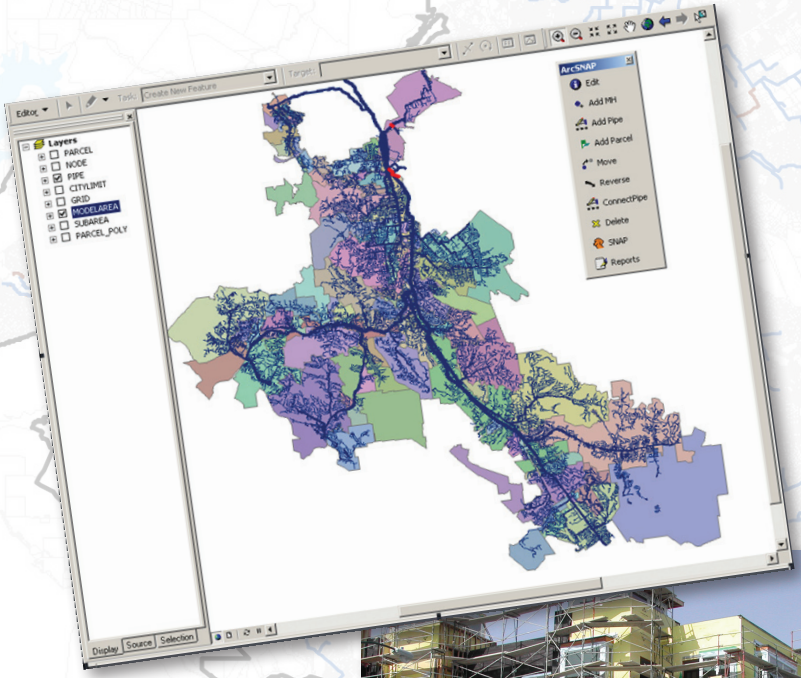
Central Contra Costa Sanitary District

FINAL REPORT

Collection System Master Plan Update



RMC *Innovative Solutions for Water and the Environment*

MAY 2010

RMC
Water and Environment

Irvine
Santa Monica
Sacramento
San Diego
San Francisco
San Jose
Walnut Creek

May 24, 2010

Central Contra Costa Sanitary District
5019 Imhoff Place
Martinez, CA 94553
Attention: Dr. Gail Chesler

Re: **Collection System Master Plan Update**

Dear Dr. Chesler:

On behalf of RMC Water and Environment, we are pleased to submit this final report for the 2010 Collection System Master Plan Update for the Central Contra Costa Sanitary District. The report presents the results of a comprehensive evaluation of the existing and projected future capacity requirements of the District's trunk sewer and interceptor system.

The capacity assessment was conducted using the District's ArcSNAP hydraulic model, based on detailed data contained within existing District mapping and customer databases and information developed through discussions with staff of the planning jurisdictions within the District's service area and the City of Concord and Town of Clayton. This report updates the previous Collection System Master Plan completed in 2000.

District staff played a significant role in this effort through review and update of model data, participation in discussions and providing guidance on decisions related to design flow and capacity criteria, and review and prioritization of recommended capacity improvement projects. We thank you for the opportunity to work with you and your staff on this important project, and look forward to continuing to assist the District in the future.

Sincerely,
RMC Water and Environment

Gisa M. Ju, P.E.
Project Manager/Principal-in-Charge

Joanne Siew
Project Planner

2001 North Main Street
Suite 400
Walnut Creek, CA 94596
ph: 925.627.4100
fax: 925.627.4101
www.rmcwater.com

Innovative Solutions for Water and the Environment

Central Contra Costa Sanitary District

Collection System Master Plan Update

Final Report

Prepared by:

RMC Water and Environment

In Association with:

Talavera & Richardson

May 2010

Table of Contents

Executive Summary ..... **i**
ES-1 Background and Master Plan Objectives i
ES-2 Land Use Planning iv
ES-3 Design Flows v
ES-4 Capacity Analysis vi
ES-5 Development of Capacity Improvement Projects vii
ES-6 Recommended Capital Improvement Plan vii

Chapter 1 Introduction **1-1**
1.1 Background and Master Plan Objectives 1-1
1.2 CCCSD Service Area and Collection System 1-1
1.3 ArcSNAP Model 1-4
1.4 Scope of Master Plan Update 1-4
1.5 Report Organization 1-5
Chapter 2 Land Use Planning **2-1**
2.1 Background 2-1
2.2 Jurisdictions within CCCSD Service Area 2-1
2.3 Planning Horizon 2-1
2.4 Methodology for Quantifying Existing Land Uses 2-1
2.5 Methodology for Updating Land Use Projections 2-3
2.6 Land Use Projections and Trends within CCCSD 2-4
2.7 Land Use Estimates for Concord and Clayton 2-7
2.8 Summary of Existing and Projected Land Uses 2-8
2.9 Incorporation of Future Land Use Information into ArcSNAP 2-9
Chapter 3 Design Flows **3-1**
3.1 Wastewater Flow Components 3-1
3.2 Flow Scenarios 3-2
3.3 Design Flow Criteria Update 3-2
3.4 ArcSNAP Model Flow Parameters 3-6
3.5 Wastewater Flow Estimates 3-9
Chapter 4 Capacity Analysis **4-1**
4.1 Modeled Sewer System 4-1
4.2 Model Scenarios 4-1
4.3 Model Scenarios 4-3
4.4 Capacity Deficiency Criteria 4-3
4.5 Capacity Analysis Results 4-3
4.6 Identification of Project Corridors 4-8
4.7 Hydraulic Gradeline Analysis 4-10
4.8 Impact of Concord Naval Weapons Station Reuse Project Flows 4-10
Chapter 5 Development of Capacity Improvement Projects **5-1**
5.1 Preliminary Solutions Model 5-1
5.2 Recommended Projects 5-3
Chapter 6 Recommended Capital Improvement Program **6-1**
6.1 Trunk and Interceptor Improvement Projects 6-1
6.2 Project Capital Costs 6-1
6.3 Project Prioritization 6-3
6.4 Project Validation Plans 6-5
6.5 Overall Recommendations 6-7
6.6 Conceptual Approach for Future Dynamic Modeling 6-8

List of Tables

Table ES - 1: Existing and Ultimate Land Uses in ArcSNAP iv
Table ES - 2: Average Base Wastewater Flow Unit Factors v
Table ES - 3: CCCSD Design Flows..... vi
Table ES - 4: Summary of ArcSNAP Capacity Deficiencies vii
Table ES - 5: Recommended Sewer Improvement Projects by Priority Group..... x

Table 2-2: Existing and Ultimate Land Uses in ArcSNAP 2-9
Table 2-3: Future Land Use Data Input Categories 2-11
Table 3-1: Average Base Wastewater Flow Unit Factors 3-7
Table 3-2: CCCSD Design Flows 3-10
Table 4-1: Hydraulic Criteria Used in Master Plan Update 4-1
Table 4-2: Summary of ArcSNAP Capacity Deficiencies.....4-8
Table 4-3: Project Corridors Identified for Hydraulic Gradeline (HGL) Analysis 4-10
Table 5-1: Identified Project Corridors and Preliminary Solutions.....5-3
Table 6-1: Cost Criteria.....6-3
Table 6-2: Recommended Sewer Improvement Projects by Priority Group 6-4

List of Figures

Figure ES - 1: Collection System Master Plan Study Area ii
Figure ES - 2: Modeled System iii
Figure ES - 3: Capacity Deficiency Corridors Identified for Projects.....viii
Figure ES - 4: Recommended Capacity Improvement Projects ix

Figure 1-1: Collection System Master Plan Study Area.....1-2
Figure 1-2: District's Collection System and Major Facilities 1-3
Figure 2-1: Location of Cities in the District's Service Area 2-3
Figure 3-1: Wastewater Flow Components.....3-1
Figure 3-2: Peak Design RDI/I Rate for 5-Year Event as Function of Sewer/Parcel Construction Year.....3-4
Figure 3-3: BWF Peaking Factor Curve.....3-8
Figure 4-1: Modeled System.....4-2
Figure 4-2: Capacity Deficiencies in 2010 Development, 5-Year Event 4-4
Figure 4-3: Capacity Deficiencies in 2040 Development, 5-Year Event 4-5
Figure 4-4: Capacity Deficiencies in 2010 Development, 20-Year Event 4-6
Figure 4-5: Capacity Deficiencies in 2040 Development, 20-Year Event 4-7
Figure 4-6: Location of Corridor Project Areas 4-9
Figure 4-7: Potential Load Points from CNWS Development 4-13
Figure 5-1: Capacity Deficiency Corridors Identified for Projects 5-2
Figure 5-2: Capacity Deficiencies and Improvements for Corridor A3-A Martinez – Alhambra Avenue.....5-6
Figure 5-3: Capacity Deficiencies and Improvements for Corridor C4-A Pleasant Hill – Pleasant Hill Road/Grayson Creek 5-7
Figure 5-4: Capacity Deficiencies and Improvements for Corridor C5-A Walnut Creek – Contra Costa Canal Trail 5-8
Figure 5-5: Capacity Deficiencies and Improvements for Corridor D2-A Orinda – Miner Road/Camino Pablo.....5-9

Figure 5-6: Capacity Deficiencies and Improvements for Corridor D3-A Lafayette – Happy Valley Road.....5-10
Figure 5-7: Capacity Deficiencies and Improvements for Corridor D4-A Walnut Creek – Walnut Boulevard.....5-11
Figure 5-8: Capacity Deficiencies and Improvements for Corridor D4-B Lafayette – Pleasant Hill Road.....5-12
Figure 5-9: Capacity Deficiencies and Improvements for Corridor E3-A Lafayette – Moraga Road.....5-13
Figure 5-10: Capacity Deficiencies and Improvements for Corridor E4-A Walnut Creek – Lancaster Road.....5-14
Figure 5-11: Capacity Deficiencies and Improvements for Corridor E5-A Walnut Creek – Palmer Road.....5-15
Figure 5-12: Capacity Deficiencies and Improvements for Corridor F3-A Orinda – Moraga Way5-16
Figure 5-13: Capacity Deficiencies and Improvements for Corridor F5-A Alamo – Stone Valley Road.....5-17
Figure 5-14: Capacity Deficiencies and Improvements for Corridor H6-A San Ramon Schedule C.....5-18
Figure 6-1: Recommended Capacity Improvement Projects 6-2

Appendices (bound separately)

Appendix A - TM: Land Use Planning
Appendix B - TM: Concord Naval Weapons Station Development Sensitivity Analysis
Appendix C - TM: Model Calibration and Design Flow Criteria Review
Appendix D - TM: Conceptual Approach for Dynamic Modeling
Appendix E - TM: Capacity Analysis and Preliminary Solutions Model
Appendix F - Project Cost Estimates
Appendix G - ArcSNAP Model Pipe Data and Results

Acknowledgements

Central Contra Costa Sanitary District Project Team

Gail Chesler, Project Manager
Ann Farrell, Director of Engineering
Curt Swanson, Environmental Services Division Manager
Tad Pilecki, Capital Projects Division Manager
Bill Brennan, Collection System Operations Department Manager
Jarred Miyamoto-Mills, Principal Engineer
Alex Rozul, Senior Engineer
Mark Wenslawski, Staff Engineer
Rita Cheng, Staff Engineer
Samantha Engelage, Staff Engineer

RMC Water and Environment Project Team

Gisa Ju, Project Manager/Principal-in-Charge
Joanne Siew, Project Planner
Paul Giguere
Cathy Greenman
Aaron Hope
Glenn Hermanson

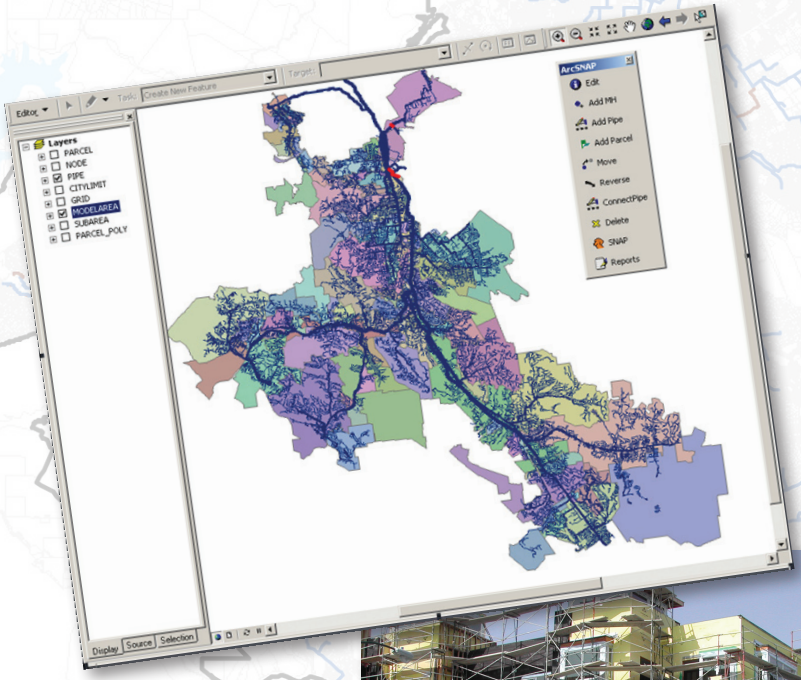
Subconsultants

Robert Talavera (Talavera & Richardson)
David Richardson (Talavera & Richardson)
Karen Johnson (Water Resources Planning)

List of Abbreviations

ABWF	Average Base Wastewater Flow
AF	RDI/I Attenuation Factor
ARDI/I	Attenuated RDI/I
BWF	Base Wastewater Flow
CCCSD	Central Contra Costa Sanitary District
CCWD	Contra Costa Water District
CIP	Capital Improvement Plan
CNWS	Concord Naval Weapons Station
d/D	Ratio of flow depth to pipe diameter
District	Central Contra Costa Sanitary District
DS	Downstream
DU	Dwelling Unit
EBMUD	East Bay Municipal Utility District
EIR	Environmental Impact Report
ENR-CCI	Engineering News Record Construction Cost Index
fps	feet per second
GIS	Geographic Information System
gpd	gallons per day
gpm	gallons per minute
GWI	Groundwater Infiltration
HCF	hundred cubic feet
HGL	hydraulic gradeline
HTE	CCCSD sewer service charge database
I/I	Infiltration/Inflow
mgd	million gallons per day
MH	Manhole
n	Manning's Friction Factor
PBWF	Peak Base Wastewater Flow
PDWF	Peak Dry Weather Flow
PF	Peaking Factor
PWWF	Peak Wet Weather Flow
RDI/I	Rainfall-Dependent Infiltration/Inflow
RMC	RMC Water and Environment
RMF	Residential Multi-Family
ROW	Right-of-way
RSF	Residential Single Family
SNAP	Sewer Network Analysis Program
TM	Technical Memorandum
T&R	Talavera & Richardson
US	Upstream
WSMP 2040	EBMUD Water Supply Management Program 2040
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY



Executive Summary

ES-1 Background and Master Plan Objectives

This Collection System Master Plan Update for Central Contra Costa Sanitary District (CCCSD or District) presents the findings of a comprehensive analysis of the capacity of the CCCSD wastewater collection system and recommendations for updates to the required collection system improvement projects in the District's Capital Improvement Plan (CIP).

