CITY OF RIVERSIDE

City of Riverside Public Works Department

UPDATE OF THE INTEGRATED MASTER PLAN FOR THE WASTEWATER COLLECTION AND TREATMENT FACILITIES

VOL. 1

Executive Summary

JANUARY 2020

carollo

Engineers...Working Wonders With Water®

CITY OF RIVERSIDE

carollo

Engineers...Working Wonders With Water®

Volume Table of Contents

Abbreviations

αF	alpha factor
µg/L	micrograms per liter
A/A Trunk Sewer	Acorn/Arlanza Trunk Sewer
AACE	Advancement of Cost Engineering
AADF	annual average daily flow
AAF	average annual flow
AB	Assembly Bill
ABS	Acrylonitrile-Butadiene-Styrene
ACI	American Concrete Institute
ACP	asbestos cement pipe
ACS	American Community Survey
ACT treatment train	Activated treatment train
ADC	alternative daily cover
ADEQ	Arizona Department of Environmental Quality
ADF	average daily flow
ADWF	average dry weather flow
AFY	acre-feet per year
APAD	acid-phase anaerobic digestion
AQMD	Air Quality Management District
AQMP	Air Quality Management Plan
ARB	California Air Resources Board
ARVs	air release valves
ASCE	American Society of Civil Engineers
AWT	Advanced Water Treatment
BACT	best available control technology
BCM	Best Available Control Measures for Fugitive Dust Sources
BFP	belt filter press
BMP	best management practices
BNR	Biological nutrient removal
BOD	biochemical oxygen demand
BOD_5	5-day biochemical oxygen demand
BPTC	Best Practicable Treatment or Control
Btu/lb	British thermal unit per pound
BWF	base wastewater flow
C	Celsius
$CaCO_3$	calcium carbonate
Carollo	Carollo Engineers, Inc.

CASA	California Association of Sanitation Agencies
CCB	chlorine contact basin
CCF	hundred cubic feet
CCI	Construction Cost Index
CCTV	Closed Circuit Television
CDFW	California Division of Fish and Wildlife
CDM	Camp Dresser & McKee, Inc.
CECs	Contaminants of Emerging Concern
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
cfd	cubic feet per day
cfm	cubic feet per minute
cfs	cubic feet per second
CIP	Capital Improvement Program
City	City of Riverside
CIWQS	California's Integrated Water Quality System
CMB	Combustion Sources
CMMS	Computerized Maintenance Management System
CNG	compressed natural gas
CO_2	carbon dioxide
COD	chemical oxygen demand
COS	cost-of-service
cP	centipoise
CSCI	California Stream Condition Index
CSD	Community Services Districts
CTS	Coatings and Solvents
cu ft	cubic feet
CWA	Clean Water Act
CWC	California Water Code
CWEA	California Water Environment Association
DAF	dissolved air flotation
DAFT	dissolved air flotation thickeners
days/week	days per week
DCR	demand-capacity ratio
DDW	California Division of Drinking Water
DG	digester gas
DIR	Department of Industrial Relations
DMR	discharge monitoring report
DU	dwelling unit

DWF	dry weather flow
EBRT	empty bed residence time
EC	Emerging Constituents
EDR	electro-dialysis reversal
EDU	equivalent dwelling units
EGM	Emission Growth Management
EIR	Environmental Impact Report
EnerTech	EnerTech Environmental California, LLC
ENR	Engineering News Record
EPA	Environmental Protection Agency
EQ	equalization
ESA	Endangered Species Act
F	Fahrenheit
FDA	Food & Drug Administration
Flo-Dar	Marsh-McBirney Flo-Dar™
FLX	Compliance Flexibility Program
FOG	fats, oils, and grease
fps	feet per second
ft	feet
FTE	Full Time Employee
FUG	Fugitive Emissions
FY	fiscal years
g	grams
gal	gallons
GBT	gravity belt thickeners
GHG	Greenhouse Gas
GIS	Geographic Information System
GL	General Ledger
gpcd	gallons per capita day
gpd	gallons per day
gpd/ac	gallons per day per acre
gpm	gallons per minute
gpm/sq ft	gallons per minute per square feet
GWI	groundwater infiltration
H_2S	hydrogen sulfide
HGL	hydraulic grade line
HID	High-Intensity Discharge
hp	horsepower
hr	hour

hrs/day	hours per day
HS^-	hydrogen sulfide ion
HVAC	heating, ventilation, and air conditioning
I/I	Infiltration/inflow
IEBL	Inland Empire Brine Line
IEUA	Inland Empire Utilities Agency
in.	inch
iPACS	Internet-based POTW Administration and Compliance System
IRWD	Irvine Ranch Water District
IT	Information Technology
IWWMP	Integrated Wastewater Master Plan
klb/d	thousand pounds per day
klbN/d	thousand pounds of nitrogen per day
KPI	Key Performance Indicator
kWh	kilowatt hour
lbs	pounds
lbs/cfd	pounds per cubic feet per day
lbs/ft^3	pounds per cubic feet
LF	linear feet
LIMS	Laboratory Information Management System
LM	Longitudinal Motion
LOTO	Lock Out / Tag Out
LRO	legally responsible official
Master Plan	Integrated Master Plan for the Wastewater Collection and Treatment Facilities
MBR	Membrane Bioreactor
MBR treatment train	Membrane Bioreactor treatment train
MCC	motor control center
MCS	Multiple Component Sources
MDD	maximum day demand
MDL	Method Detection Limits
MF	microfiltration
MFR	multi-family residential
MG	million gallons
mg-min/L	milligrams per minute per liter
mg/L	milligrams per liter
mgd	million gallons per day
mgN/L	milligrams of nitrogen per liter
min	minute

min/hr	minutes per hour
ML&C	mortar lined and coated
MLSS	mixed liquor suspended solids
mm	millimeter
MMBtu	million British thermal units
MMBtu/hr	million British thermal units per hour
MMRP	Measurement, Monitoring and Reporting Procedures
MOB	Mobile Source Programs
MP	Master Plan
MPN	most probable number
MRP	Monitoring and Reporting Program
msl	mean sea level
mV	millivolt
N/L	nitrogen per liter
N_2O	nitrous oxide
NACWA	National Association of Clean Water Agencies
$NaHSO_3$	sodium bisulfite
NaOCl	sodium hypochlorite
NASSCO	National Association of Sewer Service Companies
NEC	National Electric Code
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NFPA	National Fire Protection Association
NGO	Non-Governmental Organizations
NH_3-N	ammonia nitrogen
NOAA	National Oceanic and Atmospheric Association
NOI	notice of intent
NO_X	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
O&M	Operations and Maintenance
OCSD	Orange County Sanitation District
OERP	Overflow Emergency Response Plan
OES	Office of Emergency Services
OJT	On-the-Job Training
ORP	Oxidation-Reduction Potential
P/L	phosphorus per liter
PACP	Pipeline Assessment Certification Program
PAYGO	Pay-As-You-Go

PDR	Preliminary Design Report
PEIR	Programmatic Environmental Impact Report
PFRP	Process to Further Reduce Pathogens
PLC	programmable logic controller
POTW	Publicly Operated Treatment Work
ppbv	parts per billion by volume
ppcd	pounds per capita per day
ppd	pounds per day
ppd/cu ft	pounds per day per cubic feet
ppd/sq ft	pounds per day per square feet
pph	pounds per hour
ppm	parts per million
psf	pounds per square foot
psi	pounds per square inch
PTZ	Pan-Tilt-Zoom
PVC	Polyvinyl Chloride
PWS	potable water salinity
PWWF	peak wet weather flow
QICS	Qualitative Intelligence and Communication System
R&R	rehabilitation and repair
RAS	return activated sludge
RCNLD	Replacement Cost New Less Depreciation
RCP	reinforced concrete pipe
RDII	Rain Derived Infiltration and Inflow
RDT	rotary drum thickeners
RECLAIM	Regional Clean Air Incentives Market
Regional Board	California Regional Water Quality Control Board
RG	rain gauge
RNG	renewable natural gas
RO	reverse osmosis
RPU	Riverside Public Utilities
RST	rotary screw thickeners
RTP	Regional Transportation Plan
RWQCB	Regional Water Quality Control Board
RWQCP	Regional Water Quality Control Plant
S_2^-	sulfide ion
SARDA	Santa Ana River Dischargers Association
SART	Santa Ana River Trail
SB	Senate Bill

sBOD	Soluble biochemical oxygen demand
SBT	sludge blending tank
SCADA	supervisory control and data acquisition
SCAG	Southern California Association of Governments
SCAP	Site Cleanup Subaccount Program
SCAQMD	South Coast Air Quality Management District
scfm	standard cubic feet per minute
sCOD	soluble chemical oxygen demand
SECAP	System Evaluation and Capacity Assurance Plan
SFR	single-family residential
SFY	square feet per year
SIU	Significant Industrial Users
SLCP	Short Lived Climate Pollutant
SLR	solids loading rate
SOC	Strengths, Opportunities, and Concerns
SOP	Standard Operating Procedures
SOR	surface overflow rate
South Star	South Star Engineering & Consulting, Inc.
SO_X	Sulphur oxides
sq mi	square mile
SQR	Structural Quick Rating
SRF	State Revolving Fund
SRT	solids retention time
SS	stainless steel
SSC	Sustainable Communities Strategy
SSMP	Sewer System Management Plan
SSO	Sanitary Sewer Overflows
State Water Board	California State Water Resources Board
SWMM	Storm Water Management Model
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
TIN	total inorganic nitrogen
TKN	total Kjeldahl nitrogen
TL	
TM	Technical Memorandum
TMDL	total maximum daily load
TN	total nitrogen
TOC	total organic carbon
TP	total phosphorus

TS	total solids
TSS	total suspended solids
TST	Test for Significant Toxicity
URS	URS Corporations
USACE	United States Army Corps of Engineers
USBR	U.S. Department of the Interior Bureau of Reclamation
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UV/AOP	Ultraviolet/Advanced Oxidation Process
V&A	V&A Consulting Engineers
VCP	Vitrified Clay Pipe
VFA	volatile fatty acids
VFD	variable frequency drive
VSR	volatile solids reduction
VSS	volatile suspended solids
WaPUG	Wastewater Planning Users Group
WAS	waste activated sludge
WDR	Waste Discharge Requirements
WLAM	Waste Load Allocation Model
WMWD	Western Municipal Water District
WQMP	Water Quality Management Plan
WRCRWA	Western Riverside County Regional Wastewater Authority
wt	wet ton
WTPD	wet tons per day
WWTP	wastewater treatment plant
ZLD	Zero Liquid Discharge

CITY OF RIVERSIDE

City of Riverside Public Works Department

UPDATE OF THE INTEGRATED MASTER PLAN FOR THE WASTEWATER COLLECTION AND TREATMENT FACILITIES

VOL. 1

Executive Summary

carollo

Engineers...Working Wonders With Water®

City of Riverside Public Works Department

Update of the Integrated Master Plan for the Wastewater Collection and Treatment Facilities

VOLUME 1: EXECUTIVE SUMMARY

FINAL | January 2020

carollo

City of Riverside Public Works Department

Update of the Integrated Master Plan for the Wastewater Collection and Treatment Facilities

VOLUME 1: EXECUTIVE SUMMARY

Carollo Project No. 10495A00

Contents

Executive Summary

Tables

Figures

EXECUTIVE SUMMARY

ES.1 Purpose

This Update of the 2008 Integrated Master Plan for the Wastewater Collection and Treatment Facilities for the City of Riverside (City) Public Works Department, has been prepared to facilitate planning through a 20-year horizon for the City's Regional Water Quality Control Plant (RWQCP) and collection system. The recommended plan is intended to enable the RWQCP to continue to reliably provide wastewater treatment for the City and surrounding communities as the wastewater flow and loading increase due to projected population growth. In addition, a CIP and the resulting rate structure to pay for the Capital Improvements Program (CIP) has been developed. This update of the Master Plan brings key portions of the 2008 Master Plan and the 2014 rate and development study up to date and addresses collection system and facility needs for projected influent flow and loading through the year 2037. The purpose of Volume 1, Executive Summary, is to provide a concise overview of the key issues and findings, and alternatives analyses carried out as part of the update of the Master Plan, that are included in Volumes 2 through 9.

ES.2 Background

The City Wastewater Division is responsible for the collection and treatment of wastewater flows generated within the City as well as the community services districts of Jurupa, Rubidoux, Edgemont, and the community of Highgrove. The City's collection system consists of over 800 miles of gravity sewers ranging from 4 to 51 inches in diameter, 414 miles of sewer laterals that are City owned, and 20 wastewater pump stations. The wastewater pump stations range in size from less than 100 gallons per minute (gpm) to over 11,000 gpm. Treatment occurs at the RWQCP, which provides preliminary, primary, secondary, and tertiary treatment for a hydraulic rated capacity of approximately 46 million gallons per day (mgd) average dry weather flow (ADWF). Water conservation efforts have substantially reduced wastewater flows since 2008, however, wastewater concentrations and loads have steadily increased in response to population growth. Thus the driver for capacity improvement requirements has shifted from flow only to a combination of both flow and loading. The loading capacity of the RWQCP is discussed in detail as part of the process design and reliability criteria in Volume 4, Chapter 3.

