



## TECHNICAL MEMORANDUM

DATE: December 13, 2017 Project No.: 425-10-16-04.006  
SENT VIA: EMAIL  
TO: City of Stockton, Municipal Utilities Department  
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SUBJECT: Stockton General Plan Update – Sewer Master Plan Supplement

This Technical Memorandum (TM) presents the Sewer Master Plan Supplement for the Stockton General Plan Update (GPU). This TM is based on the 2035 Wastewater Master Plan (2035 WWMP) prepared in 2008, with updated flows using GPU land uses. This TM includes the following Sections:

- Summary
  - Existing Sewer and Wastewater Treatment Facilities
  - Flow Projection Summary by Development Area
  - Flow Projection Summary by System
  - Required New Infrastructure Evaluations Summary
  - Approximate Regional Wastewater Control Facility Flows
  - Infrastructure Cost Evaluation Summary
- Existing Sewer and Wastewater Treatment Facilities
  - Sewer System
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- Wastewater Flow Estimates by Development Area
  - GPU Land Uses by Development Area
  - Wastewater Flow Factors
  - Average Dry Weather Flows by Development Area
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- Comparison of GPU 2040 and 2035 WWMP Flows and Costs
- Regional Wastewater Control Facility Flows and Costs
- Recommended Future Actions
  - Sewer System
  - Regional Wastewater Control Facility

The analyses and conclusions presented in this TM are based on generalized land use data and preliminary engineering evaluations. All these evaluations should be refined and updated through detailed evaluations of each specific development project.

## **SUMMARY**

Figure 1 shows the 2040 land uses based on the GPU. Figure 2 shows the City's wastewater sub-collection system boundaries, and Figure 3 show the existing pipelines and pump stations that comprise the wastewater collection systems. The basis of the summary data is presented in the sections following the summary, and the General Plan Update buildout land use map is provided in Attachment A.

### **Existing Sewer and Wastewater Treatment Facilities**

The City's sewer system is shown on Figure 3 and includes approximately 914 miles of gravity sewers and force mains (pressure pipelines) ranging from less than 6-inches to 72-inches in diameter and 28 sewer pump stations<sup>1</sup>. The sewer system generally flows from the north, east, and south to the Stockton Regional Wastewater Control Facility (RWCF), where it is treated and discharged to the San Joaquin River.

### **Flow Projection Summary by Development Area**

The estimated average dry weather flow (ADWF) and peak hour wet weather flow (PHWWF) for the collection system are summarized in Table 1. Based on land use information from the GPU and standard flow factors, the total estimated ADWF used for collection system planning is estimated to increase from about 37 million gallons per day (mgd) for existing land uses to 60 mgd for the 2040 land uses. The total PHWWF used for collection system planning is estimated to increase from about 80 mgd for existing land uses to 132 mgd for the 2040 land uses. The total of all flows used for planning collection system facilities is substantively higher than actual existing flows at the RWCF due to the need for conservative planning of collection system flows to minimize the potential for wastewater overflows.

### **Flow Projection Summary by System**

As described in the 2035 WWMP, the City's sewer system was divided into 10 existing sub-collection systems (Systems 1 through 10) and four future sub-collection systems (Systems 12 through 15). The Systems are shown on Figure 2. Improvements were identified for each of the Systems. In general, the 2040 ADWF for each System is lower than the ADWFs developed for the 2035 WWMP, which were based on buildout of the 2035 General Plan. There are three exceptions where the 2040 flows are higher than those projected in the 2035 WWMP (System 5 – serving the downtown area, System 10, and System 12). No flow from System 15 is anticipated by 2040, and about half the previously planned flow is anticipated in Systems 9, and 13.

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<sup>1</sup> City of Stockton Sewer System Management Plan 2016-2020; January 2016, City of Stockton.

<b>Table 1. Summary of Wastewater Flow Estimates for Collection System Planning</b>			
Land Use	Flow, mgd		
	Existing	Net New	2040
<b>Average Dry Weather Flow</b>			
Study Areas	1.4	3.6	5.1
Approved/Pending Development Projects Within City Limit	0.1	7.1	7.2
Approved/Pending Development Projects Outside City Limit but Within Sphere of Influence	0.0	8.3	8.3
Remaining City Outside of Study Areas and Outside of Approved/Pending Projects	35.6	3.6	39.1
<b>Total</b>	<b>37.1</b>	<b>22.5</b>	<b>59.7</b>
<b>Peak Hour Wet Weather Flow</b>			
Study Areas	8.3	10.1	18.4
Approved/Pending Development Projects Within City Limit	2.6	18.0	20.6
Approved/Pending Development Projects Outside City Limit but Within Sphere of Influence	0.0	19.0	19.0
Remaining City Outside of Study Areas and Outside of Approved/Pending Projects	68.6	5.6	74.2
<b>Total</b>	<b>79.5</b>	<b>52.7</b>	<b>132.1</b>

## Required New Infrastructure Evaluations Summary

The infrastructure evaluations were developed by:

- Estimating the ADWFs for the GPU 2040 level of development by sewer sub-collection system.
- Comparing the 2040 estimated ADWFs with the ADWFs in the 2035 WWMP, which were based on full buildout the 2035 General Plan.
- Using changes in projected flows for each sub-collection system as an indicator of how costs associated with the required infrastructure needed for the 2040 level of development would compare to the infrastructure identified in the 2035 WWMP, adjusted based on the nature of growth and planned infrastructure for each area.

The improvements anticipated within existing Systems 1, 2, 4, and 7, and future System 12 are not expected to change as a result of the GPU. Improvements needed within the other systems are expected to change as follows:

- System 3: Slightly fewer trunk sewer improvements are likely to be needed as the projected flows are reduced. The Smith Canal Pump Station, which is shared with Systems 2 and 9, will still require capacity upgrades and force main improvements. While the ultimate design flow may be slightly lower, this is unlikely to significantly reduce the cost of the needed improvements.
- System 5: The projected flows are about 30 percent higher, which may affect the size of some future improvements. The future Lincoln Street Pump Station and force main will also need to have a slightly higher capacity than previously planned.
- System 6: Lower projected flows will result in some reduction in future costs for planned upsizing and sewer extensions. The planned pump station needed for the eastern portion of System 6 would be slightly larger.
- System 8: Fewer trunk sewer upsizing projects and extensions into new service area will be needed by 2040 than previously identify for 2035 buildout.
- System 9: Some of the planned trunk sewer extensions into new service area may not be needed, and it is likely that none of the previously identified upsizing projects will be needed by 2040. The future Newton Road Pump Station would be somewhat smaller.
- System 10: Many of the previously identify trunk sewer extension have been constructed, so the projected costs will be lower. System 10 shares the 14-Mile Slough Pump Station with Systems 1, 2 and 15. Due to changes in growth planned for Systems 10 and 15, the 2040 capacity required at 14-Mile Slough Pump Station would be about 65 percent of the previously identified build-out flow. (No flow is anticipated from System 15 by 2040.)

- System 13: New pipelines and pump stations are required to serve this new service area. 2040 flows are about one half of the previously projected buildout flows, so the size of pump stations and some pipelines improvements will be less. The quantity (and cost) of infrastructure will be related to the size of new service area being added, and to the relative timing of development in the western portion versus the eastern portion. Development to the east in advance of development in the western portion will have disproportionately higher sewer infrastructure improvements due to the need to extend the collection system into the new service area.
- System 14: Most previously anticipated growth will not occur by 2040, and the infrastructure already constructed will not require improvements. The relevant facilities include the Weston Ranch Pump Station and force mains, which are shared with a portion of System 8.
- System 15: System 15 is not expected to require any sewer service by 2040, so no improvements will be needed.

### Approximate Regional Wastewater Control Facility Flows

The three-month average influent flow entering the RWCF is reported to be 27.0 mgd for May through July 2017<sup>2</sup>. The ADWF and Annual Average flow in 2016 were both 29 mgd, and the maximum month and maximum week flow were 37.7 mgd and 42.1 mgd, respectively<sup>3</sup>. These flow records compare to an ADWF of 37 mgd estimated using land uses and flow factors (above). The flow rate of 37 mgd is intended to be relatively high to reduce potential wastewater overflows in the collection system. Also, the lower reported ADWF from 2016 and 2017 reflect significant reductions from water conservation as well as areas counted as “developed” that are not currently occupied. In the absence of City-wide flow monitoring and additional analysis, adjustments to collection system flow projections are not recommended. For treatment plant planning, the City has adopted a predicted ADWF of 40.2 mgd for 2035 and 46.3 mgd for 2045<sup>4</sup>. The actual ADWF at 2040 will vary depending on the pace of development and changes in water conservation activities.

### Infrastructure Cost Evaluation Summary

Costs presented in the 2008 WWMP were adjusted based on the estimated reduction or increase in flow for each sub-collection system. Collection system total project costs associated with growth are predicted to be about \$727 million in 2007 dollars, with an additional \$67 million in 2007 dollars to address existing deficiencies. Costs for improvements at the RWCF through 2040 were not adjusted from the estimate prepared in 2011 for the Capital Improvement and Energy Management Plan, which totaled \$221 million in 2011 dollars. All costs estimates are planning level estimates based on broad assumptions and limited information, and do not necessarily reflect the economic conditions at the time a project is constructed.

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<sup>2</sup> Source: State of California CIWQS Data (self-monitoring reports); <http://ciwqs.waterboards.ca.gov>

<sup>3</sup> Source: Stockton RWCF Design Build Project; “Advanced Package 3a & 3b” of the Basis of Design Report; AECOM, October 2017.

<sup>4</sup> Ibid.

## EXISTING SEWER AND WASTEWATER TREATMENT FACILITIES

These descriptions of the existing sewer system and RWCF are based on the 2035 Wastewater Master Plan (2035 WWMP), which was prepared to identify how to collect and treat the wastewater flows from buildout of the 2035 General Plan. Additionally, these descriptions are updated based on discussions with City staff.

### Sewer System

As described in the 2035 WWMP, the City's sewer system is divided into 10 existing sub-collection systems (Systems 1 through 10) and four future sub-collection systems (Systems 12 through 15). There is no System 11. A System comprises a relatively large area that is generally tributary to a single major trunk sewer or flow route to the RWCF. System 15 will remain undeveloped at 2040, based on the GPU. The boundaries of the Systems referenced throughout this TM are shown on Figure 2.

The area labeled as System 90 is not served by the City's sewer system. Collection system planning does not incorporate flows from the area as there is no plan to connect it to the City's sewer in the future.

The City's wastewater collection infrastructure is shown on Figure 3. The sewer system generally flows from the north, east, and south toward the RWCF located on Navy Drive adjacent to the San Joaquin River. The City's sewer system, based on GIS mapping includes approximately 30 miles of force mains (pressure sewers) and 884 miles of gravity sewers<sup>5</sup>. The gravity sewers receive flow from approximately 554 miles of services laterals currently in use. The gravity sewers and force mains range in size from less than 6 inches to 72 inches in diameter. There are 28 pump stations (also shown on Figure 3) that range in capacity from 0.46 to 21.6 mgd. The capacity of each pump station is normally expressed in terms of firm capacity, which is the capacity with the largest pump on standby as a backup pump.

The wastewater infrastructure is of various ages and conditions. The City conducts regular inspection, maintenance and repairs to address deterioration and keep the system operational. Maintenance practices for the collection system are documented in the Sewer System Management Plan 2016-2020, prepared by the City in compliance with the requirements of the State Water Resources Control Board (SWRCB) Order No. 2006-003-DWQ, Statewide General Waste Discharge Requirement (WDR), dated May 2, 2006.

### Regional Wastewater Control Facility

Figure 3 depicts the location of the RWCF in relation to the collection systems. The RWCF is located on the San Joaquin River and consists of the main treatment plant, which has a design ADWF of 48 mgd, and the tertiary treatment plant, which has a designed ADWF and permitted capacity of 55 mgd. The tertiary treatment plant includes approximately 630 acres of facultative oxidation ponds surrounded by distribution canals and groundwater interceptor ditches; an engineered wetland; disinfection facilities; and a river outfall discharge system<sup>6</sup>. Solids are treated by anaerobic digestion,

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<sup>5</sup> City of Stockton Sewer System Management Plan 2016-2020; January 2016, City of Stockton.

<sup>6</sup> Ibid.

dewatered, and disposed of off-site. Effluent is discharged into the San Joaquin River adjacent to the RWCF.

Past and current flows to the RWCF are summarized below:

- 1997 ADWF: 28.4 mgd
- 2000 ADWF: 31.6 mgd
- 2005 ADWF: 35.0 mgd
- 2016 ADWF: 29.0 mgd
- 2017 ADWF (based on May, June, July): 27.0 mgd (a recent decrease in wastewater flows has occurred in many cities in California and is generally attributed to the recent drought, associated mandated water conservation, and the economic recession).

The RWCF discharges treated water to the Sacramento/San Joaquin River Delta in accordance with National Pollutant Discharge Elimination System (NPDES) permit No. CA0079138, State Water Resources Control Board Order R5-2014-0070-03. A major upgrade to the RWCF is currently in design that will improve the headworks and secondary treatment system as part of a long-term plan to address rehabilitation and replacement needs while improving treatment reliability and upgrading to provide the currently permitted capacity of 55 mgd.

## **WASTEWATER FLOW ESTIMATES BY DEVELOPMENT AREA**

Wastewater flow projections were calculated using two different methodologies. The first was based on summary data tables developed by Placeworks listing the land uses in each GPU Study Area and planned development projects (Development Areas). Projections were also developed for each wastewater collection System, as described later in this TM, to facilitate an update to the 2035 WWMP infrastructure cost analysis.

### **GPU Land Uses by Development Area**

The land use data provided by Placeworks is presented in Attachment A (including the buildout land use map, dwelling unit data, acreage data, and 2040 percent development data). The land use data was reorganized to facilitate application of wastewater flow factors. The reorganized data is provided in Table 2, which includes existing land use, net new land use for 2040, and 2040 land use. For single family and multi-family residential land uses, Table 2 includes both dwelling unit data and acreage data. For commercial and industrial land uses, Table 2 includes only acreage data.

