Business Plan for Phase 3 Expansion Project

Northwest County Recycled Water Strategic Plan

Final Report

Prepared by:

National Experience. Local Focus.

July 2018

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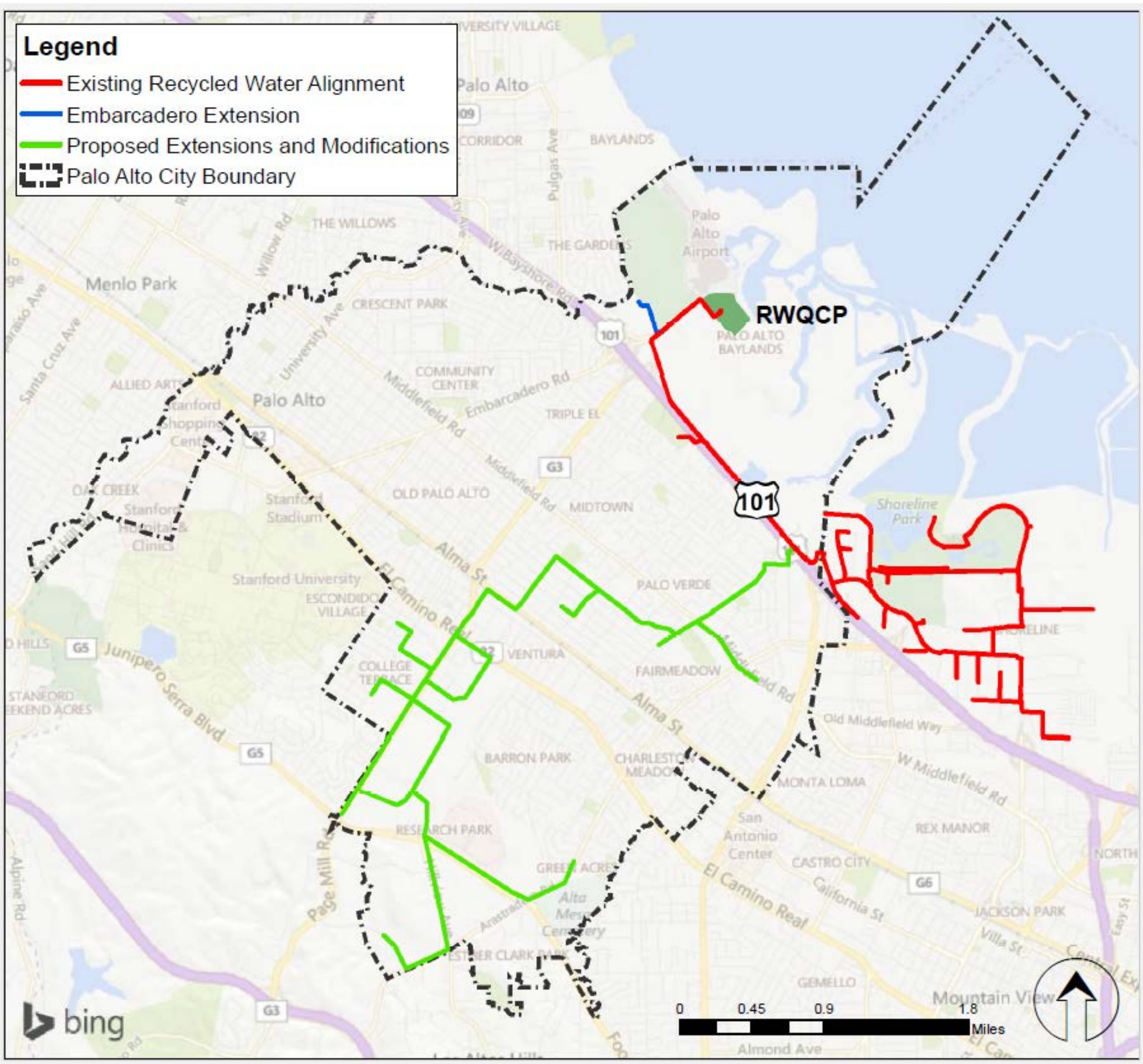
List of Abbreviations

AF	Acre-foot
ccf	100 (centum) cubic feet
CPA	City of Palo Alto
DPR	Direct Potable Reuse
gpd	gallons per day
gpm	gallons per minute
HP	Horsepower
IPR	Indirect Potable Reuse
kwh	kilowatt hours
mgd	million gallons per day
RW	Recycled Water
RWQCP	Regional Water Quality Control Plant
SCVWD	Santa Clara Valley Water District
SFPUC	San Francisco Public Utilities Commission

Executive Summary

The purpose of this Business Plan is to evaluate the economic feasibility of constructing and operating the City of Palo Alto's (CPA's) Phase 3 Expansion Project to extend recycled water service from the Regional Water Quality Control Plant (RWQCP) to the Stanford Research Park in the southwest area of the City (see Figure ES-1). At full build-out, demand for recycled water in the proposed service area is projected to be greater than 900 acre-feet per year (AFY). If the project is implemented, recycled water will be utilized primarily for landscape irrigation, but also for dual plumbing and cooling towers at several sites. Recycled water will replace groundwater being used at one location and potable water being used at over 100 other locations.

Figure ES - 1: Overview of Phase 3 Expansion Project



It is assumed in this Business Plan that the project will be economically feasible if the total monetized value of benefits exceeds the total cost to construct and operate the Phase 3 system at full build-out. As described in Chapter 1, there are several major questions answered in this Business Plan about the Phase 3

Expansion Project. The three most critical questions relate to economic feasibility, potential risks and mitigation strategies:

- **Economic Feasibility:** What conditions are required for the total value of benefits to exceed the total costs of the project?
- **Risk Assessment:** What are the probabilities that changed conditions will cause total costs to exceed the value of benefits, thus negating economic feasibility?
- **Mitigation Strategies:** What mitigation strategies could be employed to improve project feasibility or re-purpose Phase 3 facilities if changed conditions negate economic feasibility?

Economic Feasibility

The separate components that make up the comparison of costs versus benefits conducted in this Business Plan are shown in Figure ES-2. Indirect costs (e.g. impacts to businesses during construction) and indirect benefits (e.g. increase in construction jobs during construction) are not shown. The total net present values (NPVs) of costs and benefits were estimated for varying demand and external funding scenarios to determine the conditions necessary for economic feasibility.

Figure ES - 2: Cost and Benefit Components

Costs	Benefits
• Construction Costs • Other Capital Costs • Energy Costs • Other O&M Costs • Loss of Potable Water Revenue	• External Funding • Avoided Cost of Wastewater Discharges • Recycled Water Revenue • Avoided Cost of Water Purchases • System Reliability Enhancement

As developed in the preliminary design, the cost to construct the Phase 3 Expansion Project is estimated to be $36.8 Million (in 2020 dollars). Other capital costs include engineering design, construction management, legal and administrative costs. The energy cost is for operation of the recycled water pump station at the RWQCP and a booster pump station in the distribution system. Other operation and maintenance (O&M) costs include staffing and equipment required to operate and maintain the pump stations and pipelines. Potable water will be replaced by recycled water at over 100 locations and, therefore, the CPA will not receive revenue from the sale of over 750 AFY. The decrease in potable water revenue is accounted for in the total costs.

The expected benefits of project implementation are indicated in the figure. External funding includes State and Federal grants or low interest loans. The avoided cost of wastewater discharges reflects the reduced need for RWQCP nutrient removal if such treatment is required for discharge to the Bay in the future. Discharge regulations are expected to become more stringent. The CPA will lose potable water revenue but will collect recycled water revenue. Another benefit of the project will be the reduction in water purchased from SFPUC for potable water distribution (i.e. the 750 AFY referred to previously).

During droughts, the City's existing water sources may offer reduced supplies, requiring conservation by potable water customers. Because a recycled water system expansion would reduce demand for potable water on a consistent basis (including during drought years), the expansion "frees up" potable water supplies for use by water customers for whom recycled water is not available. This improves the reliability of the potable water supply, reducing the need for conservation measures. This benefit is referred to as Potable Reliability Enhancement. For purposes of this Plan, the cost of providing the Potable Reliability Enhancement Benefit is assumed to equal the difference between the quantified costs and benefits of the project. Furthermore, it is assumed that the full amount of these costs will be collectable from potable customers as an actual expense to CPAU of enhancing potable supply reliability. A separate cost of service study will be necessary to determine the amount of project costs to be allocated system-wide, and the resulting recycled water rate.

In addition to the benefits related to increased revenue and savings that are quantified in this report, implementation of the Phase 3 Expansion Project will result in a number of other system-wide benefits. First, there is an environmental benefit from reducing dependence on the Tuolumne River, the source for SFPUC Regional Water System (RWS) water supply. Second, because recycled water is a locally-controlled drought-proof supply, Mitchell Park and the Cubberley Community Center will be able to maintain playing fields and other outdoor public spaces during a water shortage, benefitting all Palo Alto residents. Even landscaped areas and trees owned by commercial customers, when kept green and lush during a water supply shortage, provide aesthetic and environmental benefits to the whole community.

As explained in the Risk Assessment discussion, values of some of the cost and benefit components are proportional to the actual amount of recycled water utilized from year to year. Other factors that significantly affect the value of benefits are the level of external funding and the rate customers will be charged for recycled water. Assuming an annual average recycled water demand of 924 AFY and total construction costs of $36.8 M (2020$), the total estimated NPV for all the cost components is $159.8 M (2020$).

There is a cemetery at the terminus of the proposed pipeline that currently does not purchase its irrigation water from CPA, but instead relies on the pumping of groundwater. This customer therefore pays the Santa Clara Valley Water District's (District) groundwater production charge instead of CPAs potable water charge. Unless recycled water rates are kept no higher than approximately 60% of potable rates, it may be difficult to serve this customer in a way that will be cost effective for the customer. Therefore, while this customer is included in the main analysis of this report, the report also includes information about what might occur if the customer were not served.

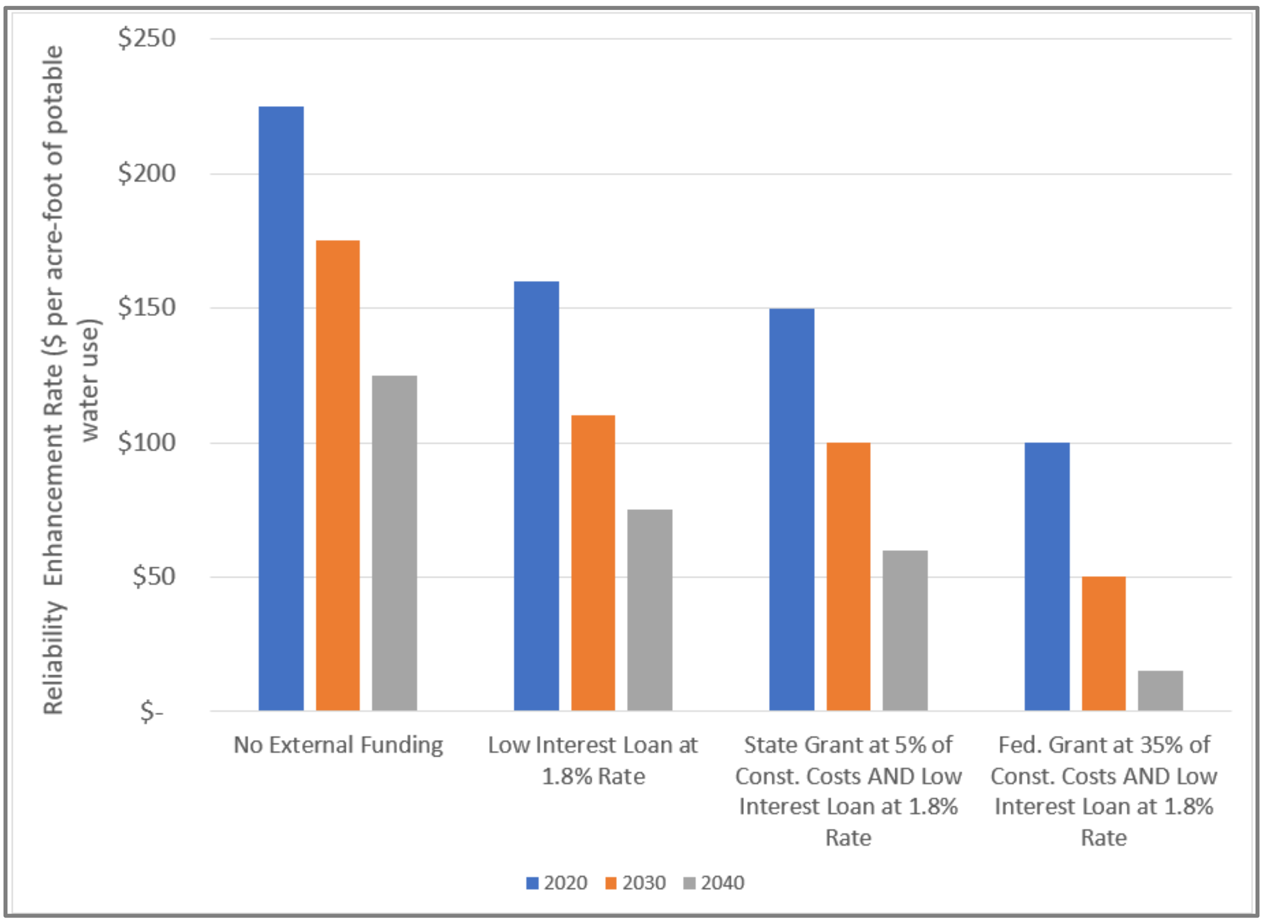
Because the cemetery is located at the end of the Phase 3 project, a scenario excluding that customer, as well as some smaller CPA customers nearby, was evaluated. That scenario assumed lower capital costs for a shorter pipeline. For the scaled-down project, a recycled water rate that is 95 percent of CPA's potable water rate would result in reliability rate of zero. For the scaled-back project, any recycled water rate greater than 70 percent of the potable water rate yields more favorable economic feasibility than the full Phase 3 Expansion Project. The preliminary rates analysis completed to date was cursory and did not include a full cost of service study. A robust study, recommended in this report, may result in a different rate design, and therefore economic feasibility of Phase 3.

The Recycled Water Strategic Plan will compare the full Phase 3 Expansion Project to other potential water reuse alternatives. Proceeding with a scaled-down Phase 3 project needs to be weighed against the potential benefits the full project facilities may provide in the future.

Risk Assessment

A risk assessment model was developed to analyze the probabilities that Phase 3 will be economically feasible for varying conditions including recycled water demand, construction costs, and assumptions related to discrete events like the external funding. Under this model, the recycled water rate is fixed at 60 percent of CPA's potable rates to match groundwater production charges. The model utilized Monte Carlo simulations to define trends and predictions for annual costs and benefits at different time steps. The results of risk assessment modeling are summarized in Figure ES-3. The reliability rate is displayed on the vertical axis. This represents the rate that would be charged to the potable water customers in addition to the base potable water rate, to fund the increased reliability of diversifying CPA's water supplies with a local drought-proof water supply. This analysis considers the potable reliability enhancement cost separately from the potable water rates. In reality, we anticipate that the cost would be charged to potable water users. A potable reliability enhancement rate of $150 per AF of potable water is consistent with the expectation that a low interest loan is likely. $150 per AF ($0.34 per ccf) is approximately a 3-4 percent increase on a typical residential bill in 2018. The analysis shows the project is economically feasible with no grants or loans if a potable reliability enhancement rate, or "reliability rate", of about $225 per AF ($0.52 per ccf) in the early years of the project is acceptable. The potable reliability enhancement rate decreases over time because the CPA potable water rate to SFPUC wholesale water rate ratio decreases.

Figure ES - 3: Reliability Enhancement Rate Over Time Given Funding Scenarios



Mitigation Strategies

The results of the risk assessment modeling indicate Phase 3 will be economically feasible for several scenarios where external funding is received. However, if continued operation of the recycled water project becomes infeasible, there are three mitigation strategies within the control of the CPA.

The first strategy is to raise the recycled water rate if supported by a cost of service study.

The second mitigation strategy is to further expand the use of non-potable water beyond Phase 3. Depending on construction challenges, a high throughput may yield lower costs system-wide. The Recycled Water Strategic Plan includes high-level feasibility studies for several scenarios that expand the distribution system beyond Palo Alto's service territory including Los Altos, Mountain View, and East Palo Alto. Stanford University may have some limited demand for non-potable water in the future as well.

The third mitigation strategy is to re-purpose the Phase 3 facilities. For example, an alternative use for Phase 3 facilities could be transport of advanced treated recycled water to groundwater recharge locations in an indirect potable reuse (IPR) project. This concept will be studied in the IPR Feasibility Study and Recycled Water Strategic Plan (both currently underway, July 2018).

Recommendations

Based upon the work conducted in this Business Plan the following actions are recommended:

- Evaluate a scaled-down project that excludes the customer currently using groundwater taking into consideration the water reuse alternative results in the Recycled Water Strategic Plan (currently underway, April 2018).
- Conduct a rigorous cost of service study to refine the estimated recycled water revenue, and update the cost versus benefit calculation.
- Continue aggressive pursuit of external funding, including grants and low interest loans.
- Continue identification and evaluation of additional uses that might be served recycled water from the Phase 3 Expansion Project.
- Evaluate incorporation of Phase 3 facilities into a future groundwater recharge project in the Indirect Potable Reuse Feasibility Study (currently underway, July 2018).
- Evaluate incorporation of Phase 3 facilities into a future Direct Potable Reuse (DPR) facility as part of the Northwest County Recycled Water Strategic Plan (currently underway, July 2018).
- Complete the Northwest County Recycled Water Strategic Plan (currently underway, July 2018) to compare Phase 3 to other recycled water use alternatives.

Chapter 1 Background

1.1 Northwest County Recycled Water Strategic Plan

The Northwest County Recycled Water Strategic Plan Project (Project) is being undertaken by the City of Palo Alto (CPA), in collaboration with the Santa Clara Valley Water District (District), with the purpose of updating CPA's 1992 Recycled Water Master Plan, assessing the feasibility of utilizing recycled water for groundwater recharge in an indirect potable reuse (IPR) project, and ushering Phase 3 of the recycled water expansion through financial planning, preliminary design and funding, culminating in a Recycled Water Strategic Plan. Construction cost estimates for this Business Plan were developed in a 30 percent engineering design documented in the Phase 3 Preliminary Design Report.

1.2 Phase 3 Expansion Project

The proposed Phase 3 Expansion Project includes over 10 miles of transmission and distribution pipelines, two pump stations, and customer connections to deliver around 1,000 acre feet per year (AFY) of recycled water to the Stanford Research Park, in the southwest area of the CPA. The Phase 3 system would build off and connect to the Phase 2 transmission main (the Mountain View/Moffett Fields pipeline). The project was first identified in a 2008 Recycled Water Facilities Plan (RMC 2008) that was then converted to a Title XVI compliant Feasibility Study in May 2012 (Palo Alto 2012). The Program Environmental Impact Report for the Phase 3 Expansion Project facilities was certified in September 2015 (RMC 2015). The primary purpose of extending the recycled water system into CPA would be to maximize recycled water as a supplemental water supply, which would reduce reliance on imported supplies and improve water supply reliability during drought conditions.

In July 2017, CPA added an additional 800-foot segment, formerly the Embarcadero Road Extension, into the Phase 3 Expansion Project. This segment would serve auto dealerships and the Baylands Athletic Center close to the Palo Alto Regional Water Quality Control Plant (RWQCP). Figure 1-1 shows the proposed Phase 3 Expansion Project facilities including this additional segment.

Figure 1-1: Phase 3 Expansion Recycled Water Pipeline

1.3 Purpose of Business Plan

There are several key issues that must be addressed to assess the long-term feasibility of the Phase 3 Expansion Project. The general approach employed was to initiate preliminary design to the extent necessary to develop an accurate, updated cost estimate for construction and operation and, in parallel, develop this comprehensive Business Plan that assesses project feasibility for a range of possible future conditions in order to:

1) Decide whether or not to proceed with implementation of Phase 3 and;

2) Define the economic risks associated with project implementation.

The updated preliminary design cost estimate for construction was used in this Business Plan; this number will be refined as the design development continues. The approach used in this Business Plan to define the economic feasibility of implementing the Phase 3 Project and the risks associated with future changed conditions involved first monetizing the projected value of benefits, identifying the possible ranges for those values, and then comparing the benefit values with total capital and operating costs. A risk assessment model was developed to assess the probabilities of varying values occurring, which in turn predicted the probability of the net present value (NPV) of benefits being greater than the NPV of costs. Finally, mitigation strategies for maintaining economic feasibility in the future were developed.

This analysis is based on the full build-out of the Phase 3 pipeline. However, there may be viable projects that include building only a small section of the extension, such as the Embarcadero Road extension to the Baylands Athletic fields, which could be accommodated by the existing backbone pipeline and pump station or a pipeline that does not extend all the way to serve the cemetery.

Major questions addressed in this Business Plan include the following:

What are the long-term recycled water demands for potential recycled water uses in the vicinity of the Phase 3 Expansion?	Chapter 2 Recycled Water Demand Projections
What are the updated costs for construction of the Phase 3 facilities considering updated demand projections, water quality requirements and various construction challenges?	Chapter 3 Costs vs. Benefits and Preliminary Design Report
What is the economic feasibility of implementing the Phase 3 Expansion Project?	Chapter 3 Costs vs. Benefits and Chapter 4 Preliminary Rate Analysis
What are the ranges of potential costs and benefits for the Phase 3 Expansion Project, and what are the resulting impacts to the potable water customers?	Chapter 5 Risk Assessment
What are the risks to economic feasibility if changes occur related to demands, water costs, and external funding-in other words, what is the risk of the Phase 3 pipeline becoming a stranded asset?	Chapter 5 Risk Assessment
What are potential risk mitigation strategies to improve project feasibility or re-purpose Phase 3 Project facilities if future changes negate the economic feasibility of planned recycled water use?	Chapter 6 Conclusions and Recommendations

Chapter 2 Recycled Water Demand Projections

This chapter includes a summary of the updated recycled demand projections. A detailed description of the methodology and the database of projected demands listed by customer is included in Appendix A - Customer Demand Update Database.

2.1 Proposed Service Area

In updating recycled water demands for the Phase 3 expansion, customers within a quarter-mile of the pipeline alignment included in the 2008 Recycled Water Facilities Plan (Facilities Plan) and associated 2015 EIR were considered. The area reviewed is shown in Figure 2-1.

2.2 2008 Demand Estimate

The 2008 Facilities Plan included a market analysis of potential recycled water demand in the proposed Phase 3 service area. Recycled water demand estimates in the Facilities Plan were based on the 2006 *Palo Alto Recycled Water Market Survey* (Market Survey), which relied on water meter data, acreage analysis for areas without adequate water meter data, and customer surveys of users with high recycled water usage potential. The Facilities Plan refined the recycled water demand estimate from the Market Survey by using updated water use records and customer use information derived from contact with large water users. The projected potential annual recycled water demand from the target customers, shown in Figure 2-2, was estimated to be 916 AFY with 85 percent attributed to irrigation use, and 15 percent split between cooling tower demands and industrial and commercial demands.

2.3 Approach to Updating Demands

2.3.1 Data Review

Water use records for Palo Alto's non-residential customers for 2013, 2015, and 2016 were provided by CPA. These years were selected as being representative of demands prior to water use restrictions enacted because of the recent drought (2013), demands at the height of the drought caused water use restrictions (2015) and demands as drought conditions began to lift (2016).

Palo Alto provided data for two different types of meters: W4 and W7. W4 meters are non-residential meters, which may include commercial, industrial and institutional uses. W7 meters are specifically for irrigation. Some customers have both W4 and W7 meters, while others have W4 meters that serve both indoor and irrigation demands.

In addition to reviewing existing water use for customers in the service area, the Palo Alto Planning Department was consulted to identify re-development plans that could change the customer base and thereby impact future recycled water demand. Currently there are no firm plans within the study area that would change water use, and thus no adjustments to the existing use to account for land use changes were made.

Modifications to the pipeline alignment proposed in 2008 are noted in Figure 2-3.

Figure 2-1: EIR Alignment and ¼ Mile Buffer

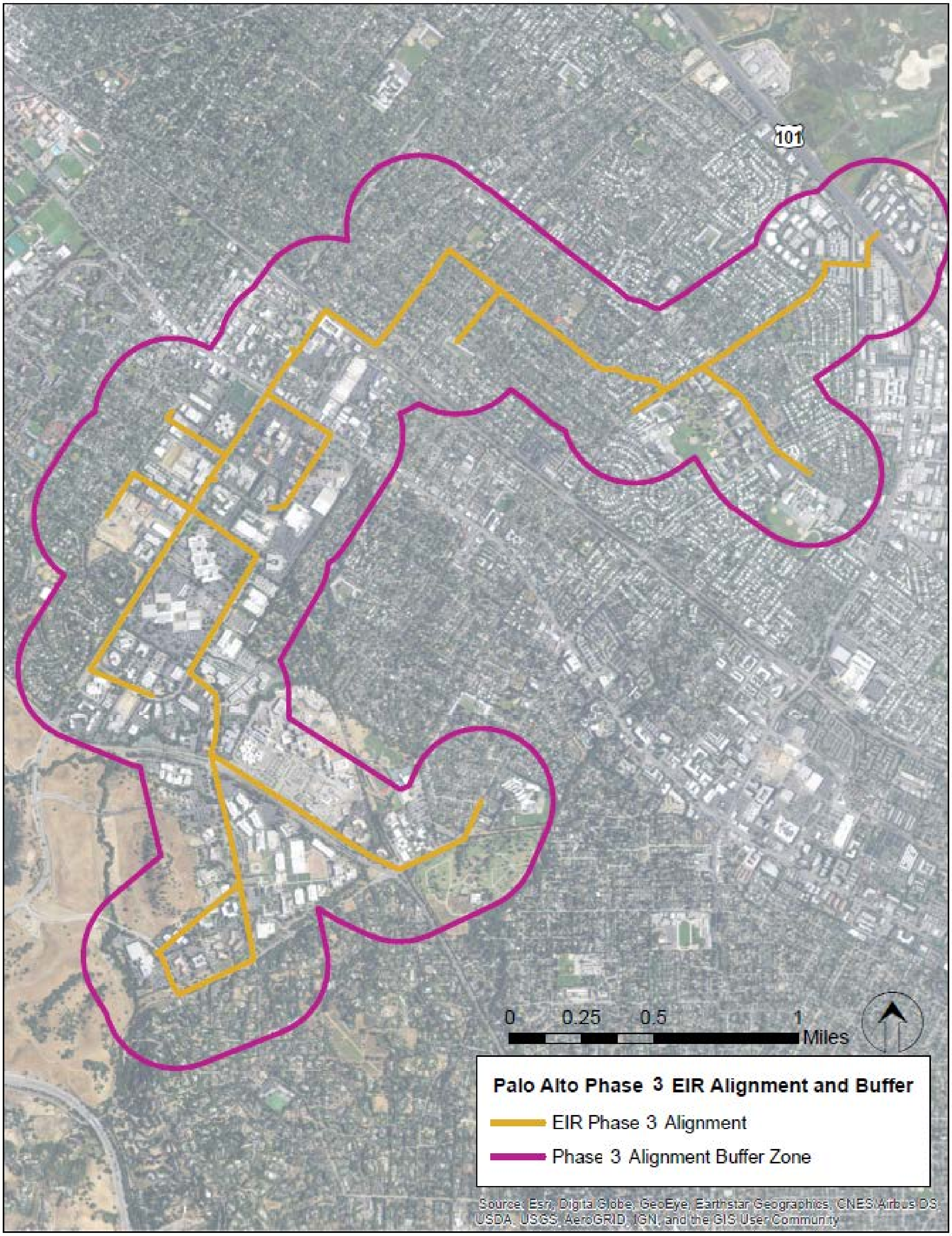
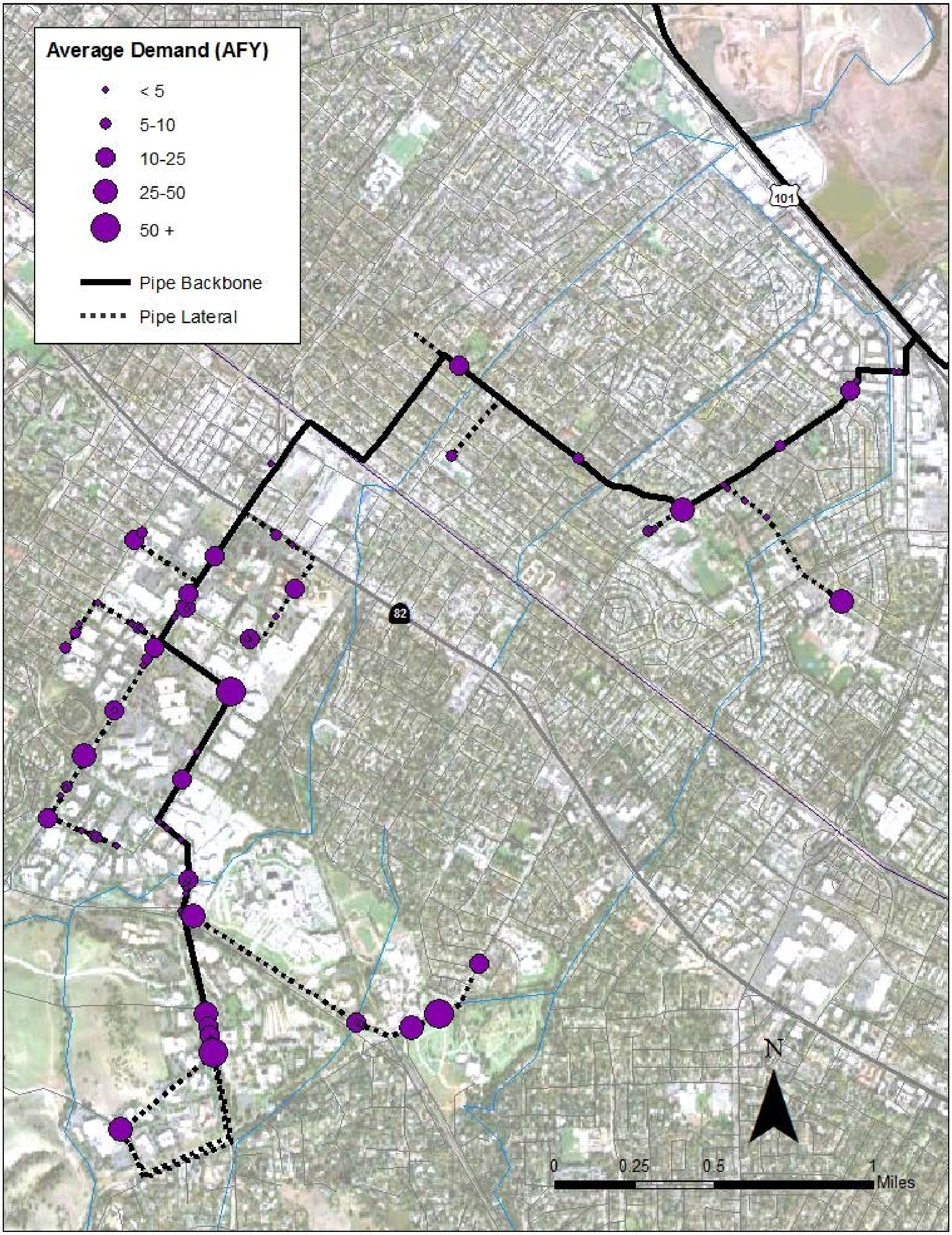
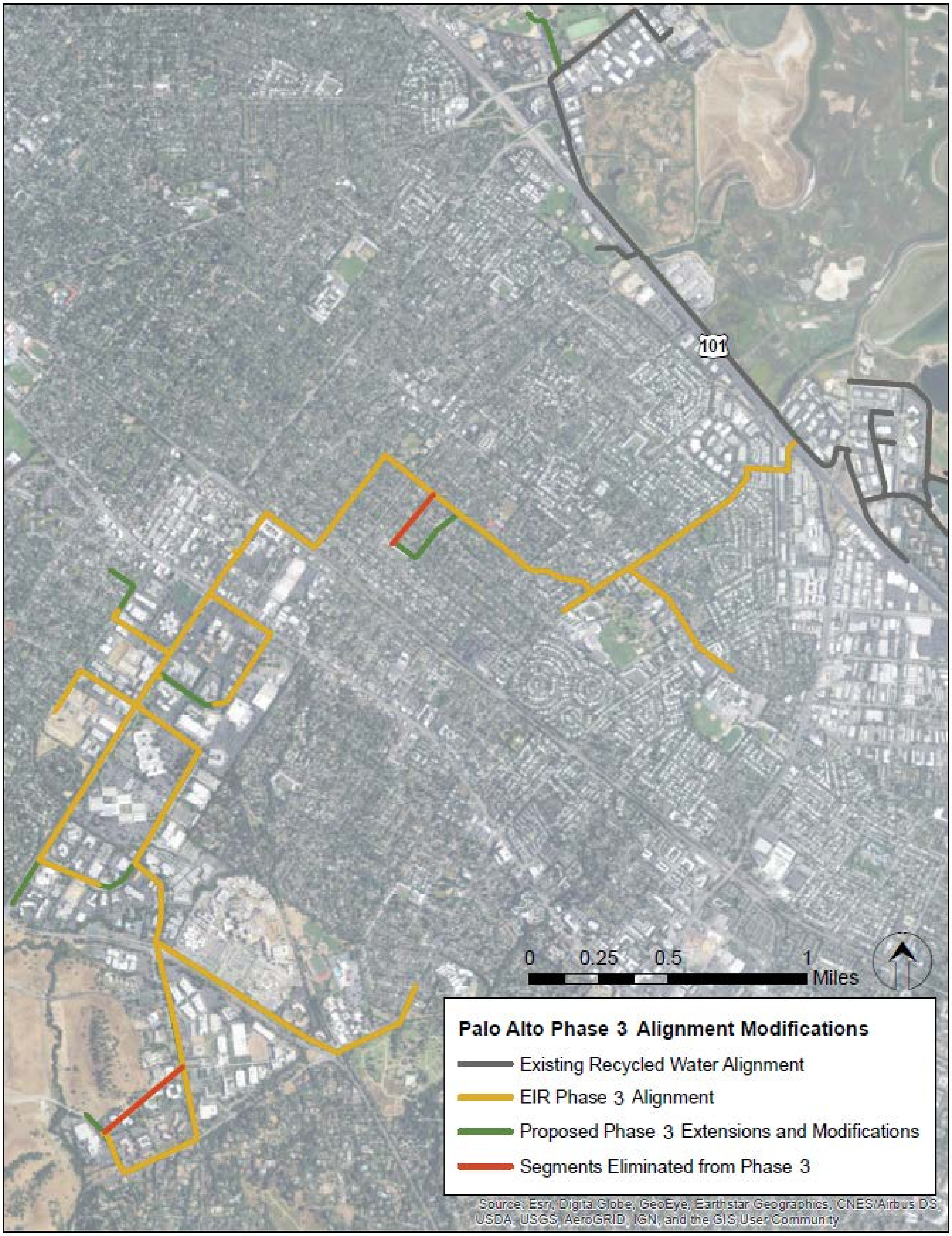