ES.3 Goals and Objectives

The purpose of this update to the Master Plan is to evaluate the City's collection system and some of the RWQCP unit processes, make recommendations for future expansions and rehabilitation of the facilities, and develop the resultant CIP and rate structures to pay for the CIP. The CIP developed as part of the update to the Master Plan is based on a planning period through the year 2037. The update of the Master Plan incorporates the findings and recommendations of previous and ongoing plans and studies. More specific goals for the update of the Master Plan included analysis of the collection system and RWQCP to develop a Master Plan that:

- Includes a CIP to serve the needs of both existing and future users (to 2037).
- Complies with regulatory requirements.
- Does not overburden rate payers.
- Is equitable to the development community.

- Develops a rate structure to fund the CIP for adoption in July 2020 (Fiscal Year (FY) 20/21).
- Recommends necessary capacity, maintenance, staffing, and funding modifications for both the collection system and treatment facility to continue to provide safe and reliable wastewater conveyance and treatment throughout the planning period and ensure the safety of the community and the environment.

Critical to accomplishing these goals is getting the wastewater flows to the treatment plant, and that is why a significant portion of the Master Plan update was focused on the collection system. A number of special collection system studies were completed as part of the Master Plan update to address specific needs.

ES.4 Organizational Structure

This update of the Master Plan is organized in 9 Volumes, as shown in Table ES.1.

Table ES.1 Integrated Master Plan Volumes

Volumes and Chapter Titles
Volume 1: Executive Summary
Volume 2: Basis of Planning
Chapter 1: Introduction Chapter 2: Regulatory and Climate Change Considerations Chapter 3: Population, Loading, and Flow Projections Chapter 4: Basis of Cost Estimates Chapter 5: Organizational Review
Volume 3: Wastewater Collection System
Chapter 1: Introduction and Background Chapter 2: Planning Area Characteristics Chapter 3: Flow Monitoring Program Chapter 4: Collection System Facilities and Hydraulic Model Chapter 5: Planning Criteria and Design Flows Chapter 6: Regulatory Review and SSMP Gap Analysis Chapter 7: Capacity Evaluation and Proposed Improvements Chapter 8: Sewer Lift Station Condition Assessment Chapter 9: Sewer Pipeline R&R Program Chapter 10: Capital Improvement Program Chapter 11: Collection System Odor Control
Volume 4: Wastewater Treatment System
Chapter 1: Existing Facilities Chapter 2: Summary of Planning Studies Chapter 3: Process Design and Reliability Criteria Chapter 4: Preliminary Treatment Chapter 5: Primary Treatment Chapter 6: Secondary Treatment Chapter 7: Tertiary Treatment Chapter 8: Advanced Water Treatment Chapter 9: Disinfection Chapter 10: Environmental Review Chapter 11: Capital Project Studies

Table ES.1 Integrated Master Plan Volumes (continued)

Volumes and Chapter Titles
Volume 5: Solids Treatment and Handling
Chapter 1: Existing Facilities Chapter 2: Summary of Planning Studies Chapter 3: Process Design and Reliability Criteria Chapter 4: Solids Production and Thickening Chapter 5: Solids Disposal
Volume 6: Regional Water Quality Control Plant Condition Assessment Results
Volume 7: Capital Improvement Program and Implementation
Volume 8: Financial Plan and User Rates and Fees
Volume 9: Additional Special Collection System Studies
Chapter 1: Introduction Chapter 2: Sewers and Manholes in Close Proximity to Waters of US Chapter 3: SSO Reporting and Response Chapter 4: Laboratory Compliance Audit Chapter 5: Chemical Root Control SOP Chapter 6: SSMP Update

ES.5 Volume 2: Basis of Planning

The purpose of Volume 2, Basis of Planning is to document the basic criteria used in facility planning for the City's update of the Master Plan. In addition to an outline of the update of the Master Plan volumes, three areas are addressed in Volume 2:

1. Regulatory and Climate Change Considerations.
2. Population, Flow, and Loading Projections.
3. Basis of Cost Estimates.

The RWQCP developed a series of goals that form the basis of the decision-making practices reflected in this update to the Master Plan. These goals are based on four resource areas: Recycled Water Production and Distribution, Organics Receiving and Treatment, Energy Production and Independence, and Waste Management and Reuse. From these four areas, ten goals were identified:

1. Energy Independence:
   Produce 100 percent of the RWQCP electrical energy needs and partner with the City's Riverside Public Utilities (RPU) to produce renewable energy from bio-methane.
2. Renewable Energy and Waste Diversion Credits:
   Reduce air emissions and waste, produce energy and pursue all available programs to receive renewable energy and waste reduction credits maximizing the value of those credits to support City incentives.
3. Infrastructure Capital Investment:
   Utilize private and public partnership opportunities, grant funding, and Sewer Enterprise capital funding to develop and implement projects.

4. Organic and Green Waste Management:
   Partner with the City's Public Works Solid Waste Division to put in place refuse and organic waste service contracts that divert waste from landfills and bring waste to the RWQCP for bio-methane production and energy generation.
5. Outside Partnerships:
   Pursue funding and research partnerships with industry, the University of California Riverside, the California Air Resources Board, non-profit organizations and other public agencies to improve and develop technology to maximize resource recovery.
6. Project Delivery:
   Pursue private and public partnerships to enhance funding opportunities, provide community value, and project success.
7. Products for Market:
   Produce products for the open market such as Class A biosolids for beneficial reuse, recycled water and renewable natural gas, as a potential revenue source for capital investment, offset wastewater operation and maintenance expenses, and stabilize rates for City rate payers.
8. Public Education and Outreach:
   Educate the public about the importance and value of resource recovery.
9. Community and Environmental Stewardship:
   Continue to provide safe and reliable wastewater conveyance and treatment, respond promptly to the concerns of citizens and others, and ensure the safety of the community and the environment with proactive monitoring, maintenance, and development of the City's extensive collection system network and treatment facilities.
10. Pre-emptive Infrastructure Improvements:
    Monitor, maintain, and develop the City's collection system in accordance with City resolutions and related regulations.

ES.5.1 Regulatory and Climate Change Considerations

In addition to these goals, regulatory and climate change considerations play a critical role in anticipating the level of treatment required to comply with state and federal regulations now and in the future. The impacts of climate change are expected to be felt largely by changes in treatment and discharge regulations for the plant. More intense rain events, triggered by climate change, would impact the collection system. These and other regulatory changes in relation to the City are discussed in more detail in Volume 2, Chapter 2.

As discussed in Volume 2, Chapter 2, a brainstorming session was conducted at the beginning of the project. The purpose of this session was to identify specific regulatory requirements likely to arise over the next 10 to 20 years and ascertain how these requirements would impact the update of the Master Plan alternative analyses. Based on the brainstorming session, it was determined that most of the potential future impacts would be addressed by developing compliance strategies rather than new capital treatment facilities. There were also a few potential regulatory changes that would require new or improved treatment processes. The discussions regarding applicable regulations can be found in Volume 2, Chapter 2.

ES.5.2 Projected Population

Population projections were developed through the year 2037. These projections were developed based on Geographic Information System (GIS) data provided by the Southern California Association of Governments (SCAG) for the 2016-2040 RTP/SSC Report, clipped to the City's service area boundary and limited by build-out projections discussed in Volume 2, Chapter 3, Section 3.5.6. Table ES.2 summarizes population projections by basin. Although the SCAG projections for the City's service area population, including the community of Highgrove (but excluding Jurupa, Rubidoux, and Edgemont Community Service Districts (CSDs)), predict a population increase to approximately 390,200 people by the year 2037, land use classifications and wastewater flow projections indicate actual build-out will occur in 2032. This means population growth will be limited to approximately 379,300 people in the year 2032 and beyond, representing a 22 percent increase above the 2016 service area population.

Table ES.2 Projected Population by Sewer Basin for the City and Highgrove Community

Basin	Service Area Population				
	2020	2025	2030	2032	2037
Arlanza	147,300	154,200	161,100	163,900	163,900
Northside	18,800	19,700	20,600	20,900	20,900
Phoenix	63,000	66,000	68,900	70,100	70,100
Spruce	34,600	36,100	37,700	38,400	38,400
Tequesquite	77,300	80,900	84,600	86,000	86,000
Total	**340,900**	**356,900**	**372,900**	**379,300**	**379,300**

Notes:
(1) Source: Southern California Association of Governments (SCAG) for the 2016-2040 Regional Transportation Plan (RTP)/Sustainable Communities Strategy (SSC) Report (GIS Shape File).
(2) Estimates include the City service area and the Highgrove community area, but do not include the Jurupa, Rubidoux, or Edgemont CSDs.

ES.5.3 Projected Flow

This project characterized historic flows on an annual average per-capita flow basis. For planning purposes, it was assumed that a per-capita flow of 77 gallons per capita day (gpcd) would be used for future flow projections. This per-capita flow was consistent with the per-capita wastewater flow observed during the flow monitoring program conducted between January 25 and March 8, 2017 as part of this update of the Master Plan effort. The results of the flow monitoring study are discussed in detail in Volume 3, Chapter 3. The measured ADWF at that time was approximately 24 mgd.

Based on the results of the flow monitoring study and the population and hydraulic models, it is estimated that the City's service area could generate a total flow of approximately 29 mgd, as shown on Figure ES.1. Applying the per-capita generation rate to the population projections indicates that build-out occurs in 2032.

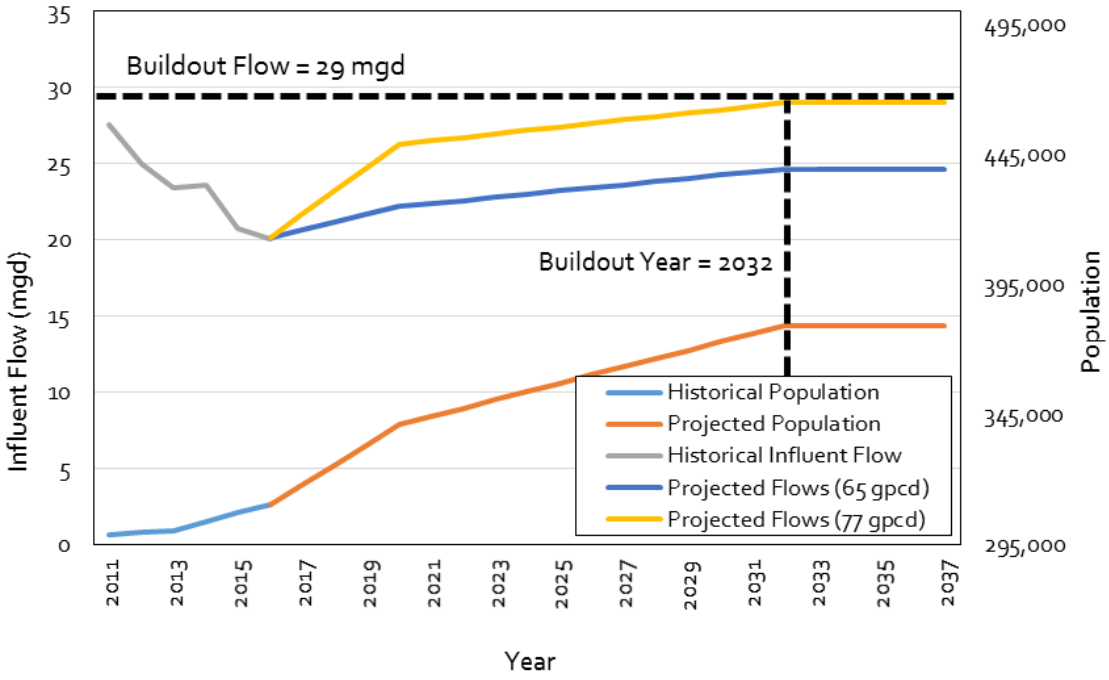

Figure ES.1 Projected Wastewater Flow

ES.5.3.1 Community Service District Flow Projections

Based on Jurupa's current purchase agreements, Jurupa has a 4.0 mgd allocation limit until 2030, after which the limit increases to 5.0 mgd. Rubidoux is limited to 3.055 mgd and Edgemont is limited to 0.89 mgd. The Highgrove community is in the process of becoming an official CSD and does not have an established allocation limit at the time of this update to the Master Plan. Loading projections for Highgrove were included with the City's projections.

Wastewater flow projections for the Jurupa, Rubidoux, and Edgemont CSDs were documented by separate master planning efforts for each agency and then incorporated into this update of the Master Plan. Purchase of additional capacity allocations may need to be negotiated with individual CSDs in the future depending on actual wastewater flows. Table ES.3 summarizes the flow projections through 2037 for each of the CSDs.

Table ES.3 Contributing Agency Flow Projections

Agency	Flow Allocation Limit	Projected Flows Through 2037 (mgd)
Jurupa[(1)]	4.0/5.0[(5)]	4.90
Rubidoux[(2)]	3.055	4.00
Edgemont[(3)(4)]	0.89	1.07
Total		**9.97**

Notes:
(1) Source: 2004 Master Sewer Plan (Albert A. Webb Associates).
(2) Source: 2015 Rubidoux Wastewater Facilities Master Plan (Krieger & Stewart).
(3) Source: 2008 Master Sewer System Evaluation Plan (Albert A. Webb Associates).
(4) Total build-out flows are estimated to be 1.32 mgd. Based on growth projections (Albert A. Webb Associates), build-out is expected to occur beyond the 2037 planning period.
(5) Jurupa is limited to 4.0 mgd until 2030, then to 5.0 mgd thereafter.

