Executive Summary

ES-1 Introduction

As the Santa Clara Valley Water District (District) entered the fourth year of a five-year drought in 2015, with ongoing concern over ground level subsidence due to dropping groundwater basin levels and its potential impacts, the District Board of Directors charged staff with evaluating the feasibility of developing up to 45,000 acre-feet per year (AFY) of potable reuse via advanced purification of treated wastewater. Subsequently, an initial goal of this Expedited Purified Water Program (Program) of 24,000 AFY was identified to complement other elements in the District's water resource portfolio to meet projected demands through 2040.

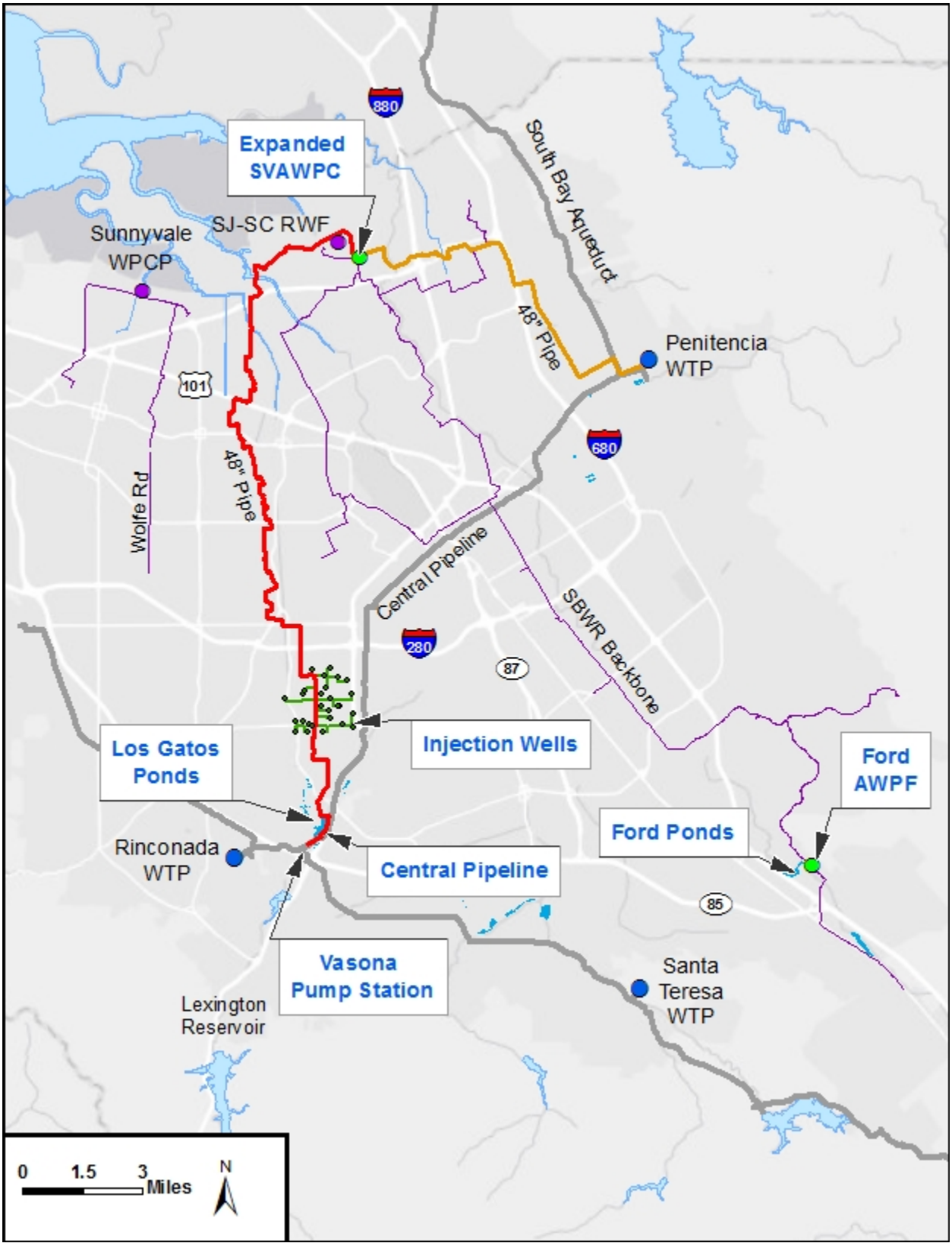
This Program Plan (Plan) summarizes the preliminary engineering conducted to determine the specific projects and associated costs to meet this initial goal. This Plan focuses on projects that could be sourced by the San Jose-Santa Clara Regional Wastewater Facility (RWF).

