 380,862 | 12 in-diameter |
| | | | | | | |
| 1.2 | Pipelines General | | | | | |
| | Pipeline Constructability (Along Roads) | | | 10% | 390,907 | |
| | *Mob/demob* | | | 5% | 195,453 | |
| | | | | | | |
| | | | | | | |
| **3.0** | **Storage** | | | | **0** | |
| | | | | | | |
| **4.0** | **Treatment** | | | | **0** | |
| | | | | | | |
| | **Subtotal Direct Facility Capital Costs** | | | | **4,495,426** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $4,495,426 | $0 | $0 | $0 | $0 | **$4,495,426** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $1,573,399 | **$6,068,826** | $1,517,206 | **$7,586,032** | **$7.6** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | Cost of additional pumping not included in analysis |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance - Pipelines** | @ | % | 0.5% | 22,477 | % of Direct Facility Costs |
| **5.0** | **Contingency** | @ | % | 10.0% | 4,123 | % of above O&M costs |
| | | | | **Annual O&M Costs ($/year)** | **$45,350** | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$130** | Based on Project Flow (AFY) = 350 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$0.40** | |

| Summary of O&M Costs ($) | | | | | | |
|---|---|---|---|---|---|---|
| **Energy Costs** | **Labor Costs** | **Chemicals** | **Maintanence** | **Lab / Regulatory Compliance** | **Contingency** | **Total O&M Costs** |
| $0 | $18,750 | $0 | $22,477 | $0 | $4,123 | $45,350 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | |
|---|---|---|---|
| **Agency:** | Napa SD | **Prepared By:** | DTT, MT |
| **Project Type:** | Distribution | **Date Prepared:** | Sep-2016 |
| **Project Title:** | MST Eastern Extension | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Napa MST Pipelines** | | | | **2,447,707** | |
| 1.1 | Pipeline ID | | | | | |
| | 137 | 1,973 | LF | 108 | 213,647 | 8 in-diameter |
| | 162 | 963 | LF | 108 | 104,274 | 8 in-diameter |
| | 161 | 967 | LF | 108 | 104,759 | 8 in-diameter |
| | 136 | 2,807 | LF | 162 | 455,909 | 12 in-diameter |
| | 132 | 2,032 | LF | 217 | 440,103 | 16 in-diameter |
| | 185 | 1,721 | LF | 162 | 279,606 | 12 in-diameter |
| | 209 | 650 | LF | 108 | 70,382 | 8 in-diameter |
| | 211 | 3,260 | LF | 108 | 352,993 | 8 in-diameter |
| | 212 | 986 | LF | 108 | 106,768 | 8 in-diameter |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| 1.2 | Pipelines General | | | | | |
| | *Pipeline Constructability (Along Roads)* | | | 10% | 212,844 | |
| | *Mob/demob* | | | 5% | 106,422 | |
| | | | | | | |
| | | | | | | |
| **3.0** | **Storage** | | | | **0** | |
| | | | | | | |
| **4.0** | **Treatment** | | | | **0** | |
| | | | | | | |
| | **Subtotal Direct Facility Capital Costs** | | | | **2,447,707** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $2,447,707 | $0 | $0 | $0 | $0 | **$2,447,707** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $856,698 | **$3,304,405** | $826,101 | **$4,130,506** | **$4.1** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | N/A |
| | | | | | | Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | Cost of additional pumping not included in analysis |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance - Pipelines** | @ | % | 0.5% | 12,239 | % of Direct Facility Costs |
| **5.0** | **Contingency** | @ | % | 10.0% | 3,099 | % of above O&M costs |
| | | | | **Annual O&M Costs ($/year)** | **$34,087** | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$227** | Based on Project Flow (AFY) = 150 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$0.70** | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $0 | $18,750 | $0 | $12,239 | $0 | $3,099 | $34,087 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | |
|---|---|---|---|
| **Agency:** | Napa SD | **Prepared By:** | DTT, MT |
| **Project Type:** | Operational Storage | **Date Prepared:** | Sep-2016 |
| **Project Title:** | Additional Soscol WRF Covered Storage | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **257,761** | |
| 1.1 | Pipelines | | | | | |
| | Pipeline from existing Pond 2 to New Pond 3 | 400 | LF | 374 | 149,426 | 24 in-diameter |
| | Pipeline from New Pond 3 to existing pump station | 200 | LF | 374 | 74,713 | 24 in-diameter |
| | | | | | | |
| 1.2 | Pipelines General | | | | | |
| | *Pipeline Constructability (Along Roads)* | | | 10% | 22,414 | |
| | *Mob/demob* | | | 5% | 11,207 | |
| | | | | | | |
| **2.0** | **Pump Station** | | | | **0** | |
| | | | | | | |
| **3.0** | **Storage** | | | | **728,910** | |
| | | | | | | |
| 3.1 | Site Work General | | | 5% | 34,710 | |
| | | | | | | |
| 3.2 | Earthwork | | | | | |
| | *Clear & Grub* | 0.25 | Acre | 1,500 | 400 | |
| | *Rough Grading* | 0.25 | Acre | 2,500 | 700 | |
| | *Fine Grading* | 0.25 | Acre | 3,500 | 900 | |
| | *Excavation Cut + Haul (Clay/Loam)* | 18,315 | CY | 5 | 96,800 | |
| | *Excavation Fill* | 2,300 | CY | 5 | 11,500 | |
| | *Import Material* | 2,300 | CY | 5 | 11,500 | |
| | | | | | | |
| 3.4 | Other Elements | | | | | |
| | *Membrane Liner* | 2,200 | SY | 5 | 11,000 | |
| | *Napa SD Floating Cover* | 1 | LS | 561,397 | 561,400 | |
| | | | | | | |
| **4.0** | **Treatment** | | | | 0 | |
| | | | | | | |
| | **Subtotal Direct Facility Capital Costs** | | | | **986,671** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $986,671 | $0 | $728,910 | $0 | $0 | **$1,715,581** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $600,453 | **$2,316,034** | $579,008 | **$2,895,042** | **$2.9** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | N/A |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance - General** | @ | % | 1.0% | 17,156 | % of Direct Facility Costs |
| **5.0** | **Contingency** | @ | % | 10.0% | 3,591 | % of above O&M costs |
| 0.0 | | | | **Annual O&M Costs ($/year)** | **$39,496** | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$165** | Based on Water Benefit (AFY) = 240 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$0.51** | Assumes operational storage provides added flexibility; water benefit estimated by additional water available due to filling/emptying the pond weekly during 6 mo. irrigation season |

| Summary of O&M Costs ($) | | | | | | |
|---|---|---|---|---|---|---|
| **Energy Costs** | **Labor Costs** | **Chemicals** | **Maintanence** | **Lab / Regulatory Compliance** | **Contingency** | **Total O&M Costs** |
| $0 | $18,750 | $0 | $17,156 | $0 | $3,591 | $39,496 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
Water Supply Reliability through Regional Reuse

**KENNEDY/JENKS CONSULTANTS**

| | | | |
|---|---|---|---|
| **Agency:** | Napa SD | **Prepared By:** | DTT, MT |
| **Project Type:** | Operational Storage | **Date Prepared:** | Sep-2016 |
| **Project Title:** | Napa State Hospital Storage Tank | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| **1.0** | **Pipelines** | | | | **2,062,859** | |
| 1.1 | Pipeline from MST pipeline to start of park land | 3,062 | LF | 374 | 1,143,859 | 24 in-diameter |
| 1.2 | Pipeline from start of park land to Storage Tank | 1,751 | LF | 348 | 610,000 | 24 (above) in-diameter |
| 1.3 | Rock Bracing | 88 | @ | 500 | 40,000 | At 20 ft intervals after crossing Napa State Hospital fenceline |
| 1.4 | Pipelines General | | | | | Apply % to all pipeline costs to reflect site specific geotechnical complexity or currently unknown conditions that could increase construction costs |
| | *Pipeline Constructability (Along Roads)* | | @ | 10% | 179,000 | |
| | *Mob/demob* | | @ | 5% | 90,000 | |
| **2.0** | **Napa State Hospital Storage Tank** | | | | **2,298,650** | |
| 2.1 | Steel Ground Tank | 5 | MG | 350,250 | 1,751,250 | Assumed cylindrical, steel, above ground tank. ~35 ft tall |
| | *Site Development/Foundation* | | @ | 5% | 87,600 | Includes grading, erosion control, cut/fill, etc. |
| 2.1 | Storage General | | | | | |
| | *Electrical/I&C and other* | | @ | 20% | 367,800 | |
| | *Mob/demob* | | @ | 5% | 92,000 | |
| | **Subtotal Direct Facility Capital Costs** | | | | **4,361,509** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $2,062,859 | $0 | $2,298,650 | $0 | $0 | **$4,361,509** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $1,526,528 | **$5,888,037** | $1,472,009 | **$7,360,047** | **$7.4** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | No additional energy cost associated with this option<br>Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | Pump Operation (hours/year) = 0<br>Total Horsepower (HP)= 0 |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance - General** | @ | % | 1.0% | 43,615 | % of Direct Facility Costs |
| **5.0** | **Contingency** | @ | % | 10.0% | 6,237 | % of above O&M costs |
| 0.0 | **Annual O&M Costs ($/year)** | | | | **$68,602** | |
| | **Annual Unit O&M Costs ($/AF)** | | | | **$160** | Based on Water Benefit (AFY) = 429 |
| | **Annual Unit O&M Costs ($/1000 gal)** | | | | **$0.49** | Assumes operational storage provides added flexibility; water benefit estimated by additional water available due to filling/emptying the pond weekly during 6 mo. irrigation season |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $0 | $18,750 | $0 | $43,615 | $0 | $6,237 | $68,602 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | |
|---|---|---|---|
| **Agency:** | Napa SD | **Prepared By:** | DTT, MT |
| **Project Type:** | Seasonal Storage | **Date Prepared:** | Sep-2016 |
| **Project Title:** | Option 1a: Raise Existing Pond Levees (Secondary) 300 AF | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| **1.0** | **Pipelines** | | | | **285,047** | |
| 1.1 | Extend conveyance pipeline from Pond 1 to discharge into Pond 4 | 1,300 | LF | 162 | 211,146 | 12 in-diameter |
| 1.2 | Pipelines General | | | | | |
| | *Pipeline Constructability (Bay Mud)* | 1,300 | LF @ | 30% | 63,344 | Apply to length of pipeline affected. Bay mud / Alluvium |
| | *Mob/demob* | | LF @ | 5% | 10,557 | Apply to direct costs |
| **2.0** | **Pump Stations** | | | | **50,000** | 1 duty, 0 standby |
| 2.1 | Pump station to lift water from Pond 2 to Pond 1 | 1 | LS | 50,000 | 50,000 | 1,136 gpm |
| | | | | | | 5 hp |
| 2.2 | Pump Station General | | | | | Assume included in pump station cost above for small pump |
| | *Yard Piping* | | @ | 5% | 0 | |
| | *Electrical/I&C and other* | | @ | 20% | 0 | |
| | *Site Work General* | | @ | 5% | 0 | |
| | *Mob/demob* | | @ | 5% | 0 | |
| **3.0** | **Increase Storage Pond 1 Capacity** | | | | **5,530,716** | |
| | Storage Volume | 330 | AF | | | |
| | Depth | 3 | LF | | | |
| | Surface Area | 111 | Acre | | | |
| | Perimeter | 7,154 | LF | | | |
| | Approx Wetted Area | 4,855,828 | SF | | | |
| 3.1 | Site work | | | | | Includes survey, dewatering, liner, etc. - see storage tab |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | MO | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 3.0 | Earthwork | | | | | |
| | *Clear & Grub* | 111.0 | Acre | 1,500 | 166,480 | |
| | *Rough Grading* | 111.0 | Acre | 2,500 | 277,467 | |
| | *Fine Grading* | 111.0 | Acre | 3,500 | 388,454 | |
| | *Excavation Cut + Haul (Clay/Loam)* | 300.0 | CY | 5 | 1,584 | |
| | *Excavation Fill* | 19,773.0 | CY | 5 | 98,865 | |
| | *Import Material* | 19,773.0 | CY | 5 | 98,865 | |
| 3.3 | Concrete | | | | | |
| | *Weir Box* | 5.0 | LS | 40,000 | 200,000 | |
| 3.4 | Mechanical | | | | | |
| 3.5 | Other Elements | | | | | |
| | *Membrane Liner* | 539,536.5 | SY | 5 | 2,697,682 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0 | SF | 5 | 0 | |
| 3.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | - | 5% | 212,720 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | - | 20% | 850,879 | Includes communication to existing system |
| | *Mob/demob* | 1 | - | 5% | 212,720 | apply to direct costs |
| | | | | **Subtotal Direct Facility Capital Costs** | **5,865,763** | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $285,047 | $50,000 | $5,530,716 | $0 | $0 | **$5,865,763** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $2,053,017 | **$7,918,780** | $1,979,695 | **$9,898,475** | **$9.9** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A | |
| 1.2 | Energy (Pumping) | 2,040 | KWh | 0.16 | 326 | Operational Hours (hr/yr) = | 1095 |
| | | | | | | Operational Hours (months/yr) = | 3 |
| | | | | | | Operational Hours (hours/day) = | 12 |
| | | | | | | Total Horsepower (HP) = | 3 |
| 1.3 | Energy (other) | 100 | KWh | 0.16 | 16 | 5% | of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Labor - General | 0.50 | No. of Staff | 75,000 | 37,500 | Based on annual salary for full time staff per year including benefits and overhead. | |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A | |
| **4.0** | **Maintenance** | | | | | | |
| | Storage Pond (>150 AF) Maintenance | 300 | AF | 150 | 45,000 | Based on seasonal weed and erosion control, periodic groundwater and leakage monitoring, and periodic liner repairs (and cleaning hydraulic structures) | |
| **5.0** | **Contingency** | @ | % | 10.0% | 8,284 | % of above O&M costs | |
| | | | | **Annual O&M Costs ($/year)** | **$91,127** | | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$304** | Based on Storage (AFY) = | 300 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$0.93** | | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $342 | $37,500 | $0 | $45,000 | $0 | $8,284 | $91,127 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | |
|---|---|---|---|
| **Agency:** | Napa SD | **Prepared By:** | DTT, MT |
| **Project Type:** | Seasonal Storage | **Date Prepared:** | Sep-2016 |
| **Project Title:** | Option 1b: Raise Existing Pond Levees (Secondary) 1,100 AF | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **0** | |
| 1.1 | Pipeline between Pond 2 / 2A | 0 | LF | 162 | 0 | 12 in-diameter |
| 1.2 | Pipelines General | | | | | |
| | *Pipeline Constructability (Bay Mud)* | 0 | LF @ | 30% | #DIV/0! | Apply to length of pipeline affected. Bay mud / Alluvium |
| | *Mob/demob* | | LF @ | 5% | 0 | Apply to direct costs |
| | | | | | | |
| | | | | | | |
| **2.0** | **Pump Stations** | | | | **364,500** | |
| 2.1 | Pump station to lift water from existing pipeline to higher Pond 1 | | | | | 1 duty, 1 standby |
| | Pump Station | 1 | LS | 270,000 | 270,000 | 3,396 gpm |
| | | | | | | 50 hp |
| 2.2 | Pump Station General | | | | | Apply % to all pump station costs |
| | *Yard Piping* | | @ | 5% | 13,500 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | | @ | 20% | 54,000 | Includes communication to existing system |
| | *Site Work General* | | @ | 5% | 13,500 | applies to PS facility costs (Includes grading, erosion control, cut/fill, etc.) |
| | *Mob/demob* | | @ | 5% | 13,500 | apply to direct costs |
| | | | | | | |
| **3.0** | **Increase Storage Pond 1 Capacity** | | | | **5,530,716** | |
| | Storage Volume | 330 | AF | | | |
| | Depth | 3 | LF | | | |
| | Surface Area | 111 | Acre | | | |
| | Perimeter | 7,154 | LF | | | |
| | Approx Wetted Area | 4,855,828 | SF | | | |
| 3.1 | Site work | | | | | |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | MO | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 3.2 | Earthwork | | | | | |
| | *Clear & Grub* | 111.0 | Acre | 1,500 | 166,480 | |
| | *Rough Grading* | 111.0 | Acre | 2,500 | 277,467 | |
| | *Fine Grading* | 111.0 | Acre | 3,500 | 388,454 | |
| | *Excavation Cut + Haul (Clay/Loam)* | 300.0 | CY | 5 | 1,584 | |
| | *Excavation Fill* | 19,773.0 | CY | 5 | 98,865 | |
| | *Import Material* | 19,773.0 | CY | 5 | 98,865 | |
| 3.3 | Concrete | | | | | |
| | *Weir Box* | 5.0 | LS | 40,000 | 200,000 | |
| 3.4 | Mechanical | | | | | |
| | | | | | | |
| 3.5 | Other Elements | | | | | |
| | *Membrane Liner* | 539,536.5 | SY | 5 | 2,697,682 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0 | SF | 5 | 0 | |
| 3.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | - | 5% | 212,720 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | - | 20% | 850,879 | Includes communication to existing system |
| | *Mob/demob* | 1 | - | 5% | 212,720 | apply to direct costs |

| | | | | | | |
|---|---|---|---|---|---|---|
| **4.0** | **Increase Storage Pond 2, 3, 4 Capacity** | | | | **12,094,982** | |
| | Storage Volume | 705 | AF | | | |
| | Depth | 3 | LF | | | |
| | Surface Area | 236 | Acre | | | |
| | Perimeter | 12,566 | LF | | | |
| | Approx Wetted Area | 10,335,846 | SF | | | |
| 4.1 | Site work | | | | | |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | MO | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 4.2 | Earthwork | | | | | |
| | *Clear & Grub* | 236.4 | Acre | 1,500 | 354,628 | |
| | *Rough Grading* | 236.4 | Acre | 2,500 | 591,047 | |
| | *Fine Grading* | 236.4 | Acre | 3,500 | 827,465 | |
| | *Excavation Cut + Haul (Clay)* | 2,739.0 | CY | 8 | 20,816 | |
| | *Excavation Fill* | 144,274.0 | CY | 5 | 721,370 | Add 5 ft of fill to raise levee 3 ft, to compensate for 2ft of settlement |
| | *Import Material* | 144,274.0 | CY | 5 | 721,370 | |
| 4.3 | Concrete | | | | | |
| | *Weir Box* | 0.0 | LS | 40,000 | 0 | |
| 4.4 | Mechanical | | | | | |
| | | | | | | |
| 4.5 | Other Elements | | | | | |
| | *Membrane Liner* | 1,148,427.3 | SY | 5 | 5,742,136 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0 | SF | 5 | 0 | |
| 4.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | - | 5% | 465,192 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | - | 20% | 1,860,767 | Includes communication to existing system |
| | *Mob/demob* | 1 | - | 5% | 465,192 | apply to direct costs |
| | | | | | | |
| | | | | | | |
| | | | | **Subtotal Direct Facility Capital Costs** | **17,990,198** | |

| Summary of Feasibility Level Facility Costs ($) | | | | | |
|---|---|---|---|---|---|
| **Pipelines** | **Pump Stations** | **Storage** | **Treatment** | **Lump Sum or Other Construction Cost** | **Total Construction Contract Costs** |
| $0 | $364,500 | $17,625,698 | $0 | $0 | **$17,990,198** |

| USBR Contingencies ($) | | | | |
|---|---|---|---|---|
| **USBR Allowance/ Contingencies (35%)** | **Opinion of Probable Const. Costs** | **USBR Non-Contract Costs (25%)** | **Opinion of Probable Total Project Capital Costs** | **Total Project Capital Costs** |
| $6,296,569 | **$24,286,768** | $6,071,692 | **$30,358,460** | **$30.4** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A |
| 1.2 | Energy (Pumping) | 20,420 | KWh | 0.16 | 3,267 | Operational Hours (hr/yr) = 1095<br>Operational Hours (months/yr) = 3<br>Operational Hours (hours/day) = 12<br>Total Horsepower (HP) = 25 |
| 1.3 | Energy (other) | 1,020 | KWh | 0.16 | 163 | 5% of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | |
| 2.1 | Labor - General | 0.50 | No. of Staff | 75,000 | 37,500 | Based on annual salary for full time staff per year including benefits and overhead. |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A |
| **4.0** | **Maintenance** | | | | | |
| | Storage Pond (>150 AF) Maintenance | 1,100 | AF | 150 | 165,000 | Based on seasonal weed and erosion control, periodic groundwater and leakage monitoring, and periodic liner repairs (and cleaning hydraulic structures) |
| **5.0** | **Contingency** | @ | % | 10.0% | 20,593 | % of above O&M costs |
| | | | | **Annual O&M Costs ($/year)** | **$226,523** | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$206** | Based on Storage (AFY) = 1,100 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$0.63** | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $3,430 | $37,500 | $0 | $165,000 | $0 | $20,593 | $226,523 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | | |
|---|---|---|---|---|
| **Agency:** | Napa SD | | **Prepared By:** | DTT, MT |
| **Project Type:** | Seasonal Storage | | **Date Prepared:** | Sep-2016 |
| **Project Title:** | Option 2: Somky Ranch Site (Secondary) 300 AF | | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **2,762,764** | |
| 1.1 | Pipeline from Soscol WRF to new north pond | 1,550 | LF | 162 | 251,751 | 12 in-diameter |
| | | | | | | |
| 1.2 | Pipe from new north pond to new DAF at Soscol WRF | 2,000 | LF | 560 | 1,120,698 | 36 in-diameter |
| | | | | | | |
| 1.3 | Pipeline from Soscol WRF to new south pond | 700 | LF | 162 | 113,694 | 12 in-diameter |
| | | | | | | |
| 1.4 | Pipe from new south pond to new DAF at Soscol WRF | 1,000 | LF | 560 | 560,349 | 36 in-diameter |
| | | | | | | |
| 1.5 | Pipelines General | | | | | |
| | *Pipeline Constructability (Bay Mud)* | 5,250 | LF @ | 30% | 613,948 | Apply to length of pipeline affected. Bay mud / Alluvium |
| | *Mob/demob* | | LF @ | 5% | 102,325 | Apply to direct costs |
| | | | | | | |
| | | | | | | |
| **2.0** | **Pump Stations** | | | | **1,701,000** | |
| 2.1 | Pump station at Soscol WRF to send water to new north pond | | | | | 1 duty, 1 standby |
| | Pump Station | 1 | LS | 150,000 | 150,000 | 568 gpm |
| | | | | | | 10 hp |
| 2.2 | Pump station at Soscol WRF to send water to new south pond | | | | | 1 duty, 1 standby |
| | Pump Station | 1 | LS | 150,000 | 150,000 | 568 gpm |
| | | | | | | 10 hp |
| 2.3 | Pump station at Soscol WRF to existing filters 30 feet up | | | | | 1 duty, 1 standby |
| | Pump Station | 1 | LS | 960,000 | 960,000 | 14,314 gpm |
| | | | | | | 300 hp |
| 2.4 | Pump Station General | | | | | Apply % to all pump station costs |
| | *Yard Piping* | | @ | 5% | 63,000 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | | @ | 20% | 252,000 | Includes communication to existing system |
| | *Site Work General* | | @ | 5% | 63,000 | applies to PS facility costs (Includes grading, erosion control, cut/fill, etc.) |
| | *Mob/demob* | | @ | 5% | 63,000 | apply to direct costs |
| | | | | | | |
| **3.0** | **North Pond + South Pond** | | | | **5,263,407** | |
| | Storage Volume | 312 | AF | | | |
| | Depth | 12 | LF | | | |
| | Surface Area | 26 | Acre | | | |
| | Perimeter | 6,026 | LF | | | |
| | Approx Wetted Area | 1,219,566 | SF | | | |
| 3.1 | Site work | | | | | Includes survey, dewatering, liner. |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | MO | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 3.2 | Earthwork | | | | | |
| | *Clear & Grub* | 26.4 | Acre | 1,500 | 39,540 | |
| | *Rough Grading* | 26.4 | Acre | 2,500 | 65,900 | |
| | *Fine Grading* | 26.4 | Acre | 3,500 | 92,260 | |
| | *Excavation Cut + Haul (Clay/Loam)* | 222,206.0 | CY | 5 | 1,173,248 | |
| | *Excavation Fill* | 159,529.0 | CY | 5 | 797,645 | |
| | *Import Material* | 159,529.0 | CY | 5 | 797,645 | |
| 3.3 | Concrete | | | | | |
| | *Weir Box* | 2.0 | LS | 40,000 | 80,000 | |
| 3.4 | Mechanical | | | | | |
| | | | | | | |
| 3.5 | Other Elements | | | | | |
| | *Membrane Liner* | 135,507.3 | SY | 5 | 677,537 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0 | SF | 5 | 0 | |
| 3.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | - | 5% | 202,439 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | - | 20% | 809,755 | Includes communication to existing system |
| | *Mob/demob* | 1 | - | 5% | 202,439 | apply to direct costs |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **4.0** | **Treatment** | | | | **0** | |
| 4.1 | New DAF Clarifier at Soscol WRF | | | | | |
| | DAF Clarifier | 0 | LS | | 0 | Per NapaSD - additional DAF capacity not needed for this option. |
| | | | | | | |
| | **Subtotal Direct Facility Capital Costs** | | | | **9,727,171** | |

| Summary of Feasibility Level Facility Costs ($) | | | | | |
|---|---|---|---|---|---|
| **Pipelines** | **Pump Stations** | **Storage** | **Treatment** | **Lump Sum or Other Construction Cost** | **Total Construction Contract Costs** |
| $2,762,764 | $1,701,000 | $5,263,407 | $0 | $0 | **$9,727,171** |

| USBR Contingencies ($) | | | | |
|---|---|---|---|---|
| **USBR Allowance/ Contingencies (35%)** | **Opinion of Probable Const. Costs** | **USBR Non-Contract Costs (25%)** | **Opinion of Probable Total Project Capital Costs** | **Total Project Capital Costs** |
| $3,404,510 | **$13,131,681** | $3,282,920 | **$16,414,601** | **$16.4** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A | |
| 1.2 | Energy (Pumping) | 130,700 | KWh | 0.16 | 20,912 | Operational Hours (hr/yr) = | 1095 |
| | | | | | | Operational Hours (months/yr) = | 3 |
| | | | | | | Operational Hours (hours/day) = | 12 |
| | | | | | | Total Horsepower (HP) = | 160 |
| 1.3 | Energy (other) | 6,540 | KWh | 0.16 | 1,046 | 5% | of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Labor - General | 0.50 | No. of Staff | 75,000 | 37,500 | Based on annual salary for full time staff per year including benefits and overhead. | |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A | |
| **4.0** | **Maintenance** | | | | | | |
| | Storage Pond (>150 AF) Maintenance | 300 | AF | 150 | 45,000 | Based on seasonal weed and erosion control, periodic groundwater and leakage monitoring, and periodic liner repairs (and cleaning hydraulic structures) | |
| **5.0** | **Contingency** | @ | % | 10.0% | 10,446 | % of above O&M costs | |
| | | | | **Annual O&M Costs ($/year)** | **$114,904** | | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$383** | Based on Storage (AFY) = | 300 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$1.18** | | |

| Summary of O&M Costs ($) | | | | | | |
|---|---|---|---|---|---|---|
| **Energy Costs** | **Labor Costs** | **Chemicals** | **Maintanence** | **Lab / Regulatory Compliance** | **Contingency** | **Total O&M Costs** |
| $21,958 | $37,500 | $0 | $45,000 | $0 | $10,446 | $114,904 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | |
|---|---|---|---|
| **Agency:** | Napa SD | **Prepared By:** | DTT, MT |
| **Project Type:** | Seasonal Storage | **Date Prepared:** | Sep-2016 |
| **Project Title:** | Option 3a: Jameson Ranch Site (Tertiary) 600 AF | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines (South Pond)** | | | | **380,474** | |
| 1.1 | Pipeline from south pond to existing pressurised (60 psi) pipeline | 1,800 | LF | 162 | 292,356 | 12 in-diameter |
| | | | | | | |
| 1.2 | Tee-off from existing RW main to South Pond (for Phase 1) | 1 | LS | 70,000 | 70,000 | |
| | | | | | | |
| 1.3 | Pipelines General | | | | | |
| | *Pipeline Constructability (Regular)* | 1,800 | LF @ | 0% | 0 | Apply to length of pipeline affected |
| | *Mob/demob* | | LF @ | 5% | 18,118 | Apply to direct costs |
| | | | | | | |
| **2.0** | **Pipelines (North Pond)** | | | | **810,070** | |
| 2.1 | Pipeline connections between north and south pond | 250 | LF | 162 | 40,605 | 12 in-diameter |
| | | | | | | |
| 2.2 | Pipeline from existing recycled water pipeline to north pond | 3,000 | LF | 244 | 730,890 | 18 in-diameter |
| | | | | | | |
| 2.3 | Pipelines General | | | | | |
| | *Pipeline Constructability (Regular)* | 3,250 | LF @ | 0% | 0 | Apply to length of pipeline affected. Sedimentary rocks |
| | *Mob/demob* | | LF @ | 5% | 38,575 | Apply to direct costs |
| | | | | | | |
| | | | | | | |
| **2.0** | **Pump Stations (South Pond)** | | | | **910,000** | |
| 2.1 | New pump station from pond to existing RW pipelines to customers | | | | | 1 duty, 1 standby to be built under 1st phase with pump housing |
| | Pump Station | 1 | LS | 700,000 | 700,000 | 1,781 gpm |
| | | | | | | 200 hp |
| 2.2 | Pump Station General | | | | | Apply % to all pump station costs |
| | *Yard Piping* | | @ | 5% | 35,000 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | | @ | 20% | 140,000 | Includes communication to existing system |
| | *Site work* | | @ | 0% | 0 | applies to PS facility costs (Includes grading, erosion control, cut/fill, etc.) |
| | *Mob/demob* | | @ | 5% | 35,000 | apply to direct costs |
| | | | | | | |
| **3.0** | **Pump Stations (North Pond)** | | | | | |
| 3.1 | New pump to be added for second phase | | | | **420,000** | 1 more duty pump to be added under 2nd phase within pump station |
| | Pump Station | 1 | LS | 420,000 | 420,000 | 1,781 gpm |
| | | | | | | 100 hp |
| | | | | | | |
| **4.0** | **South Pond** | | | | **4,101,596** | |
| | Storage Volume | 301 | AF | | | |
| | Depth | 14 | LF | | | |
| | Surface Area | 22 | Acre | | | |
| | Perimeter | 4,215 | LF | | | |
| | Approx Wetted Area | 1,015,912 | SF | | | |
| 4.1 | Site work | | | | | Includes survey, dewatering, liner, etc. - see storage tab |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | MO | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 4.2 | Earthwork | | | | | |
| | *Clear & Grub* | 22.0 | Acre | 1,500 | 33,000 | |
| | *Rough Grading* | 22.0 | Acre | 2,500 | 55,000 | |
| | *Fine Grading* | 22.0 | Acre | 3,500 | 77,000 | |
| | *Excavation Cut + Haul (Clay/Loam)* | 174,619.0 | CY | 5 | 921,988 | |
| | *Excavation Fill* | 109,869.0 | CY | 5 | 549,345 | |
| | *Import Material* | 109,869.0 | CY | 5 | 549,345 | |
| 4.3 | Concrete | | | | | |
| | *Weir Box* | 2.0 | LS | 40,000 | 80,000 | |
| 4.4 | Mechanical | | | | | |
| | | | | | | |
| 4.5 | Other Elements | | | | | |
| | *Membrane Liner* | 112,879.1 | SY | 5 | 564,396 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0 | SF | 5 | 0 | |
| 4.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | - | 5% | 157,754 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | - | 20% | 631,015 | Includes communication to existing system |
| | *Mob/demob* | 1 | - | 5% | 157,754 | apply to direct costs |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **5.0** | **North Pond** | | | | **4,039,667** | |
| | Storage Volume | 306 | AF | | | |
| | Depth | 13 | LF | | | |
| | Surface Area | 23 | Acre | | | |
| | Perimeter | 3,915 | LF | | | |
| | Approx Wetted Area | 1,060,214 | SF | | | |
| 5.1 | Site work | | | | | Includes survey, dewatering, liner, etc. - see storage tab |
| | *Mobilization* | 0.0 | LS | 75,000 | 0 | No additional cost if both ponds constructed together |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | MO | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 5.2 | Earthwork | | | | | |
| | *Clear & Grub* | 23.2 | Acre | 1,500 | 34,725 | |
| | *Rough Grading* | 23.2 | Acre | 2,500 | 57,875 | |
| | *Fine Grading* | 23.2 | Acre | 3,500 | 81,025 | |
| | *Excavation Cut + Haul (Clay/Loam)* | 178,192.0 | CY | 5 | 940,854 | |
| | *Excavation Fill* | 107,395.0 | CY | 5 | 536,975 | |
| | *Import Material* | 107,395.0 | CY | 5 | 536,975 | |
| 5.3 | Concrete | | | | | |
| | *Weir Box* | 2.0 | LS | 40,000 | 80,000 | |
| 5.4 | Mechanical | | | | | |
| | | | | | | |
| 5.5 | Other Elements | | | | | |
| | *Membrane Liner* | 117,801.5 | SY | 5 | 589,008 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | 0 | SF | 5 | 0 | |
| 5.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | - | 5% | 155,372 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | - | 20% | 621,487 | Includes communication to existing system |
| | *Mob/demob* | 1 | - | 5% | 155,372 | apply to direct costs |
| | | | | | | |
| **6.0** | **Treatment** | | | | **410,000** | |
| 6.1 | Filter at Storage Pond Oulet | | | | | |
| | Jameson Filter at Storage Pond Outlet | 1 | LS | 410,000 | 410,000 | |
| | | | | | | |
| | | | | **Subtotal Direct Facility Capital Costs** | **11,071,807** | |

| Summary of Feasibility Level Facility Costs ($) | | | | | |
|---|---|---|---|---|---|
| **Pipelines** | **Pump Stations** | **Storage** | **Treatment** | **Lump Sum or Other Construction Cost** | **Total Construction Contract Costs** |
| $1,190,544 | $1,330,000 | $8,141,264 | $410,000 | $0 | **$11,071,807** |

| USBR Contingencies ($) | | | | |
|---|---|---|---|---|
| **USBR Allowance/ Contingencies (35%)** | **Opinion of Probable Const. Costs** | **USBR Non-Contract Costs (25%)** | **Opinion of Probable Total Project Capital Costs** | **Total Project Capital Costs** |
| $3,875,132 | **$14,946,940** | $3,736,735 | **$18,683,674** | **$18.7** |

**Phase 1**

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| 1.1 | Energy (Treatment) | 3,400.000 | KWh | 0.16 | 544 | Filter at Storage Pond Outlet (mgd) = | 3.0 |
| | | | | | | Operational Hours (hr/yr) = | 3285 |
| | | | | | | Operational Hours (months/yr) = | 9 |
| | | | | | | Operational Hours (hours/day) = | 12 |
| | | | | | | Assume treatment (kwh/1000 gal)= | 3 |
| 1.2 | Energy (Pumping) | 81,690 | KWh | 0.16 | 13,070 | Operational Hours (hr/yr) = | 1095 |
| | | | | | | Operational Hours (months/yr) = | 3 |
| | | | | | | Operational Hours (hours/day) = | 12 |
| | | | | | | Total Horsepower (HP) = | 100 |
| 1.3 | Energy (other) | 4,250 | KWh | 0.16 | 680 | 5% | of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Labor - General | 0.50 | No. of Staff | 75,000 | 37,500 | Based on annual salary for full time staff per year including benefits and overhead. | |
| **3.0** | **Chemicals - Tertiary Treatment** | 3.00 | mgd | 13,000 | 14,625 | Assume similar chemical usage as Soscol WRF | |
| **4.0** | **Maintenance** | | | | | | |
| | Filtration at Storage Pond Outlet | @ | % | 1% | 4,100 | Assume 1% of filter direct capital cost | |
| | Storage Pond (>150 AF) Maintenance | 300 | AF | 150 | 45,000 | Based on seasonal weed and erosion control, periodic groundwater and leakage monitoring, and periodic liner repairs (and cleaning hydraulic structures) | |
| **5.0** | **Contingency** | @ | % | 10.0% | 11,552 | % of above O&M costs | |
| | | | | **Annual O&M Costs ($/year)** | **$127,071** | | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$424** | Based on Storage (AFY) = | 300 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$1.30** | | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $14,294 | $37,500 | $14,625 | $45,000 | $0 | $11,552 | $122,971 |