Combining the projected CSD flows with those from the City results in a total projected annual average wastewater flow in 2037 of 39 mgd.

ES.5.4 Projected Wastewater Loads

For this update of the Master Plan, loading projections were based on population projections for the City service area (the City and Highgrove Community) presented earlier. Three loading parameters are monitored as part of regulatory requirements: biochemical oxygen demand (BOD), total suspended solids (TSS), and ammonia nitrogen (NH_3-N). In addition, chemical oxygen demand (COD) is also monitored to determine its ratio relative to BOD, to establish biodegradability factors for the wastewater. Using the average per-capita loading for BOD, COD, TSS, and NH_3-N, loading conditions were projected through the year 2037, summarized in Table ES.4. Actual data is included for the years 2016 and 2017.

Table ES.4 Projected Loading Characteristics for the City Service Area (excluding CSD's)

Year	BOD (ppd)	COD (ppd)	TSS (ppd)	NH_3-N (ppd)
2016(1)	62,600	136,700	55,700	4,900
2017(1)	66,800	141,400	60,100	5,550
2025	75,000	158,700	67,400	6,240
2030	78,300	165,800	70,500	6,520
2032	79,700	168,700	71,700	6,630
2037	79,700	168,700	71,700	6,630

Notes:
Abbreviations: ppd - pounds per day.
(1) Loadings presented here are actual loadings used in conjunction with population projections as a starting point for all future projections.

ES.5.4.1 Community Service District Loading Projections

The loading projections for Jurupa and Rubidoux were determined using their respective annual average flow and loadings in 2016 and 2017. However, Edgemont did not have loading data available at the time of this investigation. Therefore, it is assumed that the City and Edgemont will have similar loading characteristics. The estimated loading contributions for Jurupa are shown in Table ES.5, while Rubidoux's equivalent is shown in Table ES.6. Table ES.7 shows the estimated loading contributions through 2037 for Jurupa, Rubidoux, and Edgemont CSDs. Additional information regarding the CSD loading projections can be found in Volume 2, Chapter 3.

Table ES.5 Projected Loading Characteristics for Jurupa CSD

Year	BOD (ppd)	COD (ppd)	TSS (ppd)	NH_3-N (ppd)
2016(1)	7,800	18,800	7,800	913
2017(1)	8,120	19,560	8,120	950
2020	9,150	22,020	9,150	1,080
2025	11,160	26,830	11,160	1,340
2030	11,930	28,680	11,930	1,440
2032	11,930	28,680	11,930	1,440
2037	11,930	28,680	11,930	1,440
Allocation Limit	**12,302**	**N/A**	**11,259**	**1,168**
Exceeded by	**Beyond 2037**	**N/A**	**2025**	**2022**

Notes:
(1) Loadings presented here are actual loadings used in conjunction with population projections as a starting point for all future projections.

Table ES.6 Projected Loading Characteristics for Rubidoux CSD

Year	BOD (ppd)	COD (ppd)	TSS (ppd)	NH_3-N (ppd)
2016(1)	11,400	29,100	9,000	844
2017(1)	12,650	32,280	9,990	940
2020	16,410	41,830	12,960	1,240
2025	18,760	47,830	14,860	1,440
2030	21,110	53,830	16,760	1,640
2032	22,050	56,230	17,520	1,720
2037	23,460	59,830	18,660	1,840
Allocation Limit	**5,860**	**N/A**	**5,605**	**815**
Exceeded by	**Pre-2012**	**N/A**	**Pre-2013**	**2015**

Notes:
(1) Loadings presented here are actual loadings used in conjunction with population projections as a starting point for all future projections.

Table ES.7 Projected Loading Characteristics for All CSDs

Year	BOD (ppd)	COD (ppd)	TSS (ppd)	NH_3-N (ppd)
2016(1)	20,900	51,500	18,300	1,890
2017(1)	22,230	54,760	19,460	2,010
2020	26,260	64,670	22,990	2,380
2025	31,210	76,840	27,320	2,830
2030	34,420	84,720	30,130	3,130
2032	36,590	90,070	32,030	3,330
2037	36,700	90,340	32,130	3,340

Notes:
(1) Loadings presented here are actual loadings used in conjunction with population projections as a starting point for all future projections.

ES.5.5 Projected Flow and Loading Basis of Planning Summary

The flow and loading projections developed in Volume 2 were used in Volume 3, Chapter 3 and Volume 4, Chapter 3 as the basis for collection system and unit process capacity determinations. The main purpose of the flow and loading projections is to provide the City with a guidance tool to compare present day flow and loading to a "trigger point," or a point by which a project will need to be initialized to ensure completion in time to maintain compliance with regulatory requirements. For this update to the Master Plan, the "trigger point" is based on the NPDES requirements regarding influent flow, which is set at 75 percent of treatment capacity. The corresponding BOD, TSS, and NH3-N loads for the trigger point flow are also shown in the table. The RWQCP is currently operating under the 2013 NPDES permit, and filed a Report of Waste Discharge to the Regional Board per the requirements in May 2018, and is awaiting receipt of a new permit. It is recommended that the City regularly compare this table to flow and loading conditions to gauge how quickly a project may need to be initialized. Table ES.8 summarizes the projections, capacity, and trigger point for each constituent. Note that in this table actual flow and loading values for four years has been included. Values for years 2018 and 2019 were added to the data set to provide up to date information to aid in planning for future capacity expansion needs.

Table ES.8 Combined Total Projected Loading Characteristics

Year	Flow (mgd)	BOD (ppd)	TSS (ppd)	NH_3-N (ppd)
2016[1]	25.8	76,500	58,200	7,000
2017[1]	27.6	82,900	64,700	8,140
2018[1]	27.5	82,900	68,700	8,150
2019[1]	26.4	75,300	63,500	8,150
2025	35.9	106,210	94,720	9,070
2030	37.9	112,720	100,630	9,650
2032	38.9	116,290	103,730	9,960
2037	39.0	116,400	103,830	9,970
Treatment Capacity[2]	**43.5[3]**	**133,900**	**123,700**	**11,600**
75% Capacity[4]	**32.6**	**100,425**	**92,775**	**8,700**

Notes:

(1) Loadings presented here were calculated using actual combined influent flow and constituent concentrations acquired in January 2020. It is included only in this volume as guidance to reconcile the projections starting in 2025 based on per capita loading and population assumptions as described in Volume 2. The actual values for 2018 and 2019 are not reflected in Volume 2 of this update to the Master Plan.

(2) Treatment capacity obtained from the 2017 process model is shown for reference. For a full description of the evaluation used to determine this capacity, see Volume 4, Chapter 3 of this update of the Master Plan.

(3) The treatment capacity for flow is limited by aeration air flow for the membrane bioreactor treatment train (MBR treatment train (Plant 1)) and by the secondary clarifier solids loading capacity for the Activated treatment train (ACT treatment train (Plant 2)).

(4) Flow capacity trigger determined by 2013 NPDES permit requirements that are still effective. BOD, TSS, and NH3-N loads calculated based on the trigger capacity value.

Comparing the volumetric 75 percent "trigger point" values in Table ES.8 with actual values from 2019, indicates that the plant influent flow can increase by about 23 percent above 2019 values before the trigger value is reached. BOD and TSS limits can accept greater changes compared with 2019 values, however, the buffer for NH3-N increases is less than 10 percent. This indicates that the NH3-N load may be the future trigger constituent for capacity expansion. However, as mentioned, the City should continue to monitor and compare actual and predicted flow and loading values to determine the decision points for future projects. Note that the Volume 2 counterpart to Table ES.8 does not include actual loading data for years 2018 and 2019.

ES.5.6 Basis of Cost Estimates

The Basis of Cost Estimates can be found in Volume 2, Chapter 4. This chapter established the procedures and guidelines for estimating operations and maintenance (O&M) and capital costs for this update of the Master Plan. Based on the Association for the AACE International's definitions of the five "class estimates" in AACE International Recommended Practice No. 18R-97, the classification of costs presented in this update of the Master Plan are Class 4 estimates and can be considered only as budget estimates. Table ES.9 and Table ES.10 list the cost factors that were applied to the capital and life-cycle cost estimates.

Table ES.9 Capital Cost Estimate Factors to develop Class 4 cost estimates

Category	Factor
Site Work	10% of direct costs
Electrical and Instrumentation	15% of direct costs
Contingency	30% of total direct costs
General Conditions	10% of total direct costs + contingency
Contractor OH&P	15% of total direct costs, contingency, GC
Escalation	3%
Bid Market Allowance	15%
Project Costs	30% of total construction costs

Table ES.10 Life-Cycle Cost Estimate Factors

Category	Factor
Escalation	3%
Discount Rate	6%

ES.5.7 Organizational Review

An organizational review was performed as part of this update to the Master Plan; details can be found in Volume 2, Chapter 5. Section managers and higher-level representatives from each work group were interviewed regarding specific strengths, opportunities, and concerns for each Section. In addition, staffing and financial information was evaluated to compare the City against other organizations using data from the 2018 National Association of Clean Water Agencies (NACWA) financial survey.

Based on the results of the interviews and evaluation, the City appears to be adequately staffed in the Operations, Maintenance, and Environmental Compliance sections. Administration may be slightly understaffed. However, it was concluded from both the interviews and financial evaluation that the Collections section appeared to be significantly understaffed. A detailed investigation is recommended to determine the necessary staffing levels to meet the City's expanding requirements. This detailed investigation should specifically target the Collections section, although other sections would also benefit.

ES.6 Volume 3: Wastewater Collection System

The purpose of Volume 3, Wastewater Collection System, is to document the hydraulic model development and assumptions used in the evaluation of the wastewater collection system for the City's update of the Master Plan. As mentioned, a significant portion of the Master Plan update was focused on the collection system. The hydraulic model was used to identify deficiencies in the existing collection system and to recommend projects to treat projected 2037 flows. The following summarizes the major assumptions and recommendations of each chapter in Volume 3.

ES.6.1 Planning Area Characteristics

The City's service area comprises approximately 81.5 square miles broken into five sewer basins: Arlanza, Northside, Phoenix, Spruce, and Tequesquite. The collection system conveys wastewater flows through these basins to the RWQCP through four major sewers: Acorn/Arlanza Trunk Sewer (A/A Trunk Sewer), Santa Ana Trunk Sewer (Riverside/Hillside), Jurupa Force Main, and Rubidoux Force Main. The Jurupa and Rubidoux force mains bring flows from the Jurupa and Rubidoux CSDs, respectively and exclusively. The Edgemont CSD and Highgrove Community, which have individual agreements with the City, both route their wastewater flows through the Santa Ana Trunk Sewer (Riverside/Hillside). The entire study area included in this update to the Master Plan consists of approximately 88.3 square miles. Approximately 8.6 miles of the study area is located outside the City's limits. Furthermore, 1.9 square miles of the area within the City's limits are outside of the collection system and are customers of Western Municipal Water District.

In general, the City service area is characterized by residential, commercial, and industrial uses within the City limits. There are some agricultural lands within the metropolitan area that are interspersed on larger parcels along the fringe of urbanized areas. Figure ES.2 shows the study area boundary and the current City limits.

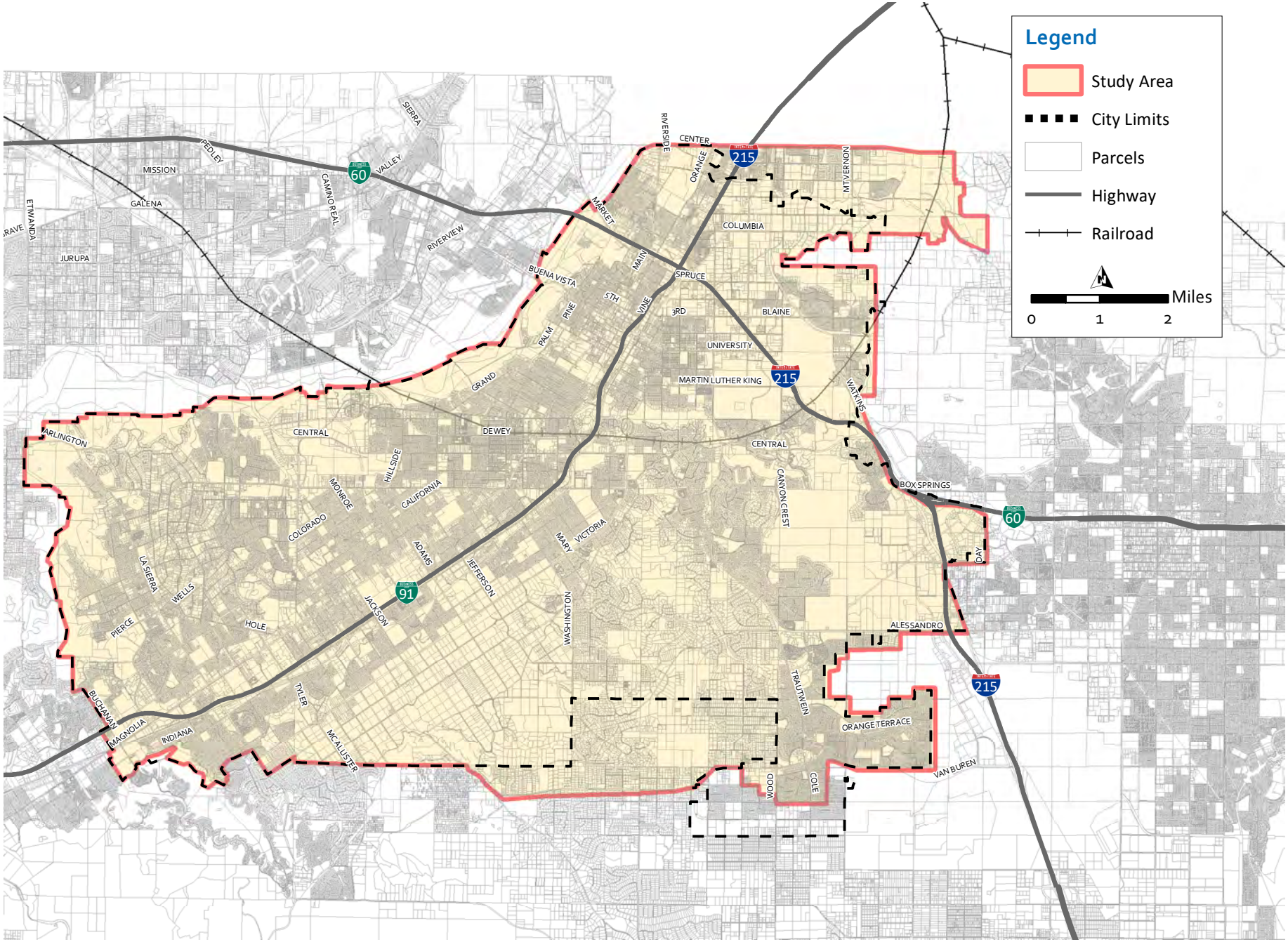

Figure ES.2 Study Area

Volume 3, Chapter 2 discusses characteristics of the service area including climate, topography, land use, and population. These characteristics formed a complex set of parameters used to calibrate the hydraulic model and predict future impacts to the sewer collection system.

