

6 March 2013

## Technical Memorandum

To: Curtis Lam, HydroScience Engineers, Inc.  
From: Jill Chamberlain  
Reviewed By: Mike Joyce  
Subject: City of Sunnyvale  
Recycled Water System Master Plan – Capital Improvement Plan  
K/J 1288012\*00

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### 1.0 Introduction and Purpose of Technical Memorandum

The City of Sunnyvale (City) developed a wastewater reclamation program in 1991 with the goal to recycle 20% to 30% of the wastewater treated at the City's Water Pollution Control Plant (WPCP) for irrigation and industrial purposes. To reduce discharges to the South San Francisco Bay, the 2000 Recycled Water Master Plan (RWMP) established the long-term goal of reusing 100% of the wastewater, approximately 15 million gallons per day (MGD), and developed a plan to construct new facilities to expand the recycled water system to meet near and medium term goals for recycled water delivery. Phases I and II of the 2000 RWMP have been completed and the City currently delivers approximately 1,060 acre-feet per year (AFY) to 120 customers in the northern part of the City through 18 miles of pipeline fed by three pump stations.

To meet changing needs an update to the 2000 RWMP is necessary and this Technical Memorandum (TM) is the final in a series of TMs which will be compiled into a single Master Plan document.

The objective of this TM is to present a 20-year Capital Improvement Plan (CIP) that describes the development of a set of projects to expand the recycled water system. The projects were developed utilizing conclusions and recommendations provided in the following TMs prepared as part of the update to the RWMP:

- **Technical Memorandum #1 – Near-Term Demand Forecast and Water Quality Requirements (TM #1):** Presents near-term potential recycled water demand forecasts (in the one to eight year range) and the associated water quality needs for each of the specific uses.
- **Technical Memorandum #2 – Treatment Alternatives Evaluation (TM #2):** Presents a plan to continuously produce recycled water that will meet the near-term recycled water demands of City customers. Four treatment alternatives are evaluated to address the WPCP recycled water production reliability, capacity, water quality, operations and maintenance (O&M), and regulatory compliance needs.

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- **Technical Memorandum #4 – Distribution System (TM#4):** Presents the development of conceptual pipeline alignments to meet the near-term demand targets and improve reliability through distribution system, expansion, improvements, and storage.

The TM is organized into the following sections including:

- **Section 1:** Introduces the WPCP and its current operational issues, and describes the purpose of this TM.
- **Section 2:** Discusses the development and methodology used to prioritize and group projects in the CIP.
- **Section 3 through 6:** Presents the phases of the CIP and includes the distribution, treatment, and pumping and storage improvements to be completed within each phase.
- **Section 7:** Summarizes the CIP and presents an overview table and figure showing the capital costs and timeframe for implementation.

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### 2.0 CIP Development and Methodology

Based on the proposed alignments discussed in TM#4, the completion of the proposed expansion of the recycled water system would add approximately 18.5 miles of 6-inch to 24-inch pipe to meet the additional demand of 2,061 AFY and total nearly \$43.2 million in capital investment for distribution system improvements. Additional capital investment is needed for treatment, pumping, and storage facility improvements to support the expansion of the recycled water system. As discussed in TM#2 the treatment improvements are dependent on the treatment processes implemented in the Strategic Infrastructure Plan (SIP). The pumping and storage improvements will be based on the selected site for the facilities. Therefore, the capital costs associated with treatment, pumping, and storage range from \$99.5 million to \$114.1 million.

For the purposes of the CIP, the proposed alignments are grouped into phases to provide the City with a logical pathway for expanding the recycled water system and break the improvements to the system into more manageable pieces. Each phase includes treatment, pumping, and storage facility improvement projects necessary to support the increased recycled water demand realized within each phase.

A method for developing phases for expansion is necessary to prioritize the alignments. The primary factor used to determine the priority is the cost per AFY delivered by the alignment. Table 2 below shows the proposed distribution system alignments and rank of the alignment, relative to one another, as well as the demand and total project cost presented in TM #4.