**Phase 2**

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| 1.1 | Energy (Treatment) | 3,400.000 | KWh | 0.16 | 544 | Filter at Storage Pond Outlet (mgd) = | 3.0 |
| | | | | | | Operational Hours (hr/yr) = | 3285 |
| | | | | | | Operational Hours (months/yr) = | 9 |
| | | | | | | Operational Hours (hours/day) = | 12 |
| | | | | | | Assume treatment (kwh/1000 gal) = | 3 |
| 1.2 | Energy (Pumping) | 81,690 | KWh | 0.16 | 13,070 | Operational Hours (hr/yr) = | 1095 |
| | | | | | | Operational Hours (months/yr) = | 3 |
| | | | | | | Operational Hours (hours/day) = | 12 |
| | | | | | | Total Horsepower (HP) = | 100 |
| 1.3 | Energy (other) | 4,250 | KWh | 0.16 | 680 | 5% | of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | Accounts for some additional staff time beyond Phase 1 staff allocation | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including benefits and overhead. | |
| **3.0** | **Chemicals - Tertiary Treatment** | 3.00 | mgd | 13,000 | 14,625 | Assume similar chemical usage as Soscol WRF | |
| **4.0** | **Maintenance** | | | | | | |
| | Filtration at Storage Pond Outlet | @ | % | 1% | 4,100 | Assume 1% of filter direct capital cost (to account of increased flow beyond Phase 1) | |
| | Storage Pond (>150 AF) Maintenance | 300 | AF | 150 | 45,000 | Based on seasonal weed and erosion control, periodic groundwater and leakage monitoring, and periodic liner repairs (and cleaning hydraulic structures) | |
| **5.0** | **Contingency** | @ | % | 10.0% | 9,677 | % of above O&M costs | |
| | | | | **Annual O&M Costs ($/year)** | **$106,446** | | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$355** | Based on Storage (AFY) = | 300 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$1.09** | | |

| Summary of O&M Costs ($) | | | | | | |
|---|---|---|---|---|---|---|
| **Energy Costs** | **Labor Costs** | **Chemicals** | **Maintanence** | **Lab / Regulatory Compliance** | **Contingency** | **Total O&M Costs** |
| $14,294 | $18,750 | $14,625 | $45,000 | $0 | $9,677 | $102,346 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | |
|---|---|---|---|
| **Agency:** | Napa SD | **Prepared By:** | DTT, MT |
| **Project Type:** | Seasonal Storage | **Date Prepared:** | Sep-2016 |
| **Project Title:** | Option 3b: Jameson Ranch Site (Tertiary) 300 AF | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Capital Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **1,291,848** | |
| 1.1 | Pipeline from existing recycled water pipeline to north pond | 3,000 | LF | 244 | 730,890 | 18 in-diameter |
| | | | | | | |
| 1.2 | Pipeline from south pond to existing pressurised (60 psi) pipeline | 1,800 | LF | 244 | 438,534 | 18 in-diameter |
| | | | | | | |
| 1.3 | Pipeline connections between east and west pond | 250 | LF | 244 | 60,908 | 18 in-diameter |
| | | | | | | |
| 1.4 | Pipelines General | | | | | |
| | *Pipeline Constructability (Regular)* | 5,050 | LF @ | 0% | 0 | Apply to length of pipeline affected. Sedimentary rocks |
| | *Mob/demob* | 0 | LF @ | 5% | 61,517 | Apply to direct costs |
| | | | | | | |
| **2.0** | **Pump Stations** | | | | **945,000** | |
| 2.1 | New pump station from pond to existing RW pipelines to customers | | | | | 1 duty, 1 standby |
| | Pump Station | 1 | LS | 700,000 | 700,000 | 1,917 gpm |
| | | | | | | 200 hp |
| 2.2 | Pump Station General | | | | | Apply % to all pump station costs |
| | *Yard Piping* | | @ | 5% | 35,000 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | | @ | 20% | 140,000 | Includes communication to existing system |
| | *Site Work General* | | @ | 5% | 35,000 | applies to PS facility costs (Includes grading, erosion control, cut/fill, etc.) |
| | *Mob/demob* | | @ | 5% | 35,000 | apply to direct costs |
| | | | | | | |
| **3.0** | **North and South Pond** | | | | **4,723,416** | |
| | Storage Volume | 303 | AF | | | |
| | Depth | 13 | LF | | | |
| | Surface Area | 23 | Acre | | | |
| | Perimeter | 5,122 | LF | | | |
| | Approx Wetted Area | 1,086,100 | SF | | | |
| 3.1 | Site work | | | | | Includes survey, dewatering, liner, etc. - see storage tab |
| | *Mobilization* | 1.0 | LS | 75,000 | 75,000 | |
| | *Survey & Layout* | 1.0 | LS | 25,000 | 25,000 | |
| | *Erosion Controls* | 1.0 | LS | 50,000 | 50,000 | |
| | *Dewatering* | 1.0 | MO | 25,000 | 25,000 | |
| | *Underdrain Piping* | 1.0 | LS | 150,000 | 150,000 | |
| 3.2 | Earthwork | | | | | |
| | *Clear & Grub* | 23.4 | Acre | 1,500 | 35,115 | |
| | *Rough Grading* | 23.4 | Acre | 2,500 | 58,525 | |
| | *Fine Grading* | 23.4 | Acre | 3,500 | 81,935 | |
| | *Excavation Cut + Haul (Clay/Loam)* | 203,510.0 | CY | 5 | 1,074,533 | |
| | *Excavation Fill* | 125,490.0 | CY | 5 | 627,450 | |
| | *Import Material* | 125,490.0 | CY | 5 | 627,450 | |
| 3.3 | Concrete | | | | | |
| | *Weir Box* | 5.0 | LS | 40,000 | 200,000 | |
| 3.4 | Mechanical | | | | | |
| | | | | | | |
| 3.5 | Other Elements | | | | | |
| | *Membrane Liner* | 120,677.8 | SY | 5 | 603,389 | |
| | *Chain Link Fence* | 0.0 | LF | 25 | 0 | |
| | *Shade Balls* | | SF | 5 | 0 | |
| 3.6 | Storage General | | | | | Apply % to all storage costs |
| | *Yard Piping* | 1 | - | 5% | 181,670 | Includes ancillary pipelines, mechanical, etc. |
| | *Electrical/I&C and other* | 1 | - | 20% | 726,679 | Includes communication to existing system |
| | *Mob/demob* | 1 | - | 5% | 181,670 | apply to direct costs |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **4.0** | **Treatment** | | | | **410,000** | |
| 4.1 | Filter at Storage Pond Oulet | | | | | |
| | Jameson Filter at Storage Pond Outlet | 1 | LS | 410,000 | 410,000 | |
| | | | | | | |
| | | | | **Subtotal Direct Facility Capital Costs** | **7,370,264** | |

| Summary of Feasibility Level Facility Costs ($) | | | | | |
|---|---|---|---|---|---|
| **Pipelines** | **Pump Stations** | **Storage** | **Treatment** | **Lump Sum or Other Construction Cost** | **Total Construction Contract Costs** |
| $1,291,848 | $945,000 | $4,723,416 | $410,000 | $0 | **$7,370,264** |

| USBR Contingencies ($) | | | | |
|---|---|---|---|---|
| **USBR Allowance/ Contingencies (35%)** | **Opinion of Probable Const. Costs** | **USBR Non-Contract Costs (25%)** | **Opinion of Probable Total Project Capital Costs** | **Total Project Capital Costs** |
| $2,579,592 | **$9,949,856** | $2,487,464 | **$12,437,320** | **$12.4** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | | |
| | | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| 1.1 | Energy (Treatment) | 3,400.000 | KWh | 0.16 | 544 | Filter at Storage Pond Outlet (mgd) = | 3 |
| | | | | | | Operational Hours (hr/yr) = | 3285 |
| | | | | | | Operational Hours (months/yr) = | 9 |
| | | | | | | Operational Hours (hours/day) = | 12 |
| | | | | | | Assume treatment (kwh/1000 gal) = | 3 |
| 1.2 | Energy (Pumping) | 81,690 | KWh | 0.16 | 13,070 | Operational Hours (hr/yr) = | 1095 |
| | | | | | | Operational Hours (months/yr) = | 3 |
| | | | | | | Operational Hours (hours/day) = | 12 |
| | | | | | | Total Horsepower (HP) = | 100 |
| 1.3 | Energy (other) | 4,250 | KWh | 0.16 | 680 | 5% | of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Labor - General | 0.50 | No. of Staff | 75,000 | 37,500 | Based on annual salary for full time staff per year including benefits and overhead. | |
| **3.0** | **Chemicals - Tertiary Treatment** | 3 | mgd | 13,000 | 14,625 | Assume similar chemical usage as Soscol WRF | |
| **4.0** | **Maintenance** | | | | | | |
| | Filtration at Storage Pond Outlet | @ | % | 1% | 4,100 | Assume 1% of filter direct capital cost | |
| | Storage Pond (>150 AF) Maintenance | 300 | AF | 150 | 45,000 | sion control, periodic groundwater and leakage monitoring, and periodic liner repairs (a | |
| **5.0** | **Contingency** | @ | % | 10.0% | 11,552 | % of above O&M costs | |
| | | | | **Annual O&M Costs ($/year)** | **$127,071** | | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$424** | Based on Storage (AFY) = | 300 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$1.30** | | |

| Summary of O&M Costs ($) | | | | | | |
|---|---|---|---|---|---|---|
| **Energy Costs** | **Labor Costs** | **Chemicals** | **Maintanence** | **Lab / Regulatory Compliance** | **Contingency** | **Total O&M Costs** |
| $14,294 | $37,500 | $14,625 | $45,000 | $0 | $11,552 | $122,971 |

This page intentionally left blank.

Engineers Opinion of Probable Costs

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**Agency:** MMWD / CMSA
**Project Type:** Distribution
**Project Title:** Recycled Water Distribution System Expansion to San Quentin Prisor

**Construction recycled**

**KENNEDY/JENKS CONSULTANTS**
**Prepared By:** DTT, MT
**Date Prepared:** Sep-2016
**K/J Proj. No.** 1468043.00

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source |
|---|---|---|---|---|---|---|
| | **Direct Facility Costs** | | | | | |
| | | | | | | |
| **1.0** | **Pipelines** | | | | **1,757,418** | Length and pipeline diameter obtained from MMWD CMSA Recycled Water Feasibility Study Jan 2016 |
| 1.1 | Pipeline from CMSA to San Quentin | 5,808 | LF | 81 | 471,668 | 6 **in-diameter** |
| 1.2 | Dual Plumbing at San Quentin | 1 | LS | $ 1,190,000 | 1,190,000 | Quantities and unit costs obtained from MMWD CMSA Recycled Water Feasibility Study Jan 2016 |
| 1.3 | Connection Fee | 1 | LS | $ 25,000 | 25,000 | |
| 1.4 | Pipelines General | | | | | |
| | *Pipeline Constructability (Along Roads,* | | | 10% | 47,167 | |
| | *Mob/demob* | | | 5% | 23,583 | |
| | | | | | | |
| **2.0** | **Pump Stations** | | | | **515,000** | 1 duty, 1 standby per MMWD CMSA Recycled Water Feasibility Study Jan 2016 |
| | New pump station at CMSA | 1 | LS | $ 515,000 | 515,000 | 356 gpm |
| | | | | | | 50 hp |
| | | | | | | |
| **3.0** | **Storage** | | | | **75,700** | |
| | MMWD / CMSA Storage Tank | 0.08 | MG | $ 1,000,000 | 75,700 | Quantities and unit costs obtained from MMWD CMSA Recycled Water Feasibility Study Jan 2016 |
| | | | | | | |
| **4.0** | **Treatment** | | | | **2,290,000** | |
| 4.1 | MMWD/CMSA Microfiltration Treatment | 200,000 | gpd | $ 9 | 1,830,000 | Quantities and unit costs obtained from MMWD CMSA Recycled Water Feasibility Study Jan 2016 |
| 4.2 | MMWD/CMSA Chlorine Contact Tank Retrofit | 1 | LS | $ 460,000 | 460,000 | |
| | | | | **Subtotal Direct Facility** | **4,638,118** | |

*OK*

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $1,757,418 | $515,000 | $75,700 | $2,290,000 | $0 | **$4,638,118** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $1,623,341 | **$6,261,459** | $1,565,365 | **$7,826,824** | **$7.8** |

This Page Intentionally Left Blank.

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A | |
| 1.2 | Energy (Pumping) | 81,690 | KWh | 0.16 | 13,070 | Operational Hours (hr/yr) =<br>Operational Hours (months/yr) =<br>Operational Hours (hours/day) =<br>Total Horsepower (HP) = | 2190<br>3<br>24<br>50 |
| 1.3 | Energy (other) | 4,000 | KWh | 0.16 | 640 | 5% | of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including | |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A | |
| **4.0** | **Maintenance - Pipelines** | @ | % | 0.5% | 23,191 | % of Direct Facility Costs | |
| **5.0** | **Contingency** | @ | % | 10.0% | 5,565 | % of above O&M costs | |
| | | | | **Annual O&M Costs ($/year)** | **$61,216** | | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$398** | Based on Flow (AFY) = | 154 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$1.22** | | |

| Summary of O&M Costs ($) | | | | | | |
|---|---|---|---|---|---|---|
| **Energy Costs** | **Labor Costs** | **Chemicals** | **Maintanence** | **Lab / Regulatory Compliance** | **Contingency** | **Total O&M Costs** |
| $13,710 | $18,750 | $0 | $23,191 | $0 | $5,565 | $61,216 |

This Page Intentionally Left Blank.

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
Water Supply Reliability through Regional Reuse

**Agency:** American Canyon
**Project Type:** Distribution
**Project Title:** Phase 1 Recycled Water Distrbution System Expansion

**KENNEDY/JENKS CONSULTANTS**
**Prepared By:** DTT, MT
**Date Prepared:** Sep-2016
**K/J Proj. No.** 1468043.00

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Direct Facility Costs** | | | | | | |
| | | | | | | | |
| **1.0** | **Pipelines** | | | | **1,838,879** | Lengths and quantities obtained from American Canyon Recycled Water Master Plan May 2016 | |
| 1.1 | RW1B Tower/Devlin/South Kelly Road | 6,110 | LF | 162 | 992,386 | 12 | **in-diameter** |
| 1.2 | RW2 Spikerush Circle | 800 | LF | 81 | 64,968 | 6 | **in-diameter** |
| 1.3 | RW3 Benton Way | 1,670 | LF | 81 | 135,621 | 6 | **in-diameter** |
| 1.4 | RW5 Jim Oswald Way/Mezzetta Court/Green Island Road | 1,800 | LF | 81 | 146,178 | 6 | **in-diameter** |
| 1.5 | RW6 Hanna Drive | 1,950 | LF | 108 | 211,146 | 8 | **in-diameter** |
| 1.6 | RW7 Dodd/Klamath Court | 600 | LF | 81 | 48,726 | 6 | **in-diameter** |
| 1.7 | Pipelines General | | | | | | |
| | *Pipeline Constructability (Along Roads)* | | | 10% | 159,902 | | |
| | *Mob/demob* | | | 5% | 79,951 | | |
| | | | | | | | |
| **2.0** | **Pump Stations** | | | | **0** | | |
| | | | | | | | |
| **3.0** | **Storage** | | | | **0** | | |
| | | | | | | | |
| **4.0** | **Treatment** | | | | **0** | | |
| | | | | | | | |
| | **Subtotal Direct Facility Costs** | | | | **1,838,879** | | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $1,838,879 | $0 | $0 | $0 | $0 | **$1,838,879** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $643,608 | **$2,482,486** | $620,622 | **$3,103,108** | **$3.1** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A | |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | Cost of additional pumping not included in analysis | |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | 5% | of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including benefits and overhead. | |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A | |
| **4.0** | **Maintenance - Pipelines** | @ | % | 0.5% | 9,194 | % of Direct Facility Costs | |
| **5.0** | **Contingency** | @ | % | 10.0% | 2,794 | % of above O&M costs | |
| | **Annual O&M Costs ($/year)** | | | | **$30,739** | | |
| | **Annual Unit O&M Costs ($/AF)** | | | | **$300** | Based on Flow (AFY) = | 102 |
| | **Annual Unit O&M Costs ($/1000 gal)** | | | | **$0.92** | | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $0 | $18,750 | $0 | $9,194 | $0 | $2,794 | $30,739 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

**Agency:** American Canyon
**Project Type:** Distribution
**Project Title:** Phase 2 Recycled Water Distrbution System Expansion

**Prepared By:** DTT, MT
**Date Prepared:** Sep-2016
**K/J Proj. No.** 1468043.00

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Direct Facility Costs** | | | | | | |
| | | | | | | | |
| **1.0** | **Pipelines General** | | | | **1,714,045** | | |
| 1.1 | RW4 Pelleria Drive | 790 | LF | 81 | 64,156 | 6 | in-diameter |
| 1.2 | RW8 Lombard/Hess Road | 2,230 | LF | 108 | 241,464 | 8 | in-diameter |
| 1.3 | RW15 Broadway and Donaldson Way | 7,080 | LF | 162 | 1,149,934 | 12 | in-diameter |
| | | 430 | LF | 81 | 34,920 | 6 | in-diameter |
| 1.4 | Pipelines General | | | | | | |
| | *Pipeline Constructability (Along Roads)* | | | 10% | 149,047 | | |
| | *Mob/demob* | | | 5% | 74,524 | | |
| | | | | | | | |
| **2.0** | **Pump Stations** | | | | **0** | | |
| | | | | | | | |
| **3.0** | **Storage** | | | | **0** | | |
| | | | | | | | |
| **4.0** | **Treatment** | | | | **0** | | |
| | | | | | | | |
| | **Subtotal Direct Facility Costs** | | | | **1,714,045** | | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $1,714,045 | $0 | $0 | $0 | $0 | **$1,714,045** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $599,916 | **$2,313,961** | $578,490 | **$2,892,451** | **$2.9** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| 1.1 | Energy (Treatment) | 0 | KWh | 0.16 | 0 | N/A | |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | Cost of additional pumping not included in analysis | |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | 5% | of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Labor - General | 0.25 | No. of Staff | 75,000 | 18,750 | Based on annual salary for full time staff per year including benefits and overhead. | |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A | |
| **4.0** | **Maintenance - Pipelines** | @ | % | 0.5% | 8,570 | % of Direct Facility Costs | |
| **5.0** | **Contingency** | @ | % | 10.0% | 2,732 | % of above O&M costs | |
| | **Annual O&M Costs ($/year)** | | | | **$30,052** | | |
| | **Annual Unit O&M Costs ($/AF)** | | | | **$1,190** | Based on Flow (AFY) = | 25 |
| | **Annual Unit O&M Costs ($/1000 gal)** | | | | **$3.65** | | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $0 | $18,750 | $0 | $8,570 | $0 | $2,732 | $30,052 |

**Engineers Opinion of Probable Costs**

# NBWRA Phase 2 Feasibility Study - Feasibility Level Cost-Analysis

NORTH BAY WATER REUSE PROGRAM
*Water Supply Reliability through Regional Reuse*

**KENNEDY/JENKS CONSULTANTS**

| | | | |
|---|---|---|---|
| **Agency:** | American Canyon | **Prepared By:** | DTT, MT |
| **Project Type:** | Treatment | **Date Prepared:** | Sep-2016 |
| **Project Title:** | AmCam WRF Phase 2 Treatment Plant Upgrades | **K/J Proj. No.** | 1468043.00 |

| Item No. | Description | Qty | Units | Total Costs $/Unit | Total Capital Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Direct Facility Costs** | | | | | | |
| **1.0** | **Pipelines** | | | | **102,731** | | |
| 1.1 | Pipeline between MBR and RO system | 100 | LF | 81 | 8,121 | 6 | in-diameter |
| 1.2 | Pipeline between RO System and Evaporation Pond | 1,000 | LF | 81 | 81,210 | 6 | in-diameter |
| 1.3 | Pipelines General | | | | | | |
| | *Pipeline Constructability (Along Roads)* | | LF @ | 10% | 8,933 | Apply to length of pipeline affected. Bay mud / Alluvium | |
| | *Mob/demob* | | LF @ | 5% | 4,467 | Apply to direct costs | |
| **2.0** | **Pump Stations** | | | | **0** | | |
| **3.0** | **Storage** | | | | **0** | | |
| **4.0** | **Treatment** | | | | **3,482,400** | | |
| 4.1 | 1st and 2nd Stage RO | 1 | LS | $ 2,277,000 | 2,277,000 | 2 Stage RO pre-packaged RO system @ 80% Recovery | |
| 4.2 | Modifications to Ponds and Brine Disposal System | 1 | LS | $ 750,000 | 750,000 | assume use of existing pond but increased for brine disposal and lining. | |
| 4.3 | Electrical/ I&C | 1 | LS | $ 455,400 | 455,400 | assume at 20% of RO cost due to proximity to MCC and existing SCADA | |
| | | | | **Subtotal Direct Facility** | **3,585,131** | | |

**Summary of Feasibility Level Facility Costs ($)**

| Pipelines | Pump Stations | Storage | Treatment | Lump Sum or Other Construction Cost | Total Construction Contract Costs |
|---|---|---|---|---|---|
| $102,731 | $0 | $0 | $3,482,400 | $0 | **$3,585,131** |

**USBR Contingencies ($)**

| USBR Allowance/ Contingencies (35%) | Opinion of Probable Const. Costs | USBR Non-Contract Costs (25%) | Opinion of Probable Total Project Capital Costs | Total Project Capital Costs |
|---|---|---|---|---|
| $1,254,796 | **$4,839,926** | $1,209,982 | **$6,049,908** | **$6.0** |

| Item No. | Description | Qty | Units | Total O&M Costs ($/year) $/Unit | Total O&M Cost | Notes/Source | |
|---|---|---|---|---|---|---|---|
| | **Annual Operations and Maintenance Costs** | | | | | | |
| **1.0** | **Energy Costs** | | | | | Operational Hours (hr/yr) = | 8760 |
| | | | | | | Composite Energy Cost ($/kwh) = | 0.16 |
| | | | | | | Peak Flow Capacity (mgd) = | 0.50 |
| 1.1 | Energy (Treatment) | 220,000 | KWh | 0.16 | 35,200 | Est Ave Annual Flow (mgd) = | 0.15 |
| | | | | | | Assume treament (kwh/1000 gal) = | 4.00 |
| 1.2 | Energy (Pumping) | 0 | KWh | 0.16 | 0 | N/A | |
| 1.3 | Energy (other) | 0 | KWh | 0.16 | 0 | 5% | of sum of treatment + pumping energy requirements |
| **2.0** | **Labor Costs** | | | | | | |
| 2.1 | Labor - General | 0.50 | No. of Staff | 75,000 | 37,500 | Based on annual salary for full time staff per year including benefits and overhead. | |
| **3.0** | **Chemicals** | 0 | 0 | 0 | 0 | N/A | |
| **4.0** | **Maintenance - Pipelines** | @ | % | 0.5% | 17,926 | % of Direct Facility Costs | |
| **5.0** | **Contingency** | @ | % | 10.0% | 9,063 | % of above O&M costs | |
| | | | | **Annual O&M Costs ($/year)** | **$99,688** | | |
| | | | | **Annual Unit O&M Costs ($/AF)** | **$593** | Based on Flow (AFY) = | 168 |
| | | | | **Annual Unit O&M Costs ($/1000 gal)** | **$1.82** | | |

**Summary of O&M Costs ($)**

| Energy Costs | Labor Costs | Chemicals | Maintanence | Lab / Regulatory Compliance | Contingency | Total O&M Costs |
|---|---|---|---|---|---|---|
| $35,200 | $37,500 | $0 | $17,926 | $0 | $9,063 | $99,688 |

This page intentionally left blank.

# Appendix E: Geologic Conditions and Geologic Constraints

This page intentionally left blank.

GEOTECHNICAL CONSULTANTS, INC.
Geotechnical Engineering • Geology • Hydrogeology

# GEOLOGIC CONDITIONS AND GEOTECHNICAL CONSTRAINTS TECHNICAL MEMORANDUM (TM) NORTH SAN PABLO BAY RESTORATION AND REUSE PHASE 2 FEASIBILITY PROJECT

**April 2017**

Prepared for:

**Brown and Caldwell**
201 N. Civic Drive, Suite 115
Walnut Creek, CA 94596

Owner:
**North Bay Water Reuse Authority**

GTC Project No. S16001

## TABLE OF CONTENTS

## TABLES

## PLATES

# 1.0 INTRODUCTION

This technical memorandum (TM) presents a discussion of the geologic and geotechnical conditions for the proposed projects associated with the North San Pablo Bay Restoration and Reuse Program (NBWRP) Phase 2 Feasibility Study (Project). Geologic conditions described include topography, stratigraphy, faulting, and seismicity. The purpose of the review is to evaluate site geologic features and existing conditions that could potentially pose geotechnical challenges or hazards for the proposed Phase 2 recycled water facilities and operation of these facilities. Examples of these hazards include ground shaking, fault rupture, liquefaction, settlement, lateral-spreading, lurching, and expansive soil, all of which can cause long-term concerns about the structural integrity of pipeline facilities and operations.

This TM presents relevant geotechnical and geologic data that were obtained from published and unpublished literature, GIS data, and online sources for the Project area. Data sources included the following: the 2008 Revised Geologic Conditions and Geotechnical Constraints Technical Memorandum, geologic literature from the U.S. Geological Survey (USGS) and California Geological Survey (CGS), soils data from the U.S. Department of Agriculture (USDA), geologic and soils GIS data from the above sources, available geotechnical reports for the area, and other readily available online reference materials. All the sources used for the purposes of characterizing baseline conditions and potential geotechnical hazards for Project are referenced as appropriate. The literature review focused on the identification of specific geologic, seismic, and geotechnical hazards at and near Phase 2 Project components.

## 1.1 PROPOSED PROJECT

The NBWRP Phase 2 Feasibility Study evaluates include new infrastructure for a variety of water management and water recycling projects for the NBWRP member agencies. Seven member agencies consisting of Marin Municipal Water District (Marin MWD), Novato Sanitation District (Novato SD), City of Petaluma, Sonoma Valley Sanitation District (SVCSD), Sonoma County Water Agency (SCWA), Napa Sanitation District (Napa SD), and City of American Canyon (American Canyon) have proposed projects being analyzed under Phase 2. Phase 2 projects with physical components that could be affected by geologic hazards that were analyzed in the document are summarized in *Table 1 – Phase 2 Projects Evaluated*; SCWA groundwater management scenario projects under Phase 2 have no current physical component that could be affected by geologic hazards and are therefore not discussed further in this document. Location of the Phase 2 projects evaluated are shown on *Plate 1 – NBWRP Phase 2 Project Location Map*.

| **Table 1 – Phase 2 Projects Evaluated** | |
|---|---|
| **Project Type** | **Project Title** |
| | **Marin MWD** |
| Treatment | CMSA Proposed Treatment Facilities |
| Distribution | MMWD Recycled Water Distribution System Expansion to San Quentin Prison |
| | **Novato SD** |
| Treatment | Novato SD WRP Capacity Expansion |
| Seasonal Storage | Option 1 - Novato SD Site Near Highway 37 (Tertiary – 150 AF) |
| | Option 2 – Novato SD Site Near Highway 37 (Secondary – 150 AF) |
| | Option 3 – Hamilton Site (Secondary – 150 AF) |
| Environmental | Marin County Lower Novato Creek Project - Distribution |
| | Marin County Lower Novato Creek Project - Restoration |
| | Turnout to Transitional Wetlands |
| | **Petaluma** |
| Treatment | Ellis Creek WRF Capacity Increase |
| Seasonal Storage | Option 1a – Site Southeast of ECWRF (Secondary – 150 AF) |
| | Option 1b – Site Southeast of ECWRF (Secondary – 150 AF) |
| Distribution | Urban Recycled Water Expansion |
| | Agricultural Recycled Water Expansion |
| | **SVCSD** |
| Seasonal Storage | Option 1 – Mulas Site (Tertiary - 49AF) |
| | Option 2 – Robledo Site (Tertiary – 49 AF) |
| Distribution | Napa Road Pipeline |
| | **SCWA** |
| Seasonal Storage | Valley of the Moon ASR |
| | Sonoma ASR |
| | **Napa SD** |
| Treatment | Soscol WRF Increased Filter Capacity |
| Operational Storage | Additional Soscol WRF Covered Storage |
| | Napa State Hospital Storage Tank |
| Seasonal Storage | Option 1a – Raise Existing Pond Levees (Secondary – 300 AF) |
| | Option 1b – Raise Existing Pond Levees (Secondary – 1100 AF) |
| | Option 2 – Somky Ranch Site (Secondary – 300 AF) |
| | Option 3a – Jameson Ranch Site (Tertiary – 300 AF) |
| | Option 3b – Jameson Ranch Site (Tertiary – 600 AF) |
| Distribution | MST Northern Loop |
| | MST Eastern Extension |
| | **American Canyon** |
| Treatment | American Canyon WRF Treatment Plant Upgrades |
| Distribution | Phase 1 Recycled Water Distribution System Expansion |
| | Phase 2 Recycled Water Distribution System Expansion |

# 2.0 EXISTING CONDITIONS

## 2.1 PHYSIOGRAPHY

The Project components are located across several different physiographic areas within Marin, Sonoma, and Napa Counties. The Project is located with the Northern Coast Ranges adjacent to San Pablo Bay on the south. Marin MWD Phase 2 projects are located adjacent and near to Corte Madera Bay at the northern edge of the San Francisco Bay, and are located on flat to gently sloping bay margins and gently sloping hills of Southern Heights Ridge with elevations ranging from about 8 to 155 feet. The Novato SD Phase 2 projects are located adjacent to San Pablo Bay, near the mouth of the Petaluma River and are located on the flat to gently sloping bay margins and on the edge of gently sloping hills of the Coast Ranges with elevation ranging from 0 to 74 feet (Google Earth, 2016). The Petaluma Phase 2 projects are located on the flat alluvial valley and gently rolling hills of the Petaluma Valley with elevations ranging from 10 to 84 feet. SWCA Phase 2 projects are located within and along the eastern edge of the Sonoma Creek drainage and range in elevation from 100 to 220 feet. The SVCSD Phase 2 projects are located within and along the eastern edge of the Sonoma Valley on flat to gently sloping alluvium and gently rolling hills with elevations ranging from 8 to 95 feet for the Napa Road Pipeline and seasonal storage sites and from 106 to 218 feet for the more northerly ASR pipelines. The Napa SD Phase 2 projects are located with and on the eastern edge of Napa Valley on alluvium and gently rolling hills with elevations ranging from about 20 to 250 feet (Google Earth, 2016). The American Canyon Phase 2 Projects are located along the eastern edge of the Napa River delta and flood plain at elevations of approximately 9 to 128 feet.

## 2.2 GEOLOGIC SETTING

The project sites are situated within the Coast Ranges Geomorphic Province of California. Past episodes of tectonism have folded and faulted the rock of the Coast Ranges creating the regional topography of northwest-trending ridges and valleys that is characteristic of this province.

The San Francisco Bay and other local topographic depressions (including San Pablo Bay) have been subsequently naturally filled with various marine, estuarine, alluvial, and wind-blown sediments. Basement rock in the region is comprised of Franciscan Complex rocks of Jurassic and Cretaceous age. The Franciscan Complex consists of an intermixed assemblage of volcanic, sedimentary and low grade metamorphic rocks that accumulated along, and were subsequently highly deformed in the boundary between two converging tectonic plates.

Underlying the Project components, near-surface deposits include artificial fill related to the historical filling of San Pablo Bay, young bay mud deposits, Holocene to Pleistocene alluvial deposits, Sonoma Volcanics, Petaluma Formation, San Pablo Group, Markley Sandstone, and Franciscan Complex. These general location, age, and description of these units are presented in Table 2 - Geologic Units Underlying Phase 2 Project Components and location of the units relative to Phase 2 project components is presented on *Plates 2 through 8*.

**Table 2 - Geologic Units Underlying Phase 2 Project Components**

| Unit Symbol | Formation | Project Location/ Member Agency | Age | Description/Comment | Excavation Characteristics[1] |
|---|---|---|---|---|---|
| afbm | Artificial fill over San Francisco Bay mud | Marin MWD, Novato SD, and Napa SD | Historic | Artificial fill over bay mud, may be engineered or non-engineered. | Easy |
| alf | Artificial levee fill | Napa SD | Historic | May be engineered or non-engineered fill. | Easy |
| Qhbm | Holocene San Francisco Bay Mud | Novato SD, Petaluma, SVCSD, and Napa SD | Holocene | Estuarine silt, clay, peat, and fine grained sand deposited in and along the edges of San Francisco and San Pablo Bays. | Easy |
| Qhf | Holocene alluvial fan deposits | Petaluma | Holocene | Sand, gravel, silt, and clay deposited by streams on alluvial fans; moderately to poorly sorted and moderately to poorly bedded. | Easy |
| Qhff | Fine-grained Holocene alluvial fan deposits | Petaluma | Holocene | Clay and silt with interbedded deposits of sand and gravel on stream deposited alluvial fans. | Easy |
| Qha | Holocene alluvium, undifferentiated | Novato SD and Napa SD | Holocene | Poorly sorted alluvium deposited on fans, terraces, or basins consisting of sand, gravel, silt, and clay. | Easy |
| Qf | Latest Pleistocene to Holocene alluvial fan deposits | American Canyon | Latest Pleistocene - Holocene | Sand, gravel, silt, and clay; moderately to well graded | Easy |
| Qa | Latest Pleistocene to Holocene alluvium, undifferentiated | Marin MWD, Novato SD, and Napa SD | Pleistocene - Holocene | Sand, gravel, silt, and clay deposited on flat relatively undissected fans, terraces, and basins. | Easy |
| Qpf | Latest Pleistocene alluvial fan deposits | Petaluma, SVCSD, SCWA, and Napa SD | Pleistocene | Sand, gravel, silt, and clay deposited as alluvial fans; moderately to poorly sorted and bedded; denser than the younger alluvial deposits and more dissected. | Easy |
| Qoa | Early to late Pleistocene undifferentiated alluvial deposits | SVCSD, Napa SD, and American Canyon | Pleistocene | Sand, gravel, silt, and clay deposited on alluvial fans, stream terraces, basins, and channels; denser than the younger alluvium. Little to no original alluvial surfaces are preserved, moderately to deeply dissected. | Easy |

**Table 2 - Geologic Units Underlying Phase 2 Project Components**

| Unit Symbol | Formation | Project Location/ Member Agency | Age | Description/Comment | Excavation Characteristics[1] |
|---|---|---|---|---|---|
| Psv | Sonoma Volcanics | SVCSD, SCWA, and Napa SD | Pliocene - Miocene | Units of flows, breccia, and tuff with varying lithologies including basalt, andesite, rhyolite, and dacite. | Difficult |
| Pp | Petaluma Formation | Petaluma | Pliocene - Miocene | Fluvial, estuarine, and lacustrine sandstone, siltstone, conglomerate, and diatomite. Lower unit is estuarine and minor marine with laminated siltstone and local dolomite interbeds. | Moderate-Difficult |
| Msp | San Pablo Group | Napa SD | Miocene | Fossiliferous brown, gray, and white marine sandstone, shale, and conglomerate; includes the Neroly Sandstone, Cierbo Sandstone, and Briones Sandstone. | Moderate - Difficult |
| Ed | Domengine Sandstone | American Canyon | Eocene | Marine feldspathic quartz sandstone with minor mudstone interbeds. | Moderate - Difficult |
| KJu | Great Valley Sequence | American Canyon | Lower Cretaceaous-Upper Jurassic | Undifferentiated marine mudstone, sandstone and conglomerate. Includes the Knoxville Formation. Locally the basal part of the sequence is a chaotically deformed mixture of sedimentary rocks, mafic igneous rocks, and serpentine. | Difficult |
| KJf | Franciscan Complex | American Canyon | Cretaceous - Jurassic | Franciscan Complex rock undifferentiated | Difficult |
| KJfsch/mg | Franciscan Complex | Novato SD and Petaluma | Cretaceous - Jurassic | Franciscan Metagraywacke (semischist); may also contain graywacke and schist. | Difficult |
| KJfss | Franciscan Complex | Novato SD | Cretaceous – Jurassic | Franciscan sandstone and shale | Difficult |
| KJfm | Franciscan Complex | Marin MWD | Cretaceous - Jurassic | Franciscan Mélange | Difficult |

Sources: CGS, 1982, CGS 2010, and USGS 2000..