ES.6.2 Flow Monitoring Program

To better understand the typical components of wastewater in a collection system, a flow monitoring program was included as part of this update to the Master Plan. There are several components that make up the total wastewater flow as shown on Figure ES.3. The flow monitoring program sought to quantify each of these components to develop design flow criteria and correlate actual collection system flows to those predicted by the hydraulic model. The temporary flow monitoring program placed 60 open-channel flowmeters throughout the collection system for approximately 6-weeks between January 25 and March 8, 2017. The 60 flow monitoring locations as well as their respective tributary areas are shown on Figure ES.4.

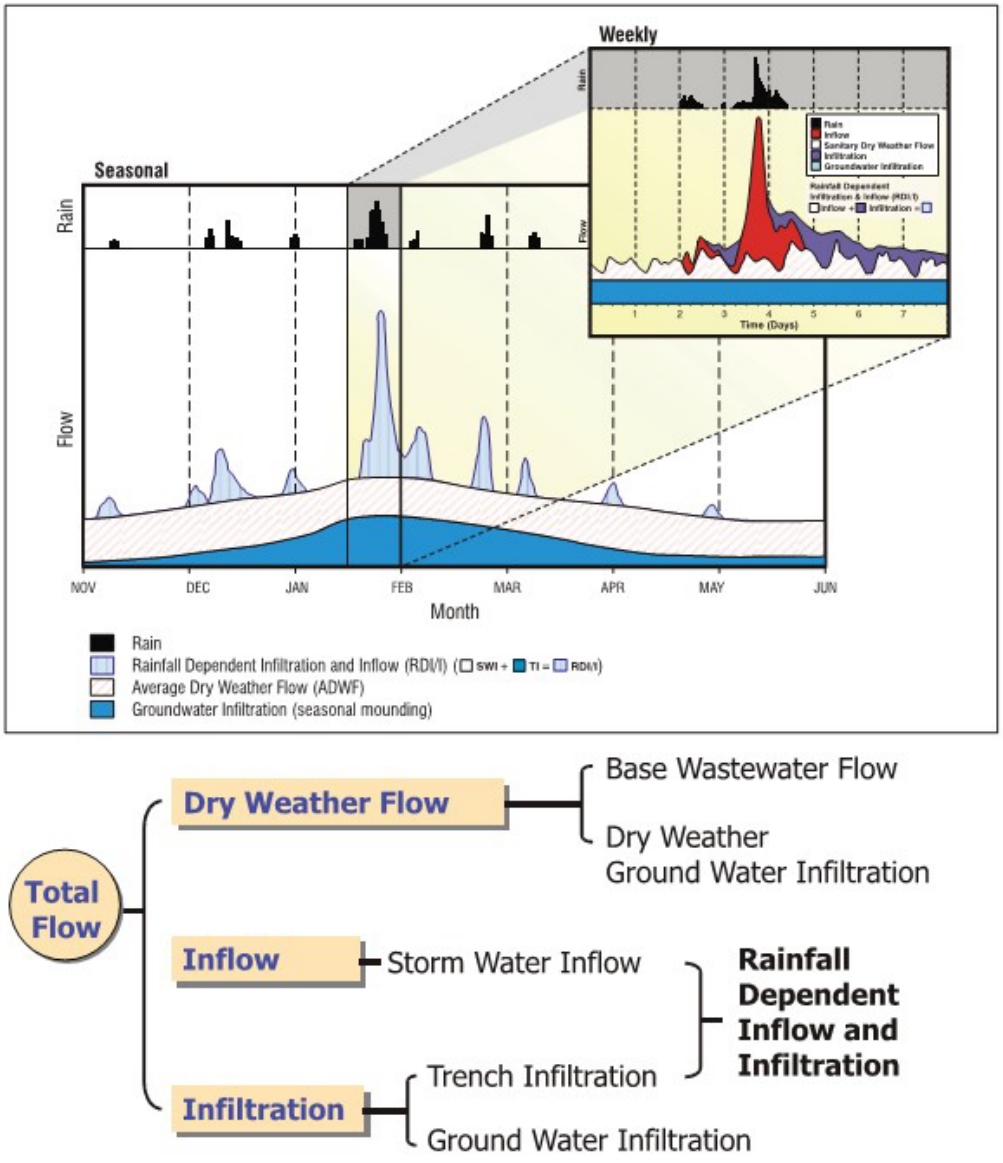

Figure ES.3 Typical Wastewater Flow Components

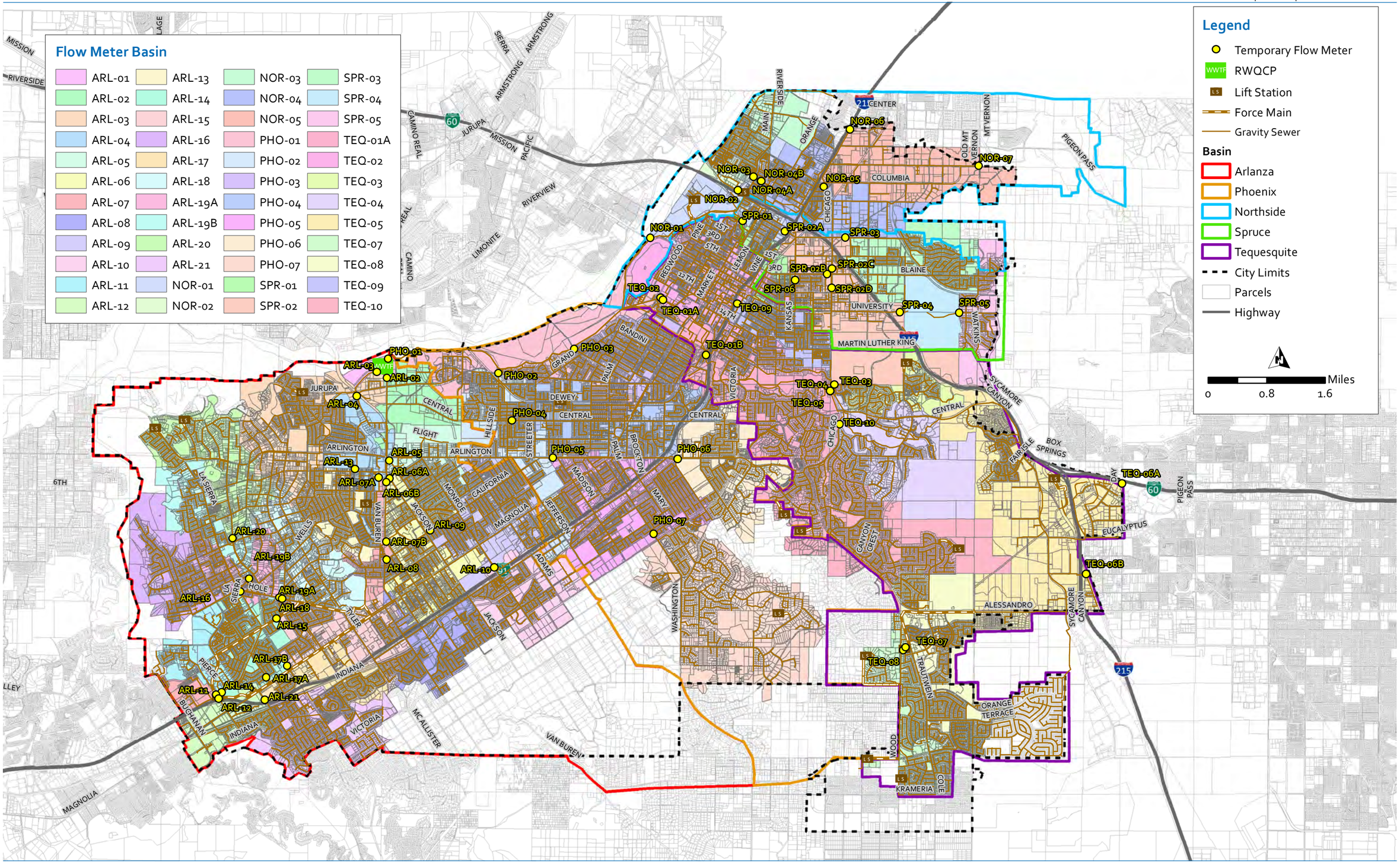

Figure ES.4 Temporary Flow Monitoring Location

While the effects of climate change are still a topic of debate, two main impacts are more intense storm events and more severe drought conditions. To assess the vulnerability of the collection system to storm events, six rain gauges were temporarily installed to capture rainfall that occurred through the study area. Rain gauges quantify rainfall during the flow monitoring program such that the additional contribution to the system due to Inflow and Infiltration (I/I) (see Figure ES.3) can be accounted for in the overall flow model. Table ES.11 summarizes their locations. Each component of the wastewater flow was quantified and used to calibrate the hydraulic model.

Table ES.11 Rain Gauge Locations

Rain Gauge (RG) ID	Location
RG North	13/14th Pump Station
RG NW	RWQCP
RG SW	Pierce Pump Station
RG Central	Garden Hills Pump Station
RG SE	Wood Pump Station
RG East	River Crest Pump Station

Overall, the results of the flow monitoring program show adequate conveyance capacity with small peaks of I/I (less than 1 mgd). This indicates that overall the collection system is relatively "tight" with respect to keeping external water sources out of the system. There are however, some areas with significantly higher peak I/I, meaning that these areas would be more vulnerable to the impacts of climate change. In these situations, rehabilitation and repair (R&R) projects would be required to prevent I/I and remove this vulnerability. A more detailed discussion of the results of the flow monitoring program can be found in Volume 3, Chapter 3.

ES.6.3 Collection System Facilities and Hydraulic Model

The City's existing collection system facilities and the hydraulic model development and calibration process are described in Volume 3, Chapter 4. The collection system has approximately 16,000 manholes, 20 lift stations, 10.4 miles of force mains, and approximately 800 miles of gravity sewer ranging from 4-inch to 51-inch pipes, and 412 miles of City-owned laterals. Almost 82 percent of the system consists of 8-inch diameter and smaller pipes and over 90 percent of the collection system is comprised of vitrified clay pipe. The firm capacity of the lift stations range in size from 80 gpm to the largest lift station by a wide margin, the Pierce Street Lift Station with 11,100 gpm of firm pumping capacity.

As part of this update of the Master Plan, six lift stations underwent a condition assessment. The selected lift stations were chosen because of their size or the criticality of importance due to risk or maintenance factors. The condition of these six lift stations was extrapolated to estimate the condition of the remaining stations, based on size and age, and this information was then used to estimate the CIP needs for all stations. More information about the condition of a selection of lift stations can be found in Volume 3, Chapter 8.

A hydraulic model of the wastewater collection system was developed and calibrated to model flows and loads throughout the collection system. An assessment of current and future conditions established hydraulic deficiencies in current and proposed developments. Information on the development and calibration of the hydraulic model can be found in Volume 3, Chapter 4.

ES.6.4 Planning Criteria and Design Flows

The planning criteria and methods used to identify deficiencies in the existing system and size future improvements and expansions are discussed in detail in Volume 3, Chapter 5. The collection system capacity, acceptable gravity sewer pipe slopes and maximum allowable depth of flow, design velocities, and changes in pipe size were all considered in the evaluation.

ES.6.5 Regulatory Review and SSMP Gap Analysis

The California State Water Resources Control Board (SWRCB) requires that all municipalities and districts with over one mile of sanitary sewer pipelines develop a Sewer System Management Plan (SSMP). The City has been proactive in its operation and management of its sanitary sewer system, and in 2007, undertook a SSMP including hydraulic modeling of its collection system and developed an R&R CIP. The City then updated its SSMP in 2016. Volume 3, Chapter 6 discusses a detailed review of the 2016 SSMP and section-by-section comparison between the existing document and City practices and what the City needs to do to become fully compliant with the WDR order.