The CCCSD wastewater collection system includes 1,500 miles of sewers, 18 pumping stations and associated force mains. The District provides wastewater collection, transport and treatment for the cities/towns of Danville, Lafayette, Moraga, Orinda, Pleasant Hill, and Walnut Creek; portions of the cities of Martinez and San Ramon; and unincorporated portions of Contra Costa County including the communities of Alamo and Pacheco. In addition, the District also provides wastewater treatment for the City of Concord and Town of Clayton under contract; these communities own and operate their own collection systems, which convey wastewater to the District's interceptor system and wastewater treatment plant (WWTP). **Figure ES-1** shows the District's boundary and the Study Area for this Master Plan Update. The Study Area is delineated by the District's sphere of influence and includes areas that the District may potentially serve in future.

The District completed a Collection System Master Plan in 1986, and conducted an update of the Plan in 2000. This report updates the District's 2000 Master Plan Update, to reflect the most current land use planning information for the service area, incorporate new flow monitoring data and revised flow criteria, and add sewer system improvements and expansions completed since the 2000 Update. This report also describes the update and use of the District's ArcSNAP collection system model to evaluate the District's system capacity needs and identify required capacity improvements to include in the CIP.

ArcSNAP is the latest version of the District's hydraulic model of its collection system. The program operates with a Geographic Information Systems (GIS) interface, and utilizes collection system information from the District's mapping system and customer billing data from the District's HTE sewer service charge database as inputs. **Figure ES-2** shows the modeled sewer system for this Master Plan Update, which consists of trunk sewers and interceptors defined as primarily 10-inch or larger pipes. Any 8-inch lines that effectively serve as trunk sewers (e.g. serve relatively large tributary areas or are located downstream of larger diameter pipes) are also included in the modeled system. It should be noted that the ArcSNAP model actually includes all sewers in the system, and flows are computed for each pipe; however, the capacity analysis presented in this report only addresses the larger trunk and interceptor network. The modeled system includes about 19 percent of the sewers in the overall collection system.

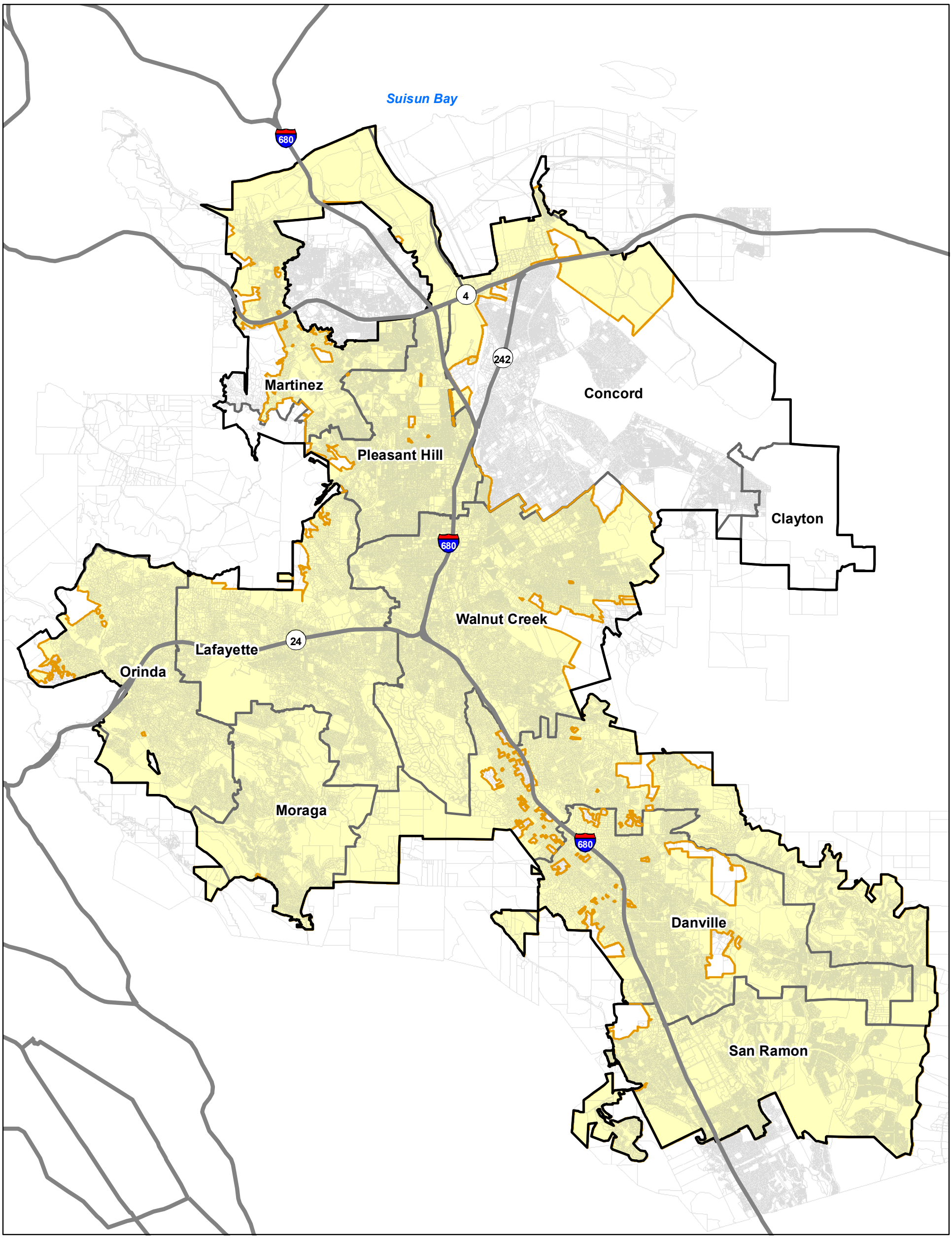


Figure ES-1: Collection System Master Plan Study Area

CCCSD Collection System Master Plan Update 2010

Legend

Service Area

- 2010 Study Area Boundary
- District Boundary
- City Sphere of Influence

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

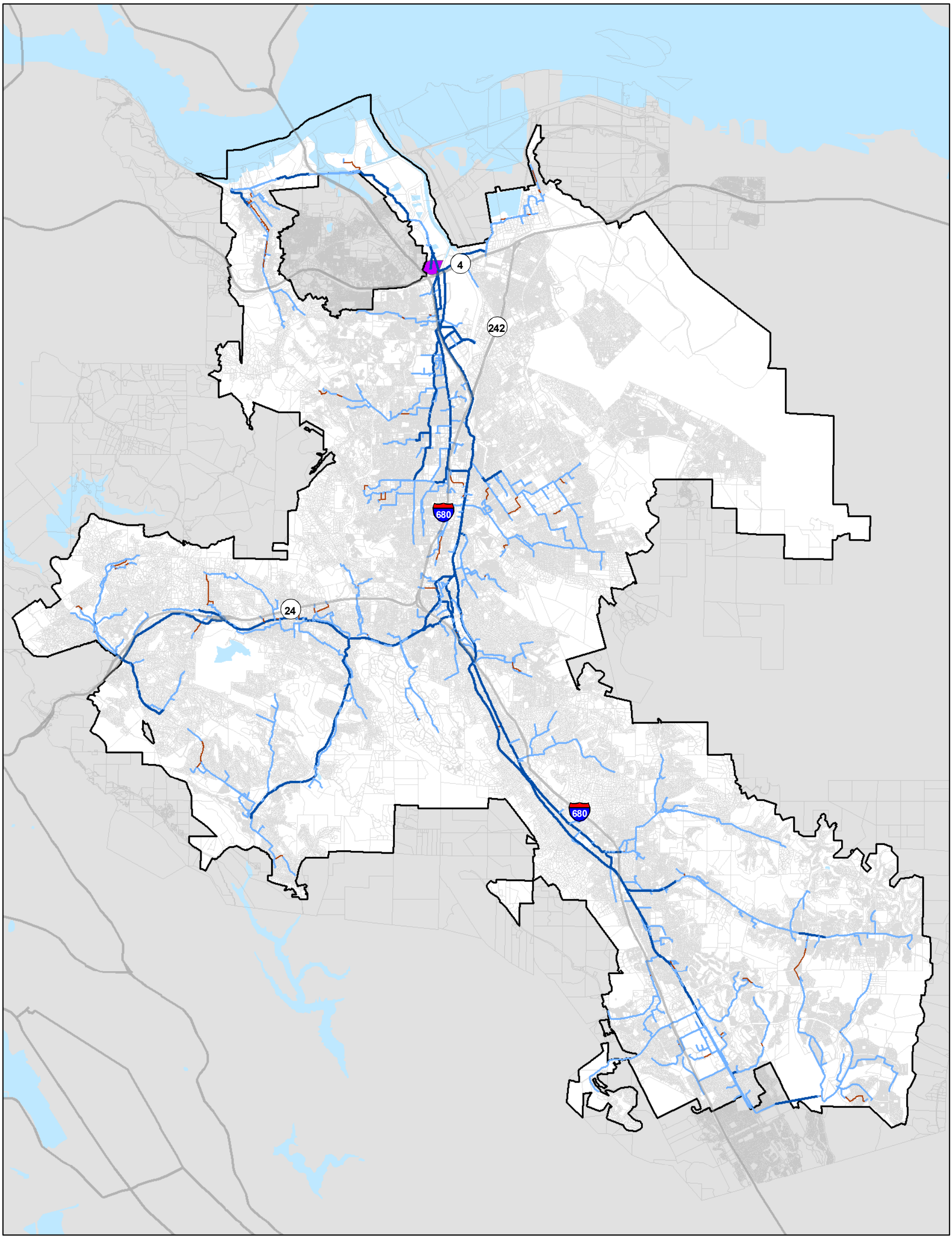


Figure ES-2: Modeled System

CCCSD Collection System Master Plan Update 2010

Legend

Modeled Pipe

- Smaller than 10"
- Trunk (10" - 24")
- Interceptor (>24")

- Study Area Boundary
- CCCSD WWTP

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

ES-2 Land Use Planning

The District's service area encompasses the various cities and towns noted previously, as well as unincorporated County areas, and the respective city and County planning agencies have jurisdiction over land use planning in the study area. The primary source of existing land use data in the ArcSNAP model is the District's HTE customer billing database, which provides information on existing parcel land uses in terms of the number of residential dwelling units and non-residential flows. A comprehensive review of General Plans, Specific Plans and other land use planning data was conducted to identify future land use changes for each jurisdiction, and meetings were held with staff from the planning departments to validate the future land use estimates. The land uses were quantified for existing (assumed to be year 2008 for this Master Plan Update) and Ultimate conditions (assumed to be year 2040). The year 2040 was selected as the planning horizon for this update because interviews conducted with the Planning agencies as part of this Master Plan Update indicated that major developments within the District's service area were anticipated to be constructed by 2040. It should be noted that the economic crisis has impacted the housing and commercial development markets significantly, and therefore, there is some uncertainty associated with the "Ultimate" year of 2040. This report is intended to be a working document to be refined and updated as additional and new land use data becomes available.

Table ES-1 presents a summary of existing (2008) and projected incremental future land uses in the District's service area based on the land use updates conducted in this Master Plan Update. A separate sensitivity analysis was conducted for the Concord Community Reuse Project (proposed for the decommissioned Concord Naval Weapons Station inland site) to evaluate the impact of future wastewater flows from that development on the District's collection system.

Table ES - 1: Existing and Ultimate Land Uses in ArcSNAP

Scenario	CCCSD Service Area	Concord and Clayton	Total
2008 Land Use (HTE data)			
Single Family (units)	84,527	30,762	115,289
Multi-Family (units)	45,842	18,835	64,677
Non-Residential Flow (gpd)	5,075,960	1,450,000	6,525,960
Sewered Area (acres)	33,441	9,781	43,222
Future (Incremental) Land Use (1),(2)			
Single Family (units)	26,541	782	27,323
Multi-Family (units)	18,583	3,866	22,449
Commercial (acres)	1,622	42	1,664
Industrial (acres)	191	0	191
Public (acres)	1,140	0	1,140
Office (1,000 square feet)	2,528	0	2,528
Sewered Area (acres)	11,785	0	11,785

Notes:
(1) Does not include future flows from the Concord Community Reuse Project.
(2) Future land use data includes new development as well as redevelopment of parcels that may have existing sewer connections in HTE. Therefore, the Future (Incremental) Land Use quantities in this table cannot be added to the 2008 Land Use (HTE data) to determine total ultimate land use quantities.

ES-3 Design Flows

Collection system design flow criteria were developed initially for the District's 1986 Collection System Master Plan and have been modified as part of subsequent planning efforts, including the most recent ArcSNAP calibration conducted in 2007. Design flow criteria are defined for each of the three components of wastewater flows: base wastewater flow (BWF), wet season groundwater infiltration (GWI), and rainfall-dependent infiltration/inflow (RDI/I).

Dry weather flows are based on the estimated average base wastewater flow (ABWF). BWF represents the sanitary and process flow contributions from residential, commercial, industrial and institutional users, as well as dry season GWI. BWF factors represent the unit contribution from different land use categories, including residential dwelling units and various types of non-residential uses. In the 1986 Master Plan and 2000 Update, the residential unit flow factors defined for the District's service area was 225 gallons per day (gpd) and 150 gpd for single-family and multiple-family residential units, respectively. As part of the design flow criteria update, these unit flow factors were revised by calibration to the 2005 flow monitoring data and to flows recorded at the District's WWTP at the end of the dry weather season. The unit flow rates are lower than those used in previous master plans, and presumably reflect the effects of indoor water conservation. BWF rates are assumed to remain the same in the future, and the same rates are used for future development. The unit flow factors used to estimate design BWF for the District's system in this Master Plan Update are shown in **Table ES-2.**

Table ES - 2: Average Base Wastewater Flow Unit Factors

Land Use Category	Units	BWF Unit Flow Factor (gpd/unit)
Residential Single Family (RSF)	Dwelling Unit	195
Residential Multi-Family (RMF)	Dwelling Unit	105
Commercial/Office(1)	Square Feet (building space)	0.1
Commercial/Office/Public(1)	Acres (lot size)	1,000
High Density Office(1)	Acres (lot size)	4,400
Industrial(1)	Acres (lot size)	1,000

Notes:
(1) Used only for future development or redevelopment (ABWF for existing non-residential development based on actual consumption in HTE database).