**Table 2: Proposed Alignments and Ranks<sup>1</sup>**

<b>Alignment</b>	<b>Demand (AFY)</b>	<b>Total Project Cost<sup>2</sup></b>	<b>Rank</b>
Infill Sites	335	\$2,675,000	2
<b>Extensions from Existing Pipeline System</b>			
Lakehaven Road	86	\$1,406,000	7
Maude Ave	36	\$1,362,000	15
Duane Ave	429	\$5,621,000	4
Kifer Road East	51	\$1,332,000	13
Kifer Road West	54	\$781,000	5
<b>Base Alignments</b>			
Wolfe Road Main	345	\$7,239,000	10
Main Loop	335	\$15,914,000	17

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Alignment	Demand (AFY)	Total Project Cost <sup>2</sup>	Rank
<b>Alignments Requiring Wolfe Road Main</b>			
Iris Ave	55	\$634,000	3
Marion Way	30	\$648,000	11
Dartshire way	65	\$1,369,000	9
<b>Alignments Requiring Main Loop</b>			
Gail Ave	39	\$578,000	6
Old San Francisco Road	26	\$450,000	8
Manet Drive	86	\$445,000	1
Sunnyvale-Saratoga Road	14	\$595,000	16
Remington Drive	59	\$1,751,000	14
Carson Drive	16	\$370,000	12
<b>Pipeline Total</b>	<b>2,061</b>	<b>\$43,170,000</b>	

**Notes:** <sup>1</sup>Source: TM #4 – Engineering Elements: Distribution System (HydroScience, 2012)

<sup>2</sup>Total Project Cost includes construction, design, permitting, CM, and contingency of both the pipeline and associated customer retrofits.

To fully realize the benefits of capital expenditure on the recycled water system retrofitting existing sites is critical to the success, therefore customer cooperation and willingness to convert to recycled water. A breakdown of the phases into smaller projects provides the City with a plan for focusing funds and reduces dependencies between projects. This allows projects to move forward if problems arise on higher priority projects. Additionally, breaking the phases into smaller projects allows the City to plan for capital improvements in smaller more manageable portions given the magnitude of the proposed expansion. Preventing stranded assets by constructing alignments that will realize recycled water delivery can also be accomplished following this model since it can allow the City to remove or postpone an alignment in a phase and still realize the benefits of the previously constructed system.

Considering the ranking methodology and grouping alignments into projects within phases, the phases of the proposed CIP are described in the following sections. Figure 1 shows an overview of the distribution system improvements included in each phase.



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### 3.0 Phase 1 – Wolfe Road

This phase includes the construction in the Wolfe Rd area to increase recycled water delivery by 495 AFY. It is anticipated this phase will start immediately, in 2013, and be completed within five years requiring \$31.0 million in capital cost. The distribution system improvements, treatment upgrades, and pumping and storage requirements to support this expansion are discussed in the following sections and the details summarized in Table 3 (See Section 7.0 CIP overview).

#### 3.1 Distribution

Due to the magnitude of distribution system improvements included in this phase, it is recommended that the phase be broken into two pipeline projects: Wolfe Road Project and Wolfe Road Extensions Project. The Wolfe Road pipeline project consists of the construction of 13,300 linear feet (lf) 12-inch to 24-inch Wolfe Rd alignment which connects to the southern terminus of existing East Main to the new Apple Campus. At full build-out, this alignment would deliver 345 AFY recycled water at an estimated cost of \$6.4 million for pipeline construction.

The three branch alignments from the Wolfe Rd main comprise of the second pipeline project, Wolfe Road Extensions. This project includes approximately 10,400 lf 6-inch to 8-inch pipeline along Iris Ave, Dartshire Way, and Marion Way at an estimated cost of \$2.1 million to deliver 150 AFY.