Based on a review of the City's 2016 SSMP, the City has set the following fixed goals for meeting the minimum requirements of the Waste Discharge Requirements (WDR) order:

1. Minimize the frequency of Sanitary Sewer Overflows (SSOs).
2. Appropriately mitigate the impacts caused by SSOs.
3. Provide notifications and reports to all required regulatory agencies in a timely manner.
4. Effectively manage, operate, maintain, and improve the collection system.
5. Provide education and outreach to the general public to increase awareness of the sanitary sewer system, its function, and operation.

Based on an overall review of the City's SSMP and Sewer Master Plan, discussions with the Public Works Wastewater Division Collection Section, and a review of all other documents provided by the City, it is our conclusion that all of these goals are well underway and can be further enhanced with the following recommendations:

1. The City should add two more goals to cover the full spectrum of the WDR Order:
   a. The City sewer system operators, employees, contractors, responders, or other agents will be adequately trained and equipped to address an SSO event.
   b. The City is committed to a sewer system that is properly designed, constructed and funded to provide sufficient capacity to convey base flows and peak flows while meeting or exceeding applicable regulations, laws and generally acceptable practices relative to sanitary sewer system O&M.
2. The City should add additional ordinances that would strengthen its overall municipal code in WDR enforcement and compliance. These include adding sections addressing I/I, design issues and standards, and fats, oils, and grease (FOG).
3. In terms of overall O&M, the City needs to leverage its GIS technology more by the use of automated GIS Applications, both for field use and office use.
   a. The City should utilize a Predictive Maintenance Program including planned and scheduled inspection and rehabilitation of its sanitary sewer system. These would include "Hot Spots" identification in GIS and trend analysis utilizing the cleaning

schedule. The City has done a good job establishing a KPI for cleaning its sewer system. This information, however, is not readily accessible by field and office staff.

b. Use of a GIS Application that connects both the as-built plans and the closed caption Television (CCTV) video to each sewer line will streamline functionality for City staff. Additionally, this Application can also be utilized on a tablet by field staff to redline and relay field updates to City staff on a regular basis.

4. The City should develop and adopt a residential FOG program. Examples include developing a web page which describes oil and grease disposal best management practices (BMPs) for residential users. In addition to general public education, targeted public education should be conducted at select locations that have been identified by Sewer Maintenance crews as potential heavy FOG sources based on the problem pipes list (also known as "Hot Spots").
5. The City should migrate towards implementing a GIS-based Computerized Maintenance Management System (CMMS) for all its work orders, to efficiently and automatically track all personnel, equipment, and material.
6. The City should implement the CIP developed in Volume 8, Financial Plan and User Rates and Fees, of this update to the Master Plan within the recommended rehabilitation timeline.
7. The City should consider developing a program that focuses on collecting data from all relevant sources, which will provide the City with critical information associated with the performance of the City's sanitary sewer system and associated public-outreach programs. It is recommended that this system be integrated with GIS to help with trend analysis for "Hot Spots", FOG, and SSO mapping as well as CIP tracking. Furthermore, a system for communication and data submittals associated with SSOs and sewer backups reported to the online SSO database, should be developed. A matrix of Key Performance Indicator (KPIs) should be developed that would help the City develop its Measurement, Monitoring and Reporting Procedures (MMRP).
8. The City should develop an audit program that addresses the following:
   a. Document Control.
   b. Training.
   c. Targets and Objectives.
   d. Data Management.
   e. Documented Procedures.
   f. Outcomes.
9. The City should create a plan for and schedule the implementation of a comprehensive public communication and educational program.

A detailed discussion of the Gap analysis can be found in Volume 3, Chapter 6.

ES.6.6 Capacity Evaluation and Proposed Improvements

Volume 3, Chapter 7 discusses the hydraulic evaluation of the wastewater collection system, identifies existing and future capacity deficiencies, and describes recommended improvement projects that correct capacity deficiencies and serve future users. The capacity analysis entailed identifying areas in the sewer system where flow restrictions occur or where pipe capacity is insufficient to convey peak wet weather flow (PWWFs). Insufficient capacity in the pipeline causes a bottleneck which can potentially lead to SSOs.

In general, the City's collection system has sufficient capacity to convey current PWWFs without exceeding the established flow depth criteria. However, there were areas of the collection system that did not meet the allowable flow depth criteria.

Future system capacities were evaluated in a similar fashion to ensure the collection system was sized to convey future PWWFs, and to identify locations that are adequately sized to convey current PWWFs, but not future PWWFs. Additionally, new trunk sewers were added to the hydraulic model and sized to service major growth areas beyond the current City sewer service area. Based on the evaluation, there will be some areas of the existing collection system that cannot convey the build-out PWWF without flows exceeding capacity. For this evaluation, only flows from the City, Edgemont, and Highgrove are considered because the Jurupa and Rubidoux CSDs do not route their flows through the City's collection system. Wastewater flows from the City and the Edgemont CSD and Highgrove community are projected to increase by an additional 19.1 mgd above existing PWWF conditions. This increase in PWWF flows will not impact the hydraulic capacity of the RWQCP due to the impacts of recent water conservation efforts compared to the RWQCP design flow expectations. However, improvements to the City's collection system will be required to meet future PWWF demands from the City and the Edgemont CSD and Highgrove community. More detailed information on the necessary improvement projects is discussed in Volume 3, Chapter 7.

ES.6.7 Lift Station Condition Assessment

While the majority of the City's collection system flows by gravity, some areas of the collection system require lift stations to facilitate conveyance. Part of this update of the Master Plan effort was to evaluate the condition of 6 of the 20 lift stations in the wastewater collection system and then extrapolate the findings from these 6 stations to suggest recommendations for capital improvements including capacity, R&R, and O&M modifications for all 20 lift stations throughout the planning period to 2037. Figure ES.5 shows the locations of the surveyed stations and Volume 3, Chapter 8 discusses the process and findings in detail. The selected lift stations were chosen because of their large capacity and/or the criticality of importance due to risk or maintenance factors. Possible R&R requirements for the remaining 14 lift stations were extrapolated from the condition of the six that were visually assessed.

ES.6.8 Sewer Pipeline R&R Program

The City has developed a collection system CCTV inspection program that will inspect the entire 800 plus miles of the gravity main portion of the collection system, every 10 years. This CCTV inspection program and cycle was presented in the 2016 SSMP, which was approved by City Council. Volume 3, Chapter 9 summarizes the review and evaluation of the City's CCTV inspection database to develop a gravity sewer R&R program to include in the City's CIP. Volume 3, Chapter 9 also discusses the development of a preliminary force main inspection program. At the time of this evaluation, approximately 22 percent, or 43,000 linear feet, of the collection system had a recent CCTV inspection. Since the televised total length of pipe represents only a small sample of the overall collection system, the data was categorized and extrapolated to estimate the condition of the entire collections system in an effort to develop a budgetary estimate of the total R&R costs. As additional CCTV data becomes available, the budget estimate for R&R work in the gravity sewers can be adjusted.

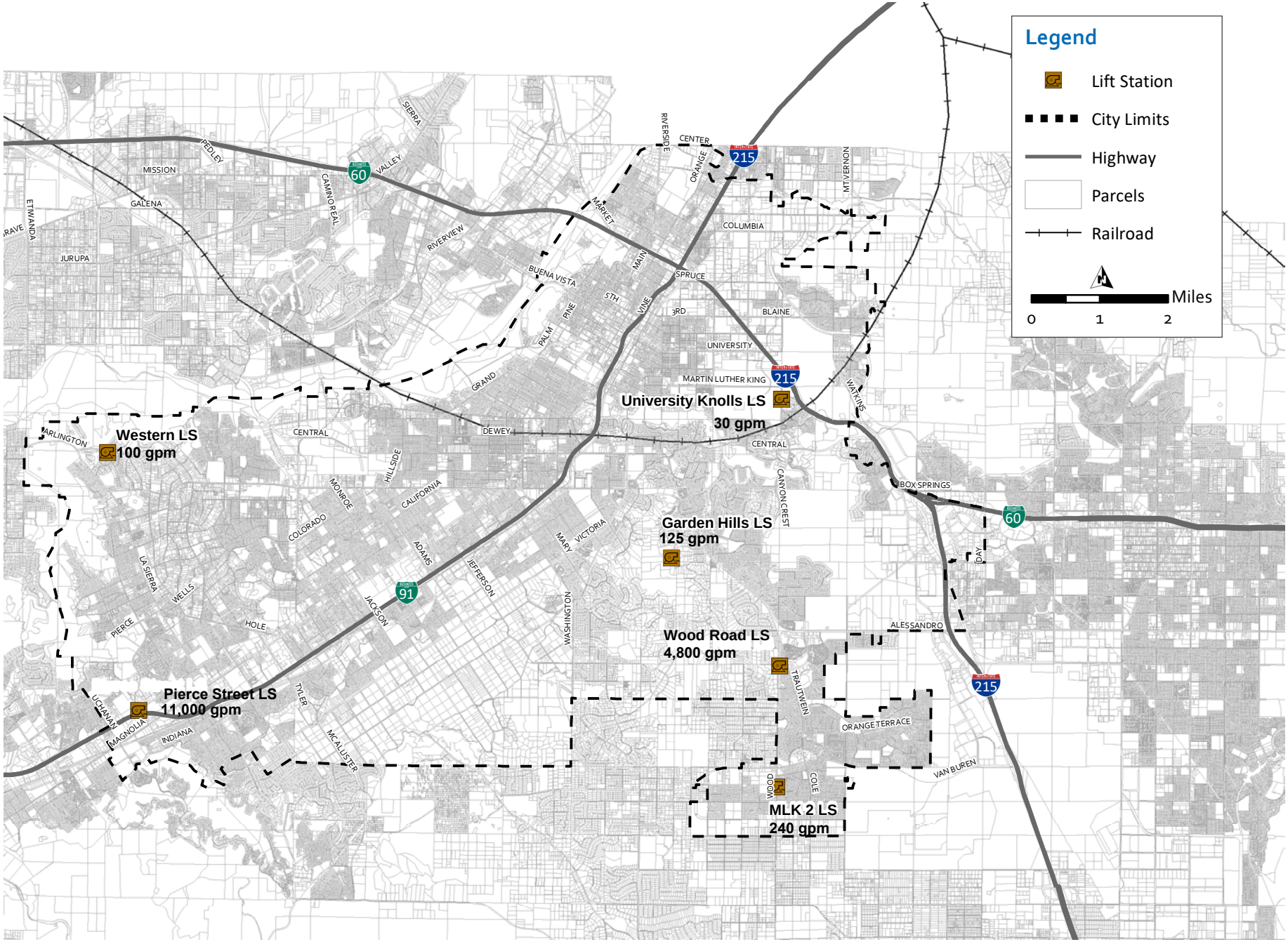

Figure ES.5 Map of the Lift Stations Included in the Condition Assessment Study

ES.6.9 Capital Improvement Program (Sewer Collection System)

The City's sewer collection system CIP is a compiled collection of all anticipated costs for the proposed capital improvement projects during the planning period through 2037. Volume 3, Chapter 10 summarizes the costs for projects identified throughout Volume 3 and in Volume 9, Chapter 2, using the cost estimating assumptions discussed in Volume 2, Chapter 4. In order to generate a preliminary CIP, some or all the following factors were considered when prioritizing the recommended improvement projects:

- Upgrading existing facilities to mitigate existing capacity deficiencies and the severity of the deficiency.
- Replacing existing trunk sewers and constructing new trunk sewers that are necessary to serve future users.
- Remaining useful life for lift station assets.
- Condition of existing gravity pipelines.
- Whether or not the project was required as part of regulatory and/or outside agreements.

The projects were grouped into the following three categories:

- Near-Team: Projects to be completed between years 2020 through 2027.
- Long-Term: Projects to be completed between years 2028 through 2037.
- Buildout: Projects to be completed from year 2038 and beyond.

Final project schedule recommendations were determined and discussed in Volume 8. The preliminary CIP is summarized by project type and phase in Table ES.12.