Wet weather flows include two components: GWI and RDI/I. GWI is defined as groundwater that infiltrates into sewer and manhole defects, particularly in winter and springtime in low-lying areas. GWI may increase significantly after prolonged periods of rainfall. RDI/I is stormwater infiltration and inflow that enter the system in direct response to rainfall events, either through direct connections or through defects in sewer pipes, manholes or service laterals. Several factors determine the magnitude of I/I flows in the collection system, including the type of soils, topography, the age/condition of sewers in each area of the system, and the design rainfall event.

Historically, RDI/I flows used for collection system planning for CCCSD have been based on analyses conducted for the 1986 Master Plan, which indicated that RDI/I rates are closely related to the age of the sewers in any particular area of the system. As part of the 2007 update and calibration of the ArcSNAP model, a new RDI/I rate curve was developed that predicts the RDI/I rate for each individual parcel in the District as a weighted function of the age of the parcel (or its service lateral) and the sewer to which it is connected. This Master Plan Update differs from previous ones in that it utilizes a generalized RDI/I rate curve rather than area-specific RDI/I rates.

The peak wet weather flow (PWWF) is defined with respect to a "design" wet weather event. The District has developed 5- and 20-year frequency design events based on continuous simulation analysis of historical rainfall to predict the occurrence of peak flows of different magnitudes at its wastewater treatment plant (WWTP). The 5-year design event is used to prioritize capacity deficiencies (i.e., "trigger" the need for capacity improvement projects), and the 20-year event is used as the basis for sizing sewer improvements and new sewer facilities. Ultimately, the District intends to provide system capacity throughout its service area to handle the peak flows from a 20-year design event.

The total flows to the District's WWTP based on the collection system design flows computed for this Master Plan Update are summarized in the **Table ES-3**.

Table ES - 3: CCCSD Design Flows

Flow Scenario	Predicted Flow (mgd)
Average Base Wastewater Flow	
2008 (Existing)	35.8(1)
2010 (Near-term)	37.2
2040 (Ultimate)	45.4
Peak Wet Weather Flow	
2008, 5-year Design Event	192
2010, 5-year Design Event	195
2010, 20-year Design Event	278
2040, 5-year Design Event	218
2040, 20-year Design Event	310

Note:
(1) Dry weather flow in 2009 was 32.5 mgd, which is typical of the lower flows that many agencies in the Bay Area have experienced in the past few years.

ES-4 Capacity Analysis

The capacity analysis was performed using the updated ArcSNAP model. The model was run for near-term (2010) and ultimate (2040) conditions for the two design events (5- and 20-year). For each pipe, the model calculates the flow for both peak dry and peak wet weather conditions, and selects the higher of the two values as the design flow.

In this Master Plan Update, capacity deficiencies in modeled sewers have been defined as sewers where the design peak flow is greater than 100 percent of full pipe capacity. Pipes with peak flows exceeding 130 percent of full pipe capacity were highlighted as having the most significant capacity deficiencies. Capacity deficiency results for the modeled scenarios are summarized in **Table ES-4**.

The model results for the 5-year design event were used to identify capacity deficiencies that need to be addressed in the District's Capital Improvement Budget and Plan. However, capacity improvements were sized to convey ultimate, 20-year design event peak flows. A separate sensitivity analysis was also conducted to assess the potential additional capacity improvement needs in the District's collection system as result of future flows from the Concord Community Reuse Project.

Table ES - 4: Summary of ArcSNAP Capacity Deficiencies

Flow Scenario	Deficiency Criteria(1)	Deficient Pipe in Modeled System	
		Length (feet)	Percent of Modeled System
2010 Development, 5-year Design Event	> 100% to ≤130% full pipe	46,304	3%
	>130% full pipe	27,703	2%
2040 Development, 5-year Design Event	> 100% to ≤130% full pipe	79,444	5%
	>130% full pipe	51,348	3%
2010 Development, 20-year Design Event	> 100% to ≤130% full pipe	108,896	7%
	>130% full pipe	109,722	7%
2040 Development, 20-year Design Event	> 100% to ≤130% full pipe	98,919	7%
	>130% full pipe	162,228	10%

Note:
(1) Based on design flow, which is maximum of peak dry weather flow (PDWF) and design event peak wet weather flow (PWWF).

ES-5 Development of Capacity Improvement Projects

The capacity deficiencies were grouped into corridors and evaluated based on the degree of capacity deficiency under the modeled scenarios. The corridors with a significant length of deficient pipe under the 2010 and/or the 2040 development, 5-year events, were considered for the development of capacity improvement projects. **Figure ES-3** shows the predicted capacity deficiencies under the 2040, 5-year event scenario and the deficiency corridors identified for development of capacity improvement projects.

A preliminary solutions model consisting of potential improvements (e.g. relief or replacement sewers) to meet the District's collection system needs through the year 2040 was developed. The solutions model assumes that pipes in the modeled system that are deficient (i.e. more than 100 percent full) during the 5-year events for the 2010 and/or 2040 level of development would need to be improved. The capacity improvements were developed assuming pipe replacement (upsizing) unless an alternate solution (e.g., new sewer alignment) was previously identified in the 2000 Master Plan Update. Improvements in the preliminary solutions model were developed based on the District's standard design criteria.

ES-6 Recommended Capital Improvement Plan

The recommended CIP includes improvements to correct identified capacity deficiencies in the District's trunk and interceptor system, including estimated capital costs and proposed prioritization and phasing of the recommended projects. The locations of the recommended projects are shown in **Figure ES-4** and individually in Figures 5-2 to 5-14 in Chapter 5 of this report. Each recommended project is identified by a Project ID designated by the location of the project.

To develop the appropriate project phasing for the CIP, the recommended sewer improvement projects were divided into four Priority Groups. The priorities reflect the relative need for the projects in terms of the severity of existing or projected capacity deficiencies. The projects were categorized into the respective Priority Groups based on the extent of the capacity deficiencies, that is, the length of pipe in the project corridor that was deficient and relative severity (length of pipe where flow would exceed 130 percent of full pipe capacity), primarily under the 5-year triggering event under 2010 (Priority Group 1) or 2040 development.

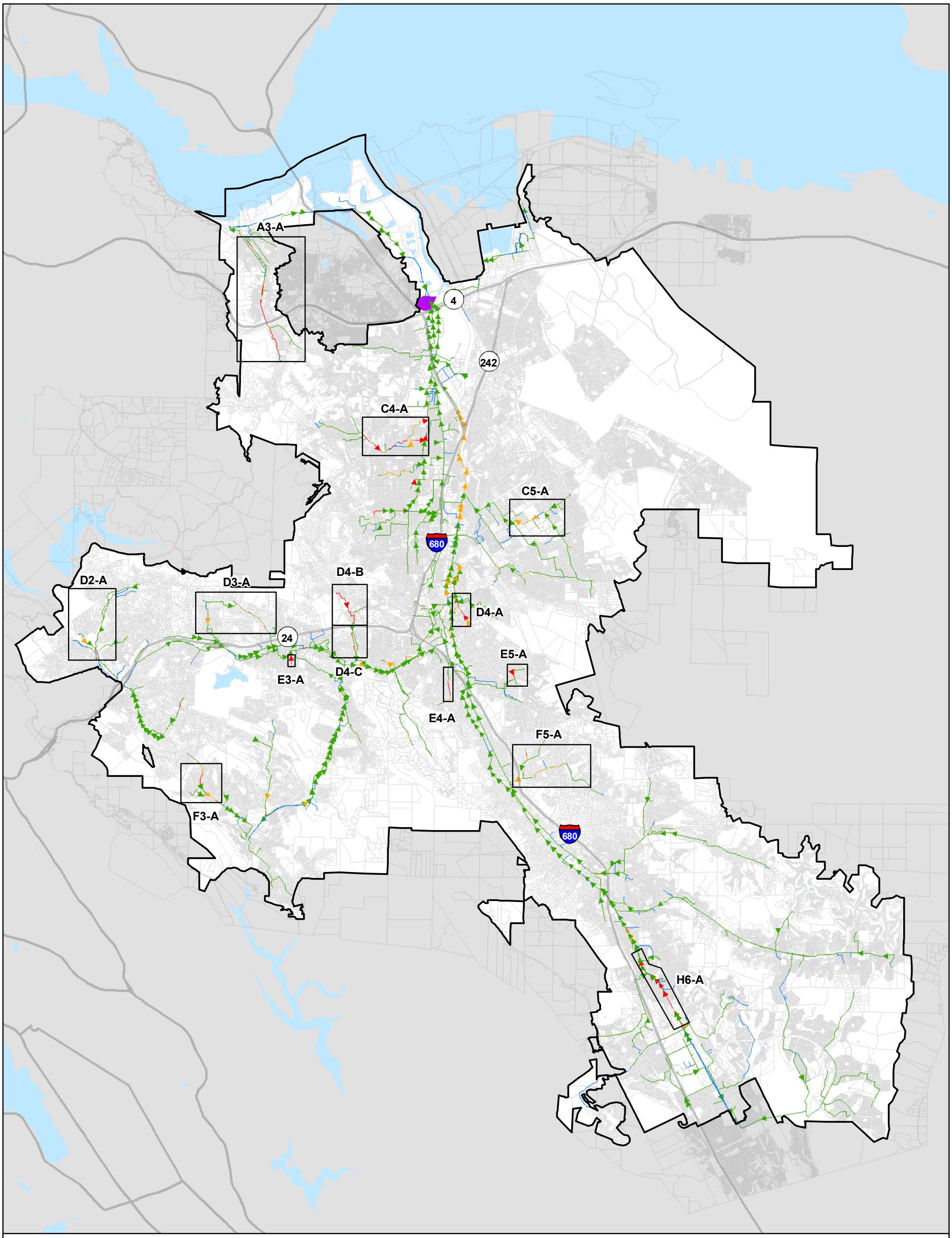


Figure ES-3: Capacity Deficiency Corridors Identified for Projects

CCCSD Collection System Master Plan Update 2010

Legend

Percent Full Pipe Capacity

2040 Development, 5-Year Event

- No Slope or Invert
- <= 100%
- >100% to <=130%
- >130%

- Project Corridor
- Study Area Boundary
- CCCSD WWTP

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

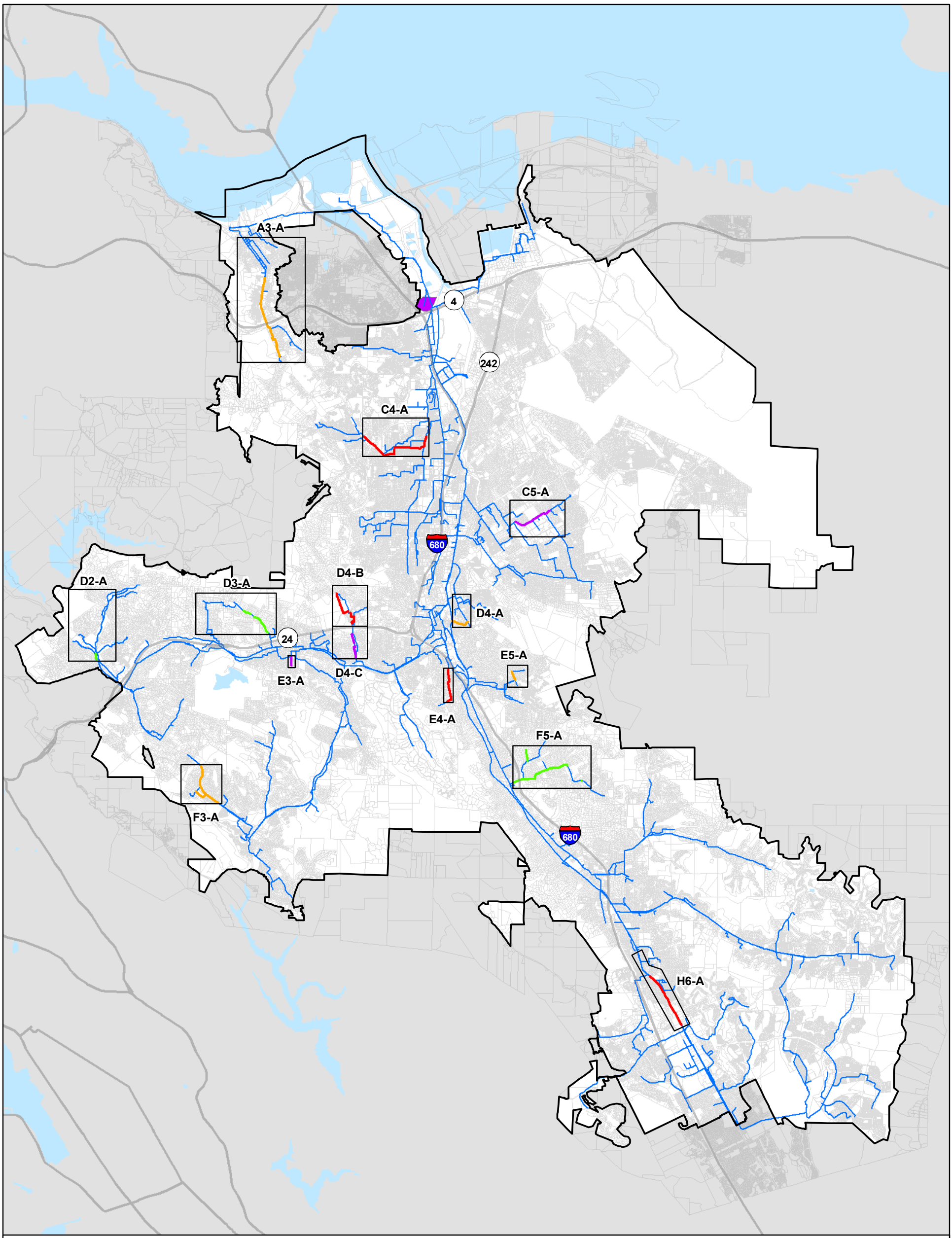


Figure ES-4: Recommended Capacity Improvement Projects

Legend

CCCSD Collection System Master Plan Update 2010

Project Priority

- Priority 1
- Priority 2
- Priority 3
- Priority 4

- Project Corridor
- Study Area Boundary
- CCCSD WWTP

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

Table ES-5 presents the required pipe length and diameters of the recommended projects, and the estimated total project cost.