Separate from the work conducted for this Plan, a Countywide Water Reuse Master Plan will incorporate the results of this Plan as well as the other potable reuse initiatives. The Countywide Water Reuse Master Plan will comprehensively examine the potential scale of potable reuse development in light of updated trends in non-potable recycled water use in the County as well as desired discharges of treated wastewater to the Bay.

ES-1.1 Potential Program Components

The 2014 *South Bay Water Recycling (SBWR) Strategic and Master Planning Report* (2014 SBWR Strategic Plan) (City of San Jose in partnership with the District) identified various components to achieve up to 45,000 AFY of reuse. Those components consisted of various advanced water purification facilities (AWPF), delivery points (the location or facility that would receive purified water and provide the interface with groundwater or surface water), and purified water conveyance facilities (pump stations and pipelines) linking the two. Figure ES-1 illustrates the array of potential components that were considered for this Program.

Figure ES-1: Potential Program Components



The delivery point receiving the purified water dictates the type of potable reuse and, accordingly, the regulatory framework by which a project would be approved. Table ES-1 below summarizes the type of potable reuse and status of associated regulations for each of the potential delivery point being considered in this Program.

Table ES-1: Types of Potable Reuse Under Consideration

Potential Delivery Point	Type of Potable Reuse	Status of Regulations
Los Gatos Ponds	Indirect Potable Reuse (IPR)– Groundwater Recharge via Surface Spreading	Promulgated in 2014
Injection Wells	Indirect Potable Reuse (DPR)– Groundwater Recharge via Subsurface Injection	Promulgated in 2014
South Bay Aqueduct or Central Pipeline	Direct Potable Reuse – Raw Surface Water Augmentation	No regulations yet in place; Department of Drinking Water (DDW) Report to Legislature in 2016 noted that establishing direct potable reuse regulations is feasible.[1]
Ford Pond	Indirect Potable Reuse – Groundwater Recharge via Surface Spreading	Promulgated in 2014

[1]AB574, signed into law on 10/2/2017, sets a 2023 deadline for development of regulations for "raw water augmentation."

It should be noted that potable reuse strategies lacking established regulations are not prohibited. DDW has the authority to permit potable reuse projects on a case by case basis, similar to DDW permitting of several IPR projects in southern California prior to formal adoption of groundwater recharge regulations.

ES-1.2 Program Planning Activities

The planning phase of the Program was comprised of several initiatives; the key initiatives included:

- Water Supply Modeling Study
- Groundwater Study
- Preliminary Engineering Services

Water Supply Modeling Study – A Water Supply Modeling Study was prepared as part of the Program to identify and assess the yields of various purified water alternatives as they added to the District's water supply mix. With the aid of Maine Technology, District staff updated the District's Water Evaluation and Planning (WEAP) model and used the updated model to simulate how various potable reuse scenarios would fit into the District's portfolio of water supplies, providing guidance in the refinement of alternatives in terms of both facility capacities and operating strategies. Based on this modeling, 2040 projected demands, and the District's 2012 Water Supply and Infrastructure Master Plan, an initial target of 24,000 AFY was established for this Program.