### **Wastewater Flow Factors**

The 2035 WWMP provided flow factors for both existing land uses (Table 2-10 of the WWMP) and for future land uses (Table 2-11 of the WWMP) for use in estimating flow in the sewer system. Flow factors used for estimating sewer system flows are intentionally conservative, meaning they are intended to result in predicted flows that are higher than the corresponding actual flows, to allow for a range of different flow rates within a land use category. For example, actual commercial flows will generally range from very low for rental storage units to very high for restaurants. To allow for this range of actual flows, conservative (high) flow factors are used for estimating collection system flows in order to reduce the risk of undersized sewers and associated wastewater outflows.

Table 2. Land Use Data

Study Area or Development Name	Single Family (Dwelling Units)			Single Family (Gross Acres)			Multi Family (Dwelling Units)			Multi Family (Gross Acres)			Commercial (Gross Acres)			Industrial (Gross Acres)			Total Area (Gross Acres)		
	Existing	Net New	2040	Existing	Net New	2040	Existing	Net New	2040	Existing	Net New	2040	Existing	Net New	2040	Existing	Net New	2040	Existing	Net New	2040
<b>Study Areas</b>																					
Study Area 1 - Eight Mile Rd Area	121	1,379	1,500	17.2	232.1	249.3	96	1,198	1,294	8.4	73.2	81.6	17.9	0.6	18.5	4.0	0.0	4.0	48	306	353
Study Area 2 - Pacific Ave Corridor	22	0	22	5.8	0.0	5.8	114	110	224	4.3	5.9	10.3	114.9	4.5	119.4	0.1	0.0	0.1	125	10	136
Study Area 3 - West Ln and Alpine Rd Area	208	77	285	51.6	68.8	120.3	94	680	774	7.3	37.4	44.7	66.9	7.7	74.6	68.1	0.0	68.1	194	114	308
Study Area 4 - Port/Waterfront	54	17	71	10.6	15.0	25.6	288	1,770	2,058	10.7	33.4	44.2	9.5	3.7	13.2	55.4	6.9	62.4	86	59	145
Study Area 5 - El Dorado/Center Corridors	45	0	45	7.4	0.0	7.4	359	1,196	1,555	10.3	21.5	31.9	7.7	2.3	9.9	12.4	0.0	12.4	38	24	62
Study Area 6 - Miner/Weber Corridors	47	0	47	5.9	0.0	5.9	219	1,248	1,467	6.0	22.5	28.5	5.7	4.2	9.9	9.0	0.0	9.0	27	27	53
Study Area 7 - Wilson Way Corridor	12	0	12	2.2	0.0	2.2	6	234	240	0.3	8.6	8.9	0.8	6.4	7.2	18.7	0.0	18.7	22	15	37
Study Area 8 - I-5/Highway 4 Interchange	8	0	8	1.4	0.0	1.4	1	659	660	0.2	47.5	47.7	0.7	1.1	1.8	16.5	0.0	16.5	19	49	67
Study Area 9 - Railroad Corridor at California St	19	0	19	3.1	0.0	3.1	23	1,340	1,363	1.7	24.1	25.7	4.4	1.9	6.3	8.7	0.0	8.7	18	26	44
Study Area 10 - I-5 and Charter Way Area	228	86	314	57.1	77.2	134.3	29	98	127	5.1	5.3	10.4	25.7	3.2	28.9	5.8	3.4	9.2	94	89	183
Study Area 11 - Charter Way/MLK Jr Blvd Corridor	5	0	5	0.4	0.0	0.4	0	396	396	0.0	9.7	9.7	2.8	0.5	3.3	0.0	0.0	0.0	3	10	13
Study Area 12 - Airport Way Corridor	53	0	53	9.6	0.0	9.6	4	108	112	0.4	5.9	6.3	4.3	12.7	17.0	111.9	16.4	128.3	126	35	161
Study Area 13 - Mariposa and Charter Area	12	0	12	5.3	0.0	5.3	77	0	77	7.4	0.0	7.4	5.2	1.9	7.2	0.0	0.0	0.0	18	2	20
Study Area 14 - East Weston Ranch	1	0	1	1.5	0.0	1.5	0	0	0	0.0	0.0	0.0	1.2	18.5	19.8	0.0	0.0	0.0	3	19	21
Study Area 15 - South of French Camp Rd	89	0	89	100.9	0.0	100.9	9	0	9	7.6	0.0	7.6	0.0	0.0	0.0	0.1	0.0	0.1	109	0	109
Study Area 16 - E French Camp Rd Area	59	0	59	163.6	0.0	163.6	4	0	4	11.4	0.0	11.4	0.1	0.0	0.1	0.2	0.0	0.2	175	0	175
<b>Subtotal (Study Areas)</b>	<b>983</b>	<b>1,558</b>	<b>2,541</b>	<b>443.4</b>	<b>393.0</b>	<b>836.5</b>	<b>1,323</b>	<b>9,036</b>	<b>10,359</b>	<b>81.4</b>	<b>294.8</b>	<b>376.2</b>	<b>267.8</b>	<b>69.3</b>	<b>337.1</b>	<b>310.8</b>	<b>26.7</b>	<b>337.5</b>	<b>1,103</b>	<b>784</b>	<b>1,887</b>
<b>Approved/Pending Development Projects Within City Limit</b>																					
Westlake Villages	0	2,630	2,630	0.0	680.0	680.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	680	680
Delta Cove	0	1,164	1,164	0.0	132.7	132.7	0	381	381	0.0	47.6	47.6	0.0	2.6	2.6	0.0	0.0	0.0	0	183	183
North Stockton Projects III	235	2,220	2,455	38.0	355.0	393.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38	355	393
Cannery Park	0	981	981	0.0	272.0	272.0	0	210	210	0.0	16.0	16.0	0.0	104.0	104.0	0.0	0.0	0.0	0	392	392
Nor Cal Logistics Center	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
Crystal Bay	0	951	951	0.0	19.4	19.4	0	392	392	0.0	78.7	78.7	0.0	0.0	0.0	0.0	0.0	0.0	0	98	98
Sanctuary	0	5,452	5,452	0.0	1,026.0	1,026.0	0	1,618	1,618	0.0	67.4	67.4	0.0	35.5	35.5	0.0	0.0	0.0	0	1,129	1,129
Tidewater Crossing	310	-310	0	869.6	-869.6	0.0	0	0	0	0.0	0.0	0.0	0.0	16.0	16.0	0.0	0.0	0.0	870	-854	16
Open Window	0	0	0	0.0	0.0	0.0	11	1,739	1,750	0.0	14.9	14.9	16.1	-1.3	14.9	0.0	0.0	0.0	16	14	30
Weston Ranch Town Center	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	41.5	41.5	0.0	0.0	0.0	0	41	41
<b>Subtotal (Approved/Pending Projects Within City Limit)</b>	<b>545</b>	<b>13,088</b>	<b>13,633</b>	<b>907.6</b>	<b>1,615.5</b>	<b>2,523.1</b>	<b>11</b>	<b>4,340</b>	<b>4,351</b>	<b>0.0</b>	<b>224.6</b>	<b>224.6</b>	<b>16.1</b>	<b>198.3</b>	<b>214.4</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>924</b>	<b>2,038</b>	<b>2,962</b>
<b>Approved/Pending Development Projects Outside City Limit but Within Sphere of Influence</b>																					
Mariposa Lakes	5	8,955	8,960	151.0	939.3	1,090.3	3	1,553	1,556	0.0	585.0	585.0	0.0	150.0	150.0	0.0	0.0	0.0	151	1,674	1,825
Airpark 599	0	0	0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0	128.0	128.0	0.0	0.0	0.0	0	128	128
Tra Vigne	0	1,244	1,244	0.0	846.4	846.4	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	846	846
<b>Subtotal (Approved/Pending Projects Outside City Limit but Within Sphere of Influence)</b>	<b>5</b>	<b>10,199</b>	<b>10,204</b>	<b>151.0</b>	<b>1,785.7</b>	<b>1,936.7</b>	<b>3</b>	<b>1,553</b>	<b>1,556</b>	<b>0.0</b>	<b>585.0</b>	<b>585.0</b>	<b>0.0</b>	<b>278.0</b>	<b>278.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>151</b>	<b>2,649</b>	<b>2,800</b>
Remaining City Outside of Study Areas and Outside of Approved/Pending Projects	76,463	1,501	77,964	18,494	1,694	20,188	33,183	0	33,183	2,395	0	2,395	683	0	683	2,230	0	2,230	23,802	1,694	25,496
<b>Grand Total</b>	<b>77,996</b>	<b>26,346</b>	<b>104,342</b>	<b>19,996</b>	<b>5,488</b>	<b>25,484</b>	<b>34,520</b>	<b>14,929</b>	<b>49,449</b>	<b>2,476</b>	<b>1,104</b>	<b>3,581</b>	<b>967</b>	<b>546</b>	<b>1,513</b>	<b>2,541</b>	<b>27</b>	<b>2,567</b>	<b>25,980</b>	<b>7,165</b>	<b>33,145</b>

The flow factors used in this GPU wastewater estimate are summarized in Table 3, and include factors for single family residential, multi-family residential, commercial, and industrial for both existing land uses and for future land uses. Flow projected for 2040 is based on both sets of factors, those listed under “Flow Factors for Existing Development Areas” are applied to currently developed areas, and those listed under “Flow Factors for Areas Planned for Future Development” are applied to currently undeveloped areas where growth is planned. A limited number of industries that produce flows well in excess of the flow that would be predicted using the standard flow factors are considered on a case-by-case basis in the 2035 WWMP.

### **Average Dry Weather Flows by Development Area**

The ADWF estimates for the Development Areas are calculated in Table 4. The ADWFs are calculated by multiplying the land use (in terms of acres or residential dwelling units) by the appropriate flow factor. The following ADWFs are calculated for existing, net new, and 2040 flows using the land use data and flow factors adopted for collection system planning:

- ADWF from exiting land uses: 37.1 mgd
- ADWF from net growth between 2017 and 2040: 22.5 mgd
- ADWF from 2040 land uses: 59.7 mgd

The average of the actual May, June, and July 2017 daily flows entering the RWCF was 27.0 mgd<sup>7</sup>. The ADWF estimated using land use data and flow factors of 37.1 mgd is 37 percent higher than the actual flow into the RWCF. As discussed above, the flow factors used in estimating the ADWFs for sewer system planning and sizing are intentionally conservative (high). It is likely that flows observed in the summer of 2017 reflect substantive residual water conservation efforts that were initiated during the recent drought and continue to result in lower than historical wastewater flows. To the extent such conservation efforts are not permanent, flows from existing users can be expected to rebound to higher values in the future, even in the absence of growth. In addition, it is likely that a portion of the areas identified as “developed” are not fully occupied. Therefore, the ratio of the total of estimated flows used in collection system planning compared to actual current dry weather flow at the treatment plant is appropriate and expected.

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<sup>7</sup> California Integrated Water Quality System Project (CIWQS); State of California ([https://www.waterboards.ca.gov/water\\_issues/programs/ciwqs/publicreports.shtml](https://www.waterboards.ca.gov/water_issues/programs/ciwqs/publicreports.shtml)).

<b>Table 3. Sewer Flow Factors for Existing and Future Development<sup>(a)</sup></b>		
<b>Land Use Category</b>	<b>Flow Factor</b>	<b>Units</b>
Flow Factors for Existing Development Areas from Table 2-10 from City of Stockton 2035 Wastewater Master Plan (West Yost, October 2008)		
Single Family Residential	240	gpd/DU
Multi-Family Residential	5,568	gpd/acre
Commercial	1,100	gpd/acre
Industrial	1,400	gpd/acre
Flow Factors for Areas Planned for Future Development Table 2-11 from City of Stockton 2035 Wastewater Master Plan (West Yost, October 2008)		
<b>Land Use Category</b>	<b>Flow Factor</b>	<b>Units</b>
Single Family Residential	2,100	gpd/acre
Multi-Family Residential	6,800	gpd/acre
Multi-Family Residential (Downtown)	20,400	gpd/acre
Commercial	2,000	gpd/acre
Industrial	3,000	gpd/acre
<sup>(a)</sup> Flow projected for 2040 is based on both sets of factors, those listed under "Flow Factors for Existing Development Areas" are applied to currently developed areas, and those listed under "Flow Factors for Areas Planned for Future Development" are applied to currently undeveloped areas where growth is planned.		