Note(s):

[1] Excavation characteristics are very generally defined as “easy,” “moderate,” or “difficult” based on increasing hardness of the rock unit. Excavation characteristic descriptions are general in nature and the actual ease of excavation may vary widely depending on site-specific subsurface conditions.

## 2.3 SOILS

The soils underlying the Project reflect the underlying rock type, the extent of weathering of the rock, the degree of slope, and the degree of human modification. Potential hazards/impacts from soils include erosion, shrink-swell (expansive soils), and corrosion. Soil mapping by the USDA National Resource Conservation Service (NRCS), Soil Conservation Service, was reviewed for information about unsuitable characteristics of surface and near-surface subsurface soil materials. A review of GIS spatial and tabular data for the Marin County, Sonoma County, and Napa County survey areas provided information for surface and shallow subsurface soil materials (NRCS, 2013, 2014a, and 2014b). Numerous soil associations and complexes are mapped in the Project area and underlying Project components. A summary of the significant characteristics of the complexes and associations traversed by Project components, listed in alphabetical not geographic order, and the general locations where they occur within the Project are presented in *Table 3 – Soil Characteristics. Plates 9 through 15* show the distribution of these soil associations underlying the Phase 2 Project components.

**Table 3 – Soil Characteristics**

| Unit Name | Project Location/ Member Agency | Description[1] | Erosion Class | | Expansion Potential[4] (Shrink-Swell) | Corrosion Potential | |
|---|---|---|---|---|---|---|---|
| | | | Water[2] | Wind[3] | | Uncoated Steel | Concrete |
| Bale | Napa SD | Clay loam, found on alluvial fans and flood plains with 0 to 2% slopes. Formed in alluvium derived from igneous rocks, somewhat poorly drained. | Low-Medium | Low-Medium | Low-Medium | High | Low |
| Blucher-Cole | Novato SD | Found on basin floors and alluvial fans and formed in alluvium on 2 to 5% slopes; somewhat poorly drained. | Medium | Medium-Low | Moderate - High | High | Low |
| Clear Lake | Novato SD, Petaluma, SVCSD, SCWA, Napa SD, and American Canyon | Clay loam and clay; found on basin floors and river valleys, formed in alluvium on 0 to 5% slopes, poorly drained. | Medium | Medium | High | High | Low-Moderate |
| Cole | Napa SD | Silt loam, found on flood plains and alluvial fans. Formed in alluvium on 2 to 5% slopes. | Medium-High | Low-Medium | Medium-High | High | Low |
| Coombs | Napa SD | Gravelly loam, found on alluvial fans and terraces. Formed in alluvium on 0 to 5% slopes; well drained. | Low-Medium | Low | Low-Medium | Moderate | Moderate |
| Diablo | Petaluma | Clay, found on hills and uplands of 2 to 30%. Formed in colluvium and weathered sedimentary rocks; well drained. | Medium | Medium | High | High | Low |
| Fagan | Napa SD and American Canyon | Clay loam; found on hillslopes of 5 to 30%. Formed in colluvium and weathered sandstone and shale; well drained. | Medium | Low-Medium | Medium-High | High | Low |
| Forward | Napa SD | Gravelly loam on hillslopes of 9 to 30%. Formed in colluvium and weathered rhyolite; well drained. | Low-Medium | Low-Medium | Low | High | Moderate |
| Goulding-Toomes | SVCSD and SCWA | Goulding component is the main component in this area. Found on hills and uplands of 9 to 50% slope. Formed in colluvium and weathered metavolcanics. | Low-Medium | Low | Low-Medium | Moderate | Low |
| Gullied Land | Petaluma | Classified as a miscellaneous area with little to no soils development. | - | - | - | - | - |

**Table 3 – Soil Characteristics**

| Unit Name | Project Location/ Member Agency | Description[1] | Erosion Class | | Expansion Potential[4] (Shrink-Swell) | Corrosion Potential | |
|---|---|---|---|---|---|---|---|
| | | | Water[2] | Wind[3] | | Uncoated Steel | Concrete |
| Haire | Petaluma, SVCSD, Napa SD, and American Canyon | Gravely loam, loam, and clay loam on alluvial fans, uplands, and terraces with 0 to 30% slope. Formed in alluvium derived from sedimentary rock; moderately well drained. | Medium | Low-Medium | Medium-High | High | Moderate |
| Hambright-Rock outcrop | Napa SD | Found on plateaus, hill, and uplands on slopes of 2 to 75%. Shallow soil and rock outcrop; formed in colluvium and weathered basic volcanic rock. Well drained. | Low | Low | Low | Moderate | Low |
| Huichica | SVCSD | Loam, found on hill and uplifted terraces with slopes of 0 to 9%. Formed in alluvium; moderately well drained. | Medium | Low-Medium | Low | Moderate | Moderate |
| Kidd | Napa SD | Loam, found on hills with slopes of 15 to 75%. Shallow soil formed in colluvium and weathered rhyolite; well drained. | Medium | Low-Medium | Low | High | Low |
| Los Osos-Bonnydoon | Novato SD | Found on hill and uplands with slopes of 15 to 30%. Formed in colluvium and weathered sandstone and shale; well drained to somewhat excessively drained. | Low-Medium | Low-Medium | Low-High | Low-Moderate | Low |
| Red Hill | SVCSD and SCWA | Clay loam, found on hills and uplands with 2 to 15% slopes. Formed in weathered andesite; moderately well drained. | Medium | Low-Medium | Medium-High | High | Moderate |
| Reyes | Novato SD, Petaluma, SVCSD, Napa SD, and American Canyon | Clay and silty clay, found on tidal flats and basin floors with 0 to 2% slope. Formed in alluvium; poorly drained. | Low-Medium | Medium | High | Moderate-High | High |
| Saurin-Bonnydoon | Marin MWD, Novato SD | Found on hills and uplands with slopes of 2 to 30%. Formed in colluvium and weathered sandstone and shale; well drained to somewhat excessively drained. | Low-Medium | Low-Medium | Medium-High | Low-Moderate | Low |
| Sobrante | Napa SD | Loam, found on hills with slopes of 5 to 50%. Formed in colluvium and weathered from sandstone; well drained. | Medium | Medium | Low | Moderate | Low |

**Table 3 – Soil Characteristics**

| Unit Name | Project Location/ Member Agency | Description[1] | Erosion Class | | Expansion Potential[4] (Shrink-Swell) | Corrosion Potential | |
|---|---|---|---|---|---|---|---|
| | | | Water[2] | Wind[3] | | Uncoated Steel | Concrete |
| Tidal Marsh | Petaluma | Classified as a miscellaneous area with little to no soils development. | - | - | - | - | - |
| Tocaloma-Saurin association | Marin MWD | Formed on slopes of 15 to 30 percent on hills and uplands. The parent material consists of residuum weathered from sandstone and shale; well drained. | Medium | Low-Medium | Low-Medium | Low-Moderate | Low |
| Wright | SVCSD | Loam, wet, found on terraces and in river valleys with slopes of 0 to 2%. Formed in alluvium, poorly drained. | Medium-High | Medium | Low-High | High | Moderate |
| Xerothents-fill, Xerothents-Urban land, or Urban land-Xerothents | Marin MWD, Novato SD | Found on valley floors with slopes of 0 to 9%. Formed in earth spread deposits derived igneous, metamorphic, and sedimentary rocks. | - | - | - | - | - |
| Yolo | Napa SD and SVCSD | Loam, moist, found on flood plains and in valleys with slopes of 0 to 10%. Formed in alluvium; well drained. | Medium-High | Low-Medium | Low-Medium | Low | Low |

Notes:

1. Loam is a soil with approximately equal amounts of sand, silt, and clay.
2. Based on Erosion factor K (used by the NRCS in the Universal Soil Lose Equation), which indicates the susceptibility of a soil to sheet and rill erosion by water. Values of K range from 0.02 to 0.69 with higher values being more susceptible to sheet and rill erosion.
3. Soils are assigned to wind erodibility groups based on their susceptibility to wind erosion, soils assigned to group 1 are the most susceptible and soils assigned to group 8 are the least susceptible.
4. Linear extensibility is the method used by the NRCS to determine the shrink-swell potential of soils. Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. The volume change is reported as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3 percent, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed in areas with expansive soils.

### 2.4 SEISMIC SETTING

The project site is in a seismically active region near the boundary between two major tectonic plates, the Pacific Plate to the southwest and the North American Plate to the northeast. The relative movement between the Pacific Plate and the North American Plate generally occurs across a 50-mile wide zone extending from the San Gregorio Fault in the southwest to the Great Valley Thrust Belt in the northeast. Strain produced by the relative motions of these plates is relieved by right lateral strike slip faulting on the San Andreas Fault Zone and related faults (San Gregorio, Calaveras, Hayward), and by vertical reverse slip displacement on the Great Valley and other thrust faults in the central California area. The San Francisco Bay Area is characterized by numerous geologically young right-lateral strike slip and normal-right oblique slip faults due to this combination of translational and extensional stress. These faults can be classified as historically active, active, potentially active, or inactive, based on the following criteria (CGS, 1999):

- Faults that have generated earthquakes accompanied by surface rupture during historic time (approximately the last 200 years) and faults that exhibit aseismic fault creep are defined as Historically Active.
- Faults that show geologic evidence of movement within Holocene time (approximately the last 11,000 years) are defined as Active.
- Faults that show geologic evidence of movement during the Quaternary time (approximately the last 1.6 million years) are defined as Potentially Active.
- Faults that show direct geologic evidence of inactivity during all of Quaternary time or longer are classified as Inactive.

Although it is difficult to quantify the probability that an earthquake will occur on a specific fault, this classification is based on the assumption that if a fault has moved during the Holocene epoch, it is likely to produce earthquakes in the future. Since periodic earthquakes accompanied by surface displacement can be expected to continue in the study area through the lifetime of the Proposed Project, the effects of strong groundshaking and fault rupture are of primary concern to safe operation of the project components.

Strong ground shaking at the project site could occur as a result of an earthquake on any one of the active regional faults shown in *Plate 16 – Regional Active and Potentially Active Faults*. The San Andreas Fault, the dominant tectonic feature of the San Francisco Peninsula (*Figure 16*), is the primary structure within the broad transform boundary that accommodates right lateral motion between the North American and Pacific tectonic plates.

Active faults in California have been divided into activity categories by the California Geological Survey based on their predicted activity and ability to generate strong earthquakes; "Type A" faults which generally have higher and well defined slip rates and well defined recurrence intervals, and "Type B" faults with well-defined slip rates but poorly constrained recurrence intervals. "Type A" faults are commonly considered more active (generally with higher slip rates) and/or capable of generating larger earthquakes than "Type B" faults. The USGS has divided the major active faults in the San Francisco Bay Area into segments based on work by the WGCEP (2003 and 2008). Based on this segmentation, various fault rupture scenarios were developed that include earthquakes and rupture of segments of the individual faults in varying segment combinations, i.e. rupture of one segment by itself or rupture of two or more segments concurrently. These scenarios result in differing earthquake and fault parameters for each of the potential segment combinations.

Both "Type A" and "Type B" faults that are mapped in the region are summarized in *Table 4 – Significant Active and Potentially Active Faults*. The distance to significant active faults and fault segments, California Geological Survey (CGS) assigned fault type ("A" or "B"), estimated maximum magnitude earthquake, and fault characteristics are summarized in *Table 4*.

**Table 4 - Significant Active and Potentially Active Faults**

| Name | Closest Distance to Project (miles)[1] | Closest Phase 2 Project Member Agency(s) | Estimated Max. Earthquake Magnitude[2] | Fault Type and Dip Direction[3] |
|---|---|---|---|---|
| **Active Type A Faults** | | | | |
| Hayward-Rodgers Creek (Varying rupture combinations of the Rodgers Creek segment alone and with the Hayward North and South segments) | 2.5 | Petaluma | 6.6-7.3 | Right Lateral Strike Slip, 90° |
| Hayward-Rodgers Creek (Rupture of the Hayward North segment alone and in combination with the Hayward South segment) | 6.7 | Novato SD | 6.6-7.0 | Right Lateral Strike Slip, 90° |
| N. San Andreas (Varying rupture combinations of segments of the N. San Andreas North Coast segment alone and with the Offshore, Peninsula, and Santa Cruz Mountain segments) | 12.6 | Novato SD | 7.5-7.9 | Right Lateral Strike Slip, 90° |
| N. San Andreas (Varying combinations of rupture of the N. San Andreas Peninsula segment alone and with of the Santa Cruz segment) | 14.8 | Novato SD | 7.2-7.5 | Right Lateral Strike Slip, 90° |
| Calaveras (Varying rupture combinations of the Calaveras Northern segment alone and with the Central and Southern segments) | 28.6 | Napa SD | 6.9-7.0 | Right Lateral Strike Slip, 90° |

| Table 4 - Significant Active and Potentially Active Faults | | | | |
|---|---|---|---|---|
| Name | Closest Distance to Project (miles)[1] | Closest Phase 2 Project Member Agency(s) | Estimated Max. Earthquake Magnitude[2] | Fault Type and Dip Direction[3] |
| Active and Potentially Active Type B Faults | | | | |
| West Napa | 0 | Napa SD | 6.7 | Right Lateral Strike Slip, 90° |
| Green Valley Connected | 2.3 | Napa SD | 6.8 | Right Lateral Strike Slip, 90° |
| Great Valley 4 | 13.2 | Napa SD | 6.6 | Thrust, 20°W |
| Great Valley 5 | 14.6 | Napa SD | 6.7 | Reverse, 90° |
| San Gregorio: Connected [4] | 21.3 | Novato SD | 7.5 | Right Lateral Strike Slip, 90° |
| Mount Diablo Thrust | 29.1 | Napa SD | 6.7 | Thrust, 38°NE |

Notes:
1. Fault-to-site distances based on the 2008 National Seismic Hazard Maps - Fault Parameters website at http://geohazards.usgs.gov/cfusion/hazfaults_search and Bryant, 2005, Digital Database of Quaternary and Younger Faults from the Fault Activity Map of California, version 2.0: CGS.
2. Maximum Earthquake Magnitude – the maximum earthquake that appears capable of occurring under the presently known tectonic framework, magnitude listed is "Ellsworth-B" magnitude from USGS OF2007-1437 (Supporting Documentation for the Uniform California Earthquake Rupture Forecast, Version 2 (UCERF 2) (WGCEP, 2008) unless otherwise noted.
3. 30-year probability of M>6.7 earthquake based on 2007 Working Group on California Earthquake Probabilities (WGCEP, 2008).
4. San Gregorio Fault analyzed as a Type A fault by the 2007 Working Group on California Earthquake Probabilities.

The 2014 USGS Working Group on California Earthquake Probabilities has concluded that there is a 72 percent probability of a Magnitude (M) ≥ 6.7 and a 20 percent probability of a M ≥ 7.5 occurring in the San Francisco Bay Region in the next thirty years (WGCEP, 2015). Additionally, the 2014 Working Group on California Earthquake Probabilities (WGCEP, 2015) has concluded that within the next 30 years the probability of a strong earthquake (M ≥ 6.7) occurring on regional faults is as follows: 7 percent for the North Coast San Andreas Fault Zone, 13 percent for the Rodgers Creek Fault Zone, and 6 percent for the Green Valley Fault Zone.

The closest significant active faults to the Project are the San Andreas, West Napa, Rodgers Creek, and the Green Valley Faults. The West Napa Fault crosses a portion of the Napa SD project as shown on *Plate 17 - Napa SD Phase 2 Project Fault Map*.

- The **San Andreas Fault Zone** is a major active right lateral strike-slip fault zone that extends for about 685 miles along the western side of California, extending from Mendocino County southeast across California to Mexico. The North Coast segment of the San Andreas Fault Zone separates the Point Reyes Peninsula from the rest of Marin County, extending from Point Area southeast to the Golden Gate. The largest recorded earthquake on the San Andreas Fault in the Bay Area was the M7.9 1906 San Francisco earthquake, which resulted in approximately 15 feet of right-lateral fault rupture and a surface fault rupture that extended over a distance of approximately 190 miles from Point Arena to San

Juan Bautista. This earthquake resulted in 3,000 deaths and approximately $524 million in property damage, including fire damage. Severe earthquake induced damage to manmade structures occurred in Santa Rosa, located approximately 20 miles east of the fault. The most recent significant earthquake in the Bay Area was the M6.9 1989 Loma Prieta earthquake centered on a branch of the San Andreas Fault Zone in the Santa Cruz Mountains, about 100 miles southeast of the project area. The earthquake caused widespread damage primarily in the Santa Cruz, San Francisco, and Oakland areas. Most losses were reportedly from significant ground shaking and associated foundation failures. Although shaking was widely felt, this earthquake caused little damage within the project area.

- The **Rodgers Creek Fault** is an active right lateral strike-slip fault that has been mapped from the north edge of San Pablo Bay extending approximately 30 miles northwest to the City of Santa Rosa. The southern end of the fault connects with the Hayward Fault via an approximately 4 mile-wide right-stepover under San Pablo Bay and the northern end apparently connects with the Maacama Fault via a complex right-stepover of about 4 miles. Historical slip is indicated by studies for the 1969 Santa Rosa earthquakes (M5.6 and 5.7) Paleoseismology studies indicate evidence of three earthquake events in the past 1,000 years and right laterally offset channels in late Holocene alluvial deposits. Surface manifestations of the fault include aligned linear troughs, closed depressions, right-laterally deflected drainages and other linear features.

- The **West Napa Fault** is a northwest trending zone of oblique strike-slip faults located in the hills west of the city of Napa and extending south to the vicinity of Oat Hill (Bryant 1982a). According to Bryant (1982a), there has been approximately 80 feet of apparent vertical offset across the fault since the Pleistocene age and the amount of strike slip displacement is not known (Bryant 1982a). The most recent earthquake on the West Napa Fault was the M6.0 2014 South Napa earthquake which caused some damage to wood-frame houses and significant damage to some commercial buildings in downtown Napa, including the 1870 courthouse (USGS, 2016).

- The **Green Valley Fault** is an active right lateral strike-slip fault extends from Wooden Valley south to Suisun Bay through southeastern Napa County; the southern end of the fault likely connects with the Concord Fault along an approximately 0.6 mile-wide extensional jog south across Suisun Bay (Bryant and Cluett, 2002). Fourteen site-specific fault rupture investigations have exposed near-surface vertical to near vertical dips in unconsolidated alluvial and colluvial deposits. Paleoseismology studies indicate multiple surface-rupturing events in the past 2700 years. Geomorphic features indicative of Holocene dextral offset include closed depressions, ponded alluvium, dextrally offset drainages, linear troughs, sidehill benches, and scarps on young alluvium (Bryant and Cluett, 2002).

Several small older Quaternary faults are located in the Project area: the Burdell Mountain Fault, the Tolay Fault, and the Soda Creek Fault. The Petaluma alignment crosses the Tolay Fault in several locations as shown on *Plate 18 - Petaluma Phase 2 Project Fault Map*. The Burdell

Mountain and Soda Creek Faults do not cross Project components. Based on field mapping and seismicity data, these faults have experienced no known activity within the Holocene age (last 11,000 years) and are only considered to be potentially active.

- The **Tolay Fault Zone** (which includes the Lakeview Fault) is a northwest high angle, right lateral strike slip fault strands that extends about 22 miles northwestward from Sears Point (Hart, 1998). The Tolay Fault Zone is not well located and is partly concealed by alluvium and surface traces are partly inferred. Quaternary activity on this fault is based on geomorphology and proximity to the Rodgers Creek Fault and an inferred possible offset of Pliocene-Pleistocene deposits to the northwest, but late Quaternary alluvium in between lacks surface evidence. The Lake View Fault is part of the Tolay fault Zone. No detailed site investigations are known and the fault lacks associated historic seismicity.

- The **Burdell Mountain Fault Zone** (BMFZ) is a northwest striking sub-vertical shear zone, located along the northeast side of Burdell Mountain (Ford and others 2003). According to Ford and others (2003), field mapping indicates up to 10 kilometers of right-lateral offset across the BMFZ.

- The **Soda Creek Fault**, also known as the East Napa Fault, was mapped in 1973 in eastern Napa County. This fault is not well defined and the type and magnitude of displacement is not known (Bryant 1982).

# 3.0 GEOTECHNICAL HAZARDS

## 3.1 GEOLOGIC HAZARDS

Geologic and geotechnical considerations include slope instability, settlement, erosion, unsuitable soils, shallow groundwater, and difficult excavation. These conditions are geologic hazards and geotechnical constraints due to soil properties and groundwater conditions, rather than hazards due to seismic events.

### 3.1.1 Slope Stability and Landslides

Important factors that affect the slope stability of an area include the steepness of the slope, the relative strength of the underlying rock material, and the thickness and cohesion of the overlying colluvium. The steeper the slope and/or the less strong the rock, the more likely the area is susceptible to landslides. The steeper the slope and the thicker the colluvium, the more likely the area is susceptible to debris flows. Another indication of unstable slopes is the presence of old or recent landslides or debris flows. Mapping of existing landslides in the Project area (USGS, 1998) indicates that portions of the Petaluma, SVCSD, and Napa SD projects cross areas mapped as having few landslides and many landslides. While not mapped as crossing landslides, portions of the Marin MWD, Novato SD, and American Canyon projects cross close to or adjacent to areas of mapped as few and many landslides.

### 3.1.2 Settlement

Settlement is the compression of the underlying soil when subject to loads, such as a new structure or new fill placement. Earthen materials underlying pipelines, levees, ant tanks are prone to settlement due to increased vertical loads resulting from placement of infrastructure and fill. If additional loads are placed due to construction or modification of pipelines, levees, or storage tanks, the rate and amount of existing settlement can increase. Soils tend to settle at different rates and by varying amounts depending on the load weight. The potential for settlement exists in the portions of the study area within areas underlain by poorly engineered artificial fill, compressible sediments such as Bay Mud, and compressible or collapsible unconsolidated Quaternary sedimentary units. Differential settlement can be quite damaging to structures and pipelines.

### 3.1.3 Erosion

Potential soil erosion hazards vary depending on the use, conditions, and textures of the soils. The properties of soil which influence erosion by rainfall and runoff affect the infiltration capacity of a soil, as well as the resistance of a soil to detachment and being carried away by falling or flowing water. Soils on steeper slopes would be more susceptible to erosion due to the effects of increased surface flow (runoff) on slopes where there is little time for water to infiltrate before runoff occurs. Soils containing high percentages of fine sands and silt and that are low in density, are generally the most erodible. As the clay and organic matter content of soils increases, the potential for erosion decreases. Clays act as a binder to soil particles, thus reducing the potential for erosion. Erosion susceptibility of soils underlying the Phase 2 project components ranges from low to high for erosion by water and from low to medium for erosion by wind.

### 3.1.4 Expansive Soil

Expansive soils are characterized by their ability to undergo significant volume change (shrink and swell) due to variation in soil moisture content. Changes in soil moisture could result from a number of factors, including rainfall, landscape irrigation, utility leakage, and/or perched groundwater. Expansive soils are typically very fine grained with a high to very high percentage of clay. Soils with moderate to high shrink-swell potential would be classified as expansive soils. Expansive soils may cause differential and cyclical movements of foundations and other buried structures that can cause damage and/or distress to structures and equipment. Expansive soils are located under portions of the Phase 2 Project, as presented in *Table 3 – Soil Characteristics*.

### 3.1.5 Corrosive Soil

Corrosivity of soils is generally related to the following key parameters: soil resistivity; presence of chlorides and sulfates; oxygen content; and pH. Typically, the most corrosive soils are those with the lowest pH and highest concentration of chlorides and sulfates. High sulfate soils are corrosive to concrete and may prevent complete curing, reducing its strength considerably. Low pH and/or low resistivity soils could corrode buried or partially buried metal structures. Corrosive subsurface soils could have a detrimental effect on concrete and metals. The Corrosion potential for the soils underlying NBWRP project components range from low to high for corrosion to metal and from low to moderate for corrosion to concrete, as presented in *Table 3 – Soil Characteristics*.

### 3.1.6 Shallow Groundwater

In the flat and gently sloping valley areas and the lowlands bordering San Pablo Bay, groundwater beneath the Phase 2 components is considered shallow, and can often be found less than 15 feet below the ground surface. Geotechnical consequences of shallow groundwater conditions include, but are not limited to, special and/or extended dewatering requirements during excavation/construction, ground instability affecting earthwork activities, and excessive water pressure and infiltration acting upon below-grade facilities and structures. It can be assumed that all project components underlain by Quaternary sediments likely have shallow groundwater conditions.

## 3.2 SEISMIC HAZARDS

The Project area could experience the effects of a major earthquake from one of the active or potentially active faults located within 50 miles of the Project. Major hazards associated with earthquakes are fault surface rupture (ground displacement), strong ground shaking, ground failure (e.g., liquefaction), and seismically induced slope instability.

### 3.2.1 Fault Rupture

Fault rupture is the surface displacement that occurs when movement on a fault deep within the earth breaks through to the surface. Fault rupture and displacement almost always follow preexisting faults, which are zones of weakness; however, not all earthquakes result in surface rupture (i.e., earthquakes that occur on blind thrusts do not result in surface fault rupture). Rupture may occur suddenly during an earthquake or slowly in the form of fault creep. In addition to damage caused by ground shaking from an earthquake, fault rupture is damaging to buildings and other structures due to the differential displacement and deformation of the ground surface that occurs from the fault offset leading to damage or structural failure of structures across this zone. Perhaps the most important single factor to be considered in the seismic design of infrastructure crossing active faults is the amount and type of potential ground surface displacement. Components of the Napa SD project are crossed by strands of the active West Napa Fault Zone and components of the Petaluma project are crossed by the strands of the potentially active Tolay Fault Zone, presented in *Figures 17 and 18*, respectively.

### 3.2.2 Strong Ground Shaking

An earthquake is classified by the amount of energy released, which traditionally has been quantified using the Richter scale. Recently, seismologists have begun using a Moment Magnitude (M) scale because it provides a more accurate measurement of the size of major and great earthquakes. For earthquakes of less than M 7.0, the Moment and Richter Magnitude scales are nearly identical. For earthquake magnitudes greater than M 7.0, readings on the Moment Magnitude scale are slightly greater than a corresponding Richter Magnitude.

The intensity of the seismic shaking, or strong ground motion, during an earthquake is dependent on the distance between the Project area and the epicenter of the earthquake, the magnitude of the earthquake, and the geologic conditions underlying and surrounding the Project area. Earthquakes occurring on faults closest to the Project area would most likely generate the largest ground motion.

The intensity of earthquake-induced ground motions can be described using peak site accelerations, represented as a fraction of the acceleration of gravity (g). GIS data based on the USGS Probabilistic Seismic Hazard Assessment (PSHA) Maps was used to estimate peak ground accelerations (PGAs) along the Project alignment. PSHA Maps depict peak ground accelerations with a 2 percent probability of exceedance in 50 years, which corresponds to a return interval of 2,475 years for a maximum considered earthquake. Peak ground acceleration is the maximum acceleration experienced by a particle on the Earth's surface during the course of an earthquake, and the units of acceleration are most commonly measured in terms of fractions of g, the acceleration due to gravity (980 cm/sec2). Peak ground accelerations in the NBWRP Project area range from 0.5 to 1.2 g, which corresponds to moderate to very strong ground shaking.

### 3.2.3 Liquefaction

Liquefaction is the phenomenon in which saturated granular sediments temporarily lose their shear strength during periods of earthquake-induced strong ground shaking. The susceptibility of a site to liquefaction is a function of the depth, density, and water content of the granular sediments and the magnitude and frequency of earthquakes in the surrounding region. Saturated, unconsolidated silts, sands, and silty sands within 50 feet of the ground surface are most susceptible to liquefaction. Liquefaction-related phenomena include lateral spreading, ground oscillation, flow failures, loss of bearing strength, subsidence, and buoyancy effects (Youd and Perkins, 1978). In addition, densification of the soil resulting in vertical settlement of the ground can also occur.

In order to determine liquefaction susceptibility of a region, three major factors must be analyzed. These include: (a) the density and textural characteristics of the alluvial sediments; (b) the intensity and duration of ground shaking; and (c) the depth to groundwater. Most of the young alluvial deposits underlying the Project are expected to be liquefiable due to the shallow groundwater levels in the Project area and their unconsolidated nature. *Plates 19 through 25* present the liquefaction susceptibility of the Quaternary units underlying the Project. Older consolidated sedimentary deposits, fine or coarse grained deposits, well-drained sedimentary materials, and crystalline or sedimentary bedrock units are not susceptible to liquefaction.

### 3.2.4 Seismic Slope Instability

Other forms of seismically-induced ground failures which may affect the Project area include ground cracking, and seismically-induced landslides. Landslides triggered by earthquakes have been a significant cause of earthquake damage; in the Bay Area large earthquakes such as the 1989 Loma Prieta earthquake triggered landslides that were responsible for destroying or damaging numerous structures, blocking major transportation corridors, and damaging life-line infrastructure. Areas that are most susceptible to earthquake-induced landslides are steep slopes in poorly cemented or highly fractured rocks, areas underlain by loose, weak soils, and areas on or adjacent to existing landslide deposits. Mapping of existing landslides in the Project area (USGS, 198) indicates that portions of the Petaluma, SVCSD, and Napa SD projects cross areas mapped as having few landslides and many landslides. While not mapped as crossing landslides, portions of the Marin MWD, Novato SD, and American Canyon projects cross close to or adjacent to areas of mapped few and many landslides.

# 4.0 Regulatory Framework

## 4.1 Federal

**Clean Water Act.** The Clean Water Act establishes the basic structure for regulating discharges of pollutants into the waters of the United States. The Act authorized the Public Health Service to prepare comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries and improving the sanitary condition of surface and underground waters with the goal of improvements to and conservation of waters for public water supplies, propagation of fish and aquatic life, recreational purposes, and agricultural and industrial uses. Construction of Phase 2 projects would disturb a surface area greater than one acre; therefore, NBWRP Agencies would be required to obtain under Clean Water Act regulations a National Pollution Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activity. Compliance with the NPDES would require that the applicant submit a Storm Water Pollution Prevention Plan (SWPPP).

**International Building Code.** The International Building Code (IBC) is published by the International Code Council (ICC); the scope of this code covers major aspects of construction and design of structures and buildings, except for three-story one- and two-family dwellings and town homes. The International Building Code has replaced the Uniform Building Code as the basis for the California Building Code and contains provisions for structural engineering design. The 2015 IBC addresses the design and installation of structures and building systems through requirements that emphasize performance. The IBC includes codes governing structural as well as fire- and life-safety provisions covering seismic, wind, accessibility, egress, occupancy, and roofs.

Institute of Electrical Engineers. The Institute of Electrical and Electronics Engineers (IEEE) 693 "Recommended Practices for Seismic Design of Substations" was developed by the Substations Committee of the IEEE Power Engineering Society, and approved by the American National Standards Institute and the IEEE-SA Standards Board. This document provides seismic design recommendations for substations and equipment consisting of seismic criteria, qualification methods and levels, structural capacities, performance requirements for equipment operation, installation methods, and documentation. This recommended practice emphasizes the qualification of electrical equipment. IEEE 693 is intended to establish standard methods of providing and validating the seismic withstand capability of electrical substation equipment. It provides detailed test and analysis methods for each type of major equipment or component found in electrical substations. This recommended practice is intended to assist the substation user or operator in providing substation equipment that will have a high probability of withstanding seismic events to predefined ground acceleration levels. It establishes standard methods of verifying seismic withstand capability, which gives the substation designer the ability to select equipment from various manufacturers, knowing that the seismic withstand rating of each manufacturer's equipment is an equivalent measure. Although most damaging seismic activity occurs in limited areas, many additional areas could experience an earthquake with forces capable of causing great damage. This recommended practice should be used in all areas that may experience earthquakes.

### 4.2 STATE

**California Building Code.** The California Building Code, Title 24, Part 2 provides building codes and standards for design and construction of structures in California. The 2013 CBC is based on the 2012 International Building Code with the addition of more extensive structural seismic provisions. Chapter 16 of the CBC contains definitions of seismic sources and the procedure used to calculate seismic forces on structures.

**Alquist-Priolo.** The Alquist-Priolo Earthquake Fault Zoning Act of 1972, Public Resources Code (PRC) sections 2621–2630 (formerly the Special Studies Zoning Act) regulates development and construction of buildings intended for human occupancy to avoid the hazard of surface fault rupture. While this act does not specifically regulate transmission and telecommunication lines; it does help define areas where fault rupture is most likely to occur. This Act groups faults into categories of active, potentially active, and inactive. Historic and Holocene age faults are considered active, Late Quaternary and Quaternary age faults are considered potentially active, and pre-Quaternary age faults are considered inactive. These classifications are qualified by the conditions that a fault must be shown to be “sufficiently active” and “well defined” by detailed site-specific geologic explorations in order to determine whether building setbacks should be established.

**Seismic Hazard Mapping Act.** The Seismic Hazards Mapping Act (the Act) of 1990 (Public Resources Code, Chapter7.8, Division 2, sections 2690–2699.) directs the California Department of Conservation, Division of Mines and Geology [now called California Geological Survey (CGS)] to delineate Seismic Hazard Zones. The purpose of the Act is to reduce the threat to public health and safety and to minimize the loss of life and property by identifying and mitigating seismic hazards. Cities, counties, and State agencies are directed to use seismic hazard zone maps developed by CGS in their land-use planning and permitting processes. The Act requires that site-specific geotechnical investigations be performed prior to permitting most urban development projects within seismic hazard zones.