Design and construction work for customer retrofits differs from more traditional pipeline work, therefore customer retrofits would be designed, bid and constructed separately from the pipeline projects. This also allows for competitive bids and accounts for the varying timeline for completion of customer retrofits. The first group of customer retrofits are those sites that would be served directly by the Wolfe Rd A pipeline. This totals 13 retrofits with an estimated \$0.8 million in construction cost. There are eight customer retrofits that comprise the sites along the Wolfe Rd Extensions Project, at an estimated cost of \$0.5 million.

As discussed in TM#4, the distribution system improvements in this phase are expected to be partially funded by others. For the purposes of the CIP development it is assumed the City will receive funding from Apple and Cal Water, totaling \$6.3 million, to offset the total capital costs. Additionally, the improvements in this phase may change in scope due to the potential to serve Santa Clara Valley Water District (SCVWD). The CIP does not consider service to SCVWD as this service would impact the plans for expansion of the recycled water system within the City limits by reducing the recycled water available to City customers.

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### **3.2 Treatment**

As stated in TM#2, to meet current and near term recycled water demand associated with this phase, a 1.67 MGD MBR system would be required. This treatment system would fulfill the average day demands while potable water would be used to supplement on peak days when demand cannot be met by storage alone. The treatment improvements would need to be in place by 2016 and have an estimated capital cost of \$20 million and annual operating costs of \$0.5 million, which includes the potable water needed to meet peak day demands.

### **3.3 Pumping and Storage**

Improvements to the San Lucar tank and pump station will be required to meet the increased recycled water demands brought online in this phase. These improvements, discussed in TM#4, will require \$1.1 million in capital cost.

### **4.0 Phase 2 – Infill and Duane Ave**

This phase consists of customer retrofits of sites along the existing distribution system and the Duane Ave branch alignment increasing recycled water demand by 764 AFY. This phase has an estimated capital cost of \$19.3 million and is anticipated to take six years to complete, commencing in 2015. The distribution system improvements, treatment upgrades, and pumping and storage requirements included in this phase are discussed in the following sections and the details summarized in Table 3 (See Section 7.0 CIP overview).

### **4.1 Distribution**

The distribution system improvements in this phase are broken into three projects to allow for the focused efforts by the City: Infill project and Duane Avenue pipeline and retrofits projects. The first project would consist entirely of infill customer retrofits as described in TM#4. Approximately \$2.7 million in capital costs is estimated for the 50 retrofits projected to deliver 335 AFY. As no additional infrastructure is necessary for this project, it is anticipated that this project would be complete in the next five years. Due to the number of retrofits included in this project, it may prove advantageous to the City break this project into smaller projects based on site similarities to assist in management and progress. Smaller projects can be created by grouping the type of retrofit site/use into the following: parks, schools, and municipality owned sites; commercial landscape use; residential landscape use; and industrial use. Retrofits for industrial use of recycled water tend to be more complex, requiring more design and construction time as compared to parks, schools, and other municipally owned sites.

The second and third projects include the Duane Avenue pipeline and Duane Avenue retrofits, respectively. Approximately 16,500 lf of 6-inch to 12-inch pipe would be constructed with an

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estimated \$4.0 million in pipeline capital cost in the second project. The 23 sites along the alignment would be retrofitted under the third project with an estimate capital cost of \$1.7 million.

### **4.2 Treatment**

Increasing the MBR treatment unit by 0.51 MGD would be necessary to meet the increased recycled water demand brought online in this phase. As noted in TM#2, the associated capital cost for the additional MBR units is estimated at \$11 million with \$0.3 million in O&M costs which included the potable water necessary to meet peak day demands that cannot be met by storage alone.

### **4.3 Pumping and Storage**

Based on the results of the hydraulic model new pumping and/or storage facilities will not be needed for this phase.

## 5.0 Phase 3: Extensions

The four extensions from the existing distribution system are included in this phase. An estimated 227 AFY of recycled water demand would be realized over a nine year period, starting in 2019, for a total estimated capital cost of \$40.8 million in distribution system improvements, treatment upgrades, and pumping and storage additions. The elements of this phase are described in the sections below and the details summarized in Table 3 (See Section 7.0 CIP overview).