Figure 2-2: Target Recycled Water Users from 2008 Facilities Plan Recommended Project



Source: RMC, 2008.

Figure 2-3: Phase 3 Alignment Modifications



2.3.2 Demand Estimate Methodologies

The water uses that are potentially convertible to recycled water are irrigation, cooling towers, toilet flushing for dual plumbed facilities and industrial process water demands. Recycled water demand for each water use type was determined based on the customer type and meter type at that customer. Customers were broadly categorized into four types:

- General – All potentially convertible customers that did not fall into one of the categories below were considered general customers.
- Park – These customers were identified as parks through the customer name and address linked with their meter.
- School – These customers were identified as schools through the customer name and address linked with their meter.
- Median – Medians were identified through satellite imagery analysis.

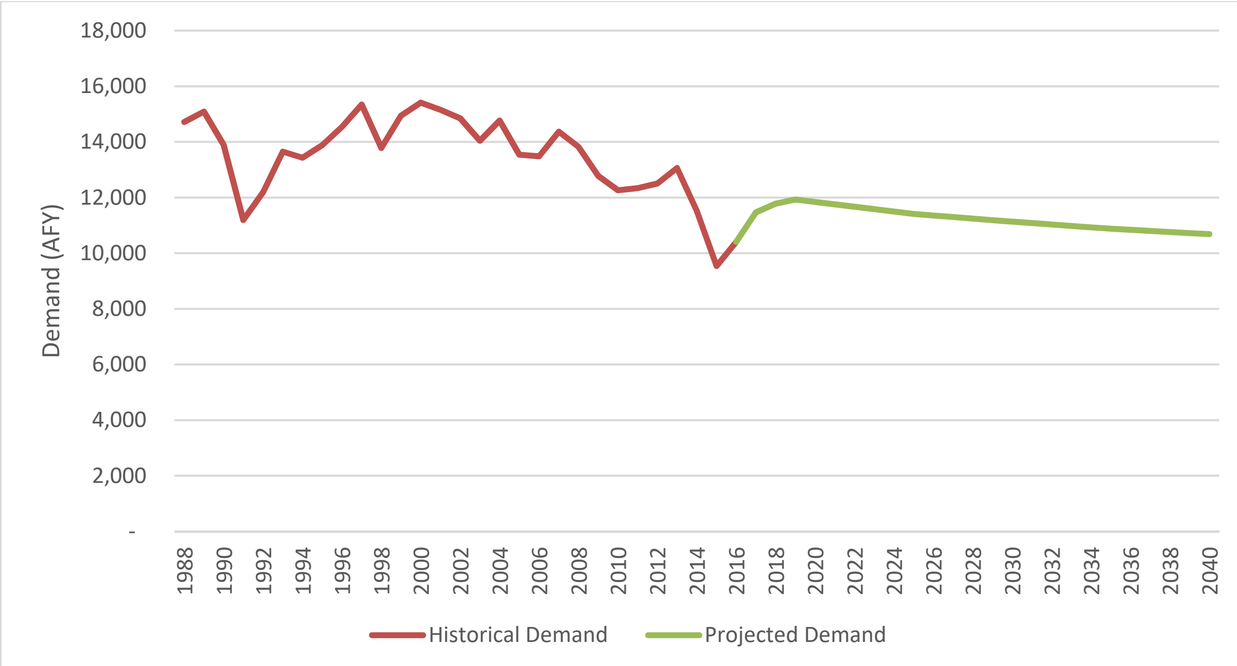
2.3.3 Net Use Factor

Factors of use were applied to each customer to account for potential issues with implementing recycled water that could prevent serving every potential recycled water use identified along the proposed alignment. This factor is less than or equal to 1 and was multiplied by each customer's estimated demand for irrigation, industrial, cooling tower, or dual plumbing use to yield a more probable demand for the overall Phase 3 expansion.

2.3.4 Rebound Factor

The water meter data used for this analysis is from 2016. While 2016 was a fairly average year for rainfall, 2012 through 2015 was a period of severe drought throughout California that triggered both state and local water restrictions. Many water use restrictions implemented during the drought were still in effect in 2016, likely suppressing the water use shown in the CPA's metered data. Irrigation demands are likely to rebound following the lifting of drought restrictions. It is assumed that the rebound in irrigation use will follow the trend projected for the CPA's overall water use. The overall water use rebound projected for Palo Alto, shown in Figure 2-4, predicts an initial increase followed by a decrease assuming additional water use efficiency measures are implemented. A 7.5 percent increase in demand over current demands is the average rebound projected in the period from 2020 through 2040. Thus, a 7.5 percent increase in irrigation demands was incorporated into the recycled water demand estimate.

Figure 2-4: Historical and Projected Water Demand Served by the CPA



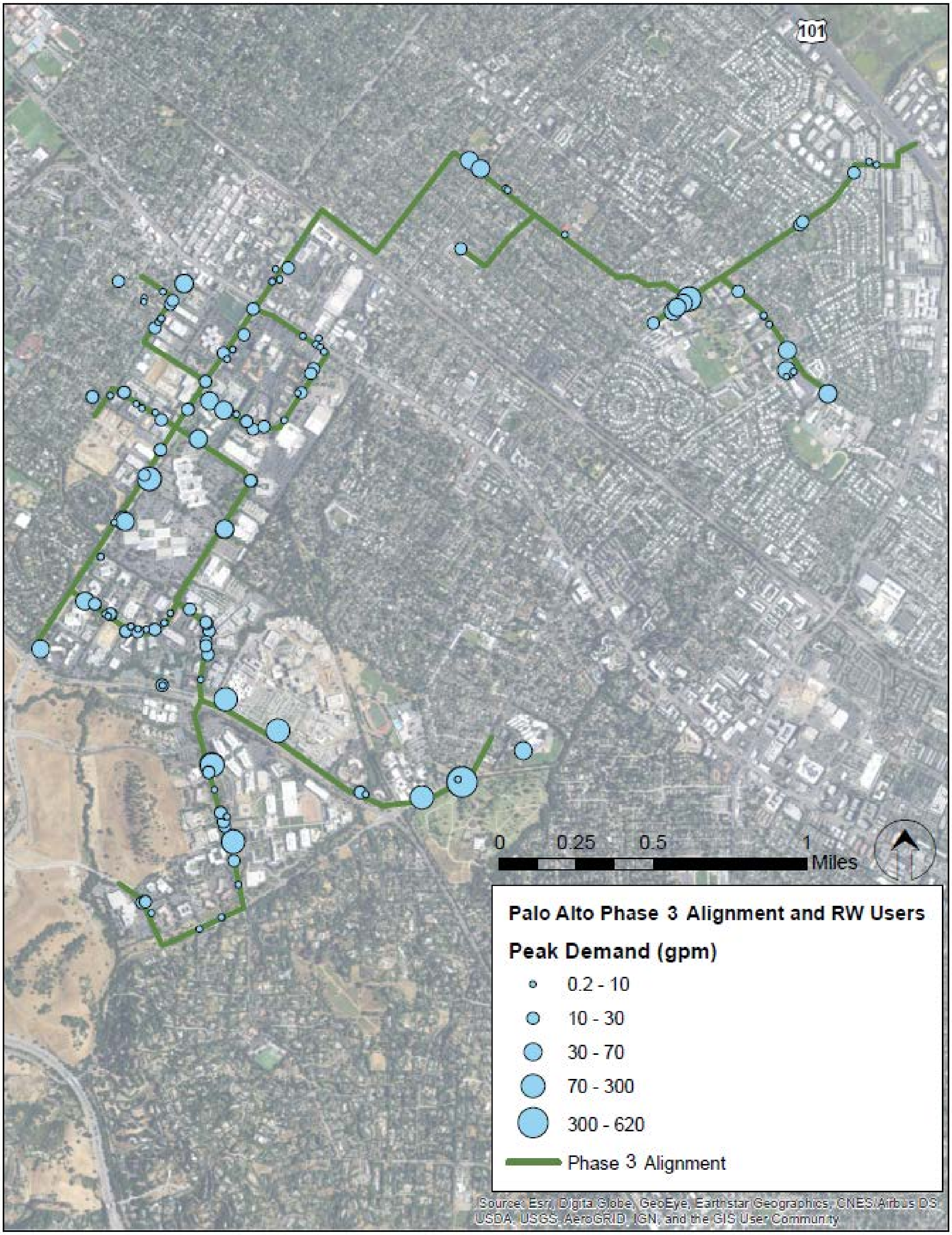
2.4 Updated Potential Phase 3 Demands

2.4.1 Annual Average and Peak Demands

Applying the demand estimate methodologies and factors discussed above yields a potential annual average recycled water demand of 810 AFY for Palo Alto's Phase 3 recycled water system service area. The updated target recycled water users are shown in Figure 2-5. Estimated potential recycled water demand for each customer, including a breakdown of total demand for each customer, is included in Appendix A -Customer Demand Update Database.

The peak month for potable demand from the 2016 water use data was August. This is the maximum demand month. The maximum day demand, defined as the average daily demand over August 2016 (the peak month), for the Phase 3 service area is 1.5 mgd.

Figure 2-5: Updated Alignment and Recommended Project Target Recycled Water Uses



2.5 Other System Demands

CPA's Phase 3 recycled water system is connected hydraulically to Phases 1 and 2 of the system. While demand estimates for these phases are not part of this Business Plan, they must be considered in the hydraulic modeling and preliminary design of the Phase 3 system.

2.5.1 Phase 1 and the Embarcadero Road Extension

Demands upstream of the Phase 3 connection are considered part of Phase 1. These demands were estimated from historical use from large customers such as Greer Park and for the proposed extension on Embarcadero Road to the auto-dealerships and an athletic center. Average annual recycled water demand for these customers is estimated at 114 AF.

2.5.2 Phase 2 and Mountain View Future Demands

Phase 2 of the recycled water system serves customers in Mountain View. While Mountain View is planning on expanding their recycled water system over the next several years, for the purposes of the Phase 3 preliminary design (as directed by CPA), Mountain View's peak demand is modeled to be roughly equal to their historical peak hour demand of 2,083 gpm.

2.6 Summary of Demands

Table 2-1 includes a summary of the updated demand projections for the project as annual demand and average day, maximum month demand. As discussed previously, it was decided in July 2017 to incorporate the Embarcadero Road Extension project into the Phase 3 Expansion Project. Unless noted otherwise, this Business Plan always assumes the Embarcadero Road Extension is included in the Phase 3 project. Table 2-2 includes a summary of the five largest projected recycled water users from the total annual demands; 40percent of the total annual demand comes from the top five customers.

Table 2-1: Summary of Updated Demand Projections

	Total Annual Demand (AF)	Average Day, Maximum Month Demand (mgd)
Phase 3 Expansion Project	810	1.5
Embarcadero Road Extension	114	0.1
Total	**924**	**1.6**

Table 2-2: Largest Projected Recycled Water Users

Potential Phase 3 Customer	Total Annual Demand (AF)
Customer 1	167
Customer 2	74
Customer 3	69
Customer 4	41
Customer 5	20
Total of Top 5 Potential Customers	**371**

Chapter 3 Costs vs. Benefits

As previously indicated, the purpose of this Business Plan is to assess the economic feasibility of constructing the Phase 3 Expansion Project to extend recycled water service from the Regional Water Quality Control Plant (RWQCP) to the Stanford Research Park in the southwest area of Palo Alto. The Phase 3 Project should be considered economically feasible if the total monetized value of benefits exceeds the total life cycle costs of the project. Key questions to be answered in this Business Plan are the following:

- What conditions are necessary for the total value of benefits to exceed the total costs of the project?
- What is the risk of those conditions changing in the future such that benefits no longer exceed costs?

This chapter defines the separate components that make up the costs and benefits, identifies the range of conditions that should be assumed for the various components and answers the first question above. The probability of conditions favorable to project feasibility occurring and the risk of those conditions changing in the future are evaluated in Chapter 5 utilizing risk assessment modeling.

3.1 Cost and Benefit Components

The separate components that make up the total costs and total benefits are presented on the following figure. As indicated, costs and benefits can be categorized as direct or indirect. Direct costs are being compared with direct benefits in this Business Plan to ascertain feasibility. The sizes of the rectangles are illustrative only and are not proportional to actual estimates which are simulated using probabilities. Indirect costs related to environmental and construction impacts have been considered in preparation of the Environmental Impact Report (EIR) for the Project. Customer connection retrofits required on private property for recycled water use are included in the cost estimate for the Project; these can range in cost from $5,000-$15,000 per site. Indirect benefits related to environmental enhancements, construction jobs and improvements to the regional economy are not accounted for, but descriptions of these benefits should be captured in applications for external funding.

Figure 3-1: Comparison of Costs and Benefits to Ascertain Feasibility

Costs

- Construction Costs
- Other Capital Costs
- Energy Costs
- Other O&M Costs
- Loss of Potable Water Revenue

Benefits

- External Funding
- Avoided Cost of Wastewater Discharges
- Recycled Water Revenue
- Avoided Cost of Water Purchases
- System Reliability Enhancement

Direct costs and benefits are shown in **Figure 3-1.** Indirect costs, such as environmental or construction related impacts, and indirect benefits, such as environmental enhancements or construction jobs, are not captured in this figure. The feasibility threshold is the point at which the total value of direct benefits exceeds the total direct costs. Net benefits are the amount that direct benefits exceed direct costs. Typically, return on investment (ROI) is defined by the value for net benefits divided by total direct costs.

3.2 Key Assumptions

The key assumptions and range of conditions utilized in conducting this analysis of direct costs vs. direct benefits and the risk modeling in Chapter 5 are described herein.

- **Financial Terms.** The assumed start date for Phase 3 is January 2020, and net present values (NPVs) are calculated for that date. The assumed planning horizon is 30 years; all facilities are assumed to have a life of at least that long. Inflation rates are assumed to be 3 percent and financing of capital costs assumes bonds would be floated for a 30-year term at a 4 percent interest rate. NPV is used to develop a comparison between costs and benefits for a discrete example.
- **Recycled Water Demand.** As indicated in Chapter 2, the average annual recycled water demand for the area to be served by the Phase 3 Project is estimated to be about 924 acre feet per year (AFY), with a maximum day demand of about 1.6 mgd. For this analysis, a bell-shaped curve is assumed for input of annual recycled water demand with one standard deviation equal to 10 percent of demand, or 92 AFY.

3.3 Direct Costs

3.3.1 Construction Costs

The preliminary design resulted in estimated costs to construct the Phase 3 Project of $35,600,000 (2017$), excluding the Embarcadero Road Extension. The level of design conducted to develop this estimate is considered Class 4 according to guidelines of the American Association of Cost Engineers (AACE) and is has an accuracy range of -20 to +30 percent (AACE No. 56R-08). The CPA made previous commitments to deliver enhanced recycled water quality with a 50/50 blend of tertiary treated recycled water and reverse osmosis (RO) treated recycled water to all of its existing and future recycled water customers. This cost does not include planned improvements at the RWQCP to provide partial treatment of the recycled water with RO to reduce salinity.

The preliminary design costs were developed assuming all irrigation customers receive water delivered on demand during an overnight delivery window. The cemetery maintains onsite storage that may allow recycled water to be delivered during the daytime window, when other demands on the recycled water system are lower. It is estimated that moving the cemetery to daytime delivery would reduce the construction costs for the pipelines and pump stations by 8 percent to an estimated $32,960,000 (2017$), excluding the Embarcadero Road Extension. Including the Embarcadero Road Extension, the estimated construction cost is $34,100,000 (2017$).

Assuming an inflation rate of 3 percent, by January of 2020 the estimated 2017 construction cost of $34,100,000 will be approximately $36,800,000 (2020$). Assuming this cost is financed with 30-year bonds at 4 percent interest, the amortized cost will be about $2,100,000 per year.

3.3.2 Other Capital Costs

Other capital costs include engineering design, construction management, legal and administration related to project construction. The total of other capital costs is assumed to be 20 percent of the construction cost, or $7,300,000 (2020$), which equates to an amortized cost of about $425,000 per year.

3.3.3 Energy Cost

Recycled water will be pumped from Palo Alto's Regional Water Quality Control Plant (RWQCP). The pressure will be boosted from an inline pump station along the route of the Phase 3 pipeline. The total estimated pumping energy to supply recycled water to the average annual demand of 924 AF is 480,350 kilowatt-hours (kWhs). Assuming pumping energy is proportional to recycled water demand, this usage equates to a ratio of 520 kWh/AF. As described in Chapter 2, a small amount of recycled water demand will occur year-round for industrial cooling and dual plumbing uses, but the major demand will be for irrigation uses during the dry months of the year. Palo Alto's current electricity rate for large non-residential users during the summer is $0.098/kWh. This rate is expected to go up by 14 percent in 2018 and 7 percent in 2019 to $0.12/kWh by 2020 (Dailey May 2017). Applying the usage ratio of 520 kWh/AF, the energy costs will be $62/AF by 2020. Thus, for the projected average annual demand of 924 AFY, the energy costs are projected to be about $58,000 per year, which equates at an NPV of $1,680,000.

3.3.4 Other O&M Costs

Other O&M costs for the pump stations and pipelines to be constructed in the Phase 3 Project, including required staffing and equipment, are assumed to be 0.6 percent of the total construction cost annually. Thus, these costs are projected to be about $191,000 per year, which equates to an NPV of $5,560,000.

3.3.5 Loss of Water Revenue

From Palo Alto's FY 2018 Water Utility Financial Plan, the 2017 volumetric water rate for irrigation (W-7) customers is $9.08/CCF, where one CCF = one hundred cubic feet. According to this reference, this volumetric rate is projected to go up by 4 percent in 2018 and 6 percent in 2019 (Palo Alto 2016). Thus, the potable water rate for irrigation customers will be $10.00/CCF by January of 2020. This equates to a value of about $4,356/AF for potable water provided by the City of Palo Alto. The only irrigation customer in the area to be served by the Phase 3 Project not currently utilizing the Palo Alto's potable supply is the groundwater user, which utilizes local groundwater. The cemetery's current water demand makes up about 167 AFY of the total average annual demand of 924 AFY projected for the Phase 3 Project. The cemetery paid the Santa Clara Valley Water District (SCVWD) a rate of $1,072/AF for this groundwater supply over the past year. By 2020 this rate is expected to go up to $1,414/AF (Dailey

March 2018), which means SCVWD would forego $236,000 per year by 2020 if Phase 3 is implemented. Any benefits to SCVWD from the cemetery ceasing pumping (and thereby keeping more water in the groundwater basin) have not be quantified or included. Assuming average annual demand conditions and the $4,356/AF water rate by 2020, the annual loss of potable water revenue for the CPA is $3,300,000 per year, which equates to an NPV of about $103,000,000.

3.4 Direct Benefits

3.4.1 External Funding

The Phase 3 Project may be eligible for one or more of the following funding programs:

- State Revolving Funds (SRF) loan
- State grants
- Federal grants

If State Revolving Funds (SRF) are secured the interest rate for capital improvements would be ½ of the State's rate for general obligation bonds, currently about 1.8 percent. If all capital costs are funded using this mechanism, the total annual capital costs would go down from $2,550,000 to about $1,910,000, a savings of about $640,000 per year. This annual savings equals an NPV of about $12,400,000. It is assumed that funding from State and Federal grants could range from 0 percent up to a maximum of about 35 percent of the total construction cost, which would equal about $12,900,000. If this amount were amortized it would equate to a benefit of about $743,000 per year, assuming 4 percent interest or $558,000 assuming 1.8 percent interest.

3.4.2 Avoided Cost of Wastewater Discharges

The San Francisco Bay Regional Water Quality Control Board (RWQCB) generally recognizes the benefit of maximizing the use of recycled water and minimizing discharges of treated wastewater to the Bay. Palo Alto's RWQCP provides tertiary treatment and, therefore, effluent discharged from the RWQCP is relatively high in quality. However, the RWQCB is currently assessing the Bay's assimilative capacity for nutrients discharged from Bay Area wastewater treatment plants, and it may be necessary for the RWQCP to reduce levels of nutrients, particularly nitrogen, in the future. If nitrogen removal is required at the RWQCP, it is expected that the cost of removal will be in the range of $7.00 to $8.00 per pound of nitrogen removed and that the value of this benefit would be about $300/AF if the plant's tertiary treated effluent were recycled rather than discharged to the Bay. The costs reflect new equipment needed and are largely fixed; installation depends on future regulations. For the Phase 3 Project, however, one-half of the recycled water flow is expected to be treated with RO to reduce salinity of the supply provided to Phase 3 customers. Assuming the majority of nutrients are removed with the RO process and discharged with RO concentrate back into the plant effluent, the resulting value of this benefit would be up to $150/AF, if nutrient removal is ultimately required. For the average annual demand of 924 AFY, this benefit would equal about $138,600 per year, which equates to an NPV of about $4,040,000.

3.4.3 Recycled Water Revenue

The City of Mountain View currently delivers recycled water produced from the RWQCP for a rate equal to 55 percent of its commercial potable water rate. For the Phase 3 Project, and for Mountain View in the future, when one-half of the recycled water produced at the RWQCP receives RO treatment, the water quality will be significantly enhanced, and the value of this supply will also be enhanced. For purposes of this analysis, it is assumed that Phase 3 customers receiving enhanced recycled water will be charged a rate equal to 60 percent of CPA's potable water rate, which would be equal to $2,614 by 2020. For the average annual demand of 924 AFY, the value of this benefit would be $2,400,000 per year, which equates to NPVs of $75,600,000. The rate used here is illustrative only; Chapter 4 includes a more in-depth discussion of preliminary rates. Rates will be set in a comprehensive Cost of Service Analysis and will be consistent with the requirements of Proposition 218.

3.4.4 Avoided Cost of Water Purchases

As previously explained, all of the customers to be served recycled water with the Phase 3 project (except the cemetery) are currently utilizing potable water from CPA purchased from the San Francisco Public Utilities Commission (SFPUC). With implementation of the Phase 3 Project, CPA will be able to reduce its purchase of SFPUC supply. The cost of the SFPUC supply is projected to be $1,949/AF by January of 2020 so the value of this benefit will be about $1,475,000 in average demand years, which equates to an NPV of $49,900,000.

3.4.5 Potable Reliability Enhancement

During droughts, the City's existing water sources may offer reduced supplies, necessitating conservation measures by potable water customers. Because a recycled water system expansion would reduce demand for potable water on a consistent basis (including during drought years), the expansion "frees up" potable water supplies for use by water customers who cannot use recycled water. This improves the reliability of the potable water supply systemwide, reducing the need for conservation measures. This benefit is referred to as Potable Reliability Enhancement. For purposes of this Plan, the cost of providing the Potable Reliability Enhancement Benefit is assumed to equal the difference between the quantified costs and benefits of the project. Furthermore, it is assumed that the full amount of these costs will be collectable from potable customers as an actual expense to CPA of enhancing potable supply reliability. A separate cost of service study will be necessary to determine the amount of project costs allocated system-wide.

A reliability rate of $150/AF applied to the potable water rate is consistent with the expectation that a low interest loan is likely. $150/AF ($0.34 per ccf) is approximately a 3-4 percent increase on a typical residential bill in 2018. The analysis shows the project is economically feasible with no grants or loans if a reliability rate of about $225/AF ($0.52 per ccf) in the early years of the project is acceptable.

In addition to the benefits of increased revenue or savings there are socioeconomic benefits of improved reliability system-wide if recycled water rather than potable water is supplied for non-potable uses. This benefit is sometimes called a welfare loss. "Welfare loss estimates are based on the relationships that capture the amount consumers would pay to avoid a shortage of a given magnitude. Economists refer to this value as 'willingness to pay' (WTP)" (Sunding 2017).

While not relevant to a cost of service analysis, studies on this concept provide useful data at the feasibility study stage. The SCVWD recently conducted a random survey of 400 voters of Santa Clara County and found that, generally, there was support for improving water supply reliability and support for a small rate increase of $5 to $10 per month to accomplish that objective (EMC 2017). A previous survey taken in 1994 by the California Urban Water Agencies showed, on average, that California residents were willing to pay $12 to $17 more per month to ensure reliable water supplies, which in today's dollars equates to a range of $20 to $28 per month (Barakat 1994). For current potable water rates, these values would equal about $700/AF to $1,000/AF, significantly greater than the project reliability rate range of $150 to $225/AF. Another recent study of the value of reliability was published in the Journal of the Association of Environmental and Resource Economists. This study was conducted in urban areas of California serving over 20 million customers, and it identified "welfare losses for an annual disruption range from an average of $1,458 per acre-foot of shortage for a 10 percent supply disruption to an average of $3,426 per acre-foot of shortage for a 30% supply disruption…" (Buck 2016).

For purposes of this Business Plan, a range of $0 to $700/AF has been assumed for the value of this benefit. For the average potable water demand remaining after the Phase 3 project is online, 10,000 AF, this benefit would range from $0 to $7,000,000 per year, which equates to an NPV range of $0 to $203,900,000.

3.5 Total Costs versus Total Benefits

Table 3-1 and Table 3-2 provide summaries of NPVs for direct costs and direct benefits specifically for the projected average annual recycled water demand of 924 AFY.