Table ES - 5: Recommended Sewer Improvement Projects by Priority Group

Project ID	Project Name	New Pipe Length[1] (feet)	New Pipe Diameter[1] (inches)	Estimated Total Project Cost[2] ($'000)
Priority Group 1 Projects				
C4-A	Pleasant Hill - Pleasant Hill Rd/Grayson Creek	9,552	18 - 24	4,155
D4-B	Lafayette - Pleasant Hill Road (Phase I – north of Hwy 24)	4,829	15 - 18	1,676
E4-A	Walnut Creek – Lancaster Road	4,067	15 - 18	1,424
H6-A	San Ramon – San Ramon Schedule C	6,628	36	3,300
	Priority Group 1 Subtotal	**25,076**		**10,555**
Priority Group 2 Projects				
A3-A	Martinez - Alhambra Ave	9,976	18 - 24	3,964
D4-A	Walnut Creek - Walnut Blvd.	2,005	18	1,901
E5-A	Walnut Creek – Palmer Road	1,026	15	350
F3-A	Orinda – Moraga Way	6,702	12 - 15	2,592
	Priority Group 2 Subtotal	**19,709**		**8,807**
Priority Group 3 Projects				
D2-A	Orinda - Miner Road/Camino Pablo	826	15	282
D3-A	Lafayette - Happy Valley Road	3,172	15 - 18	1,118
F5-A	Alamo – Stone Valley Road	8,430	15 - 27	3,483
	Priority Group 3 Subtotal	**12,428**		**4,883**
Priority Group 4 Projects				
C5-A	Walnut Creek - Contra Costa Canal Trail	4,539	24	1,820
D4-C	Lafayette – Pleasant Hill Road (Phase II – south of Hwy 24)	3,159	21	1,175
E3-A	Lafayette – Moraga Road	982	15	335
	Priority Group 4 Subtotal	**8,680**		**3,330**
			TOTAL	**27,575**

Notes:
(1) District will refine project alignments and pipe sizes during project implementation.
(2) Engineering New Record Construction Cost Index (ENR-CCI) 9781. San Francisco Bay Area, September 2009.

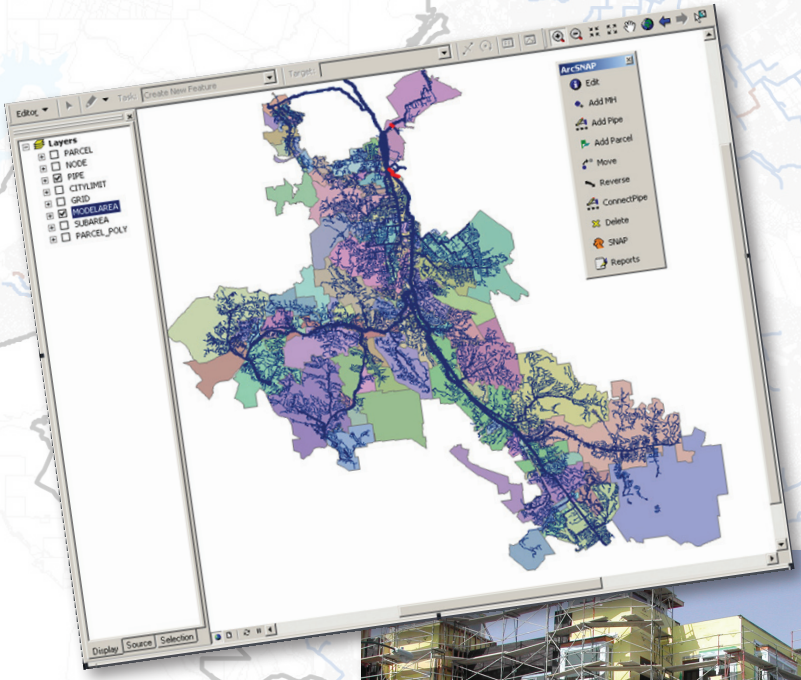
The recommended projects identified in this Master Plan Update represent a preliminary development and prioritization of capacity improvement projects. Further project validation, including field verification, flow monitoring, confirmation of model data and additional hydraulic modeling should be conducted to confirm the need for, timing of, and/or sizing of specific projects. These activities can also provide additional useful information for incorporation into future Master Plan Updates and capital improvement plans.

The District should begin implementation of the CIP recommended in this Master Plan Update starting with the highest priority projects. The following are suggested guidelines that should be considered in project scheduling and design, and in future updates of the Master Plan.

- Perform flow monitoring to verify modeled flows and capacity deficiencies for specific project areas, particularly for projects in Priority Groups 1 and 2. Prior to the District's next update of the Master Plan, a more extensive flow monitoring program should be performed focused on verifying the accuracy of model results in key trunk and interceptor facilities.
- Conduct additional review of hydraulic modeling results for the 2010 development, 20-year event to confirm the order of projects in Priority Groups 2, 3 and 4.
- Review and analyze isolated capacity deficiencies not included in defined project corridors as part of project validation.
- Consider installing surcharge meters to confirm if any project reaches are likely exceeding full pipe capacity during large storm events.
- In cases where peak wet weather flow is driving the need for the project (as is the case for all but one of the identified projects), review available information on the nature of the I/I response and likely sources of I/I, and consider performing source detection activities such as smoke testing and manhole and pipe inspections to identify I/I sources that may be cost-effective to correct.
- Review and verify the slope and invert data for existing sewers in the project areas, including verifying any critical flow diversions. Perform field inspections and surveying as needed.
- Review the basis for future flow projections in the model for the areas upstream of CIP projects, with particular attention to any proposed new developments or redevelopment projects for which plans (timing, density, or type of development) may change or any new ones that may not have been identified in this Master Plan Update.
- Obtain and review available information on the condition of the sewers in the project areas, and consider any plans and/or need for rehabilitation or replacement of the sewers.
- Coordinate with other City, County, or utility agencies to identify opportunities for combining or co-locating projects (e.g. major construction projects or before street repaving) to minimize construction impacts within neighborhoods.
- Conduct appropriate alignments studies, topographic surveys, geotechnical investigations, utility research, and constructability reviews to determine the most viable and cost-effective solutions to identified capacity deficiencies for each project area.
- Keep the ArcSNAP model database up-to-date by periodic downloads from GIS and HTE, including making necessary updates to the land use override tables to reflect parcel subdivisions, completed developments, or changes in development plans.
- Continue to improve the ArcSNAP database by incorporating and validating additional slope and invert data.

- Ensure that trained staff are available to maintain and effectively use the ArcSNAP model to meet the District's needs for sewer planning and design.
- Consider developing a new dynamic hydraulic model to supplement ArcSNAP and provide more accurate information for planning and design of key system facilities.

CHAPTER ONE
Introduction



Chapter 1 Introduction

This report presents the results and recommendations of the 2010 Collection System Master Plan Update for the Central Contra Costa Sanitary District (CCCSD or District). The report was prepared by RMC Water and Environment (RMC). This introductory chapter provides background information on the scope and objectives of the Master Plan Update, the District's sewer system and service area, and the contents and organization of this study report.

1.1 Background and Master Plan Objectives

In September 2007, the District retained RMC, in association with Talavera & Richardson (T&R), to prepare an update of the Master Plan for its wastewater collection system. The Master Plan was last updated in 2000, and prior to that time, had not been updated since 1986. As part of the 1986 Master Plan, the District developed a computerized hydraulic model of the trunk sewer system, called the Sewer Network Analysis Program or SNAP. Over the past 20+ years, the District has used the model for collection system planning and design. Since the 2000 Master Plan Update, the District has conducted additional flow monitoring in the collection system and implemented improvements to the SNAP model (now called ArcSNAP).

The primary objectives of this Master Plan Update are to update the ArcSNAP model with the latest land use projections for the jurisdictions within the District's service area and use the model to identify required capacity improvements to include in its Capital Improvement Plan (CIP).

1.2 CCCSD Service Area and Collection System

CCCSD covers approximately 150 square miles (not including the City of Concord and Town of Clayton) and serves a population of about 310,000 in central Contra Costa County. The District includes the cities/towns of Danville, Lafayette, Moraga, Orinda, Pleasant Hill, and Walnut Creek; portions of the cities of Martinez and San Ramon (the other portions of those cities are served by the Mountain View Sanitary District and Dublin San Ramon Services District, respectively); and unincorporated portions of Contra Costa County including the communities of Alamo and Pacheco. The District also serves approximately 135,000 residents in the City of Concord and Town of Clayton under contract; those communities own and operate their own collection systems, which convey wastewater to CCCSD's interceptor system and wastewater treatment plant (WWTP). **Figure 1-1** shows the District's Sphere of Influence, which comprises the Study Area for this Master Plan Update.

The CCCSD wastewater collection system includes 1,500 miles of 4- through 102-inch diameter sewers and an estimated 130,000 private service laterals. The system also includes 18 sewage pumping stations and associated force mains. The system conveys wastewater generated in the service area to the District's WWTP, located near the junction of Interstate 680 and Highway 4, where it is treated and discharged to Suisun Bay. **Figure 1-2** shows the District's collection system and major facilities.