### **5.1 Distribution**

The distribution system improvements are broken into four projects, two pipeline projects and two customer retrofit projects associated with the pipeline projects. These projects include the Lakehaven Road and Kifer Road West pipeline and retrofit projects. Approximately 6,000 lf of 6-inch and 8-inch pipe would be constructed to serve 16 sites in the first pipeline project with an estimated capital cost of \$1.3 million. The Lakehaven Rd and Kifer Rd West alignments are included and the associated retrofits, at an estimate capital cost of \$0.9 million, comprise the first customer retrofit package which would increase recycled water demand by 140 AFY.

The third and fourth projects, which are the Kifer Road East and Maude Avenue pipeline and retrofits projects, are optional. Approximately 11,800 lf of 6-inch and 8-inch pipe would be constructed under the third project for an estimated capital cost of \$2.2 million. A total of seven customer retrofits would be included in the estimated \$0.5 million fourth project to deliver 87 AFY of recycled water.

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It is anticipated Phase 3 will be started in eight years and is expected to be complete by year 17 bringing total recycled water delivery to City customers to 2,546 AFY. If the City proceeds with serving SCVWD, it should be determined before year 5 to prevent stranding assets, since expansion of the recycled water system up to and through Phase 3 is generally necessary to extend the pipeline to SCVWD.

### 5.2 Treatment

This phase will include adding MBR units to bring the recycled water treatment system up to the full 3.6 MGD build-out capacity to handle the increased demands associated with this phase and the future phase. A total of 1.42 MGD capacity will be added with an estimated capital cost of \$25 million and O&M costs of \$0.5 million per year.

### 5.3 Pumping and Storage

To meet the demands of the recycled water system that will be experienced, new pumping and storage facilities will be necessary and are included in this phase. Due to the location of the proposed pumping and storage facilities discussed in TM#4, it is recommended that the Wolfe-Evelyn site be used to meet the needs of the system. The estimated project cost for this site is \$10.9 million. If this site proves to be problematic a small portion of third project A under Phase 4, as describe below, could be completed early to allow the service to the Central Tank site. Additional funds will also be necessary for the Central Tank site which is accounted for in Phase 4.

## 6.0 Phase 4: Main Loop Area

Phase 4 consists of the Main Loop area with an estimated of \$17.4 million to \$23.0 million to increase recycled water demand by 575 AFY. This phase is anticipated to begin in 2025 and take nine years to be completed. The associated improvements included in this phase are discussed in the following sections and the details summarized in Table 3 (See Section 7.0 CIP overview).

### 6.1 Distribution

The distribution system improvements in phase 4 are broken into six projects, three pipeline and 3 customer retrofits, to assist in management, priority, and design and construction process.

The first two projects are the Main Loop pipeline and customer retrofits. The pipeline project consists of the 24,800 lf of 16-inch to 24-inch pipeline with an estimated cost of \$13.5 million. The second project are those customers served directly by the Main Loop pipeline and includes

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the retrofit of 43 sites with an estimated \$2.4 million in construction cost in increase recycled water delivery by 335 AFY.

To limit cost, staffing, and construction impacts to the City with one large pipeline project, the Main Loop pipeline project could be completed in segments. One segment would consist of eastern most portion of the Main Loop from Wolfe Ave to Sunnyvale-Saratoga Rd. Breaking the alignment into two segments would allow the first group of branches, as described below, along the Main Loop to be constructed before completing the entire Main Loop alignment. The first group of branches has a high recycled water demand and would allow the use the Central Tank site for pumping and storage facilities if this site becomes the best option. The second segment would be the remainder of the Main Loop pipeline, from Sunnyvale Saratoga Road to the terminus of existing distribution system at Encinal Park.