**Table 4. Average Dry Weather Flows**

Study Area Name	Single Family, gpd			Multi Family, gpd			Commercial, gpd			Industrial, gpd			Total, gpd		
	Existing	Net New	2040	Existing	Net New	2040	Existing	Net New	2040	Existing	Net New	2040	Existing	Net New	2040
<b>Study Areas</b>															
Study Area 1 - Eight Mile Rd Area	29,040	487,393	516,433	46,908	497,555	544,462	19,657	1,206	20,863	5,646	0	5,646	101,250	986,154	1,087,404
Study Area 2 - Pacific Ave Corridor	5,280	0	5,280	24,200	40,178	64,378	126,441	8,988	135,429	133	0	133	156,053	49,166	205,220
Study Area 3 - West Ln and Alpine Rd Area	49,920	144,416	194,336	40,643	254,176	294,819	73,591	15,467	89,058	95,319	0	95,319	259,473	414,059	673,532
Study Area 4 - Port/Waterfront	12,960	31,467	44,427	59,819	568,150	627,969	10,468	7,354	17,822	77,579	20,835	98,415	160,827	627,806	788,633
Study Area 5 - El Dorado/Center Corridors	10,800	0	10,800	57,590	243,022	300,612	8,421	4,512	12,933	17,295	0	17,295	94,106	247,534	341,640
Study Area 6 - Miner/Weber Corridors	11,280	0	11,280	33,641	305,728	339,369	6,255	8,397	14,652	12,541	0	12,541	63,717	314,125	377,842
Study Area 7 - Wilson Way Corridor	2,880	0	2,880	1,725	58,166	59,891	904	12,811	13,715	26,136	0	26,136	31,645	70,977	102,622
Study Area 8 - I-5/Highway 4 Interchange	1,920	0	1,920	952	322,974	323,926	736	2,231	2,967	23,053	0	23,053	26,662	325,204	351,866
Study Area 9 - Railroad Corridor at California St	4,560	0	4,560	9,306	163,656	172,962	4,848	3,728	8,577	12,230	0	12,230	30,945	167,385	198,329
Study Area 10 - I-5 and Charter Way Area	54,720	162,109	216,829	28,322	35,797	64,119	28,243	6,402	34,646	8,052	10,205	18,258	119,337	214,514	333,851
Study Area 11 - Charter Way/MLK Jr Blvd Corridor	1,200	0	1,200	0	65,753	65,753	3,057	1,088	4,146	0	0	0	4,257	66,842	71,099
Study Area 12 - Airport Way Corridor	12,720	0	12,720	2,450	39,984	42,434	4,687	25,449	30,135	156,707	49,097	205,804	176,564	114,530	291,094
Study Area 13 - Mariposa and Charter Area	2,880	0	2,880	41,329	0	41,329	5,746	3,871	9,617	0	0	0	49,955	3,871	53,826
Study Area 14 - East Weston Ranch	240	0	240	0	0	0	1,359	37,076	38,436	0	0	0	1,599	37,076	38,676
Study Area 15 - South of French Camp Rd	21,360	0	21,360	42,496	0	42,496	0	0	0	114	0	114	63,970	0	63,970
Study Area 16 - E French Camp Rd Area	14,160	0	14,160	63,629	0	63,629	161	0	161	328	0	328	78,278	0	78,278
<b>Subtotal (Study Areas)</b>	<b>235,920</b>	<b>825,385</b>	<b>1,061,305</b>	<b>453,009</b>	<b>2,595,141</b>	<b>3,048,150</b>	<b>294,576</b>	<b>138,580</b>	<b>433,157</b>	<b>435,134</b>	<b>80,138</b>	<b>515,272</b>	<b>1,418,640</b>	<b>3,639,243</b>	<b>5,057,883</b>
<b>Approved/Pending Development Projects Within City Limit</b>															
Westlake Villages	0	1,428,000	1,428,000	0	0	0	0	0	0	0	0	0	0	1,428,000	1,428,000
Delta Cove	0	278,733	278,733	0	323,612	323,612	0	5,160	5,160	0	0	0	0	607,505	607,505
North Stockton Projects III	56,400	745,500	801,900	0	0	0	0	0	0	0	0	0	56,400	745,500	801,900
Cannery Park	0	571,200	571,200	0	108,800	108,800	0	208,000	208,000	0	0	0	0	888,000	888,000
Nor Cal Logistics Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crystal Bay	0	40,740	40,740	0	535,160	535,160	0	0	0	0	0	0	0	575,900	575,900
Sanctuary	0	2,154,600	2,154,600	0	458,320	458,320	0	71,060	71,060	0	0	0	0	2,683,980	2,683,980
Tidewater Crossing	74,400	-74,400	0	0	0	0	0	32,000	32,000	0	0	0	74,400	-42,400	32,000
Open Window	0	0	0	0	101,162	101,162	17,739	-1,375	16,364	0	0	0	17,739	99,787	117,527
Weston Ranch Town Center	0	0	0	0	0	0	0	82,902	82,902	0	0	0	0	82,902	82,902
<b>Subtotal (Approved/Pending Development Projects Within City Limit)</b>	<b>130,800</b>	<b>5,144,373</b>	<b>5,275,173</b>	<b>0</b>	<b>1,527,054</b>	<b>1,527,054</b>	<b>17,739</b>	<b>397,747</b>	<b>415,486</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>148,539</b>	<b>7,069,174</b>	<b>7,217,713</b>
<b>Approved/Pending Development Projects Outside City Limit but Within Sphere of Influence</b>															
Mariposa Lakes <sup>(a)</sup>	0	1,972,530	1,972,530	0	3,978,000	3,978,000	0	300,000	300,000	0	0	0	0	6,250,530	6,250,530
Airpark 599	0	0	0	0	0	0	0	256,000	256,000	0	0	0	0	256,000	256,000
Tra Vigne	0	1,777,541	1,777,541	0	0	0	0	0	0	0	0	0	0	1,777,541	1,777,541
<b>Subtotal (Approved/Pending Development Projects Outside City Limit but Within Sphere of Influence)</b>	<b>0</b>	<b>3,750,071</b>	<b>3,750,071</b>	<b>0</b>	<b>3,978,000</b>	<b>3,978,000</b>	<b>0</b>	<b>556,000</b>	<b>556,000</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8,284,071</b>	<b>8,284,071</b>
Remaining City Outside of Study Areas and Outside of Approved/Pending Projects	18,351,120	3,557,377	21,908,497	13,334,753	0	13,334,753	751,613	0	751,613	3,121,617	0	3,121,617	35,559,103	3,557,377	39,116,479
<b>Grand Total</b>	<b>18,717,840</b>	<b>13,277,205</b>	<b>31,995,045</b>	<b>13,787,762</b>	<b>8,100,195</b>	<b>21,887,957</b>	<b>1,063,929</b>	<b>1,092,327</b>	<b>2,156,255</b>	<b>3,556,751</b>	<b>80,138</b>	<b>3,636,889</b>	<b>37,126,282</b>	<b>22,549,865</b>	<b>59,676,147</b>

<sup>(a)</sup> Small amount of existing development accounts for zero flow since the collection system is not yet constructed.

## Peak Hour Wet Weather Flows by Development Area

The Peak Hour Wet Weather Flows estimates (PHWWFs) for sewer design purposes are the sum of the ADWF and the Infiltration and Inflow (I&I) multiplied by a peaking factor<sup>8</sup>.

- Derivation of ADWF was discussed above.
- I&I accounts for rainfall and groundwater that enters the sewer systems during storm events. The I&I is estimated by multiplying the land use area by the I&I factor (400 gallons per day per acre). The estimated I&I flows are presented in Table 5.
- The peaking factor is multiplied by the sum of the ADWF and I&I flows. The peaking factor accounts for variations in the flow during the daily cycle of activity. For example, on weekdays, the residential ADWFs are typically highest in the morning as people wake up and getting ready to go to work. Commercial and industrial ADWFs are often highest in the day time when many people are at work. The peaking factor accounts for the variation in flows during the daily cycle and the aggregate effect of differences in flow patterns from different land uses. The peaking factor is dependent on the total ADWF, and as the ADWF increases, the peaking factor decreases. Peaking factors are calculated in Table 6 using the equations from the City's design standards and reported on page 2-19 of the 2035 WWMP. The maximum allowed peaking factor is 5.0. Where a study area comprises multiple independent sewer sub-sheds, the listed aggregate peaking factor is lower than the peaking factor that would be applied to individual sub-sheds.
- The PHWWF presented in Table 7 is calculated by multiplying the peaking factor by the sum of the ADWF and I&I flows for the existing land uses and for the 2040 land uses. The net new PHWWFs are the difference between the 2040 values and the existing values. These PHWWFs are used to size sewer system pipelines and pump stations.

A more thorough flow study and calibrated model would be needed for a more reliable estimate of PHWWFs based on historical flow patterns and I&I measurements throughout the collection system. The City has projected that the PHWWF at the RWCF will be 104.5 mgd in 2035 and 120.5 mgd in 2045<sup>9</sup>. Assuming linear growth from 2035 to 2045, the corresponding PHWWF for 2040 would be 112.5 mgd.

As stated above, the flow estimates presented in this TM are based on generalized land use data and preliminary engineering evaluations. All these flow estimates should be refined and updated through detailed evaluations of each specific development project.

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<sup>8</sup> Standard Drawing No. S-1, City of Stockton, 2016.  
([http://www.stocktongov.com/files/Standard\\_Drawings\\_2016.pdf](http://www.stocktongov.com/files/Standard_Drawings_2016.pdf))

<sup>9</sup> Source: Stockton RWCF Design Build Project; "Advanced Package 3a & 3b" of the Basis of Design Report; AECOM, October 2017.

**Table 5. Infiltration and Inflow**

Study Area Name	Single Family, gpd			Multi Family, gpd			Commercial, gpd			Industrial, gpd			Total, gpd		
	Existing	Net New	2040	Existing	Net New	2040	Existing	Net New	2040	Existing	Net New	2040	Existing	Net New	2040
<b>Study Areas</b>															
Study Area 1 - Eight Mile Rd Area	6,887	92,837	99,723	3,370	29,268	32,638	7,148	241	7,389	1,613	0	1,613	19,018	122,346	141,363
Study Area 2 - Pacific Ave Corridor	2,315	0	2,315	1,738	2,363	4,102	45,979	1,798	47,776	38	0	38	50,070	4,161	54,231
Study Area 3 - West Ln and Alpine Rd Area	20,622	27,508	48,130	2,920	14,952	17,871	26,760	3,093	29,854	27,234	0	27,234	77,536	45,553	123,089
Study Area 4 - Port/Waterfront	4,243	5,994	10,237	4,297	13,368	17,666	3,807	1,471	5,277	22,166	2,778	24,944	34,513	23,611	58,123
Study Area 5 - El Dorado/Center Corridors	2,953	0	2,953	4,137	8,612	12,749	3,062	902	3,964	4,941	0	4,941	15,094	9,514	24,608
Study Area 6 - Miner/Weber Corridors	2,343	0	2,343	2,417	8,992	11,409	2,275	1,679	3,954	3,583	0	3,583	10,618	10,671	21,289
Study Area 7 - Wilson Way Corridor	879	0	879	124	3,422	3,545	329	2,562	2,891	7,468	0	7,468	8,799	5,984	14,783
Study Area 8 - I-5/Highway 4 Interchange	550	0	550	68	18,998	19,067	268	446	714	6,587	0	6,587	7,473	19,445	26,917
Study Area 9 - Railroad Corridor at California St	1,226	0	1,226	669	9,627	10,295	1,763	746	2,509	3,494	0	3,494	7,152	10,373	17,525
Study Area 10 - I-5 and Charter Way Area	22,849	30,878	53,727	2,035	2,106	4,140	10,270	1,280	11,551	2,301	1,361	3,661	37,455	35,625	73,080
Study Area 11 - Charter Way/MLK Jr Blvd Corridor	151	0	151	0	3,868	3,868	1,112	218	1,329	0	0	0	1,262	4,086	5,348
Study Area 12 - Airport Way Corridor	3,828	0	3,828	176	2,352	2,528	1,704	5,090	6,794	44,773	6,546	51,320	50,481	13,988	64,469
Study Area 13 - Mariposa and Charter Area	2,103	0	2,103	2,969	0	2,969	2,090	774	2,864	0	0	0	7,161	774	7,936
Study Area 14 - East Weston Ranch	606	0	606	0	0	0	494	7,415	7,910	0	0	0	1,100	7,415	8,515
Study Area 15 - South of French Camp Rd	40,351	0	40,351	3,053	0	3,053	0	0	0	33	0	33	43,436	0	43,436
Study Area 16 - E French Camp Rd Area	65,459	0	65,459	4,571	0	4,571	59	0	59	94	0	94	70,183	0	70,183
<b>Subtotal (Study Areas)</b>	<b>177,364</b>	<b>157,216</b>	<b>334,580</b>	<b>32,544</b>	<b>117,927</b>	<b>150,471</b>	<b>107,119</b>	<b>27,716</b>	<b>134,835</b>	<b>124,324</b>	<b>10,685</b>	<b>135,009</b>	<b>441,351</b>	<b>313,544</b>	<b>754,895</b>
<b>Approved/Pending Development Projects Within City Limit</b>															
Westlake Villages	0	272,000	272,000	0	0	0	0	0	0	0	0	0	0	272,000	272,000
Delta Cove	0	53,092	53,092	0	19,036	19,036	0	1,032	1,032	0	0	0	0	73,160	73,160
North Stockton Projects III	15,200	142,000	157,200	0	0	0	0	0	0	0	0	0	15,200	142,000	157,200
Cannery Park	0	108,800	108,800	0	6,400	6,400	0	41,600	41,600	0	0	0	0	156,800	156,800
Nor Cal Logistics Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crystal Bay	0	7,760	7,760	0	31,480	31,480	0	0	0	0	0	0	0	39,240	39,240
Sanctuary	0	410,400	410,400	0	26,960	26,960	0	14,212	14,212	0	0	0	0	451,572	451,572
Tidewater Crossing	347,848	-347,848	0	0	0	0	0	6,400	6,400	0	0	0	347,848	-341,448	6,400
Open Window	0	0	0	0	5,951	5,951	6,451	-500	5,951	0	0	0	6,451	5,451	11,901
Weston Ranch Town Center	0	0	0	0	0	0	0	16,580	16,580	0	0	0	0	16,580	16,580
<b>Subtotal (Approved/Pending Projects Within City Limit)</b>	<b>363,048</b>	<b>646,204</b>	<b>1,009,252</b>	<b>0</b>	<b>89,827</b>	<b>89,827</b>	<b>6,451</b>	<b>79,324</b>	<b>85,775</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>369,499</b>	<b>815,355</b>	<b>1,184,854</b>
<b>Approved/Pending Development Projects Outside City Limit but Within Sphere of Influence</b>															
Mariposa Lakes	60,400	375,720	436,120	0	234,000	234,000	0	60,000	60,000	0	0	0	60,400	669,720	730,120
Airpark 599	0	0	0	0	0	0	0	51,200	51,200	0	0	0	0	51,200	51,200
Tra Vigne	0	338,579	338,579	0	0	0	0	0	0	0	0	0	0	338,579	338,579
<b>Subtotal (Approved/Pending Projects Outside City Limit but Within Sphere of Influence)</b>	<b>60,400</b>	<b>714,299</b>	<b>774,699</b>	<b>0</b>	<b>234,000</b>	<b>234,000</b>	<b>0</b>	<b>111,200</b>	<b>111,200</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>60,400</b>	<b>1,059,499</b>	<b>1,119,899</b>
Remaining City Outside of Study Areas and Outside of Approved/Pending Projects	7,397,586	677,596	8,075,182	957,956	0	957,956	273,314	0	273,314	891,891	0	891,891	9,520,747	677,596	10,198,343
<b>Grand Total</b>	<b>7,998,399</b>	<b>2,195,315</b>	<b>10,193,714</b>	<b>990,500</b>	<b>441,754</b>	<b>1,432,254</b>	<b>386,883</b>	<b>218,240</b>	<b>605,123</b>	<b>1,016,215</b>	<b>10,685</b>	<b>1,026,900</b>	<b>10,391,997</b>	<b>2,865,994</b>	<b>13,257,991</b>