Table ES.12 CIP Cost Estimate by Project Type and Phase

Project Type	CIP Cost Estimate by Phase ($, Millions)			Planning Period ($, Millions)	Total ($, Millions)
	Near Term (2020-2027)	Long Term (2028-2037)	Build Out (2038 and beyond)		
Capacity Related Improvements	$34.0	$21.7	$0.0	$55.7	$55.7
Gravity Mains[8]	$30.4	$21.7	$0.0	$52.1	$52.1
Lift Stations[9]	$1.8	$0.0	$0.0	$1.8	$1.8
Force Main[10]	$1.8	$0.0	$0.0	$1.8	$1.8
New Service Related Improvements	$11.8	$30.6	$0.0	$42.4	$42.4
Gravity Mains[8]	$4.9	$27.1	$0.0	$32.0	$32.0
Lift Stations[9]	$2.6	$2.8	$0.0	$5.5	$5.5
Force Main[10]	$4.2	$0.7	$0.0	$4.9	$4.9
Rehabilitation and Replacement Projects	$106.2	$100.0	$82.1	$206.2	$288.3

Table ES.12 CIP Cost Estimate by Project Type and Phase (continued)

Project Type	CIP Cost Estimate by Phase ($, Millions)			Planning Period ($, Millions)	Total ($, Millions)
	Near Term (2020-2027)	Long Term (2028-2037)	Build Out (2038 and beyond)		
Gravity Mains[8]	$77.5	$84.0	$82.1	$161.5	$243.6
Lift Stations[9]	$15.4	$5.6	$0.0	$21.0	$21.0
Proximate Sewers Renewal Program[11]	$13.3	$10.5	$0.0	$23.7	$23.7
Inspection Programs	$17.8	$17.5	$0.0	$34.1	$34.1
Total	**$169.8**	**$169.8**	**$82.1**	**$339.5**	**$421.6**

Notes:
(1) The Notes 2 through 7 are general notes that apply to all the values in the Table.
(2) Costs listed are expressed in terms of total project cost as defined in Volume 2, Chapter 4.
(3) Numbers may vary slightly due to rounding.
(4) Engineering News Record (ENR) Construction Cost Index (CCI) of 11,555 (LA, February 2017).
(5) Estimated Construction Cost includes a 30-percent contingency, 10 percent for general conditions, 15 percent for general contractor, and 4.375 percent for sales tax of the baseline construction costs cost.
(6) Total project costs include a 30-percent markup of the estimated construction cost that accounts for engineering, management, and legal fees.
(7) Total Markup Coefficient is 223 percent of the baseline construction costs.
(8) For information regarding the projects associated with Gravity Mains, see Volume 3, Chapters 4, 7, and 9.
(9) For information regarding the projects associated with Lift Stations Mains, see Volume 3, Chapter 8.
(10) For information regarding the projects associated with Force Mains, see Volume 3, Chapters 4, 7, and 9.
(11) For information regarding the projects associated with Proximate Sewers Renewal Programs, see Volume 9, Chapter 2.

ES.6.10 Collection System Odor Control

In an effort to address concerns regarding odor complaints within the wastewater collection system, Volume 3, Chapter 11 discusses the investigative efforts and potential solutions for mitigation. As a result of this investigation, two programs were proposed: an Odor Response Program and an Odor Control Program. The Odor Response Program aims at understanding the nature of odor complaints received by the City and the potential associated causes. The Odor Control Program is intended to determine when a remedy is warranted and implement permanent solutions to problem areas based on the results of the Odor Response Program. More details are available in Volume 3, Chapter 11.

ES.7 Volume 4: Wastewater Treatment System

The purpose of Volume 4, Wastewater Treatment System, is to identify rehabilitation and replacement needs for the existing treatment systems at the RWQCP and to recommend projects that would meet the year 2037 flow and loading projections, while complying with upcoming regulations. The alternative analyses were based on the resulting treatment capacity need of 39.0 mgd and associated loads as shown in Table ES.8. Volume 4, Chapter 1, presents a summary of the attributes of the existing treatment facilities from the headworks through to the recycled water pump station and the Santa Ana River Outfall to meet a 25,000 acre feet per year (AFY) discharge commitment. Volume 4, Chapter 2 summarizes the planning studies that were completed for the RWQCP since the 2008 Master Plan, and Volume 4, Chapter 3 presents the process modeling and estimated capacity of the existing facilities to be used as a basis for the current master planning exercise.

The following summarizes the major recommendations for each treatment area and discussed in detail in Volume 4. All capital costs for improvements recommended in Volume 4 are incorporated into Volumes 7 and 8.

ES.7.1 Preliminary Treatment

Preliminary treatment consists of influent metering, screening, and grit removal. The Headworks building houses the screens, screenings washing and compacting, and grit removal equipment.

Influent metering is critical in understanding plant influent flow and loading, and process performance metrics. It is also the basis for billing the CSDs.

Plant influent flows by gravity through bar screens which are the first step in the treatment process. Bar screens remove debris based on the size of the screen opening (in this case 1/2-inch), including rocks, plastics, paper, rags and other material that makes its way into the sewer system. Material removed by the screens is washed to remove as much organic material as possible and then compacted to reduce the volume for landfill disposal.

The grit basins, located just downstream of the Headworks building, remove smaller suspended solids particles like grit and sand using a vortex action. Heavier particles are removed, washed and also sent to landfill for disposal.

Upgrades to the existing headworks and upstream flowmetering facilities were discussed in Volume 4, Chapter 4. The principle conclusions and recommendations are summarized below:

ES.7.1.1 Influent metering

Limitations associated with the current arrangement were evaluated in detail with the findings as presented below. Refer to Volume 4, Chapter 4, Appendix 4A for additional information.

- A single, centralized influent flowmeter (master meter) to measure the combined influent flow rate of all wastewater entering the plant was found to be infeasible due to hydraulic limitations at the headworks, which if corrected, would cost between $50 and $70 million.
- A single flowmetering structure for the A/A Trunk Sewer was also deemed infeasible due to operational constraints and negative hydraulic characteristics, such as reverse flow through the inverted siphon and backwater conditions at the headworks.
- The Santa Ana Trunk Sewer (Riverside/Hillside) flowmeter location proposed by URS Corporations (URS) was confirmed as feasible through hydraulic modeling.
- Assuming construction of the influent metering structures proposed by URS, the total estimated project cost is approximately $6.3 million. This cost was used in the CIP for the influent metering modifications and improvements.

ES.7.1.2 Headworks

The existing headworks facility has a capacity of 52 mgd on an average daily flow basis. This is sufficient for the estimated capacity of 39 mgd in 2037.

A headworks bypass channel tying the influent pipelines directly into the grit basin bypass channel is recommended.

ES.7.1.3 Headworks Screening

The Existing conveyance system in the screenings room should be replaced in kind. Climber-type and multi-rake-type bar screens are two alternatives for the bar screens. During preliminary

design, special consideration should be given to methods of overcoming capacity limitations of multi-rake bar screens. Bar screen spacing should not be less than 3/8-inch.

The Existing screenings washer/compactor should be replaced with a shaftless auger compactor with increased washing capabilities.

ES.7.1.4 Grit Removal

The Existing grit chambers have a treatment capacity of 60 mgd and should be rehabilitated in lieu of a costly upgrade. Grit washing technology should be selected during preliminary design.

ES.7.2 Primary Treatment

The objective of Primary Treatment is to remove the bulk of the settleable solids through gravity settling called clarification. Solids that are removed are pumped to anaerobic digesters for further treatment. The clarified primary effluent flows to the secondary treatment process.

Volume 4, Chapter 5 addresses primary treatment. Based on sludge production estimates through 2037, 300 gpm of reliable pumping capacity is required. Although the existing primary sludge pumps on the ACT treatment train (Plant 2) provide sufficient capacity, the pump stations themselves are highly congested and revised layouts should be considered to improve operation and maintenance conditions within the stations. Other primary treatment recommendations include:

- Provision of a scum recirculation/mixing system for the primary sludge/scum pump stations to mitigate clogging.
- Submersible chopper pumps for scum services. The recommended pump configuration for the ACT treatment train (Plant 2) scum pumps is one duty pump at each station and one uninstalled standby.
- Two 150-gpm rotary lobe pumps (one duty and one standby) for each ACT treatment train (Plant 2) primary sludge pump station.

ES.7.3 Secondary Treatment

Secondary treatment is typically a biological treatment step in which bacteria naturally present in the wastewater oxidizes the organic matter and ammonia. To provide optimal conditions for bacterial growth, oxygen from the air is added to the wastewater in large aeration basins using aeration blowers. Some organic nitrogen and phosphorous in the wastewater is consumed during this process by the growing bacteria. When the biological reaction is complete, solids are separated from the liquid. This is achieved either through settling in secondary clarifiers, as is the case for the ACT treatment train (Plant 2), or using membrane filters, as is the case for the MBR treatment train (Plant 1). Some settled solids is recirculated to the aeration basins to maintain the treatment process, and excess is pumped to the anaerobic digesters for stabilization.

Volume 4, Chapter 6 addresses secondary treatment. In order to meet treatment needs through 2037 with an incoming average daily wastewater flow of 39 mgd, additional capacity is required. This additional capacity will come in two parts: first, capacity of the MBR treatment train (Plant 1) will need to be increased to 32 mgd annual average daily flow (ADF), and an enhanced nutrient removal project will be required to remove additional nitrogen and phosphorus as required to meet the anticipated regulatory limitations of 3.0 milligrams per liter (mg/L) for Total Nitrogen (TN) and 1.0 mg/L for Total Phosphorus (TP) (as discussed in Volume 2, Chapter 2).

The Phase II expansion of the MBR treatment train (Plant 1) will increase the capacity by 6 mgd.

The chosen method for nitrogen and phosphorous removal in the MBR treatment train (Plant 1) to meet potential total nitrogen and total phosphorous discharge limits to the Santa Ana River is:

1. Modify existing aeration basin to provide an anaerobic zone for phosphorus removal.
2. Construct an additional aeration basin.
3. Add supplemental carbon to aid in denitrification.

The chosen method for nitrogen and phosphorous removal at the ACT treatment train (Plant 2) to meet the same discharge limits is:

1. Modify the existing aeration basins to provide an anaerobic zone for phosphorous removal.
2. Retrofit the existing tertiary filters to become a denitrifying filter.
3. Add a coagulant to precipitate excess phosphorous.
4. Add supplemental carbon to aid in denitrification.

ES.7.4 Tertiary Treatment

Tertiary treatment follows secondary treatment and is a polishing step focused on removal of remaining suspended solids. The ACT treatment train (Plant 2) uses two layers of granular media (anthracite over sand) to filter out suspended solids from the effluent stream. Solids that accumulated in the filter media are removed periodically by backwashing. Because the MBR treatment train (Plant 1) uses membrane filters as part of the secondary treatment process, that process produces an equivalent tertiary treatment effluent and no further filtration step is required for suspended solids removal.

Tertiary treatment is addressed in Volume 4, Chapter 7. Even with a future expansion of the MBR treatment train (Plant 1) to 32 mgd, flow above 32 mgd will need to be treated in the ACT treatment train (Plant 2), and tertiary treatment will be required. Tertiary treatment rehabilitation projects associated with the ACT treatment train (Plant 2) are recommended as a result of the condition assessment completed as part of this update to the Master Plan. The existing filters exhibit several unfavorable characteristics that should be addressed. Several tertiary treatment alternatives and the associated capital cost estimates are discussed in Volume 4, Chapter 7. However, final decisions regarding specific equipment selection and layouts will be determined during preliminary and final design. The following summarizes some key points regarding the tertiary treatment system:

- Existing filters are not user friendly and are expensive and difficult to operate.
- Five alternatives were presented to the City for consideration. However, two alternatives pertaining to tertiary membranes were eliminated due to cost. The remaining three alternatives were considered for detailed evaluation:
  - Replacement media filters In-Kind.
  - Retrofit with AquaDisk™ Cloth Disk Filters.
  - Install Package Cloth Disk Filters.
- Although the alternative to retrofit the existing tankage with cloth disk filter units resulted in the least expensive net present value, the difference in costs between that and the packaged cloth disk filter units was not significant enough to warrant the inherent risk associated with a retrofit project.
- Packaged cloth disk filters are recommended to be installed in phases, with Phase 1 installed by 2022 and a Phase 2 expansion installed beyond this planning period. During Phase 1 pre-design, further consideration should be given to the capacity phasing of the

Tertiary filters based on the plan for operation of the ACT treatment train (Plant 2) and the influent flows at the time.

ES.7.5 Advanced Water Treatment

Advanced water treatment (AWT) is a generic term that covers an additional treatment process step that is used to produce a higher quality water than can be achieved by tertiary treatment. The type of AWT process is largely dependent on the goals and objectives for higher effluent quality. For the RWQCP, an AWT system may be necessary in the future to reduce effluent salinity in order to meet effluent total dissolved solids (TDS) regulations, and would consist of a membrane technology like reverse osmosis (RO) to remove dissolved solids.

Volume 4, Chapter 8 evaluated Advanced Water Treatment (AWT) alternatives to reduce effluent salinity. Effluent TDS concentrations have varied between 500 and 650 mg/L since 1985, and have also shown seasonal variations. Various studies have been conducted for the City to estimate TDS projections. In the 2015 Salinity Study, source control of influent TDS was found to be the most feasible and cost-effective method for the City to achieve future reliable National Pollutant Discharge Elimination System (NPDES) effluent permit compliance. Accordingly, Public Works has committed to heavy collaboration with Public Utilities and the CSDs to monitor and mitigate source water TDS levels. Therefore, Volume 4, Chapter 8 primarily discusses the various end-of-pipe brine disposal technologies that may be considered in the future should an AWT project become necessary to meet NPDES permit requirements. For the purposes of this update of the Master Plan, RO was selected as the primary AWT technology. Other technologies for comparable results are available and should be evaluated during preliminary design. A summary of the main findings of Volume 4. Chapter 8 follow:

- The 2015 Salinity Study commissioned by the City indicated that the most effective method of TDS mitigation was source control. Therefore, the City intends to work with RPU and the CSDs to manage TDS in potable source waters below 400 mg/L and in influent wastewater streams to meet the effluent TDS discharge limit of 650 mg/L.
- The City has implemented pretreatment program ordinances to limit the wastewater TDS concentrations from each of the CSDs to the agreed permit levels.
- A comparison of technical alternatives for end-of-pipe treatment for removal of TDS was conducted to provide the City with an approach to treatment should potable water and wastewater source control strategies become unable to satisfy effluent requirements.
- If an end-of-pipe project were implemented, it was assumed that it would reduce effluent TDS by 50 mg/L. This target was selected to result in a project that was large enough to prevent back-to-back projects but small enough to be economically feasible.
- To meet TDS removal goals, RO was selected as the primary AWT technology. Other technologies for comparable results are available and should be evaluated during preliminary design.
- Both on-site and off-site RO treatment were considered. However, off-site RO treatment was eliminated early in the analysis due to the excessive project costs in comparison with on-site RO alternatives and other potential regulatory challenges.
- On-site RO treatment alternatives evaluated seven brine disposal alternatives. Alternatives featuring RO treatment and direct hauling of brine (Alternatives 1A and 1B) result in too many trucks per day to be feasible. RO treatment followed by brine concentration and varying brine disposal methods (Alternatives 2A, 2B, and 2C) are feasible and reasonably cost-effective. Piped disposal of RO brine without concentration (Alternative 3) would be cost prohibitive. RO treatment followed by brine softening

(Alternative 4) would result in both a solid and liquid waste stream for disposal increasing complexity and cost; the City did not consider this alternative further. Alternatives 2A, 2B, and 2C were evaluated for life-cycle costs. Alternative 2C, RO treatment followed by electro-dialysis reversal (EDR) brine concentration and piped disposal of brine, is the most expensive of the three alternatives, but eliminates concerns associated with truck hauling. For planning purposes, Alternative 2C is used in this update of the Master Plan.