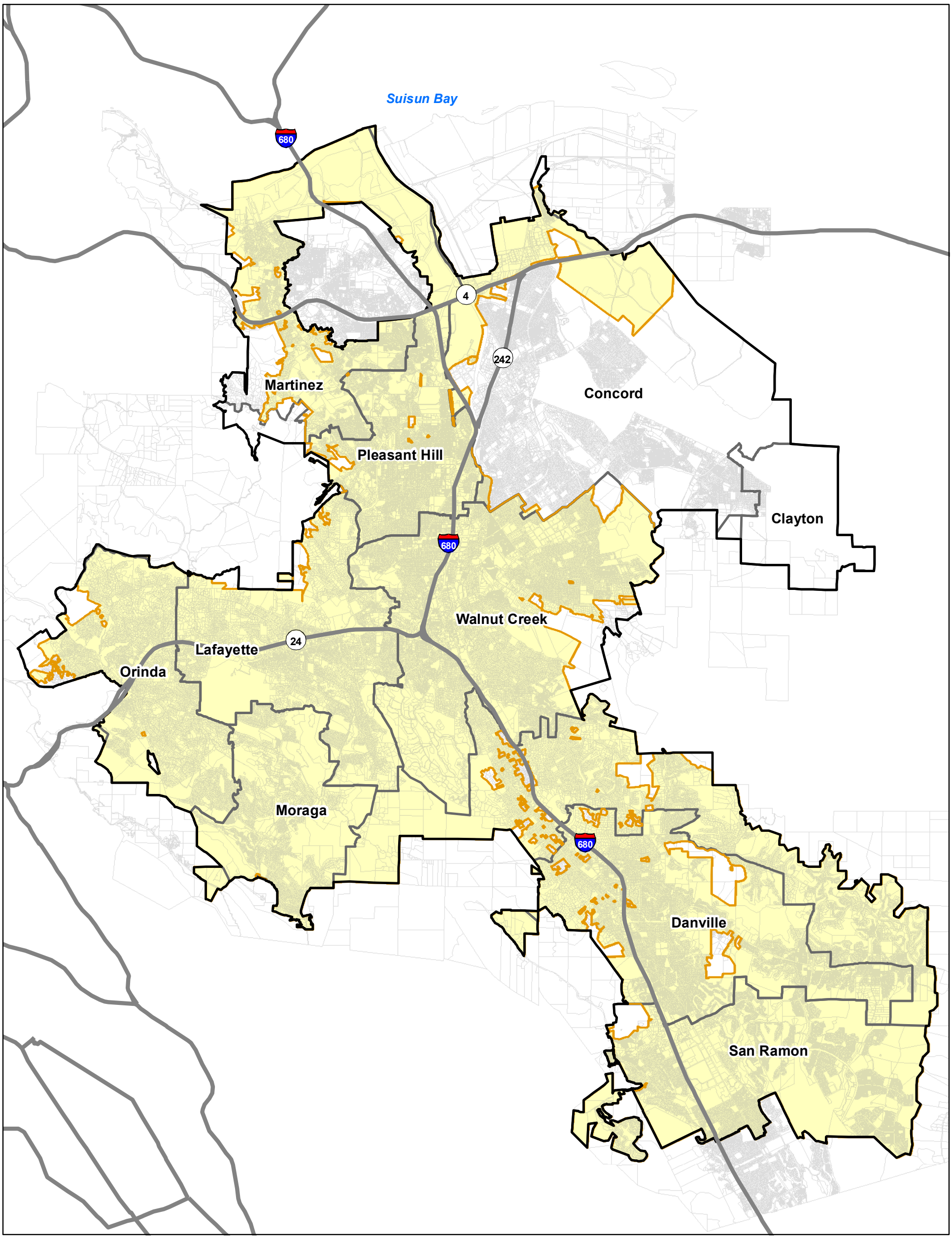


Figure 1-1: Collection System Master Plan Study Area

CCCSD Collection System Master Plan Update 2010

Legend

Service Area

- 2010 Study Area Boundary
- District Boundary
- City Sphere of Influence

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

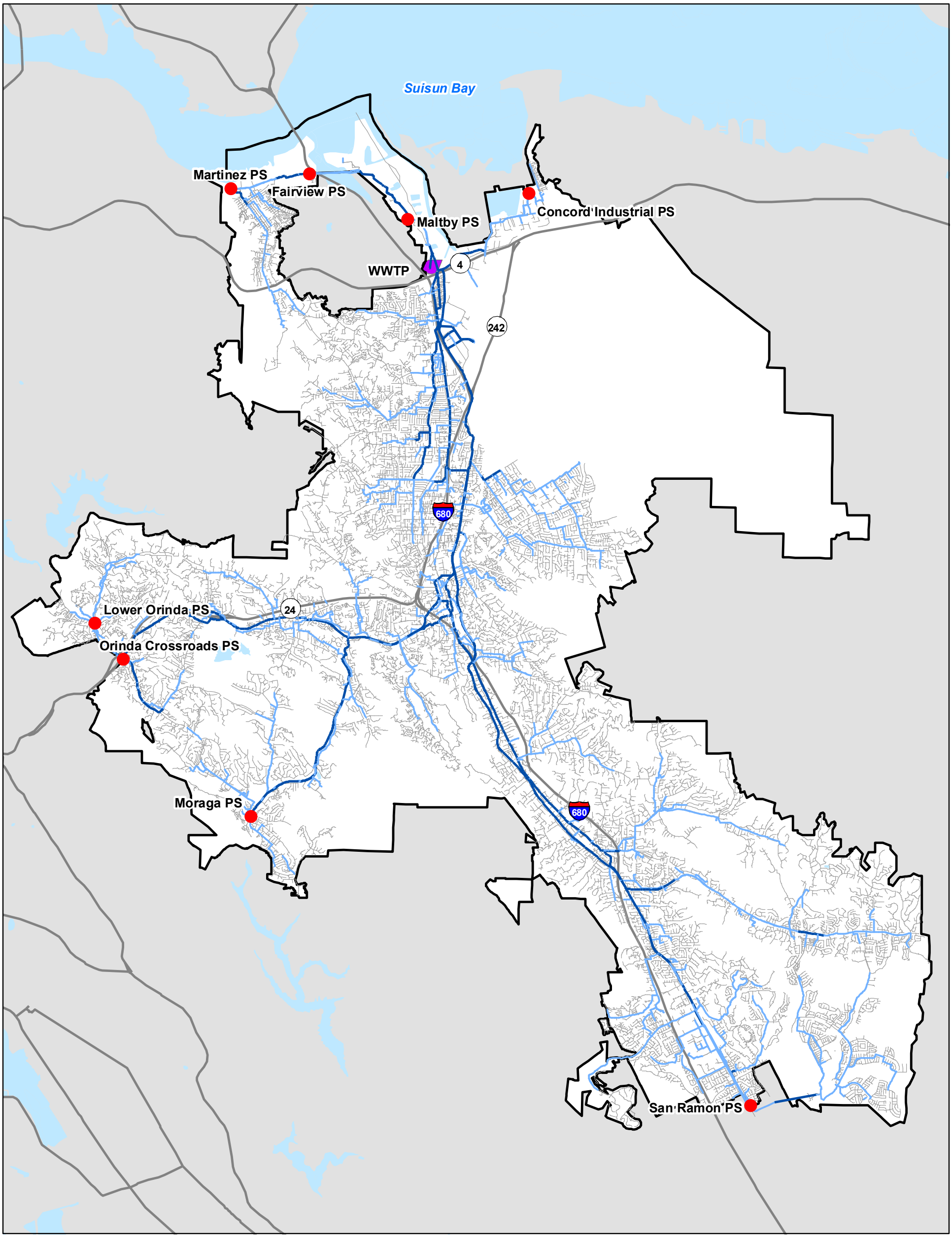


Figure 1-2: District's Collection System and Major Facilities

CCCSD Collection System Master Plan Update 2010

Legend

Study Area Boundary

Major Facilities

Major Pump Station

CCCSD WWTP

Sewer

Smaller than 10"

Trunk (10" - 24")

Interceptor (>24")

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

1.3 ArcSNAP Model

As noted previously, the District originally developed the SNAP hydraulic model of its collection system as part of its 1986 Collection System Master Plan. Over the years, the District has made improvements to the model, including update of the model software to operate in an ArcGIS environment. The latest version of the model, called ArcSNAP, provides for direct upload and update of collection system information (sewer pipes, manholes, parcels, and parcel connections) from the District's GIS mapping system; computation of base wastewater flows from information in the District's HTE customer billing database; and generation of infiltration/inflow (I/I) flows using information on the age of sewer pipes and laterals. The model includes and computes flows for all pipes in the collection system; however, only those pipes with information on pipe slope are evaluated for capacity. Currently, about 22 percent of the system have pipe slope or invert data. The model produces both tabular reports and graphical displays of results (flows and capacities of sewer pipelines) for use by District staff in the planning and design of collection system improvement projects.

Subsequent to the flow monitoring program conducted in the January through April 2005 wet weather season, and prior to initiating this Master Plan Update, the District retained T&R to re-calibrate the ArcSNAP model using the new flow data and results from continuous simulation modeling of treatment plant flows (see Chapter 3 for further discussion on these efforts). This Master Plan Update builds upon that work, with some refinements, to enable use of the updated model to identify existing and predicted future capacity deficiencies. The model is also used to determine the required size of relief or replacement pipes to provide needed capacity. The basis for model flow estimates and use of the model to evaluate system capacity are described in the subsequent chapters of this report.

1.4 Scope of Master Plan Update

The scope of this Master Plan Update included ten tasks, as described below:

Task 1 - Review Existing Collection System Information consisted of review of background information and data, including the current ArcSNAP model; 2005 flow monitoring data and permanent flow monitoring data from the WWTP and pump stations; technical memoranda (TMs) completed since the 2000 Master Plan Update; and other relevant maps and documents prepared by District staff. The project team also interviewed the District's collection system planning staff responsible for maintenance of the ArcSNAP model and users of the model in the District's permitting, capital projects, and collection system operations groups.

Task 2 – Develop Land Use Planning Information involved update of the land use projections of the jurisdictions served by CCCSD. This task included meeting with the planning staff of each of the jurisdictions to identify near-term and long-term development and redevelopment areas; and preparation of GIS mapping showing projected land uses. The information obtained as part of this effort was formatted for input to the ArcSNAP model. Information related to proposed alternative development scenarios for the Concord Naval Weapons Station (CNWS) site was also obtained in order to assess the potential impact of future flows from that site on the CCCSD system.

Task 3 – Review and Update Design Flow Criteria included review of previous TMs prepared by T&R on the re-calibration of the ArcSNAP model and refinement of the criteria based on review of flow monitoring data and discussions with District staff.

Task 4 – Update ArcSNAP Model included update of the model program and database based on the design flow refinements recommended in Task 3; and other modifications and updates to improve model reporting, flow split calculations, and hydraulic gradeline analyses. Additional uploads to the ArcSNAP database to incorporate updated collection system and HTE data were also conducted as part of this task. A conceptual approach for possible future dynamic modeling of the CCCSD system was developed as a separate TM.

Task 5 – Evaluate System Hydraulic Capacity involved running the ArcSNAP model and evaluating the results to identify collection system capacity deficiencies under various modeling scenarios. Based on the results, preliminary solutions to capacity deficiencies were developed and input to the model for confirmation. Hydraulic gradeline analyses were run for selected project "corridors" in order to evaluate the relative severity (risk of overflow) of the capacity deficiencies.

Task 6 – Develop Project Prioritization Process developed a methodology for prioritizing required capacity improvement projects based on timing and degree of capacity deficiencies, potential risk of overflows, and other considerations such as need for sewer rehabilitation to address maintenance or structural problems. This task was conducted in close coordination with District staff.

Task 7 – Develop Capacity Improvement Projects was conducted in conjunction with the solutions modeling in Task 5 to develop recommended projects for correcting identified capacity deficiencies. Projects included upsizing existing deficient pipes, diversions to other pipes with available capacity, and in some cases, alternative alignments where these had been previously identified in the 2000 Master Plan Update. Although originally envisioned to be part of the scope of this study, detailed development and analysis of project alternatives were not conducted as part of this Master Plan Update; rather, District staff will conduct these analyses as part of implementation of recommended projects.

Task 8 – Develop Capital Improvement Program included preparation of planning level cost estimates for recommended capacity improvement projects and development of a proposed CIP schedule for the projects based on the prioritization criteria developed in Task 6. Project validation plans, including recommendations for follow-up flow monitoring, field investigations, or other analyses, were also developed to improve confidence in the need for and priority of recommended projects.

Task 9 – Prepare Master Plan Report involved the preparation of this Master Plan Update document.

Task 10 – Project Management and Quality Control included day-to-day management of project activities, budget, and schedule; coordination with District staff; and review of key deliverables and work products by senior RMC staff.

District staff were actively involved in the preparation of the Master Plan Update through participation at task workshops and by providing information for and review of model results and project TMs. Workshops were held at key project milestones to discuss critical project assumptions and results, including the basis of land use planning, review of design flow criteria, preliminary model results, and recommended capacity improvement projects and priorities. All of the TMs prepared as part of this study are included as appendices to this Master Plan Update report.

1.5 Report Organization

This report includes six chapters and six appendices, as follows:

Chapter 1 – Introduction describes the Master Plan Update background, objectives, scope of work, and report organization; and key characteristics of the CCCSD collection system and service area.

Chapter 2 – Land Use Planning presents the basis of land use planning for the Master Plan Update, including development projections for each of the jurisdictions served by the District.

Chapter 3 – Design Flows describes the components of wastewater flows and explains the methodology used to compute design wastewater flows in the ArcSNAP model.

Chapter 4 – Capacity Analysis describes the modeled sewer system, model scenarios, and capacity analysis criteria; and presents the results of the capacity analysis.

Chapter 5 – Development of Capacity Improvement Projects presents the preliminary solutions model and recommended projects to correct identified capacity deficiencies.

Chapter 6 – Recommended Capital Improvement Program presents the recommended CIP, including estimated project costs and priorities; proposed project validation plans; and other recommended guidelines for implementation and future updates of the Master Plan.

The appendices to the report, bound separately, include the following TMs:

Appendix A – Land Use Planning

Appendix B – Concord Naval Weapons Station Development Sensitivity Analysis

Appendix C – Model Calibration and Design Flow Criteria Review

Appendix D – Conceptual Approach for Dynamic Modeling

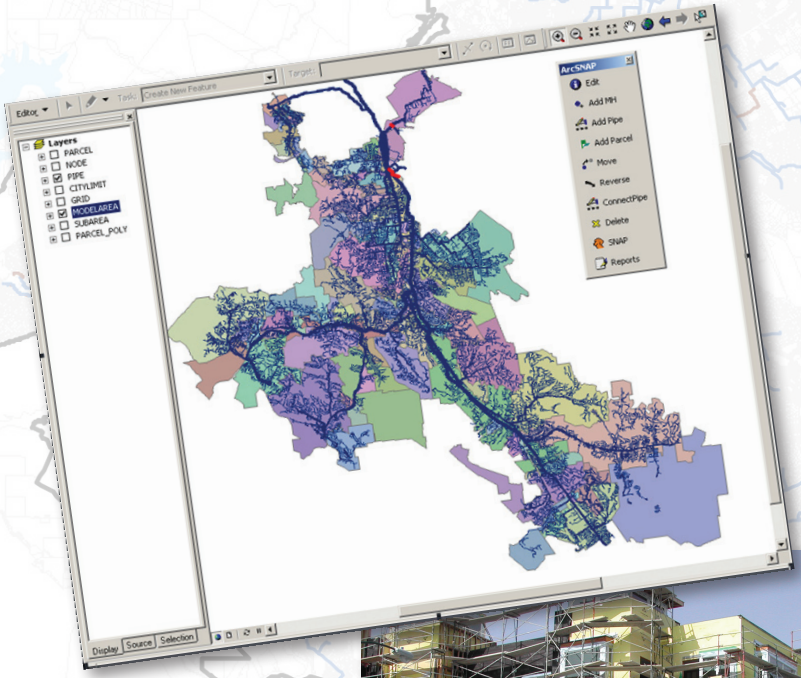
Appendix E – Capacity Results and Preliminary Solutions Model

Other supporting information for the Master Plan Update is included in the following additional appendices:

Appendix F – Project Cost Estimates

Appendix G – ArcSNAP Model Pipe Data and Results

CHAPTER TWO
Land Use Planning



Chapter 2 Land Use Planning

This chapter presents the basis of the land use projections, including the sources of land use information used in this Master Plan Update, the land use projections and general future land use trends up to Year 2040 in the District's service area, and the methodology for incorporating future land use data into the District's ArcSNAP model.

2.1 Background

As part of the 1986 Collection System Master Plan,[1] land use projections were developed for the District's service area and for the cities of Concord and Clayton. In the 1986 Master Plan, existing land uses were determined from the Contra Costa County Assessors maps, tax rolls, District collection system maps, and permit files. Future land use projections were developed by the District's Planning Division staff, utilizing various resources including general plans, zoning maps, specific plans, topographic maps, and etc.

An update to the Master Plan was prepared for the District in 2000.[2] In the 2000 Master Plan Update, existing land use data in the SNAP model were updated using the District's HTE sewer service charge database. Future land uses were assigned to vacant areas for input into the model, and population projections for the District service area were compiled and compared to the land use projections.

Since the 2000 update, the ArcSNAP model has been regularly updated with the District's current GIS and HTE data, although future land use projections have not been revised.

2.2 Jurisdictions within CCCSD Service Area

The District's service area includes various cities as well as unincorporated areas of Contra Costa County. These city and County planning agencies have jurisdiction over land use planning within the District's service area. The District provides wastewater collection, transport and treatment for the City of Pleasant Hill, City of Walnut Creek, Town of Danville, City of Lafayette, Town of Moraga, City of Orinda, unincorporated areas in Central Contra Costa County (including Alamo and Pacheco), and a portion of the City of San Ramon and the City of Martinez. The Cities of Concord and Clayton operate their own wastewater collection systems while the District provides the wastewater transport and treatment. **Figure 2-1** shows the location of the cities in the District's service area.

2.3 Planning Horizon

The land uses were quantified for existing (assumed to be Year 2008 for this Master Plan Update) and "Ultimate" conditions (assumed to be Year 2040). The year 2040 was selected as the planning horizon for this update because interviews conducted with the Planning agencies as part of this Master Plan Update indicated that major developments within the District's service were anticipated to be constructed by 2040, and most General Plan Updates and Specific Plans were based on that time horizon. It should be noted that the economic crisis has impacted the housing and commercial development markets significantly, and therefore, there is some uncertainty associated with the "Ultimate" year of 2040.

2.4 Methodology for Quantifying Existing Land Uses

The methodology for updating future land uses and development is generally based on the approach established in the 2000 Master Plan Update. Existing land uses in the ArcSNAP model were updated with the District's latest data from the District's HTE customer billing database. The HTE database includes all parcels within the District's service area and classifies each connected parcel according to the following categories and units: Single-family residential (dwelling units, or DUs), Multi-family residential (DUs),

[1] Camp Dresser & McKee (October 1986).
[2] Montgomery Watson (March 2000).