Groundwater Modeling - Since introduction of purified water into a groundwater basin via either percolation ponds or injection wells is the most common means of potable reuse, refinement of the District's MODFLOW groundwater flow model for the northern Santa Clara Subbasin was

critical to the assessment of that category of options. District staff, with support from Todd Groundwater, incorporated results of the WEAP model into the groundwater model as multiple potable reuse scenarios were crafted and evaluated. Results were evaluated in terms of groundwater levels and subsurface travel time to assess both operational and regulatory viability.

Preliminary Engineering Services – Preliminary engineering services, including technical assessments and facilities planning of alternative advanced water purification systems, purified water conveyance systems, and delivery points were performed by RMC/Woodard & Curran. The progression of technical assessment and facilities planning provided the level of detail necessary to evaluate the operational needs; capital and operations and maintenance costs; and benefits of potential purified water components and alternatives.

ES-1.3 Key Assumptions and Decisions

During preliminary planning, certain key assumptions and decisions were made to support the ongoing development of this Plan.

Program yield could be sustainably sourced by the RWF. Starting with the 2014 SBWR Strategic Plan and during this planning effort, it was recognized that reducing the RWF effluent discharge to Artesian Slough could have water quality implications on the Slough and South San Francisco Bay. It is assumed, pending further study, that the maximum amount of RWF effluent diverted to support this initial 24,000 AFY phase would not negatively impact the salt marsh and Bay environment. District staff are currently engaging with the City of San Jose regarding source water availability.

Reverse osmosis and advanced oxidation to be used for all IPR options. Alternative, non-RO water purification strategies were considered during the technical assessment phase (based on limited information available) for groundwater recharge via surface spreading options. It is recognized that such options offer a supplemental treatment component (commonly referred to as soil-aquifer treatment or SAT). Regulatory restrictions may limit a project's "yield" for certain water purification strategies, and the District's policy (E 2.1.1.) is to "aggressively protect groundwater from the threat of contamination." Thus, reverse osmosis and advanced oxidation treatment was assumed for all IPR projects. Reverse osmosis and advanced oxidation are explicitly specified in state regulations and incorporated by most potable reuse projects throughout California (including Orange County Water District's Groundwater Replenishment System). As discussed later in this Plan, advanced water purification and monitoring enhancements are included in the DPR facility component.

Existing RWF Outfall and NPDES permit could accommodate reverse osmosis (RO) concentrate. A technical assessment was conducted to evaluate the potential for discharging RO concentrate from expanded advanced water purification facilities to the RWF outfall. Preliminary results suggested that RO concentrate from the initial 24,000 AFY phase would not implicate either the operation of the outfall or the RWF's NPDES permit for priority pollutants. Accordingly, it was assumed for this Plan, pending further study of chronic toxicity, that all RO concentrate would be discharged to the RWF Outfall. This issue is being more fully vetted in the District's RO Concentrate Management Plan, which is anticipated to be complete in 2018.

ES-2 Alternatives Development

A three-step process was used to identify and develop alternatives to achieve the goals of the Program. First, potential program components (AWPF, conveyance alignments, and delivery point improvements) were refined through a series of technical assessments and bundled into

potential project components. Table ES-2 presents potential program components evaluated during Program planning.

Table ES-2: Source and Delivery Points Summary[1]

Facility	Production Capacity	Delivery Points	Delivery Point Capacity[2]
Expanded Silicon Valley Advanced Water Purification Center (SVAWPC)	24,000 AFY	Los Gatos Ponds	19,200 AFY
		Injection Wells	12,000 AFY
		South Bay Aqueduct near Penitencia WTP	19,200 AFY
Ford Advanced Water Purification Facility (AWPF)	4,200 AFY	Ford Pond	3,400 AFY

[1]Expanded SVAWPC would receive treated wastewater from the RWF; Ford AWPF would receive non-potable source water via the SBWR system.
[2]Delivery point capacity based on average annual utilization of 80 percent.

Second, facility plans were prepared for each potential project component, providing Class 4 cost estimates and operational parameters that would carry into the evaluation process. In addition to cost estimates, potential project components were evaluated based on implementability and operational flexibility. Implementability considerations included ease of Regional Water Quality Control Board approval, DDW approval, and institutional arrangements. Operational flexibility considerations included compatibility with existing operations and maintenance, expandability, and delivery point "turn down" capability.