**Table 6. Peaking Factors**

Study Area Name	Peaking Factor	
	Existing	2040
<b>Study Areas</b>		
Study Area 1 - Eight Mile Rd Area	5.0	2.5
Study Area 2 - Pacific Ave Corridor	4.3	3.9
Study Area 3 - West Ln and Alpine Rd Area	3.6	2.7
Study Area 4 - Port/Waterfront	4.2	2.6
Study Area 5 - El Dorado/Center Corridors	5.0	3.3
Study Area 6 - Miner/Weber Corridors <sup>(a)</sup>	5.0	3.2
Study Area 7 - Wilson Way Corridor	5.0	4.9
Study Area 8 - I-5/Highway 4 Interchange	5.0	3.3
Study Area 9 - Railroad Corridor at California St	5.0	4.0
Study Area 10 - I-5 and Charter Way Area	4.7	3.3
Study Area 11 - Charter Way/MLK Jr Blvd Corridor	5.0	5.0
Study Area 12 - Airport Way Corridor	4.1	3.5
Study Area 13 - Mariposa and Charter Area	5.0	5.0
Study Area 14 - East Weston Ranch <sup>(b)</sup>	5.0	5.0
Study Area 15 - South of French Camp Rd	5.0	5.0
Study Area 16 - E French Camp Rd Area	5.0	5.0
<b>Approved/Pending Development Projects Within City Limit</b>		
Westlake Villages	0.0	2.3
Delta Cove	0.0	2.8
North Stockton Projects III	5.0	2.6
Cannery Park	0.0	2.6
Nor Cal Logistics Center	0.0	0.0
Crystal Bay	0.0	2.8
Sanctuary	0.0	2.1
Tidewater Crossing	5.0	5.0
Open Window <sup>(a)</sup>	5.0	4.7
Weston Ranch Town Center	0.0	5.0
<b>Approved/Pending Development Projects Outside City Limit but Within Sphere of Influence</b>		
Mariposa Lakes	0.0	1.9
Airpark 599	0.0	3.6
Tra Vigne <sup>(b)</sup>	0.0	2.2
<b>Remaining City Outside of Study Areas and Outside of Approved/Pending Project</b>	1.5	1.5
<b>RWCF</b>	1.5	1.4
<p>Note: A peaking factor of 0.0 is used for development areas with no existing wastewater flow.</p> <p><sup>(a)</sup> Peaking factors based on City of Stockton 2016 Standard Drawing No. S-1.</p> <p><sup>(b)</sup> As flows combine with flows from onther areas, the applicable peaking factor will be lower than listed.</p>		

## COMPARISON OF GPU 2040 AND 2035 WWMP FLOWS AND COSTS

Wastewater collection infrastructure improvements were grouped by the numbered collection Systems identified in the 2035 WWMP. In order to assess potential changes to the planned facilities resulting from the GPU, it is useful to evaluate the change in projected flows for each System.

A summary of the ADWFs for the current GPU evaluations (2040 ADWF estimates, representing partial build-out) and the 2035 WWMP evaluation (2035 General Plan buildout) is provided in Table 8. As shown, there are significant differences between the 2040 projection and the 2035 WWMP buildout ADWFs. Some of the changes can be attributed to updated land use data and differing flow calculation methodologies, but they provide a reliable indication of the magnitude of differences associated with the new planning horizon and General Plan land use diagram. These differences potentially result in changes to the previously planned sewer system improvements. The changes are discussed in the following paragraphs by System. Costs are planning level estimates of construction cost without contingencies based on Table 8-2 of the 2035 WWMP. The adjusted costs applying the following changes are provided in Table 9:

- System 1: In this System, the change in ADWF is a decrease of 0.1 mgd out of a 2035 WWMP estimated flow of 3.0 mgd (a decrease of 3.0 percent). This small change results in no significant change in the planned sewer system infrastructure for this shed. Consequently, the estimated costs from the 2035 WWMP for this System are still appropriate.
- System 2: In this System, the change in ADWF is a decrease of 1.1 mgd out of a 2035 WWMP estimated flow of 13.6 mgd (a decrease of 7.8 percent). This small change results in no significant change in the planned sewer system infrastructure for this shed. Consequently, the estimated costs from the 2035 WWMP for this System are still appropriate.
- System 3: In this System, the change in ADWF is a decrease of 3.0 mgd out of a 2035 WWMP estimated flow of 10.3 mgd (a decrease of 29 percent). A significant portion of the apparent decrease in projected flow appears to be associated with a revision to the existing conditions land use data. Nevertheless, this change will likely result in a reduction of the planned sewer system improvements, including:
  - Trunk Sewers: All pipeline improvements comprised upsizing of existing pipelines. Approximately 20 percent of the previously estimated cost was associated with existing deficiencies. Based on the reduced estimate of existing flows, a relatively small reduction (10 percent) in the projected trunk sewer costs for this System is warranted.
  - Pump Stations: System 3 shares a major pumping facility with Systems 2 and 9, the Smith Canal Pump Station, which will require major upgrades in the future. One additional small pump station, Kirk and Del Rio (County) Pump Station, is also expected to require upgrades and eventual replacement to accommodate growth. Any change in cost to planned improvements at these pumping facilities attributable to changes in System 3 is expected to be minor and a change in the planning level estimate of costs is not warranted.

The costs associated with System 3 exclude the cost of improvements to Smith Canal Pump Station, which are accounted for separately as a shared facility, below.

**Table 7. Peak Hour Wet Weather Flow**

Study Area Name	Single Family, gpd		Multi Family, gpd		Commercial, gpd		Industrial, gpd		Total, gpd		
	Existing	2040	Existing	2040	Existing	2040	Existing	2040	Existing	Net New	2040
<b>Study Areas</b>											
Study Area 1 - Eight Mile Rd Area	178,413	1,512,761	249,680	1,416,872	133,116	69,365	36,048	17,822	597,257	2,419,562	3,016,820
Study Area 2 - Pacific Ave Corridor	32,588	29,707	111,288	267,837	739,769	716,544	731	667	884,377	130,377	1,014,754
Study Area 3 - West Ln and Alpine Rd Area	254,870	660,183	157,394	851,391	362,574	323,773	442,788	333,687	1,217,626	951,408	2,169,034
Study Area 4 - Port/Waterfront	73,062	143,852	272,306	1,699,033	60,627	60,789	423,620	324,626	829,615	1,398,686	2,228,300
Study Area 5 - El Dorado/Center Corridors	68,765	45,278	308,635	1,031,654	57,415	55,629	111,183	73,208	545,997	659,771	1,205,769
Study Area 6 - Miner/Weber Corridors	68,115	43,349	180,287	1,116,186	42,651	59,205	80,622	51,308	371,675	898,374	1,270,048
Study Area 7 - Wilson Way Corridor	18,796	18,584	9,245	313,600	6,164	82,092	168,019	166,121	202,224	378,172	580,396
Study Area 8 - I-5/Highway 4 Interchange	12,350	8,051	5,103	1,118,008	5,019	11,997	148,201	96,614	170,673	1,063,998	1,234,670
Study Area 9 - Railroad Corridor at California St	28,932	22,894	49,873	725,072	33,057	43,861	78,623	62,216	190,485	663,557	854,042
Study Area 10 - I-5 and Charter Way Area	364,398	897,701	142,604	226,484	180,925	153,279	48,636	72,727	736,562	613,628	1,350,190
Study Area 11 - Charter Way/MLK Jr Blvd Corridor	6,753	6,753	0	348,105	20,844	27,374	0	0	27,597	354,635	382,232
Study Area 12 - Airport Way Corridor	68,095	57,508	10,806	156,257	26,300	128,341	829,117	893,582	934,318	301,370	1,235,688
Study Area 13 - Mariposa and Charter Area	24,915	24,915	221,488	221,488	39,179	62,406	0	0	285,582	23,228	308,809
Study Area 14 - East Weston Ranch	4,228	4,228	0	0	9,269	231,726	0	0	13,497	222,457	235,954
Study Area 15 - South of French Camp Rd	308,553	308,553	227,745	227,745	0	0	732	732	537,030	0	537,030
Study Area 16 - E French Camp Rd Area	398,096	398,096	341,000	341,000	1,098	1,098	2,109	2,109	742,303	0	742,303
Subtotal (Study Areas)	1,910,929	4,182,412	2,287,455	10,060,733	1,718,006	2,027,478	2,370,429	2,095,417	8,286,818	10,079,222	18,366,041
<b>Approved/Pending Development Projects Within City Limit</b>											
Westlake Villages	0	3,935,207	0	0	0	0			0	3,935,207	3,935,207
Delta Cove	0	923,852	0	953,985	0	17,239			0	1,895,076	1,895,076
North Stockton Projects III	358,000	2,514,861	0	0	0	0			358,000	2,156,861	2,514,861
Cannery Park	0	1,744,182	0	295,485	0	640,217			0	2,679,884	2,679,884
Nor Cal Logistics Center	0	0	0	0	0	0			0	0	0
Crystal Bay	0	136,599	0	1,595,924	0	0			0	1,732,523	1,732,523
Sanctuary	0	5,378,573	0	1,017,588	0	178,808			0	6,574,969	6,574,969
Tidewater Crossing	2,111,240	0	0	0	0	192,000			2,111,240	-1,919,240	192,000
Open Window	0	0	0	505,792	120,951	105,373			120,951	490,214	611,165
Weston Ranch Town Center	0	0	0	0	0	497,410			0	497,410	497,410
Subtotal (Approved/Pending Projects Within City Limit)	2,469,240	14,633,274	0	4,368,774	120,951	1,631,047	0	0	2,590,191	18,042,904	20,633,095
<b>Approved/Pending Development Projects Outside City Limit but Within Sphere of Influence</b>											
Mariposa Lakes	0	4,548,083	0	7,953,220	0	679,762			0	13,181,066	13,181,066
Airpark 599	0	0	0	0	0	1,114,992			0	1,114,992	1,114,992
Tra Vigne	0	4,672,178	0	0	0	0			0	4,672,178	4,672,178
Subtotal (Approved/Pending Projects Outside City Limit but Within Sphere of Influence)	0	9,220,260	0	7,953,220	0	1,794,754	0	0	0	18,968,235	18,968,235
<b>Remaining City Outside of Study Areas and Outside of Approved/Pending Projects</b>	39,190,957	45,100,427	21,754,295	21,498,606	1,559,995	1,541,659	6,108,780	6,036,981	68,614,027	5,563,646	74,177,673
<b>Estimated Total at RWCF</b>									<b>71,939,687</b>	<b>32,167,306</b>	<b>104,106,993</b>

**Table 8. Summary of Flows by Sewer Shed**

Collection System	Current General Plan Update Evaluation	2035 WWMP Evaluation	Change in Estimated ADF for 2040 versus 2035 Buildout	Change as a percent of the Estimated 2035 Buildout Flow <sup>(a)</sup>
	Estimated 2040 ADF	Estimated 2035 Buildout ADF		
1	2.9	3.0	(0.1)	-3.0%
2	12.6	13.6	(1.1)	-7.8%
3	7.3	10.3	(3.0)	-29.1%
4	2.4	2.5	(0.12)	-4.9%
5	3.7	2.8	0.91	32.6%
6	5.6	8.0	(2.5)	-30.6%
7	6.2	8.8	(2.6)	-29.2%
8	14.6	22.7	(8.0)	-35.5%
9	3.2	7.0	(3.7)	-53.4%
10	16.9	16.2	0.79	4.9%
12	10.4	9.7	0.69	7.1%
13	7.7	15.3	(7.6)	-49.8%
14	0.9	10.5	(9.6)	-91.4%
15 <sup>(b)</sup>	-	24.1	(24.1)	-100.0%

<sup>(a)</sup> Reductions or increases in predicted future flows do not change the analysis of existing flows and capacities. The analysis of existing pipes identified in the 2008 Master Plan with potential existing limitations has not changed as a result of changes in future development assumptions.

<sup>(b)</sup> System 15 will remain unserved at 2040.