Table 3-1: Summary of Net Present Value of Direct Costs

Direct Cost	NPV	Variability Based on Demand	Other Variability
Construction	$36,800,000	n/a	-20% to +30% per AACE curve
Other Capital Cost	$7,400,000	n/a	Proportional to construction cost
Energy	$1,700,000	$62/AF in 2020	n/a
Other O&M	$5,600,000	n/a	Proportional to construction cost
Potable Revenue Loss (CPA)[a]	$103,200,000	$4,356/AF in 2020	n/a
Total Costs	**$154,700,000**		

a. Revenue loss to SCVWD for reduction in groundwater pumping fees from the cemetery is not included in the costs but has a NPV of $9,800,000.

Table 3-2: Summary of Net Present Value of Direct Benefits

Direct Benefit	NPV	Variability Based on Demand	Other Variability
External: SRF Loan[a]	$0 - $12,500,000	n/a	Upper limit proportional to total capital costs
External: Grant	$0 - $12,900,000	n/a	Upper limit proportional to total construction costs
Avoided Wastewater Treatment	$0 - $4,100,000	Upper limit of $150/AF	Uncertainty of future regulations
RW Revenue	$75,600,000	$2,614/AF in 2020	n/a
Avoided SFPUC Purchases	$49,900,000	$1,949/AF in 2020	n/a
Other Local Grant Funding	$0 - $10,000,000	n/a	n/a
Reliability Fund	$0 - $203,900,000	Upper limit of $700/AF in 2020	n/a
Total Benefits	**$125,500,000 - $368,900,000**		

a. Benefit from SRF loan represents the cost savings that the project would realize with capital financing at an interest rate of 1.8 percent compared with conventional financing with an interest rate of 4 percent.

As shown in Tables 3-1 and 3-2, for the projected average annual recycled water demand of 924 AFY, the total NPV of direct costs is estimated to be about $154.7 million, but the total estimated NPV of direct benefits has a wide range, from about $125.5 million to $368.9 million. The results in the two tables show that, for a fixed recycled water demand, the benefits may or may not exceed the cost but the results do not incorporate the impact of varying demands. Likewise these results do not reveal anything about the probability of economic feasibility nor the future economic risk. The probabilities of various outcomes are evaluated using Monte Carlo simulations presented in Chapter 5.

An example scenario to help understand the results presented in Chapter 4 and Chapter 5 is provided in Table 3-3 and Table 3-4. These results represent a single model run from the Risk Assessment Model.

Table 3-3: Example Scenario Net Present Value of Direct Costs

Direct Cost	NPV
Construction [a]	$41,700,000
Other Capital Cost [a]	$8,400,000
Energy	$1,700,000
Other O&M	$5,600,000
Potable Revenue Loss (CPA)[a]	$103,200,000
Total Costs	**$160,600,000**

a. NPV of Construction and of Other Capital Costs are based on conventional financing with an interest rate of 4 percent.

Table 3-4: Example Scenario Net Present Value of Direct Benefits

Direct Benefit	NPV
External: SRF Loan [a]	$12,500,000
External: 5% State Grant	$1,900,000
Avoided Wastewater Treatment	$0
RW Revenue	$75,600,000
Avoided SFPUC Purchases	$49,900,000
Potable Reliability Enhancement	$203,900,000
Total Benefits	**$343,800,000**

a. Benefit from SRF loan represents the cost savings that the project would realize with capital financing at an interest rate of 1.8 percent compared with conventional financing with an interest rate of 4 percent.

In this example the total benefits exceed the total costs; this indicates that the reliability rate could be reduced to less than $700/AF with benefits equal to costs. A reliability rate of $71/AF yields a NPV of $20,700,000, which changes the total benefits to $160,600,000, matching the total costs.

Chapter 4 Preliminary Rate Analysis

4.1 Background on Recycled Water Rates in Palo Alto

An important aspect of protecting against the risk of costs exceeding benefits is appropriate recycled water rate setting. While CPA provides recycled water service to some City facilities, there is no recycled water rate structure in place. Rates developed for Phase 3 must proportionately reflect cost of service, in compliance with Propositions 218 and 26, and contribute to the success of implementing recycled water within CPA.

4.2 Purpose of the Preliminary Rate Analysis

The purpose of the preliminary rate analysis was to evaluate costs and revenues to determine a potential rate structure for the Phase 3 system. The rate analysis considered cash flows over the first 21 years of operation (from 2020 to 2040) and incorporated available information about future rates for SFPUC, CPA, and SCVWD.

For potential revenues, the preliminary rate analysis considered the following:

- Recycled water sales (volumetric)
- Recycled water monthly service charges (per meter)
- Avoided SFPUC wholesale water purchases
- Potable reliability enhancement

For potential costs, the preliminary rate analysis considered the following:

- Capital debt for construction of the Phase 3 system, financed at SRF borrowing rate of 1.8percent
- Energy usage
- Other O&M costs (e.g. labor, chemicals)
- Lost potable water sales revenue (volumetric)
- Lost potable water monthly service charges (per meter)

4.3 Summary of Revenue Inputs

4.3.1 Recycled Water Sales

The revenue from recycled water sales was based on recycled water being offered at a reduced amount compared to the CPA potable water rate. The reduced amount was determined through the rate analysis such that the cemetery is charged an equivalent amount once they convert from groundwater to recycled water. Using SCVWD projected groundwater pumping charges and projected CPA potable water rates, the recycled water rate would be around 60 percent of the CPA potable water rate to maintain parity with groundwater pumping charges. Based upon a review of other recycled water programs in California, rates for recycled water are typically 60 to 90 percent of potable water rates.

4.3.2 Recycled Water Monthly Service Charges

Similar to the CPA potable water system, a fixed monthly service charge equivalent to the potable water monthly charge for every recycled water meter was assumed. Avoided SFPUC Wholesale Water Purchase

By using the locally available recycled water, CPA will purchase less wholesale water from SFPUC. The value of the avoided wholesale purchases was determined annually using SFPUC's projected wholesale rates.

4.3.3 Potable Reliability Enhancement

As is typical with recycled water projects, there is a benefit to all water customers from increasing supply reliability through the incorporation of recycled water into the supply portfolio. The value of this benefit, called the reliability rate, is levied across the potable water customers and, for the purposes of the preliminary rate analysis, was estimated as the difference between the benefits and costs. Due to the various inputs (costs and benefits) changing at different rates, the reliability rate varies annually through the 21-year analysis. As discussed in Chapter 5, the reliability rate will also change with variations to the projected demands, costs, and funding/financing options. Since all customers on the RWS would benefit from reduced demand on the Tuolumne River and increased reliability on the system, there may be opportunities to share some project costs with other stakeholders.

4.4 Summary of Cost Inputs

4.4.1 Capital Debt for Phase 3 System

As discussed in Section 3.3.1, the Phase 3 system construction cost estimate is $35,600,000 (2017$), not including the Embarcadero Road Extension. The groundwater customer's existing onsite storage allows for daytime deliveries of irrigation water, therefore the modified Phase 3 system construction cost is estimated to be $32,960,000 (2017$), or $34,100,000 (2017$) when including the Embarcadero Road Extension. Including additional capital expenses and assuming SRF financing at 1.8 percent, the annual capital debt service for the Phase 3 system is $1,800,000. For the purposes of the rate analysis, the economic benefits to the project of including the cemetery are credited back to that customer.

4.4.2 Energy Usage and Other O&M

Costs for annual energy consumption were included in the rate analysis using estimated energy usage between 450,000-500,000 kwh/year and using projected CPA energy rates. Other O&M costs, primarily labor and chemical usage, were included based on estimates from the Preliminary Design Report for the Phase 3 system. Other O&M costs are escalated assuming inflation.

4.4.3 Lost Potable Water Sales Revenue

Converting potable water customers to recycled water customers reduces the potable water sales revenue. For the purposes of the rate analysis, the lost potable water sales revenue was calculated as the difference between the CPA potable water sales rate and the avoided SFPUC wholesale purchase rate multiplied by the amount of potable water displaced with recycled water. The rate analysis used future projections for the CPA potable water rate and SFPUC wholesale purchase rate as described previously.

4.4.4 Lost Potable Water Monthly Service Charges

Customers with W-7 (irrigation) meters currently pay a potable monthly meter service charge. Once converted to a recycled water meter, they would instead pay the monthly service charge to the recycled water fund, and cause a loss of revenue to the potable water fund.

4.5 Conclusions from the Preliminary Rate Analysis

Given the revenues and costs discussed in the previous sections, and assuming a recycled water rate set at 60 percent of the CPA potable water rate, the preliminary rate analysis shows a potable reliability rate of approximately $1.0 million annually or a 3 percent rate increase. The magnitude of the reliability rate depends heavily on the CPA retail rate to SFPUC wholesale rate ratio. This analysis utilized projected rates from both and did not consider the uncertainty of the relationship between the two, which is CPA's distribution system rate. The SFPUC wholesale rate is reflected in CPA's retail rate. If CPA distribution rates increase less than projected, the economic feasibility of the project improves.

If the cemetery is excluded from the recycled water system, reducing the annual demand and upfront capital costs, and the rate was set at around 95 percent of the CPA potable water rate, the preliminary rate analysis shows a reliability revenue of approximately $706,000 in the first year, then decreasing to $0 by 2030 as the ratio of CPA retail potable water rates to SFPUC wholesale rates decreases over time.

Appendix B - Preliminary Rate Analysis Results contains the detailed rate analysis results for 2020-2040 for both the baseline and without groundwater customers. The preliminary rate analysis included a single discrete scenario; the risk assessment modeling described in Chapter 5 examines varying inputs and the resulting impact to the reliability revenue.

The preliminary rates analysis completed to date was cursory and did not include a full cost of service study. A robust study, recommended in this report, may result in a different rate design, and therefore a different estimate of recycled water revenue. An assessment of Phase 3 economic feasibility will be revised.

Chapter 5 Risk Assessment

5.1 Risk Assessment Methodology

A Risk Assessment Model was developed specifically for this analysis using GoldSim software, which is a graphical, object-oriented modeling platform often used in water resources applications. Models in GoldSim are built by creating and manipulating built-in objects representing the components of the system being modeled, data, and relationships between the data. The Risk Assessment Model and the mathematical functions it utilizes are depicted in Figure 5-1 and Figure 5-2.

One of the main advantages of GoldSim over similar generic tools is its ability to model probabilistically. The Risk Assessment Model evaluates the probability that the Phase 3 Expansion Project will remain cost effective given the range of estimates for the individual components that make up the costs and benefits of the project. The model uses the Monte Carlo simulation technique for generating a range of values using statistical sampling. This approach involves establishing a probability distribution for each of the parameters. The entire system is then simulated a large number (typically thousands) of times. The result is a large number of separate and independent results, called realizations, with each representing an equally likely outcome. The outputs are not single values, but a large number of separate and independent results, represented as probability distributions.

Figure 5-1: Risk Assessment Model in GoldSim

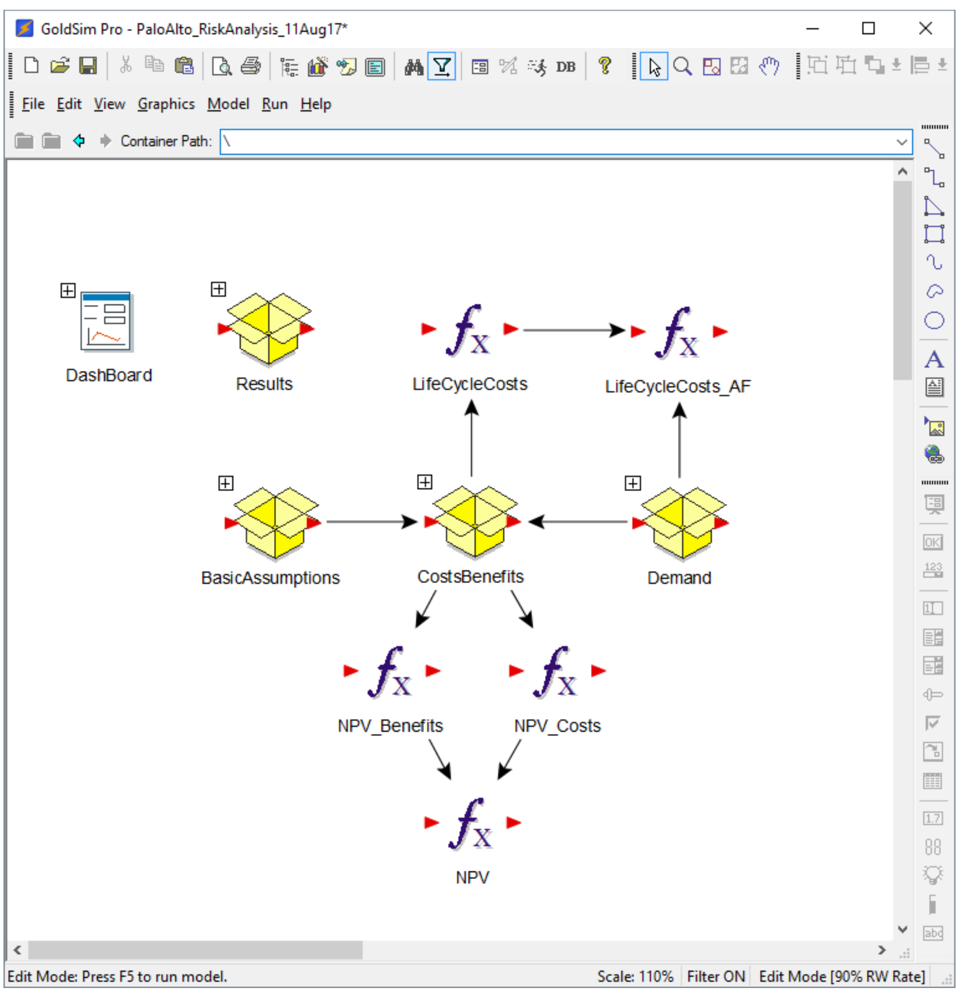
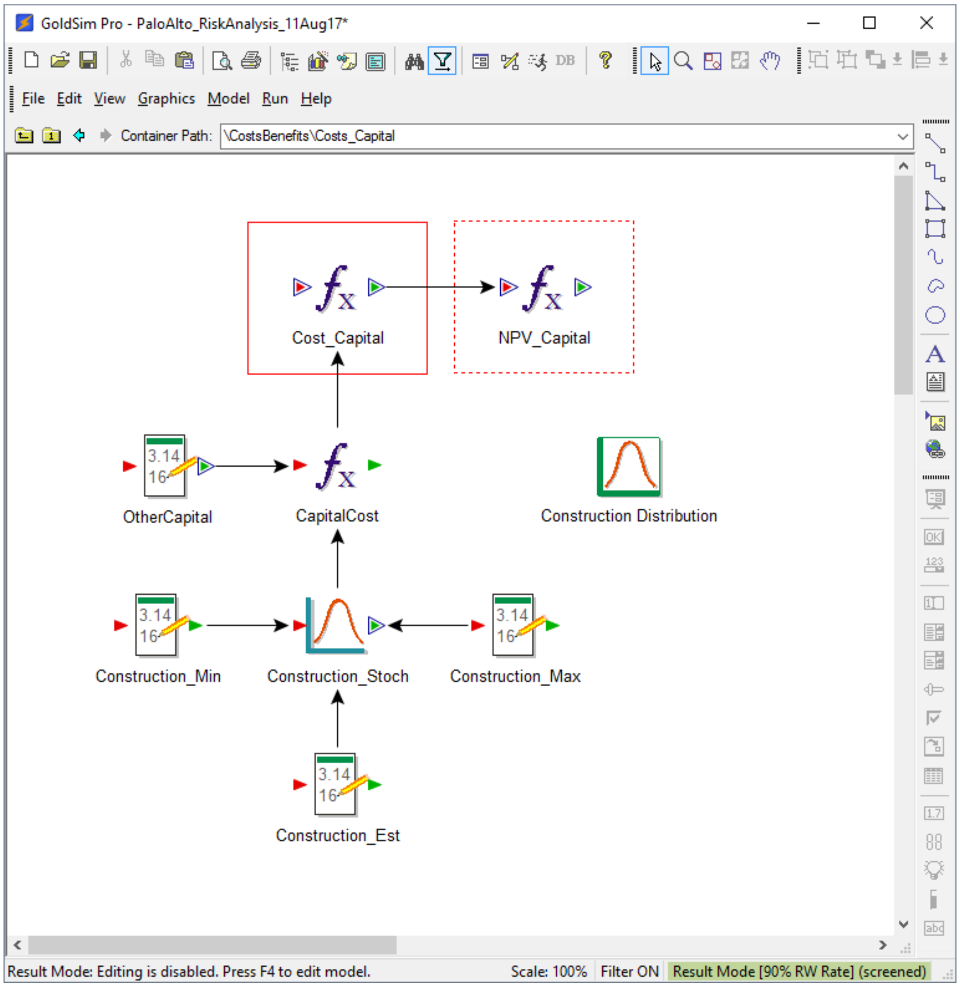


Figure 5-2: Risk Assessment Model in GoldSim (Part 2)



5.2 Assumed Input Ranges

5.2.1 Overview of Ranges for Costs and Benefits

Chapter 3 introduced the various benefit and cost components that were monetized for use in the Risk Assessment Model. Some of the components have probabilities associated with a discrete number of events. For example, the possible inclusion of a Federal grant can be simulated at 35 percent of the construction cost (~$10 million), or with no Federal grant ($0). Each of these discrete events is assigned a probability of occurrence, and the Risk Assessment Model samples one of these outcomes at each realization. Table 5-1 summarizes the discrete events used in the Risk Assessment Model.

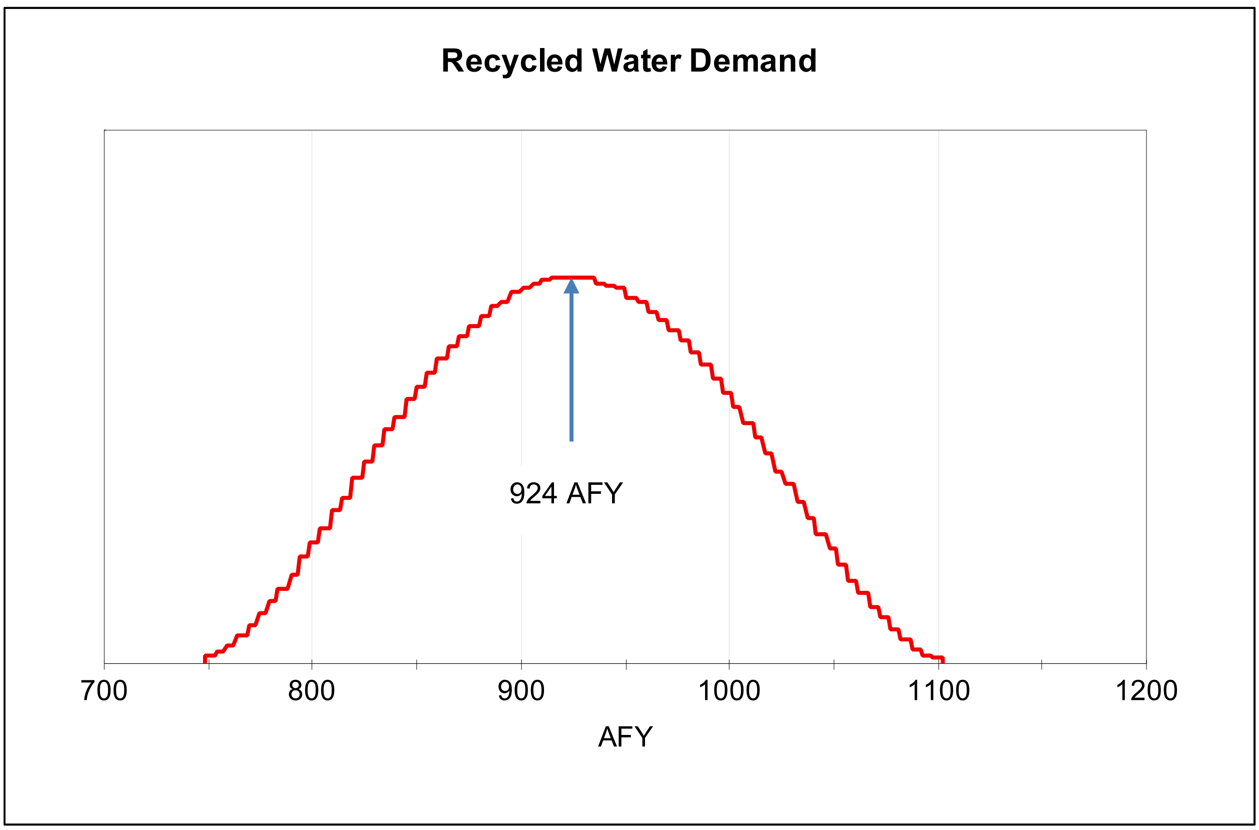
Table 5-1: Probability of Discrete Events in Risk Assessment Model

	Value	Selected Probability of Occurrence in the Risk Assessment Model
State Grant	10% of Construction (~$3M)	80% chance
	No State Grant	20% chance
State Revolving Fund Loan	1.8% Interest Loan	80% chance
	No Loan	20% chance
Federal Grant	35% of Construction (~$10M)	5% chance
	No Federal Grant	95% chance

5.2.2 Recycled Water Demands

Chapter 2 provides information on the detailed methodology that was used to estimate the total recycled water demand for the project (924 AFY). While this was a rigorous approach and includes built in conservativism, real-world experience tells us that demands for water can be different than planned. The Phase 3 recycled water distribution system will have excess capacity due to use of standard pipe sizes and potentially through controlling peak demands (e.g. assigning users to different time slots to offset demand peaks - 8pm to midnight, midnight to 4am). Therefore, for the Risk Assessment Model, a range of recycled water demands was modeled rather than a single predicted value. Figure 5-3 shows the normal distribution assumed for the recycled water demands.

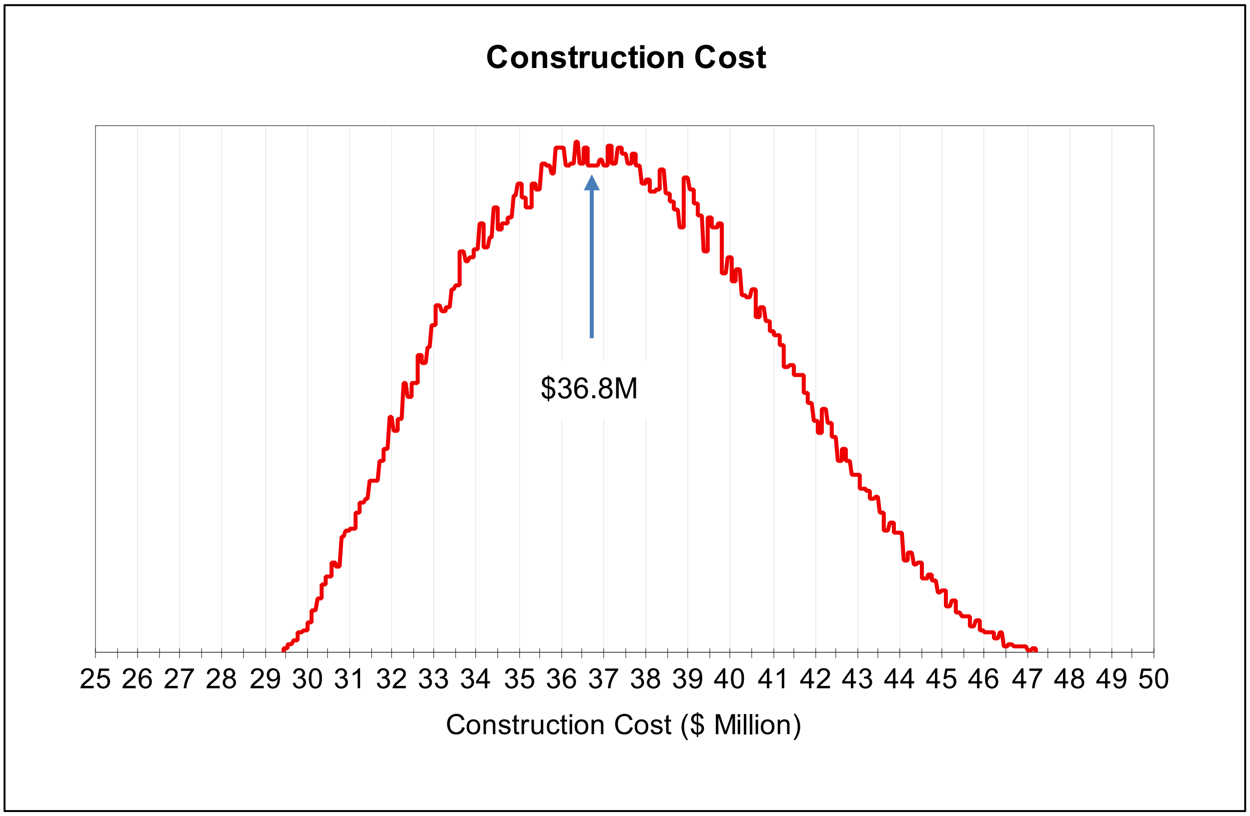
Figure 5-3: Range of Recycled Water Demands Used in Risk Assessment Model



5.2.3 Construction Costs

As introduced in Chapter 3, the construction cost estimate ($36.8 million in 2020$) is a Class 4 estimate according to guidelines of the American Association of Cost Engineers (AACE) and is considered to have an accuracy range of -20 percent to +30 percent. The accuracy range represents an 80 percent confidence level, with a 50 percent confidence level at the peak (including the contingency). Figure 5-4 shows the skewed distribution assumed for the construction costs.

Figure 5-4: Range of Construction Costs used in Risk Assessment Model

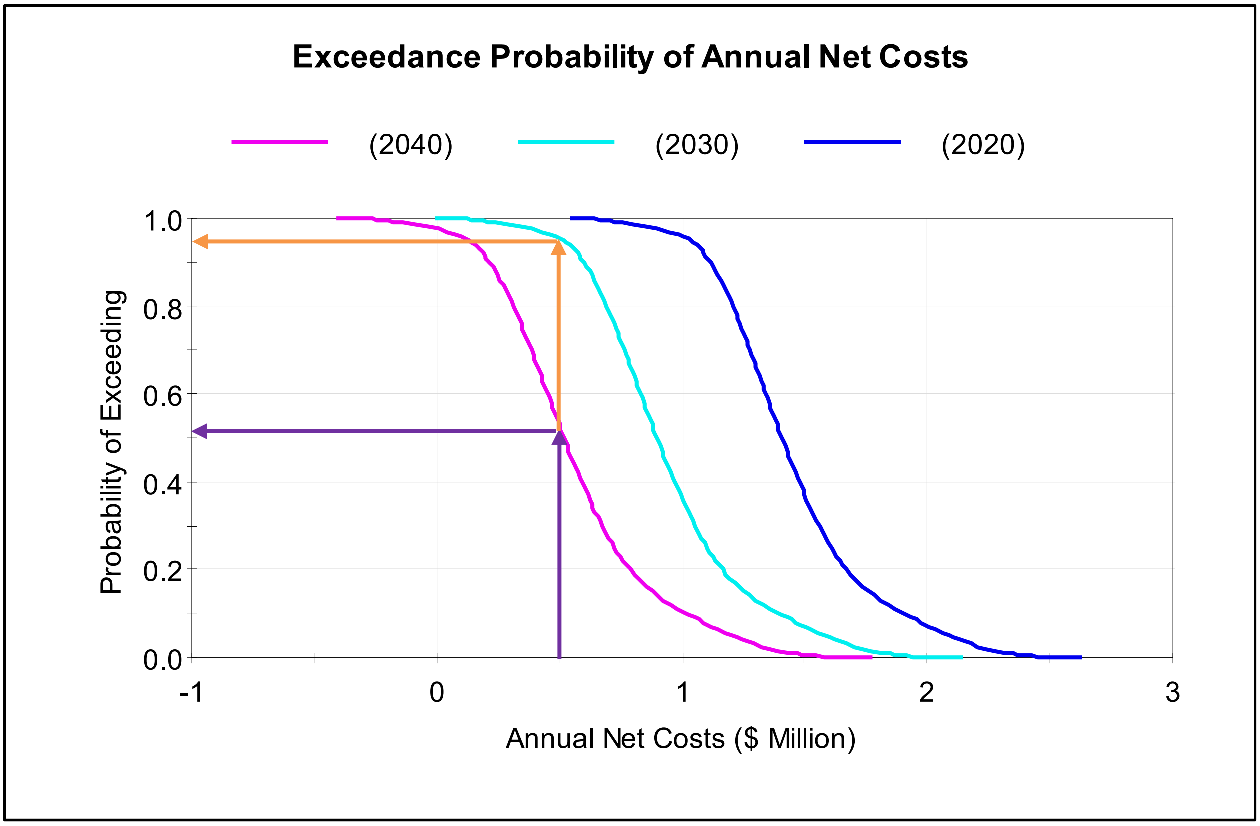


5.3 Risk Assessment Modeling Results

5.3.1 Understanding the Modeling Results

Figure 5-5 shows an example output from the Risk Assessment Model. The plot shows the difference in the annual costs and benefits (i.e. costs minus benefits) on the x-axis. The difference less than zero (i.e. benefits equal costs) or a net negative value (i.e. benefits are greater than costs) indicates economic feasibility. The y-axis of the plot shows the probability of exceedance. Probability of exceedance is the percentage of modeled scenarios where the condition shown on the x-axis occurred. For the example shown in Figure 5-5, the purple arrows illustrate a 52 percent probability of the annual net costs being at least $0.5 million in the year 2040. In the year 2030, this probability changes to 95 percent (orange arrows).