- The City should conduct pilot testing of the Alternative 2C configuration to confirm performance of the treatment process prior to design.

ES.7.6 Disinfection

Before the treated wastewater can be safely discharged into the environment, it must be disinfected. There are very specific and highly regulated disinfection standards and different facilities use various methods to achieve disinfection. The RWQCP uses sodium hypochlorite (bleach) which is mixed in with the treated effluent and held for a specified time in a contact basin to achieve the desired disinfection. Dechlorination is the process of removing any excess chlorine from the system to protect downstream aquatic life. Following disinfection at the RWQCP, a small amount of sodium bisulfite is mixed in with the treated effluent to achieve dechlorination prior to discharge into the Santa Ana River.

Volume 4, Chapter 9 discusses the disinfection system. In order to demonstrate compliance with the DDW design and reliability requirements of Water Recycling Criteria of Title 22, Division 4 of the California Administrative Code, the RWQCP disinfection processes were reviewed. In addition, an on-site CT Study was commissioned by the City to evaluate the capacity of the existing chlorine contact basins (CCBs) and convert the disinfection process to a free chlorine residual system.

CCB 2 was increased in size during the MBR Phase I Plant Expansion. As part of the CT Study, a tracer study on CCB 2 was carried out. The tracer study recovered more than 98 percent of the tracer, indicating that CCB 2 has a high degree of plug flow characteristics. Some other conclusions from the study are summarized below:

- The chlorine demand of the MBR Plant effluent and the ACT tertiary filter effluent was about the same. In addition, free chlorine was able to meet the required bacterial and virus removal rates to satisfy the Title 22 regulations during bench testing.
- A full-scale on-site test at an average flow rate of 47 mgd showed that bacterial removal requirements could be comfortably achieved with a free chlorine residual.
- A draft updated Title 22 Report was submitted to the State. The state approved operating CCB 2 at a free chlorine CT of 30 mg-min/L and a modal contact time of 29 mins at 46 mgd, well within projected flows throughout the planning period, pending some on-site modifications to confirm the free chlorine CT and provide an automatic backup system. The City is working through the State requirements.
- Since the only modifications to the plant are relatively minor, no projects have been included in the CIP for disinfection improvements as part of the update of the Master Plan.

ES.7.7 Environmental Review

Volume 4, Chapter 10 deals with environmental review for all projects at the RWQCP. Collection system projects and the required environmental permitting needs will be assessed on a case-by-case basis at the time of design. This update to the Master Plan as well as previous iterations of this Master Plan (i.e., the 2008 and 2014 revisions) have recommended a breadth of projects and improvements to the RWQCP, most of which involve improvements to existing facilities. An

environmental review was conducted to estimate the impact of environmental permitting on the proposed CIP. Each project was evaluated by Environmental Science Associates to anticipate the level of environmental impact each proposed project may have. Table ES.13 provides a summary of the anticipated California Environmental Quality Act (CEQA) requirements along with comments for each project proposed in this update of the Master Plan. Additional permits would be required, such as air quality permits. However, CEQA permits are usually the most cumbersome and give a good idea of what to expect for other permit applications. A total of 19 projects at the RWQCP were evaluated.

Table ES.13 Anticipated CEQA Requirements

Project No.	Project Name	Anticipated Start of Construction (Year)	Anticipated CEQA Requirement[1]	Comments
FI-01	Influent Flowmetering Project	2020-2025	CE	The work involves installing flowmeters in existing on-site pipelines.
FI-02[2]	Headworks Rehabilitation	2020-2025	CE	The work is primarily replacing existing equipment and appurtenances within an existing process. There are no external impacts.
FI-03[2]	Headworks Screening Conveyor Replacement	2020-2025	CE	See FI-02
FI-04[2]	Headworks Bypass	2020-2025	CE	The work involves minor piping and conveyance upgrades.
FI-05	Headworks Grit Classifiers and Pumps	2030-2037	CE	See FI-02
FI-06	MBR treatment train (Plant 1) Phase II Expansion	2020-2025	Neg Dec	This work involves construction of two new MBR basins and an MBR screening facility
FI-07	MBR treatment train (Plant 1) Enhanced Nutrient Removal	2030-2037	CE or Neg Dec	See FI-02
FI-08	ACT treatment train (Plant 2) Rehabilitation	2020-2025	CE	See FI-02
FI-09	ACT treatment train (Plant 2) Mixers Rehabilitation	2030-2037	CE	See FI-02
FI-10	ACT treatment train (Plant 2) RAS/WAS Pump Station Rehabilitation	2020-2025	CE	See FI-02
FI-11	ACT treatment train (Plant 2) RAS/WAS Pumps Replacement	2025-2030	CE	See FI-02

Table ES.13 Anticipated CEQA Requirements (continued)

Project No.	Project Name	Anticipated Start of Construction (Year)	Anticipated CEQA Requirement(1)	Comments
FI-12	ACT treatment train (Plant 2) Enhanced Nutrient Removal	2030-2037	CE	Documentation will depend on what ENR process is selected for construction.
FI-13	Tertiary Filter Replacement and CCB Retrofits	2020-2025	CE	See FI-02
FI-14	CCB Rehabilitation	2025-2030	CE	See FI-02
FI-15	First Primary Sludge Pumping Rehabilitation Project	2025-2030	CE	See FI-02
FI-16	Second Primary Sludge Pumping Rehabilitation Project	2030-2037	CE	See FI-02
FI-17	WAS Thickening Project	2030-2037	CE	See FI-02
FI-18	AWT (Desalting) Project	2030-2037	EIR	This includes construction of a new, complete 3.36 mgd desalting process.
FI-19	Levee Rehabilitation Phase II	2030-2037	Neg Dec or EIR	This project will affect areas inhabited by threatened species.

Notes:
Abbreviations: RAS - return activated sludge; WAS - waste activated sludge.
(1) Anticipated CEQA Requirement:
- CE Exempt – Categorical Exemption (1530ID).
- Neg Dec – Prepare a negative declaration or mitigated negative declaration.
- EIR – Prepare an EIR or an amendment to the PEIR.

(2) Projects F1-02, F1-03, and F1-04 should be continued in one Categorical Exemption.

ES.7.8 Capital Project Studies

During this update to the Master Plan, project recommendations sparked feasibility studies requiring additional discussion. Three projects are discussed in Volume 4, Chapter 11, and address concerns regarding the structural integrity of Digester 5 for use in organic food waste diversion, biomethane utilization logistics, and Phase II of the Santa Ana River Levee project. More information about these three studies can be found in Volume 4, Chapter 11.

ES.8 Volume 5: Solids Treatment and Handling

Volume 5, Solids Treatment and Handling addresses expansion needs in the solids treatment and handling area and includes findings and recommendations from the 2017 RWQCP Biosolids Handling Assessment Study, the 2014 Capital Improvement Program and Rate Development Study, and the 2010 Riverside RWQCP Phase 1 Plant Expansion Technical Memorandums. The findings of these documents are presented in Volume 5.

The evaluation of existing facilities and projections for future solids treatment and handing facilities showed there is sufficient anaerobic digestion capacity and sufficient solids dewatering capacity to meet the 2037 projections. However, the solids thickening capacity would need enhancement. The following subsections summarize recommendations for solids production and thickening, as well as solids disposal.

ES.8.1 Solids Production and Thickening

Several processes in a wastewater treatment facility produce solids which needs to be stabilized before it can be dewatered and then disposed of in an environmentally sustainable manner. At the RWQCP, solids are stabilized to Class B solids in anaerobic digesters. After a minimum period of digestion (15 days at 95 degrees F) the digested sludge is removed and dewatered to reduce the amount of water that must be hauled with the solids for disposal. Both the existing digester capacity and dewatering capacity are adequate for future needs. Prior to entering anaerobic digesters, solids streams may need to be thickened to increase the solids content. The RWQCP uses dissolved air flotation thickeners (DAFTs) and rotary drum thickeners (RDTs) for this purpose. DAFTs use fine bubbles of air to float solids to the top of a tank where it thickens and is skimmed off. RDTs use centrifugal force to separate water from the solids. Recovered water is recycled to the Headworks for treatment.

Volume 5, Chapter 4 presents an evaluation of the solids production and thickening requirements to meet the 2037 projections. A summary of the key points of the analysis is given below:

- Based on the DAFTs design criteria, the DAFTs are currently operating near their rated capacity without redundancy.
- To provide redundancy for the WAS thickening process, it is recommended that mechanical thickening units be placed in the existing Dewatering Building and that the DAFTs be used as standby thickening units.
- RDTs and rotary screw thickeners (RSTs) are the preferred equipment to use as the basis for the update of the Master Plan CIP WAS thickening cost.
- Based on solids projections and design criteria for RDTs and RSTs, it is estimated that two units of either type of thickening equipment will be required. This new equipment needs to be installed by 2028 and sized to meet future capacity needs.

ES.8.2 Solids Disposal

Disposal of solids is becoming an increasingly regulated process. As mentioned above, the RWQCP currently produces what is called a "Class B" sludge, which is dewatered and hauled to Arizona for land application on alfalfa and cotton farms as a soil amendment.

Volume 5, Chapter 5 presents an evaluation of the City's solids disposal alternatives. Five alternative approaches were analyzed to either supplement or replace the current land application approach. A summary of the key findings is presented below:

- Based on the current and projected biosolids regulatory environment it is likely that at some point during the planning horizon to 2037, the City's current solids disposal method of land application in Arizona could be restricted or possibly terminated altogether. To address this problem the City should develop alternative biosolids disposal methods.

- All alternative disposal options would be more expensive than the current approach but would yield higher quality "Class A" biosolids that can benefit the local agricultural industry.
- City staff are interested in negotiating a Public/Private Partnership Agreement to expand the solids disposal portfolio with a regional partner.
- The future of biosolids disposal regulations is uncertain. The City should diversify the biosolids disposal portfolio to be in a good position to adapt and adhere to whatever future regulatory and/or biosolids market changes may occur. Furthermore, alternative approaches to land application are expected to be more expensive than current practices and may include additional processes. The City should begin to increase the budget for biosolids disposal to offset any sudden and unexpected changes.

ES.9 Volume 6: RWQCP Plant Condition Assessment

The purpose of Volume 6, RWQCP Plant Condition Assessment is to provide repair/replacement recommendations for the existing facilities in-kind. More specifically, the costs associated with the condition assessment assume that all rehabilitation efforts will revitalize the assessed areas to "like-new" condition at full capacity. A prioritized list of R&R projects was developed based on the condition assessment and analyses of each asset's condition, risk, vulnerability, remaining useful life, and associated costs. Where economically and operationally feasible, the findings and recommendations from the condition assessment were carried forward into the capital improvement projects throughout 2037.

The condition assessment was limited to a visual assessment of the following seven plant areas:

- Headworks.
- Primary sludge pumping.
- Aeration basins (ACT treatment train (Plant 2 only)), specifically focusing on the mixed liquor return pumps, baffles, membrane diffusers, and mixers.
- RAS and WAS pumping.
- WAS thickening.
- Tertiary filters.
- Chlorine contact basins.

The recommended R&R CIP for the seven assessed process areas for the update of the Master Plan is shown in Table ES.14 and includes all projects identified specifically by the condition assessment. This table represents the anticipated costs for the R&R of the assessed areas only and assumes projects would repair or replace in-kind to the full or greater capacity of existing conditions. However, not all the R&R recommended projects are economically or operationally feasible and are therefore not all are included in the final recommended CIP.

For example, Table ES.14 shows $20.9M in near-term expenses for the Tertiary Filters. This assumes all sixteen tertiary filters would be fully rehabilitated to like-new condition and placed in service at or near capacity. However, alternative tertiary treatment technologies were evaluated in Volume 4, Chapter 8 resulting in a substantially smaller project cost. Therefore, the developed CIP presented in Volume 7 does not carry the full $20.9M project forward.