Third, through this screening process, and with the ongoing aid of the District's WEAP model, project components were refined, and in some cases combined, to create a set of alternatives that could achieve the Program's 24,000 AFY initial target. Potential alternatives combining the Ford Pond delivery point and a reduced Los Gatos Ponds yield were evaluated. WEAP modeling indicated that any potential yield increase did not justify the additional cost of these merged facilities, eliminating Ford Pond delivery point from further consideration for the initial phase. Table ES-3 presents the resulting 24,000 AFY alternatives.

Table ES-3: 24,000 AFY[1] Alternatives

Description	Alternative 1 IPR[2] to Los Gatos Ponds	Alternative 2 IPR to Los Gatos Ponds and Injection Wells[3]	Alternative 3 DPR[2] RWA[2] to South Bay Aqueduct[4]
SVAWPC Expansion Capacity acre feet per year (AFY)	24,000	24,000	24,000
Conveyance Pipeline Length	18 miles	18 miles	9 miles
Number of Injection Wells	-	6	-
Operational Storage	-	-	6 MG

[1]Maximum project production based on dry year scenario.
[2]IPR – Indirect Potable Reuse; DPR – Direct Potable Reuse; RWA – Raw Water Augmentation
[3] In addition to the conveyance pipeline, Alternative 2 includes lateral pipelines from the conveyance pipeline to each injection well.

[4] In addition to the conveyance pipeline, Alternative 3 includes pipelines in proximity to the Penitencia Water Treatment Plant to convey the purified water to the new tank and to the water treatment plant.

Alternative 1 – IPR to Los Gatos Ponds

Alternative 1, shown in Figure ES-2, would deliver purified water produced by a 24,000 AFY expanded SVAWPC, conveyed through an approximately 18-mile, 48-inch pipeline to a system of feeder pipelines to Los Gatos Ponds. Delivery of purified water would be managed (scaled back in wet winter months) to allow Los Gatos ponds to continue to receive diversions from Los Gatos Creek and releases from Lexington Reservoir as a means of maintaining and using existing water rights.

Alternative 2 – IPR to Injection Wells and Los Gatos Ponds

Alternative 2, shown in Figure ES-3, would construct six injection wells to enhance the District's groundwater recharge capacity and increase flexibility to receive purified water flows. The injection wells would be located along the Los Gatos pipeline corridor to minimize infrastructure needs. This alternative would have the same water purification and conveyance infrastructure as Alternative 1 – IPR to Los Gatos Ponds, with added distribution piping to the wells.

Alternative 3 – Direct Potable Reuse to South Bay Aqueduct

Alternative 3, shown in Figure ES-4, would introduce purified water directly into the District's raw water supply system. Unlike IPR projects that deliver purified water to a natural environment (groundwater basin or large surface water body), DPR delivers purified water directly to the raw surface water infrastructure. Alternative 3 would construct an enhanced (supplemental water purification and monitoring), expanded SVAWPC. Purified water would be conveyed via a 9-mile pipeline to the Penitencia Water Treatment Plant (PWTP) site, where purified water would be blended with South Bay Aqueduct (SBA) water in the existing SBA terminal tank prior to delivery to the Penitencia Water Treatment Plant (PWTP) and the Central Pipeline, which serves Los Gatos Ponds and the Rinconada Water Treatment Plant (RWTP). In addition to enhanced advanced purification and monitoring, two 3-million gallon (MG) storage tanks, one at the expanded SVAWPC and the other at the PWTP, would be constructed as part of this alternative to support regulatory requirements and operational flexibility.