The third and fourth projects in phase 4 are the three westernmost branches from the Main Loop and associated customer retrofits: Gail Avenue, Old San Francisco Road, and Manet Drive pipeline and retrofits. Approximately 4,300 lf of 6-inch and some 8-inch pipeline would be constructed to deliver 151 AFY with an estimated construction cost of \$0.8 million. Ten retrofits along these branches are included in the fourth project with an estimated cost of \$0.6 million.

The fifth and sixth projects are optional pipeline and customer retrofits. The projects consist of the Sunnyvale Saratoga Road, Remington Drive, and Carson Drive pipelines and retrofits, which are the remaining branches off of the Main Loop. At an estimated construction cost of \$2.1 million, approximately 10,500 lf of 6-inch to 8-inch pipe would deliver 89 AFY to customers along these alignments. Customer retrofits in the sixth project cover 11 sites along these branches with an estimated construction cost of \$0.6 million.

### **6.2 Treatment**

The treatment system upgrades necessary for supporting the demand associated with this phase will have already been completed as described in Phase 3.

### **6.3 Pumping and Storage**

The necessary pumping and storage facilities needed for the expansion of the recycled water system are included under Phase 3; no additional facilities are needed to meet the demands under this phase. If it is determined that the Central Tank site is the preferred location for the pumping and storage facilities, a small portion of the Main Loop branches pipeline, under this phase, could be constructed to make the service to this site feasible. Therefore, some cost of this phase may be realized sooner but this consideration is not included in the CIP. The estimated cost for the Central Tank site is approximately \$2.8 million greater than the Wolfe-Evelyn site. For the purposes of CIP planning of capital expenditure, this additional capital cost

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is accounted for in this Phase since the Central site could not be served by the distribution system until the portions of this phase are completed.

### 7.0 CIP Overview

A summary of the phases and associated projects, and other associated improvements (treatment, pumping, and storage) is provided in Table 3 below.

**Table 3: Proposed Phases and Projects**

Phase	Projects	Demand (AFY)	Capital Cost
1	Pipeline - Wolfe Rd <sup>1</sup>	345	\$6,399,000
	Pipeline – Apple Contribution <sup>1</sup>		-\$4,800,000
	Customer Retrofits - Wolfe Rd		\$840,000
	Pipeline - Wolfe Rd Extensions	150	\$2,136,000
	Pipeline – Cal Water Contribution <sup>2</sup>		-\$1,500,000
	Customer Retrofits - Wolfe Rd Extensions		\$515,000
	Treatment Improvements		\$20,000,000
	Pumping/Storage Improvements		\$1,064,000
<b>Phase 1 Total (without Apple and Cal Water contribution)</b>		<b>495</b>	<b>\$24.7 million (\$31.0 million)</b>
2	Customer Retrofits - Infill	335	\$2,675,000
	Pipeline - Duane Ave	429	\$3,956,000
	Customer Retrofits - Duane Ave		\$1,665,000
	Treatment Improvements		\$11,000,000
<b>Phase 2 Total</b>		<b>764</b>	<b>\$19.3 million</b>
3	Pipeline - Extensions	140	\$1,287,000
	Customer Retrofits - Extensions		\$900,000
	Pipeline - Optional Extensions	87	(\$2,239,000)
	Customer Retrofits - Optional Extensions		(\$455,000)
	Treatment Improvements		\$25,000,000
	Pumping/Storage Improvements		\$10,901,000
<b>Phase 3 Total (if optional added)</b>		<b>140 (227)</b>	<b>\$38.1 million (\$40.8 million)</b>
4	Pipeline - Main Loop	335	\$13,504,000