Table ES.14 RWQCP CIP Summary[1][2][3]

Process Area	Near-Term Projects	Long-Term Projects	End of Life Assessment	Total
Headworks	$8,679,300	$103,300	$1,855,700	**$10,638,300**
Primary Sludge Pumping	$1,876,200	$749,500	$0	**$2,625,700**
Aeration Basins	$3,323,600	$60,400	$532,000	**$3,916,000**
RAW/WAS Pumping	$2,073,200	$198,600	$943,400	**$3,215,200**
WAS Thickening	$656,600	$285,800	$1,636,800	**$2,579,200**
Tertiary Filters	$20,919,600	$2,568,100	$7,389,700	**$30,877,400**
Chlorine Contact Basins	$223,200	$1,278,200	$1,005,300	**$2,506,700**
TOTAL	**$37,751,700**	**$5,243,900**	**$13,362,900**	**$56,358,500**

Notes:
(1) Detailed cost estimates included in Volume 6, Appendix 1B.
(2) Recommended timing based on engineering judgment of assessors.
(3) In total, the preliminary CIP for the next 20 years is $56.4 million. Roughly two-thirds of that is recommended in the first 10 years. One third of the total is based on the end of life asset assessments.

ES.10 Volume 7: Capital Improvement Program and Implementation

Volume 7, Capital Improvement Program and Implementation provides a summary of the capital improvement projects developed as a result of analyses presented in Volumes 1 through 6 and in Volume 9.

Volume 7 also details the project prioritization step completed for the initial project list. During this process, the schedule and costs for some projects in the initial project list were adjusted based on project triggers set by looking at three criteria:

1. Consideration of recommendations that were used to develop the initial project list.
2. Annual expenditures versus available funds.
3. The impact of the CIP on customer rates.

The Capital Improvement Program discussed in Volume 7 was developed in an iterative manner. Initially, a list of 18 RWQCP projects and scores of Collection System projects produced a projected total CIP expenditure of approximately $542 million. A preliminary rate impact analysis was performed that estimated a required annual user rate increase of 5 percent, which was deemed too severe and unrealistic. Therefore, a prioritization step was implemented to determine if the City could meet the same level of service without requiring a rate increase of 5 percent every year. Multiple scenarios were developed using one of four actions as follows:

- Changing the project implementation period.
- Removing one or more projects from the planning period.
- Changing the project elements to alter the project cost.
- Combinations of the above.

The prioritization step showed two things:

- The series of projects and CIP that would result following the MBR treatment train (Plant 1) Expansion would cost more than the series of projects and CIP resulting from implementing a larger Tertiary Filter Project.
- The more recycled water that RPU is willing to accept, the lower the CIP scenario costs become.

For planning purposes, the most conservative scenario was selected. This option gives the RWQCP the flexibility to function with minimal RPU commitment constraints or a change in the Santa Ana River discharge commitments. It also allows the City to continue the philosophy of maximizing the use of the MBR treatment train (Plant 1) to be better positioned to meet future regulatory requirements.

- Based on the prioritization process, the original RWQCP CIP was reduced by approximately $36 million. However, two additional projects were added to the RWQCP CIP totaling approximately $16 million. Furthermore, the Collection System CIP also underwent considerable changes as discussed in Volume 3, Chapter 10.
- The updated combined sewer CIP, including the selected RWQCP CIP implementation scenario (Scenario 4, Option 1) and Collection System projects, is approximately $500 million (an 8-percent reduction over the initial combined sewer CIP estimate). This CIP was used to estimate the impacts on user rates, discussed in detail in Volume 8.

Table ES.15 presents the final recommended RWQCP project CIP, totaling $160.7 million. Each project was assigned a project driver (either O&M, Condition, Capacity, Regulatory, or Site protection) which is shown in the table, and represents the major reason that the project has been included in the CIP.

Site Keys shown in Table ES.15 refer to Figure ES.6, which shows the approximate location of the main project areas at the RWQCP. Note that Figure ES.6 includes a category of projects called Renewable Resource Projects (Category 10). These projects are focused on beneficial use of the biomethane produced at the RWQCP through anaerobic digestion of biosolids, fats, oils and grease, and future food waste and organics trucked to the plant. These projects are not part of the update to the Master Plan, but are being undertaken at the RWQCP and are included in Figure ES.6 for completeness.

Table ES.15 RWQCP Project List with Scenario 4 Option 1 Implemented

Project No.	Site Key	Project Name	Project Driver	Project Cost
FI-01	-	Influent Flowmetering Project	O&M	$6,226,800
FI-02	1	Headworks Rehabilitation	Condition	$8,782,600
FI-03	1	Headworks Screening Conveyor Replacement	Condition	$933,700
FI-04	1	Headworks Bypass	O&M	$1,070,600
FI-05	1	Headworks Grit Classifiers and Pumps	Condition	$1,855,700
FI-06	2	MBR Phase II Expansion	O&M	$20,517,500
FI-07	2	MBR Enhanced Nutrient Removal	Regulatory	$24,207,600
FI-08	3	ACT Rehabilitation	Condition	$3,384,000
FI-09	3	ACT Mixers Rehabilitation	Condition	$532,000

Table ES.15 RWQCP Project List with Scenario 4 Option 1 Implemented (continued)

Project No.	Site Key	Project Name	Project Driver	Project Cost
FI-10	3	ACT RAS/WAS Pump Station Rehabilitation	Condition	$2,073,200
FI-11	3	ACT RAS/WAS Pumps Replacement	Condition	$1,142,000
FI-12	3	ACT Enhanced Nutrient Removal	Regulatory	$24,205,000
FI-13	5	Tertiary Filter Replacement and CCB Retrofits	Condition	$6,119,100
FI-14	6	CCB Rehabilitation	Condition	$1,005,300
FI-15	4	First Primary Sludge Pumping Rehabilitation	Condition	$1,876,200
FI-16	4	Second Primary Sludge Pumping Rehabilitation	Condition	$749,500
FI-17	8	WAS Thickening Project	Capacity	$8,028,800
FI-18	7	First AWT Project	Regulatory	$38,615,700
FI-19	9	Levee Rehabilitation Phase II	Site Protection	$9,364,800
		FACILITY CIP TOTAL		**$160,690,200**

ES.11 Volume 8: Financial Plan and User Rates and Fees

Volume 8, Financial Plan and User Rates and Fees presents the results of an assessment of the rates charged to individual users to determine if they are adequate to address current and future O&M and capital costs. The goal is to establish appropriate rates and fees for the 5-year forecast period from FY 2020/21 through 2024/25, during which the City will continue major improvements to the Riverside RWQCP and the collection system.

The City's last rate study resulted in the adoption of 5 years of annual rate increases for FY 2014/15 through FY 2018/19. Four of those five adopted increases were implemented as scheduled which allowed for the funding of Phase I Expansion Project at the RWQCP, and other plant and collection system R&R projects. The last increase, scheduled for July 1, 2018, was not implemented as City Council deemed the position of the wastewater fund to be adequate and opted to forgo the increase.

Volume 8 also includes an assessment of both the City's sewer user rates and capacity fees. The sewer user rates and sewer capacity fees are designed to distribute the cost of the operation and improvement of the RWQCP equitably among all users in accordance with California legal requirements as defined by Proposition 218 and California Government Code §66013, respectively.

The following were included in the financial plan and user rates and capacity charge study:

- The development of a capital funding strategy for the proposed FY 2020/21 through 2024/25 CIP.
- The 5-year revenue requirement forecast analysis.
- The development of a 5-year rate package.
- The update to the City's sewer capacity fee schedule.

Figure ES.6 RWQCP CIP Projects

ES.11.1 Key Findings and Recommendations

The key findings and recommendations of Volume 8 are as follows.

- *Proposed Rate Increases.* Annual user rate increases of 4.0 percent will be required in each year of the next 5 year cycle, FY 2020/2021 through FY 2022/2023, to fund the activities of the City's Wastewater Division.
- *Retain Existing Rate Structure:* Due to the close proximity of the results of an updated cost of service (COS) analysis to those of the City's previous rate planning effort, the rate structure will remain consistent. The proposed user rates retain the City's current rate structure and represent across-the-board rate increases for each year of the study period.
- *Recommended Update to Flow and Loading Assumptions.* Due to the age of the current flow and loading assumptions and because costs may change with the completion of the RWQCP upgrades and proposed sewer trunk and collection system work within the next decade, it is recommended that the City complete a flow and sampling study or incorporate the results of the ongoing multi-agency study to update the customer discharge assumptions prior to the next 5-year rate cycle.
- *Proposed Capacity Fees.* Capacity fees have been calculated to reflect the updated CIP, flow, and loadings projections. The calculated capacity fee is $4,648 per equivalent dwelling units (EDU). The proposed fee represents an increase of 12.2 percent over the existing fee of $4,143 per EDU. However, the City could opt to adopt a lower fee, or to phase-in the fee over time to avoid a large one-time increase. It is recommended that the City continues the current practice of adjusting the capacity fee each year based on the ENR CCI 20 City Average.

Additional and more detailed information about the financial plan and rate analysis conducted as part of this update to the Master Plan can be found in Volume 8.

ES.12 Volume 9: Additional Special Collection System Studies

The purpose of Volume 9 is to document additional collection system studies completed pursuant to the Agreement between California River Watch and the City. The River Watch Agreement is included in of Volume 9, Chapter 1, Appendix 1A. In this agreement, the City was tasked with the following:

- Investigate and repair the sewer collection system in close proximity to the water of the United States: Described in detail in Volume 9, Chapter 2.
- Update the SSO reporting and response protocol: Described in detail in Volume 9, Chapter 3.
- Conduct an audit of the RWQCP laboratory performance and procedures: Described in detail in Volume 9, Chapter 4.
- Produce an SSO Reporting and Outreach Program specifically targeting private lateral inspection and repair initiatives. This work is being completed by the City separately from the work contained within Volume 9.
- Prepare Standard Operating Procedures (SOP) for Chemical Root Control application methods: Described in detail in Volume 9, Chapter 5.
- Update the SSMP: Modifications to the City's existing SSMP specifically related to the River Watch Agreement are discussed in detail in Volume 9, Chapter 6.

The following sections provide a summary of each chapter presented in Volume 9.

ES.12.1 Sewers and Manholes in Close Proximity to Waters of the United States

Volume 9, Chapter 2 summarizes the inspection and evaluation of the City's existing collection system per the Agreement. Inspections were conducted via CCTV for sewer lines and manholes identified as being within 500 feet of waters of the United States. Each inspected manhole and pipeline was assigned a grade using the Pipeline Assessment Certification Program (PACP) program developed through National Association of Sewer Service Companies (NASSCO).

Of the 136 miles of pipe surveyed in proximity to waters of the US, most are in good condition, with only 13.6 miles having identified defects. Only 7.2 miles had significant structural defects, and 2.3 miles had operation and maintenance defects that need to be addressed. More than 2,750 manholes were evaluated. More than 70 percent of these are in good condition.

The evaluation results were characterized to build a Renewal Program for defective pipelines and manholes. For pipelines, categories included, replace in-kind, replace and upsize, line, and spot repairs. The 13.6 miles of pipe shown to have defects was divided into these categories. Manhole projects were categorized into either, line, repair, and coat. A total of 48 manholes were identified for such action. The CIP cost for the proposed repairs totaled $23.6 million, with the vast majority of that amount allocated to the gravity pipes. Details are presented in Volume 9, Chapter 2.

ES.12.2 SSO Reporting and Response

The California SWRCB requires that all municipalities and districts with over one mile of sanitary sewer pipelines develop an SSMP. One component of the SSMP is an Overflow Emergency Response Plan (OERP). Carollo Engineers, Inc. (Carollo) reviewed and revised the City's existing OERP to ensure compliance with the Statewide Waste Discharge Requirements (WDRs). Volume 9, Chapter 3 summarizes updates made to the City's Final OERP, as well Carollo's additional recommendations regarding the OERP.

ES.12.3 Laboratory Compliance Audit

Carollo contracted William Ray Consulting, LLC to perform an assessment of the RWQCP Laboratory analytical operating procedures and associated quality management system. The assessment included a documentation review as well as an onsite visit consisting of further document review, observation of staff performing analytical procedures, and observation of equipment operation.

The assessment found that the laboratory is well organized and conducts its activities efficiently and in accordance to its own operating procedures. Staff appear knowledgeable about procedures and quality system requirements. The assessor observed staff's response when a method failed its quality system criteria and was impressed with staff's professionalism. A full copy of the assessor report is included in Volume 9, Chapter 4, Appendix 4A.

In terms of potential improvements to the laboratory procedures and documentation, some minor clarifications were recommended to some documents, and some clarifications to procedures were also recommended.

Volume 9, Chapter 4 discusses the results of this audit in detail.

ES.12.4 Chemical Root Control SOP

Details regarding the implementation and SOPs for the application of chemicals to control root incursion into the pipelines is required. As roots invade pipelines and manholes, they cause cracks and fissures in the collection system leading to sanitary sewer contamination incidents. The use of chemicals to control root ingress is required to minimize damage. The purpose of this Volume 9, Chapter 5 is to summarize the development of the chemical root control SOPs that addresses the issue, but is also an environmentally acceptable approach. Four application methods were identified; each method has a designated SOP included in the Appendices of Volume 9, Chapter 5.

ES.12.5 Update to the SSMP

Updates or recommendations to the SSMP identified are discussed in detail in Volume 9, Chapter 6. The recommendations made in this Volume 9, Chapter 6 relate to areas needing update identified in the other chapters of Volume 9 and are intended to provide clarity and/or address potential gaps in the City's SSMP.