**California Geological Survey.** Although not state regulation, the CGS Special Publication 117A (CGS, 2008) provides guidelines for evaluating seismic hazards other than surface fault-rupture, and for recommending mitigation measures as required by Public Resources Code Section 2695(a). Nothing in these Guidelines is intended to conflict with or supersede any requirement, definition, or other provision of Chapter 7.8 of the Public Resources Code; California Code of Regulations, Title 14, Division 2, Chapter 8, Article 10; the Business and Professions Code; or any other state law or regulation.

### 4.3 LOCAL

Construction activities are regulated by city and county agencies through the issuance of grading and building permits. In general, city permits are required for projects within a city's limits and county permits are required for projects outside of the city limits. The local agencies require site specific geotechnical evaluation and incorporation of seismic hazard mitigation measures into the design plans as part of the permit process. Geotechnical evaluations must be overseen by a California state-certified engineering geologist and/or civil engineers with expertise in the geotechnical discipline or geotechnical engineer.

## 5.0 CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the geotechnical hazards and constraints identified in this document.

**Table 5 - Potential Mitigation for Identified Geotechnical Constraints**

| Hazards/Impact | Geologic or Geotechnical Constraints at NBWRP Phase 2 Projects | Potential Mitigation |
|---|---|---|
| Fault Rupture | • Portions of the Napa SD project located within the Alquist-Priolo Earthquake Fault Zones and crossing recent active fault traces.<br>• There is the potential for fault rupture within 1,000 feet of an active fault in the Napa SD project area<br>• Potentially active faults cross portions of Petaluma project | • Evaluation of fault rupture hazard in accordance with CGS Special Publication 42.<br>• Design to accommodate some potential displacement<br>• Relocation of structures or pipeline alignment |
| Strong Ground Shaking | • The entire Project is located within a seismically active region.<br>• Earthquakes generated along active faults may result in moderate to very strong ground shaking. | • Seismic design in accordance with code requirements.<br>• Design to accommodate some displacement |
| Liquefaction | • Quaternary units with moderate to very high liquefaction susceptibility underlie all project areas | • Ground improvement of the liquefiable soils<br>• Remove and replace liquefiable soils with engineered fill<br>• Design to accommodate some displacement<br>• Structural strengthening, or support on deep foundation |
| Slope Stability | • Areas mapped to have the potential for moderate to high risks of landslides<br>• Areas mapped to have existing landslide deposits | • Conduct slope stability evaluation<br>• Implement slope remediation measures |
| Compressible/ Collapsible soils | • Unconsolidated deposits that are Quaternary in age and have potential to be poorly compacted or soft resulting in settlement. | • Over-excavation and replacement with engineered fill.<br>• Place structures on deep foundation founded in competent underlying layer |
| Expansive Soils | • Quaternary units containing interbeds of potentially expansive clay.<br>• Clay rich soils with Moderate to High expansion (shrink-swell) potential | • Identify and remove expansive soils and replace with select fill<br>• Lime treatment of expansive soils<br>• Place structures on drilled pier founded on deeper non-expansive bearing layer |
| Corrosive Soils | • Quaternary units with low pH, low resistivity, high sulfate.<br>• Soils with Moderate to High potential for corrosion to uncoated steel or concrete. | • Epoxy coating of reinforcing steel<br>• Use of Type V cement |
| Shallow Groundwater | • Groundwater occurring within 15 feet of the ground surface. | • Groundwater dewatering |

**Table 5 - Potential Mitigation for Identified Geotechnical Constraints**

| Hazards/Impact | Geologic or Geotechnical Constraints at NBWRP Phase 2 Projects | Potential Mitigation |
|---|---|---|
| Difficult Excavation Due to Hard Bedrock or Oversized Material | • Consolidated/hard bedrock or soils and rock fragments with particle size greater than 12 inches underlying portions of the Project | • Special equipment may be required to facilitate excavation and removal of hard and oversized material. |

Table Modified from 2008 Phase 1 Geologic Conditions and Geotechnical Constraints Technical Memorandum, North San Pablo Bay Restoration and Reuse Project by CDM.

## 6.0 CLOSURE

The geologic and geotechnical constraints information provided in this TM are solely for reference purposes only. This TM was prepared for the use of Brown and Caldwell, the member agencies of NBWRP, and their consultants for planning purpose for the NBWRP Phase 2 Feasibility Study. This report does not provide all of the information needed by the NBWRP agencies and its consultants for design of the NBWRP Phase 2 projects. The geologic and geotechnical constraints information provided in this report are presented within the limits prescribed by the client, in accordance with generally accepted professional engineering and geologic practices. No other warranty, either express or implied, is made.

## 7.0 REFERENCES

Bryant, W. A. (compiler), 2005, Digital Database of Quaternary and Younger Faults from the Fault Activity Map of California, version 2.0: California Geological Survey Web Page, http://www.consrv.ca.gov/CGS/information/publications/QuaternaryFaults_ver2.htm

Bryant, W.A., 1982, West Napa Fault Zone; Soda Creek Fault (East Napa Fault): California Division of Mines and Geology Fault Evaluation Report FER-129, 9 pp.

Bryant, W.A., and Cluett, S.E., compilers, 2002, Fault number 37, Green Valley Fault, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, http://earthquakes.usgs.gov/hazards/qfaults.

Cao, T., Bryant, W.A., Rowshandel, B., Branum, D., and Wills, C.J., 2003, The Revised 2002 California Probabilistic Seismic Hazard Maps, Appendix A – 2002 California Fault Parameters, June.

Hart, E.W., compiler, 1998a, Fault number 33, Tolay Fault, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, http://earthquakes.usgs.gov/hazards/qfaults.

Hart, E.W., compiler, 1998b, Fault number 32, Rodgers Creek Fault, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, http://earthquakes.usgs.gov/hazards/qfaults.

United States Geological Survey (USGS) and California Geological Survey (CGS), 2010, Quaternary Fault and Fold Database for the United States: U.S. Geological Survey and California Geological Survey, http://earthquake.usgs.gov/regional/qfaults/, Updated November 3.

USGS, 2014, Earthquake Hazards Program Website, M6 South Napa, California Earthquake – August 24, 2014, http://earthquake.usgs.gov/research/napa2014/.

USGS, 2009, 2008 National Seismic Hazard Mapping Program (NSHMP) Probabilistic Seismic Hazard Analysis (PSHA) Interactive Deaggregation Website, http://geohazards.usgs.gov/deaggint/2008/index.php.

USGS, updated 1998. San Francisco Bay Region Landslide Information: Summary Distribution of Slides and Earth Flows, accessed at http://resilience.abag.ca.gov/landslides/

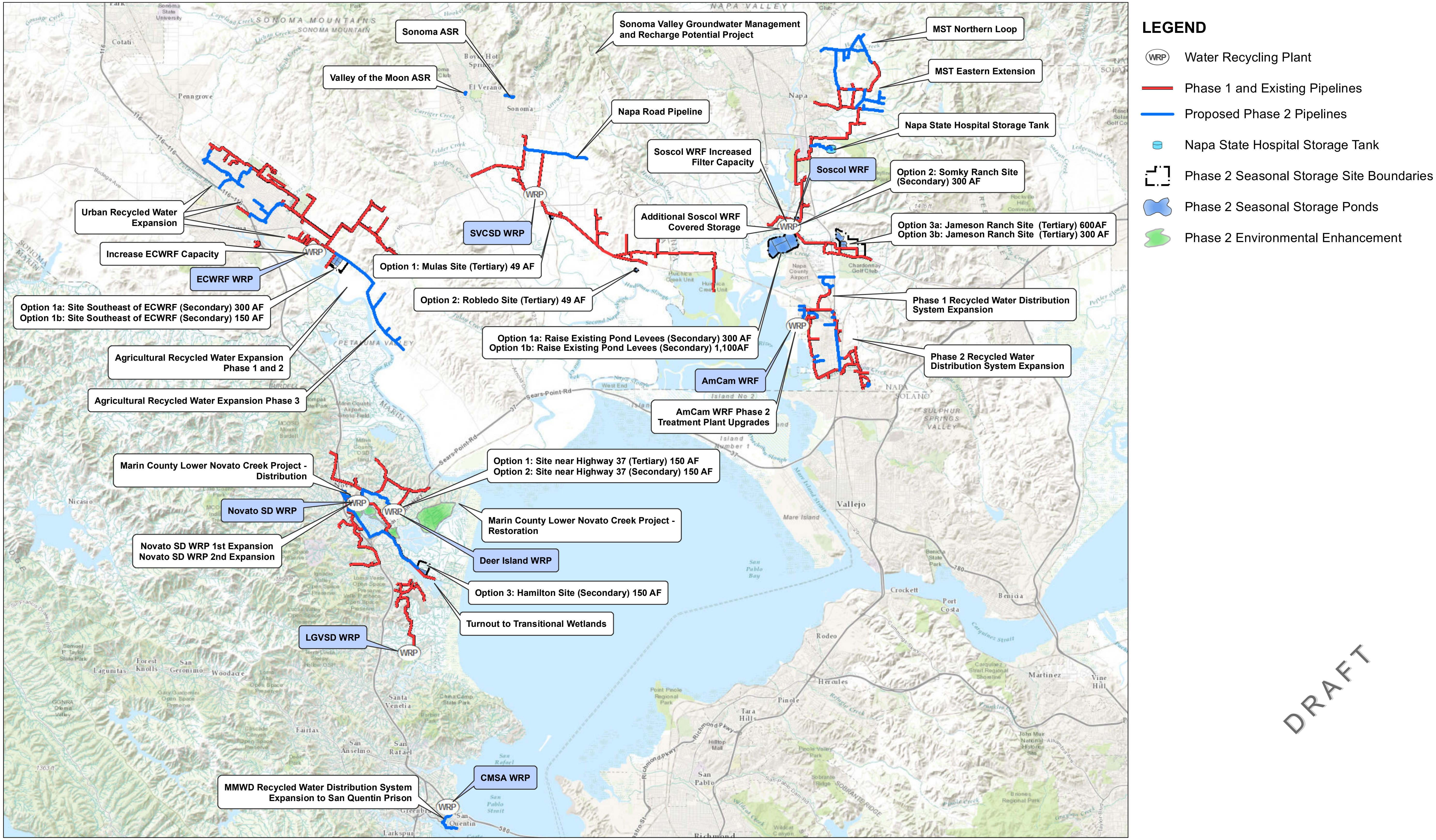
WGCEP, 2015, UCERF3: A New Earthquake Forecast for California's Complex Fault System. U.S. Geological Survey (USGS) Fact Sheet 2015–3009, http://pubs.usgs.gov/fs/2015/3009/.

WGCEP, 2008, The Uniform California Earthquake Rupture Forecast, Version 2 (UCERF 2): U.S. Geological Survey (USGS) Open-File Report (OFR) 2007-1437 and California Geological Survey Special Report 203, http://pubs.usgs.gov/of/2007/1437/.

Working Group on California Earthquake Probabilities (WGCEP), 2003, "Earthquake Probabilities in the San Francisco Bay Region: 2002 to 2031," U.S. Geological Survey Open File Report 03-214.

PLATES

This page intentionally left blank.

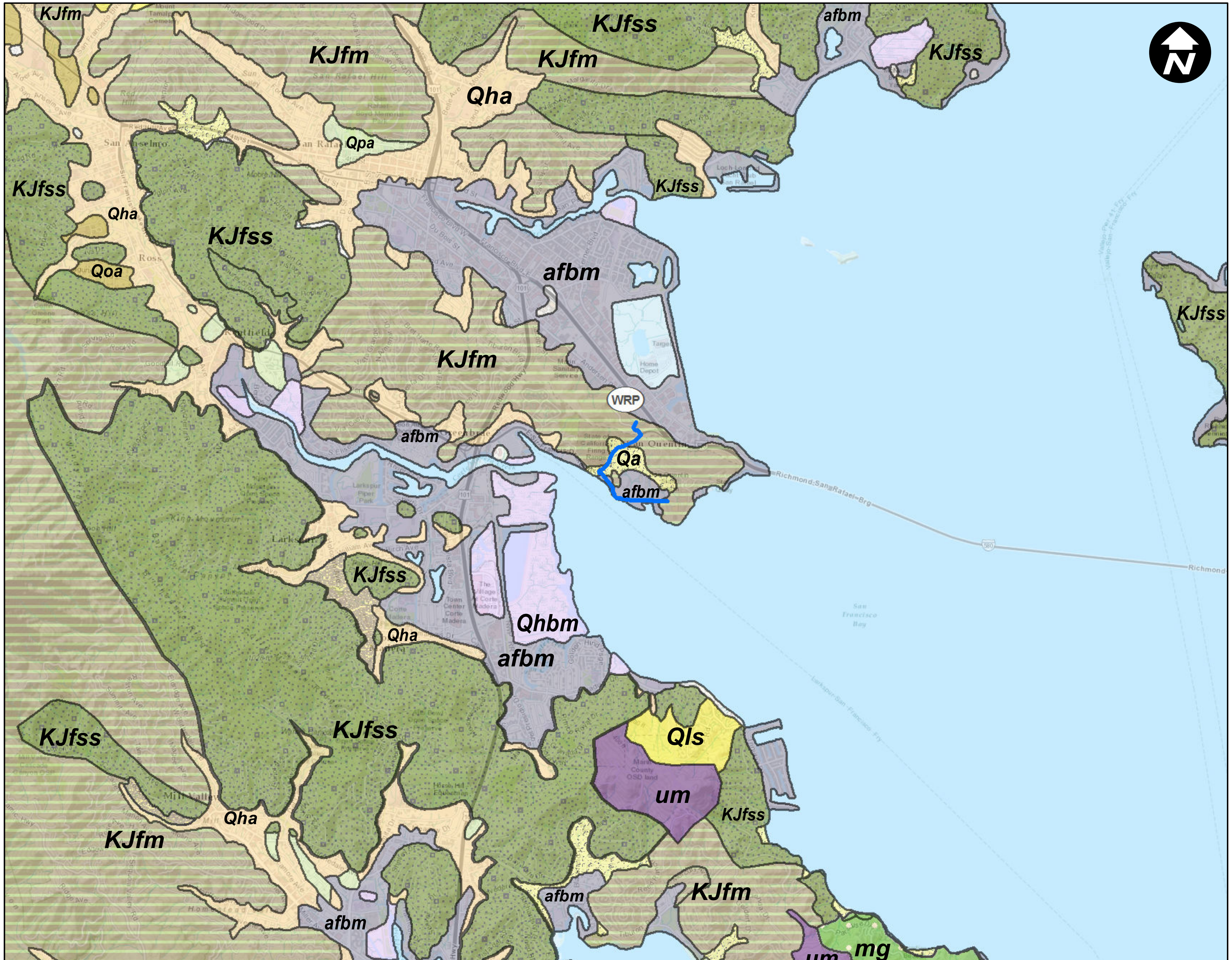



GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| NBWRP PHASE 2 PROJECT LOCATION MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 1 |
| APRIL 2017 | S16001 |

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - NBWRP Phase 2 Project Location Map.mxd

This page intentionally left blank.




## LEGEND

WRP Water Recycling Plant

Phase 1 and Existing Pipelines

Proposed Phase 2 Pipelines

### Geologic Units

### Quaternary Units

- afbm - Artificial fill over Bay Mud
- Qhbm - Holocene Bay Mud
- Qha - Holocene alluvium
- Qf - Latest Pleistocene to Holocene alluvial fan deposits
- Qa - Latest Pleistocene to Holocene alluvium
- Qpa - Latest Pleistocene alluvium
- Qoa - Early to Late Pleistocene alluvial deposits
- Qls - Quaternary landslide deposits

### Bedrock Units

- KJfm - Fransican Melange
- KJfss - Franciscan sandstone
- KJfsch/mg - Franciscan metagraywacke
- um - Serpentinized ultramafic rocks

DRAFT

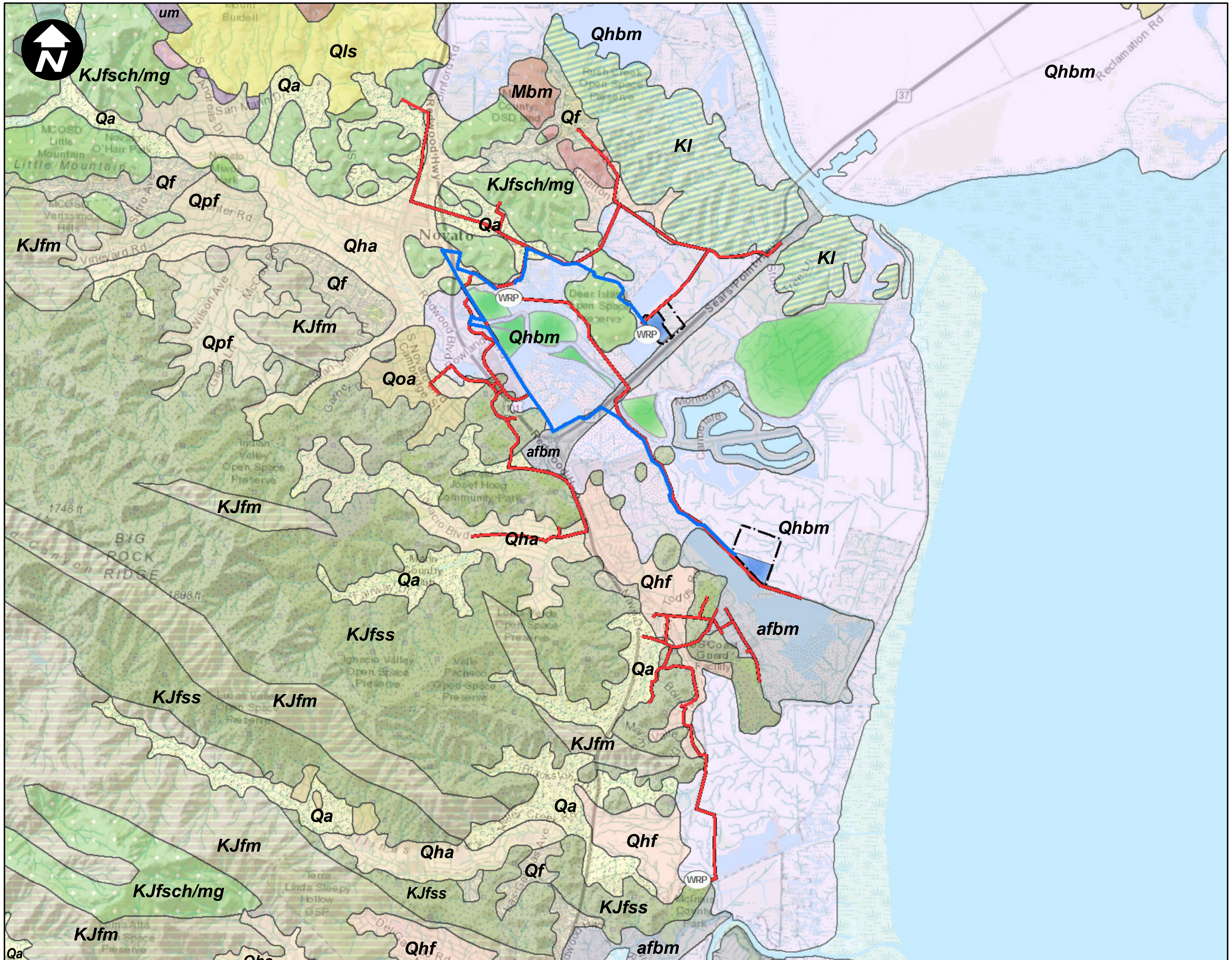
0 4,000 8,000
Feet

Geology Source: CGS, 1982. Geologic Map of the Santa Rosa Quadrangle, California, 1:250,000, Regional Geologic Map Sheet No. 2A; USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444; and CGS, 2010. Preliminary Geologic Map of the Napa 30' x 60' Quadrangle, California.

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| MARIN MWD PHASE 2 GEOLOGIC MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 2 |
| APRIL 2017 | S16001 |

This page intentionally left blank.




## LEGEND

- WRP — Water Recycling Plant
- Phase 2 Seasonal Storage Site Boundaries
- Phase 2 Seasonal Storage Ponds
- Phase 2 Environmental Enhancement

### Geologic Units

Quaternary Units

- afbm - Artificial fill over Bay
- Qhbm - Holocene Bay Mud
- Qhf - Holocene alluvial fan deposits
- Qha - Holocene alluvium
- Qf - Latest Pleistocene to Holocene alluvial fan deposits
- Qa - Latest Pleistocene to Holocene alluvium
- Qpf - Latest Pleistocene alluvial fan deposits
- Qoa - Early to Late Pleistocene alluvial deposits
- Qls - Quaternary landslide deposits

Bedrock Units

- Psv - Sonoma Volcanics
- Mbm - Volcanic rocks of Burdell Mtn.
- Kl - Lower Cretaceaous Great Valley Sequence
- KJfm - Fransican Melange
- KJfgs - Franciscan greenstone
- KJfss - Franciscan sandstone
- KJfsch/mg - Franciscan metagraywacke
- um - Serpentinized ultramafic rocks

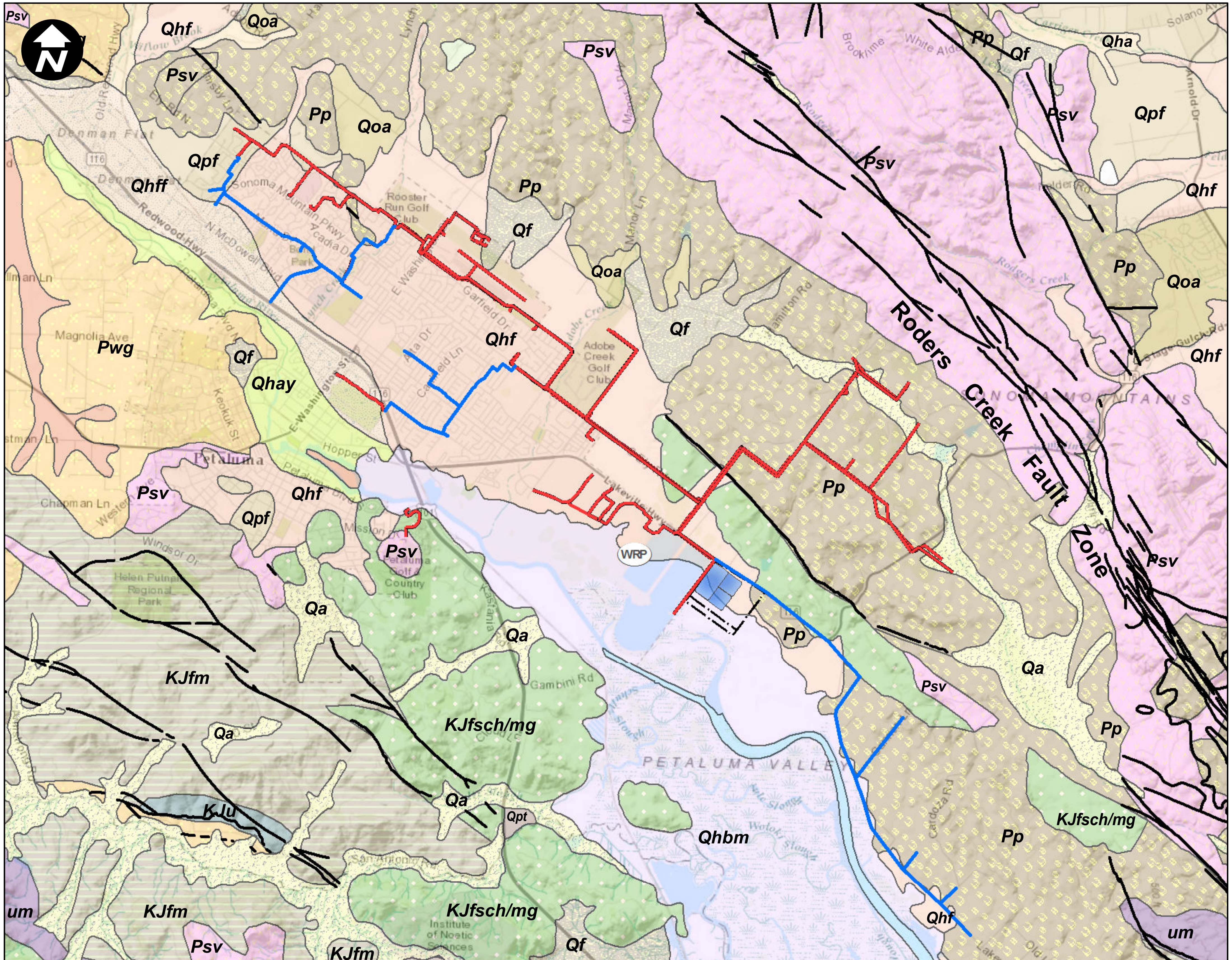
DRAFT

0 5,000 10,000
Feet

Geology Source: CGS, 1982. Geologic Map of the Santa Rosa Quadrangle, California, 1:250,000, Regional Geologic Map Sheet No. 2A; USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444; and CGS, 2010. Preliminary Geologic Map of the Napa 30' x 60' Quadrangle, California.

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| NOVATO SD PHASE 2 GEOLOGIC MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 3 |
| APRIL 2017 | S16001 |




## LEGEND

- WRP Water Recycling Plant
- Phase 1 and Existing Pipelines
- Proposed Phase 2 Pipelines
- Phase 2 Seasonal Storage Site Boundaries
- Phase 2 Seasonal Storage Ponds

### Geologic Units

Quaternary Units

- Qhay - Latest Holocene alluvial deposits
- Qhbm - Holocene Bay Mud
- Qhff - FIne-grained Holocene alluvial fan deposits
- Qhf - Holocene alluvial fan deposits
- Qht - zHolocene stream terrace deposits
- Qha - Holocene alluvium
- Qf - Latest Pleistocene to Holocene alluvial fan deposits
- Qa - Latest Pleistocene to Holocene alluvium
- Qpf - Latest Pleistocene alluvial fan deposits
- Qpt - Latest Pleistocene stream sterrace deposits
- Qpa - Latest Pleistocene alluvium
- Qoa - Early to Late Pleistocene alluvial deposits

Bedrock Units

- Pwg - Wilson Grove Formation
- Psv - Sonoma Volcanics
- Pp - Petaluma Formation
- KJu - Lower Cretaceaous-Upper Jurassic Great Valley Sequence
- KJfm - Fransican Melange
- KJfsch/mg - Franciscan schist, semischist/metagraywacke
- um - Serpentinized ultramafic rocks

- Faults

0 5,000 10,000
Feet



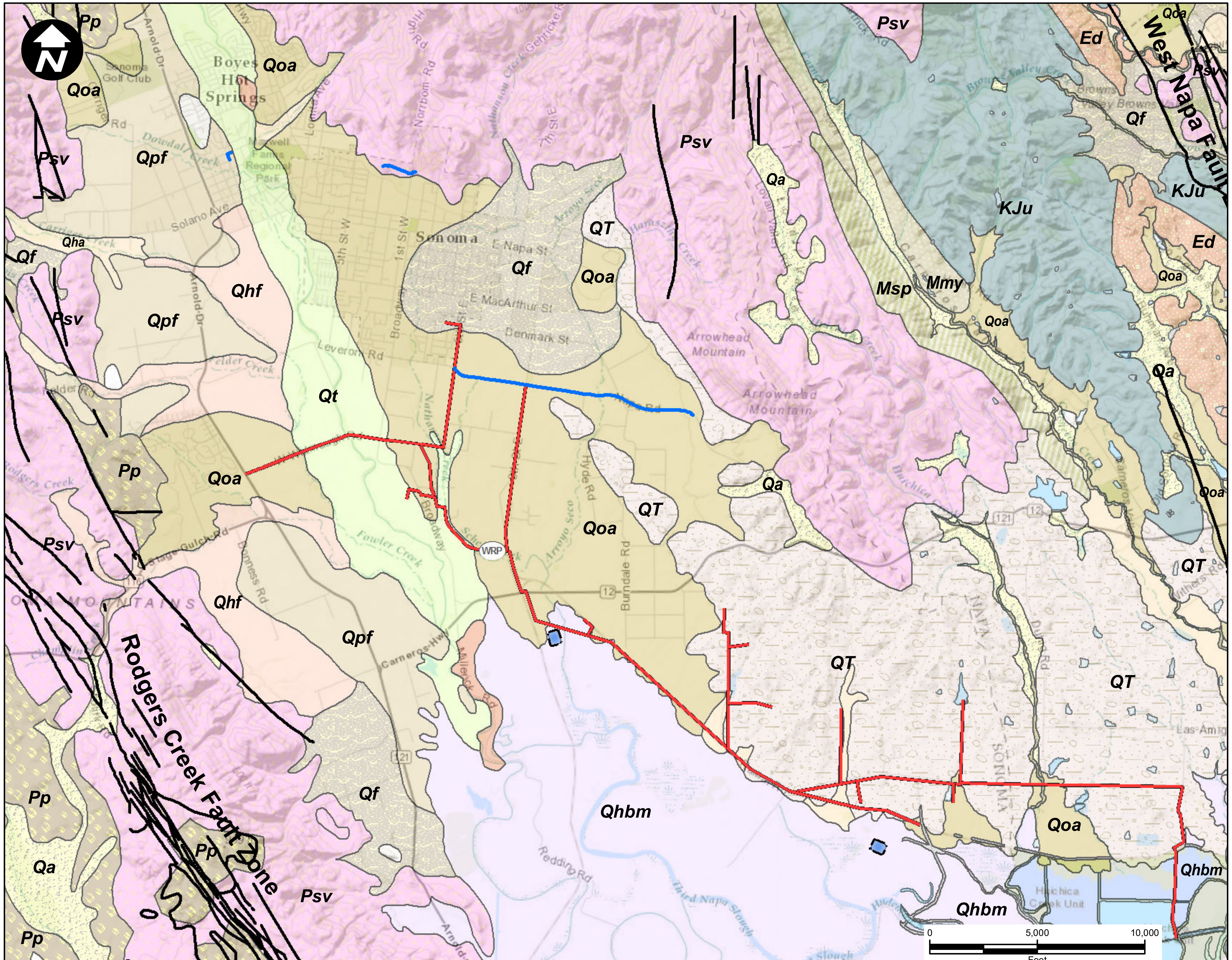
Geology Source: CGS, 1982. Geologic Map of the Santa Rosa Quadrangle, California, 1:250,000, Regional Geologic Map Sheet No. 2A; USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444; and CGS, 2010. Preliminary Geologic Map of the Napa 30' x 60' Quadrangle, California.

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| PETALUMA PHASE 2 PROJECT GEOLOGIC MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 4 |
| APRIL 2017 | S16001 |

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - Petaluma Geologic Map.mxd

This page intentionally left blank.




## LEGEND

- WRP Water Recycling Plant
- Phase 1 and Existing Pipelines
- Proposed Phase 2 Pipelines
- Phase 2 Seasonal Storage Site Boundaries
- Phase 2 Seasonal Storage Ponds

### Geologic Units

Quaternary Units

- af - Artificial fill
- afbm - Artificial fill over Bay Mud
- alf - Artificial levee fill
- Qhc - Modern stream channel deposits
- Qhbm - Holocene Bay Mud
- Qhf - Holocene alluvial fan deposits
- Qht - zHolocene stream terrace deposits
- Qha - Holocene alluvium
- Qf - Latest Pleistocene to Holocene alluvial fan deposits
- Qt - Latest Pleistocene to Holocene stream terrace deposits
- Qa - Latest Pleistocene to Holocene alluvium
- Qpf - Latest Pleistocene alluvial fan deposits
- Qoa - Early to Late Pleistocene alluvial deposits

Bedrock Units

- QT - Huichica and Glen Ellen Formations
- Psv - Sonoma Volcanics
- Pp - Petaluma Formation
- Msp - San Pablo Group
- Mmy - Monterey Group
- Ed - Domengine Sandstone
- KJu - Lower Cretaceaous-Upper Jurassic Great Valley Sequence
- Faults

DRAFT

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - SVCSD Geologic Map.mxd

Geology Source: CGS, 1982. Geologic Map of the Santa Rosa Quadrangle, California, 1:250,000, Regional Geologic Map Sheet No. 2A; USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444; and CGS, 2010. Preliminary Geologic Map of the Napa 30' x 60' Quadrangle, California.


GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111


SVCSD PHASE 2 PROJECT GEOLOGIC MAP

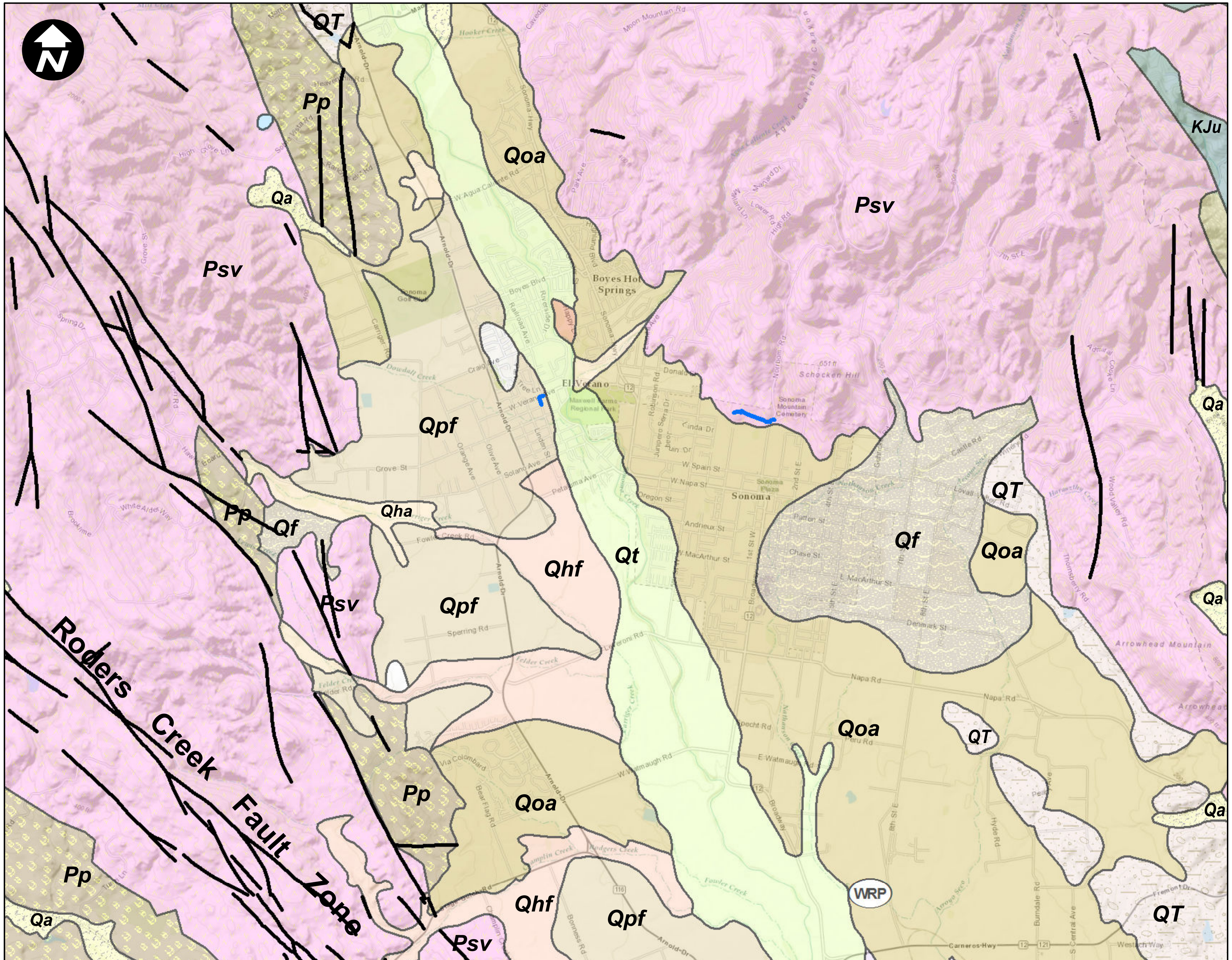
PHASE 2 FEASIBIITY STUDY
NORTH BAY WATER REUSE PROGRAM

APRIL 2017

PLATE 5

S16001

This page intentionally left blank.