Figure ES-2: IPR to Los Gatos Ponds

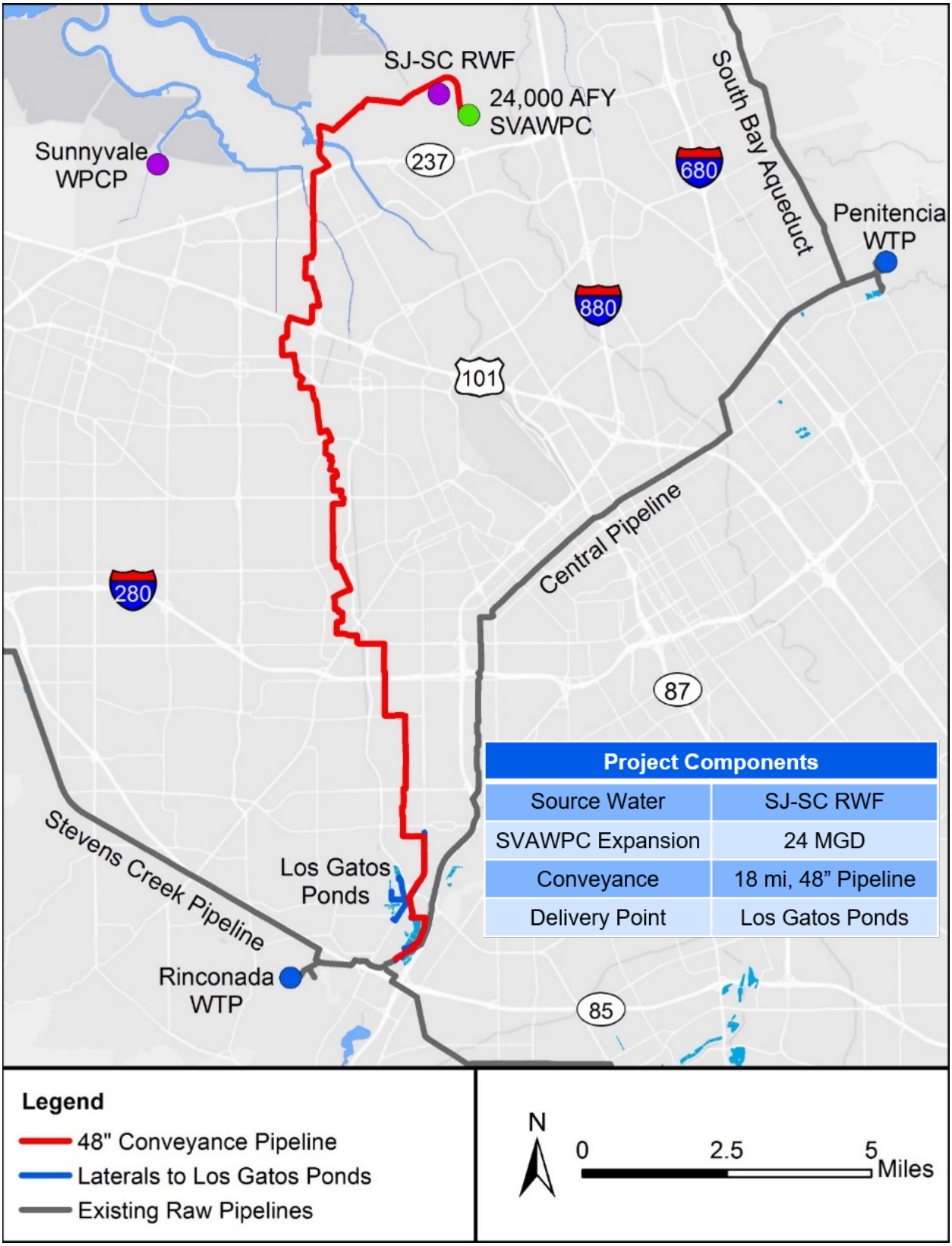