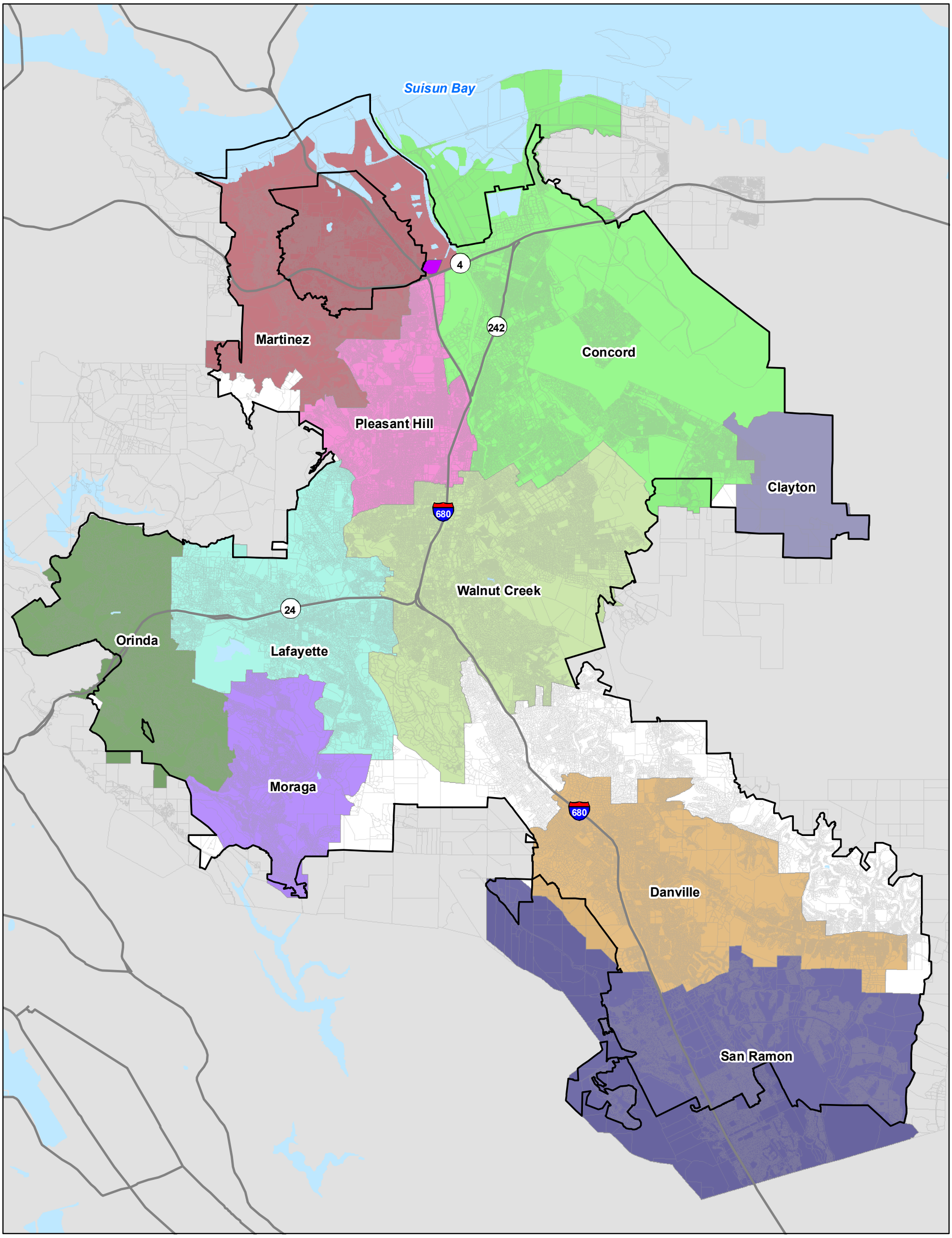


Figure 2-1: Location of Cities in the District's Service Area

Legend

CCCSD Collection System Master Plan Update 2010

City Sphere of Influence

City Sphere of Influence
(City names in figure)

Study Area Boundary

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

and Non-residential Consumption (HCF/year). Non-residential consumption is based on winter water use, which represents the approximate amount of wastewater discharged to the sewer system. The HTE database also indicates vacant parcels and parcels currently served by on-site septic systems. For this Master Plan Update, the existing scenario represents land uses based on 2008 HTE data, which is when the model database was updated at the initiation of this study.

Since the District's HTE database only includes parcels within its own service area, existing land uses for Concord and Clayton had to be determined by alternate methods. The methodology used to estimate existing land uses for Concord and Clayton is described later in this chapter.

2.5 Methodology for Updating Land Use Projections

Information on future land uses and projected development and redevelopment were compiled from General Plans, Specific Plans and other land use information available from the community development departments of each city and town within the District's service area and Contra Costa County. In addition, this update also utilized GIS data comprising city and county land use planning information from two recent water supply and master planning studies: East Bay Municipal Utility District's (EBMUD) Water Supply Management Program (WSMP) 2040 Demand Study and Contra Costa Water District's (CCWD) Future Water Supply Study 2008 Update.

Preliminary GIS land use maps were developed using information and data gathered from the abovementioned sources. Future land use designations from the cities and county were consolidated into a common set of land use designations for the District's entire service area, based on future land use designations developed in EBMUD's WSMP 2040 Demand Study. The consolidated future land use designations are shown in **Table 2-1**.

Table 2-1: Consolidated Future Land Use Designations

Land Use Code	Description	Density(1)
FR1	Low-density Residential	0 – 2.9 DU/acre
FR2	Medium-density Residential	3 – 9.9 DU/acre
FR3	High-density Residential	10 – 19.9 DU/acre
FR4	Very high-density Residential	20 – 50 DU/acre
FR5	Special high-density Residential	50 – 100 DU/acre
FMUR2	Mixed use with FR2	3 – 9.9 DU/acre
FMUR3	Mixed use with FR3	10 – 19.9 DU/acre
FMUR4	Mixed use with FR4	20 – 50 DU/acre
FMUR5	Mixed use with FR5	50 – 100 DU/acre
FC	Commercial/Office/Industrial	
FP	Public/Government	
FOS	Open Space/Parks	
FS	Schools	

Notes:
(1) Only applicable to residential uses.

Vacant parcels (larger than about 5 acres) and parcels that would be undergoing a change in land use were identified and linked to a corresponding future land use designation, and an estimated year of development (between 2010 and 2040 in 5-year increments). These parcels were highlighted on the GIS maps and reviewed for further verification and discussion with the planning departments.

Meetings were held with planning departments of the land use jurisdictions within the District's service area to discuss the projected land uses highlighted in the preliminary maps, development density, and anticipated timing of development. Other areas proposed for redevelopment or densification not included in the maps were also identified and marked. In addition, jurisdictional boundaries (e.g. city limits, spheres of influence, and urban limit lines) were verified with respective city and County agencies. The land use maps were updated with information from the meetings, and a parcel table identifying all assessor parcels, their associated future land use, and anticipated timing of development was created.

2.6 Land Use Projections and Trends within CCCSD

The total number of residential number of residential dwelling units in the District's service area, including the Cities of Concord and Clayton, is projected to increase from approximately 180,000 in 2008 to 230,000 at Ultimate development (assumed to be year 2040), representing a 30 percent growth. The area of developed land will increase from approximately 43,000 acres to 55,000 acres.

The following paragraphs describe the anticipated future land uses and trends for each of the jurisdictions within the District's service area. More detailed information is contained in the Land Use Planning TM in **Appendix A**.

2.6.1 Contra Costa County

Unincorporated Central Contra Costa County areas in the District's service area include Buchanan Field, Pacheco/Vine Hill, Pleasant Hill BART, Reliez Valley, Alamo, Diablo/Blackhawk, Camino Tassajara, and pockets in Walnut Creek and Dougherty Valley.

Buchanan Field Area

The County is currently in the process of updating the Master Plan for the airport in Buchanan Field; however there would be no significant expansion of the airport. There is a tentative proposal to convert some existing hangers into combined office/hanger spaces.

Pacheco/Vine Hill Area

There are currently no plans for densification in this area. Infill residential development is projected for the Center Ave area between 2015 and 2020, with no changes to existing density. The slopes of Vine Hill Ridge are unstable for building and would be maintained primarily as open space. Approximately 40 acres of land south of the ATSF tracks, between Morello and Pacheco, is designated as "Agricultural Lands" to encourage the continued operation of the Viano family vineyards and winery.

Pleasant Hill BART Area

A residential mixed-use transit village is currently under construction, as planned for in the Pleasant Hill BART Station Specific Plan.[3] The mixed-use areas are generally located south of Las Juntas Way. Some existing office or commercial uses located along I-680 and Oak would be converted to mixed uses with residential housing approximately in 2025. Several existing single-family residential parcels located south of Honey Trail would be redeveloped into high-density multi-family residential housing.

Reliez Valley Road Area

This area is largely built-out, and no significant changes in land use are expected. Existing vacant parcels are designated as open space in the County's General Plan 2025.

[3] Adopted in 1983 and amended through 1988.

Saranap (Walnut Creek) Area

Future development in the Saranap Area is likely to be infill. In the long-term (beyond 2020), the County is planning to change single-family residences fronting Olympic Blvd. to multi-family housing or commercial uses. The undeveloped hillside south of Olympic Blvd. and west of Tice Valley Blvd. would remain mostly undeveloped due to the steep, unbuildable topography.

Other Unincorporated Areas

Vacant parcels are scattered throughout the community of Alamo that are developable, but no significantly sized developments are planned. The community is considering incorporating in the future. Blackhawk has some limited residential development potential, but changes are anticipated primarily for the shopping center. Camino Tassajara has developers expressing interest in large scale residential projects, but the County General Plan does not currently allow for much residential development other than subdivisions within allowable density limits. Other projects being considered, such as The Farm outside of Danville or Bollinger Canyon outside of Moraga, do not have approved General Plan designations for residential development as of this time. Dougherty Valley lands are annexed by the City of San Ramon as they are developed per the County General Plan.

2.6.2 Town of Danville

Future developments in the Town of Danville consist mainly of single-family residential development in several undeveloped lots, and multi-family housing and mixed-use development in the Downtown area and periphery. The Town of Danville has identified sites where residential densification may occur (e.g. Navlet's site and Fostoria Way), and mixed use opportunities in the Downtown area, the Wood Ranch Headquarters site, and on the Thiessen property along West El Pintado Road. Medium- to high-density residential housing projects are envisioned for the Downtown area as a redevelopment of existing uses. There are other smaller sites dispersed throughout Danville that would be developed into single-family housing residences, but on a lesser scale.

2.6.3 City of Lafayette

Land use changes in the City of Lafayette are characterized mainly by the development of existing rural residential or vacant urban acreages into low-density single family residential uses. Due to the steep topography, many parcels on ridgelines are zoned with a minimum of 5 to 10 acres per dwelling unit; restricting subdivision and densification in these areas to very low density uses. Development of low-density single family residences on vacant parcels would generally occur during 2020 to 2030. Mixed use residential projects have been proposed in several areas close to Highway 24. Preparation of a Downtown Strategic Plan is underway, with final Plan adoption anticipated in May 2010. The Plan proposes increased development and redevelopment to medium to high-density housing in the downtown area.

2.6.4 City of Martinez

Central Contra Costa Sanitary District does not service the entire City of Martinez; sewer service in the eastern portion of Martinez is provided by Mountain View Sanitary District. Land use changes within the District's service areas in Martinez are mostly concentrated in the Downtown area, consisting mostly of mixed use development. Based on the Downtown Martinez Specific Plan, approximately 700 additional multi-family housing units are projected for the Downtown area. Development of multi-family housing and mixed use projects in the Downtown area and surrounding neighborhoods are projected to occur from 2010 to 2020. Single-family housing development is mainly concentrated in the southern areas of the City. A residential project, Alhambra Highlands I & II, comprising more than 200 housing units has been approved for development, and is projected to develop by 2020.

2.6.5 Town of Moraga

There are currently two potential development scenarios for large vacant residential parcels in the Town of Moraga. The first scenario is based on implementation of the Moraga Open Space Ordinance, which

will limit development in these parcels to 1 DU per 20 acres. The alternative scenario assumes full buildout based on the underlying General Plan designations for specific areas: Palos Colorados, Rancho Laguna, Bollinger Canyon, and the Moraga Country Club extension. The Moraga Center Specific Plan, adopted in February 2010, proposes to redevelop the Moraga Center area as a mixed use area, with an additional 90,000 square feet of commercial space, and between 300 to 720 multi-family housing units by 2020.

2.6.6 City of Orinda

The City of Orinda does not have any significant land use changes planned except for the current construction in Gateway Valley. The large, undeveloped EBMUD watershed lands in the north and west of the City will remain as open space. Some mixed uses are planned for in the Orinda Village area which will require development on vacant and underutilized parcels. A senior housing project will be built by 2010, as part of a larger mixed use development planned for the area along Ave de Orinda. A section of the BART parking lot will be developed with office uses by 2030. The Montenera Project in Gateway Valley will include low density single-family residential units, a community art and garden center, and a private swim club. Approximately 775 acres of surrounding land would be preserved as open space. The project is expected to be developed by 2015.

2.6.7 City of Pleasant Hill

Pleasant Hill has limited vacant lands, with about 60 acres, or 1.5 percent of the land in the City available for new development.[4] Future development is expected to consist primarily of infill and reuse or redevelopment of lands. The key reuse areas identified in the current General Plan are lands along Contra Costa Boulevard, the Contra Costa Shopping Center (former Ward's site), DVC Plaza (K-Mart) Shopping Center, the Mangini/Delu property, and the former Oak Park Elementary School site. Mixed use development with multi-family housing has been proposed for the Downtown area bound by Boyd Road, Woodsworth Lane, Cleaveland Road, and Contra Costa Boulevard, the former Oak Park Elementary School Site, and the K-Mart/DVC Plaza Shopping Center. The majority of the mixed use projects would be developed between 2010 and 2020. The Mangini/Delu property is currently designated as single-family residential, but may also develop commercial uses within the 2010 to 2015 time frame. The City has also identified parcels currently zoned for office uses on Hookston Road that could be developed with multi-family residential uses.

2.6.8 City of San Ramon

San Ramon has been developing rapidly due to a fast-expanding employment base and the historical availability of vacant land. However, there are limited vacant lands remaining within the City limits for development. To accommodate its increasing population, the City annexed the Westside area, and is in the process of annexing unincorporated areas of Dougherty Valley. The City may eventually annex Tassajara Valley, but the County General Plan does not currently allow for large scale developments. There are also areas within the City that are planned for intensification through infill and redevelopment. These areas include the Crow Canyon Redevelopment Area, which will be redeveloped as mixed uses: commercial, service-commercial, and residential uses. Mixed uses have also been proposed for a new City Center. Several residential projects consisting of single- and multi-family housing are under review or construction. The Faria Ranch project, located in the northwest corner of San Ramon, near Bollinger Canyon Road and the Valley Vista Senior Village Apartments project along San Ramon Valley Boulevard are currently being reviewed. Construction of the Dougherty Valley housing projects is ongoing, with full development expected to occur around 2015. The development of Norris Canyon Estates, a County-approved project, is currently in the last construction phase. This project is currently within County unincorporated limits, but may be annexed by the City.