**Table 9. GPU Planning-Level Estimate of Collection System Cost for 2040**

Improvements	Existing Deficiencies <sup>(a)</sup>		Growth Related Budget Costs, dollars	Buildout	
	Comments	Budget Costs, dollars		Comments	Budget Costs, dollars
<b>COLLECTION SYSTEM 1 FACILITIES</b>					
Improvements to Existing Gravity Sewers		\$ 138,000	\$ -		\$ 138,000
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ -		\$ -
Pump Stations					
<i>Plymouth &amp; 5 Mile Cr. P.S.</i>	Construct new pump station with required additional capacity	\$ 573,000	\$ 66,000	Construct new pump station with required additional capacity	\$ 639,000
<i>Cumberland &amp; 5 Mile Cr. P.S.</i>	No Upgrade	\$ -	\$ -	No Upgrade	\$ -
Subtotals		\$ 711,000	\$ 66,000		\$ 777,000
<b>COLLECTION SYSTEM 2 FACILITIES</b>					
Existing Gravity Sewers		\$ 9,962,000	\$ 3,886,000		\$ 13,848,000
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ -		\$ -
Force Mains					
<i>Thornton &amp; Davis P.S. FM</i>		\$ 14,000	\$ -		\$ 14,000
Pump Stations					
<i>Kelly &amp; Mosher P.S.</i>	Replace pumps and controls	\$ 645,000	\$ -	Replace pumps and controls	\$ 645,000
<i>Thornton &amp; Davis P.S. (Stonewood)</i>	Construct new pump station with required additional capacity	\$ 847,000	\$ 154,000	Construct new pump station with required additional capacity	\$ 1,001,000
<i>Don Ave. &amp; Santiago L.S.</i>	Construct new pump station with required additional capacity	\$ 1,003,000	\$ 116,000	Construct new pump station with required additional capacity	\$ 1,119,000
<i>Swenson &amp; 5 Mile Cr. P.S. (North P.S.)</i>	Replace pumps and controls	\$ 5,155,000	\$ 839,000	Replace pumps and controls	\$ 5,994,000
<i>Blossom Ranch P.S.</i>	Replace pumps and controls	\$ 183,000	\$ 91,000	Replace pumps and controls	\$ 274,000
<i>Camanche P.S.</i>	Replace pumps and controls	\$ 467,000	\$ 321,000	Construct new pump station with required additional capacity	\$ 788,000
<i>Alexandria &amp; 14 Mile Sl. P.S. (Quail Lake)</i>	Replace pumps and controls	\$ 386,000	\$ 36,000	Replace pumps and controls	\$ 422,000
<i>March-Brookside &amp; I-5 P.S.</i>	No Upgrade. Monitor actual run-times and/or flows	\$ 25,000	\$ 199,000	Replace pumps and controls	\$ 224,000
Subtotals		\$ 18,687,000	\$ 5,642,000		\$ 24,329,000
<b>COLLECTION SYSTEM 3 FACILITIES</b>					
Existing Gravity Sewers		\$ 9,221,000	\$ 39,929,000		\$ 49,150,000
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ -		\$ -
Pump Stations					
<i>Kirk &amp; Del Rio (County P.S.)</i>	Replace pumps and controls	\$ 291,000	\$ 700,000	Construct new pump station with required additional capacity	\$ 991,000
Subtotals		\$ 9,512,000	\$ 40,629,000		\$ 50,141,000
<b>COLLECTION SYSTEM 4 FACILITIES</b>					
Existing Gravity Sewers		\$ 2,829,000	\$ 13,521,000		\$ 16,350,000
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ -		\$ -
Pump Stations					
<i>Waterloo &amp; Roosevelt/North P.</i>	No Upgrade	\$ -	\$ 366,000	Replace pumps and controls	\$ 366,000
<i>Drake &amp; Hwy. 99/South P.S.</i>	No Upgrade	\$ -	\$ -	No Upgrade	\$ -
Subtotals		\$ 2,829,000	\$ 13,887,000		\$ 16,716,000
<b>COLLECTION SYSTEM 5 FACILITIES</b>					
Existing Gravity Sewers		\$ 3,762,000	\$ 5,009,000		\$ 8,771,000
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ 61,000		\$ 61,000
Force Mains					
<i>Lincoln Street PS FM</i>		\$ -	\$ 1,274,000	Construct new force main to accommodate growth	\$ 1,274,000
Pump Stations					
<i>Lincoln Street PS</i>		\$ -	\$ 2,587,000	Construct new pump station to accommodate growth	\$ 2,587,000
Subtotals		\$ 3,762,000	\$ 8,931,000		\$ 12,693,000
<b>COLLECTION SYSTEM 6 FACILITIES</b>					
Existing Gravity Sewers		\$ 254,000	\$ 19,742,000		\$ 19,996,000
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ 7,800,000		\$ 7,800,000
Force Mains					
<i>System 6 North PS FM</i>		\$ -	\$ 937,000		\$ 937,000
<i>Backpressure Sustaining Facilities</i>		\$ -	\$ -		\$ -
Pump Stations					
<i>System 6 North PS</i>		\$ -	\$ 1,172,000	Future Pump Station	\$ 1,172,000
Crossings					
		\$ -	\$ 3,230,000		\$ 3,230,000
Subtotals		\$ 254,000	\$ 32,881,000		\$ 33,135,000
<b>COLLECTION SYSTEM 7 FACILITIES</b>					
Existing Gravity Sewers		\$ 12,000	\$ 5,591,000		\$ 5,603,000
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ 6,084,000		\$ 6,084,000
Pump Stations					
<i>Duck Creek PS</i>		\$ -	\$ 1,348,000	Future Pump Station	\$ 1,348,000
Crossings					
		\$ -	\$ 800,000		\$ 800,000
Subtotals		\$ 12,000	\$ 13,823,000		\$ 13,835,000
<b>COLLECTION SYSTEM 8 FACILITIES</b>					
Existing Gravity Sewers		\$ 125,000	\$ 25,173,000		\$ 25,298,000
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ 24,147,000		\$ 24,147,000
Force Mains					
<i>Arch Road PS FM</i>		\$ -	\$ -	Completed	\$ -
<i>Backpressure Sustaining Facilities</i>		\$ -	\$ -		\$ -
Pump Stations					
<i>Arch Road Industrial Park P.S.</i>		\$ -	\$ -	Completed	\$ -
<i>County P.S. (Hospital)</i>	Monitor actual run-times and/or flows	\$ -	\$ -	Assume removed from service at buildout. Must confirm grades are adequate for gravity flow.	\$ -
Crossings					
		\$ -	\$ 3,440,000		\$ 3,440,000
Subtotals		\$ 125,000	\$ 52,760,000		\$ 52,885,000

**Table 9. GPU Planning-Level Estimate of Collection System Cost for 2040**

Improvements	Existing Deficiencies <sup>(a)</sup>		Growth Related Budget Costs, dollars	Buildout	
	Comments	Budget Costs, dollars		Comments	Budget Costs, dollars
<b>COLLECTION SYSTEM 9 FACILITIES</b>					
Existing Gravity Sewers		\$ -	\$ -		\$ -
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ 5,100,000		\$ 5,100,000
Force Mains					
<i>Newton Road FM</i>		\$ -	\$ 287,000		\$ 287,000
<i>Backpressure Sustaining Facilities</i>		\$ -	\$ -		\$ -
Pump Stations					
<i>Origone PS</i>	No Upgrade	\$ -	\$ -	Replace pumps and controls	\$ -
<i>Sanguinetti PS</i>	No Upgrade	\$ -	\$ -	Replace pumps and controls	\$ -
<i>Newton Rd PS</i>		\$ -	\$ 2,131,000	Future Pump Station	\$ 2,131,000
Crossings		\$ -	\$ 4,000,000		\$ 4,000,000
Subtotals		\$ -	\$ 11,518,000		\$ 11,518,000
<b>COLLECTION SYSTEM 10 FACILITIES</b>					
Existing Gravity Sewers		\$ 55,000	\$ 16,380,000		\$ 16,435,000
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ 21,368,000		\$ 21,368,000
Pump Stations					
<i>Brookside Pumping Station</i>	No Upgrade	\$ -	\$ -	No Upgrade	\$ -
<i>Westlake P.S.</i>	No Upgrade	\$ -	\$ -	No Upgrade	\$ -
<i>Sanctuary PS</i>		\$ -	\$ 2,094,000	Future Pump Station	\$ 2,094,000
Crossings		\$ -	\$ 8,585,000		\$ 8,585,000
Subtotals		\$ 55,000	\$ 48,427,000		\$ 48,482,000
<b>COLLECTION SYSTEM 12 FACILITIES</b>					
Existing Gravity Sewers		\$ -	\$ -		\$ -
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ 26,768,000		\$ 26,768,000
Force Mains					
<i>Central Stockton FM</i>		\$ -	\$ 23,232,000		\$ 23,232,000
<i>Backpressure Sustaining Facilities</i>		\$ -	\$ 500,000		\$ 500,000
Pump Stations					
<i>Mariposa PS</i>	Future Pump Station	\$ -	\$ 7,268,000	Future Pump Station	\$ 7,268,000
Crossings		\$ -	\$ 6,600,000		\$ 6,600,000
Subtotals		\$ -	\$ 64,368,000		\$ 64,368,000
<b>COLLECTION SYSTEM 13 FACILITIES</b>					
Existing Gravity Sewers		\$ -	\$ -		\$ -
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ 34,178,000		\$ 34,178,000
Force Mains					
<i>System 13 East PS FM</i>		\$ -	\$ 282,000		\$ 282,000
<i>Tidewater PS FM</i>		\$ -	\$ 7,765,000		\$ 7,765,000
<i>Backpressure Sustaining Facilities</i>		\$ -	\$ 800,000		\$ 800,000
Pump Stations					
<i>System 13 East PS</i>		\$ -	\$ 4,622,000	Future Pump Station	\$ 4,622,000
<i>Tidewater PS</i>		\$ -	\$ 7,168,000	Future Pump Station	\$ 7,168,000
Crossings		\$ -	\$ 9,760,000		\$ 9,760,000
Subtotals		\$ -	\$ 64,575,000		\$ 64,575,000
<b>COLLECTION SYSTEM 14 FACILITIES</b>					
Existing Gravity Sewers		\$ -	\$ -		\$ -
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ -	Area not developed by 2040	\$ -
Force Mains					
<i>System 14 PS FM</i>		\$ -	\$ -	Area not developed by 2040	\$ -
<i>Backpressure Sustaining Facilities</i>		\$ -	\$ -	Area not developed by 2040	\$ -
Pump Stations					
<i>System 14 PS</i>		\$ -	\$ -	Area not developed by 2040	\$ -
Crossings		\$ -	\$ -	Area not developed by 2040	\$ -
Subtotals		\$ -	\$ -		\$ -
<b>COLLECTION SYSTEM 15 FACILITIES</b>					
Existing Gravity Sewers		\$ -	\$ -		\$ -
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ -	Area not developed by 2040	\$ -
Force Mains					
<i>Thompson PS FM</i>		\$ -	\$ -	Area not developed by 2040	\$ -
<i>System 15 East PS FM</i>		\$ -	\$ -	Area not developed by 2040	\$ -
<i>Gateway PS FM</i>		\$ -	\$ -	Area not developed by 2040	\$ -
<i>System 15 FM</i>		\$ -	\$ -	Area not developed by 2040	\$ -
<i>Backpressure Sustaining Facilities</i>		\$ -	\$ -	Area not developed by 2040	\$ -
Pump Stations					
<i>Thompson PS</i>		\$ -	\$ -	Area not developed by 2040	\$ -
<i>Gateway PS</i>		\$ -	\$ -	Area not developed by 2040	\$ -
<i>System 15 East PS</i>		\$ -	\$ -	Area not developed by 2040	\$ -
Crossings		\$ -	\$ -	Area not developed by 2040	\$ -
Subtotals		\$ -	\$ -		\$ -
<b>SHARED FACILITIES</b>					
Force Mains					
<i>Westside Parallel FM</i>		\$ -	\$ -	Would have served System 15	\$ -
<i>Smith Canal FM West</i>		\$ 551,000	\$ 3,689,000	Primarily serve Systems 3 & 9	\$ 4,240,000
<i>Smith Canal FM East</i>		\$ 328,000	\$ 6,154,000	Primarily serve Systems 3 & 9	\$ 6,482,000
<i>Weston Ranch P.S. FM</i>	Exceeds capacity; however other FM facilities exist to address this issue	\$ -	\$ -	Serves Systems 8 and 14	\$ -
<i>Backpressure Sustaining Facilities</i>		\$ -	\$ -	Would have served System 15	\$ -

**Table 9. GPU Planning-Level Estimate of Collection System Cost for 2040**

Improvements	Existing Deficiencies <sup>(a)</sup>		Growth Related Budget Costs, dollars	Buildout	
	Comments	Budget Costs, dollars		Comments	Budget Costs, dollars
<b>Pump Stations</b>					
<i>Smith Canal Pump Station</i>	Monitor flow split. Adjust as appropriate	\$ -	\$ 9,885,000	Replace pumps and controls; primarily serve Systems 3 and 9	\$ 9,885,000
<i>Weston Ranch P.S.</i>	No Upgrade	\$ -	\$ -	Construct new pump station with required additional capacity; Serves Systems 8 and 14	\$ -
<i>14 Mile Slough PS</i>	No Upgrade	\$ -	\$ 11,362,000	Construct new pump station with required additional capacity; Serves Systems 10, 1, and 15	\$ 11,362,000
Crossings		\$ -	\$ 3,600,000		\$ 3,600,000
Subtotals		\$ 879,000	\$ 34,690,000		\$ 35,569,000
<b>SUMMARY</b>					
Existing Gravity Sewers		\$ 26,400,000	\$ 129,200,000		\$ 155,600,000
Future Gravity Sewers <sup>(b)</sup>		\$ -	\$ 125,500,000		\$ 125,500,000
Force Mains		\$ 900,000	\$ 44,900,000		\$ 45,800,000
Pump Stations		\$ 9,600,000	\$ 52,500,000		\$ 62,100,000
Crossings		\$ -	\$ 40,000,000		\$ 40,000,000
TOTAL (Construction Costs) <sup>(d)</sup>		\$ 36,900,000	\$ 392,100,000		\$ 429,023,000
Estimating Contingency (Level of Planning and Construction Contingency), 35%		\$ 12,900,000	\$ 137,200,000		\$ 150,100,000
TOTAL CONSTRUCTION BUDGET (2007 dollars)		\$ 49,800,000	\$ 529,300,000		\$ 579,123,000
Engineering, Administration and Other Project Costs, 35%		\$ 17,400,000	\$ 185,300,000		\$ 202,700,000
TOTAL PROJECT COSTS w/o Land (2007 dollars)		\$ 67,200,000	\$ 714,600,000		\$ 781,823,000
Property Acquisition Allowance (7% of bare growth pipeline construction)		\$ -	\$ 11,900,000		\$ 11,900,000
TOTAL PROJECT COSTS (2007 dollars)		\$ 67,200,000	\$ 726,500,000		\$ 793,723,000

(a) Only fractional quantities of each gravity sewer total are used for projecting CIP costs (2035 WWMP). Findings from the City's ongoing condition assessment activities and additional flow  
(b) Costs provided for gravity sewers 18 inches and larger only and for all force mains (irrespective of diameter).