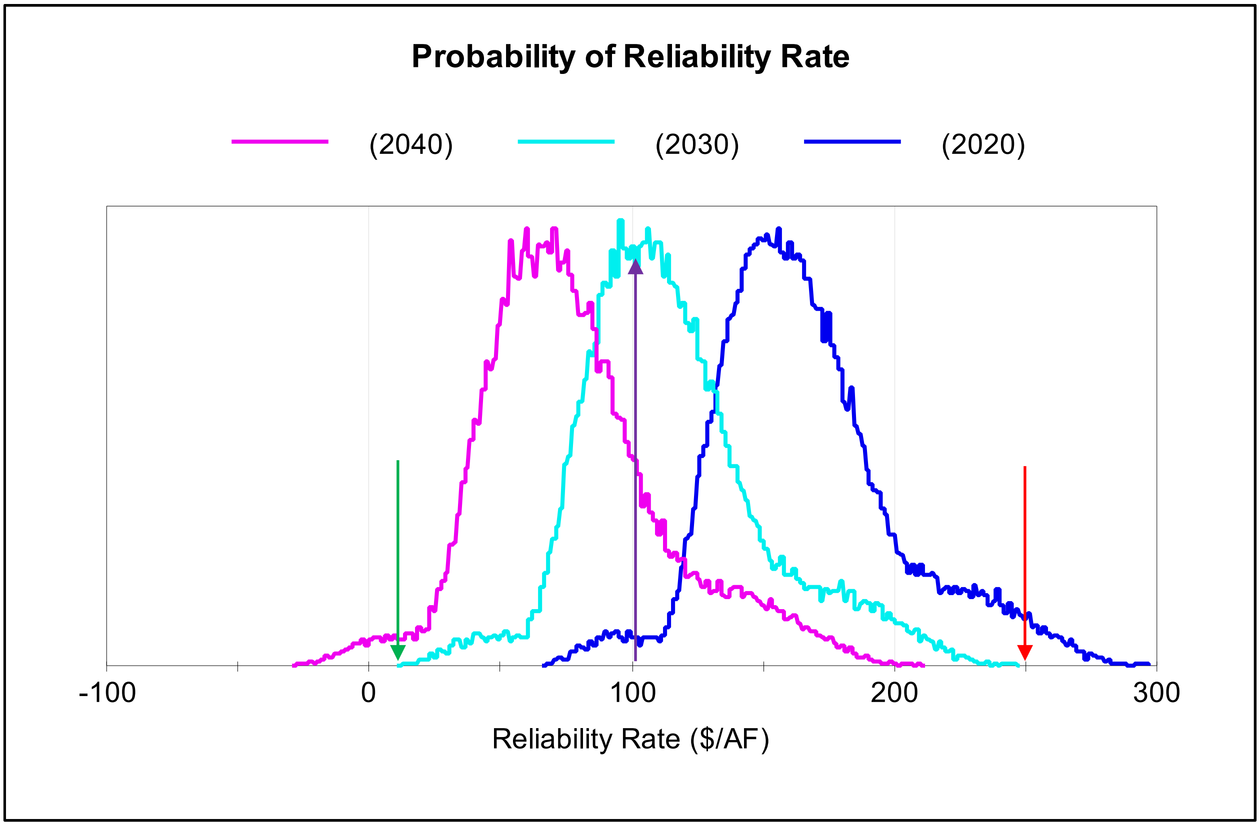
Figure 5-5: Example of How to Read an Exceedance Chart



An alternative x-axis is the reliability rate that would be used to supply the reliability benefit revenue. This is the annual net cost spread over the remaining potable water customers (around 10,000 AFY) shown as a rate charged per unit of potable water consumed. The exceedance plots can be presented with either annual net costs or reliability rate as the x-axis.

The modeling results can also be represented by a bell curve which shows the most frequently occurring event and the overall range of events. The x-axis for the bell curve can be either annual net costs or reliability rate, similar to the exceedance plots. The example shown in Figure 5-6 shows that the most likely occurring reliability rate in the Year 2030 is $100/AF (purple arrow), but it could be as low as $25/AF (green arrow) or as high as $250/AF (red arrow). In ccf, the most likely occurring reliability rate in the Year 2030 is $0.23/ccf (purple arrow), but it could be as low as $0.06/ccf (green arrow) or as high as $0.57/ccf (red arrow)

Figure 5-6: Example of How to Read a Bell Curve



5.3.2 Trends Given Range of Recycled Water Demand

As discussed in Section 5.2.2, recycled water demands were given a range of values in the Risk Assessment Model rather than a single input. Figure 5-7 shows the correlation between recycled water demand and annual net costs (cost minus revenue). As the recycled water demand rises, the benefits from more demand (primarily increased recycled water sales revenue) increase at a rate greater than any correlated increases in costs (e.g. more pumping energy to move more water). This shows in the scatter plots as a slightly downward trend, meaning less of a difference between costs and revenue.

For the scenarios shown in these figures, the recycled water sales rate was 60 percent of potable water rate and the time steps of 2020, 2030, and 2040 are shown. The impact of time as SFPUC and CPA rates increase while capital debt stays constant can be seen for all the realizations as the annual net cost reduces over time.

5.3.3 Trends Given Range of Construction Costs

As discussed in Section 5.2.3, construction costs were given a range of values in the Risk Assessment Model rather than a single input. Figure 5-8 shows the correlation between construction cost and annual net costs (costs minus revenue). As the construction cost increases, the costs increase with no increase in benefits (e.g. no additional recycled water revenue, no additional avoided SFPUC purchases, etc.). This causes the deficit between costs and revenues to grow as construction costs increase, seen as an upward trend in the scatter plots.

For the scenarios shown in these figures, the recycled water sales rate is 60 percent of potable water rate and the time steps of 2020, 2030, and 2040 are shown. The impact of time as SFPUC and CPA rates increase while capital debt stays constant is true for all the realizations as the annual net cost reduces over time.

Figure 5-7: Trend in Feasibility as Recycled Water Demand Varies

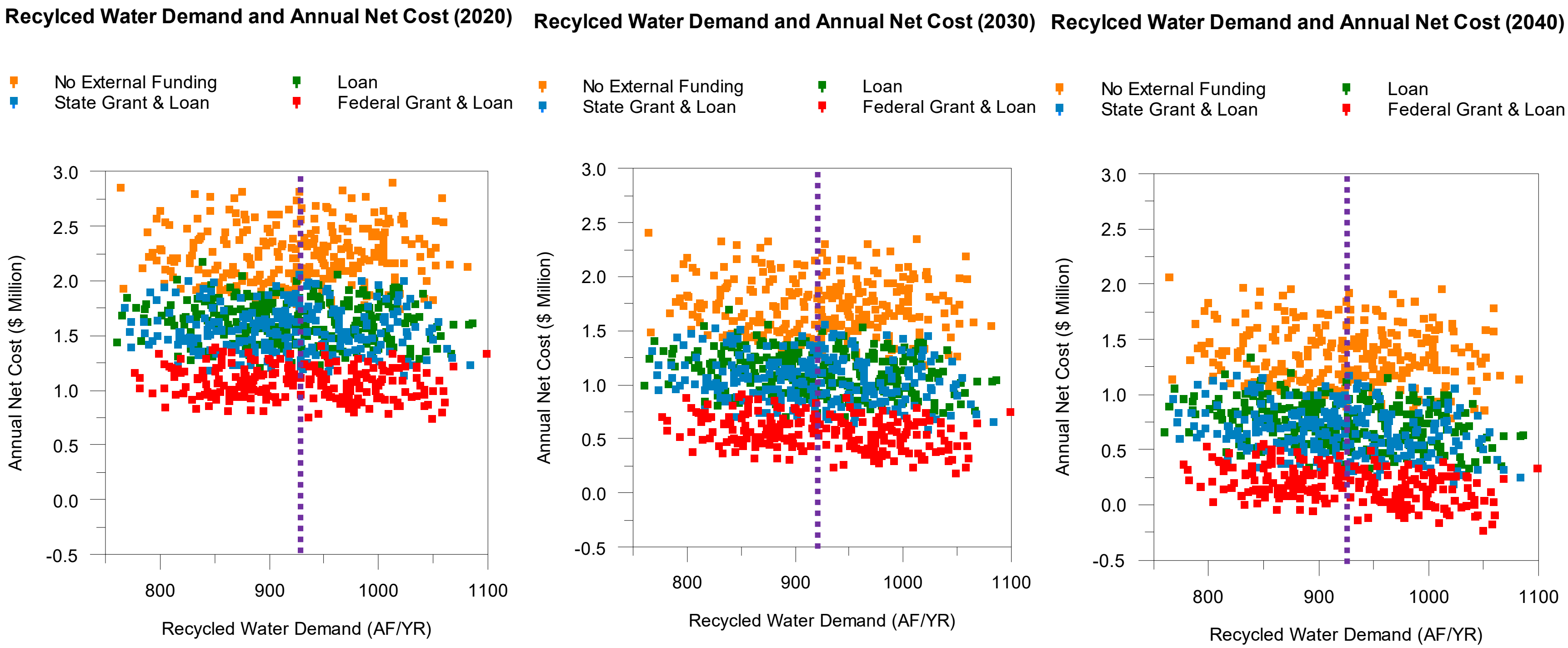
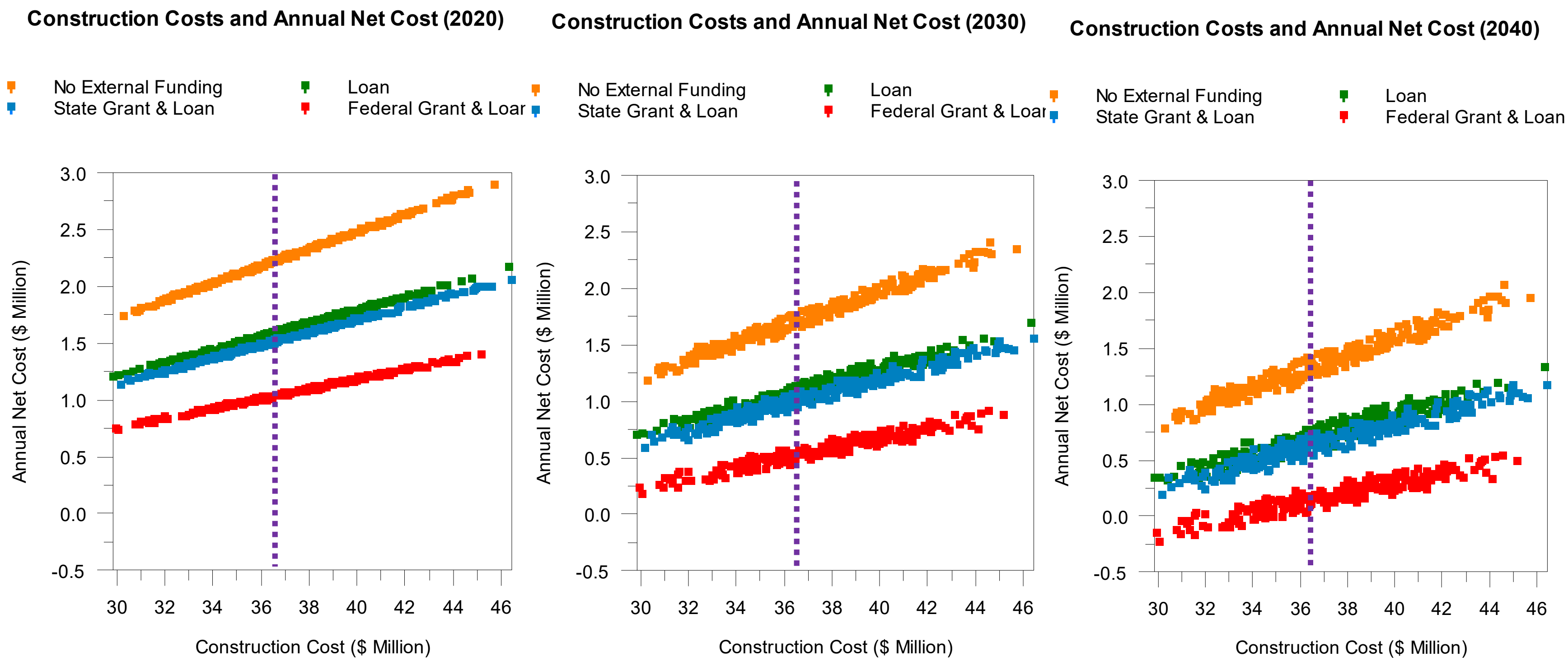


Figure 5-8: Trend in Feasibility as Construction Costs Varies

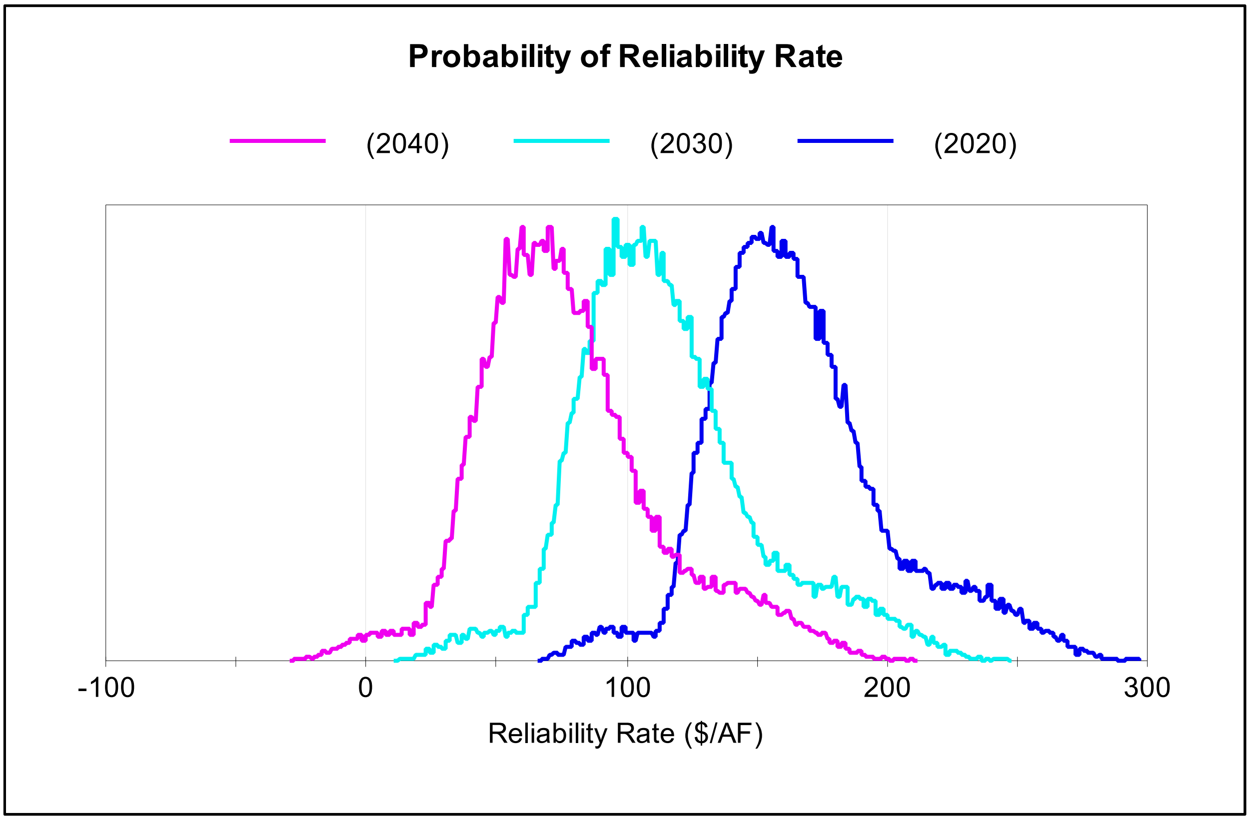


5.3.4 Modeling Results Given Different Time Steps

As seen in the scatter plots in Section 5.3.2 and Section 5.3.3, the annual net cost (or similarly, the reliability rate) decreases over time as the capital debt service is held constant but SFPUC and CPA water rates increase. This is seen in aggregate for the various model runs in Figure 5-9. The farther we look into the future, the greater likelihood that the reliability rate will trend towards zero.

Figure 5-9: Bell Curves for Reliability Rate in All Modeling Scenarios and at Different Time Steps

(Combined Result of Variable Recycled Water Demand and Construction Cost)



5.3.5 Modeling Results Given Different Funding Scenarios

Figure 5-10 shows the bell curves at different combinations of funding and financing for the Year 2020. The additional bell curves that illustrate other years (2030 and 2040) are included in Appendix C - Risk Assessment Modeling Results As a summary, Table 5-2 shows the approximate reliability rates given different combinations of funding and financing and time steps.

Figure 5-10: Bell Curves for Reliability Rate in the Year 2020 Given Different Funding Scenarios

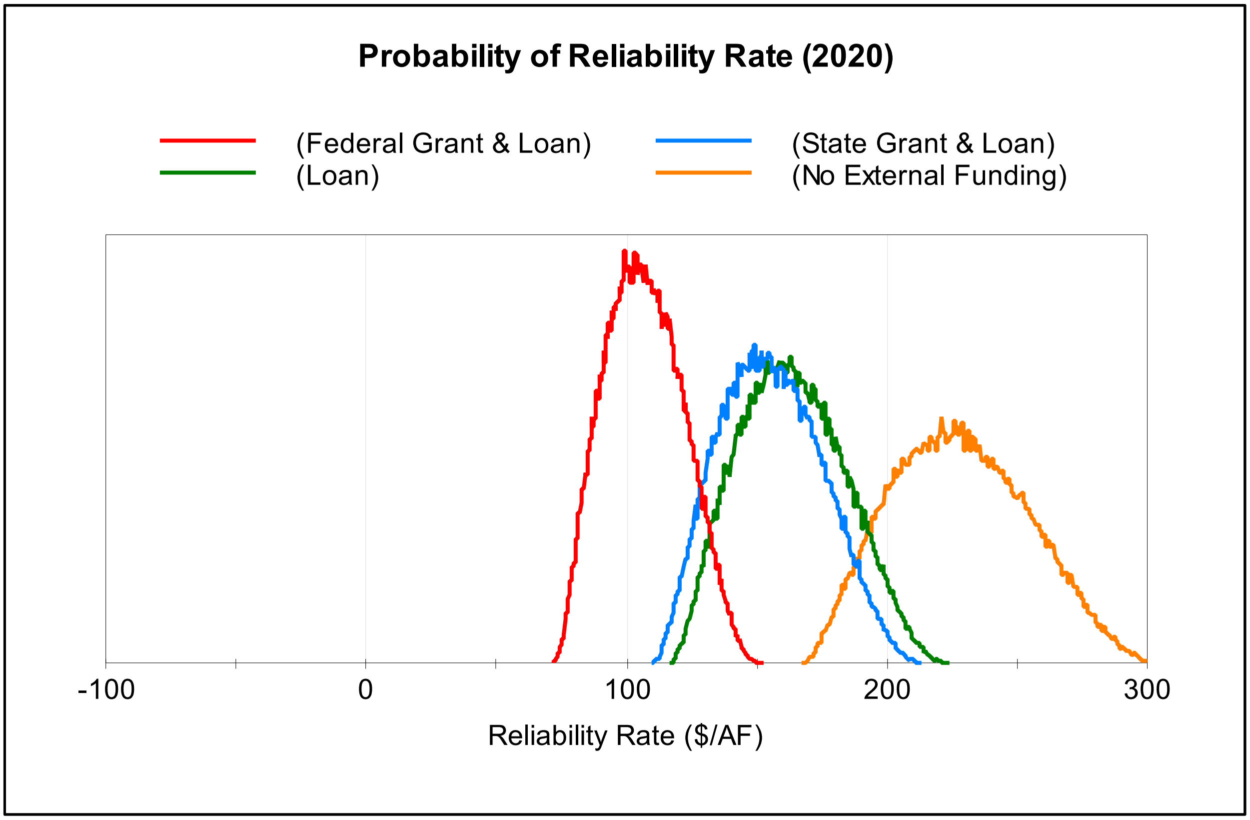


Table 5-2: Reliability Rates at Different Time Steps Given Different Funding Scenarios

Scenarios	2020	2030	2040
No External Funding	$225/AF	$175/AF	$125/AF
Low Interest Loan at 1.8% Borrowing Rate	$160/AF	$110/AF	$75/AF
State Grant at 5% of Construction Costs and Low Interest Loan at 1.8% Borrowing Rate	$150/AF	$100/AF	$60/AF
Federal Grant at 35% of Construction Costs and Low Interest Loan at 1.8% Borrowing Rate	$100/AF	$50/AF	$15/AF

Chapter 6 Conclusions and Recommendations

6.1 Business Plan Objectives

As described in Chapter 1, major questions needed to be answered in this Business Plan to determine the feasibility of constructing and operating the Phase 3 Expansion Project. These questions and summaries of the answers are as follows:

- **What are the long-term recycled water demands for potential recycled water uses in the vicinity of the Phase 3 Expansion?** The total average annual recycled water demand for uses that would be served by the Phase 3 Project, including uses in the Embarcadero Road area near the RWQCP, is 924 AFY. In the future, if dual-plumbing uses at Stanford University are also served, demand increases by about 17 AFY. Details regarding seasonal and diurnal variations of these user demands are provided in Chapter 2.
- **What are the updated costs for construction of the Phase 3 facilities considering updated demand projections and various construction challenges?** As indicated in Chapter 3, the construction costs are estimated to be $36,800,000 in 2020 dollars. Various cost saving measures have been identified in the Preliminary Design Report that have actually reduced the total estimated cost compared to the 2008 Facilities Plan. The unit cost of the Phase 3 Project (without any outside funding or financing) is estimated to be $3,030/AF in 2020 dollars, which is higher than some projects with limited distribution system piping, but lower than other similar projects in urban settings.
- **What is the economic feasibility of implementing the Phase 3 Expansion Project?** As described in Chapter 3, the Phase 3 Project is considered economically feasible if the total value of project benefits equals or exceeds total project costs. Outside funding, in the form of a low interest loan and/or a grant, is the most significant factor for economic feasibility. With a low interest loan, an expected reliability rate of $150 per AF for the early years of the project is necessary. Without external funding, the expected reliability is $225 per AF. Because the project increases reliability on the RWS, it may be possible to solicit funding from other stakeholders for the reliability benefit.

  A project that excludes the cemetery may be more economically feasible, but other water reuse alternatives that utilize the full Phase 3 Expansion Project facilities must be fleshed out in the Recycled Water Strategic Plan before a scaled-down Phase 3 is pursued. Further, a cost of service study may result in a different rate design, different estimated recycled water revenue, and revised economic feasibility assessment.
- **What are the variations in ranges of potential costs and benefits for the Phase 3 Expansion Project and what are the resulting impacts to the potable water customer base?** The variations for the Phase 3 Project annual net costs / reliability rate were defined by the risk assessment modeling conducted in Chapter 5. Secondly, CPA must acknowledge the reliability value to all water customers in Palo Alto and on the RWS of a locally-controlled drought-proof supply.
- **What are the risks to economic feasibility if changes occur related to demands, water costs, and external funding—in other words, what is the risk of the Phase 3 pipeline becoming a stranded asset?** The risks are characterized by the range of probabilities defined by the risk assessment modeling in Chapter 5. Construction costs, recycled water demand, and outside funding are all significant variables that impact the economic feasibility of Phase 3 Expansion Project. For the early years of the project, a reliability rate between $60 and $225 per AF is adequate 90 percent of the time. The economic feasibility of the project is expected to improve over time as the CPA retail potable water rate to SFPUC wholesale rate ratio decreases. The

alternative uses for the Phase 3 pipeline will be developed under the next phase of work - the Recycled Water Strategic Plan.

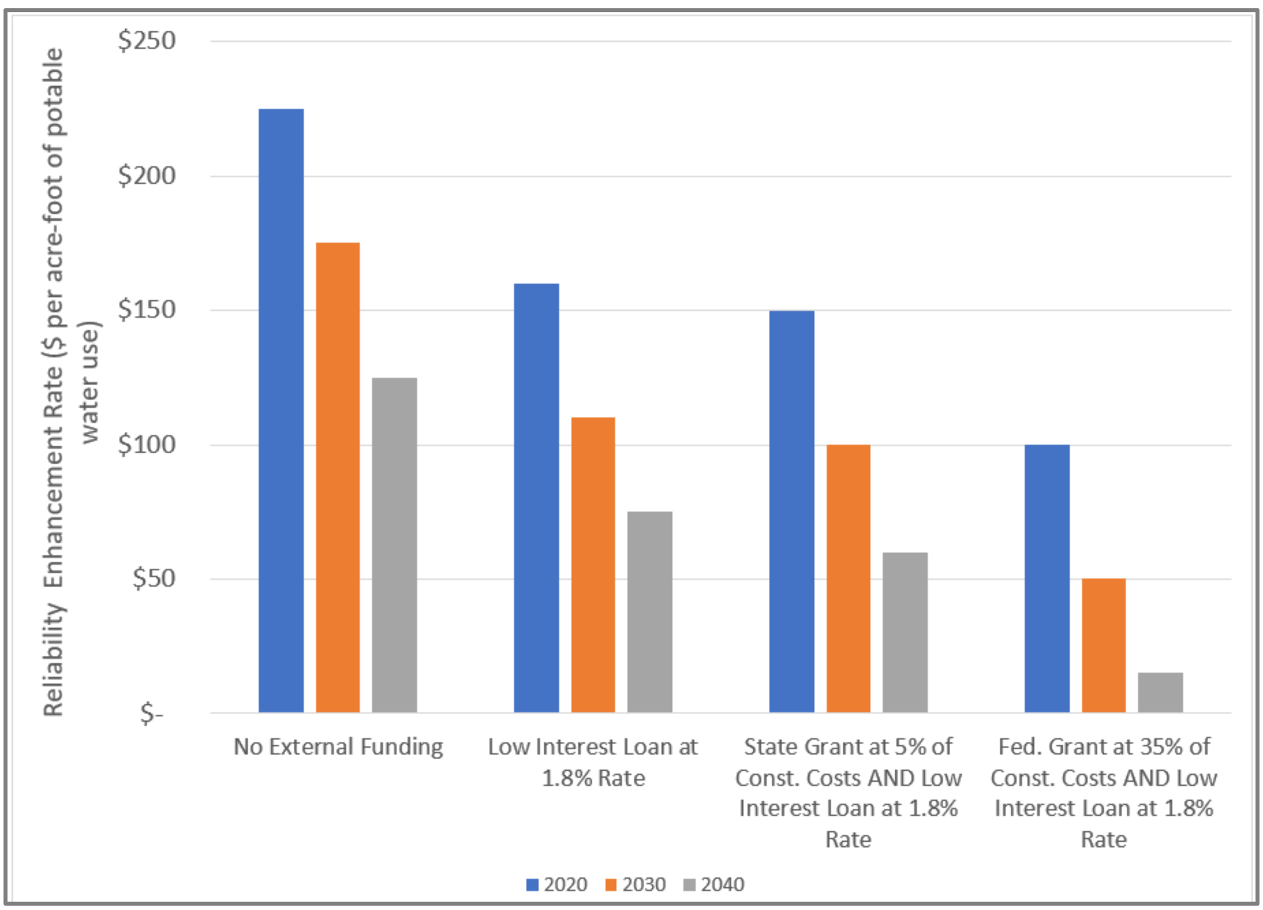
- **What are potential mitigation strategies to improve project feasibility or re-purpose Phase 3 Project facilities if future changes negate the cost-effectiveness of planned recycled water use?** There are three potential mitigation strategies: (1) increasing the price for which recycled water is sold; and (2) expanding the recycled water throughput by expanding to other service territories and (3) finding an alternative use for the Phase 3 Expansion Project facilities. The expansion potentials and alternative uses for the Phase 3 pipeline will be developed under the next phase of work - the Recycled Water Strategic Plan.

6.2 Project Feasibility Assessment

Figure 6-1 illustrates the reliability rate given different points in time and funding and financing scenarios. CPA will need to determine an acceptable reliability rate. Assuming CPA secures a low interest state loan, the reliability rate in the early years of the project is about $150 per AF ($0.34 per ccf) or about a 3-4 percent rate increase for potable water customers. The maximum reliability rate in 2020 with no outside funding is $250 per AF ($0.57 per ccf) and the lowest reliability rate in 2040 is about $25 per AF ($0.06 per ccf).

The reliability rate for a scaled-down project is therefore lower than for the full Phase 3 Expansion Project. Proceeding with a scaled-down Phase 3 project needs to be weighed against the other water reuse alternatives to be identified in the Recycled Water Strategic Plan because some of those alternatives may rely on the full Phase 3 Expansion Project facilities.

Figure 6-1: Most Likely Reliability Rate Over Time Given Funding Scenarios



6.3 Business Plan Recommendations

Based upon the work conducted in this Business Plan the following actions are recommended:

- Evaluate a scaled-down project that excludes the customer currently using groundwater taking into consideration the water reuse alternative results in the Northwest County Recycled Water Strategic Plan (currently underway, July 2018).
- Conduct a rigorous cost of service study to refine the estimated recycled water revenue, and update the cost versus benefit calculation.
- Continue aggressive pursuit of external funding, including grants and low interest loans.
- Continue identification and evaluation of additional uses that might be served recycled water from the Phase 3 Expansion Project.
- Evaluate incorporation of Phase 3 facilities into a future groundwater recharge project in the Indirect Potable Reuse Feasibility Study (currently underway, July 2018).
- Evaluate incorporation of Phase 3 facilities into a future Direct Potable Reuse (DPR) facility as part of the Northwest County Recycled Water Strategic Plan (currently underway, July 2018).
- Complete the Northwest County Recycled Water Strategic Plan (currently underway, July 2018) to compare Phase 3 to other recycled water use alternatives.