Figure ES-3: IPR to Injection Wells and Los Gatos Ponds

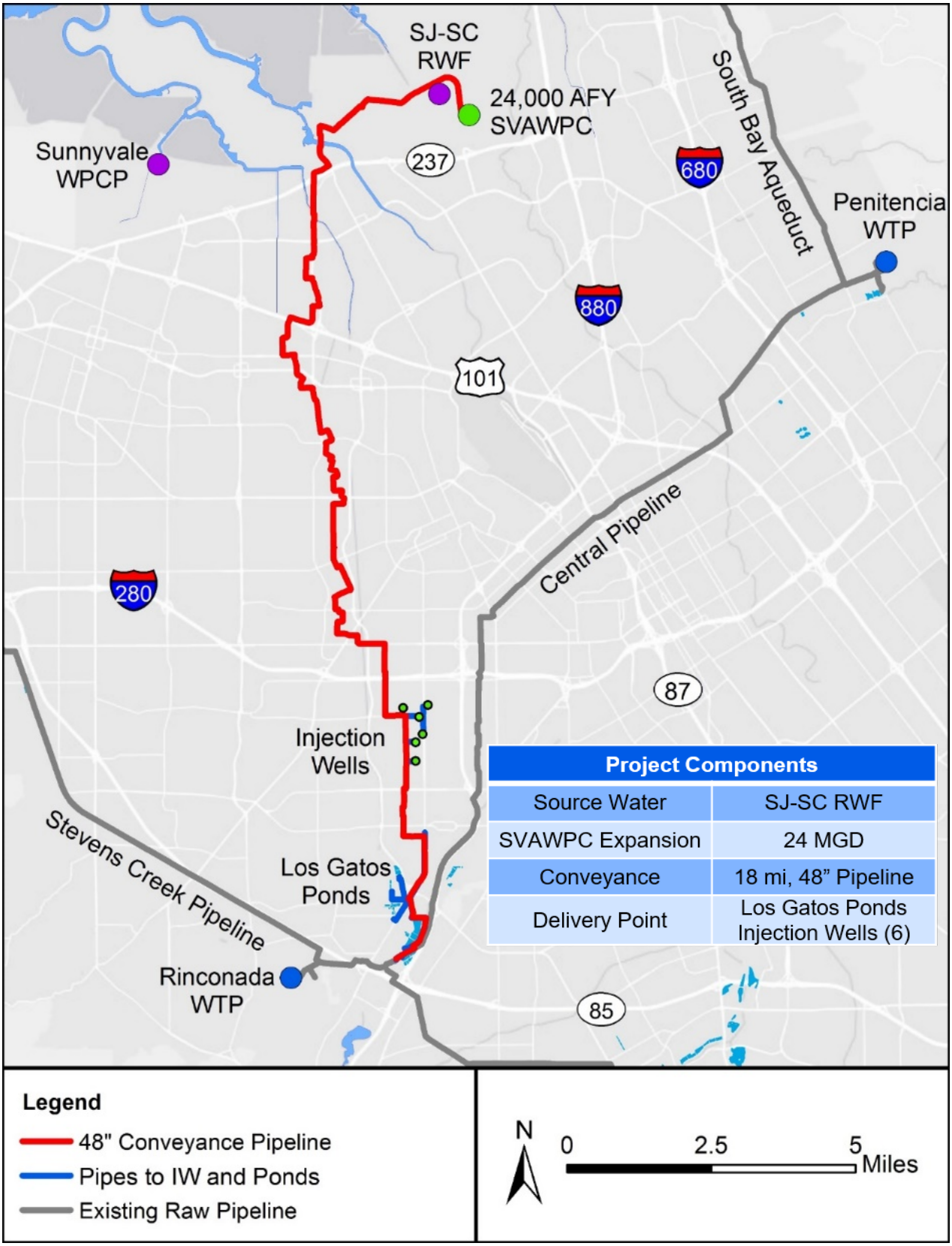
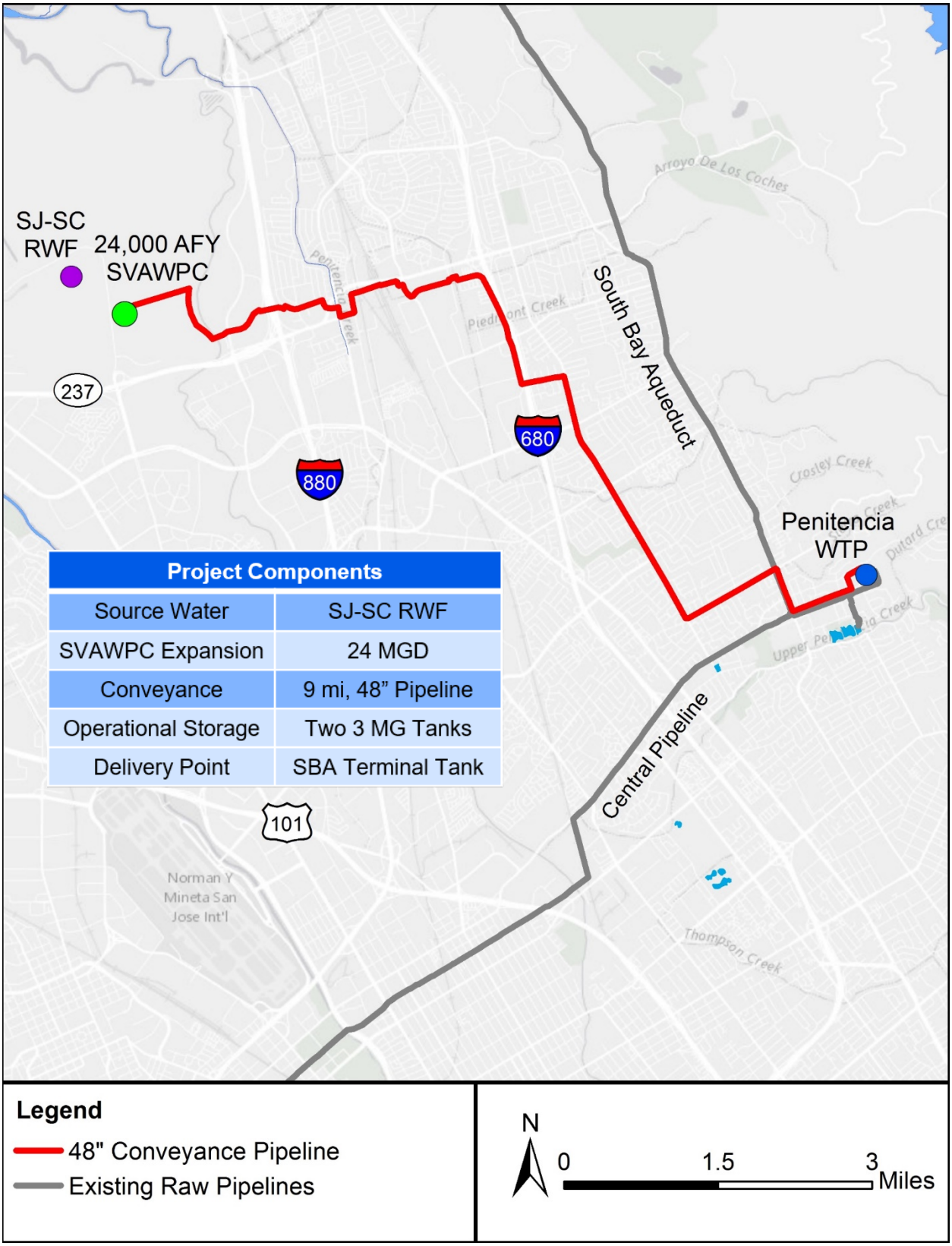