## LEGEND

WRP Water Recycling Plant

Phase 1 and Existing Pipelines

Proposed Phase 2 Pipelines

### Geologic Units

Quaternary Units

- Qhbm - Holocene Bay Mud
- Qhf - Holocene alluvial fan deposits
- Qht - zHolocene stream terrace deposits
- Qha - Holocene alluvium
- Qf - Latest Pleistocene to Holocene alluvial fan deposits
- Qt - Latest Pleistocene to Holocene stream terrace deposits
- Qa - Latest Pleistocene to Holocene alluvium
- Qpf - Latest Pleistocene alluvial fan deposits
- Qoa - Early to Late Pleistocene alluvial deposits

Bedrock Units

- QT - Huichica and Glen Ellen Formations
- Psv - Sonoma Volcanics
- Pp - Petaluma Formation
- Mmy - Monterey Group
- KJu - Lower Cretaceaous-Upper Jurassic Great Valley Sequence

Faults

DRAFT

0 5,000 10,000

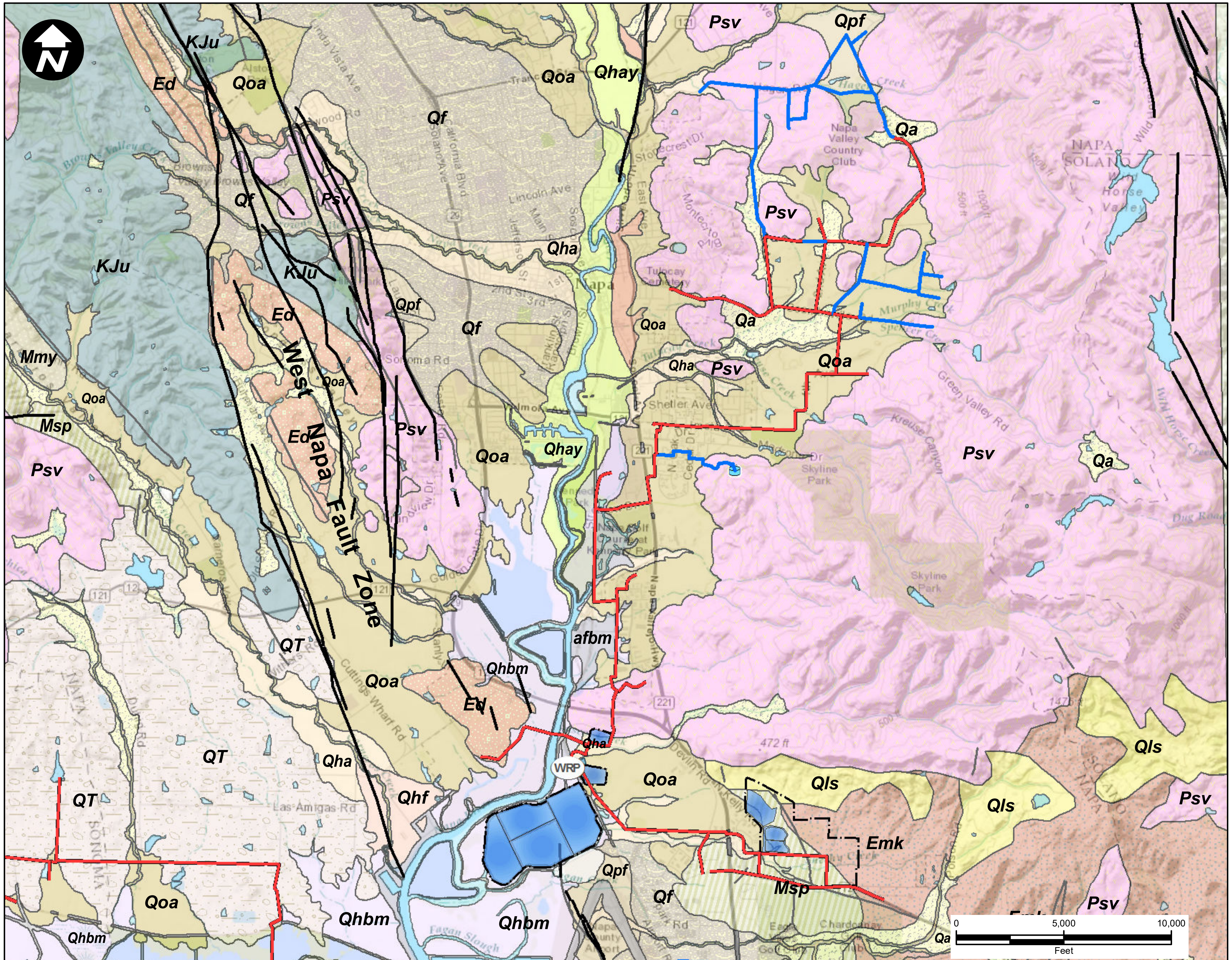
Feet

Geology Source: CGS, 1982. Geologic Map of the Santa Rosa Quadrangle, California, 1:250,000, Regional Geologic Map Sheet No. 2A; USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444; and CGS, 2010. Preliminary Geologic Map of the Napa 30' x 60' Quadrangle, California.

C:\Users\Owner\Soon Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - SCWA Geologic Map.mxd

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| SCWA PHASE 2 PROJECT GEOLOGIC MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 6 |
| APRIL 2017 | S16001 |




## LEGEND

- Phase 1 and Existing Pipelines
- Proposed Phase 2 Pipeline
- Napa State Hospital Storage Tank
- Phase 2 Seasonal Storage Ponds
- Phase 2 Seasonal Storage Site Boundaries

### Geologic Units

Quaternary Units

- af - Artificial fill
- afbm - Artificial fill over Bay
- alf - Artificial levee fill
- Qhc - Modern stream channel deposits
- Qhay - Latest Holocene alluvial deposits
- Qhbm - Holocene Bay Mud
- Qhf - Holocene alluvial fan deposits
- Qht - zHolocene stream terrace deposits
- Qha - Holocene alluvium
- Qf - Latest Pleistocene to Holocene alluvial fan deposits
- Qa - Latest Pleistocene to Holocene alluvium
- Qpf - Latest Pleistocene alluvial fan deposits
- Qoa - Early to Late Pleistocene alluvial deposits
- Qls - Quaternary landslide deposits

Bedrock Units

- QT - Huichica and Glen Ellen Formations
- Psv - Sonoma Volcanics
- Msp - San Pablo Group
- Mmy - Monterey Group
- Emk - Markley Sandstone
- Ed - Domengine Sandstone
- KJu - Lower Cretaceaous-Upper Jurassic Great Valley Sequence

- Faults

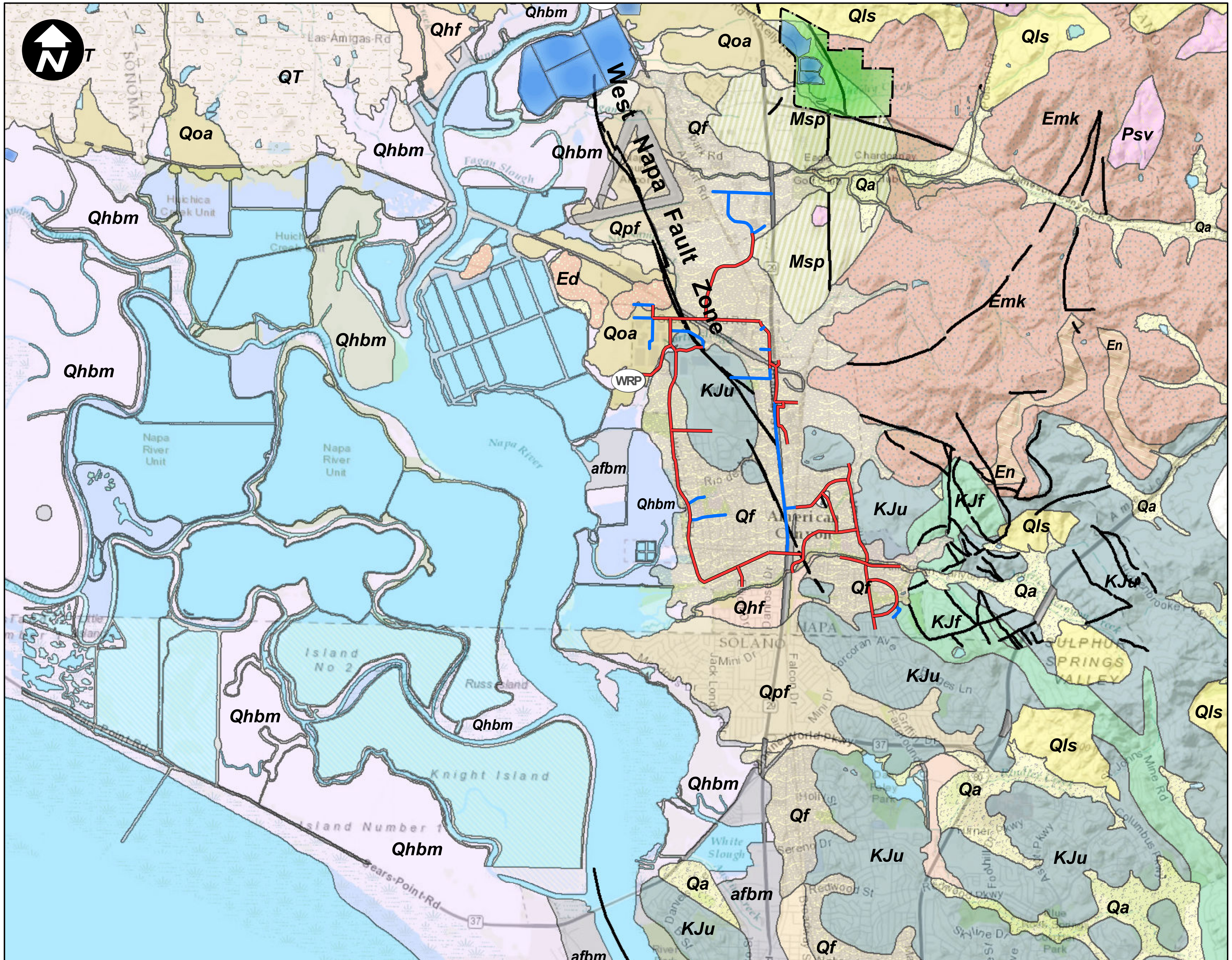
DRAFT

Geology Source: CGS, 1982. Geologic Map of the Santa Rosa Quadrangle, California, 1:250,000, Regional Geologic Map Sheet No. 2A; USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444; and CGS, 2010. Preliminary Geologic Map of the Napa 30' x 60' Quadrangle, California.

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| NAPA SD PHASE 2 PROJECT GEOLOGIC MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 7 |
| APRIL 2017 | S16001 |

This page intentionally left blank.




## LEGEND

- Phase 1 and Existing Pipeline
- Proposed Phase 2 Pipelines
- Phase 2 Seasonal Storage Site Boundaries
- Phase 2 Seasonal Storage Ponds
- Phase 2 Environmental Enhancement

### Geologic Units

Quaternary Units

- af - Artificial fill
- afbm - Artificial fill over Bay Mud
- alf - Artificial levee fill
- Qhc - Modern stream channel deposits
- Qhbm - Holocene Bay Mud
- Qhf - Holocene alluvial fan deposits
- Qha - Holocene alluvium
- Qf - Latest Pleistocene to Holocene alluvial fan deposits
- Qa - Latest Pleistocene to Holocene alluvium
- Qpf - Latest Pleistocene alluvial fan deposits
- Qoa - Early to Late Pleistocene alluvial deposits
- Qls - Quaternary landslide deposits

Bedrock Units

- QT - Huichica and Glen Ellen Formations
- Psv - Sonoma Volcanics
- Msp - San Pablo Group
- Emk - Markley Sandstone
- En - Nortonville Shale
- Ed - Domengine Sandstone
- KJu - Lower Cretaceaous-Upper Jurassic Great Valley Sequence
- KJf - Franscican Complex- undifferentiated
- um - Serpentinized ultramafic rocks

- Faults

0 5,000 10,000
Feet

DRAFT

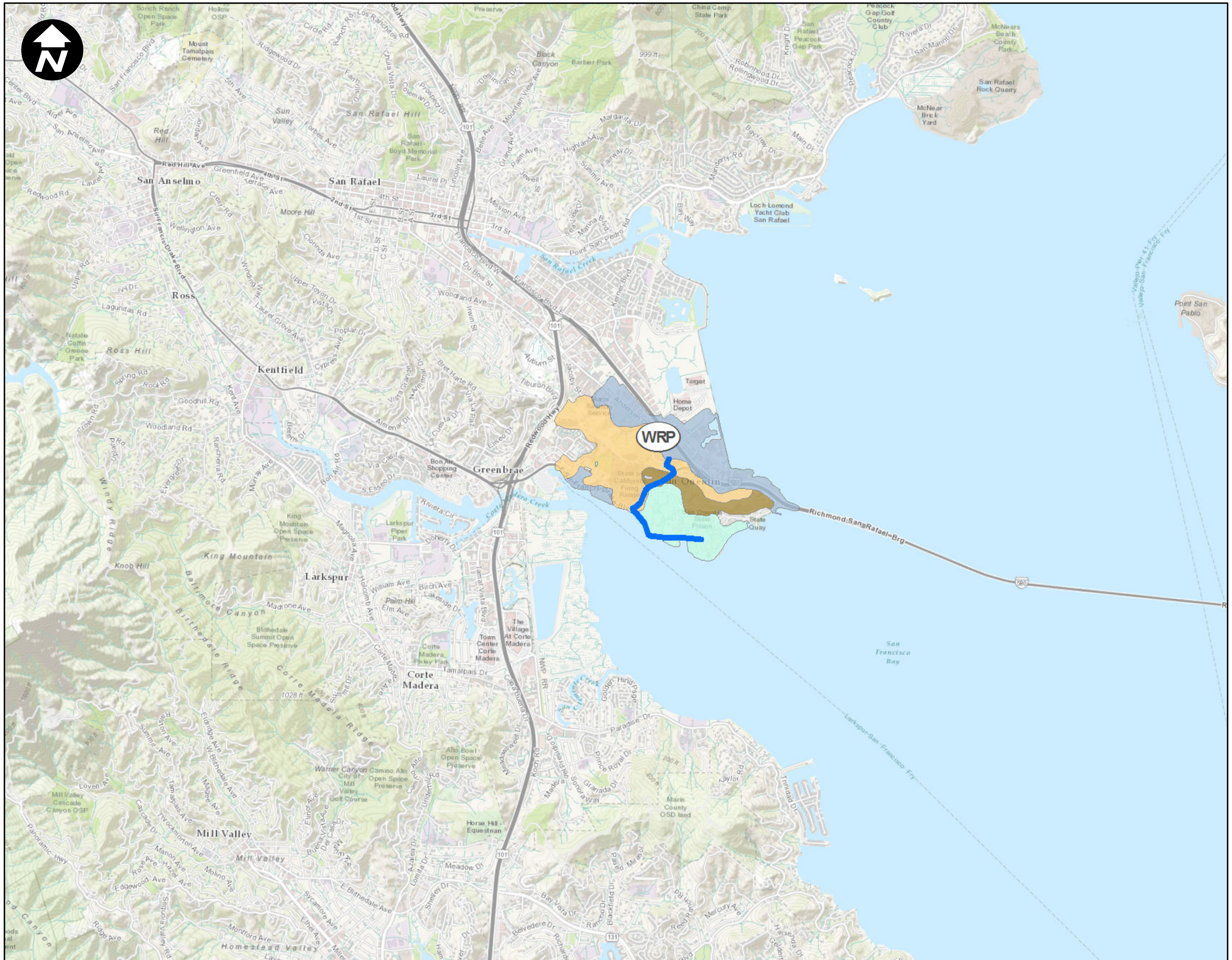
Geology Source: CGS, 1982. Geologic Map of the Santa Rosa Quadrangle, California, 1:250,000, Regional Geologic Map Sheet No. 2A; USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444; and CGS, 2010. Preliminary Geologic Map of the Napa 30' x 60' Quadrangle, California.

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| AMERICAN CANYON PHASE 2 PROJECT GEOLOGIC MAP | PLATE |
|---|---|
| PHASE 2 FEASIBITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 8 |
| APRIL 2017 | S16001 |

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - American Canyon Geology Map.mxd

This page intentionally left blank.




**LEGEND**

WRP Water Recycling Plant

Phase 1 and Existing Pipelines

Proposed Phase 2 Pipelines

**Soils underlying Marin MWD Phase 2 components**

Saurin-Bonnydoon complex

Tocaloma-Saurin association

Urban land-Xerorthents complex

Xerorthents, fill



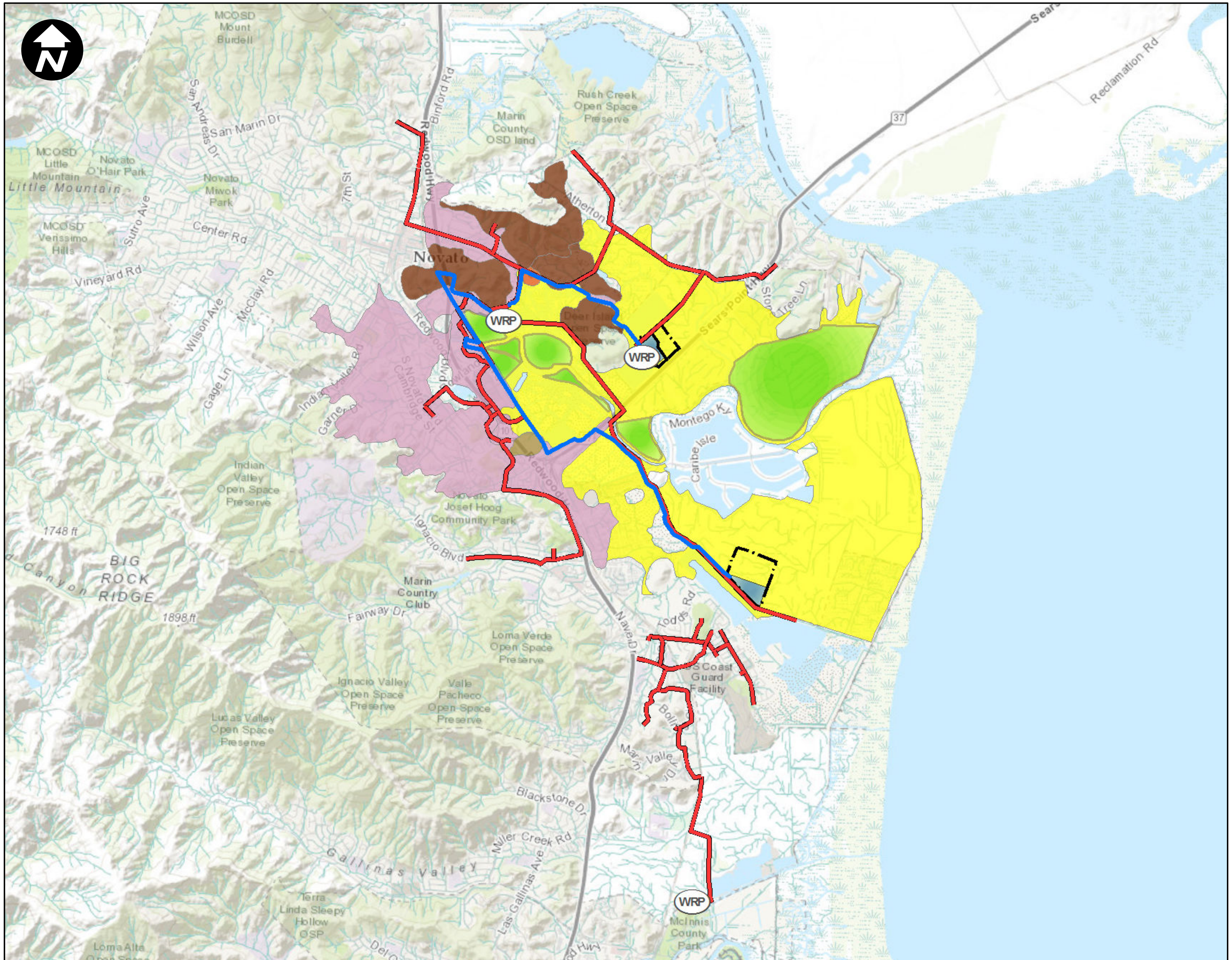
0 4,000 8,000
Feet

Source: USDA NRCS, 2013. Soil Survey Geographic Database for Marin County, California.

| | | |
|---|---|---|
| GEOTECHNICAL CONSULTANTS, INC.<br>500 Sansome St., Suite 402<br>San Francisco, CA 94111 | MARIN MWD NBWRP PHASE 2 SOIL MAP | PLATE |
| | PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 9 |
| | APRIL 2017 | S16001 |

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - Marin MWD Soil Map.mxd

This page intentionally left blank.




**LEGEND**

- WRP Water Recycling Plant
- Phase 1 and Existing Pipelines
- Proposed Phase 2 Pipelines
- Phase 2 Seasonal Storage Site Boundaries
- Phase 2 Seasonal Storage Ponds
- Phase 2 Environmental Enhancement

Soils underlying the Novato SD Phase 2 components

- Blucher-Cole complex
- Los Osos-Bonnydoon complex
- Reyes association
- Saurin-Bonnydoon complex
- Xerorthents-fill-urban land

0 5,000 10,000
Feet

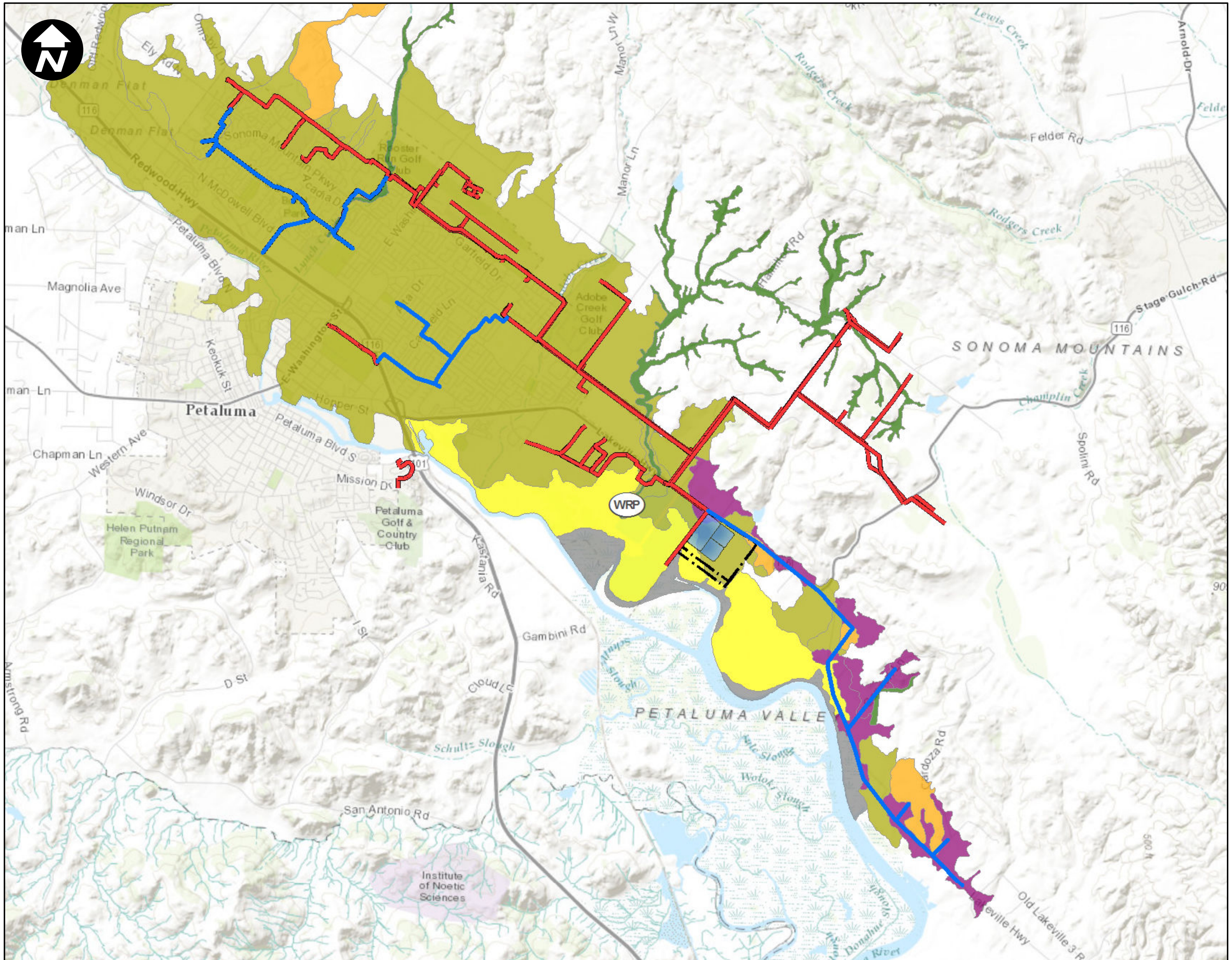


Source: USDA NRCS, 2013. Soil Survey Geographic Database for Marin County, California.

GTC
GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| NOVATO SD NBWRP PHASE 2 SOIL MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 10 |
| APRIL 2017 | S16001 |

This page intentionally left blank.




**LEGEND**

- WRP Water Recycling Plant
- Phase 1 and Existing Pipelines
- Proposed Phase 2 Pipelines
- Phase 2 Seasonal Storage Site Boundaries
- Phase 2 Seasonal Storage Ponds

Soils underlying Petaluma Phase 2 components

- Clear Lake association
- Diablo association
- Gullied land
- Haire association
- Reyes association
- Tidal marsh

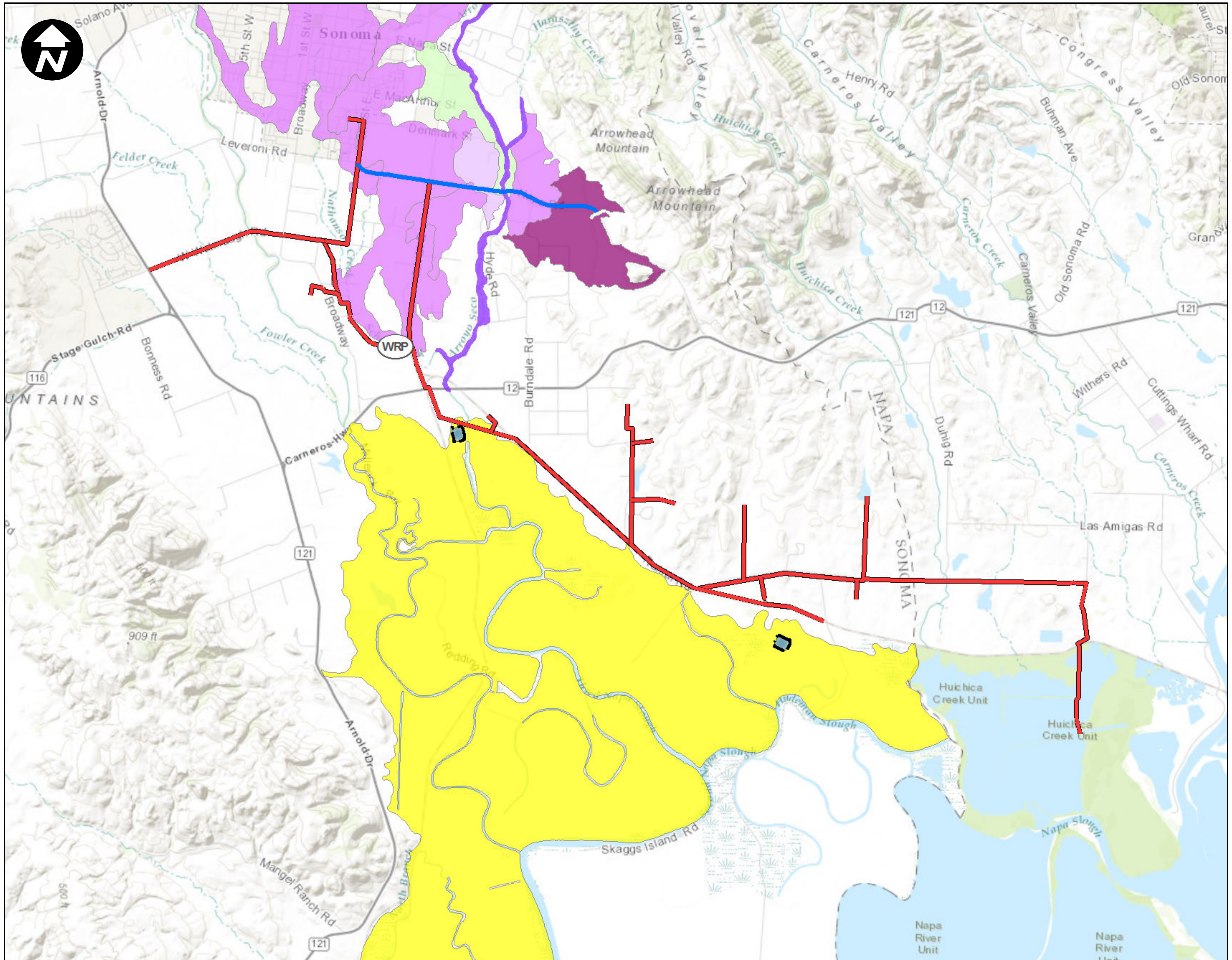
Source: USDA NRCS, 2014a. Soil Survey Geographic Database for Sonoma County, California.

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| PETALUMA NBWRP PHASE 2 SOIL MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 11 |
| APRIL 2017 | S16001 |

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - Petaluma Soil Map.mxd

This page intentionally left blank.



**LEGEND**

WRP Water Recycling Plant

Phase 1 and Existing Pipelines

Proposed Phase 2 Pipelines

Phase 2 Seasonal Storage Site Boundaries

Phase 2 Seasonal Storage Ponds

Soils underlying the SVCSD Phase 2 components

Haire association

Huichica association

Reyes association

Riverwash

Wright association

Yolo association

DRAFT

0 5,000 10,000
Feet

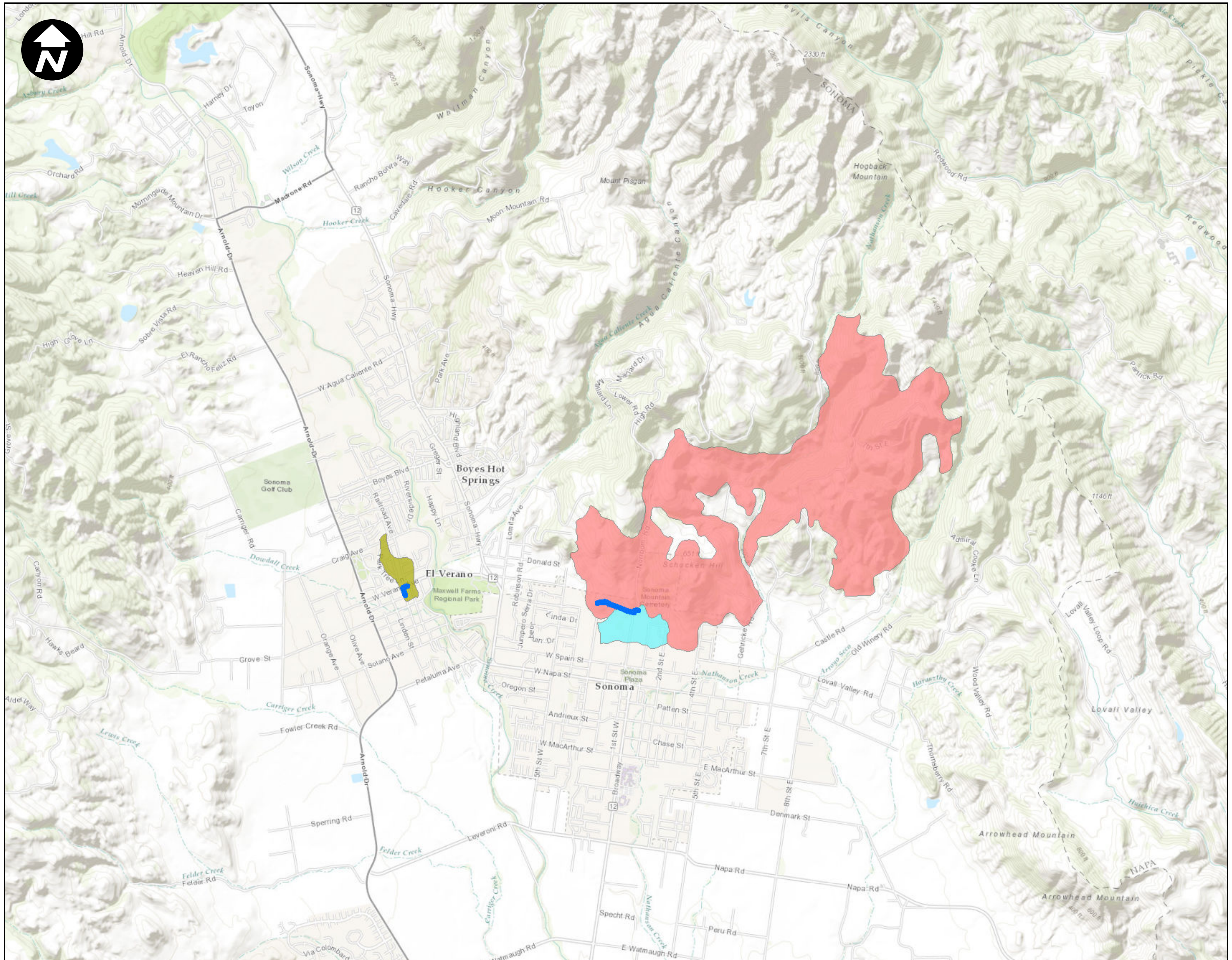
Source: USDA NRCS, 2014a. Soil Survey Geographic Database for Sonoma County, California.

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - SVCSD Soil Map.mxd

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| SVCSD NBWRP PHASE 2 SOIL MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 12 |
| APRIL 2017 | S16001 |

This page intentionally left blank.