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Appendix A - Customer Demand Update Database

1. DETAILED METHODOLOGY FOR UPDATED PROJECTED RECYCLED WATER DEMANDS FOR THE PHASE 3 EXPANSION PROJECT

1.1 APPROACH TO UPDATING DEMANDS

1.1.1 Data Review

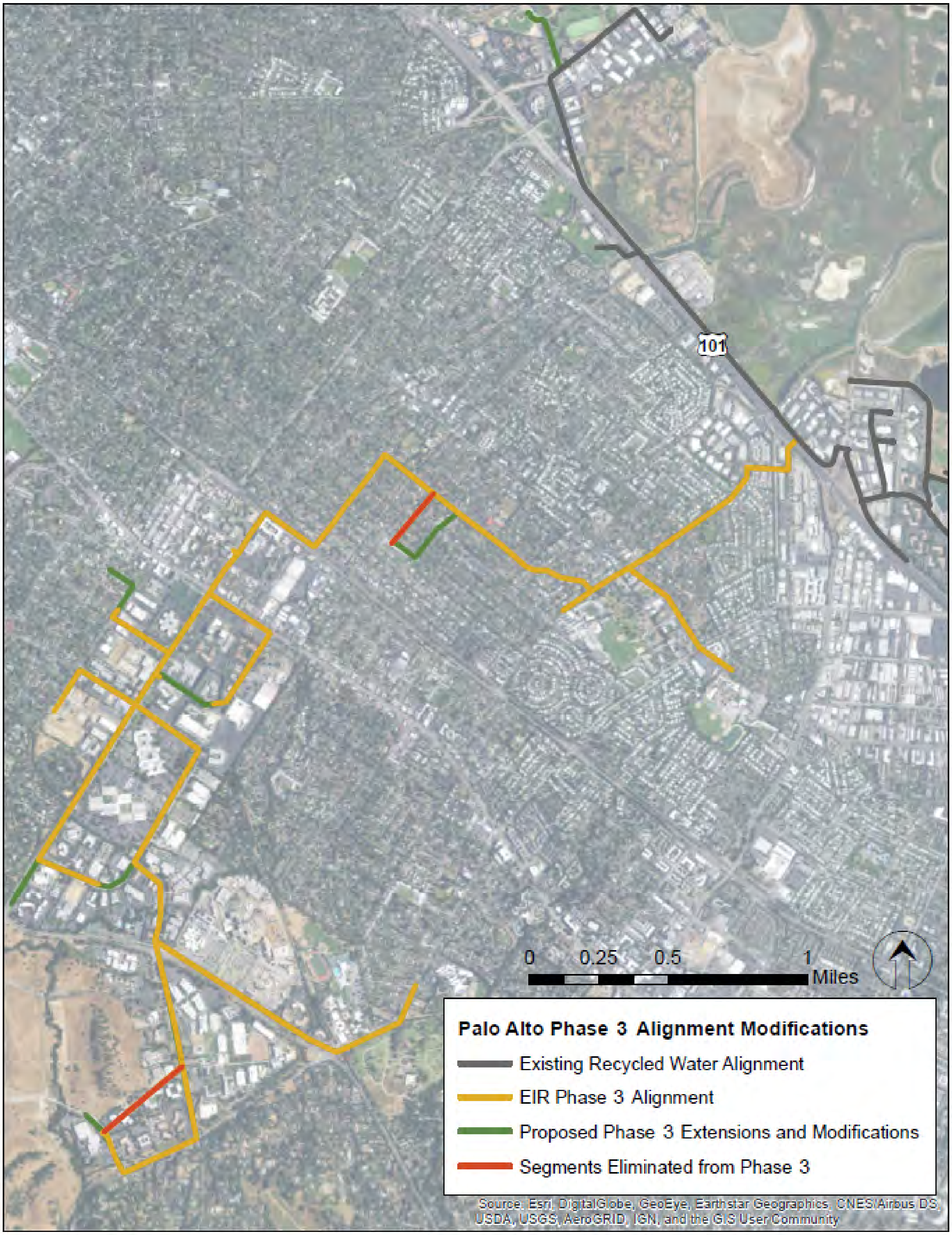
Water use records for Palo Alto's non-residential customers for 2013, 2015, and 2016 were provided by CPA. These years were selected as being representative of demands prior to water use restrictions enacted because of the recent drought (2013), demands at the height of the drought caused water use restrictions (2015) and demands as drought conditions began to lift (2016). The intent of reviewing data across these years was to try to identify whether the pre-restriction or post-restriction use is a better representation of recycled water potential for this area. The review found that the percent change in water use varied greatly among the customers, and moreover, while some customers exhibited a decrease in usage from 2013 to 2016 with an increase in usage from 2015 to 2016, which was the anticipated pattern, that trend was not consistent. As such, the 2016 data, which represents the most up to date customer base, was used as the basis for estimating potential recycled water demands.

Palo Alto provided data for two different types of meters: W4 and W7. W4 meters are non-residential meters, which may include commercial, industrial and institutional uses. W7 meters are specifically for irrigation. Some customers have both W4 and W7 meters, while others have W4 meters that serve both indoor and irrigation demands.

The customer use data was summarized by meter numbers. These meter numbers were also included in the GIS shapefile of customer meter locations provided by Palo Alto. Total annual use and peak month (August) use for each customer meter were extracted from the customer use data and joined to the attributes for each meter location in the GIS database developed by CPA and RMC. Thus, the expected water and recycled water demand for each customer is presented spatially in GIS. Modifications to the pipeline alignment proposed in 2008 were proposed as seen in Figure 1. Extensions were proposed for potential recycled water users with at least 20 AFY of demand and within 1500 feet of the existing alignment to be cost effective. Additionally, through the GIS review, adjustments to the previously proposed alignment were identified to keep the proposed pipeline within the public right of way. Both the proposed extensions and portions of the 2008 alignment that have been eliminated due to these adjustments are noted in Figure 1.

In addition to reviewing existing water use for customers in the service area, the Palo Alto Planning Department was consulted to identify re-development plans that could change the customer base and thereby impact future recycled water demand. Currently there are no firm plans within the study area that would change water use, and thus no adjustments to the existing use to account for land use changes were made. Section 1.1.2 addresses tentative re-development plans that have been contemplated within the Stanford Research Park.

Figure 1: Phase 3 Alignment Modifications



1.1.2 Demand Estimate Methodologies

The water uses that are potentially convertible to recycled water are irrigation, cooling towers, toilet flushing for dual plumbed facilities and industrial process water demands. Recycled water demand for each water use type was determined based on the customer type and meter type at that customer. Customers were broadly categorized into four types:

- General – All customers that did not fall into one of the categories below were considered general customers.
- Park – These customers were identified as parks through the customer name and address linked with their meter.
- School – These customers were identified as schools through the customer name and address linked with their meter.
- Median – Medians were identified through satellite imagery analysis.

W7 and W4 meters for non-residential customers were considered as part of the initial estimate for recycled water demands. Each customer was assigned a customer classification, described Table 1and shown for each customer in the demand estimate table presented in this appendix, depending on its customer categorization and water meter. This analysis describes how the recycled water (RW) demand was estimated for that customer. Customers may have multiple customer classifications assigned to them if they have multiple types of demand; for example, a customer may have both irrigation and cooling tower demands and may have analysis types 1A and 3B assigned to it.

Table 1: Recycled Water Customer Classification

Customer Classification	Description
0	No Demand Served by RW.
1A	Irrigation. Assumed 100% of 2016 W7, including rebound factor. Use can be met with RW.
1B	Irrigation. No W7 meter, so % of W4 use assigned for irrigation portion of demand based on customer type. Includes rebound factor.
1C	Irrigation. Special data overrides formula, see customer notes in Appendix A
2	Industrial. Based on customer survey information.
3A	Cooling Tower. Based on sq ft of building and cooling tower load assumptions.
3B	Cooling Tower. Special data, see customer notes
4	Dual Plumbing. Based on 30% of total water use used for toilet flushing assumption.

All demands from type 1A customers with W7 meters are assumed to be irrigation demands, and thus convertible to recycled water. For 1B customers, the amount of demand from the W4 meter deemed convertible to recycled water depends on customer type. Based on an analysis of the percentage of total demand used for irrigation from customers that have both a W4 and a W7 meter, 50% of W4 demands for general and school users are assumed to be for irrigation purposes. Where W4 meters are present for parks and medians, 100% of their demand is attributed to irrigation. For 1C customers, special considerations were used to determine demand. The largest potential irrigation customer in the service area is a cemetery, which was categorized as a 1C customer as it currently operates groundwater wells for irrigation. Irrigation demands for the cemetery were estimated from acreage analysis of their irrigated area. The cemetery's site is approximately 72 acres, with 75% of that area assumed irrigated. Analysis of evapotranspiration rates in Palo Alto indicate that the annual irrigation demand in this area is 41.3 inches. Thus, total irrigation demand for the cemetery was determined to be 185.9 AFY.

Potential type 2 industrial demands were identified through customer surveys conducted in 2008. Based on data previously provided by an industrial customer, 70% of the water measured by their W4 meter is for manufacturing processes. This customer had expressed interest in using recycled water if the water could meet its bio-science specifications. Several other customers were identified as having industrial uses, and their process water needs were estimated as 8% of combined use as measured by their W4 and W7 meters. The 8% was derived in the 2008 study using water usage information provided by one of the CPA's major industrial accounts at the time and assumed to be applicable to other industrial customers.

Demands for cooling towers included customers previously identified as having cooling towers and customers assumed to have cooling towers as determined by building square footage and number of stories. Using analysis type 3A, buildings over 100,000 square feet and above two stories are assumed to have cooling towers that could use recycled water. The magnitude of cooling tower demand was determined using historical use data from southern California, adjusted for the climate in Palo Alto using Cooling Degree Days (CDD, the number of degrees that a day's average temperature is above 65°F, which is assumed to be when air conditioning is needed, summed over an entire year). The historical data from several office buildings in Burbank, California showed that the average water demand for cooling towers was .073 AF per 1,000 sq ft of building. Burbank has approximately 4.1 times as many CDDs as Palo Alto, so the Burbank cooling tower use factor was divided by 4.1 to yield a cooling tower use factor of 0.018 AF per 1,000 sq ft for the Palo Alto area. This factor was applied to all large office buildings assumed to have cooling towers in the service area to reach a total cooling tower demand of 54.2 AFY. Several buildings with special circumstances had cooling tower demands that were evaluated using analysis type 3B.

There is one customer in the service area known to have dual plumbing and was analyzed as a type 4 customer. It is assumed that 30% of the water measured by its W4 meter is used for toilet flushing that could be converted to recycled water. The 30% of indoor water use for toilet flushing is derived from a California Energy Commission report, which states that toilet flushing accounts for 28-40% of indoor water use, on average (Hauenstein, 2013).

1.1.3 Net Use Factor

Factors of use were applied to each customer to account for potential issues with implementing recycled water that could prevent serving every potential recycled water use identified along the proposed alignment. This factor is less than or equal to 1 and was multiplied by each customer's estimated demand for irrigation, industrial, cooling tower, or dual plumbing use to yield a more probable demand for the overall Phase 3 expansion. A factor of use of 1 was applied to irrigation demands for parks and medians, as these areas are irrigated by CPA and can easily be converted to recycled water. All other customers with irrigation demands that have a total water demand of over 2 AFY were assigned a factor of use of 0.9, as performing retrofits may be a challenge for some customers and CPA is unlikely to be able to convert every customer with potential recycled water demands. A factor of use of 0 was applied to non-park or median users with a demand less than 2 AFY, as conversions are likely to be cost prohibitive for these low water users.

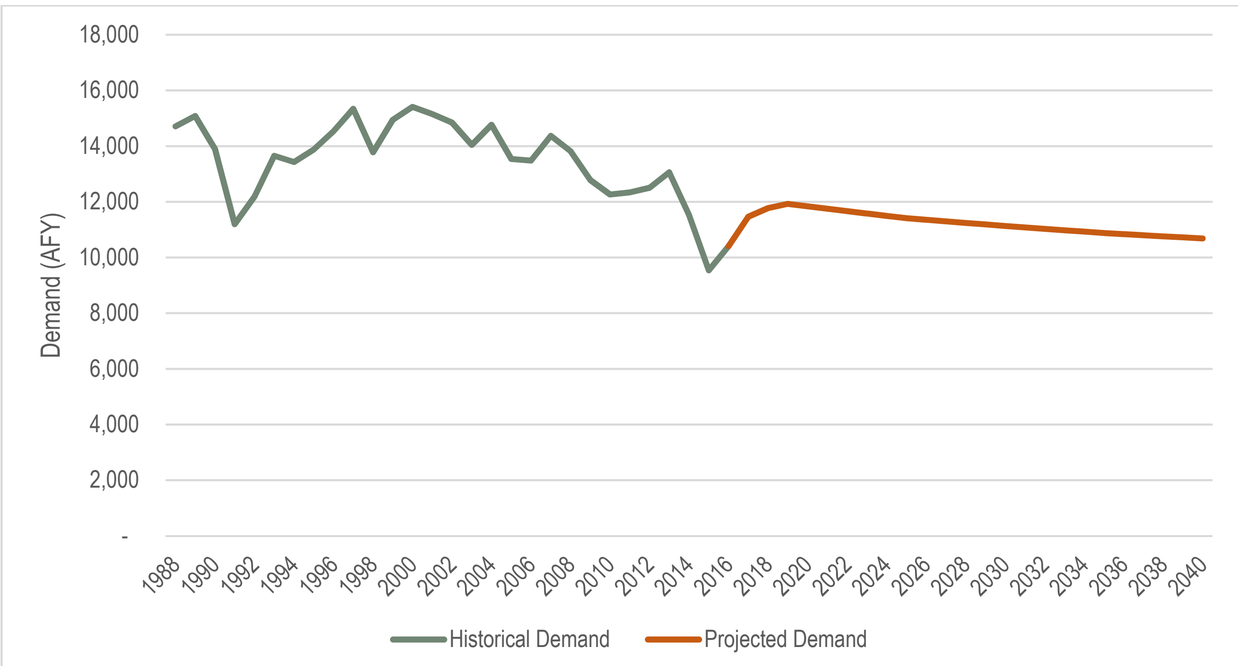
Most customers with industrial and cooling tower demands were assigned a factor of use of 0.5 to reflect uncertainty of their acceptance of recycled water. For these users, taking recycled water will likely depend on cost effectiveness and recycled water quality. Several industrial users in the service area were given a factor of use of 0 if they responded negatively to the customer survey due to water quality concerns or concerns regarding retrofit costs.

Customers with dual plumbing were given a factor of use of 1 since they are already set up to take recycled water.

1.1.4 Rebound Factor

The water meter data used for this analysis is from 2016. While 2016 was a fairly average year for rainfall, 2012 through 2015 was a period of severe drought throughout California that triggered both state and local water restrictions. Many water use restrictions implemented during the drought were still in effect in 2016, likely suppressing the water use shown in the CPA's metered data. Irrigation demands are likely to rebound following the lifting of drought restrictions. It is assumed that the rebound in irrigation use will follow the trend projected for the CPA's overall water use. The overall water use rebound projected for Palo Alto, shown in Figure 2, predicts an initial increase followed by a decrease assuming additional water use efficiency measures are implemented. A 7.5% increase in demand over current demands is the average rebound projected in the period from 2020 through 2040. Thus, a 7.5% increase in irrigation demands was incorporated into the recycled water demand estimate.

Figure 2: Historical and Projected Water Demand Served by the CPA



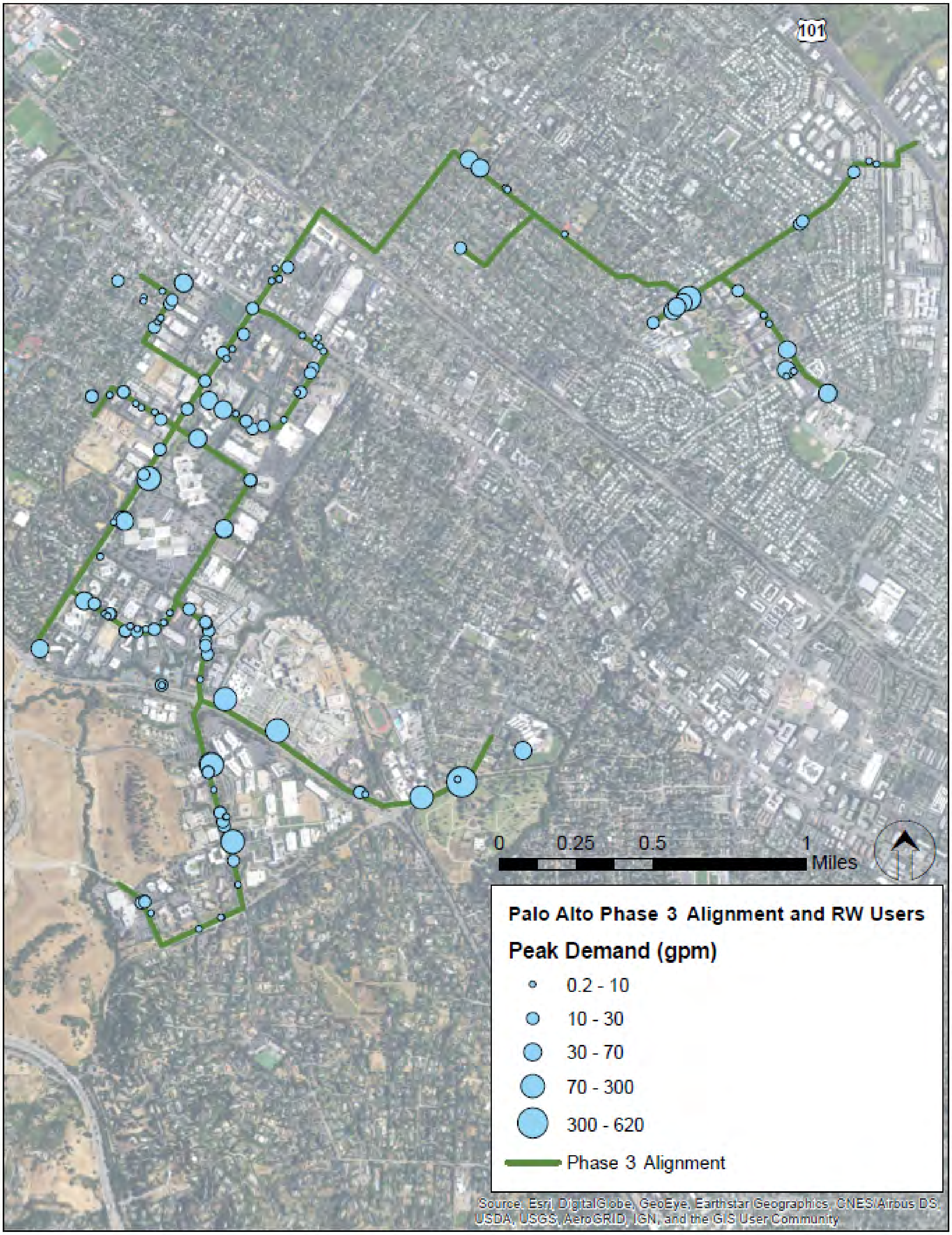
1.1 UPDATED POTENTIAL PHASE 3 DEMANDS

1.1.1 Annual Average and Peak Demands

Applying the demand estimate methodologies and factors discussed above yields a potential annual average recycled water demand of 810 AFY for Palo Alto's Phase 3 recycled water system service area. The updated target recycled water users are shown in Figure 3. Estimated potential recycled water demand for each customer, including a breakdown of total demand for each customer, is included in this appendix.

The peak month for demand from the 2016 water use data was August. This is the maximum demand month. The maximum day demand, defined as the average daily demand over August 2016, for the Phase 3 service area is 1.5 MGD.

Figure 3: Updated Alignment and Recommended Project Target Recycled Water Uses



Peak hour demand was determined by creating diurnal demand curves for each use type. Industrial use is assumed to be continuous throughout the day and night and thus has no hourly peaking factor. Cooling towers and dual plumbing demand is assumed to only occur for a 12-hour period during daytime, from 6AM to 6PM. Thus, the maximum day demand to the peak hour demand peaking factor for these uses is 2. Irrigation is assumed to occur only overnight in an 8-hour period from 9PM to 5AM, resulting in an hourly peaking factor of 3. The total peak demand in Phase 3 occurs in this overnight period at a rate of 2,781 gpm. The diurnal peaking factors used to determine demand are shown in Figure 4 and the demand curve for each type of recycled water use is displayed in Figure 5.

Figure 4: Diurnal Peaking Factors for Phase 3 Customers

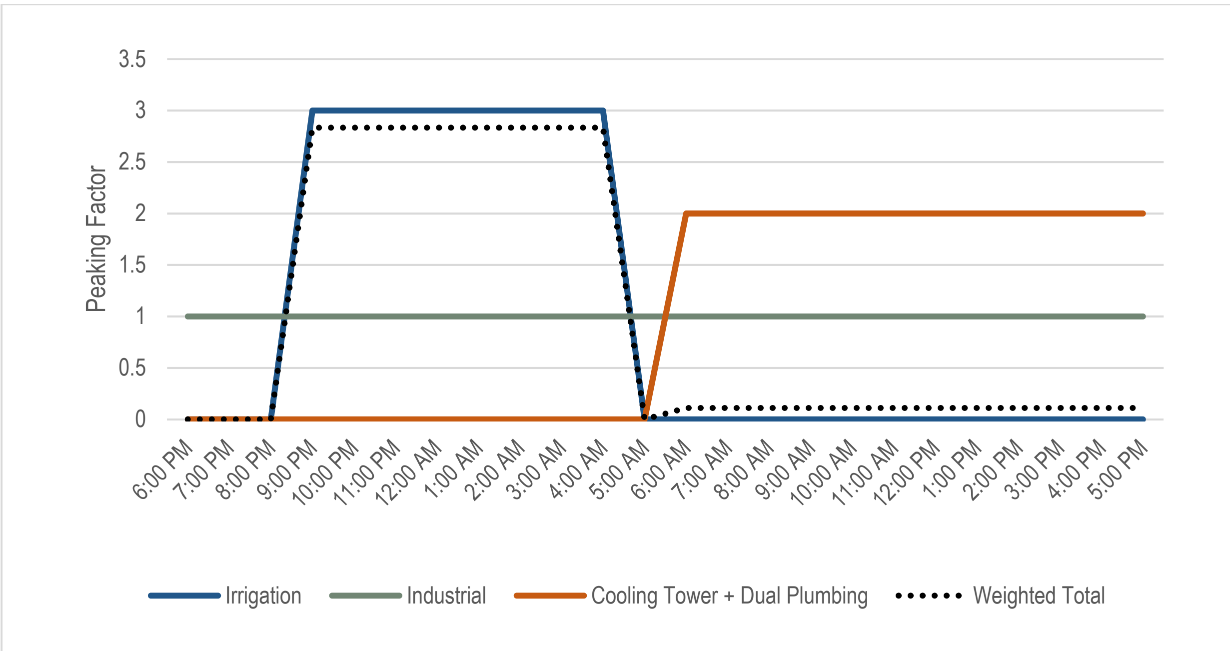
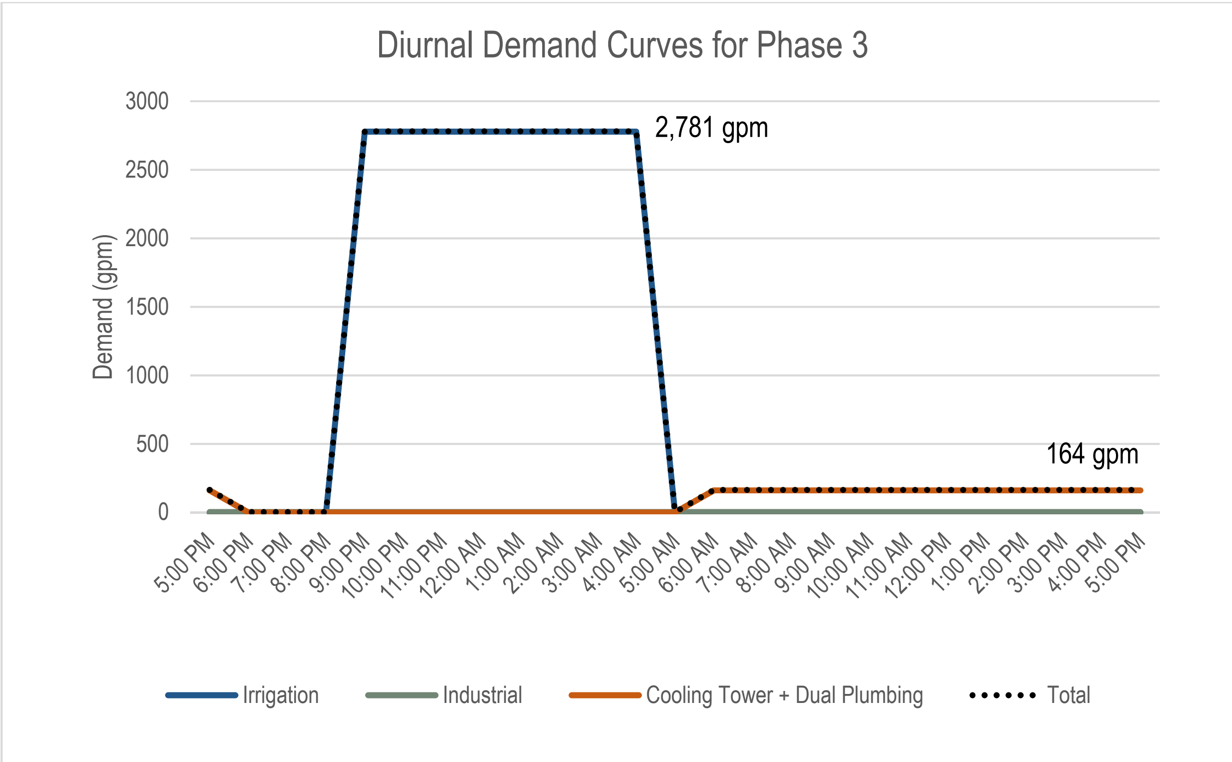


Figure 5: Diurnal Demand Curve for Phase 3 Customers



1.1.2 Potential Demand Variability, 2020 – 2040

As discussed in Section 1.1.4, the projected demand for the Phase 3 system assumed that irrigation demands served by the Phase 3 expansion will be 7.5% greater than current irrigation demands. This assumes that recycled water use will follow the overall trend for water use within the City of Palo Alto. However, given recycled water's branding as a drought proof supply, recycled water irrigators may not adopt the same attitude of water use efficiency for recycled water as they do potable water. The overall water use peaks at 13% above existing demands. Applying this rebound factor to the Phase 3 irrigation demands would result in a total annual demand for Phase 3 of 840 AFY.

The Phase 3 service area has seen several changes in the last decade that have led to changes in water consumption. In addition to changes in the customer base, there have been changes in customer practices. Customer account representatives shared that for economic reasons companies have been moving their data servers out of state, resulting in reduced cooling tower water demands for the service area. In recent years, some companies have opted to implement xeriscaping to reduce irrigation demand.

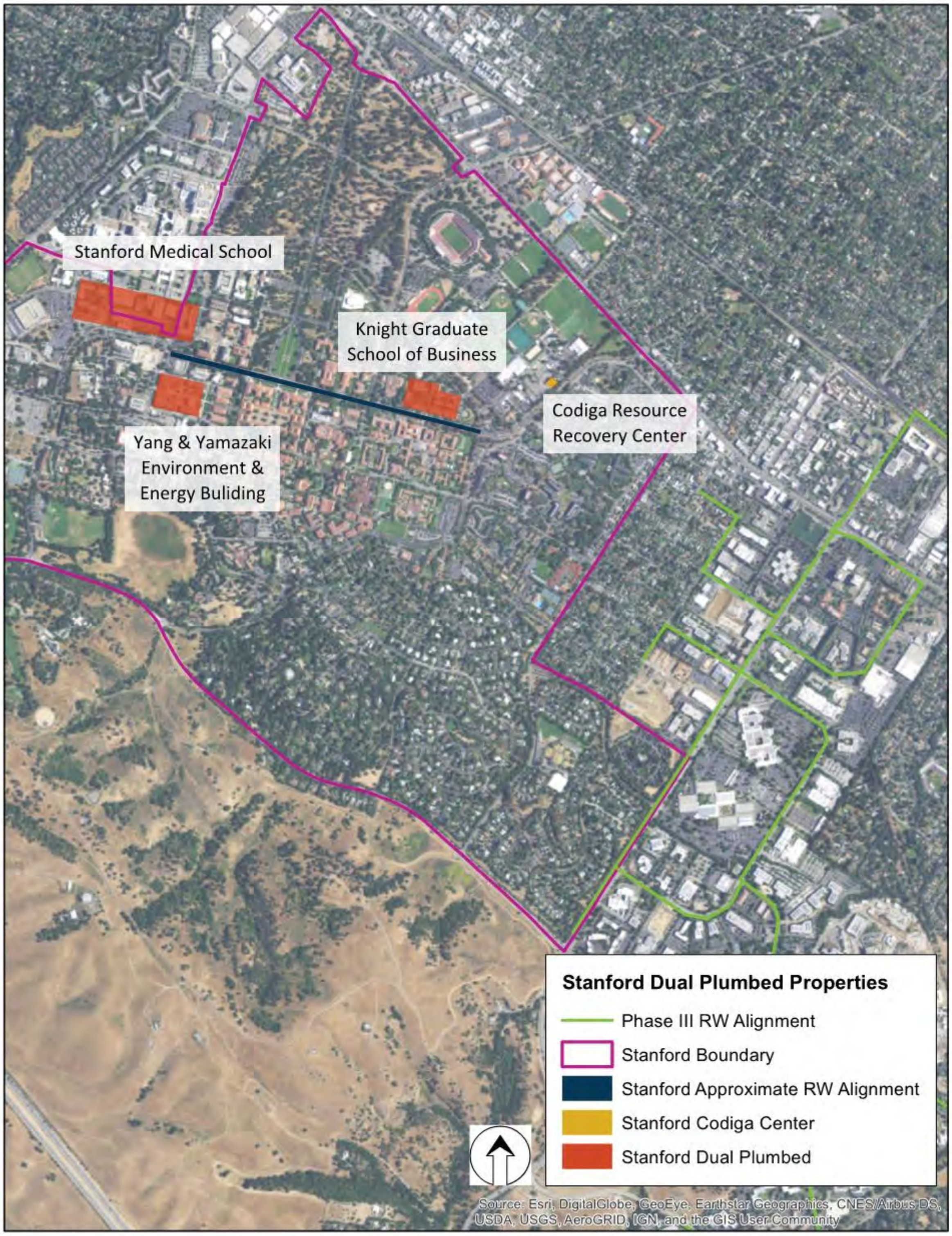
It is likely that the Phase 3 service area will continue to see changes through the next two decades, but whether these changes will lead to further reduction in water use or will result in increased recycled water demand is difficult to predict. As discussed in Section 1.1.1, potential zoning changes and re-development plans for the service area were investigated to attempt to account for anticipated changes. However, no firm plans were identified. Concepts that have been discussed include incorporating housing into Stanford Research Park and the development of a hotel and conference center near Palo Alto Square.