- System 4: In this System, the change in ADWF is a decrease of 0.12 mgd out of a 2035 WWMP estimated flow of 2.54 mgd (a decrease of 4.9 percent). This small change would result in no significant change in the planned sewer system infrastructure for this shed. Consequently, the estimated costs from the 2035 WWMP for this System are still appropriate.
- System 5: In this System, the change in ADWF is an increase of 0.91 mgd out of a 2035 WWMP estimated flow of 2.8 mgd (an increase of 33 percent). A portion of this increase may be attributed to an updated and improved identification of existing land uses; nevertheless, this change will likely result in some additional improvements being needed to accommodate the planned growth, including:
  - Trunk Sewers: Approximately 30 percent of the previously estimated cost was associated with existing deficiencies and the remainder is associated with growth. Several significant pipeline upsizing projects were predicted. It is assumed that the higher projected flows will result in a slight increase in a portion of the previously predicted upsizing projects resulting in an assumed 10 percent increase in the previously estimated cost. In addition, it is possible that some additional sewers will need to be upsized, so it is assumed that the previously estimated cost will increase an additional 10 percent, for a total increase of 20 percent.
  - Pump Stations: One new pump station, the Lincoln Street Pump Station, and an associated force main were planned to serve the downtown area only. Due to the apparent increase in buildout flows, it is assumed the cost of this pump station and force main project will increase approximately 10 percent.
- System 6: In this System, the change in ADWF is a decrease of 2.5 mgd out of a 2035 WWMP estimated flow of 8.0 mgd (a decrease of about 31 percent). This change will likely result in a reduction of the planned sewer system improvements, including:
  - Trunk Sewers: Pipeline improvements include upsizing of existing pipelines as well as extension of new sewers into the eastern portions of System 6 that are currently undeveloped. It is assumed about half of the future sewer extensions will be approximately 15 percent lower cost than previously estimated and that the cost of the remaining half will not be affected. For the upsizing of existing sewers, it is assumed the cost will be approximately 20 percent lower than previously estimated, based on the lower predicted flows.
  - Pump Stations: The eastern portions of System 6 will require a new pump station and force main. Any change in the cost of these new facilities attributable to the lower flow projections is expected to be small, so a five percent reduction in the planning level estimate of costs is assumed.
- System 7: In this System, the change in ADWF is a decrease of 2.6 mgd out of a 2035 WWMP estimated flow of 8.8 mgd (a decrease of about 29 percent). One major new trunk relief sewer was attributed to System 7, a 5,600 ft. long 54" diameter pipeline primarily located along Tillie Lewis Drive. In addition, some gravity sewer extensions into growth areas and one associated pump station at the eastern end of the System were identified, as well as improvements to existing sewers to correct apparent grade issues or localized capacity concerns. However, the apparent decrease in flows from the System are not expected to substantively affect the costs previously

identified improvements for System 7. Consequently, the estimated costs from the 2035 WWMP for this System are still appropriate.

- System 8: In this System, the change in ADWF is a decrease of 8.0 mgd out of a 2035 WWMP estimated flow of 22.7 mgd (a decrease of about 36 percent). Major costs associated with upsizing of existing sewers as well as major extensions east of State Highway 99 were identified. This reduction in planned flow is likely attributed to a decrease in the rate of development, and depending on the location of the development that occurs by 2040, it is likely that substantial portions of the future extensions will not be needed by 2040. The change will likely result in a reduction of the planned sewer system improvements, including:
  - Trunk Sewers: The need for both new sewer extensions and upsizing in existing sewers will likely be reduced, unless development begins at the eastern end of the System 8, requiring long extensions into those areas. Therefore, it is assumed that the cost of trunk sewer improvements will be reduced by approximately 20 percent.
  - Pump Stations: The Arch Road Industrial Park Pump Station identified in the 2035 WWMP has been constructed.
- System 9: In this System, the change in ADWF is a decrease of 3.7 mgd out of a 2035 WWMP estimated flow of 7.0 mgd (a decrease of about 53 percent). Costs associated with upsizing of existing sewers as well as major extensions into areas not currently served by the sewer system were identified. The reduction in planned flow is likely attributed to a decrease in the rate of development, and depending on the location of the development that occurs by 2040, it is likely that some of the future extensions will not be needed by 2040. The change will likely result in a reduction of the planned sewer system improvements, including:
  - Trunk Sewers: It is assumed the need for upsizing existing trunk sewers will be eliminated by the decrease in projected flow. The need for new sewer extensions might be reduced slightly; however, the new sewer extensions are primarily smaller diameter trunks necessary in each portion of the Shed that begins to develop. Therefore, costs reductions will only be realized where portions of the Shed do not develop. It is assumed that most or all areas of the Shed will begin to develop by 2035, and therefore no substantive reduction in the cost of new trunk sewer extensions is appropriate.
  - Pump Stations: It is assumed the need for upsizing existing pumps stations will be eliminated by the decrease in projected flow. A new pump station, the Newton Road Pump Station is needed to connect a significant portion of the Shed. The Pump Station would likely require smaller pumping equipment sized for lower flows early in its useful life, so a 10 percent reduction in the planning level estimate of costs is assumed.
- System 10: In this System, the change in ADWF is an increase of 0.79 mgd over a 2035 WWMP estimated flow of 16.2 mgd (an increase of about 5 percent). This change is not likely to result in a substantive reduction in the cost of the planned sewer system improvements. The following changes will likely affect the projected cost of improvements:

- Trunk sewers: Approximately 15 to 20 percent of trunk extensions planned in the 2035 WWMP have been completed since 2008, so the estimated cost of the future extensions should be reduced by about 15 percent. Improvements to existing trunk sewers are dominated by a large upsizing project along Whistler Way and extending east from Lower Sacramento Road along Bear Creek. The cost of this improvement or other upsizing projects is not likely to be affected.
- Pump Stations: System 10 shares the 14-Mile Slough Pump Station, which is discussed separately.
- System 12: In this System, the change in ADWF is an increase of 0.69 mgd out of a 2035 WWMP estimated flow of 9.7 mgd (an increase of about 7 percent). This small change is not likely to result in a substantive increase in the cost of planned sewer system infrastructure. Consequently, the estimated costs from the 2035 WWMP for this System are still appropriate.
- System 13: In this System, the change in ADWF is a decrease of 7.6 mgd out of a 2035 WWMP estimated flow of 15.3 mgd (a decrease of about 50 percent). New sewers and pump stations are required to serve the System 13 area. The reduction in projected flow may result in somewhat smaller sewer diameters and pump capacities; however, costs will primarily be related to the extent of new service area being added within the 2040 planning horizon. For example, if the eastern portion of the service area develops first, a disproportionate cost would be triggered to extend the collection system to the new service area. Therefore, for the purposes of this analysis, it is assumed that the cost of new trunk sewers and pump stations will be reduced by 20 percent, reflecting fewer facilities constructed than those identified for build out in the 2035 WWMP.
- System 14: In this System, the change in ADWF is a decrease of 9.6 mgd out of a 2035 WWMP estimated flow of 10.5 mgd (a decrease of about 91 percent). Most of this growth area has been eliminated from the 2040 sewer service area, and the planned trunk sewers for developing areas have already been constructed. Therefore, all planned costs for System 14 are eliminated.
- System 15: Nearly all of System 15 will remain undeveloped at 2040. A small area adjacent to the existing 14-Mile Slough Pump Station is planned for institutional land use; however, only a small diameter sewer would be needed to serve the area by connecting it to the pump station if the small area ever develops. It is assumed that the Delta Water Supply Project treatment facility will remain disconnected from the collection system, and that no other existing or future development will be served by 2040. Therefore, all costs associated with System 15 identified in the 2035 WWMP are eliminated.
- Shared Facilities: Each shared facility is critical component in more than one System. The largest shared facility is the RWCF. The GPU is expected to have the following impacts on shared facilities:

- 14-Mile Slough Pump Station: This pump station serves Systems 1, 2 and 10, and was designed for expansion to serve System 15. The modeled ratio of peak to average flow was about 2.4 in the 2035 WWMP. The revised 2040 average flow for Systems 1 and 10 is 19.2 mgd, and the peak flow can be estimated using the same 2.4 peaking factor to be 46 mgd, or about 65 percent of the buildout peak flow projected in the 2035 WWMP. The current peak flow capacity of the pump station is 14.5 mgd, so even though the future peak flow is substantially lower, a major upgrade will be necessary. For the purposes of this analysis, it is assumed that the cost of increased capacity will be 80 percent of the previously estimated cost for future expansion.
- Westside Parallel Force Main: The existing West Side Force Main receives flow from the 14-Mile Slough Pump Station as well as the Brookside Pump Station, and serves Systems 1, 2 and 10. A parallel force main was planned to serve System 15, but will not be needed for capacity reasons.
- Smith Canal Pump Station and Force Mains: Two force mains receive flow from the Smith Canal Pump Station, primarily serving Systems 3 and 9. Replacement and upsizing of the force mains, pumps and controls will be needed to serve planned growth. The required upsizing may be slightly reduced and is potentially deferred as a result of reduced growth planned for 2040; however, it is likely that most or all of the anticipated improvements will be needed by 2040 and for the purposes of this analysis no reduction in the planned cost is recommended.
- Weston Ranch Pump Station and Force Main: Pump station and force main improvements were identified in the 2035 WWMP primary triggered by planned development in System 14, which is no longer planned for 2040. It is assumed that no significant upgrade will be needed for serving growth within the existing pump station service area.

The adjusted costs are presented in Table 9 which is adapted from Table 8-2 of the 2035 WWMP. All costs estimates are planning level estimates based on broad assumptions and limited information, and do not necessarily reflect the economic conditions at the time a project is constructed.

The planning level estimate of construction costs (without contingencies, engineering, administration, land acquisition for pipeline extensions or other project costs) can be compared to the 2035 WWMP buildout estimates as follows in terms of 2007 dollars:

- Construction costs for existing deficiencies decreased slightly from \$38 million to \$36.9 million.
- Construction costs for growth-related improvements decreased from \$599 million to \$392 million.
- The corresponding updated planning level estimates of total project costs (total capital costs) are \$67.2 million to address existing deficiencies and \$727 million for growth-related improvements, as shown in Table 9.

## REGIONAL WASTEWATER CONTROL FACILITY FLOWS AND COSTS

As presented previously, actual flow to the RWCF in the summer of 2017 averaged about 27 mgd, and the ADWF for 2016 was 29 mgd. It is assumed these flows reflect significant water conservation originating from the recent drought conditions, which would be consistent with most other communities in California. Furthermore, it is assumed that flow would rebound upward over time, even in the absence of growth. Nevertheless, it is likely that standard flow factors used to predict flows for prudent collection system planning will over predict the aggregate combined flow at the RWCF. Indeed, the 2017 land uses with standard flow factors applied would generate an average flow of about 37 mgd.

The 2035 WWMP included a predicted buildout influent flow of 70 mgd, based on population of 580,717, a per capita flow of 112 gallons per day, and an analysis of industrial flows in excess of the per capita flow factor. (For treatment plant design purposes, plant recycle flows must also be considered.) The total estimated project cost to accommodate the buildout flow, based on very preliminary planning analysis was about \$417 million in 2007 dollars.

The City prepared a Capital Improvement and Energy Management Plan (CIEMP) for the RWCF in 2011 which predicted flows would reach 49.3 mgd by 2035, which did not represent a general plan buildout value<sup>10</sup>. The CIEMP is being implemented through a series of projects, and the projection of future flows was recently updated as part of the CIEMP implementation work. The adopted flow projection is based on a population of 401,961 (from the San Joaquin Council of Governments) and a per capita flow rate of 100 gallons per day for 2035<sup>11</sup>. As noted above, the revised projected ADWF is 40.2 mgd for 2035 and 46.3 mgd for 2045. Assuming linear growth from 2035 to 2045, the corresponding ADWF for 2040 would be 43.3 mgd.

Existing treatment facilities have a rated secondary ADWF treatment capacity of 48 mgd, and a rated tertiary treatment capacity of 55 mgd. Preparation of the CIEMP involved an extensive analysis of existing treatment facilities, both capacity and condition. The CIEMP recommended a series of short-term and long-term improvements to address rehabilitation and replacement needs while improving treatment reliability. The total project cost for the short and long-term projects, excluding energy-related projects, was about \$221 million, based on 2011 dollars<sup>12</sup>.

For the purposes of this analysis, the CIEMP estimate of costs to achieve a reliability at the permitted capacity should be used as the cost to accommodate flows at the 2040 planning horizon.

All costs estimates are planning level estimates based on broad assumptions and limited information, and do not necessarily reflect the economic conditions at the time a project is constructed.

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<sup>10</sup> City of Stockton RWCF Capital Improvement and Energy Management Plan; Carollo Engineers, August 2011.

<sup>11</sup> Information provided by City staff, and resulting 40.2 mgd ADWF for 2035 is reported in the Stockton RWCF Design Build Project; "Advanced Package 3a & 3b" of the Basis of Design Report; AECOM, October 2017.

<sup>12</sup> Ibid. (Table 19.2)

The infrastructure analyses and cost evaluations presented in this TM are based on generalized land use data and preliminary engineering evaluations. All these analyses should be refined and updated through detailed evaluations of each specific development project.

## **RECOMMENDED FUTURE ACTIONS**

The recommended actions to address wastewater infrastructure needs are addressed in this section.

### **Sewer System**

The projected land uses for 2040 are different that the buildout land uses from the 2035 General Plan. Consequently, the collection system improvements identified in the 2035 WWMP may no longer be appropriate. This could result in some sewer system infrastructure being undersized, which could lead to sanitary sewer overflows. Some sewer system infrastructure could be oversized, resulting in unnecessary capital expenditures and increased operations and maintenance efforts and costs. Therefore, it is recommended that an updated citywide collection system model and capital improvement plan be developed and periodically updated. The model and plan should,

- a) Incorporate industry standard calibration procedures, which will require additional flow monitoring throughout the collection system and peak wet weather flow analysis;
- b) Be based on field-verified sewer invert elevation data where existing data indicates anomalies such as pipes with adverse or unexpected slopes; and
- c) Use software capable of dynamic hydraulic computations so that surcharging conditions can be more accurately represented.