[4] City of Pleasant Hill General Plan (2003-2023).

2.6.9 City of Walnut Creek

Future development in the City of Walnut Creek will be dominated by infill and redevelopment of low intensity uses. The City envisions the Walnut Creek core area, bound by I-680, Broadway, and Walden Road, as a transit-oriented area, and has identified locations within the core area for densification and other mixed use development. The City is proposing to develop mixed use areas with either a commercial office or residential emphasis. Mixed use areas with a commercial emphasis are required to have office or retail as the primary use, with residential uses optional. Areas identified for mixed use with residential emphasis would have residential as the primary use.

Three areas in downtown Walnut Creek are planned for mixed use development with a commercial emphasis, including a 32-acre area along West Mt. Diablo Blvd., a 17-acre area between Botelho Drive and Newell Ave, and the 5-acre Quail Court site at North Main St./Creekside Dr. Both sites at West Mt. Diablo and Botelho Drive may be developed with residential housing by 2020. The Quail Court site currently consists of offices and redevelopment of the site is required for the new land uses. Construction of the site is expected by 2025.

There are several sites around Walnut Creek that are designated in the General Plan for mixed use with residential emphasis: North Main St/Ygnacio Valley Rd, near Walnut Creek BART Station, North California Blvd/Bonanza St, Trinity/Cole Ave, 1510 Geary Rd, and Palos Verde Mall. In addition to the change areas identified in the General Plan, other potential areas of densification include the Cole/LaCassie area.

2.7 Land Use Estimates for Concord and Clayton

The City of Concord and the Town of Clayton are point sources in the ArcSNAP model. Estimated flows for 2008 and future development scenarios were derived from land use information on residential dwelling units and non-residential acres. Existing land use information for Concord and Clayton was updated based on information from the cities' zoning maps and benchmarked against city population/housing estimates from the Department of Finance (as of January 1, 2008). Future incremental residential and commercial land use estimates for Concord were derived from a comparison of Concord's General Plan 2030 land use and existing zoning designations and discussions with the City's Planning Department staff. In addition, preliminary estimates from the Housing Element land inventory[5] were used as a benchmark. Future incremental land use for Clayton was estimated based on maps from the city's General Plan and Specific Plans, and information obtained during an interview with the City's Planning Department.

2.7.1 City of Concord

Concord is redeveloping existing uses in central Concord (commercial, industrial, public) to mostly mixed uses. The North Concord area will be developed for Business Park and Regional Commercial land uses, with completion expected by 2030. Other areas of densification include areas that would be converted from single-family residential to multi-family residential: the Four Corners/Ygnacio Valley area, Clayton Valley, and Olivera Road. The City has identified approximately 14 acres of vacant infill sites designated as either medium density residential or Central Area Multiple Use, which may accommodate up to 400 new residential units.

Concord Community Reuse Project

In 2006, the City of Concord initiated a multi-phased process to develop the Reuse Plan for the decommissioned inland area of the Concord Naval Weapons Station (CNWS), called the Concord Community Reuse Project. Planning workshops were conducted with residents and community leaders, and seven alternative concepts for the Reuse Project were developed in late 2007. The range of alternatives was narrowed down to two alternatives in September 2008, with one alternative selected by

[5] City of Concord, 2008. Staff Report on "Housing Element Update Study Session". June 9, 2008.

the Community Advisory Committee as the Preferred Reuse Plan. The Final EIR, evaluating the impacts of the Preferred Reuse Plan, was published on January 15, 2010. A range of alternatives for the conversion of the CNWS site was developed. There were seven alternatives proposed in the draft EIR, which were grouped around three broad themes: Extended Neighborhoods; Clustered Villages; and Concentration and Conservation. On January 12, 2009, the Concord City Council selected the alternative "Clustered Villages" as the Preferred Reuse Plan for the CNWS site.

The Clustered Villages alternative concentrates uses in neighborhood "villages" that are linked together by transit service, and intensifies some uses to gain space for parks, recreation and open space. Features of this alternative include retail, residential and commercial development near the North Concord BART station, a series of three pedestrian-friendly villages west of Mt. Diablo Creek and parks and open space. About 65 percent of the 5,028-acre site is designated for parks and open space. Based on the land use plan, there will be 12,272 residential units, with an average density of 12 DU/acre, supporting a total projected population of 28,800. The plan includes land for a number of community amenities, including a tournament-level sports complex, a university/education center, a public safety training facility, and a variety of active and passive parks. The development is anticipated to be completed in 2050.

Note that because the CNWS Reuse Project was still in preliminary planning stages when this Master Plan Update was initiated, it is not included in the basic master plan land use and flow projections and model analyses presented in this report. Rather, it is addressed in a "sensitivity analysis", as discussed later in Chapter 4.

2.7.2 City of Clayton

The main areas of development in the City of Clayton will be the Town Center, and vacant or underutilized lands along Marsh Creek Road near Mt. Diablo State Park (Marsh Creek Specific Plan). There are some commercially-designated parcels within the Town Center that may be converted to mixed uses comprised of commercial and residential uses. These mixed use developments in the Town Center are expected to be completed by 2020. Development of the Marsh Creek Specific Plan is expected to be completed by 2020. Other areas of significant residential development include the Seeno Property in northwest Clayton, Diablo Pointe, and the Easley Ranch property.

2.8 Summary of Existing and Projected Land Uses

Table 2-2 summarizes the existing and projected land uses in the District's service area based on the land use updates conducted for this Master Plan Update.

Table 2-2: Existing and Ultimate Land Uses in ArcSNAP

Scenario	CCCSD Service Area	Concord and Clayton	Total
2008 Land Use (HTE data)			
Single Family (units)	84,527	30,762	115,289
Multi-Family (units)	45,842	18,835	64,677
Non-Residential Flow (gpd)	5,075,960	1,450,000	6,525,960
Sewered Area (acres)	33,441	9,781	43,222

Table 2-2 continued on the following page

Scenario	CCCSD Service Area	Concord and Clayton	Total
Future (Incremental) Land Use (1)			
Single Family (units)	26,541	782	27,323
Multi-Family (units)	18,583	3,866	22,449
Commercial (acres)	1,622	42	1,664
Industrial (acres)	191	0	191
Public (acres)	1,140	0	1,140
Office (1,000 square feet)	2,528	0	2,528
Sewered Area (acres)	11,785	0	11,785

Notes:
(1) Does not include future flows from the Concord Community Reuse Project.
(2) Future land use data includes new development as well as redevelopment of parcels that may have existing sewer connections in HTE. Therefore, the Future (Incremental) Land Use quantities in this table cannot be added to the 2008 Land Use (HTE data) to determine total ultimate land use quantities.

2.9 Incorporation of Future Land Use Information into ArcSNAP

ArcSNAP models the flows from each parcel based on its connection status and land use. As noted previously, connected parcels are designated by one of the following HTE-assigned categories: Single-family residential (number of dwelling units), Multi-family residential (number of dwelling units), or Non-residential Consumption (HCF/Year). Future land uses for unconnected or vacant parcels, or land use changes to currently connected parcels, are updated in ArcSNAP in one of two ways: parcels that were identified through meetings with planning jurisdictions are updated through the ArcSNAP "Override Land Use" table, which quantifies the specific land uses and estimated year of development for the parcel. For small parcels (e.g., less than about five acres) not specifically identified or discussed during the meetings, future land use is based on the underlying General Plan land use designation and its associated density. (Note: this is a change to the method previously used in ArcSNAP, in which the land use code in HTE was used as the future land use designation, rather than the General Plan designation based on GIS mapping.) The amount of development by year for these smaller parcels is automatically assigned by the model, which projects development on a linear time-scale between existing and ultimate conditions.

Following the methodology of previous Master Plan updates, GIS land use data for this update were organized according to the input categories in the override table (see **Table 2-3**) to facilitate incorporation of data into the model. Where the exact number of dwelling units for a parcel was not known or identified by the planning departments, the number of dwelling units was estimated assuming 75 percent of the maximum allowable General Plan density for single-family parcels and 80 percent of the maximum General Plan density for multi-family parcels. Vacant parcels that would be maintained as open space are represented in the model by a corresponding unsewered acreage, and classified as "Open Space".

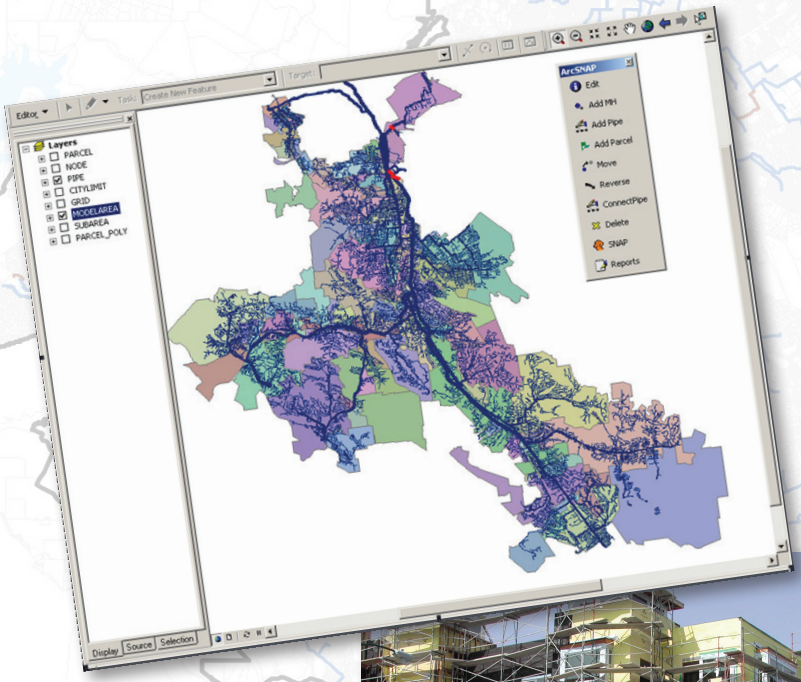
Table 2-3: Future Land Use Data Input Categories

Override (Buildout) Year	Represented by 2010 to 2040 (at 5-year intervals)
Future Buildout Land Use	Residential (represented by the number of single-family or multi-family dwelling units)
	Non-Residential (represented by the acreage of Commercial/Industrial/Public uses or 1,000 square feet of Office building floor space)
	Point Source (represented by HCF/Year)
	Open Space (represented as unsewered acres)

2.9.1 Interim ArcSNAP Updates

This Master Plan Update has attempted to identify future land use changes and significant development within the District's service area that are anticipated to occur within the next thirty years. The District anticipates that it will complete the next major Master Plan Update in about 8 to 10 years. Between the Master Plan Updates, the ArcSNAP model will be maintained and updated by District staff on a regular basis as new data (e.g., new connections, parcel splits, changes in projected land uses) become available. The model will be updated primarily through downloads of the most current HTE data and updates to the override land use table as subdivided parcels and new connections to the system get incorporated into the HTE database. As part of this project, procedures for performing these updates have been developed for the District's use in the future.

CHAPTER THREE
Design Flows



Chapter 3 Design Flows

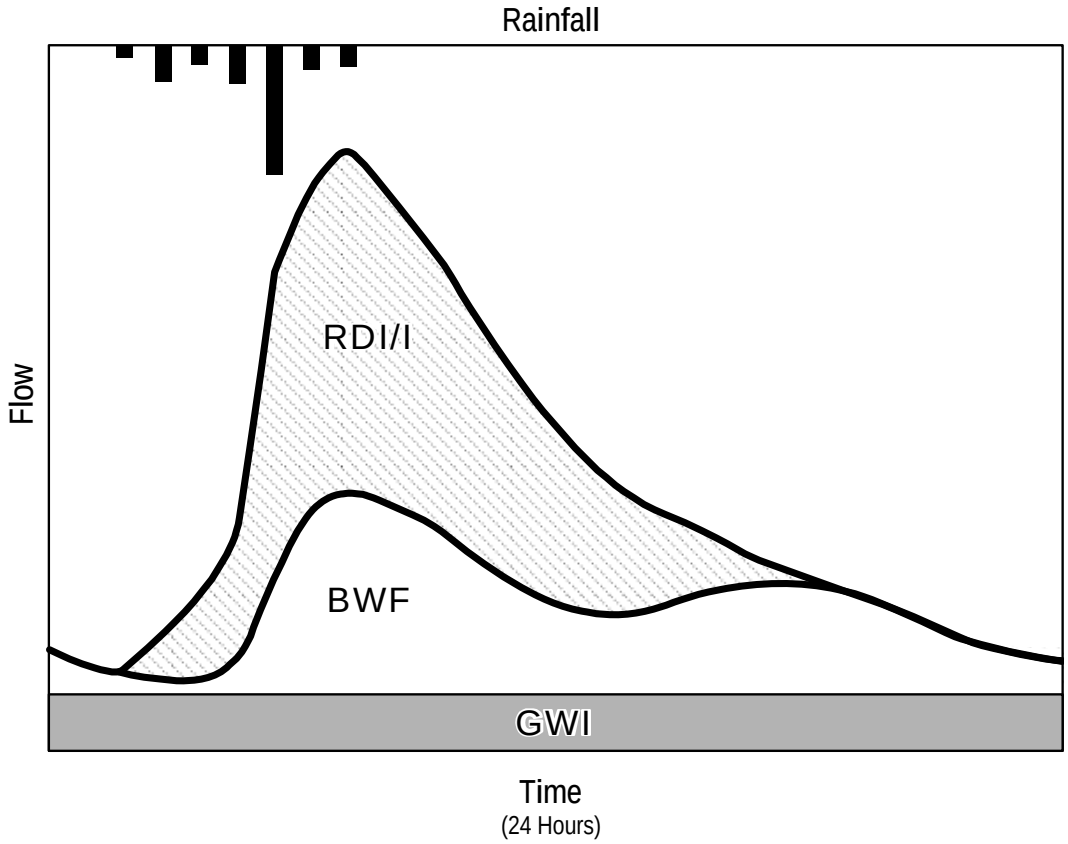
This section of the Master Plan Update report documents the design flow criteria used for estimating existing and projected future flows in the wastewater collection system and presents the design wastewater flow estimates for key locations in the system. Collection system design flow criteria were developed initially for the District's 1986 Collection System Master Plan and have been modified a number of times as part of subsequent planning efforts, including the most recent ArcSNAP model calibration conducted in 2007. The 2000 Master Plan Update Report presented a detailed description of the "history" of CCCSD design flow criteria. This section describes how the criteria are currently formulated based on the results of the 2007 calibration and additional modifications made as part of this Master Plan Update.