The Palo Alto City Council has expressed interest in pursuing residential development within Stanford Research Park, but specific locations for housing have not been identified. The vision is to design these developments as communities and not simply adding houses on top of parking lots. If the new housing were to displace parcels with significant landscaping and associated irrigation demands, recycled water demand could decrease. On the other hand, if a new residential community were to take the place of parcels dominated by hardscaping, the recycled water demand could increase through irrigation demand for landscaping around multi-family residences or the lawns of single family homes. Though not mandated by Palo Alto's mandatory recycled water use ordinance (Ordinance No. 5002), recycled water can be used for irrigation of single family homes. Several California agencies, including Irvine Ranch Water District, City of Windsor and El Dorado Irrigation District, currently supply recycled water to residential developments for lawn irrigation.

In addition to requiring new construction to use recycled water for irrigation, for new construction that is within a Recycled Water Project Area, Ordinance No. 5002 requires the use of recycled water for toilet and urinal flushing and trap priming for construction greater than 10,000 square feet or where installation of 25 or more toilets and urinals is proposed. If a new hotel and conference center were constructed near Palo Alto Square (at the corner of Page Mill and El Camino) it would presumably be subject to Palo Alto's mandatory use ordinance. Whether it would result in a future decrease or increase to recycled water use again depends on the demands it would displace.

Expansion of the Phase 3 service area to include Stanford University was considered as part of this Plan. Stanford previously used recycled water for dual-plumbed buildings within the Knight Graduate School of Business, Stanford Medical School and Yang & Yamazaki Environment & Energy Building, and these buildings reached a combined recycled water demand of 15,000 gpd or 16.8 AFY. The Cardinal Cogeneration plant, which was their source of recycled water has been demolished, but the recycled water distribution infrastructure is still in place. The location of these buildings is shown in Figure 6. If Stanford's existing recycled water pipeline were to be connected to the Phase 3 pipeline, roughly a mile of additional pipeline would be needed. Serving the existing dual-plumbed buildings alone would probably not be cost effective given the length of pipeline required to make the connection. However, there is significant potential for recycled water use within the Stanford campus. As new buildings are constructed on campus they could be connected to the recycled water pipeline, which runs through the center of campus along Serra Street. Along Serra Street is Stanford's new Codiga Resource Recovery Center. The Codiga Center, which serves a testbed for wastewater treatment technologies, could be a place for the City of Palo Alto and Stanford to partner on research using recycled water from the CPA. Additionally, there are significant irrigation demands within the university campus and neighboring Stanford golf course. Currently Stanford is not interested in using recycled water from CPA, so these demands were not included in the projected demand for Phase 3.

Figure 6: Dual Plumbed Buildings at Stanford University



Meter Types	Customer Type	RW Factor of Use for Irrigation	Estimated Irrigation Use Including Rebound (AFY)	RW Factor of Use for Industrial Process Water Use	RW Estimated for Industrial Process Water (AFY)	RW Factor of Use for Cooling Tower	RW Estimate for Cooling Tower (AFY)	RW Factor of Use for Dual Plumbing	RW Estimate for Dual Plumbing (AFY)	Total Annual Demand (AFY)[1]	Total Max Day Demand (gal)	Customer Classification
W4 & W7	General	1	5.9		0		0		0	5.91	8,249	1C
W4 & W7	General	1	14.4		0		0		0	14.39	27,234	1A
W4	General	0.9	1.3		0		0		0	1.33	2,390	1B
	General	0.9	167.3		0		0		0	167.27	331,128	1C
W4	General	0.9	3.0		0	0.5	1.5		0	4.52	6,236	1B, 3B
W4 & W7	General	1	1.8		0		0		0	1.76	2,599	1A
W7	General	1	19.1		0		0		0	19.15	30,172	1A
W4 & W7	School	1	5.6		0		0		0	5.58	15,369	1A
W4 & W7	General	1	0.3		0		0		0	0.26	452	1A
W4 & W7	Park	1	17.6		0		0		0	17.63	36,839	1A
W7	Park	1	14.0		0		0		0	13.96	30,285	1A
W4	Park	1	6.4		0		0		0	6.41	13,334	1B
W4	Median	1	0.3		0		0		0	0.27	226	1B
W7	Median	1	1.1		0		0		0	1.06	4,181	1A
W4	Park	1	2.4		0		0		0	2.35	6,780	1B
W4	Park	1	2.8		0		0		0	2.80	6,893	1B
W4	Park	1	1.2		0		0		0	1.16	678	1B
W4	Park	1	3.7		0		0		0	3.71	5,198	1B
W4 & W7	Park	1	9.6		0		0		0	9.62	18,533	1A
W4 & W7	General	1	1.4		0		0	1	0.5	1.88	3,085	1A, 4
W4 & W7	General	1	20.1		0		0		0	20.10	25,087	1A
W4 & W7	General	1	6.1		0		0		0	6.13	8,814	1A
W4	General	0.9	10.6	0	0	0.5	3.3		0	13.92	7,852	1B, 3A
W7	General	1	2.5		0		0		0	2.45	3,616	1A
W4	General	0.9	1.4		0		0		0	1.43	1,882	1B
W4	General	0.9	7.0		0	0.5	1.7		0	8.70	12,642	1B, 3A
W4	General	0	0.0		0	0.5	0.9		0	0.91	2,152	3A
W4	General	0.9	3.1		0		0		0	3.13	2,644	1B
W4	General	0.9	3.1		0		0		0	3.13	4,678	1B
W4	General	0.9	3.4	0.5	4.1		0		0	7.44	7,403	1C, 2
W7	General	1	6.0		0		0		0	6.02	8,362	1A
W4 & W7	General	1	8.0		0		0		0	7.99	13,900	1A
W4 & W7	General	1	6.2		0		0		0	6.25	11,187	1A
W4 & W7	General	1	0.0	0	0	0.5	9.4		0	9.35	22,114	3A
W4 & W7	General	1	35.9	0	0	0.5	4.6		0	40.54	69,261	1A, 3A
W4 & W7	General	1	6.7		0		0		0	6.65	18,646	1A
W4 & W7	General	1	1.0		0		0		0	1.03	2,260	1A
W4	General	0.9	1.6		0		0		0	1.55	1,526	1B
W4	General	0.9	3.5		0		0		0	3.54	6,153	1B
W4 & W7	General	1	6.8		0		0		0	6.80	10,396	1A
W4 & W7	General	1	3.4		0		0		0	3.41	6,441	1A
W4 & W7	General	1	0.5		0		0		0	0.49	791	1A
W4	General	0.9	3.6		0		0		0	3.60	5,492	1B
W4	General	0.9	5.1		0	0.5	2.8		0	7.92	11,011	1B, 3A

Meter Types	Customer Type	RW Factor of Use for Irrigation	Estimated Irrigation Use Including Rebound (AFY)	RW Factor of Use for Industrial Process Water Use	RW Estimated for Industrial Process Water (AFY)	RW Factor of Use for Cooling Tower	RW Estimate for Cooling Tower (AFY)	RW Factor of Use for Dual Plumbing	RW Estimate for Dual Plumbing (AFY)	Total Annual Demand (AFY)[1]	Total Max Day Demand (gal)	Customer Classification
W4 & W7	General	1	8.3		0		0		0	**8.27**	**7,684**	1A
W4	General	0.9	4.1		0		0		0	**4.11**	**7,272**	1B
W4 & W7	General	1	0.2		0		0		0	**0.19**	**226**	1A
W4	Park	1	3.2		0		0		0	**3.24**	**5,424**	1B
W4 & W7	General	1	13.6		0		0		0	**13.63**	**18,985**	1A
W4 & W7	General	1	12.1		0		0		0	**12.13**	**11,300**	1A
W4 & W7	General	1	5.2		0		0		0	**5.20**	**9,605**	1A
W4	General	0.9	3.0		0		0		0	**3.00**	**2,502**	1C
W7	General	1	1.0		0		0		0	**0.97**	**1,130**	1A
W7	General	1	0.8		0		0		0	**0.80**	**904**	1A
W4 & W7	General	1	3.1		0		0		0	**3.07**	**6,441**	1A
W4	General	0	0.0		0	0.5	1.3		0	**1.34**	**3,157**	3A
W4	General	0.9	1.5		0		0		0	**1.49**	**1,729**	1B
W4 & W7	General	1	1.3		0	0.5	2.0		0	**3.33**	**6,699**	1A, 3A
W4	School	0.9	13.8		0		0		0	**13.85**	**11,137**	1B
W4	School	0.9	12.3		0		0		0	**12.34**	**20,697**	1B
W4	School	0.9	17.8		0		0		0	**17.80**	**68,707**	1B
W4	School	0.9	2.0		0		0		0	**1.98**	**6,204**	1B
W4	General	0.9	4.6		0	0.5	1.9		0	**6.50**	**4,458**	1B, 3A
W4	General	0.9	1.1		0		0		0	**1.14**	**1,322**	1B
W4	General	0.9	1.6		0		0		0	**1.56**	**2,746**	1B
W4 & W7	General	1	1.9		0		0		0	**1.87**	**3,051**	1A
W4	General	0.9	1.2		0		0		0	**1.17**	**966**	1B
W4 & W7	General	1	1.1		0		0		0	**1.12**	**1,808**	1A
W4	General	0.9	1.6		0		0		0	**1.58**	**1,932**	1B
W4 & W7	General	1	5.4		0		0		0	**5.35**	**9,040**	1A
W4 & W7	General	1	4.0		0		0		0	**4.01**	**9,379**	1A
W4	General	0.9	2.1		0		0		0	**2.11**	**3,661**	1B
W4 & W7	General	1	3.8		0		0		0	**3.83**	**8,136**	1A
W4	General	0.9	4.5		0		0		0	**4.54**	**3,865**	1B
W4	General	0.9	4.1		0		0		0	**4.14**	**8,441**	1B
W4	General	0.9	1.1		0		0		0	**1.08**	**3,763**	1B
W7	General	1	8.6		0		0		0	**8.64**	**13,673**	1A
W4 & W7	General	1	3.9		0		0		0	**3.92**	**8,814**	1A
W4 & W7	General	1	1.8		0		0		0	**1.82**	**4,746**	1A
W4 & W7	General	1	1.7		0		0		0	**1.70**	**3,390**	1A
W4 & W7	General	1	0.9		0		0		0	**0.91**	**2,260**	1A
W4	General	0.9	0.0		0	0.5	1.1		0	**1.08**	**2,542**	1B, 3A
W4 & W7	General	1	1.1		0		0		0	**1.08**	**1,695**	1A
W4 & W7	General	1	2.5		0		0		0	**2.45**	**3,955**	1A
W4 & W7	General	1	1.6		0		0		0	**1.59**	**3,842**	1A
W4	General	0.9	2.3		0		0		0	**2.28**	**2,492**	1B
W4 & W7	General	1	1.4		0		0		0	**1.37**	**2,825**	1A
W4 & W7	General	1	0.4		0		0		0	**0.39**	**226**	1A

Meter Types	Customer Type	RW Factor of Use for Irrigation	Estimated Irrigation Use Including Rebound (AFY)	RW Factor of Use for Industrial Process Water Use	RW Estimated for Industrial Process Water (AFY)	RW Factor of Use for Cooling Tower	RW Estimate for Cooling Tower (AFY)	RW Factor of Use for Dual Plumbing	RW Estimate for Dual Plumbing (AFY)	Total Annual Demand (AFY)[1]	Total Max Day Demand (gal)	Customer Classification
W4 & W7	General	1	1.9		0		0		0	**1.95**	**4,407**	1A
W7	General	1	0.1		0		0		0	**0.05**	**113**	1A
W4	General	0.9	5.0		0	0.5	2.6		0	**7.63**	**13,065**	1B, 3B
W4 & W7	General	1	7.7		0		0		0	**7.69**	**12,769**	1A
W4 & W7	General	1	10.7		0		0		0	**10.66**	**11,187**	1A
			617.9		**4.1**		**33.1**		**0.5**	**655.7**	**1,158,551**	
W4 & W7	General	1	0.3		0		0		0	**0.32**	**452**	1A
W4	General	0.9	3.1		0		0		0	**3.07**	**4,882**	1B
W7	General	1	3.5		0		0		0	**3.47**	**6,893**	1A
W4	General	0.9	2.8		0		0		0	**2.80**	**4,729**	1B
W4	General	0.9	8.4		0		0		0	**8.43**	**12,560**	1B
W4	General	0.9	0.0		0	0.5	5.4		0	**5.36**	**25,344**	1B, 3B
W4	General	0.9	11.0		0	0.25	8.1		0	**19.06**	**61,978**	1B, 3B
W4 & W7	General	1	16.1		0		0		0	**16.13**	**33,675**	1C
W4 & W7	General	1	0.8		0		0		0	**0.78**	**339**	1A
W4 & W7	General	1	63.2		0	0.5	6.1		0	**69.26**	**138,726**	1A, 3A
W4	General	0.9	1.6		0		0		0	**1.62**	**3,000**	1B
W4 & W7	General	1	3.1		0		0		0	**3.10**	**5,311**	1A
W4 & W7	General	1	5.4		0		0		0	**5.44**	**10,735**	1A
W4 & W7	General	1	7.4		0		0		0	**7.44**	**30,285**	1A
W4	General	0.9	6.6		0	0.5	1.7		0	**8.28**	**15,293**	1B, 3A

Appendix B - Preliminary Rate Analysis Results

Rate Analysis - Phase 3 + Embarcadero Road (including service to existing groundwater pumpers)

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Projected Rates												
	SFPUC (1) [per AF]	$ 1,949	$ 1,951	$ 1,952	$ 2,115	$ 2,373	$ 2,492	$ 2,650	$ 2,772	$ 2,911	$ 3,057	$ 3,148
	CPA Potable Water	$ 4,356	$ 4,574	$ 4,757	$ 5,042	$ 5,345	$ 5,505	$ 5,725	$ 5,840	$ 5,957	$ 6,135	$ 6,319
	Delta of CPA-SFPU	$ 2,407	$ 2,623	$ 2,805	$ 2,927	$ 2,972	$ 3,013	$ 3,075	$ 3,068	$ 3,046	$ 3,078	$ 3,171
	Annual Cost of Mor	$ 761	$ 776	$ 792	$ 807	$ 824	$ 840	$ 857	$ 874	$ 891	$ 909	$ 927
Revenue - Consumptive												
Enter % here:												
60%	Rate (% of CPA Po	$ 2,614	$ 2,744	$ 2,854	$ 3,025	$ 3,207	$ 3,303	$ 3,435	$ 3,504	$ 3,574	$ 3,681	$ 3,791
	Recycled Water Us	924	924	924	924	924	924	924	924	924	924	924
	Revenue Subtotal	$2,414,966	$ 2,535,826	$ 2,637,281	$ 2,795,285	$ 2,963,268	$ 3,051,972	$ 3,173,940	$ 3,237,696	$ 3,302,561	$ 3,401,244	$ 3,503,254
		$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637
	Net Revenue Cons	$2,280,329	$ 2,401,188	$ 2,502,643	$ 2,660,647	$ 2,828,631	$ 2,917,335	$ 3,039,303	$ 3,103,059	$ 3,167,923	$ 3,266,607	$ 3,368,616
Revenue - Fixed												
	# of Connections	194	194	194	194	194	194	194	194	194	194	194
	Net Revenue Fixed	$ 147,595	$ 150,547	$ 153,558	$ 156,629	$ 159,762	$ 162,957	$ 166,216	$ 169,540	$ 172,931	$ 176,390	$ 179,918
	Net Revenue Total	$2,427,924	$ 2,551,735	$ 2,656,201	$ 2,817,277	$ 2,988,392	$ 3,080,292	$ 3,205,519	$ 3,272,599	$ 3,340,855	$ 3,442,996	$ 3,548,534
Annual Cost - Modified Design												
	Capital Debt (5)	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854
	Energy (5)	$46,661	$46,661	$47,128	$48,070	$48,551	$49,036	$49,527	$50,022	$50,522	$51,028	$51,538
	Other O&M (5)	$177,000	$180,540	$184,151	$187,834	$191,590	$195,422	$199,331	$203,317	$207,384	$211,531	$215,762
	Lost Potable Water	$1,822,099	$1,985,611	$2,123,385	$2,215,739	$2,249,804	$2,280,841	$2,327,775	$2,322,476	$2,305,822	$2,330,046	$2,400,447
	Lost Fixed Revenu	$147,595	$150,547	$153,558	$156,629	$159,762	$162,957	$166,216	$169,540	$172,931	$176,390	$179,918
	Cost Total	$3,982,209	$4,152,213	$4,297,075	$4,397,126	$4,438,561	$4,477,111	$4,531,703	$4,534,210	$4,525,513	$4,557,849	$4,636,518
	Difference betwee	**-$1,554,285**	**-$1,600,478**	**-$1,640,874**	**-$1,579,850**	**-$1,450,169**	**-$1,396,819**	**-$1,326,184**	**-$1,261,611**	**-$1,184,658**	**-$1,114,852**	**-$1,087,984**
	Average Difference	-$1,160,178										

1 SFPUC water rate projections 2020-2027 provided by K. Dailey via email, February 20, 2018. FY28-30 extrapolated at 5% per year; FY31-40 extrapolated at 3% per year.
2 Per the FY 2018 Water Utility Financial Plan page, published February 2016. CPA 2017 W-7 Rate is $9.08; 2018 & 2019 increases are projected at 4% & 6%, resulting in a CPA 2020 W-7 Rate of $10/CCF. FY21-28 escalated based on percentages provided by E. Keniston via email, February 20, 2018. FY29-40 escalated at 3%.
CPA 2020 Monthly Service Charge for a 1.5" meter is $63.40 which equates to $760.80 annually. Per the FY 2017 Water Utility Financial Plan Page 7, published
3 February 2016. Escalated forward at 2%.
4 See Worksheet "Cemetery Savings" for details.
5 See Worksheet "Inputs_Mod" for details.
Lost Potable Water Sales Revenue = (Delta between CPA Potable Water Rate and the SFPUC Purchase Price) x (924-167 AF [which is the RW sales minus Cemetery
6 who is a GW pumper resulting in no loss of revenue to CPAU])

2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
$ 3,243	$ 3,340	$ 3,440	$ 3,543	$ 3,650	$ 3,759	$ 3,872	$ 3,988	$ 4,108	$ 4,231
$ 6,509	$ 6,704	$ 6,905	$ 7,112	$ 7,326	$ 7,546	$ 7,772	$ 8,005	$ 8,245	$ 8,493
$ 3,266	$ 3,364	$ 3,465	$ 3,569	$ 3,676	$ 3,787	$ 3,900	$ 4,017	$ 4,137	$ 4,262
$ 946	$ 965	$ 984	$ 1,004	$ 1,024	$ 1,044	$ 1,065	$ 1,087	$ 1,108	$ 1,131
$ 3,905	$ 4,022	$ 4,143	$ 4,267	$ 4,396	$ 4,528	$ 4,663	$ 4,803	$ 4,947	$ 5,096
924	924	924	924	924	924	924	924	924	924
$ 3,608,590	$ 3,716,698	$ 3,828,132	$ 3,942,893	$ 4,061,534	$ 4,183,502	$ 4,308,797	$ 4,437,972	$ 4,571,028	$ 4,708,519
$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637
$ 3,473,952	$ 3,582,060	$ 3,693,495	$ 3,808,255	$ 3,926,897	$ 4,048,865	$ 4,174,159	$ 4,303,335	$ 4,436,391	$ 4,573,882
194	194	194	194	194	194	194	194	194	194
$ 183,516	$ 187,186	$ 190,930	$ 194,749	$ 198,644	$ 202,617	$ 206,669	$ 210,802	$ 215,018	$ 219,319
$ 3,657,468	$ 3,769,247	$ 3,884,425	$ 4,003,004	$ 4,125,541	$ 4,251,482	$ 4,380,828	$ 4,514,137	$ 4,651,409	$ 4,793,200
$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854
$52,053	$52,574	$53,099	$53,630	$54,167	$54,708	$55,256	$55,808	$56,366	$56,930
$220,077	$224,479	$228,968	$233,548	$238,219	$242,983	$247,843	$252,800	$257,856	$263,013
$2,472,362	$2,546,548	$2,623,005	$2,701,733	$2,782,732	$2,866,759	$2,952,300	$3,040,869	$3,131,709	$3,226,334
$183,516	$187,186	$190,930	$194,749	$198,644	$202,617	$206,669	$210,802	$215,018	$219,319
$4,716,862	$4,799,641	$4,884,857	$4,972,514	$5,062,615	$5,155,921	$5,250,921	$5,349,133	$5,449,803	$5,554,449
-$1,059,394	**-$1,030,394**	**-$1,000,432**	**-$969,510**	**-$937,074**	**-$904,439**	**-$870,093**	**-$834,996**	**-$798,394**	**-$761,249**

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Annual Cost - Original Design (1)													
	Capital Debt	$1,923,491	$1,923,491	$1,923,491	$1,923,491	$1,923,491	$1,923,491	$1,923,491	$1,923,491	$1,923,491	$1,923,491	$1,923,491	$1,923,491
	Energy	$46,661	$46,661	$47,128	$48,070	$48,551	$49,036	$49,527	$50,022	$50,522	$51,028	$51,538	$52,053
	Other O&M	$177,000	$180,540	$184,151	$187,834	$191,590	$195,422	$199,331	$203,317	$207,384	$211,531	$215,762	$220,077
	Subtotal	$2,147,152	$2,150,692	$2,154,770	$2,159,395	$2,163,633	$2,167,950	$2,172,349	$2,176,831	$2,181,397	$2,186,050	$2,190,791	$2,195,622
Annual Cost - Modified Design (2)													
	Capital Debt	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854
	Energy	$46,661	$46,661	$47,128	$48,070	$48,551	$49,036	$49,527	$50,022	$50,522	$51,028	$51,538	$52,053
	Other O&M	$177,000	$180,540	$184,151	$187,834	$191,590	$195,422	$199,331	$203,317	$207,384	$211,531	$215,762	$220,077
	Subtotal	$2,012,515	$2,016,055	$2,020,132	$2,024,758	$2,028,995	$2,033,313	$2,037,711	$2,042,193	$2,046,760	$2,051,413	$2,056,154	$2,060,984
Savings Attributed to Cemetery		$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637
Cemetery Water Usage	AF	167	167	167	167	167	167	167	167	167	167	167	167
Groundwater Pumping Charge (3)		$ 1,413	$ 1,551	$ 1,702	$ 1,867	$ 2,048	$ 2,246	$ 2,442	$ 2,557	$ 2,677	$ 2,757	$ 2,840	$ 2,925
Annual Pumping Charge Cost to SCVWD		$ 235,971	$ 259,017	$ 284,234	$ 311,789	$ 342,016	$ 375,082	$ 407,814	$ 427,019	$ 447,059	$ 460,419	$ 474,280	$ 488,475
Power Cost to Extract GW (Estimate)		$ 16,700	$ 17,034	$ 17,034	$ 17,034	$ 17,034	$ 17,034	$ 17,034	$ 17,034	$ 17,034	$ 17,034	$ 17,034	$ 17,034
Total Cost to Cemetery		$ 252,671	$ 276,051	$ 301,268	$ 328,823	$ 359,050	$ 392,116	$ 424,848	$ 444,053	$ 464,093	$ 477,453	$ 491,314	$ 505,509
RW - Consumptive		$ 436,471	$ 458,315	$ 476,651	$ 505,208	$ 535,569	$ 551,601	$ 573,645	$ 585,168	$ 596,891	$ 614,727	$ 633,164	$ 652,202
RW - Fixed		$ 761	$ 776	$ 792	$ 807	$ 824	$ 840	$ 857	$ 874	$ 891	$ 909	$ 927	$ 946
RW Cost to Cemetery		$ 437,232	$ 459,091	$ 477,443	$ 506,016	$ 536,393	$ 552,441	$ 574,502	$ 586,042	$ 597,783	$ 615,636	$ 634,091	$ 653,148
Savings Credit		$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637
Net RW Cost to Cemetery		$ 302,595	$ 324,453	$ 342,805	$ 371,378	$ 401,755	$ 417,804	$ 439,864	$ 451,404	$ 463,145	$ 480,999	$ 499,454	$ 518,510
Cost as RW Customer - Costs as GW Pumper		$ 49,924	$ 48,402	$ 41,537	$ 42,555	$ 42,705	$ 25,688	$ 15,016	$ 7,351	$ (948)	$ 3,546	$ 8,140	$ 13,001

1 See Worksheet "Inputs_Orig" for details.
2 See Worksheet "Inputs_Mod" for details.
3 SCVWD groundwater charge projections 2020-2028 provided by K. Dailey via email, March 21, 2018. Projections for 2029-2040 extrapolated at 3% per year.
4 See "Rev& Costs" worksheet for RW rate by year.
5 See "Rev&Costs" worksheet for per RW meter cost by year.

2032	2033	2034	2035	2036	2037	2038	2039	2040
$1,923,491	$1,923,491	$1,923,491	$1,923,491	$1,923,491	$1,923,491	$1,923,491	$1,923,491	$1,923,491
$52,574	$53,099	$53,630	$54,167	$54,708	$55,256	$55,808	$56,366	$56,930
$224,479	$228,968	$233,548	$238,219	$242,983	$247,843	$252,800	$257,856	$263,013
$2,200,544	$2,205,559	$2,210,669	$2,215,877	$2,221,183	$2,226,589	$2,232,099	$2,237,713	$2,243,434
$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854	$1,788,854
$52,574	$53,099	$53,630	$54,167	$54,708	$55,256	$55,808	$56,366	$56,930
$224,479	$228,968	$233,548	$238,219	$242,983	$247,843	$252,800	$257,856	$263,013
$2,065,906	$2,070,922	$2,076,032	$2,081,239	$2,086,545	$2,091,952	$2,097,461	$2,103,076	$2,108,796
$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637
167	167	167	167	167	167	167	167	167
$ 3,013	$ 3,103	$ 3,196	$ 3,292	$ 3,391	$ 3,493	$ 3,598	$ 3,706	$ 3,817
$ 503,171	$ 518,201	$ 533,732	$ 549,764	$ 566,297	$ 583,331	$ 600,866	$ 618,902	$ 637,439
$ 17,034	$ 17,034	$ 17,034	$ 17,034	$ 17,034	$ 17,034	$ 17,034	$ 17,034	$ 17,034
$ 520,205	$ 535,235	$ 550,766	$ 566,798	$ 583,331	$ 600,365	$ 617,900	$ 635,936	$ 654,473
$ 671,741	$ 691,881	$ 712,622	$ 734,065	$ 756,109	$ 778,754	$ 802,101	$ 826,149	$ 850,999
$ 965	$ 984	$ 1,004	$ 1,024	$ 1,044	$ 1,065	$ 1,087	$ 1,108	$ 1,131
$ 672,706	$ 692,865	$ 713,626	$ 735,089	$ 757,154	$ 779,820	$ 803,188	$ 827,257	$ 852,129
$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637	$ 134,637
$ 538,068	$ 558,228	$ 578,989	$ 600,452	$ 622,516	$ 645,182	$ 668,550	$ 692,620	$ 717,492
$ 17,863	$ 22,993	$ 28,223	$ 33,654	$ 39,185	$ 44,817	$ 50,650	$ 56,684	$ 63,019

	Original	
Capital Cost (2017$) (1)	$ 44,288,000	Ph 3 + Emb Rd
Borrowing Rate (2)	1.8%	
Borrowing Term (yrs) (2)	30	
Capital Debt Service	$1,923,491.22	

			2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy Usage (1)	kwh		444894	444894	444894	444894	444894	444894	444894	444894	444894	444894	444894
Energy Rate Increase (3)		--		0%	1%	2%	1%	1%	1%	1%	1%	1%	1%
Unit Energy Cost (4)	$/kwh	$	0.105	$ 0.105	$ 0.106	$ 0.108	$ 0.109	$ 0.110	$ 0.111	$ 0.112	$ 0.114	$ 0.115	$ 0.116
Annual Energy Cost	$	$	46,661	$ 46,661	$ 47,128	$ 48,070	$ 48,551	$ 49,036	$ 49,527	$ 50,022	$ 50,522	$ 51,028	$ 51,538
Other O&M													
Labor & Chem Increase (5)		--		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Annual Other O&M (1)		$	177,000	$ 180,540	$ 184,151	$ 187,834	$ 191,590	$ 195,422	$ 199,331	$ 203,317	$ 207,384	$ 211,531	$ 215,762
Capital Debt Service		$	1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491
Subtotal - Costs (Original)		$	2,147,152	$ 2,150,692	$ 2,154,770	$ 2,159,395	$ 2,163,633	$ 2,167,950	$ 2,172,349	$ 2,176,831	$ 2,181,397	$ 2,186,050	$ 2,190,791

1 Capital cost estimate includes construction plus soft costs. See Preliminary Design Report for detailed Capital Cost Estimate, Energy Usage estimate, O&M estimate.
2 Assuming SRF financing with 30 year term
3 Published planned Energy Rate Increases through FY2024; assuming 1% increase for years 2025-2040. Per FY 2018 Electric Utility Financial Plan, May 2017.
4 2020 Rate is Proposed E-7 Summer Rate effective 7/1/2017 including a 9% increase in FY 2019. Per FY 2018 Electric Utility Financial Plan, May 2017.
5 Assumed 2% increase for inflation on chemical and labor costs.