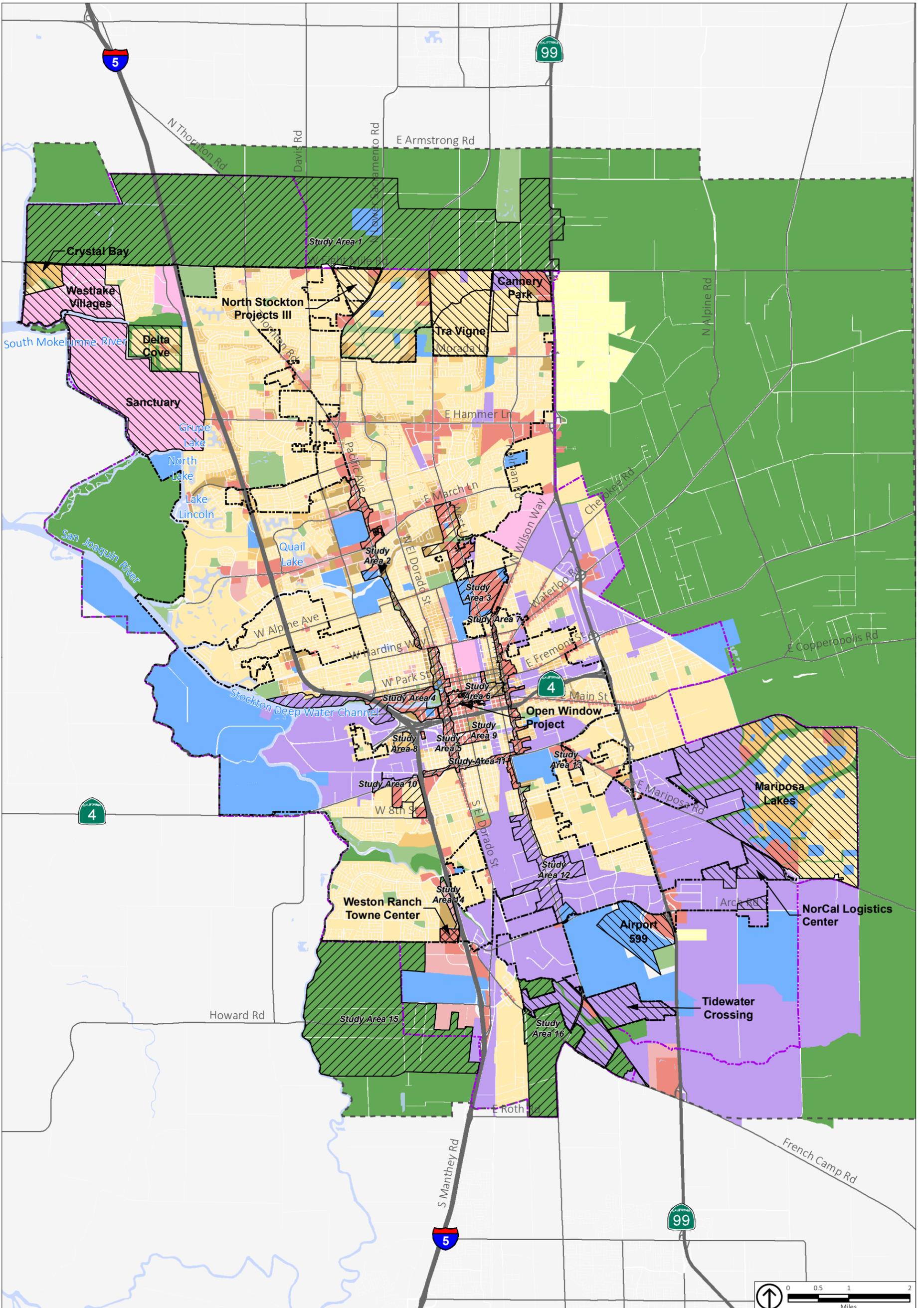
Routine inspection and maintenance should be conducted in order to maintain capacity and reliability in existing facilities. Such activities should include completion (and future updates) of ongoing efforts to assess the condition of gravity sewers, and a thorough condition assessment of pumping facilities. The condition assessment data should be used to quantify and prioritize rehabilitation needs, including an analysis of annual funding required to restore and maintain system reliability.

Beyond the need for collection system model calibration, a long-term program of wet and dry weather flow monitoring is recommended as a tool for detecting excessive infiltration and inflow problems that develop over time as pipelines deteriorate.

### **Regional Wastewater Control Facility**

Major improvements to the RWCF have been identified as necessary to address rehabilitation needs and provided sufficient capacity for the planned growth. Current RWCF planning is based on providing capacity for flows and loads predicted for partial buildout, which is appropriate. However, it is also recommended that as the layout and orientation of new or replacement facilities are designed, consideration is given to how the plant can be efficiently increased in the future. A plant layout reflecting flows at General Plan buildout should be configured to avoid unnecessarily increasing the cost of future improvements.

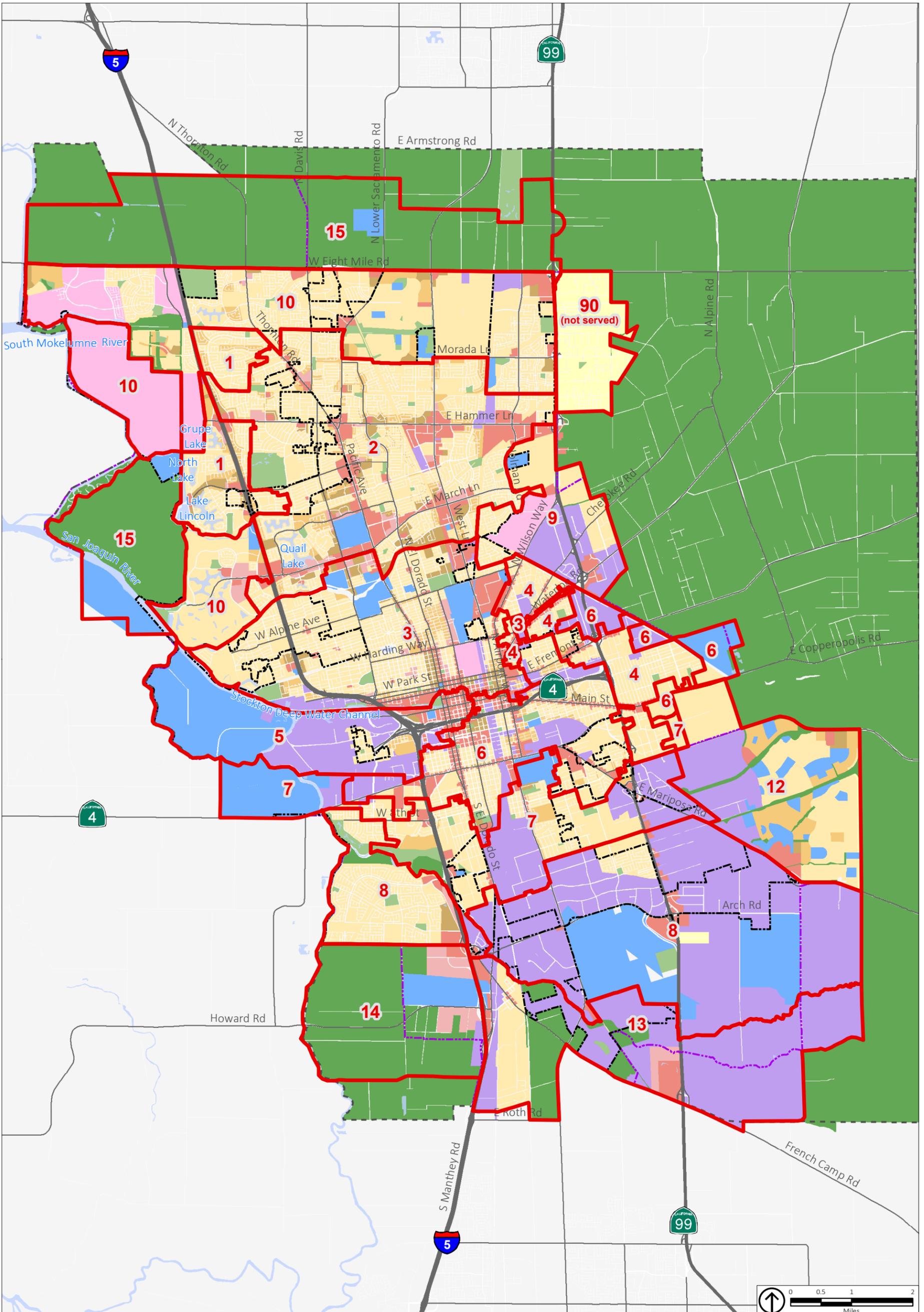
The CIEMP, which is serving as a long-term facilities plan for the RWCF, should be periodically updated to reflect actual flows and loads measured for existing conditions, operational experience with recently constructed facilities, and improvements in treatment and energy management technologies.



Source: City of Stockton, June & August 2017.



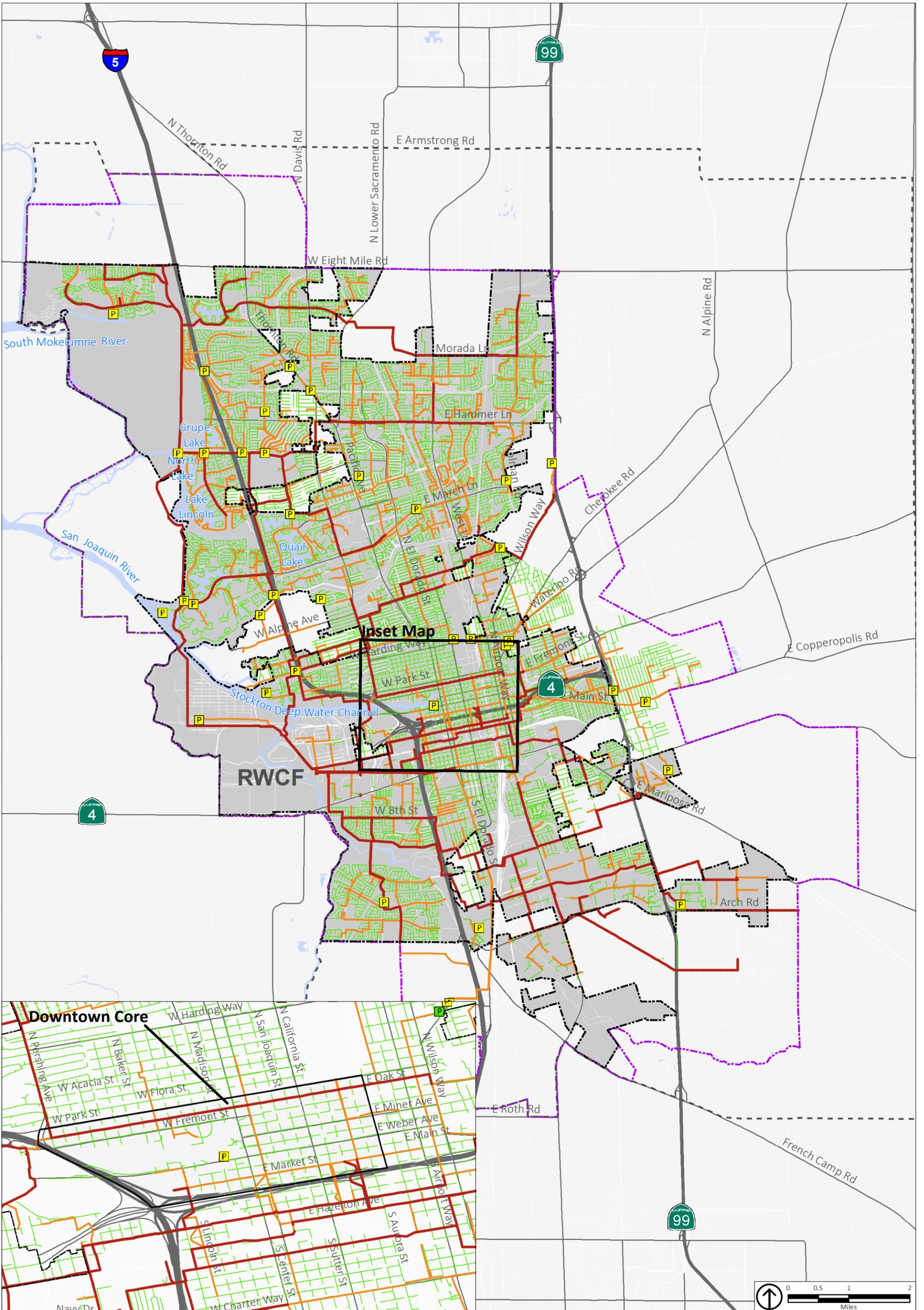
Figure 1  
**2017 Preferred 2040 Land Uses  
and Development Areas**



Source: City of Stockton, June & August 2017.

- |                            |                            |                             |                                   |
|----------------------------|----------------------------|-----------------------------|-----------------------------------|
| System Boundary            | Residential Estate         | Mixed Use                   | Economic and Education Enterprise |
| General Plan Planning Area | Low Density Residential    | Commercial                  | Institutional                     |
| City Limit                 | Medium Density Residential | Administrative Professional | Parks and Recreation              |
| Sphere of Influence        | High Density Residential   | Industrial                  | Open Space/Agriculture            |

Figure 2  
**2017 Preferred 2040 Land Uses and Sewer  
Sub - Collection System Boundaries**



Source: City of Stockton, April 2016.