LEGEND

WRP Water Recycling Plant

Phase 1 and Existing Pipelines

Proposed Phase 2 Pipelines

**Soils underlying SCWA Phase 2 components**

Clear Lake association

Goulding-Toomes complex

Red Hill association

DRAFT

0 4,000 8,000
Feet

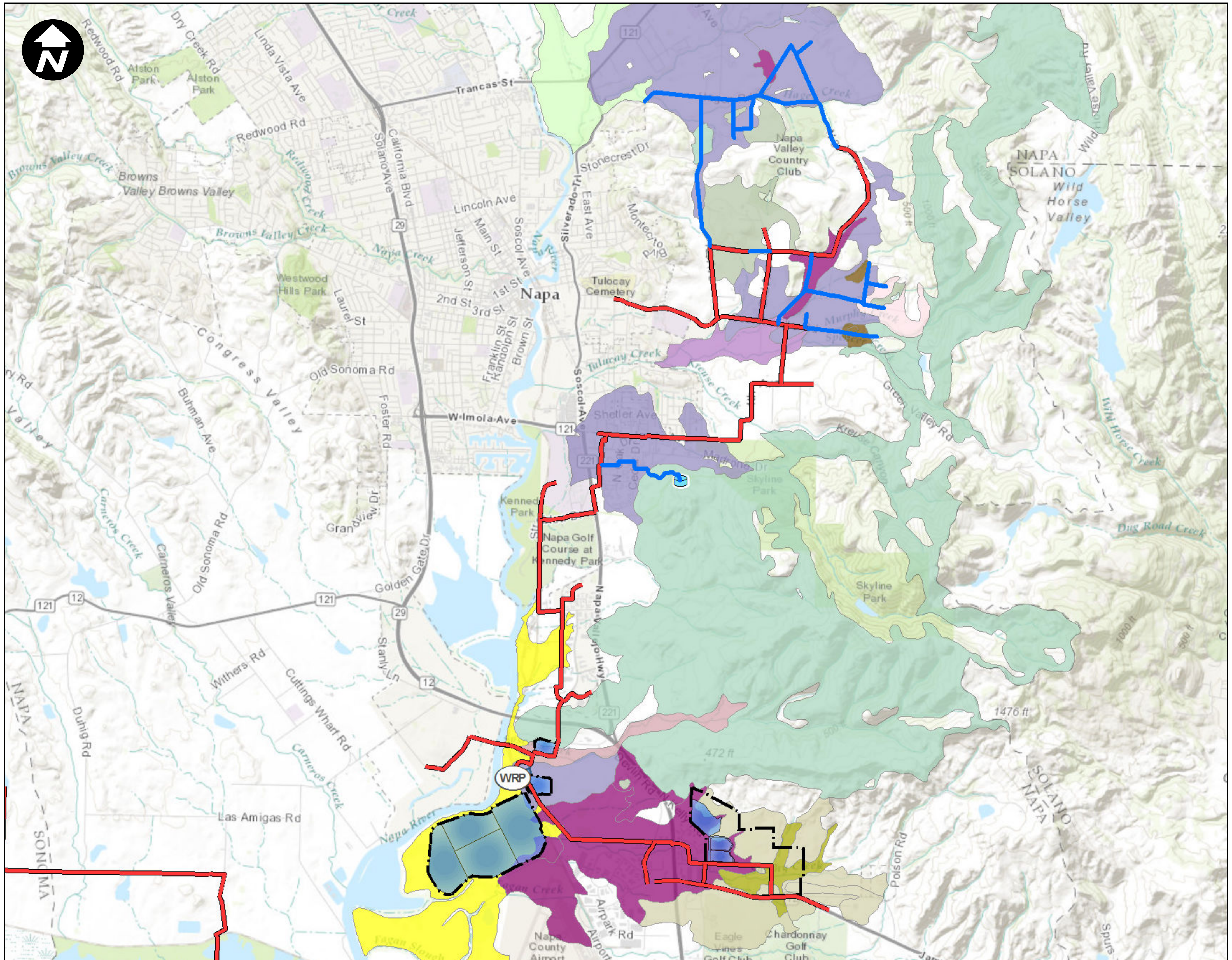
Source: USDA NRCS, 2014a. Soil Survey Geographic Database for Sonoma County, California.

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| | |
|---|---|
| SCWA NBWRP PHASE 2 SOIL MAP | PLATE |
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 13 |
| APRIL 2017 | S16001 |

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - SCWA Soil Map.mxd

This page intentionally left blank.




**LEGEND**

- WRP Water Recycling Plant
- Phase 1 and Existing Pipelines
- Proposed Phase 2 Pipelines
- Napa State Hospital Storage Tank
- Phase 2 Seasonal Storage Site Boundaries
- Phase 2 Seasonal Storage Ponds

Soils underlying Napa SD Phase 2 components

- Bale association
- Clear Lake associatoin
- Cole association
- Coombs association
- Fagan association
- Forward association
- Haire association
- Hambright - Rock Outcrop complex
- Kidd association
- Reyes association
- Sobrante association
- Yolo association

DRAFT

0 5,000 10,000
Feet

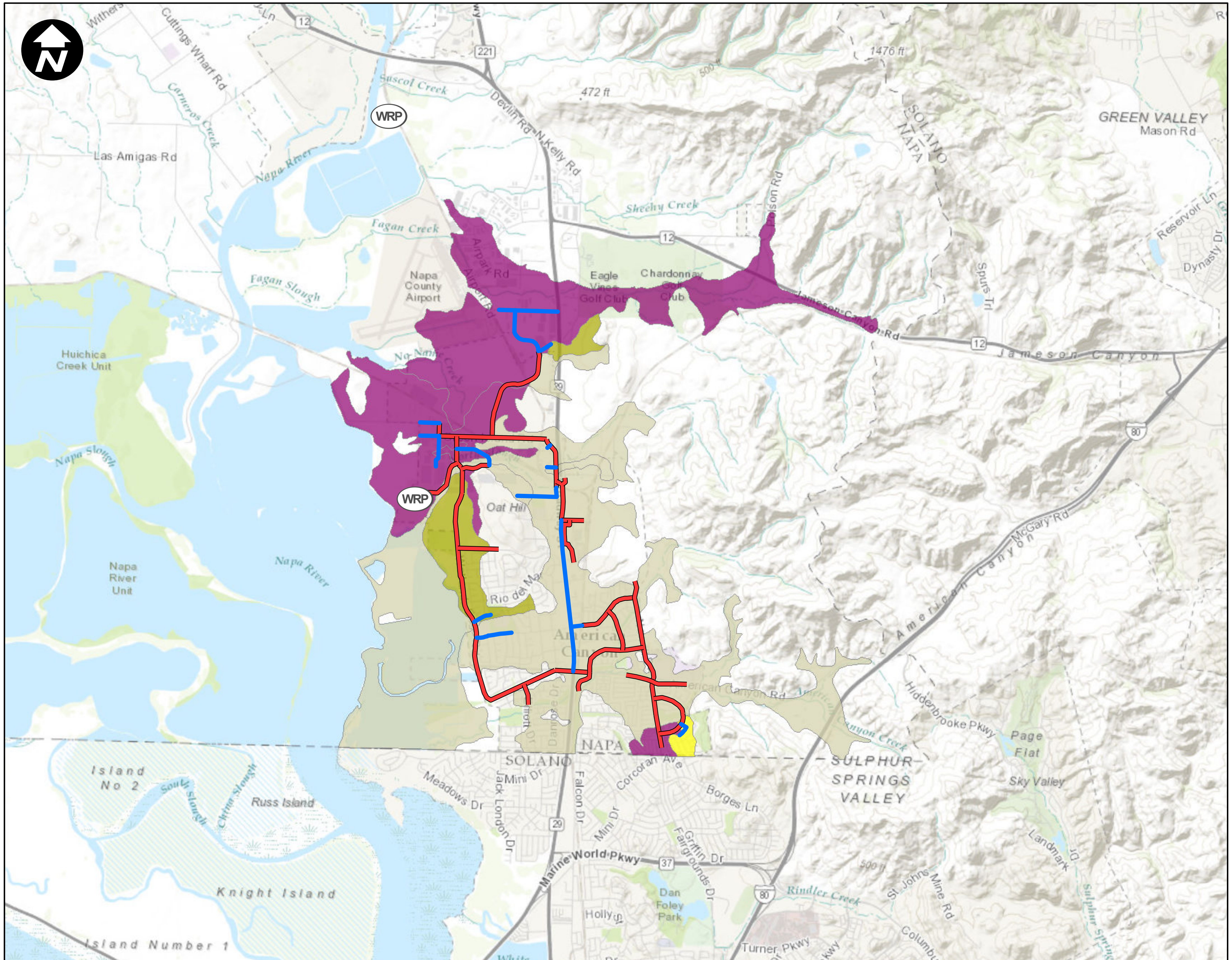
Source: USDA NRCS, 2014b. Soil Survey Geographic Database for Napa County, California.

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| NAPA SD NBWRP PHASE 2 SOIL MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 14 |
| APRIL 2017 | S16001 |

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - NAPA SD Soil Map.mxd

This page intentionally left blank.




**LEGEND**

- WRP Water Recycling Plant
- Phase 1 and Existing Pipelines
- Proposed Phase 2 Pipelines

**American_Canyon_soils**

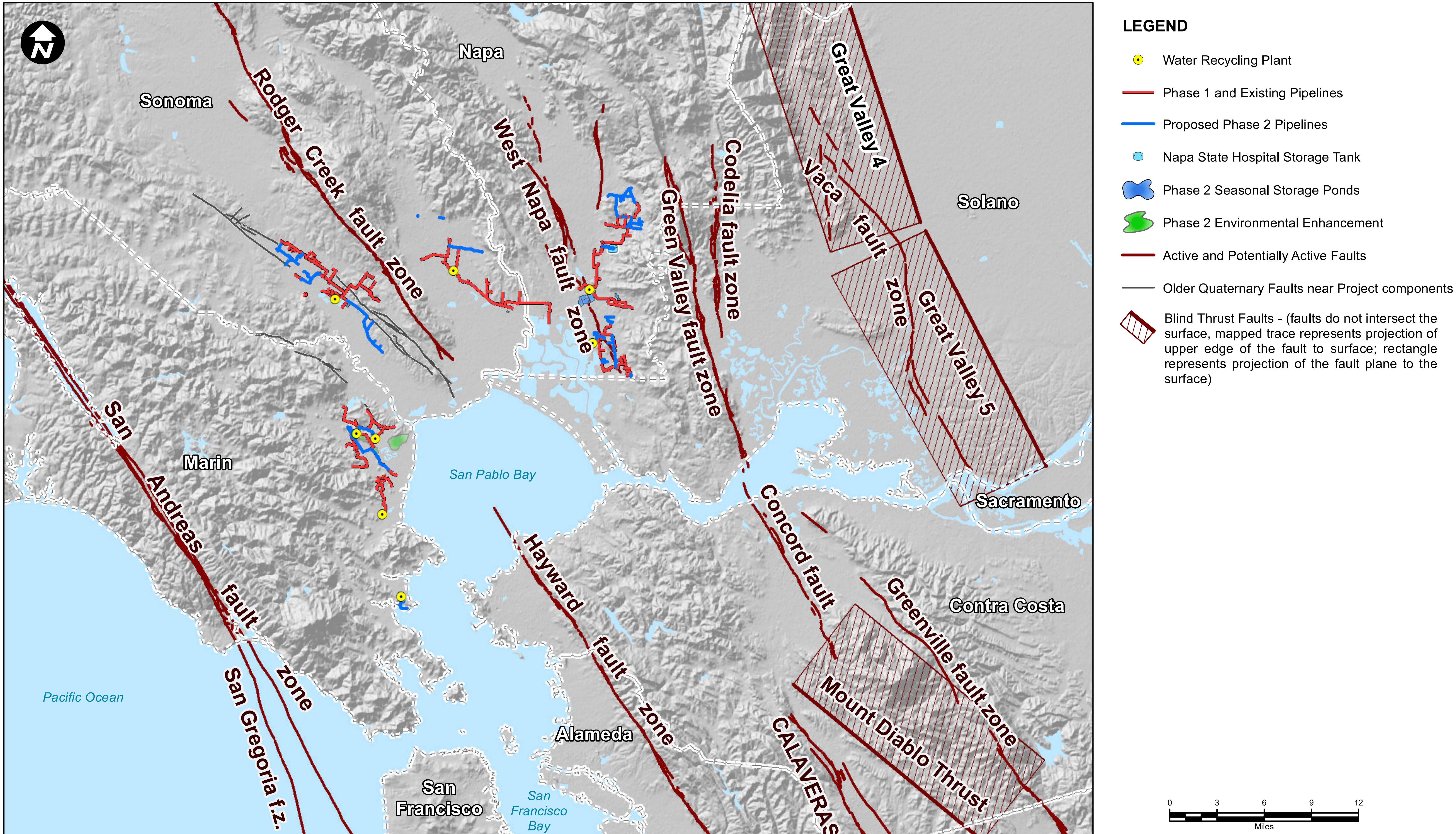
- Clear Lake association
- Fagan association
- Haire associatoin
- Reyes association

DRAFT

0 5,000 10,000
Feet

Source: USDA NRCS, 2014b. Soil Survey Geographic Database for Napa County, California.

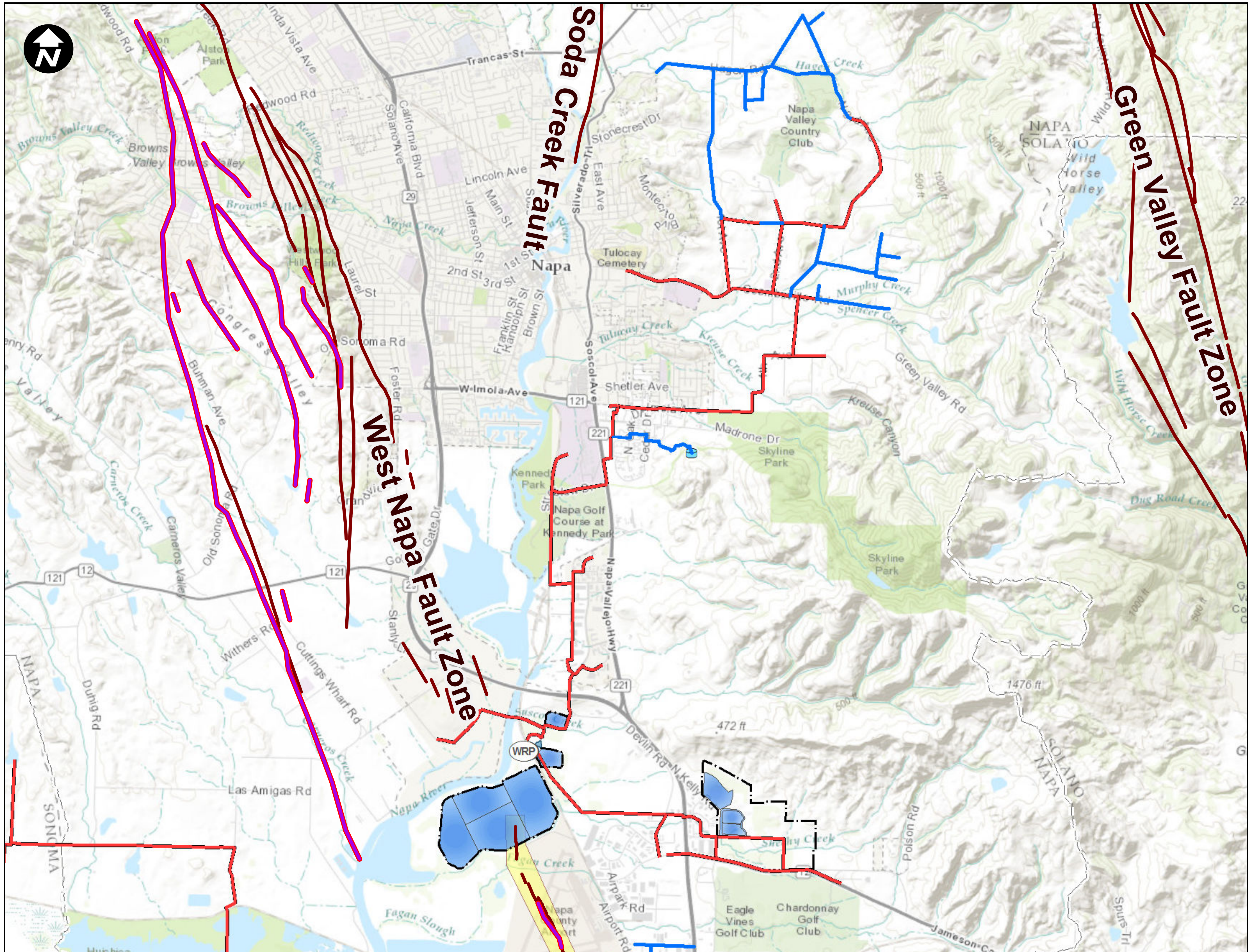
| | | |
|---|---|---|
| GEOTECHNICAL CONSULTANTS, INC.<br>500 Sansome St., Suite 402<br>San Francisco, CA 94111 | AMERICAN CANYON NBWRP PHASE 2 SOIL MAP | PLATE |
| | PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 15 |
| | APRIL 2017 | S16001 |




Fault Data Sources: U.S.G.S. and C.G.S., 2010, Quaternary fault and fold database for the United States; and Cao, et. al., 2003, The Revised 2002 California Probabilistic Seismic Hazard Maps, Appendix A - 2002 California Fault Parameters (blind thrust fault data).

| | | |
|---|---|---|
| GEOTECHNICAL CONSULTANTS, INC.<br>500 Sansome St., Suite 402<br>San Francisco, CA 94111 | REGIONAL ACTIVE AND POTENTIALLY ACTIVE FAULTS | PLATE |
| | PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 16 |
| | APRIL 2017 | S16001 |

This page intentionally left blank.




**LEGEND**

- WRP — Water Recycling Plant
- Phase 1 and Existing Pipelines
- Proposed Phase 2 Pipelines
- Napa State Hospital Storage Tank
- Phase 2 Seasonal Storage Site Boundaries
- Phase 2 Seasonal Storage Ponds
- Active and Potentially Active Faults
- 2014 Napa Earthquake Fault Rupture
- Alquist-Priolo Earthquake Fault Zone

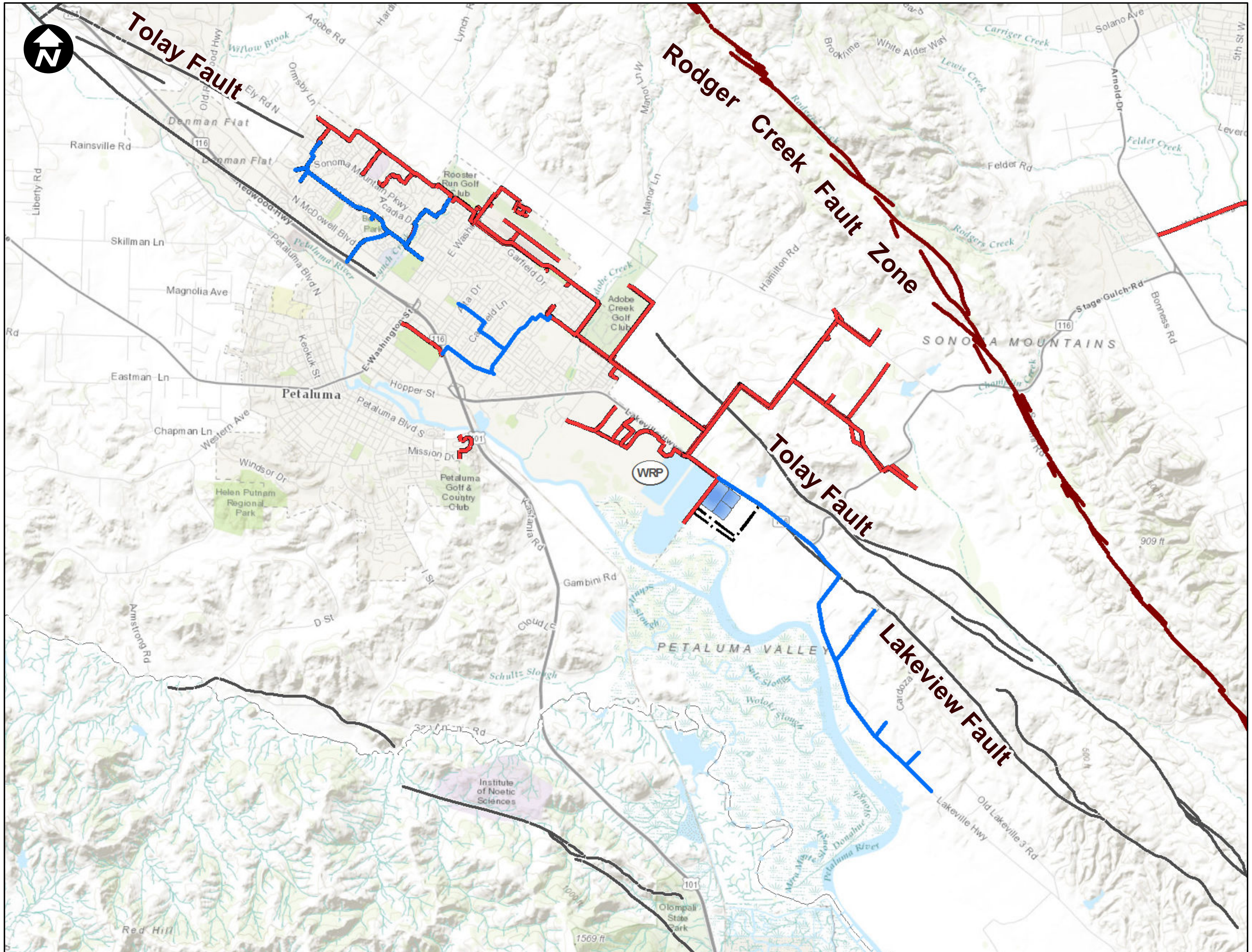
0 6,000 12,000
Feet

Fault Data Sources: U.S.G.S. and C.G.S., 2010, Quaternary fault and fold database for the United States; Cao, et. al., 2003, The Revised 2002 California Probabilistic Seismic Hazard Maps, Appendix A - 2002 California Fault Parameters (blind thrust fault data); and CGS, 2001, GIS files Alquist-Priolo Earthquake Fault Zones, Cuttings Wharf Quadrangle.

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| NAPA SD PHASE 2 PROJECT FAULT MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 17 |
| APRIL 2017 | S16001 |

This page intentionally left blank.




**LEGEND**

- WRP Water Recycling Plant
- Phase 1 and Existing Pipelines
- Proposed Phase 2 Pipelines
- Phase 2 Seasonal Storage Site Boundaries
- Phase 2 Seasonal Storage Ponds
- Active and Potentially Active Faults
- Older Quaternary Faults near Project components

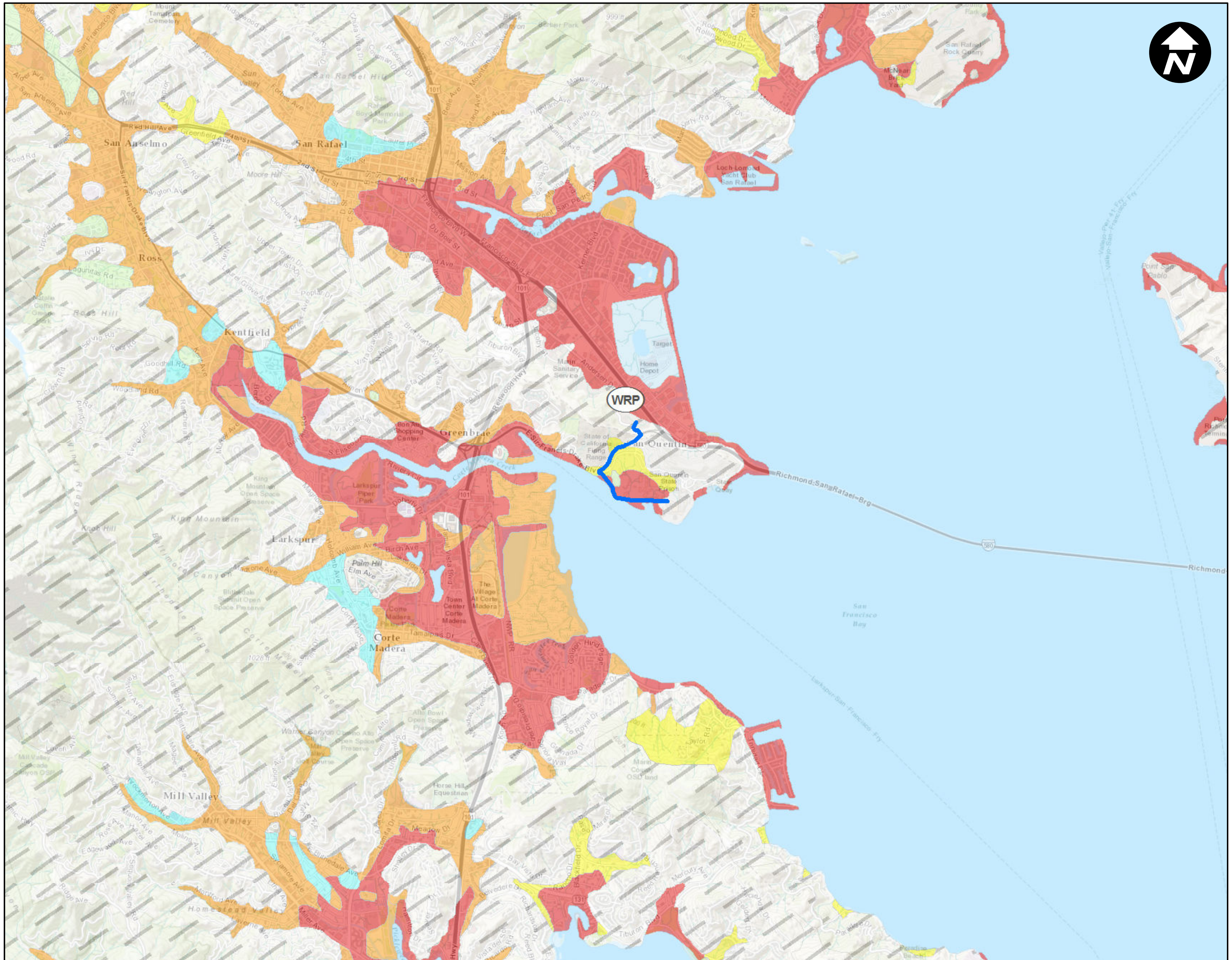
0 6,000 12,000
Feet

Fault Data Sources: U.S.G.S. and C.G.S., 2010, Quaternary fault and fold database for the United States; and Cao, et. al., 2003, The Revised 2002 California Probabilistic Seismic Hazard Maps, Appendix A - 2002 California Fault Parameters (blind thrust fault data).

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| PETALUMA PHASE 2 PROJECT FAULT MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 18 |
| APRIL 2017 | S16001 |

This page intentionally left blank.




**LEGEND**

WRP Water Recycling Plant

Phase 1 and Existing Pipelines

Proposed Phase 2 Pipelines

**Liquefaction Hazard**

**LIQ**

- VH - Very High
- H - High
- M - Moderate
- L - Low
- VL - Very Low
- Bedrock - No Liquefaction Hazaed

0 4,000 8,000
Feet

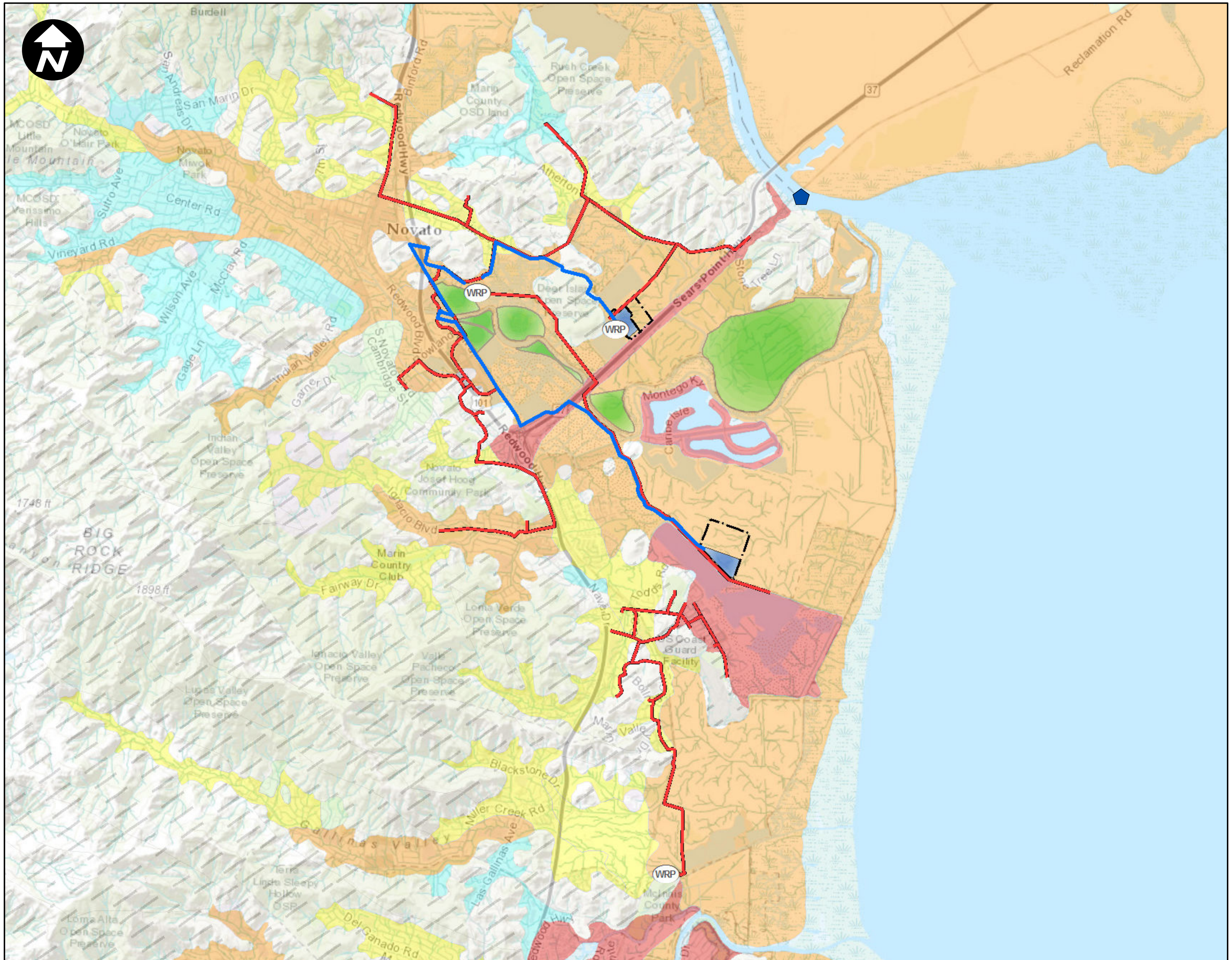


Geology Source: CGS, 1982. Geologic Map of the Santa Rosa Quadrangle, California, 1:250,000, Regional Geologic Map Sheet No. 2A; USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444; and CGS, 2010. Preliminary Geologic Map of the Napa 30' x 60' Quadrangle, California.

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| MARIN MWD PHASE 2 LIQUEFACTION HAZARD MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 19 |
| APRIL 2017 | S16001 |

This page intentionally left blank.




## LEGEND

- WRP Water Recycling Plant
- Phase 1 and Existing Pipelines
- Proposed Phase 2 Pipelines
- Phase 2 Seasonal Storage Site Boundaries
- Phase 2 Seasonal Storage Ponds
- Phase 2 Environmental Enhancement

Liquefaction Hazard

- VH - Very High
- H - High
- M - Moderate
- L - Low
- VL - Very Low
- Bedrock - No Liquefaction Hazaed

Historic Liquefaction Effects

- Lateral Spreading

DRAFT

0 5,000 10,000
Feet

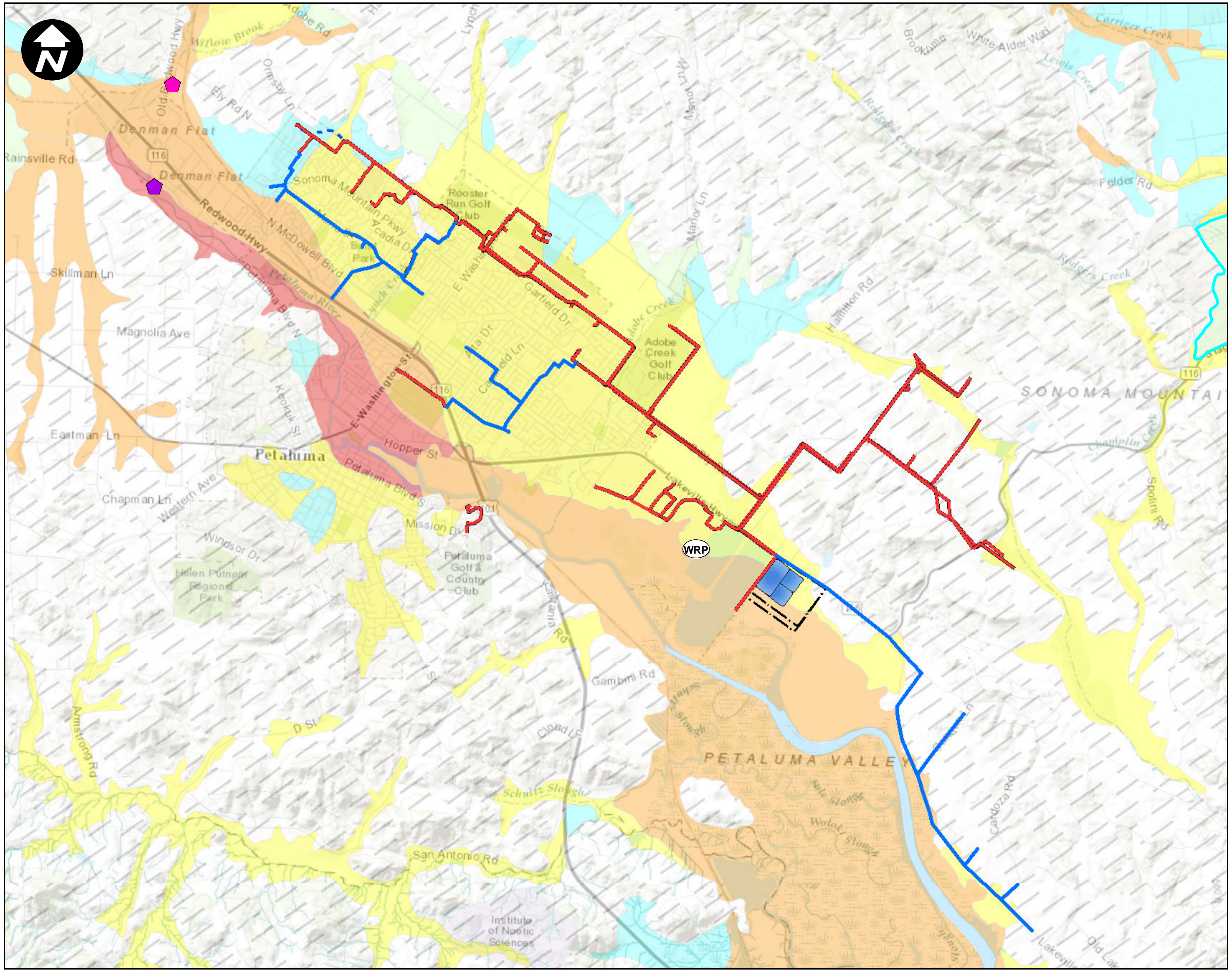
Source: USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444.


GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111


| | |
|---|---|
| NOVATO SD PHASE 2 LIQUEFACTION HAZARD MAP | PLATE |
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 20 |
| APRIL 2017 | S16001 |

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - Novato SD Liquefactin Hazard Map.mxd

This page intentionally left blank.