2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
444894	444894	444894	444894	444894	444894	444894	444894	444894	444894
1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
$ 0.117	$ 0.118	$ 0.119	$ 0.121	$ 0.122	$ 0.123	$ 0.124	$ 0.125	$ 0.127	$ 0.128
$ 52,053	$ 52,574	$ 53,099	$ 53,630	$ 54,167	$ 54,708	$ 55,256	$ 55,808	$ 56,366	$ 56,930
2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
$ 220,077	$ 224,479	$ 228,968	$ 233,548	$ 238,219	$ 242,983	$ 247,843	$ 252,800	$ 257,856	$ 263,013
$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491	$ 1,923,491
$ 2,195,622	$ 2,200,544	$ 2,205,559	$ 2,210,669	$ 2,215,877	$ 2,221,183	$ 2,226,589	$ 2,232,099	$ 2,237,713	$ 2,243,434

	Original	
Capital Cost (2017$) (1)	$ 41,188,000	Ph 3 + Emb Rd
Borrowing Rate (2)	1.8%	
Borrowing Term (yrs) (2)	30	
Capital Debt Service	$1,788,853.78	

			2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy Usage (1)	kwh		444894	444894	444894	444894	444894	444894	444894	444894	444894	444894	444894
Energy Rate Increase (3)		--		0%	1%	2%	1%	1%	1%	1%	1%	1%	1%
Unit Energy Cost (4)	$/kwh	$	0.105	$ 0.105	$ 0.106	$ 0.108	$ 0.109	$ 0.110	$ 0.111	$ 0.112	$ 0.114	$ 0.115	$ 0.116
Annual Energy Cost	$	$	46,661	$ 46,661	$ 47,128	$ 48,070	$ 48,551	$ 49,036	$ 49,527	$ 50,022	$ 50,522	$ 51,028	$ 51,538
Other O&M													
Labor & Chem Increase (5)		--		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Annual Other O&M (1)		$	177,000	$ 180,540	$ 184,151	$ 187,834	$ 191,590	$ 195,422	$ 199,331	$ 203,317	$ 207,384	$ 211,531	$ 215,762
Capital Debt Service		$	1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854
Subtotal - Costs (Modified)		$	2,012,515	$ 2,016,055	$ 2,020,132	$ 2,024,758	$ 2,028,995	$ 2,033,313	$ 2,037,711	$ 2,042,193	$ 2,046,760	$ 2,051,413	$ 2,056,154

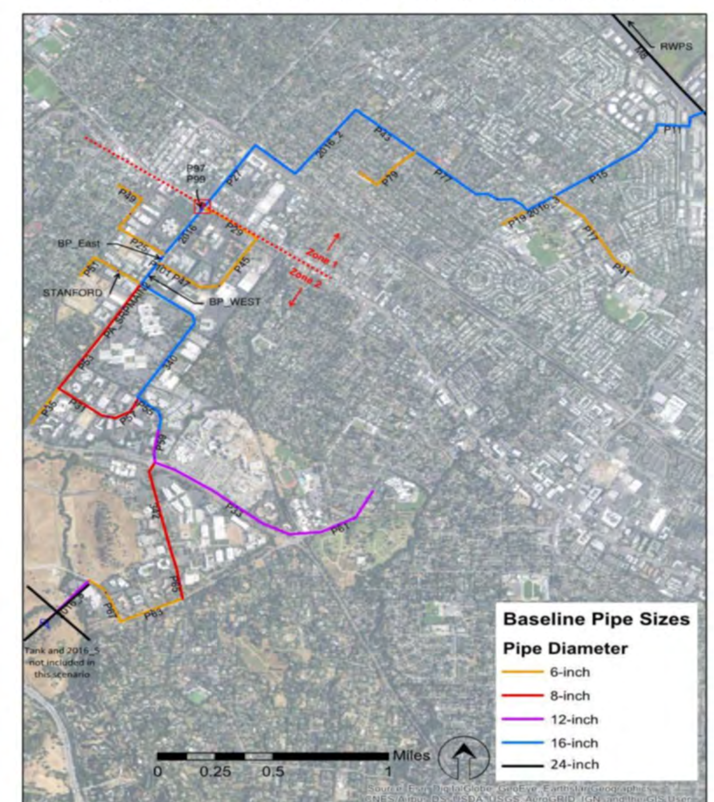
1 Capital cost estimate includes construction plus soft costs. See Preliminary Design Report for detailed Capital Cost Estimate, Energy Usage estimate, O&M estimate. The capital cost is modified to reduce pipe sizes leadin
to reduce pump station capacity by 10% to reflect benefit of delivering recycled water to Cemetery offpeak.
2 Assuming SRF financing with 30 year term
3 Published planned Energy Rate Increases through FY2024; assuming 1% increase for years 2025-2040. Per FY 2018 Electric Utility Financial Plan, May 2017.
4 2020 Rate is Proposed E-7 Summer Rate effective 7/1/2017 including a 9% increase in FY 2019. Per FY 2018 Electric Utility Financial Plan, May 2017.
5 Assumed 2% increase for inflation on chemical and labor costs.

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
	444894	444894	444894	444894	444894	444894	444894	444894	444894	444894
	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
	$ 0.117	$ 0.118	$ 0.119	$ 0.121	$ 0.122	$ 0.123	$ 0.124	$ 0.125	$ 0.127	$ 0.128
	$ 52,053	$ 52,574	$ 53,099	$ 53,630	$ 54,167	$ 54,708	$ 55,256	$ 55,808	$ 56,366	$ 56,930
	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
	$ 220,077	$ 224,479	$ 228,968	$ 233,548	$ 238,219	$ 242,983	$ 247,843	$ 252,800	$ 257,856	$ 263,013
	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854	$ 1,788,854
	$ 2,060,984	$ 2,065,906	$ 2,070,922	$ 2,076,032	$ 2,081,239	$ 2,086,545	$ 2,091,952	$ 2,097,461	$ 2,103,076	$ 2,108,796

g to Cemetery by one diameter and

	Original	Modified
P11	16	12
P15	16	12
P77	16	12
P43	16	12
2016_2	16	12
P27	16	12
2016	16	12
BP_EAST	16	12
BP_WEST	16	12
340	16	12
P55	16	12
P59	12	10
P33	12	10
P61	12	10

Figure 3-2: Phase 3 Pipe Diameters for Baseline (No Tank) Configuration



Rate Analysis - Phase 3 + Embarcadero Road (excluding service to existing groundwater pumpers)

		2020	2021	2022	2023	2024	2025	2026	2027
Projected Rates									
	SFPUC (1) [per AF]	$ 1,949	$ 1,951	$ 1,952	$ 2,115	$ 2,373	$ 2,492	$ 2,650	$ 2,772
	CPA Potable Water Rate (W-7) (2) [per AF]	$ 4,356	$ 4,574	$ 4,757	$ 5,042	$ 5,345	$ 5,505	$ 5,725	$ 5,840
	Delta of CPA-SFPUC (Net Revenue of Potable Water Sale) [per AF]	$ 2,407	$ 2,623	$ 2,805	$ 2,927	$ 2,972	$ 3,013	$ 3,075	$ 3,068
	Annual Cost of Monthly Service Charge (1.5" meter) (3) [per connection]	$ 761	$ 776	$ 792	$ 807	$ 824	$ 840	$ 857	$ 874
Revenue - Consumptive									
Enter % here:									
95%	Rate (% of CPA Potable) [per AF]	$ 4,138	$ 4,345	$ 4,519	$ 4,790	$ 5,078	$ 5,230	$ 5,439	$ 5,548
	Recycled Water Usage [AFY]	687	687	687	687	687	687	687	687
	Revenue Subtotal	$ 2,842,943	$ 2,985,221	$ 3,104,656	$ 3,290,661	$ 3,488,414	$ 3,592,838	$ 3,736,421	$ 3,811,476
	Net Revenue Consumptive Subtotal	$ 2,842,943	$ 2,985,221	$ 3,104,656	$ 3,290,661	$ 3,488,414	$ 3,592,838	$ 3,736,421	$ 3,811,476
Revenue - Fixed									
	# of Connections	191	191	191	191	191	191	191	191
	Net Revenue Fixed Subtotal	$ 145,313	$ 148,219	$ 151,183	$ 154,207	$ 157,291	$ 160,437	$ 163,646	$ 166,919
	Net Revenue Total (Consumptive + Fixed)	$ 2,988,256	$ 3,133,440	$ 3,255,839	$ 3,444,868	$ 3,645,705	$ 3,753,275	$ 3,900,067	$ 3,978,395
Annual Cost - Modified Design									
	Capital Debt (5)	$1,671,589	$1,671,589	$1,671,589	$1,671,589	$1,671,589	$1,671,589	$1,671,589	$1,671,589
	Energy (5)	$46,661	$46,661	$47,128	$48,070	$48,551	$49,036	$49,527	$50,022
	Other O&M (5)	$177,000	$180,540	$184,151	$187,834	$191,590	$195,422	$199,331	$203,317
	Lost Potable Water Sales Revenue (6)	$1,653,609	$1,802,001	$1,927,035	$2,010,849	$2,041,764	$2,069,931	$2,112,525	$2,107,716
	Lost Fixed Revenue	$145,313	$148,219	$151,183	$154,207	$157,291	$160,437	$163,646	$166,919
	Cost Total	$3,694,172	$3,849,010	$3,981,086	$4,072,549	$4,110,786	$4,146,416	$4,196,617	$4,199,563
	Difference between Net Revenue and Cost	**-$705,916**	**-$715,570**	**-$725,246**	**-$627,681**	**-$465,080**	**-$393,140**	**-$296,550**	**-$221,168**
	Average Difference over 2020-2040	-$48,449							

1 SFPUC water rate projections 2020-2027 provided by K. Dailey via email, February 20, 2018. FY28-30 extrapolated at 5% per year; FY31-40 extrapolated at 3% per year.

2 Per the FY 2018 Water Utility Financial Plan page, published February 2016. CPA 2017 W-7 Rate is $9.08; 2018 & 2019 increases are projected at 4% & 6%, resulting in a CPA 2020 W-7 Rate of $10/CCF.

3 CPA 2020 Monthly Service Charge for a 1.5" meter is $63.40 which equates to $760.80 annually. Per the FY 2017 Water Utility Financial Plan Page 7, published February 2016. Escalated forward at 2%.
5 See Worksheet "Inputs_Mod" for details.
6 Lost Potable Water Sales Revenue = (Delta between CPA Potable Water Rate and the SFPUC Purchase Price) x (RW sales)

2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
$ 2,911	$ 3,057	$ 3,148	$ 3,243	$ 3,340	$ 3,440	$ 3,543	$ 3,650	$ 3,759	$ 3,872	$ 3,988	$ 4,108	$ 4,231
$ 5,957	$ 6,135	$ 6,319	$ 6,509	$ 6,704	$ 6,905	$ 7,112	$ 7,326	$ 7,546	$ 7,772	$ 8,005	$ 8,245	$ 8,493
$ 3,046	$ 3,078	$ 3,171	$ 3,266	$ 3,364	$ 3,465	$ 3,569	$ 3,676	$ 3,787	$ 3,900	$ 4,017	$ 4,137	$ 4,262
$ 891	$ 909	$ 927	$ 946	$ 965	$ 984	$ 1,004	$ 1,024	$ 1,044	$ 1,065	$ 1,087	$ 1,108	$ 1,131
$ 5,659	$ 5,828	$ 6,003	$ 6,184	$ 6,369	$ 6,560	$ 6,756	$ 6,960	$ 7,169	$ 7,383	$ 7,605	$ 7,833	$ 8,068
687	687	687	687	687	687	687	687	687	687	687	687	687
$ 3,887,836	$ 4,004,008	$ 4,124,095	$ 4,248,099	$ 4,375,366	$ 4,506,548	$ 4,641,647	$ 4,781,314	$ 4,924,897	$ 5,072,396	$ 5,224,463	$ 5,381,099	$ 5,542,956
$ 3,887,836	$ 4,004,008	$ 4,124,095	$ 4,248,099	$ 4,375,366	$ 4,506,548	$ 4,641,647	$ 4,781,314	$ 4,924,897	$ 5,072,396	$ 5,224,463	$ 5,381,099	$ 5,542,956
191	191	191	191	191	191	191	191	191	191	191	191	191
$ 170,257	$ 173,662	$ 177,135	$ 180,678	$ 184,292	$ 187,978	$ 191,737	$ 195,572	$ 199,483	$ 203,473	$ 207,542	$ 211,693	$ 215,927
$ 4,058,093	$ 4,177,670	$ 4,301,231	$ 4,428,777	$ 4,559,657	$ 4,694,526	$ 4,833,384	$ 4,976,886	$ 5,124,380	$ 5,275,869	$ 5,432,006	$ 5,592,793	$ 5,758,884
$1,671,589	$1,671,589	$1,671,589	$1,671,589	$1,671,589	$1,671,589	$1,671,589	$1,671,589	$1,671,589	$1,671,589	$1,671,589	$1,671,589	$1,671,589
$50,522	$51,028	$51,538	$52,053	$52,574	$53,099	$53,630	$54,167	$54,708	$55,256	$55,808	$56,366	$56,930
$207,384	$211,531	$215,762	$220,077	$224,479	$228,968	$233,548	$238,219	$242,983	$247,843	$252,800	$257,856	$263,013
$2,092,602	$2,114,586	$2,178,477	$2,243,742	$2,311,068	$2,380,455	$2,451,903	$2,525,412	$2,601,669	$2,679,300	$2,759,679	$2,842,119	$2,927,994
$170,257	$173,662	$177,135	$180,678	$184,292	$187,978	$191,737	$195,572	$199,483	$203,473	$207,542	$211,693	$215,927
$4,192,354	$4,222,396	$4,294,501	$4,368,140	$4,444,001	$4,522,089	$4,602,407	$4,684,958	$4,770,433	$4,857,460	$4,947,418	$5,039,623	$5,135,453
-$134,261	**-$44,726**	**$6,730**	**$60,637**	**$115,656**	**$172,436**	**$230,977**	**$291,927**	**$353,947**	**$418,409**	**$484,588**	**$553,170**	**$623,431**

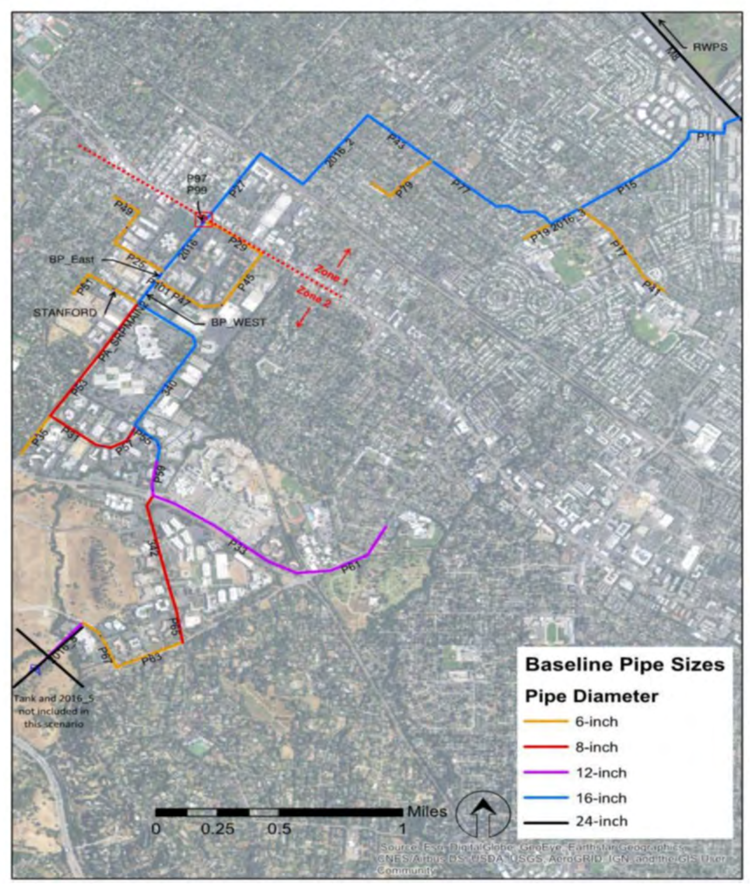
	Original	
Capital Cost (2017$) (1)	$ 38,488,000	Ph 3 + Emb Rd
Borrowing Rate (2)	1.8%	
Borrowing Term (yrs) (2)	30	
Capital Debt Service	$1,671,588.92	

		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Energy Usage (1)	kwh	444894	444894	444894	444894	444894	444894	444894	444894	444894	444894	444894	444894
Energy Rate Increase (3)		--	0%	1%	2%	1%	1%	1%	1%	1%	1%	1%	1%
Unit Energy Cost (4)	$/kwh	$ 0.105	$ 0.105	$ 0.106	$ 0.108	$ 0.109	$ 0.110	$ 0.111	$ 0.112	$ 0.114	$ 0.115	$ 0.116	$ 0.117
Annual Energy Cost	$	$ 46,661	$ 46,661	$ 47,128	$ 48,070	$ 48,551	$ 49,036	$ 49,527	$ 50,022	$ 50,522	$ 51,028	$ 51,538	$ 52,053
Other O&M													
Labor & Chem Increase (5)		--	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Annual Other O&M (1)		$ 177,000	$ 180,540	$ 184,151	$ 187,834	$ 191,590	$ 195,422	$ 199,331	$ 203,317	$ 207,384	$ 211,531	$ 215,762	$ 220,077
Capital Debt Service		$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589
Subtotal - Costs (Modified)		$ 1,895,250	$ 1,898,790	$ 1,902,867	$ 1,907,493	$ 1,911,730	$ 1,916,048	$ 1,920,447	$ 1,924,928	$ 1,929,495	$ 1,934,148	$ 1,938,889	$ 1,943,719

1 Capital cost estimate includes construction plus soft costs. See Preliminary Design Report for detailed Capital Cost Estimate, Energy Usage estimate, O&M estimate.
2 Assuming SRF financing with 30 year term
3 Published planned Energy Rate Increases through FY2024; assuming 1% increase for years 2025-2040. Per FY 2018 Electric Utility Financial Plan, May 2017.
4 2020 Rate is Proposed E-7 Summer Rate effective 7/1/2017 including a 9% increase in FY 2019. Per FY 2018 Electric Utility Financial Plan, May 2017.
5 Assumed 2% increase for inflation on chemical and labor costs.

	2032	2033	2034	2035	2036	2037	2038	2039	2040
	444894	444894	444894	444894	444894	444894	444894	444894	444894
	1%	1%	1%	1%	1%	1%	1%	1%	1%
	$ 0.118	$ 0.119	$ 0.121	$ 0.122	$ 0.123	$ 0.124	$ 0.125	$ 0.127	$ 0.128
	$ 52,574	$ 53,099	$ 53,630	$ 54,167	$ 54,708	$ 55,256	$ 55,808	$ 56,366	$ 56,930
	2%	2%	2%	2%	2%	2%	2%	2%	2%
	$ 224,479	$ 228,968	$ 233,548	$ 238,219	$ 242,983	$ 247,843	$ 252,800	$ 257,856	$ 263,013
	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589	$ 1,671,589
	$ 1,948,641	$ 1,953,657	$ 1,958,767	$ 1,963,974	$ 1,969,280	$ 1,974,687	$ 1,980,197	$ 1,985,811	$ 1,991,531

Figure 3-2: Phase 3 Pipe Diameters for Baseline (No Tank) Configuration

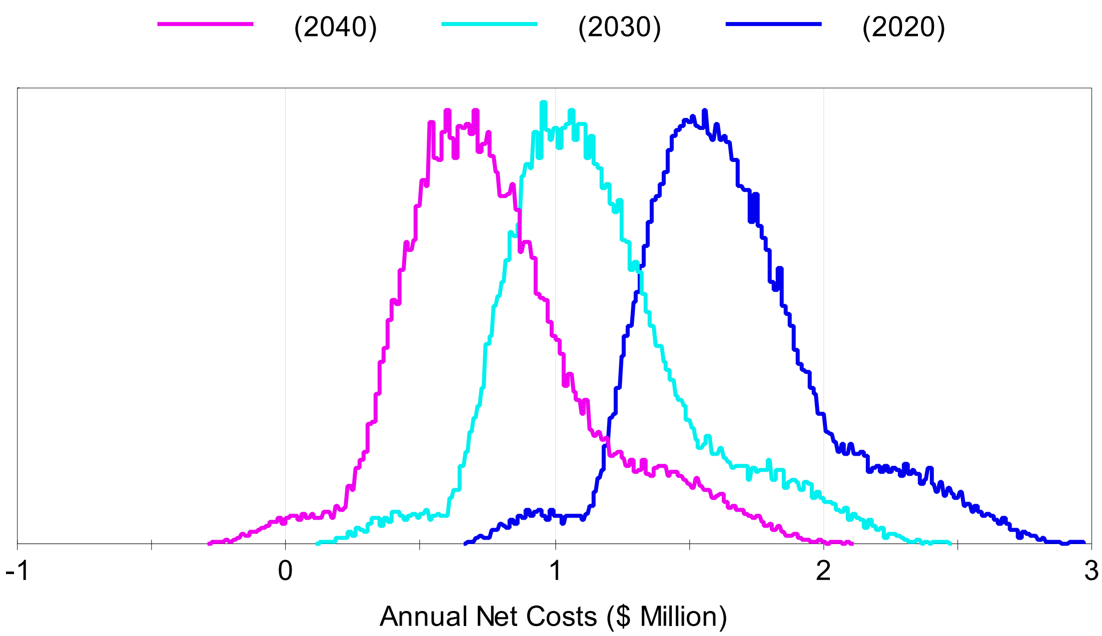


	Original	Modified	LF
P11	16	12	1316
P15	16	12	3084
P77	16	12	3112
P43	16	12	1760
2016_2	16	12	3369
P27	16	12	1979
2016	16	12	1493
BP_EAST	16	12	253
BP_WEST	16	12	689
340	16	8	4039
P55	16	8	1101
P59	12	8	842
P33	12	8	3617
P61	12	0	2415

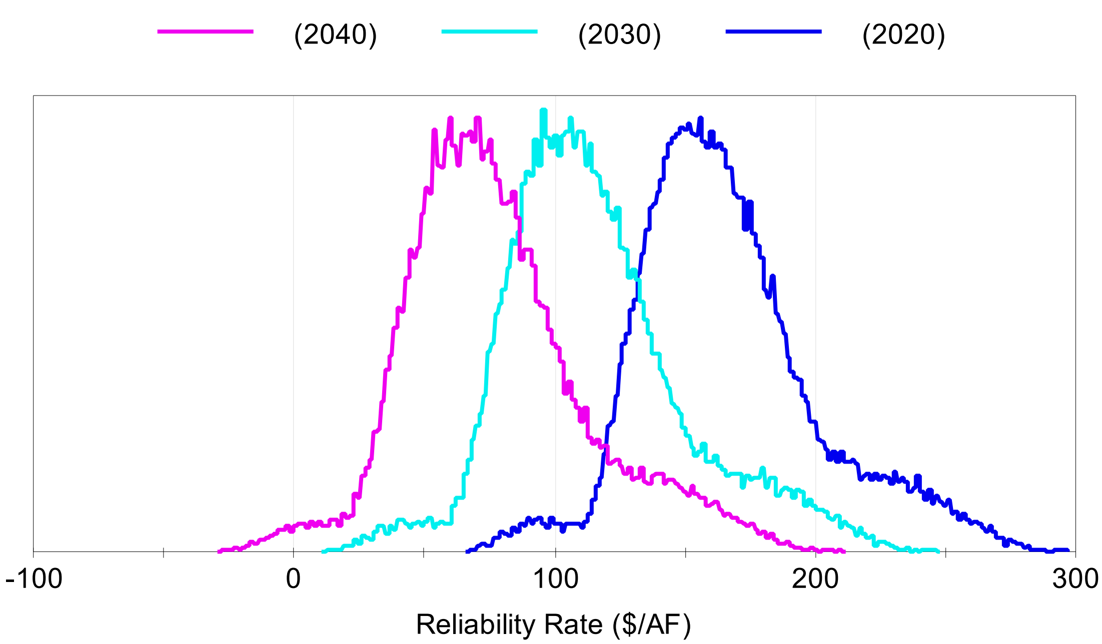
Appendix C - Risk Assessment Modeling Results

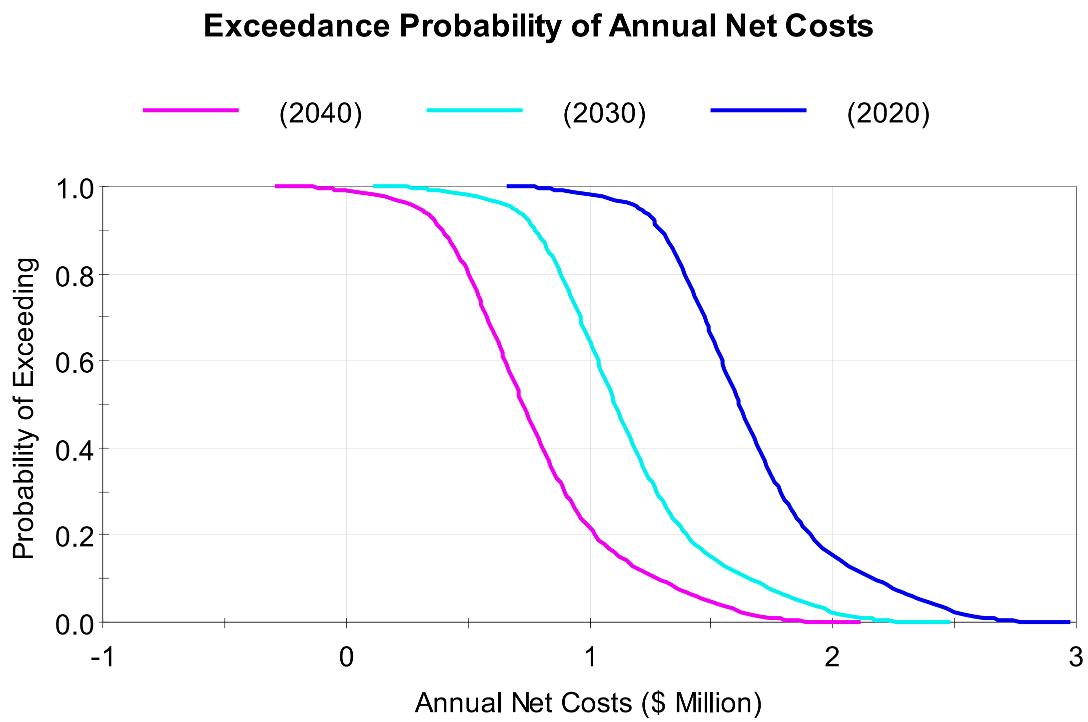
Palo Alto GoldSim Modeling Results – 4/2018

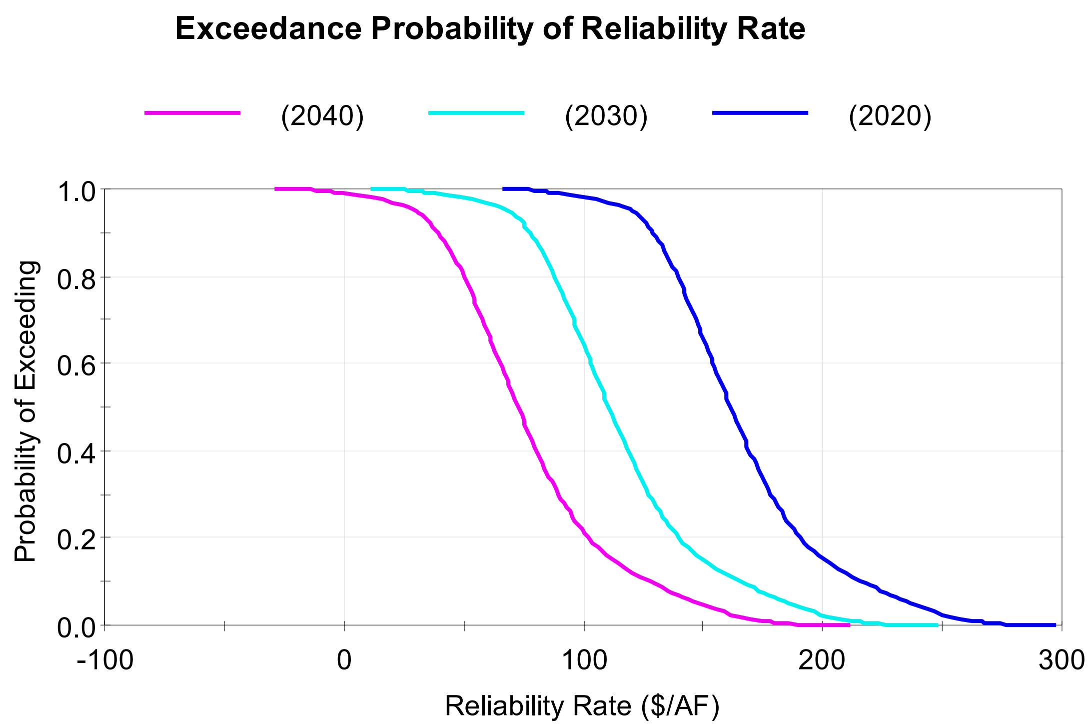
Probability of Annual Net Costs



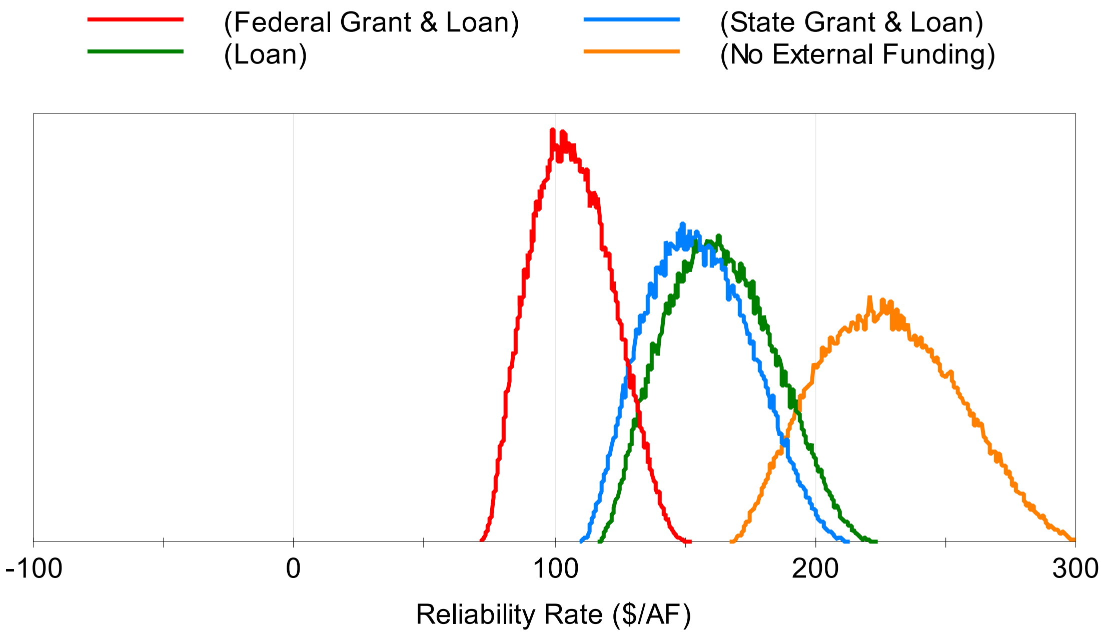
Probability of Reliability Rate



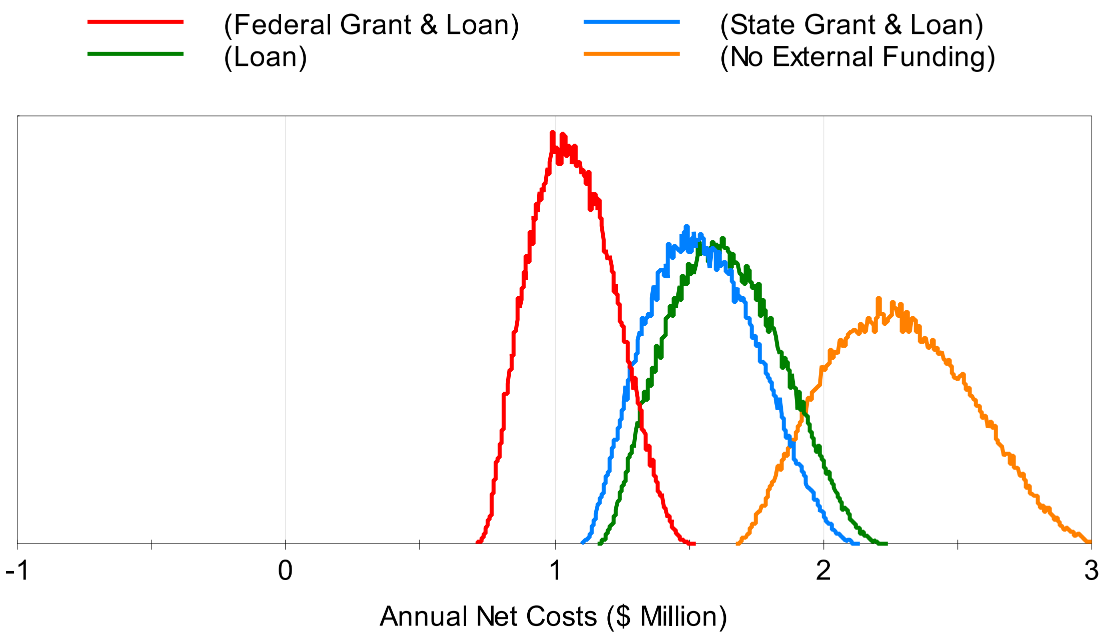

Exceedance Probability of Annual Net Costs
(2040)
(2030)
(2020)
Probability of Exceeding
1.0
0.8
0.6
0.4
0.2
0.0
-1
0
1
2
3
Annual Net Costs ($ Million)