Figure ES-4: DPR to South Bay Aqueduct (Raw Water System)



ES-3 Alternatives Comparison

A comparison of the three viable alternatives was conducted based on four key parameters; project life-cycle unit cost, expandability, regulatory certainty, and implementation timeline. Table ES-5 presents the results of this comparison.

Table ES-5: 24,000 AFY Alternative Comparison (August 2017 Value)

Category	Alternative 1 – IPR to Los Gatos Ponds	Alternative 2 – IPR to Injection Wells and Los Gatos Ponds	Alternative 3 – DPR to South Bay Aqueduct
Total Capital Cost ($M)	$648	$692	$596
Annual O&M Cost[1] ($M/yr)	$12	$12	$14
Annual R&R Cost[2] ($M/yr)	$13	$15	$12
Unit Cost[3] ($/AF)	$2,000	$2,200	$2,000
Expandability	High expandability with options including injection wells and DPR to either Central Pipeline or Vasona Pump Station (feed to RWTP)		Limited expandability due to need for blending with surface water and capacity of Central Pipeline, plus once mixed with raw water it cannot be used for injection wells
Regulatory Certainty	Regulations in place.		Regulations not in place; additional research required.
Implementation Timeline	Timeline well established due to established regulations and no need for additional research and demonstration.		Timeline uncertain due to lack of established regulations and potential need for additional research and demonstration.

[1]Based on the assumption that facilities operate at 80% capacity.
[2] Refurbishment and replacement (R&R) costs reflect a constant, annualized cost based on 100-year life cycle analysis
[3]Unit cost represents 100-yr lifecycle present value divided by project yield present value. Lifecycle present value includes initial Capital costs, annual operations and maintenance costs, and anticipated R&R costs. Unit costs are based on an assumed average annual yield of 80% of the 24,000 AFY capacity.

Alternative 3 – DPR to South Bay Aqueduct has a lower total capital cost but higher total annual costs than Alternative 1 – IPR to Los Gatos Ponds. This combination results in nearly equal unit costs between these two alternatives. Alternative 2 – IPR to Injection Wells and Los Gatos Ponds has higher capital costs than either of the other alternatives and an associated higher unit cost.

Alternatives 1 and 2 would support expandability, as both include a pipeline that could readily serve new or additional injection wells, or be extended to intertie with the District's Central Pipeline or the Vasona Pump Station. An intertie with the Vasona Pump Station would add a future DPR component to the Program.

Both IPR Alternatives (Alternatives 1 and 2) provide equivalent regulatory certainty, as the regulation for this type of potable reuse is in place. Regulations for Alternative 3 - DPR have not been established, and there is a potential that additional, unforeseen requirements could impact the cost analysis developed to date for this alternative.

Finally, the implementation timeline for Alternative 3 is less certain, due to lack of regulation and potential need for supplemental research and demonstration.

ES-4 Recommendations

Based on the multi-stage analysis conducted during Program planning, **Alternative 1 – Los Gatos Ponds IPR** has been identified as the recommended alternative to supplement the District's water supply with up to 24,000 AFY of purified water. Table ES-6 summarizes the reasons for this recommendation.

Table ES-6: Recommended Alternative for Purified Water Program Initial Target of 24,000 AFY

Parameter	Alternative 1 – IPR to Los Gatos Ponds Features
Unit Cost ($/AF)	Among the lowest unit cost of alternatives evaluated.
Expandability	High expandability potential, with future delivery points at injection wells (IPR); and to either Central Pipeline or Vasona Pump Station (feed to RWTP) (DPR).
Regulatory Certainty	Regulations in place and several similar projects in operation.
Implementation Timeline	Timeline well established due to established regulations and no need for additional research and demonstration.

In addition to this recommendation for a 24,000 AFY project, the Program planning effort has identified a variety of potential options and delivery points to expand the Program in the future. Table ES-7 summarizes future expansion options for the Program.

Table ES-7: Future Expansion Options

Source	Conveyance	Potential Delivery Points
Expanded SVAWPC	Pipeline to Los Gatos Ponds (built as part of 24,000 AFY project)	Injection Wells (IPR)
		Connection to Central Pipeline (DPR)
		Vasona Pump Station (to Rinconada WTP) (DPR)
Ford AWPF (sourced by SBWR)	Ford Pond Pipeline	Ford Pond(s) (IPR)

The future expansion options should be considered as part of the District's Countywide Water Reuse Master Plan that is currently underway. This plan will include Sunnyvale and Palo Alto / Mountain View recycled and purified water options that function independently or interconnect with the expanded SVAWPC.

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