## LEGEND

- WRP — Water Recycling Plant
- Phase 1 and Existing Pipelines
- Proposed Phase 2 Pipelines
- Phase 2 Seasonal Storage Site Boundaries
- Phase 2 Seasonal Storage Ponds

**Liquefaction Hazard**

- VH - Very High
- H - High
- M - Moderate
- L - Low
- VL - Very Low
- Bedrock - No Liquefaction Hazaed

**Historic Liquefaction Effects**

- Ground Cracking
- Settlement, Boil



0 5,000 10,000
Feet

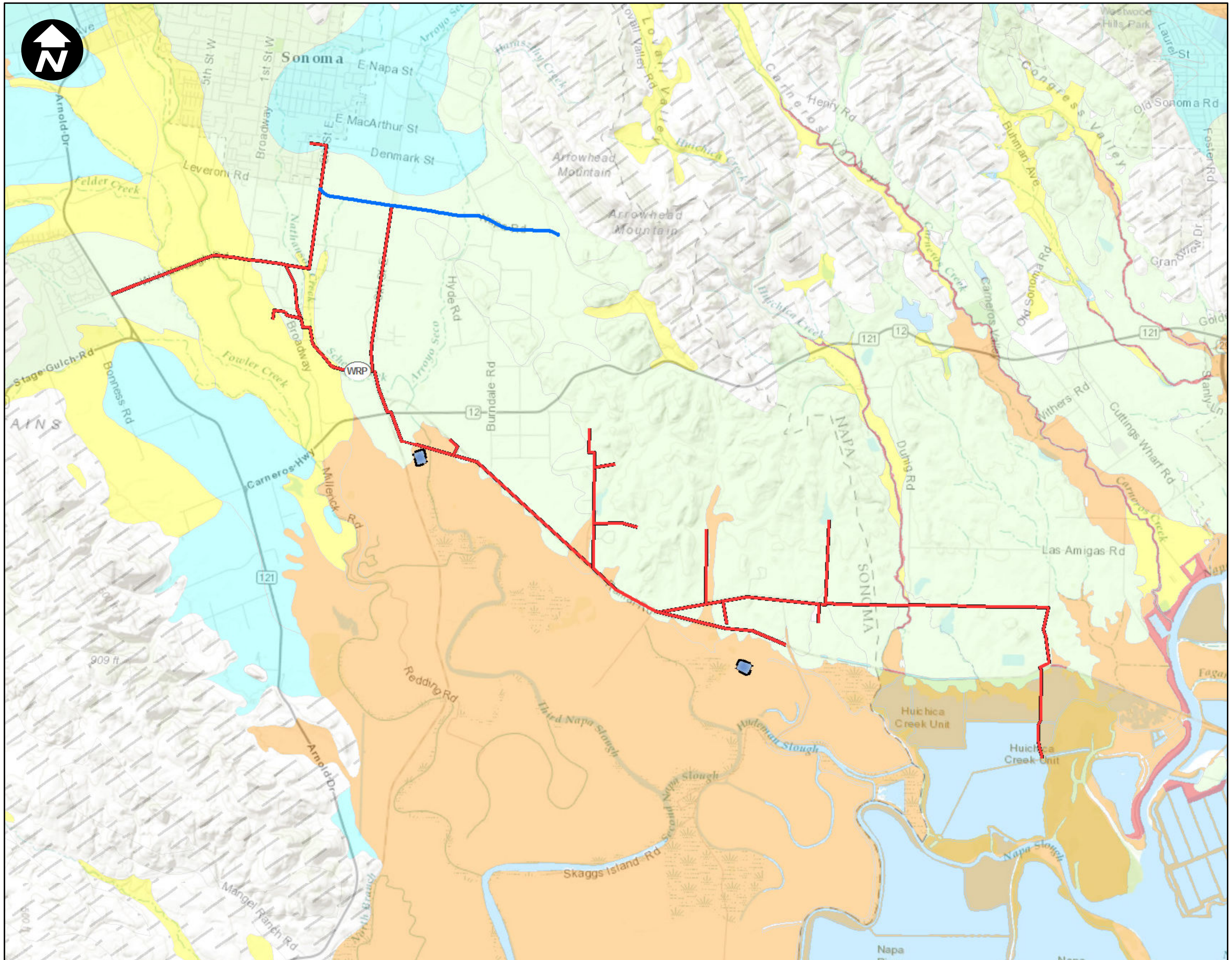
Source: USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444.

GTC
GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| PETALUMA PHASE 2 LIQUEFACTION HAZARD MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 21 |
| APRIL 2017 | S16001 |

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - Petaluma Liquefactin Hazard Map.mxd

This page intentionally left blank.




## LEGEND

- WRP Water Recycling Plant
- Phase 1 and Existing Pipelines
- Proposed Phase 2 Pipelines
- Phase 2 Seasonal Storage Site Boundaries
- Phase 2 Seasonal Storage Ponds

**Liquefaction Hazard**

- VH - Very High
- H - High
- M - Moderate
- L - Low
- VL - Very Low
- Bedrock - No Liquefaction Hazaed

DRAFT

0 5,000 10,000
Feet

Source: USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444.

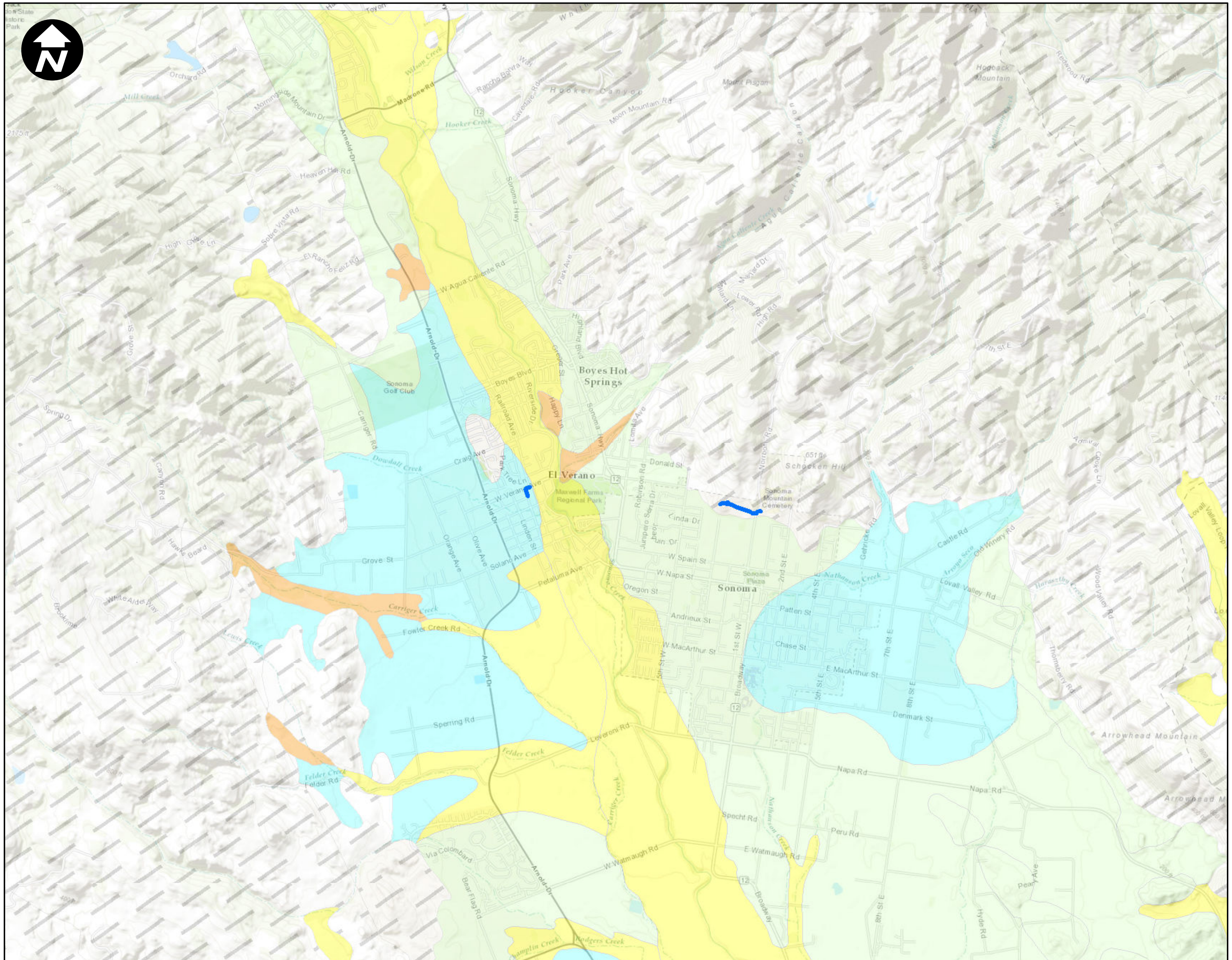
GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| SVCSD PHASE 2 LIQUEFACTION HAZARD MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 22 |
| APRIL 2017 | S16001 |

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - SVCSD Liquefactoin Hazard Map.mxd

This page intentionally left blank.

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - SCWA Liquefactoin Hazard Map.mxd




## LEGEND

Phase 1 and Existing Pipelines

Proposed Phase 2 Pipelines

### Liquefaction Hazard

VH - Very High

H - High

M - Moderate

L - Low

VL - Very Low

Bedrock - No Liquefaction Hazaed

DRAFT

0 5,000 10,000

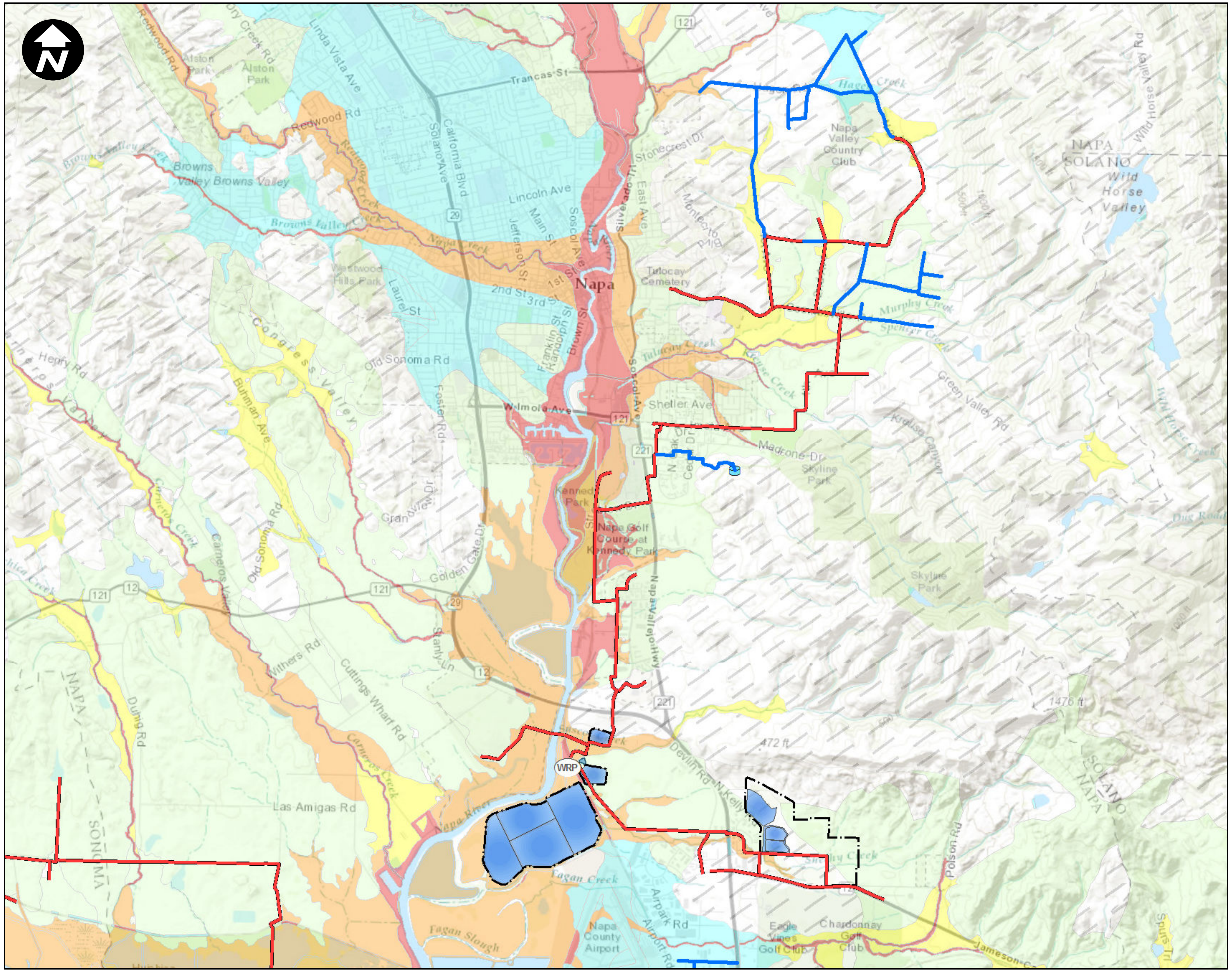
Feet

Geology Source: CGS, 1982. Geologic Map of the Santa Rosa Quadrangle, California, 1:250,000, Regional Geologic Map Sheet No. 2A; USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444; and CGS, 2010. Preliminary Geologic Map of the Napa 30' x 60' Quadrangle, California.

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| SCWA PHASE 2 LIQUEFACTION HAZARD MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 23 |
| APRIL 2017 | S16001 |

This page intentionally left blank.




## LEGEND

- WRP — Water Recycling Plant
- Phase 1 and Existing Pipelines
- Proposed Phase 2 Pipelines
- Napa State Hospital Storage Tank
- Phase 2 Seasonal Storage Site Boundaries
- Phase 2 Seasonal Storage Ponds

**Liquefaction Hazard**

- VH - Very High
- H - High
- M - Moderate
- L - Low
- VL - Very Low
- Bedrock - No Liquefaction Hazaed

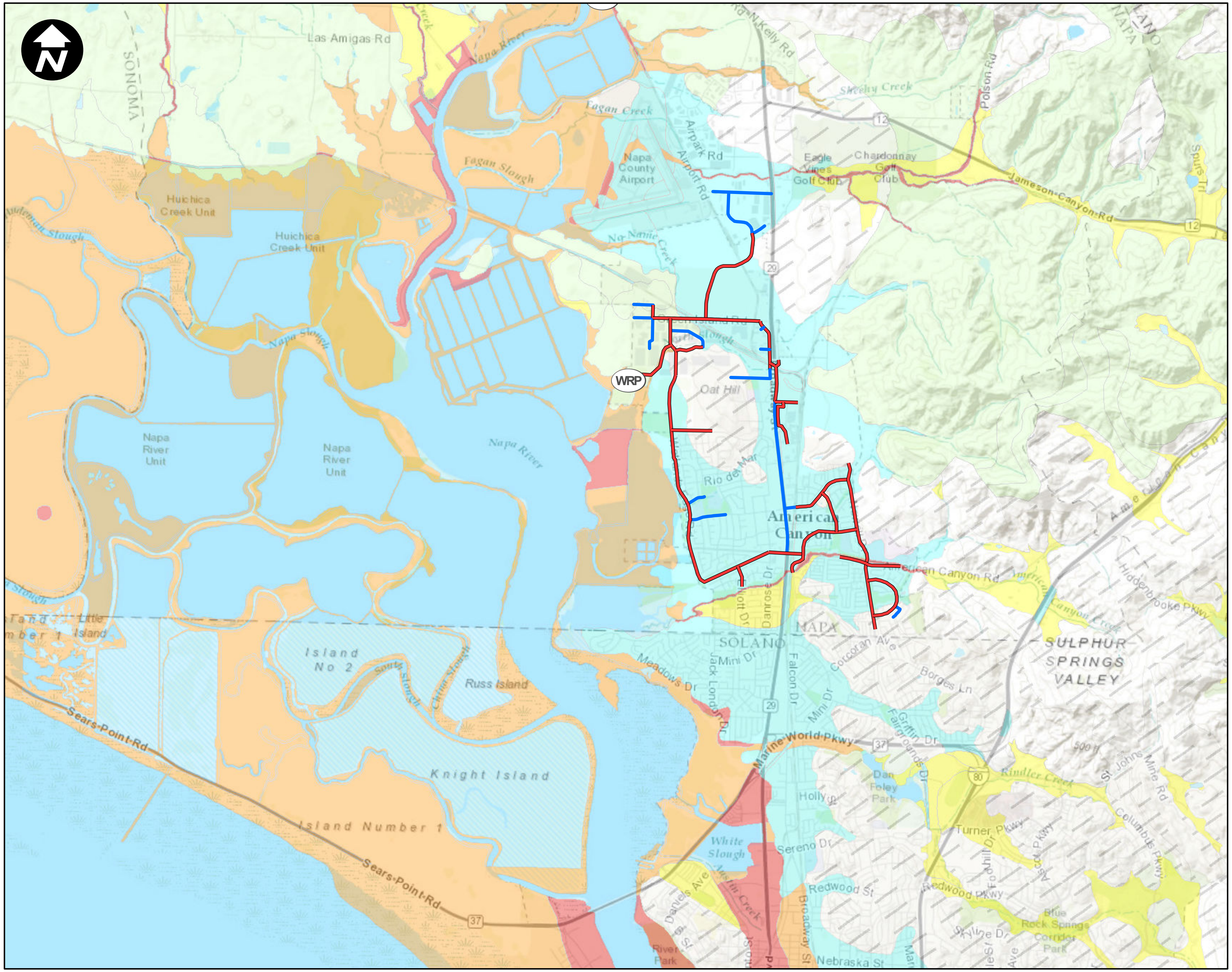
DRAFT

0 5,000 10,000
Feet

Source: USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444.

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| NAPA SD PHASE 2 LIQUEFACTION HAZARD MAP | PLATE |
|---|---|
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 24 |
| APRIL 2017 | S16001 |




## LEGEND

- WRP — Water Recycling Plant
- Phase 1 and Existing Pipeline
- Proposed Phase 2 Pipelines

### Liquefaction Hazard

- VH - Very High
- H - High
- M - Moderate
- L - Low
- VL - Very Low
- Bedrock - No Liquefaction Hazaed

DRAFT

0 5,000 10,000
Feet

Geology Source: CGS, 1982. Geologic Map of the Santa Rosa Quadrangle, California, 1:250,000, Regional Geologic Map Sheet No. 2A; USGS, 2000. Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database, OFR 00-444; and CGS, 2010. Preliminary Geologic Map of the Napa 30' x 60' Quadrangle, California.

GEOTECHNICAL CONSULTANTS, INC.
500 Sansome St., Suite 402
San Francisco, CA 94111

| | |
|---|---|
| AMERICAN CANYON PHASE 2 LIQUEFACTION HAZARD MAP | PLATE |
| PHASE 2 FEASIBIITY STUDY<br>NORTH BAY WATER REUSE PROGRAM | 25 |
| APRIL 2017 | S16001 |

C:\Users\Owner\Soonr Workplace\Projects, Starting January 2016\S16001 - North Bay Water Reuse\GIS\S16001 - American Canyon Liquefaction Hazars Map.mxd

This page intentionally left blank.

# Appendix F: Supporting Information for Engineering Analysis

This page intentionally left blank.

## Appendix F

# Supporting Information for Engineering Analysis

This appendix includes typical drawings and other supporting information used to support the feasibility level engineering analysis.

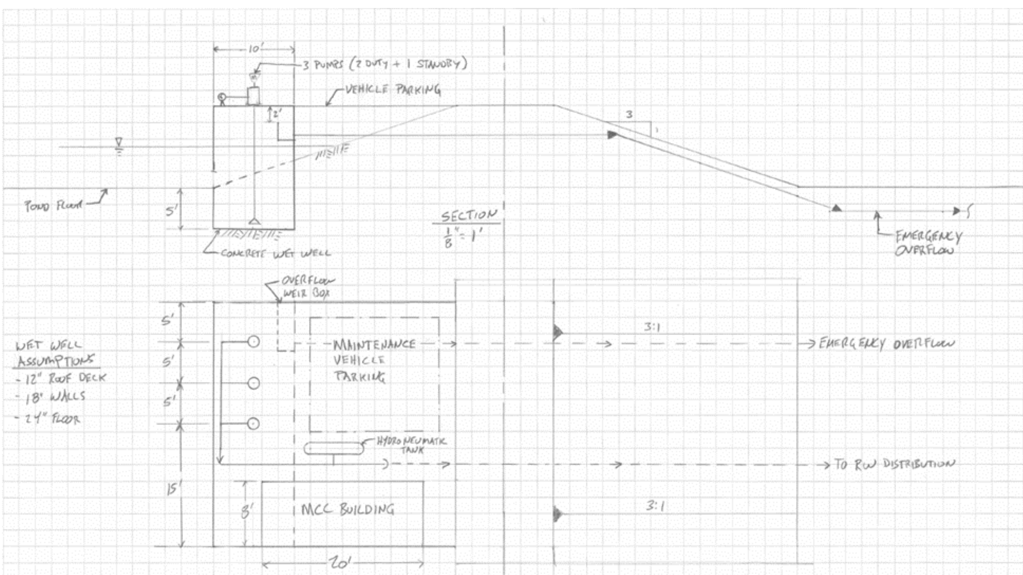



**Figure F-1. Typical Pump Wet Well Cross Section and Plan View for Storage Ponds**

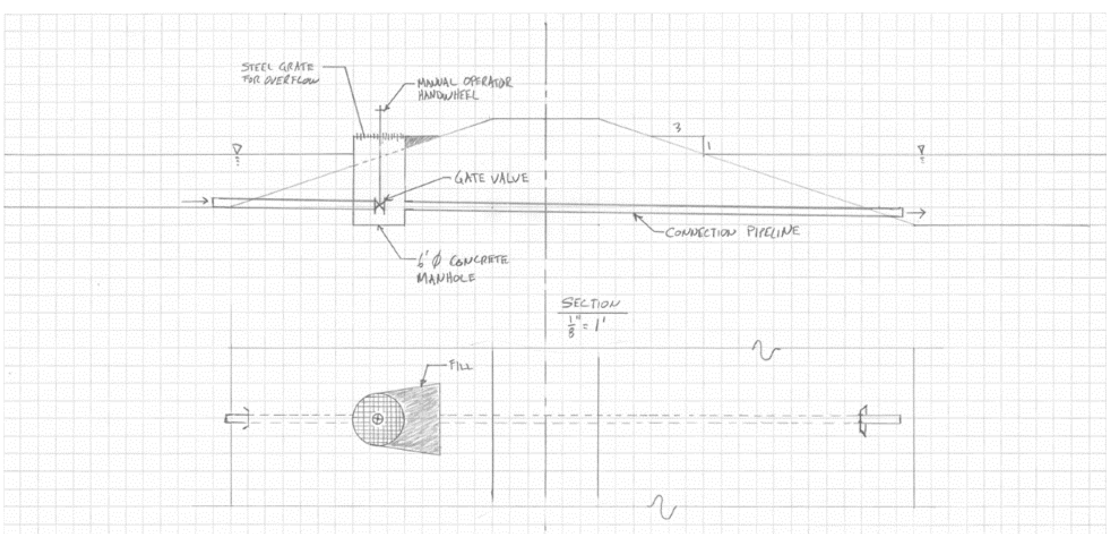



**Figure F-2: Typical Gate Valve Cross Section and Plan View for Storage Ponds**

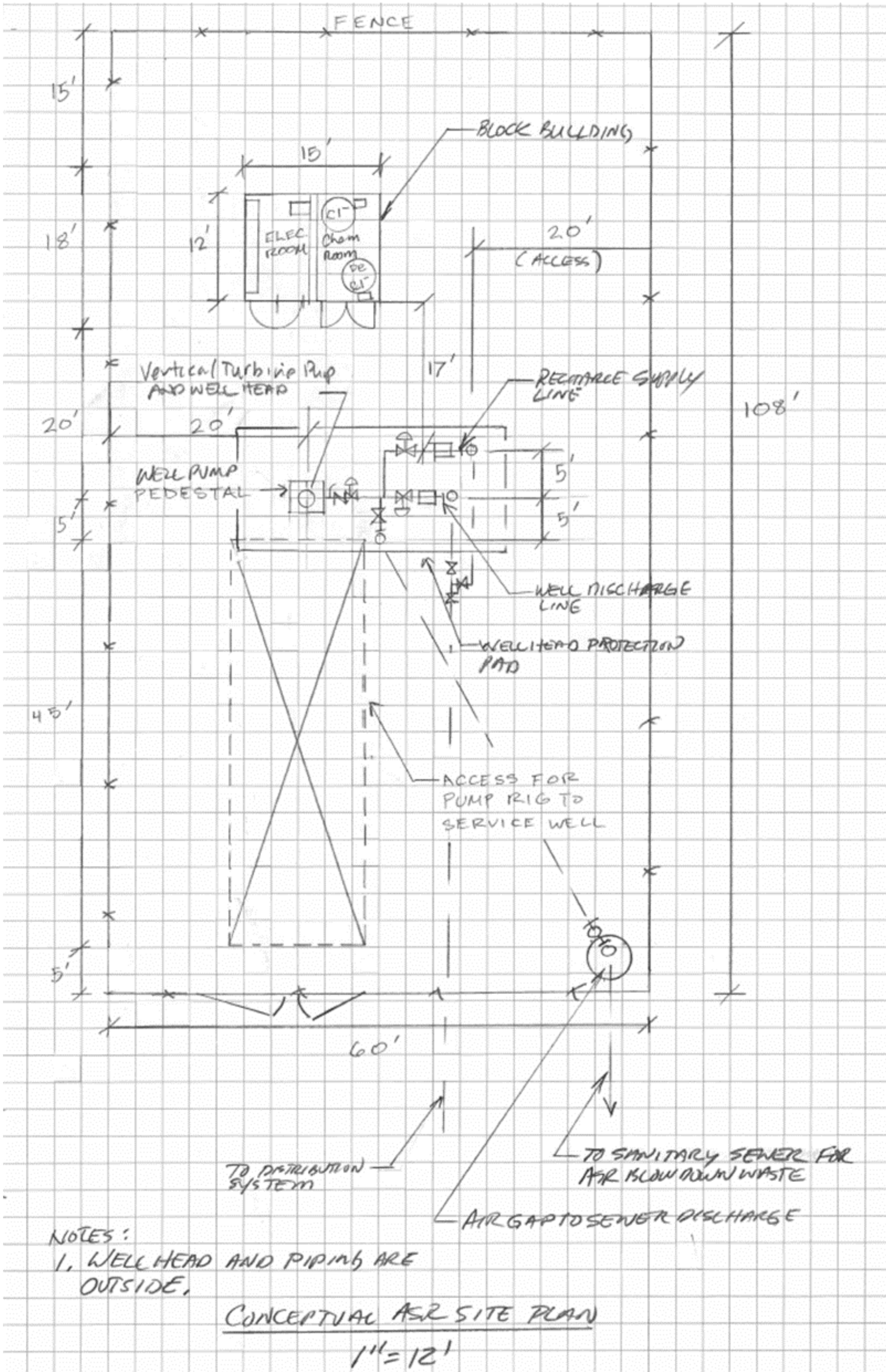



**Figure F-3: Typical ASR Site Plan**

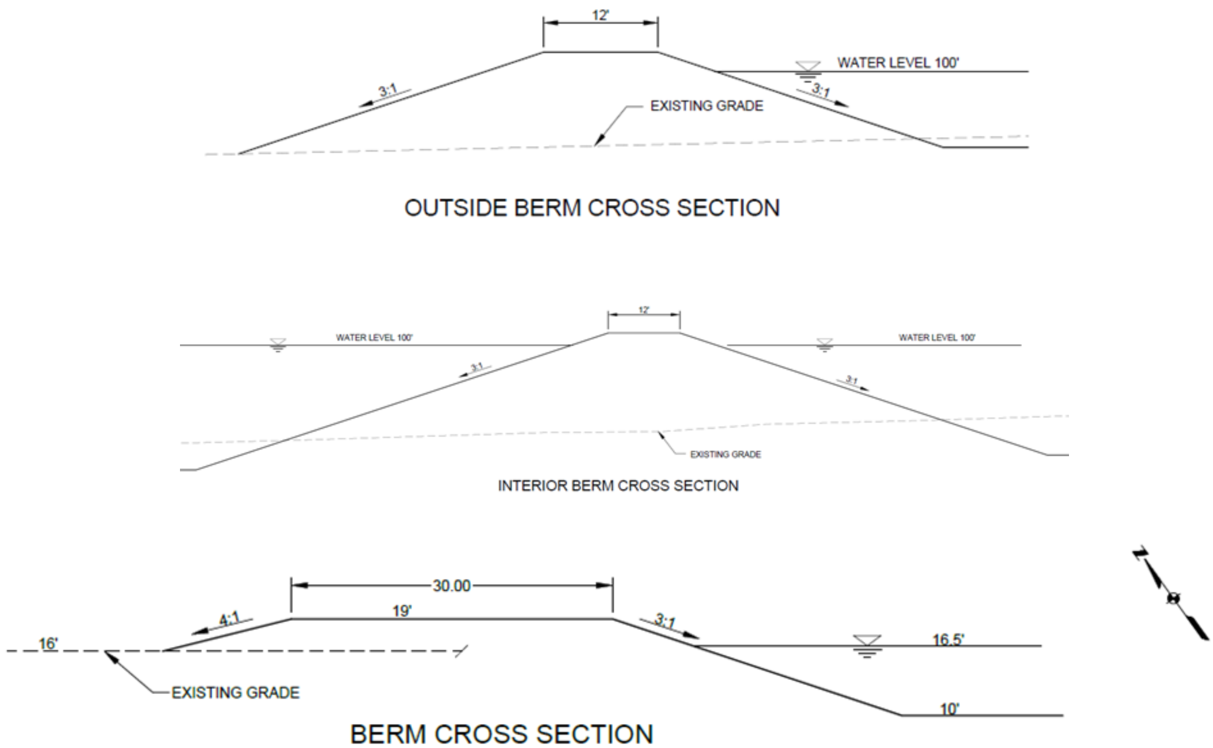



**Figure F-4: Typical Levee Cross Section(s) for Storage Ponds**

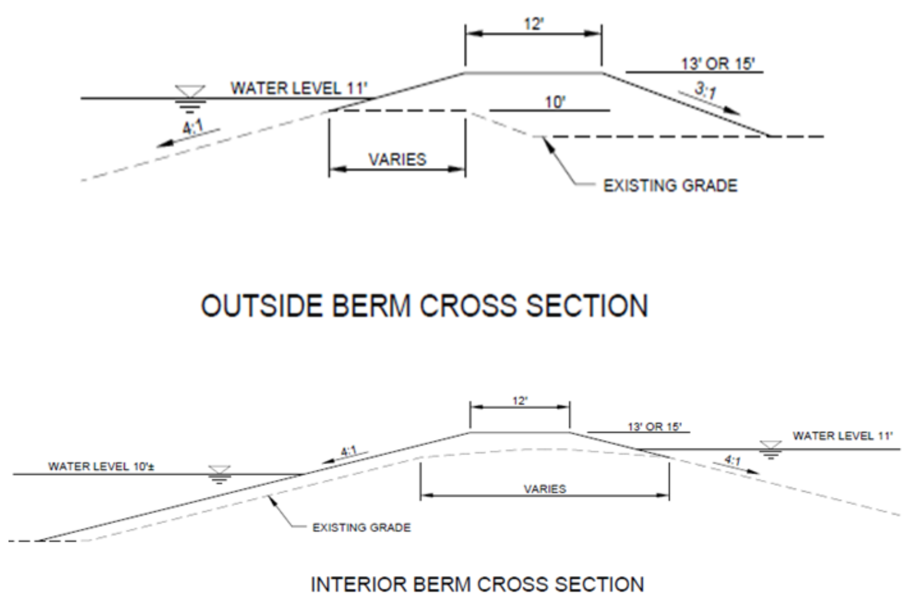



**Figure F-5: Typical Levee Cross Section for Raising Existing Napa Pond Levee(s)**

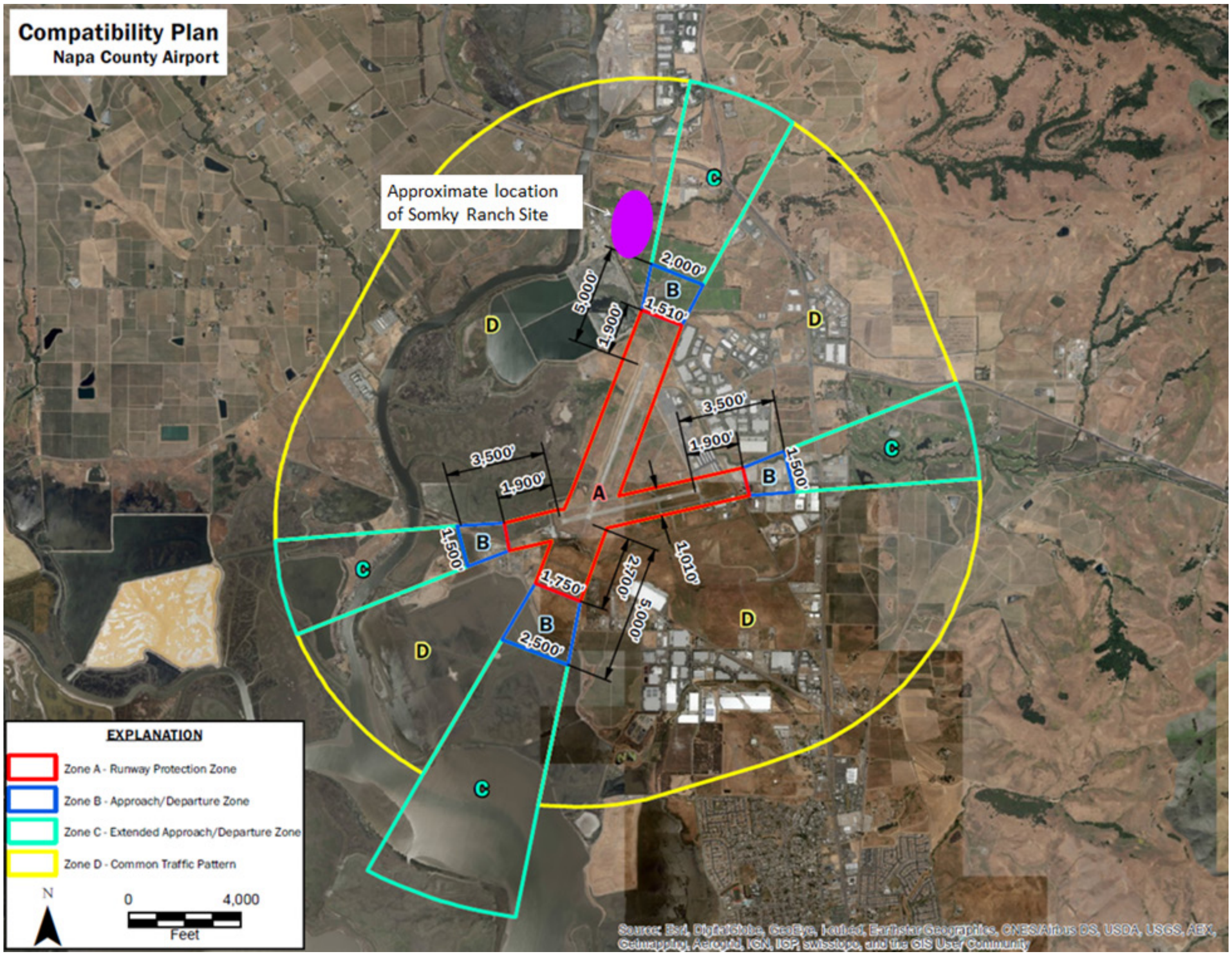
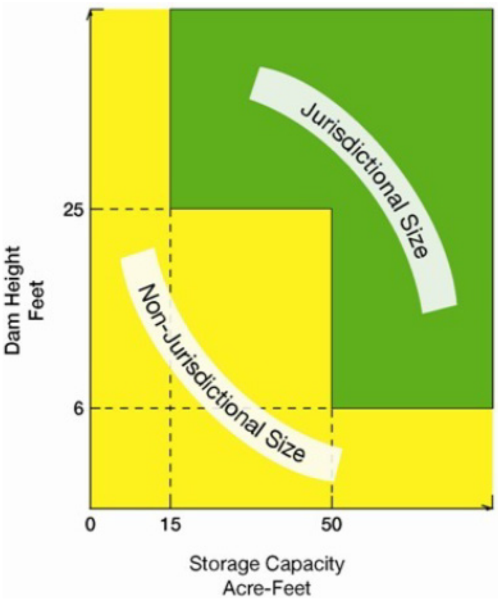



**Figure F-6: Napa County Airport Flight Plan**

The Somky Ranch site described in Section 5.3.5.3. is located in close proximity to the Napa County Airport, which could result in challenging construction constraints due to flight path zones.