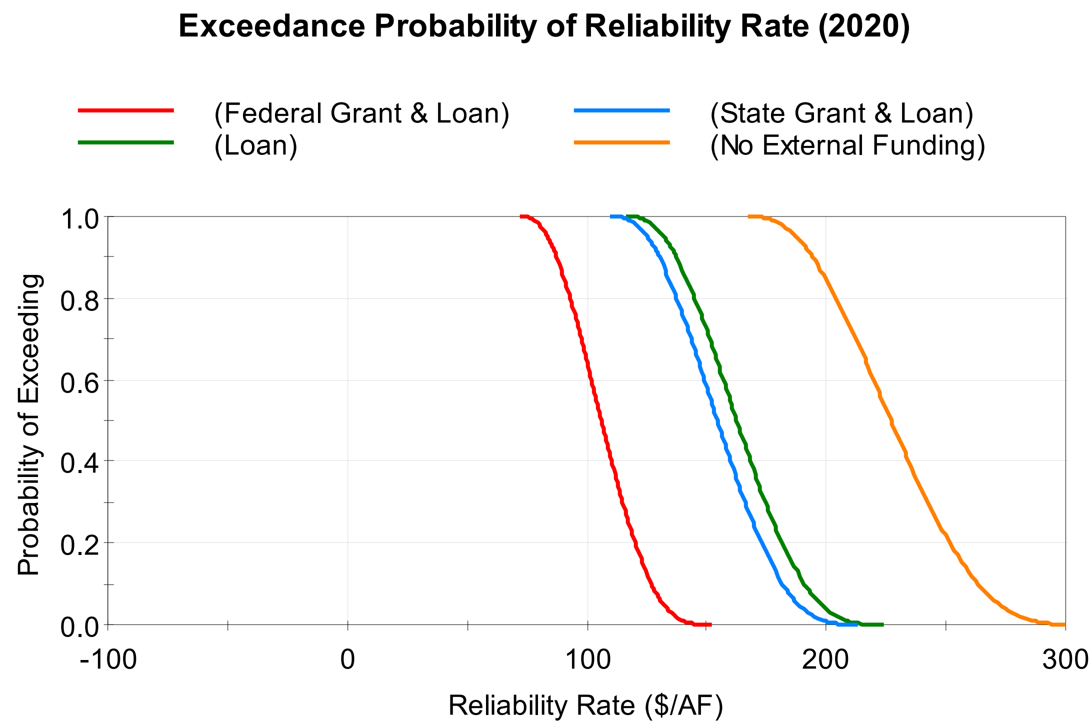

Exceedance Probability of Reliability Rate
(2040)
(2030)
(2020)
Probability of Exceeding
1.0
0.8
0.6
0.4
0.2
0.0
-100
0
100
200
300
Reliability Rate ($/AF)

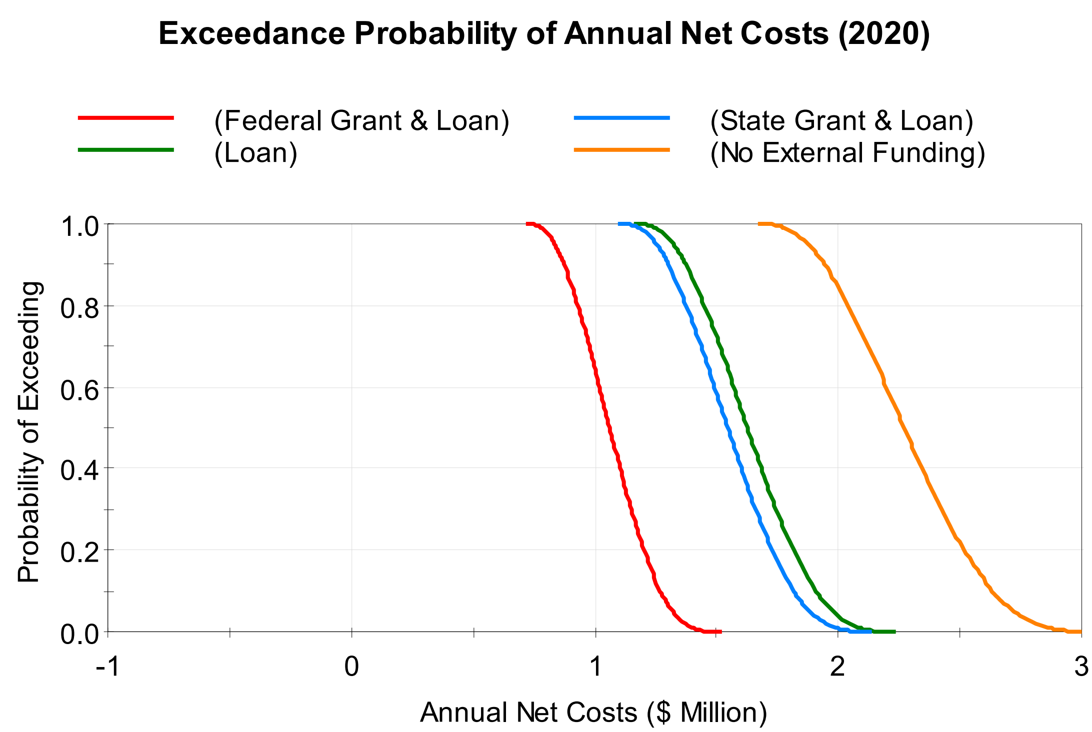
Probability of Reliability Rate (2020)



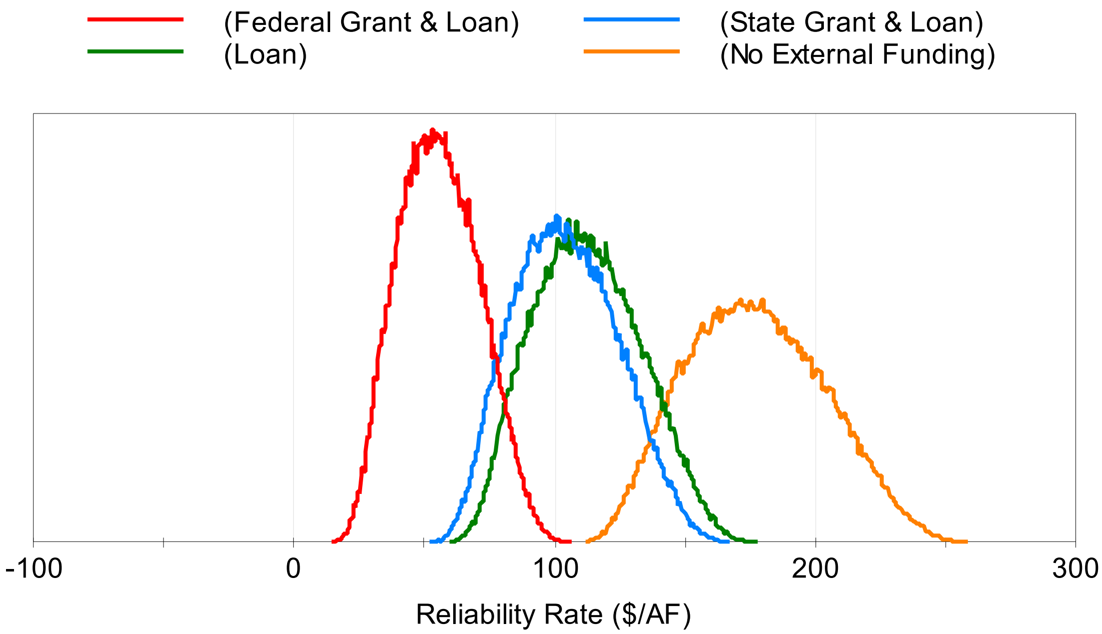
Probability of Annual Net Costs (2020)



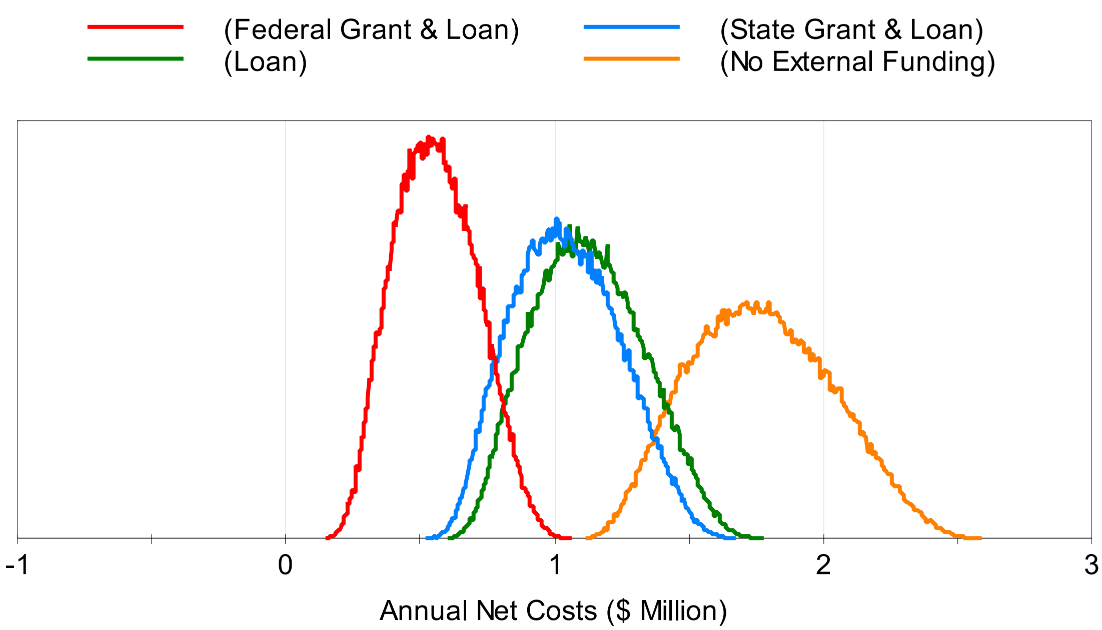

Exceedance Probability of Reliability Rate (2020)
(Federal Grant & Loan)
(Loan)
(State Grant & Loan)
(No External Funding)
Probability of Exceeding
1.0
0.8
0.6
0.4
0.2
0.0
-100
0
100
200
300
Reliability Rate ($/AF)

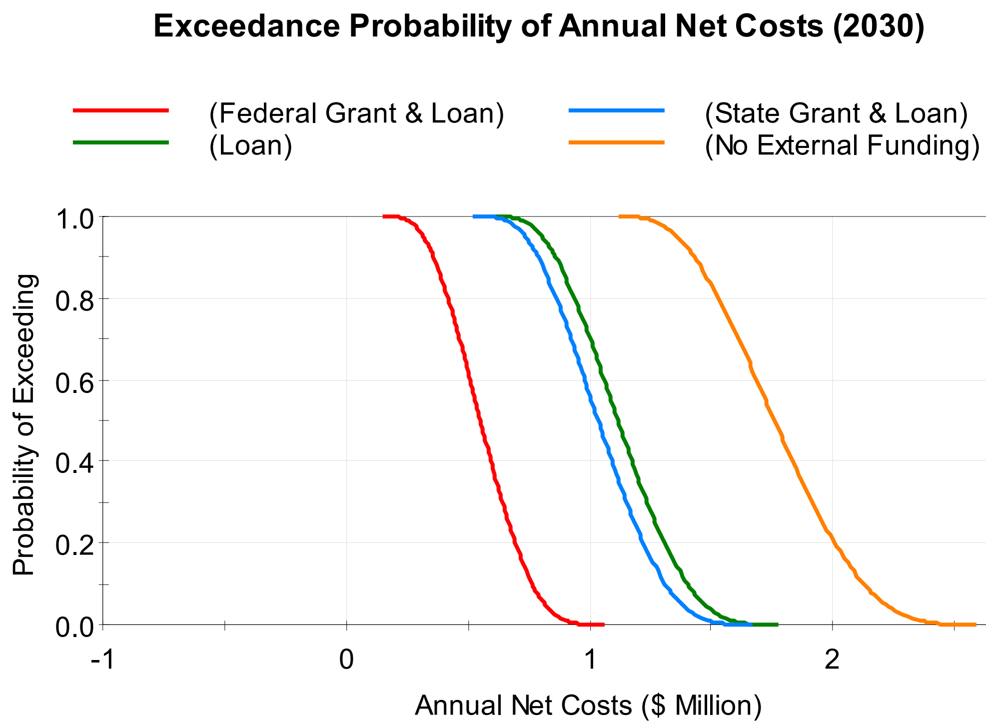

Exceedance Probability of Annual Net Costs (2020)
(Federal Grant & Loan)
(Loan)
(State Grant & Loan)
(No External Funding)
Probability of Exceeding
1.0
0.8
0.6
0.4
0.2
0.0
-1
0
1
2
3
Annual Net Costs ($ Million)

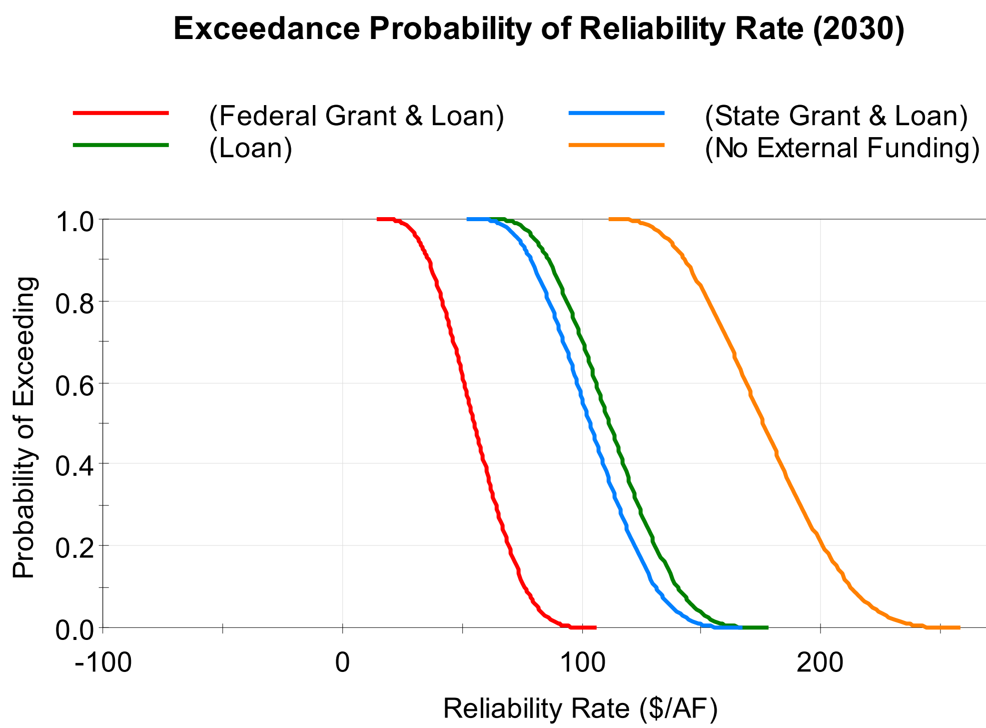
Probability of Reliability Rate (2030)

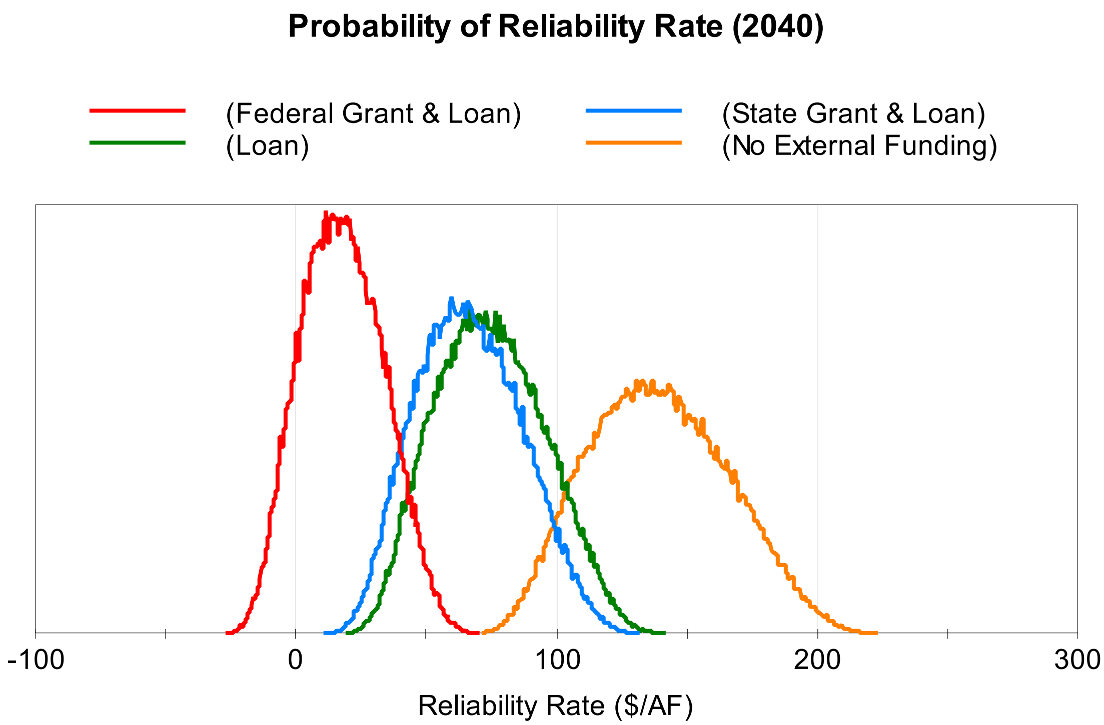


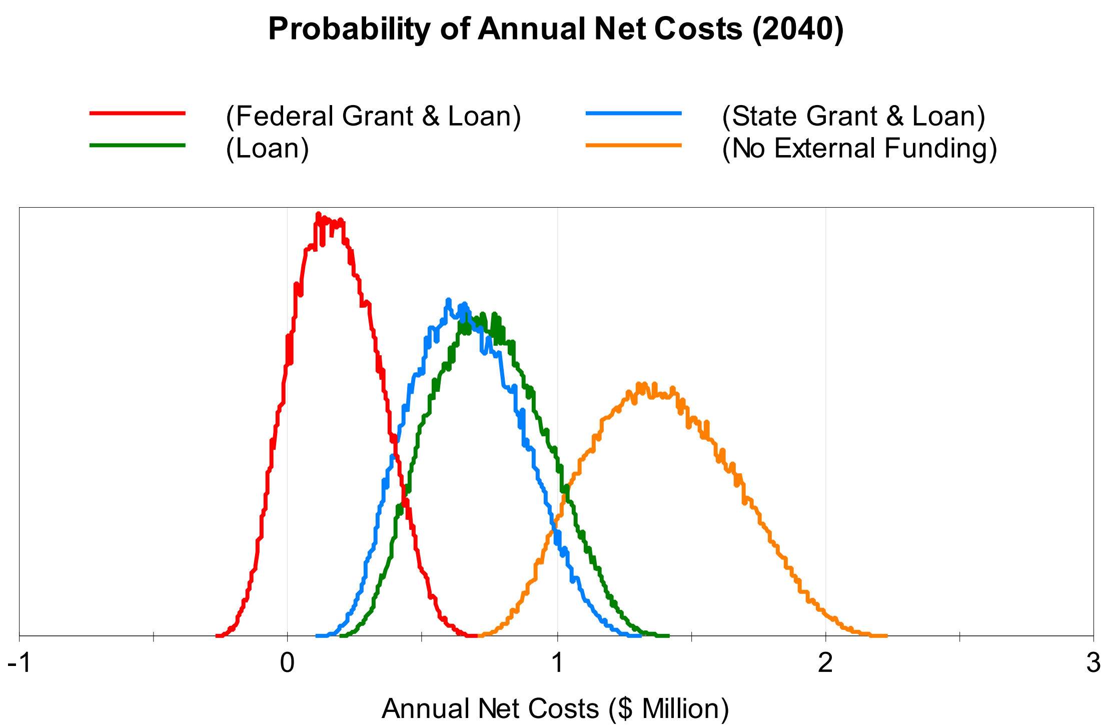
Probability of Annual Net Costs (2030)

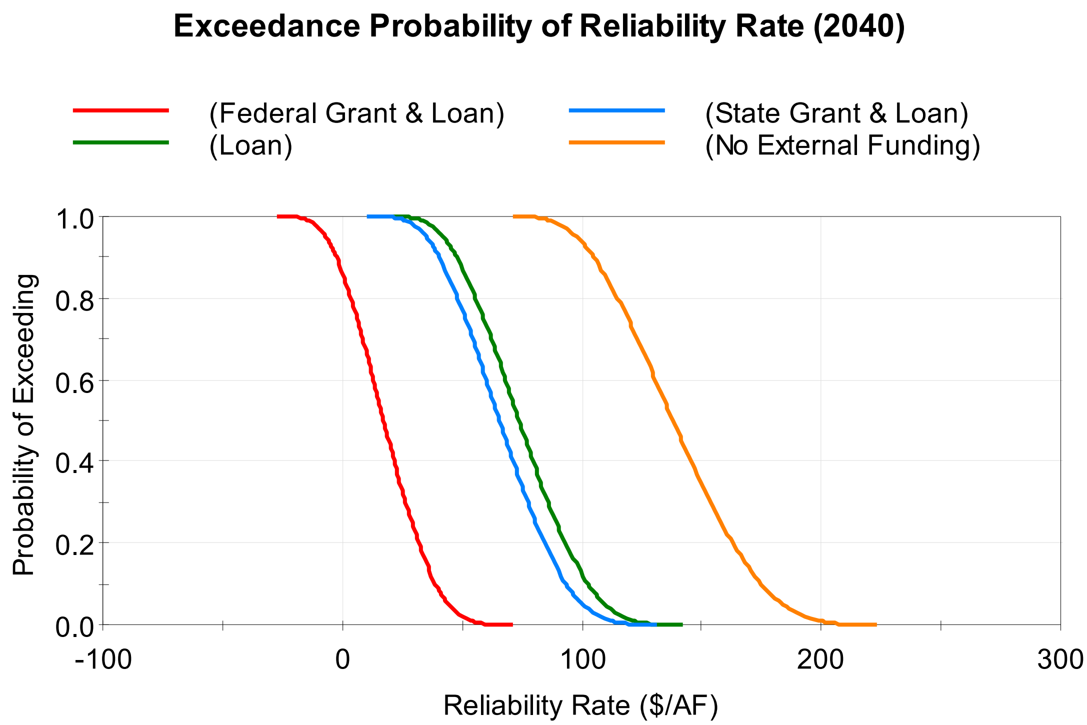


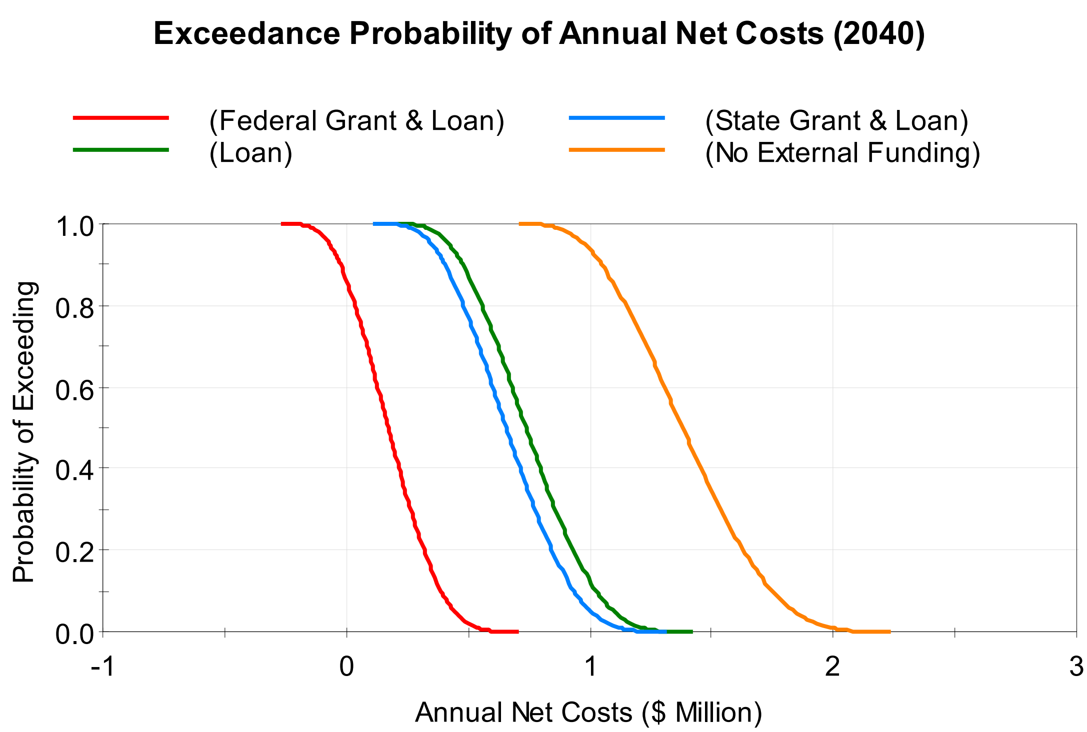

Exceedance Probability of Annual Net Costs (2030)
(Federal Grant & Loan)
(Loan)
(State Grant & Loan)
(No External Funding)
Probability of Exceeding
1.0
0.8
0.6
0.4
0.2
0.0
-1
0
1
2
3
Annual Net Costs ($ Million)


Exceedance Probability of Reliability Rate (2030)
(Federal Grant & Loan)
(Loan)
(State Grant & Loan)
(No External Funding)
Probability of Exceeding
1.0
0.8
0.6
0.4
0.2
0.0
-100
0
100
200
300
Reliability Rate ($/AF)


Probability of Reliability Rate (2040)
(Federal Grant & Loan)
(Loan)
(State Grant & Loan)
(No External Funding)
-100
0
100
200
300
Reliability Rate ($/AF)


Probability of Annual Net Costs (2040)
(Federal Grant & Loan)
(Loan)
(State Grant & Loan)
(No External Funding)
-1
0
1
2
3
Annual Net Costs ($ Million)


Exceedance Probability of Reliability Rate (2040)
(Federal Grant & Loan)
(Loan)
(State Grant & Loan)
(No External Funding)
1.0
0.8
0.6
0.4
0.2
0.0
Probability of Exceeding
-100
0
100
200
300
Reliability Rate ($/AF)


Exceedance Probability of Annual Net Costs (2040)
(Federal Grant & Loan)
(Loan)
(State Grant & Loan)
(No External Funding)
1.0
0.8
0.6
0.4
0.2
0.0
Probability of Exceeding
-1
0
1
2
3
Annual Net Costs ($ Million)