- Sanitary Pump Station
- General Plan Planning Area
- Existing Sewer Line (Diameter)**
- < 8 Inches
- 10 - 18 Inches
- > 18 Inches
- City Limit
- Sphere of Influence

Figure 3  
Sewer System Facilities

# ATTACHMENT A

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Land Use Data Received from Placeworks and Buildout Land Use Map

Acreage Gross or Net	Study Area Name	Single Family Net New 2040	Single Family Net New 2040	Single Family Net New 2040 + Existing	Single Family Net New 2040 + Existing	Multi Family Net New 2040	Multi Family Net New 2040	Multi Family Net New 2040 + Existing	Multi Family Net New 2040 + Existing	Commercial Net New 2040 + Existing	Commercial Net New 2040 + Existing	Industrial Net New 2040	Industrial Net New 2040 + Existing							
		Units	Acres	Units	Acres	Units	Acres	Units	Acres	Units	Acres	Total Square Feet	0.3 FAR Sq Ft	0.5 FAR Sq Ft	5.0 FAR Sq Ft	0.3 FAR Acres	0.5 FAR Acres	5.0 FAR Acres	Sq Ft	Acres
Gross	Study Area 1 - Eight Mile Rd Area	1,379	646	1,500	663	1,198	209	1,294	217	39,408	39,408	0	0	15	0	0	241,408	20	0	105,400
Net	Study Area 2 - Pacific Ave Corridor	0	0	22	4	110	19	224	22	93,961	93,961	0	0	17	0	0	1,560,846	103	0	1,980
Net	Study Area 3 - West Ln and Alpine Rd Area	77	13	285	52	680	120	774	125	323,399	323,399	0	0	102	0	0	975,325	163	0	1,423,576
Net	Study Area 4 - Port/Waterfront	17	3	71	11	1,770	33	2,058	42	2,040,010	6,100	0	2,033,911	2	0	31	2,865,512	62	580,859	1,739,495
Net	Study Area 5 - El Dorado/Center Corridors	0	0	45	6	1,196	22	1,555	30	1,310,216	0	0	1,310,216	0	0	21	2,158,663	53	0	258,300
Net	Study Area 6 - Miner/Weber Corridors <sup>(a)</sup>	0	0	47	4	1,248	22	1,467	27	1,463,025	0	0	1,463,025	0	0	14	2,152,972	33	0	187,300
Net	Study Area 7 - Wilson Way Corridor	0	0	12	2	234	27	240	28	606,716	103,753	0	502,963	19	0	5	1,321,076	65	0	390,342
Net	Study Area 8 - I-5/Highway 4 Interchange	0	0	8	1	659	47	660	48	388,671	0	0	388,671	0	0	4	388,671	4	0	344,300
Net	Study Area 9 - Railroad Corridor at California St	0	0	19	2	1,340	24	1,363	25	1,299,279	0	0	1,299,279	0	0	24	1,365,999	26	0	182,658
Net	Study Area 10 - I-5 and Charter Way Area	86	15	314	58	98	42	127	46	133,864	133,864	0	0	42	0	0	377,363	77	83,678	203,939
Net	Study Area 11 - Charter Way/MLK Jr Blvd Corridor	0	0	5	0	396	15	396	15	323,733	9,597	0	314,135	6	0	7	703,670	38	0	0
Net	Study Area 12 - Airport Way Corridor	0	0	53	7	108	19	112	19	205,461	135,225	70,236	0	14	4	0	272,544	48	1,368,744	3,709,140
Net	Study Area 13 - Mariposa and Charter Area	0	0	12	4	0	0	77	6	80,944	80,944	0	0	25	0	0	93,560	28	0	0
Net	Study Area 14 - East Weston Ranch <sup>(b)</sup>	0	0	1	1	0	0	0	0	430,677	0	430,677	0	0	26	0	430,677	26	0	0
Net	Study Area 15 - South of French Camp Rd	0	0	89	76	0	0	9	6	0	0	0	0	0	0	0	0	0	0	1,700
Net	Study Area 16 - E French Camp Rd Area	0	0	59	123	0	0	4	9	0	0	0	0	0	0	0	5,100	17	0	4,900
Net	Outside of Study Areas <sup>(c)</sup>	1,501	246	77,964	14,117	0	0	33,183	1,916	0	0	0	0	0	0	0	23,811,089	1,607	0	46,620,901
	<b>Grand Total</b>	<b>3,059</b>	<b>923</b>	<b>80,505</b>	<b>15,131</b>	<b>9,036</b>	<b>600</b>	<b>43,542</b>	<b>2,583</b>	<b>8,739,364</b>	<b>926,252</b>	<b>500,913</b>	<b>7,312,200</b>	<b>242</b>	<b>31</b>	<b>105</b>	<b>38,724,475</b>	<b>2,371</b>	<b>2,033,281</b>	<b>55,173,931</b>

<sup>(a)</sup> Excludes Open Window approved project.

<sup>(b)</sup> Excludes Weston Ranch Town Center approved project.

<sup>(c)</sup> Excludes approved/pending projects.

Acreage Gross or Net	Approved/Pending Projects Details	Net New						Full Build (2040)					
		Single Family Units	Single Family Acres	Multi-Family Units	Multi-Family Acres	Commercial Square Feet	Commercial Acres	Single Family Units	Single Family Acres	Multi-Family Units	Multi-Family Acres	Commercial Square Feet	Commercial Acres
	<b>Approved within city limit</b>												
Gross	Westlake Villages	2,630	680	0		0		2,630	680	0		0	
Gross	Delta Cove	1,164	133	381	48	31,000	3	1,164	133	381	48	31,000	2.6
Gross	North Stockton Projects III	2,220	355	0		0		2,455	393	0		0	
Gross	Cannery Park	981	272	210	16	1,078,762	104	981	272	210	16	1,078,762	104
Gross	Nor Cal Logistics Center	0	0	0	0	0	0	0	0	0	0	0	0
Gross	Crystal Bay	951	19	392	79	0		951	19	392	79	0	0
Gross	Sanctuary	5,452	1,026	1,618	67	692,256	36	5,452	1,026	1,618	67	692,256	36
Gross	Tidewater Crossing	-310	-870	0		186,200	16	0	0	0	0	186,200	16
Net	Open Window <sup>(a)</sup>	0	0	1,391	12	-68,800	-1	0	0	1,400	12	290,000	12
Gross	Weston Ranch Town Center	0	0	0	0	481,000	41	0	0	0	0	481,000	41
	<b>Approved/pending outside city limit, inside SOI</b>												
Gross	Mariposa Lakes	8,955	939	1,553	585	1,009,503	150	8,960	1,090	1,556	585	1,009,503	150
Gross	Airpark 599	0	0	0	0	1,678,500	128	0	0	0	0	1,678,500	128
Gross	Tra Vigne <sup>(b)</sup>	1,244	846	0	0	0	0	1,244	846	0	0	0	0

<sup>(a)</sup> The Master Development Plan for Open Window is approved for 1,034 units, with an option to expand the capacity to 1,400 units if the General Plan Update increases the maximum densities in the Downtown, which is being considered as part of this General Plan Update.

<sup>(b)</sup> Pending; not approved.

**2040 Development Study Area**

	Net New Single Family Units (full buildout)	Percent applied to 2040	Net New Single Family Units (2040)	Net New Multi-Family Units (full buildout)	Percent applied to 2040	Net New Multi-Family Units (2040)	Net New Commercial Square Feet (full buildout)	Percent applied to 2040	Net New Commercial Square Feet (2040)	Net New Industrial Square Feet (full buildout)	Percent applied to 2040	Net New Industrial Square Feet (2040)
Study Area 1 – Eight Mile Rd Area	3,940	35%	1,380	3,420	35%	1,200	197,000	20%	39,000	0	0%	0
Study Area 2 – Pacific Ave Corridor	0	0%	0	440	25%	110	188,000	50%	94,000	0	0%	0
Study Area 3 – West Ln and Alpine Rd Area	80	100%	80	2,720	25%	680	1,294,000	25%	323,000	0	0%	0
Study Area 4 – Port/Waterfront	20	100%	20	2,210	80%	1,770	6,800,000	30%	2,040,000	2,323,000	25%	581,000
Study Area 5 – El Dorado/Center Corridors	0	0%	0	1,500	80%	1,200	4,367,000	30%	1,310,000	0	0%	0
Study Area 6 – Miner/Weber Corridors <sup>(a)</sup>	0	0%	0	1,560	80%	1,250	2,926,000	50%	1,463,000	0	0%	0
Study Area 7 – Wilson Way Corridor	0	0%	0	940	25%	230	1,213,000	50%	607,000	0	0%	0
Study Area 8 – I-5/Highway 4 Interchange	0	0%	0	820	80%	660	777,000	50%	389,000	0	0%	0
Study Area 9 – Railroad Corridor at California St	0	0%	0	1,680	80%	1,340	5,197,000	25%	1,299,000	0	0%	0
Study Area 10 – I-5 and Charter Way Area	90	100%	90	980	10%	100	535,000	25%	134,000	98,000	85%	84,000
Study Area 11 – Charter Way/MLK Jr Blvd Corridor	0	0%	0	790	50%	400	1,619,000	20%	324,000	0	0%	0
Study Area 12 – Airport Way Corridor	0	0%	0	430	25%	110	274,000	75%	205,000	5,475,000	25%	1,369,000
Study Area 13 – Mariposa and Charter Area	0	0%	0	570	0%	0	324,000	25%	81,000	0	0%	0
Study Area 14 – East Weston Ranch <sup>(b)</sup>	0	0%	0	610	0%	0	574,000	75%	431,000	0	0%	0
Study Area 15 – South of French Camp Rd	0	0%	0	0	0%	0	0	0%	0	0	0%	0
Study Area 16 – E French Camp Rd Area	0	0%	0	0	0%	0	0	0%	0	0	0%	0
Outside of Study Areas <sup>(c)</sup>	16,360	9%	1,500	29,810	0%	0	19,487,000	0%	0	126,805,000	0%	0
<b>Grand Total<sup>(d)</sup></b>	<b>20,480</b>		<b>3,060</b>	<b>48,470</b>		<b>9,040</b>	<b>45,773,000</b>		<b>8,739,000</b>	<b>134,701,000</b>		<b>2,033,000</b>

<sup>(a)</sup> Excludes Open Window approved project.

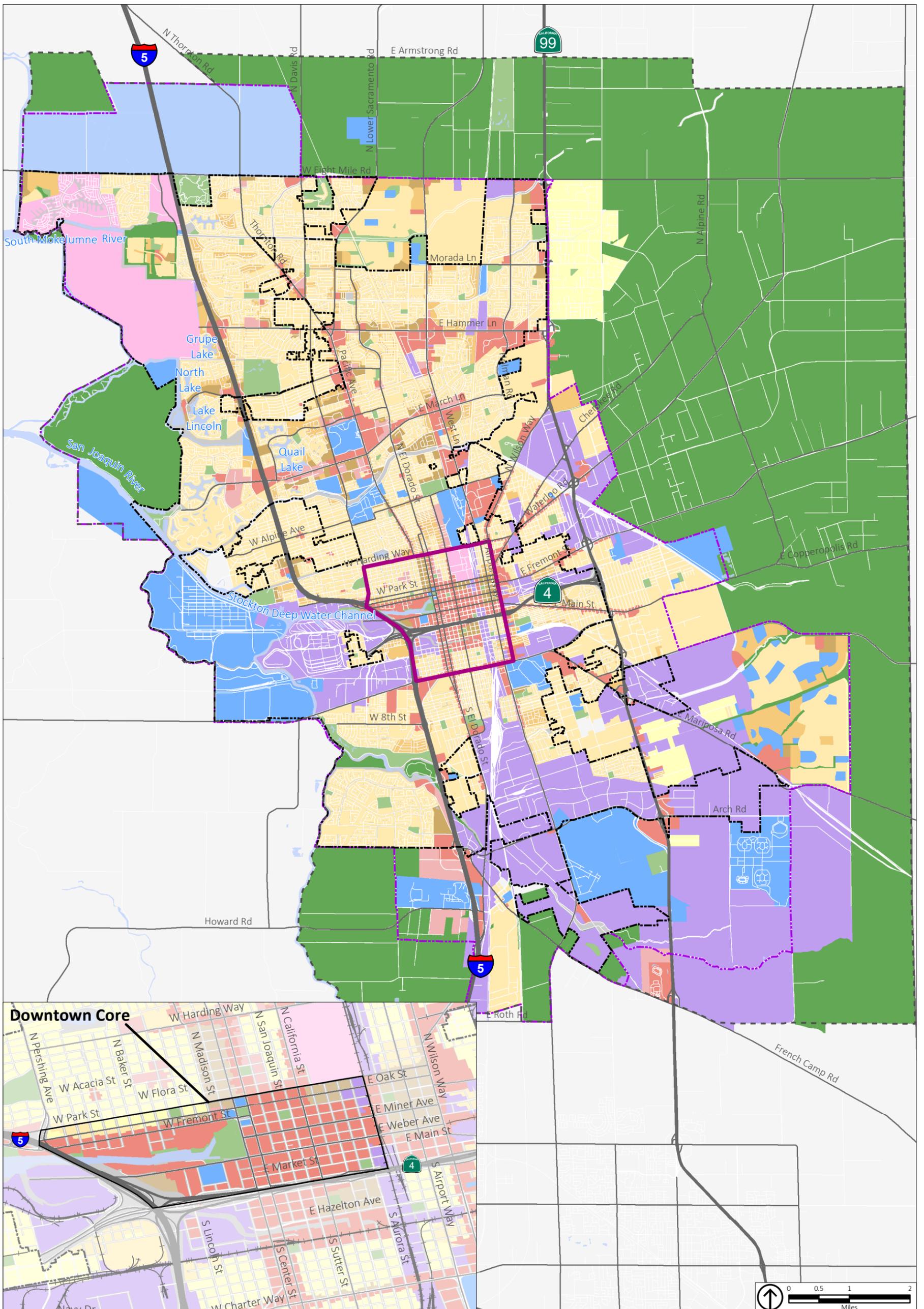
<sup>(b)</sup> Excludes Weston Ranch Town Center approved project.

<sup>(c)</sup> Excludes approved/pending projects

<sup>(d)</sup> Numbers do not always add up due to rounding.

The "full buildout" of the proposed General Plan assumes the maximum development of every parcel, combined with approved and pending developments throughout the Planning Area. The 2040 land uses are based on realistic land use demand projections. The full buildout of the General Plan would result in almost three times more new housing units and over 24 times more new non-residential development than estimated for 2040. Therefore, it is extremely unlikely that the full buildout would occur by the year 2040. Full buildout may not occur until well beyond the useful lifespan of the proposed infrastructure (for example, the lifespan of concrete structures is typically 50 to 75 years). Consequently, this infrastructure planning was based on the estimated 2040 level of development. This table is included in this TM to document the relationship between the buildout land uses and the 2040 land uses.

Source: PlaceWorks, 2017.



Source: City of Stockton, 2017; PlaceWorks, 2017.

- |                            |                             |                                   |                            |                           |
|----------------------------|-----------------------------|-----------------------------------|----------------------------|---------------------------|
| Residential Estate         | Mixed Use                   | Economic and Education Enterprise | City Limit                 | Greater Downtown Boundary |
| Low Density Residential    | Commercial                  | Institutional                     | Sphere of Influence        |                           |
| Medium Density Residential | Administrative Professional | Parks and Recreation              | General Plan Planning Area |                           |
| High Density Residential   | Industrial                  | Open Space/Agriculture            |                            |                           |

Figure 3-3

Proposed General Plan Land Use Map