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Phase	Projects	Demand (AFY)	Capital Cost
	Customer Retrofits - Main Loop		\$2,410,000
	Pipeline - Main Branches A	151	\$848,000
	Customer Retrofits - Main Branches A		\$625,000
	Pipeline - Optional Main Branches	(89)	(\$2,076,000)
	Customer Retrofits - Optional Main Branches		(\$640,000)
	Pumping/Storage Improvements <sup>3</sup>		(\$2,848,000)
	<b>Phase 4 Total</b>	<b>486</b>	<b>\$17.4 million</b>
	<b>(if optional added)</b>	<b>(575)</b>	<b>(\$23.0 million)</b>
	<b>CIP Total</b>	<b>1,885</b>	<b>\$99.5 million</b>
	<b>(if optional added)</b>	<b>(2,061)</b>	<b>(\$114.1 million)</b>

**Notes:** <sup>1</sup> CIP assumes Apple will provide \$4.8 million in funding.

<sup>2</sup> CIP assumes Cal Water will provide \$1.5 million in funding for this phase.

<sup>3</sup> This cost would only be incurred if the Central Tank site was selected and is considered an addition to the \$10.9 million for pumping/storage improvements under Phase 3.

Figure 2 provides a timeline of implementation and associated costs for the CIP. Detailed costs can be found in Appendix A.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033			
<b>Phase 1: Wolfe Rd</b>	Capital: \$24.7M (\$31.0M) <sup>1</sup>																							
	Pipeline - Wolfe Rd					Capital: \$1.6M																		
	Customer Retrofits - Wolfe Rd					Capital: \$0.8M																		
	Pipeline - Wolfe Rd Extensions					Capital: \$0.6M																		
	Customer Retrofits - Wolfe Rd Extensions					Capital: \$0.5M																		
	Treatment Improvements					Capital: \$20M																		
Pumping/Storage Improvements					Capital: \$1.1M																			
<b>Phase 2: Infill &amp; Extension</b>	Capital: \$19.3M																							
	Customer Retrofits - Infill					Capital: \$2.7M																		
	Pipeline - Duane Ave					Capital: \$4.0M																		
	Customer Retrofits - Duane Ave					Capital: \$1.7M																		
	Treatment Improvements					Capital: \$11M																		
<b>Phase 3: Extensions</b>	Capital: \$38.1M (\$40.8M) <sup>2</sup>																							
	Pipeline - Extensions					Capital: \$1.3M																		
	Customer Retrofits - Extensions					Capital: \$0.9M																		
	Pipeline - Optional Extensions					Capital: \$2.2M																		
	Customer Retrofits - Optional Extensions					Capital: \$0.5M																		
	Treatment Improvements					Capital: \$25M																		
	Pumping and Storage					Capital: \$10.9M																		
<b>Phase 4</b>	Capital: \$17.4M (\$23.0M) <sup>2</sup>																							
	Pipeline - Main Loop					Capital: \$13.5M																		
	Customer Retrofits - Main Loop					Capital: 2.4M																		
	Pipeline - Main Branches					Capital: \$0.8M																		
	Customer Retrofits - Main Branches					Capital: \$0.6M																		
	Pipeline - Optional Main Branches					Capital: \$2.1M																		
	Customer Retrofits -Optional Main Branches					Capital: \$0.6M																		
	Pumping and Storage (additional for Central Tank site)					Capital: \$2.8M																		

<sup>1</sup> Assumes Apple and Cal Water funding is not available.

<sup>2</sup> Assumes optional projects are incorporated.

**Kennedy/Jenks Consultants**

City of Sunnyvale Recycled Water Master Plan  
Capital Improvements Plan

**CIP Timeline**

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**Figure 2**

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## References

AWWA Research Foundation. Long-Term Performance Prediction for PVC Pipes. 2005.

Eisenberg, Olivieri & Associates (EOA). City of Sunnyvale, Recycled Water Program Master Plan. December 2000.

HydroScience Engineers, Inc. City of Sunnyvale 2010 Urban Water Management Plan. June 2011.

HydroScience Engineers, Inc. TM #1 – Near-Term Demand Forecast and Water Quality Requirements. August 2012.

HydroScience Engineers, Inc. TM #4 – Engineering Elements: Distribution System. November 2012.