Provisions of division 3 of the California Water Code Affecting Jurisdiction over Dams and Reservoirs

**DAM HEIGHT** is measured from the downstream toe to the maximum storage elevation/spillway.

For a complete text of exemptions, please refer to "Statutes and Regulations Pertaining to Supervision of Dams and Reservoirs", California Water Code, Division 3, Dams and Reservoirs, Part 1, Supervision of Dams and Reservoirs, Chapter 1, Definitions, 6000-6008.

**Figure F-7: Division of Safety of Dams Jurisdictional Size Figure**

The volume of storage for Sonoma Valley County Sanitation District (SVCSD) ponds on private land at the Mulas Site (Section 5.3.2.1) and the Robledo Site (5.3.2.2) was conservatively capped at 49 AF to avoid additional permitting requirements under the California Division of Safety of Dams requirement that apply to most ponds over 50 AF.

This page intentionally left blank.

# Appendix G: Memorandum of Understanding

This page intentionally left blank.

# NORTH BAY WATER REUSE AUTHORITY

# THIRD AMENDED

# MEMORANDUM OF UNDERSTANDING

<u>Supersedes</u>

| | |
|---|---|
| Memorandum of Understanding | March 15, 2005 |
| First Amended Memorandum of Understanding | September 24, 2008 |
| Second Amended Memorandum of Understanding | November 3, 2010 |

This page intentionally left blank.

Table of Contents

**MEMORANDUM OF UNDERSTANDING**

**ESTABLISHING THE**

**NORTH BAY WATER REUSE AUTHORITY**

This Memorandum of Understanding ("MOU") establishes the North Bay Water Reuse Authority ("NBWRA") for the purposes described herein. This MOU is made and entered into by and between the parties that are signatories to this MOU. The MOU was first approved March 15, 2005. The first amendment to the MOU was approved September 24, 2008.The second amendment to the MOU was approved November 3, 2010. This is the third amendment of the MOU that originally established the NBWRA. This third amendment to the MOU supersedes all previous versions of the MOU.

## **Recitals**

WHEREAS, each of the parties to this MOU is a local government entity functioning within the North Bay Region, as depicted in **Exhibit A** attached hereto and incorporated by reference; and

WHEREAS, the parties desire to enter into an MOU to explore the feasibility of coordinating interagency efforts to expand the beneficial use of recycled water in the North Bay Region thereby promoting the conservation of limited surface water and groundwater resources; and

WHEREAS, the parties do not intend to create a separate public agency pursuant to Government Code §6500 et seq. through this MOU and no provision of this MOU should be so construed; and

WHEREAS, the parties hereto may later explore the feasibility of changing their organizational structure by establishing a Joint Powers Authority in a separate agreement that would advance the purpose and goals of the NBWRA, if construction projects are to be undertaken jointly or if such changes are necessary in order to receive federal or state funds; and

WHEREAS, the parties hereto recognize the value of using common resources effectively; and

WHEREAS, the parties hereto desire to be proactive on regulatory issues affecting the North Bay Region that transcend the traditional political boundaries of the parties; and

WHEREAS, the parties hereto desire to inform communities and the public in the North Bay Region about the importance of water conservation and the benefits of water reuse; and

WHEREAS, the parties hereto wish to coordinate their consideration and review of local, state and federal policies and programs related to the expansion of existing recycled water programs and the development of new recycled water programs in the North Bay Region; and

WHEREAS, the parties hereto find that promoting the stewardship of water resources in the North Bay Region is in the public interest and for the common benefit of all within the North Bay Region; and

WHEREAS, the parties recognize that there are current and future regulatory requirements which apply to water resources in the North Bay Region affecting one or more of said parties, and that these multiple regulatory requirements may be better addressed on a regional basis, and in a collaborative manner, and the parties wish to investigate more effective ways to share information and coordinate efforts to comply with said regulatory requirements; and

WHEREAS, the parties intend that participation in this MOU be entirely voluntary; and

WHEREAS, it is understood that the primary purpose of this MOU is to provide a governance structure, led by a Board of Directors consisting of members of the governing boards from the Member Agencies, for the successful completion of recycled water projects in the North Bay Region.

WHEREAS, the parties previously applied for federal funds to assist them with implementing their projects; and

WHEREAS, the parties did receive funding, which is part of a program authorized for construction in PL 111-11 that was signed into law in March 2009. The program can receive appropriations through the United States Bureau of Reclamation’s Title XVI program which can include funds from the American Recovery and Reinvestment Act of 2009 and the U.S. Department of Interior, Bureau of Reclamation's Title XVI Program, including the WaterSMART Grant Program.

WHEREAS, Phase 1 includes receipt of the full $25,000,000 federal authorization, and

WHEREAS, the parties are currently conducting Scoping Studies for potential additional projects that are known as Phase 2. The magnitude of Phase 2 projects has not yet been determined, but would be determined by a Feasibility Study should the parties choose to conduct one. The results of a Feasibility Study may lead to additional modifications of this MOU.

WHEREAS, the parties understand that reallocation of costs described herein, can be made with the approval of the parties as provided herein.

NOW, THEREFORE, the parties hereto do hereby enter into this Memorandum of Understanding, as follows:

**Memorandum of Understanding**

1. **Definitions**. As used in this MOU, the following words and phrases shall have the meanings set forth below unless the context clearly indicates otherwise.

   (a) "MOU" shall mean this third amended Memorandum of Understanding.

   (b) "NBWRA" shall mean the unincorporated, cooperative group of public agencies organized through this MOU and otherwise referred to as the North Bay Water Reuse Authority.

   (c) "Board of Directors" shall mean the governing body composed of members of the governing boards of the Member Agencies established pursuant to this MOU.

   (d) "Technical Advisory Committee" shall mean the administrative body established at the discretion of the Board of Directors pursuant to this MOU.

   (e) "Member Agency" or "Member Agencies" shall mean the local and/or regional public agencies regulated under the Clean Water Act, 33 U.S.C. § 1251 et seq., the federal Safe Drinking Water Act, 42 U.S.C. § 300f et seq., and/or the state Safe Drinking Water Act, Health & Safety Code § 116275 et seq., that operate within or have jurisdiction over any area within the North Bay Region, and that are signatories to this MOU. Member Agencies are entitled to one voting member on the Board of Directors and Technical Advisory Committee as defined herein.

   (f) "North Bay Region" shall mean the four counties identified in the North San Pablo Bay watershed as defined in PL 111-11, Section 9110, Title XVI; 43 U.S.C.390h-34: Marin, Napa, Solano, and Sonoma. Said area is depicted on the map attached hereto and incorporated herein as **Exhibit A.**

(g) "Associate Member" shall mean a local and/or regional public agency as described in Section 1(e) or other organizations interested in the Purpose and Objectives of NBWRA. Associate Members may not sponsor current projects in Phase 1 or Phase 2 but may partner with Member Agencies. Associate Members are entitled to appoint one non-voting representative to the Board of Directors and to the Technical Advisory Committee.

(h) "Administrative Agency" shall mean that Member Agency authorized pursuant to Section 12 to enter into contracts and perform other administrative functions on behalf of the NBWRA.

(i) "EIR/EIS" shall mean the Environmental Impact Report/Environmental Impact Statement, prepared by Environmental Science Associates, that was certified and or approved by the Member Agencies during December 2009 and January 2010 and which serves as the basis of the projects to be partially funded by USBR.

(j) "USBR" shall mean the United States Bureau of Reclamation.

(k) "Phase 1" shall mean the projects described as Phase 1 of Alternative 1 of the EIR/EIS. It is understood that minor modifications to said projects may occur as actual design and construction occurs and that the individual agencies are responsible for possible modifications to the requirements of the EIR/EIS. Phase 1 participating Member Agencies include: Las Gallinas Valley Sanitary District, Novato Sanitary District, North Marin Water District, Sonoma Valley County Sanitation District, Sonoma County Water Agency, Napa Sanitation District, and Napa County.

(l) "Phase 2" shall mean the remaining projects in the EIR/EIS Alternative 1 that are not included in Phase 1. Phase 2 shall also mean those potential projects described in the Final

Report – Phase 2 Project Definition Scoping Study Report, prepared by CDM Smith. It is understood that those projects may change through the completion of a Final Phase 2 Scoping Study and will not be finalized until a full Feasibility Study is completed. Phase 2 participating Member Agencies include: Las Gallinas Valley Sanitary District, Novato Sanitary District, Sonoma Valley County Sanitation District, Sonoma County Water Agency, Napa Sanitation District, Marin Municipal Water District, and City of Petaluma.

(m) "Construction Project" shall mean a project described in either the Phase 1 EIR/EIS or the Phase 2 EIR/EIS should one be completed.

(n) "Phase 1 Costs" shall mean those costs associated with engineering and environmental analysis associated with the construction of projects described in "Phase 1", above.

(o) "Phase 2 Costs" shall mean those costs associated with efforts to conduct Scoping Studies, Workshops, Feasibility Studies, or obtaining federal funding for support of said studies for projects as described in "Phase 2", above.

(p) "Joint Use Costs" shall mean those costs that are not easily differentiated between Phase 1 and Phase 2 since they benefit the entire program and not just a particular set of projects. These costs may include but not be limited to program management and program development costs; costs of efforts to obtain federal funding; federal authorization and appropriations; state funding and legislation; outreach and community support; and administrative agency management and oversight in support of the program.

2. **Purpose**. The purpose of NBWRA is to provide recycled water for agricultural, urban, and environmental uses thereby reducing reliance on local and imported surface water and

groundwater supplies and reducing the amount of treated effluent released to San Pablo Bay and its tributaries.

3. **Objectives**. NBWRA projects will promote the expanded beneficial use of recycled water in the North Bay Region to:

   (a) Offset urban and agricultural demands on surface water and groundwater supplies;

   (b) Enhance local and regional ecosystems;

   (c) Improve local and regional water supply reliability;

   (d) Maintain and protect public health and safety;

   (e) Promote sustainable practices;

   (f) Give top priority to local needs for recycled water, and

   (g) Implement recycled water facilities in an economically viable manner.

4. **Establishment of the NBWRA**. There is hereby established the North Bay Water Reuse Authority ("NBWRA"). The geographic boundaries of the NBWRA shall be the North Bay Region. (See **Exhibit A**). The NBWRA is an unincorporated association. By entering into this MOU, the parties do not intend to form a Joint Powers Authority pursuant to Government Code §6500 et seq.

5. **NBWRA Membership**. Any local and/or regional public agency regulated under the Clean Water Act, 33 U.S.C. § 1251 et seq., the federal Safe Drinking Water Act, 42 U.S.C. § 300f et seq., and/or the state Safe Drinking Water Act, Health & Safety Code § 116275 et seq., that operates within or has jurisdiction over any area within the North Bay Region may be a Member Agency or Associate Member of the NBWRA. Each Member Agency must be a signatory to this MOU.

6. **Governance**. NBWRA governance structure shall consist of a Board of Directors. The composition and responsibilities of the Board of Directors is detailed in Section 7.

7. **Board of Directors**

   (a) Membership. The Board of Directors of the NBWRA shall consist of one voting representative from each Member Agency and may include one non-voting representative from each Associate Member. Such representative shall be a member of the governing board of the Member Agency or Associate Member. The Member Agency or Associate Member shall designate one representative and alternate(s) each of whom shall be members of the governing board of the Member Agency or Associate Member. In the event that a Member Agency's governing body representative and alternate(s) are unavailable for a particular meeting, the Member Agency's representative on the Technical Advisory Committee may serve as an alternate.

   (b) Voting and Authorization Requirements. Each Member Agency representative on the Board of Directors shall have one vote. Except as set forth in subsections (i) and (iii) below and as otherwise specified herein, the affirmative vote of a majority of the voting members of the Board of Directors is required and is sufficient to approve any item.

      (i) An affirmative vote representing two-thirds of all Member Agencies shall be required to adopt or modify the budget. The budget may not be increased by more than fifteen percent (15%) annually, without the unanimous approval of the members of the Board of Directors representing all Member Agencies.

      (ii) Votes to approve the budget may not be unreasonably withheld.

      (iii) Approval by the governing bodies of two-thirds of all Member Agencies shall be required to modify this MOU.

(c) Quorum. Representatives or alternates from a majority of the Member Agencies shall constitute a quorum for purposes of transacting business, except that less than a quorum may vote to adjourn a meeting or to set a date for the next meeting.

(d) Open Meetings. The Board of Directors will comply with the Ralph M. Brown Act in conducting its meetings.

(e) Adding Associate Members. Representatives of Associate Members may be added to the Board of Directors without modifying this MOU by a majority vote of the Board of Directors.

## 8. Technical Advisory Committee

(a) Purpose. The Board of Directors may create a Technical Advisory Committee as needed for the month-to-month management of budget, schedule, and scopes of work for the NBWRA. Typical duties of a Technical Advisory Committee include recommending contracting for a program manager; working through technical details of work scopes and products; authorizing the administrative agency to enter into, modify, or accept work under any contract that is consistent with the budget approved by the Board of Directors, and reviewing and recommending courses of action to the Board of Directors for their consideration. The Board of Directors may create or dissolve the Technical Advisory Committee at any time for any purpose, and may adopt a set of rules governing the Technical Advisory Committee as it determines necessary to achieve the purpose and objectives stated herein. The Technical Advisory Committee may create subcommittees for specific purposes, including, but not limited to, budget and financial issues, and modification of the MOU.

(b) Membership. The Technical Advisory Committee shall consist of one representative, not from the governing body, from each Member Agency. Such representative shall be the general manager or a designated staff member of the Member Agency. In the event that the general manager or staff member is unavailable for a meeting, he or she may designate an alternate. Associate Members may appoint a non-voting representative to the Technical Advisory Committee.

(c) Voting and Authorization Requirements: Each Member Agency representative on the Technical Advisory Committee shall have one vote. An affirmative vote of a majority of all voting members of the Technical Advisory Committee is required and sufficient to approve any item.

(d) Quorum. Representatives or alternates from a majority of the Member Agencies shall constitute a quorum for purposes of transacting business, except that less than a quorum may vote to adjourn a meeting or to set a date for the next meeting.

**9. Terms of Office**. Each representative on the Board of Directors shall serve for as long as he or she is a member of the governing board of his or her Member Agency and is designated by the Member Agency to act as its representative. If at any time a vacancy occurs on the Board of Directors, a replacement shall be appointed by the Member Agency to fill the unexpired term of the previous representative within ninety (90) days of the date that such position becomes vacant.

10. **Alternates**. Alternate representatives to the Board of Directors or its Technical Advisory Committee shall be empowered to cast votes in the absence of the regular representative or, in the event of a conflict of interest preventing the regular representative from voting, to vote because of such a conflict of interest.

11. **Officers of the NBWRA**. The Board of Directors of the NBWRA shall elect a Chair, a Vice-Chair and such other officers annually on the first meeting of the calendar year. The Chair and Vice-Chair shall be selected from among the Member Agency representatives. The Board of Directors may choose to adopt a policy that requires the rotation of the Chair, by Member Agency, on an annual basis. The duties of the Chair and Vice-Chair are as follows:

    (a) Chair. The Chair shall direct the preparation of agendas, call meetings of the Board of Directors to order and conduct other activities as deemed appropriate by the Board of Directors. Any member of the Board of Directors may place an item on the NBWRA agenda.

    (b) Vice-Chair. The Vice-Chair shall serve as the Chair in the absence of the regularly-elected Chair. In the event both the Chair and Vice-Chair are absent from a meeting which would otherwise constitute a quorum and a temporary Chair was not designated by the Chair at the last regular meeting, any voting Board member may call the meeting to order, and a temporary chair may be elected by majority vote to serve until the Chair or Vice-Chair is present.

12. **Administrative Agency**. The Member Agencies hereby designate the Sonoma County Water Agency to act as the Administrative Agency for the purpose of carrying out the provisions of this MOU. The authority delegated herein to the Administrative Agency shall be subject to the

restrictions upon the manner of exercising power applicable to the Administrative Agency, including but not limited to the purchasing ordinances and purchasing procedures of the Administrative Agency. Within these limits, the Board of Directors may direct the Administrative Agency's actions with respect to this MOU. The Administrative Agency, for the benefit of the NBWRA Members, shall:

(a) Award, execute in its own name, and administer such contracts on behalf of the NBWRA, as may be authorized as set forth in Sections 7 and 8.

(b) Through its controller and treasurer, act as the financial officer or functional equivalent and be the depositor and have custody of all money of the NBWRA from whatever source. The Administrative Agency shall draw warrants to pay demands for expenditures authorized by the Board of Directors or by its authorized representative pursuant to any delegation of authority authorized by the Board of Directors. The Administrative Agency will strictly account for all NBWRA funds, and will hold the funds in trust in a segregated account.

(c) Provide budget analyses, warrant lists and other financial documents as required by the Board of Directors. The Administrative Agency's financial activities with regards to the NBWRA shall be subject to an outside audit at any time at the request of the Board of Directors. As a matter of course, the Administrative Agency will provide a separate annual audit of NBWRA funds to the Board of Directors.

(d) Determine charges to be made against the NBWRA for the Administrative Agency's services. Payment of these charges shall be subject to the approval of the Board of Directors.

(e) Prepare the reports identified in Section 20 if the Board of Directors has not designated another party or person to complete that task.

(f) Enter into contracts with values up to $15,000 without the approval of the Board of Directors or the Technical Advisory Committee, if consistent with the budget approved by the Board of Directors.

The Administrative Agency may resign its position as Administrative Agency upon 120 days written notice to all Member Agencies, and shall, before the effective date of its resignation, transfer all funds held on behalf of the NBWRA to any designated successor Administrative Agency. The Board of Directors may designate a successor Administrative Agency by majority vote. Should no other party be designated to act as Administrative Agency by the effective date of the resignation, the MOU shall terminate and the Administrative Agency shall distribute all property held on behalf of the NBWRA pursuant to Section 23.

**13. Staff and Consultants**. Subject to the approval and procedural provisions of Sections 7 and 12, the Administrative Agency may employ or contract for any staff or consultants as may be reasonably necessary to carry out the purposes of this MOU. Such persons may include legal counsel, administrative executives and other types of specialists. If an employee from any Member Agency performs staff or consulting work for the NBWRA, the governing body of that Member Agency may determine the charges to be made against the NBWRA for the services of that employee. Payment of these charges by the Administrative Agency on behalf of the NBWRA shall be subject to the approval of the Board of Directors, which approval shall not be unreasonably withheld.

**14. Sharing of Costs and Resources**.

(a) The Board of Directors may assess annual dues of $5,000 for membership in the NBWRA for Associate Members. Dues shall be used to offset Joint Use Costs for the Member Agencies.

(b) The Board of Directors shall assess each Member Agency for costs associated with paying the Administrative Agency, staff or consultants and the funding of approved projects, under agreements approved by the Technical Advisory Committee pursuant to Section 8, or the Administrative Agency as provided in Section 12, or as authorized by the budget adopted by the Board of Directors as set forth in Section 7. Further, legal liabilities may arise out of actions of the Member Agencies (including the Administrative Agency) taken pursuant to this MOU. The activities of the NBWRA are part of a regional program that provides benefit to all agencies. Therefore, as described more particularly below, all Member Agencies that participate in Phase 1 construction projects shall pay a portion of ongoing Phase 1 costs equally and the remaining Phase 1 costs shall be based on approved project costs for Phase 1 of Alternative 1, as described in the certified EIR/EIS or as amended pursuant to Sections 14(e) and 16. The costs and liabilities will be allocated among each of the Member Agencies as follows:

(i) one quarter (25%) of costs and liabilities shall be allocated equally among each of the Member Agencies; and

(ii) three quarters (75%) of costs and liabilities shall be allocated among Member Agencies in proportion to the benefit to each Member Agency of participating in the NBWRA, in the form of federal funding that is described in applications for federal funding that have been submitted to the USBR as of April 15, 2010 or as modified pursuant to Sections 14 (e) and 16 herein. The Sonoma County Water Agency shall pay its pro-rata share of the quarter of costs allocated under subsection (i) above, but shall not pay any costs allocated under subsection (ii), as it does not have any individual projects to be funded.

(c) The parties hereto agree that the criteria set forth in subsection (b)(ii) produce the allocations listed in **Exhibit B**, attached hereto, and incorporated by reference. The parties agree that **Exhibit B** may be modified pursuant to Sections 14 (e) and 16.

(d) Member Agencies were afforded the opportunity to receive reimbursement for previously allocated Phase 1 Costs and liabilities that were not based on benefits received during the period from the end of Fiscal Year 2010-2011 back to Fiscal Year 2005-2006 (the "Reimbursement Period"). Reimbursements were equal to (i) the actual costs paid by a Member Agency during the Reimbursement Period minus (ii) the amount of costs that were allocated to that Member Agency during the Reimbursement Period if the percentages defined in **Exhibit B** had been in effect. The final determination of costs and reimbursements subject to this subsection (d) was approved by a majority of the Board of Directors on May 21, 2012. No further or subsequent reimbursement for Phase 1 Costs as described in this section shall be contemplated.

(e) Two or more Member Agencies can agree to reallocate project costs for Phase 1 among themselves, as long as the combined total for those agencies before and after reallocation are the same as the combined total for those agencies in the project schedule, subject to the approval of the Board of Directors. Such approval shall not be unreasonably withheld.

(f) (1) In the case of non-contractual liabilities arising out of the activities of the parties under this MOU, the Member Agencies specifically repudiate the division of liability outlined in Government Code sections 895.2 *et seq*. and instead agree to share liability based on the relative fault of the parties.

(2) Notwithstanding the foregoing paragraph, each Member Agency agrees that it is solely responsible for, and agrees to indemnify and defend the other Member Agencies from and against, any claims, liabilities, or losses relating to or arising out of the design, construction, inspection, operation, or maintenance of its separate project. Each Member Agency agrees that nothing in this MOU shall create, impose, or give rise to any liability, obligation, or duty of the Member Agency to the other Member Agencies or to any third party with respect to the manner in which the Member Agency designs, constructs, inspects, operates, or maintains its separate project.

(g) A separate agreement between the Administrative Agency and the Member Agencies has been developed based on the requirements of the American Recovery and Reinvestment Act and Title XVI. A similar agreement may be established for Phase 2.

(h) For those agencies choosing to participate in Phase 2 as defined herein, they shall share equally in all Phase 2 Costs as defined herein. Should member agencies choose to construct projects as part of Phase 2, there will be an opportunity to receive reimbursement for previously allocated costs and liabilities that were not based on benefits received. Said reimbursement shall be calculated in a manner similar to that described in Paragraph (d), above. Expenses for Phase 2 Scoping Studies shall not be eligible for reimbursement.

(i) All Member Agencies shall pay an equal share of Joint Use Costs as defined herein.

(ii) If a Member Agency that chooses to opt out of Phase 2/other non-Phase 1 tasks then later decides to participate, it will be subject to a buy-in fee approved by the Board of Directors. Said fee may include applicable costs plus interest from the inception of Phase 2/other non-Phase 1 tasks until such time that they decide to participate. Costs shall be based on the approved annual budget. Interest shall be based on the annual change in the Consumer Price Index - All Urban Consumers for San Francisco-Oakland-San Jose as determined by the Bureau of Labor Statistics, United States Department of Labor.

**15. Distribution of Funds Received**.

(a) Distribution of funds received from USBR for Phase 1 projects shall be based on the Phase 1 project schedule as described in applications for federal funding submitted to USBR as of April 15, 2010 or as modified pursuant to Sections 14 (e) and 16, herein. Those percentages are based on the $25,000,000 federal funding authorization for projects totaling $100,000,000 and are detailed in **Exhibit C**, attached hereto, and incorporated by reference. The parties agree that **Exhibit C** may be modified pursuant to Sections 14 (e) and 16. Once a Member Agency has received federal funds for a project, that Member Agency is required to remain a participant in the NBWRA and a signatory to this MOU throughout the term of this MOU as described in Section 22. Should State funding become available to the NBWRA, its distribution shall also be as described in this Section. It is acknowledged that the Member Agencies may receive State funding from programs on an individual basis, and (i) this Section shall not apply to such individual State funding and

(ii) the allocations set forth in this Section shall not be affected by the receipt of any State funding.

(b) Should NBWRA be designated to receive federal funds for Phase 2/other non-Phase 1 tasks, this MOU will be modified accordingly.

16. **Initiation of Membership**. If an eligible agency as defined in Section 5 requests to join the NBWRA as a new Member Agency, the Board of Directors shall establish a membership initiation fee to such agency as a condition of joining the NBWRA. For the purposes of this revision of the MOU, the new Member Agencies shall include Marin Municipal Water District and City of Petaluma. The purpose of the initiation fee is to allow the Phase 1 Member Agencies to recover a portion of their investment costs in obtaining federal authorization for construction projects. The initiation fee for each new member agency shall be equal to 0.6% of the new Member Agency project costs as determined upon completion of the Phase 2 Scoping Study. The initiation fee shall be paid in a two-step process. Step one shall be a payment of $25,000 by June 30, 2013. Step two shall be a payment of the remaining initiation fee by June 30, 2014. The collected initiation fees shall be distributed to the Phase 1 participating agencies according to the percentages specified in **Exhibit B**.

Cost allocations as described in **Exhibits B** and **C** may be revised upon the addition of additional Member Agencies, subject to the approval of a majority of the existing Member Agencies at that time. By virtue of becoming a signatory agency to this MOU pursuant to this Section 16, a new Member Agency is subject to all provisions of this MOU, including Section 17 below.

**17. Termination of Membership**. Member Agencies that participate in Phase 1 and have received federal monies for Phase 1 construction projects may not terminate their membership in the NBWRA before the completion of all Phase 1 construction projects or before the termination of this MOU as defined herein, whichever comes first. Member Agencies that participate in Phase 2 and have received federal monies for Phase 2 construction projects may not terminate their membership in the NBWRA before the completion of all Phase 2 construction projects or before the termination of this MOU as defined herein, whichever comes first. Phase 2 participants may voluntarily withdraw from the NBWRA prior to the receipt of federal monies for Phase 2 construction projects.

(a) Notwithstanding the above a Member Agency may petition the Board in writing for withdrawal from the NBWRA and may withdraw with the approval of two-thirds of the members of the Board of Directors representing Member Agencies.

(b) Effect of Termination. All rights of a Member Agency under this MOU shall cease on the termination of such Member Agency's membership. Termination shall not relieve the Member Agency from any obligation for charges, costs or liabilities incurred or arising from acts or omissions before the date of termination. The terminating Member Agency's responsibility for such charges, costs or liabilities shall be determined in a manner consistent with the allocations set forth in Section 14. Likewise, termination shall not preclude the Member Agency from any benefits that fully accrue before the date of termination. However, a resigned or terminated agency has no right to receive a portion of surplus funds at the termination of the NBWRA.

18. **Procedures**. The Board of Directors may adopt bylaws, rules of conduct for meetings and operating procedures for the NBWRA. To facilitate such efforts, the NBWRA may adopt the administrative procedures and policies of a Member Agency.

19. **Meetings**. The Board of Directors and the Technical Advisory Committee shall provide for meetings, as necessary.

20. **Reports to Member Agencies**. Each year the NBWRA shall submit a written report to the governing body of each of the Member Agencies. This report shall describe the financial activities of the NBWRA during the preceding year.

21. **Offices**. For the purposes of forming the NBWRA and for initial operation, the principal office of the NBWRA shall be located at the Administrative Agency. The Board of Directors may change said principal office from one location to another after providing thirty (30) days notice of such a change. The Chair shall notify each Member Agency in writing of the change.

22. **Term**. This MOU shall terminate five years from its effective date, unless extended by some or all of the parties. This MOU shall also be terminated if the Administrative Agency has resigned pursuant to Section 12 and no other Member Agency has been designated to act as the Administrative Agency prior to the effective date of the resignation.

23. **Disposition of Property and Surplus Funds**. At the termination of this MOU, any and all property, funds, assets, and interests therein held by the Administrative Agency on behalf of the NBWRA shall become the property of and be distributed to the then-Member Agencies. Money collected from Member Agencies and held in reserve by the Administrative Agency for payment of the costs of programs shall be allocated among Member Agencies in proportion to each Member Agency's contributions to such reserves. All other property,

funds, assets, and interests shall be distributed by the Administrative Agency to Member Agencies in proportion to each Member Agency's contributions to the NBWRA for dues and allocated costs. However, liabilities of the NBWRA in excess of those assets held by the Administrative Agency on behalf of the NBWRA at the time of termination shall be assessed against the Member Agencies and said Member Agencies shall be responsible for such liabilities. The allocation of responsibility for the payment of such liabilities shall be determined in a manner consistent with the provisions of Section 14.

24. **Minutes**. A secretary or clerk shall be appointed by the Board of Directors. The secretary or clerk shall cause to be kept minutes of all meetings of the Board of Directors and the Technical Advisory Committee, and shall cause a copy of the minutes to be forwarded to each Member Agency.

25. **Effective Date**. This revision to the MOU shall become effective when two-thirds of the Member Agencies listed in Exhibit B have authorized its execution.

26. **Counterparts**. This revision to the MOU may be executed in counterpart and each of these executed counterparts shall have the same force and effect as an original instrument and as if all of the parties to the aggregate counterparts had signed the same instrument.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as set forth below.

**Sonoma County Water Agency**

By: ______________________

Print Name: David Rabbitt

Title: Chair

Date: 7/30/13

**Napa Sanitation District**

By: Jill Techel

Print Name: Jill Techel

Title: Chair

Date: 04/19/13

**Sonoma Valley County Sanitation District**

By: ______________________

Print Name: David Rabbitt

Title: Chair

Date: 7/30/13

**Novato Sanitary District**

By: ______________________

Print Name: Mike Di Giorgio

Title: Board President

Date: 5-13-13

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as set forth below.

**Las Gallinas Valley Sanitary District**

By: [signature]

Print Name: MEGAN CLARK

Title: BOARD PRESIDENT

Date: 5/2/13

**North Marin Water District**

By: [signature]

Print Name: Rick Fraites

Title: Board President

Date: 04/17/13

**County of Napa**

By: [signature]

Print Name: Brad Wagenknecht

Title: Chairman, Board of Supervisors

Date: 4/23/2013

ATTEST:
Clerk of the Board of Supervisors

By: [signature]

APPROVED 4/23/2013
BOARD OF SUPERVISORS
COUNTY OF NAPA
GLADYS I. COIL
CLERK OF THE BOARD
BY [signature] Deputy

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as set forth below.

| **Marin Municipal Water District** | **City of Petaluma** |
| --- | --- |
| By: Tom Cronin | By: |
| Print Name: Tom Cronin | Print Name: JOHN C. BROWN |
| Title: Acting G.M. | Title: CITY MANAGER |
| Date: 5-8-13 | Date: 7-15-13 |

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as set forth below.

**County of Marin**

By: Judy Arnold

Print Name: Judy Arnold

Title: President, Marin BOS

Date: 9/18/13

# Exhibit A


Sonoma County Water Agency
San Pablo Bay Watershed
Sonoma County
Napa County
Napa
Napa County
Sonoma
Sonoma Valley County Sanitation District
Napa Sanitation District
Fairfield
Suisun City
City of Petaluma
Solano County
North Marin Water District
Novato
Novato Sanitary District
Vallejo
Marin County
San Pablo Bay
Benicia
Lucas Valley-Marinwood
Las Gallinas Valley Sanitary District
Martinez
San Rafael
Contra Costa County
Marin Municipal Water District
Mill Valley
Google™ earth

# Exhibit B

## Percentages for Ongoing Phase 1 NBWRA Costs

| Agency | 25% Split Equally | Federal Authorization, Phase 1 | Percentage of Remaining 75% | Total of Percentages |
|---|---|---|---|---|
| **Las Gallinas Valley Sanitary District** | 3.57% | $1,222,473 | 3.67% | 7.24% |
| **Novato Sanitary District** | 3.57% | $1,679,893 | 5.04% | 8.61% |
| **North Marin Water District** | 3.57% | 4,689,504 | 14.07% | 17.64% |
| **Sonoma Valley County Sanitation District** | 3.57% | $7,967,134 | 23.90% | 27.47% |
| **Sonoma County Water Agency** | 3.57% | $0.00 | 0.00% | 3.57% |
| **Napa Sanitation District** | 3.57% | $9,440,996 | 28.32% | 31.89% |
| **Napa County** | 3.57% | $0.00 | 0.00% | 3.57% |
| **Marin Municipal Water District** | 0.00% | $0.00 | 0.00% | 0.00% |
| **City of Petaluma** | 0.00% | $0.00 | 0.00% | 0.00% |
| **TOTALS** | 25.00% | $25,000,000 | 75.00% | 100.00% |

Notes:

1. Percentages may be revised pursuant to the provisions of this MOU based on adding additional signatory members, revisions to the projects in Phase 1, or continuation beyond Phase 1, subject to the approval of the parties.
2. The above schedule only includes costs and percentages related to Phase 1. Should member agencies choose to implement Phase 2 projects this schedule will be modified or a new schedule will be developed to detail cost sharing for Phase 2.

# Exhibit C

## Percentages for Distribution of Phase 1 Federal Funds Received

| Agency | Federal Authorization, Phase 1 | Percentage |
|---|---|---|
| **Las Gallinas Valley Sanitary District** | $1,222,473 | 4.89% |
| **Novato Sanitary District** | $1,689,893 | 6.72% |
| **North Marin Water District** | $4,689,504 | 18.76% |
| **Sonoma Valley County Sanitation District** | $7,967,134 | 31.87% |
| **Sonoma County Water Agency** | $0.00 | 0.00% |
| **Napa Sanitation District** | $9,440,996 | 37.76% |
| **Napa County** | $0.00 | 0.00% |
| **Marin Municipal Water District** | $0.00 | 0.00% |
| **City of Petaluma** | $0.00 | 0.00% |
| **TOTALS** | $25,000,000 | 100.00% |

Notes:

1. Percentages may be revised pursuant to the provisions of this MOU based on adding additional signatory members, revisions to the projects in Phase 1, or continuation beyond Phase 1, subject to the approval of the parties.
2. The above schedule only includes costs and percentages related to Phase 1. Should member agencies choose to implement Phase 2 projects this schedule will be modified or a new schedule will be developed to detail cost sharing for Phase 2.

Brown AND Caldwell

In Association with

BRYANT & ASSOCIATES | Kennedy/Jenks Consultants | GTC | ESA | Data instincts Public Outreach Consultants

Walnut Creek

201 North Civic Drive, Suite 300
Walnut Creek, CA 94596
Tel: 925.937.9010