3.1 Wastewater Flow Components

Wastewater flows include three components: base wastewater flow (BWF), groundwater infiltration (GWI), and rainfall-dependent infiltration/inflow (RDI/I), as illustrated conceptually in **Figure 3-1**.

Figure 3-1: Wastewater Flow Components

(Not to Scale)



BWF represents the sanitary and process flow contributions from residential, commercial, institutional, and industrial users of the system. BWF varies throughout the day, but typically follows predictable diurnal patterns depending on the type of land use.

GWI is groundwater that infiltrates into defects in sewer pipes and manholes, particularly in winter and springtime in low-lying areas. GWI is typically seasonal in nature and can remain relatively constant over periods of several days or months. However, rainfall clearly has long-term impacts on GWI rates, as evidenced by measurable increases in GWI after prolonged periods of rainfall.

RDI/I is storm water inflow and infiltration that enter the system in direct response to rainfall events, either through direct connections such as holes in manhole covers or illegally connected roof leaders or area drains, or, more commonly, through defects in sewer pipes, manholes, and service laterals. RDI/I typically results in short term peak flows that recede relatively quickly after the rainfall ends. The magnitude of RDI/I flows are related to the intensity and duration of the rainfall, the relative soil moisture at the time of the rainfall event, and the condition of the sewers.

3.2 Flow Scenarios

Flow projections for wastewater collection systems are normally developed for different flow conditions. Typically, these are defined as average dry weather flow (ADWF), peak dry weather flow (PDWF), and peak wet weather flow (PWWF).

ADWF is considered to represent average BWF (ABWF) plus dry season GWI. The dry season GWI is often considered to be part of the BWF component, in which case ADWF is equivalent to ABWF. For modeling purposes, PDWF is considered to be the peak flow that would occur on a day during the wet weather season that is not affected by rainfall-induced flows. As such, PDWF represents a peak BWF (PBWF) condition coupled with wet season GWI.

PWWF is the peak flow during a “design” wet weather event. As such, it is a combination of peak RDI/I due to the rainfall, wet season GWI, and the BWF occurring at the time of the peak RDI/I. The design event is based on an expected peak flow recurrence frequency, and different design events may be used for different purposes such as identifying capacity deficiencies, sizing new or relief sewers, or prioritizing capital projects. The District uses two design events, 5-year and 20-year, as discussed later in this report.

The magnitude of flows under each of the above flow conditions also depends on the extent of service area development, and may also be impacted by other factors related to time, such as sewer deterioration. Therefore, flow scenarios represent a specific flow condition (ADWF, PDWF, PWWF) in a particular year. For this Master Plan Update, flow scenarios have been analyzed for year 2010 and ultimate (considered to be year 2040) conditions.

3.3 Design Flow Criteria Update

This subsection discusses the updates to design flow criteria that have been made based on the District’s most recent flow monitoring program conducted in 2005. These updates were summarized in two Technical Memoranda (TMs) prepared by Talavera & Richardson (T&R) in 2007 and a TM on Model Calibration and Design Flow Criteria Review prepared by RMC as part of this Master Plan Update. These TMs are included in **Appendix C** of this report. Following the completion of the draft TM, a workshop was held with District staff to discuss the findings and recommendations and to agree upon the modifications to the design criteria that would be made for this Master Plan Update.

The 2000 Master Plan largely utilized the same design flow criteria that had originally been developed as part of the District’s 1986 Collection System Master Plan and subsequent wastewater treatment plant (WWTP) and interceptor projects. During January through April 2005, the District undertook its first system-wide flow monitoring program since the 1980s. The monitoring program included 32 flow meters placed throughout the system. The District retained T&R to analyze the flow monitoring data (in

addition, data from the District's pump station meters and three permanent meters measuring flow from Concord were also used), as well as recent WWTP flows, and use the data to re-calibrate the ArcSNAP model. The additional improvements made to the model since the 2000 Master Plan also provided more detailed data on parameters such as sewer and parcel age, which allowed for a re-formulation of the methodology used to compute RDI/I in the model. Based on the updated model database and the analyses of the 2005 flow monitoring data, completed in 2007 and refined as part of this Master Plan Update, the District updated its design flow criteria for modeling. The following paragraphs describe the findings and results of the design flow criteria update.

3.3.1 Residential Base Wastewater Flow

Residential BWF is computed in ArcSNAP at the parcel level based on the number of developed residential single-family (RSF) and residential multi-family (RMF) dwelling units from the District's HTE database. As part of the design flow criteria update, these unit flow factors were revised by calibration to the 2005 flow monitoring data and to flows recorded at the District's WWTP at the end of the dry weather season (late summer or early fall). A value of 36 mgd was determined to be the total BWF in 2005 based on review of WWTP influent data for the period 2001 through 2006, and the unit flow rates were set to match that flow.[6] Specifically, the rates were developed by determining the combination of RSF and RMF unit rates, plus non-residential flows from HTE, that resulted in a total BWF of 36 mgd at the WWTP and the best match to the estimated BWF at most of the 2005 flow meters (metered BWF was determined by analysis of non-rainfall period data to estimate the BWF and GWI components, as noted below under discussion of wet season GWI). The unit flows rates are lower than those used in previous master plans, and presumably reflect the effects of reduced indoor water use. The resulting residential unit BWF rates per dwelling unit are:

RSF: 195 gpd/unit

RMF: 105 gpd/unit

The same flow rates are applied to dwelling units in all parts of the District service area.

(It should be noted that current dry season flows to the WWTP are even lower than in previous years (e.g., the lowest dry weather flow in 2009 was 32.5 mgd), so it is possible that unit BWF rates have decreased even further since 2006 due to mandated water conservation and other factors.)

3.3.2 Wet Season Groundwater Infiltration

Although GWI into sewers occurs to some extent on a year-round basis, the design GWI represents only the increase in average flow that occurs during the wet weather season, excluding RDI/I. Any residual GWI at the end of the dry weather season is assumed to be included in the BWF. The existing design GWI (i.e., the increase in average flow during the wet weather season) was estimated to be about 12 mgd based on an analysis of several years of WWTP flow records. It should be noted that the design GWI is intended to represent GWI in a typical wet year, and can be expected to be exceeded in wetter than normal years, as occurred during the 2005 flow monitoring period.

GWI is computed in ArcSNAP by applying per-acre flow rates at the parcel level. GWI rates vary by "model area", of which there are 109 in the total service area. The rates in each of the model areas are based on extrapolation of the rates determined in the1986 Master Plan. Those rates have been adjusted system-wide (by a factor determined to be 1.06) to generate 12 mgd at the WWTP under 2008 conditions. A GWI rate of 100 gpd/acre is assumed for parcels with equivalent parcel connection years (see discussion in paragraph below) later than 1980.

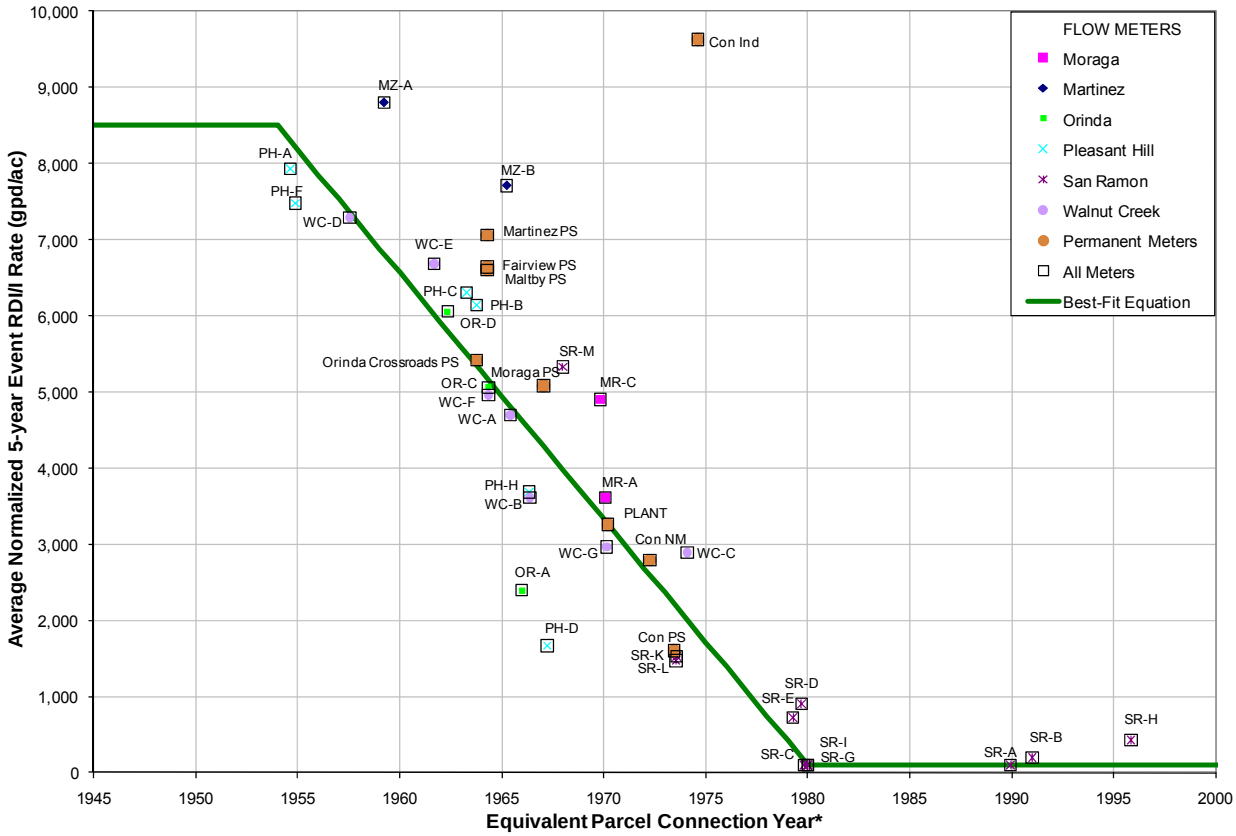
[6] As presented and discussed with District staff at Design Flow Criteria Review Workshop on September 29, 2008.

3.3.3 Rainfall-Dependent I/I

RDI/I represents the increased flow that occurs during and within a few days following rainfall events. The District's peak design RDI/I corresponds to major rainfall events with return periods of 5 years or 20 years. In ArcSNAP, per-acre peak design RDI/I rates are applied at the parcel level, with the rates computed as a function of the year of sewer and assumed service lateral construction. The year of construction, or "equivalent parcel connection year", is a weighted composite year consisting of the parcel connection year (or lateral construction or replacement year, if known) (60% weight) and the construction year of the main to which the parcel connects (40% weight).

The peak RDI/I estimates were made through analysis of 2005 flow monitoring data. For each meter, the RDI/I for up to seven storm events was graphically isolated from BWF and GWI, and peak RDI/I rates were determined. The rates for each individual event were scaled up to represent the 5-year return period event, using a multiplier that was based on the ratio of the observed peak RDI/I at the WWTP to the projected peak RDI/I at the WWTP during a 5-year event (determined to be 144 mgd based on the results of continuous simulation of WWTP flows over a 52-year period – see TM on Continuous Simulation in Appendix C). The same multiplier was used for all meters for a particular storm, but different multipliers were applied for each of the seven storm events. This process resulted in estimates of the 5-year peak RDI/I rate for each observed storm, and these estimates were averaged to arrive at a single estimate of the 5-year peak RDI/I for that meter. The RDI/I function was developed by fitting a curve to the estimated 5-year return period peak RDI/I at about 45 metering points throughout the District service area. The RDI/I rate curve is shown in **Figure 3-2**.

Figure 3-2: Peak Design RDI/I Rate for 5-Year Event as Function of Sewer/Parcel Construction Year



* Based on weighted average of sewer main construction year (40%) and parcel connection year (60%)

The peak wet weather flow generated by ArcSNAP at the WWTP should match the peak flow for the corresponding design storm event as estimated in the continuous simulations. Initial ArcSNAP runs incorporating all the flow criteria were found to underestimate the peak RDI/I slightly, and so a multiplier of 1.11 was applied to all the RDI/I rates as a final calibration step. The 20-year return period peak RDI/I rate was computed as 1.58 times the 5-year return period rate, with the 1.58 multiplier determined from the continuous simulation.

It is important to note that this method of modeling RDI/I is based on the concept that the peak RDI/I generated from any upstream tributary area for a given storm is solely dependent on the years in which the sewers and service laterals in that area were constructed. The relationship between RDI/I rate and year of sewer construction was first observed in the District's 1985 flow monitoring program, and was considered in the wet weather flow criteria used in the 1986 Master Plan and in the 2000 Master Plan Update. However, the method used in those studies to determine peak RDI/I from any area was more complex and not based solely of sewer construction year. The "existing" RDI/I rates in 1985 were different for each metered area and were based solely on the analysis of a single major storm event. Although the RDI/I for each metered area was based on the observed flow, the distribution of that flow to upstream subareas was based on the percentage of sewers built in different periods (pre-1960 and post-1960). The "ultimate" RDI/I rates in all areas were assumed to be independent of the existing rates and were based on the percentage of sewers built in different periods (pre-1960, 1960-1985, and post-1985) and also varied with mean annual rainfall (higher rates in wetter areas of the District). The ultimate rates were set to correspond to the rates observed in the worst areas of a given age, so they were higher than the existing rates. The sewers were assumed to deteriorate over time from their existing RDI/I rates in 1985 to their ultimate rates in 2035. This approach led to a rather complex set of rates that varied from area to area and changed over time.

The decision to simplify the RDI/I criteria was made by the District after considering the advantages and disadvantages of the previous criteria. The previous criteria had been found to be too complex, and not easily understood, utilized, or maintained by District staff. Furthermore, analysis of the 2005 flow monitoring data indicated that the increase in RDI/I over time that was built into the criteria was not actually occurring. In developing the current relationship between peak RDI/I and sewer construction year (essentially the calibration process), other factors such as pipe material and location (mean annual rainfall) were analyzed but found to add complexity without improved results.

The assumption that peak wet weather flow rates will not increase in the future is justified by flow trends observed over the past 20 years. However, it should be recognized that this assumption is contingent on the District continuing to invest in ongoing system maintenance, inspection and testing, and sewer rehabilitation and replacement.

It should be noted that the data points in Figure 3-2 do indicate that in some areas, the RDI/I function can be expected to generate flows that are significantly higher or lower than actual flows. While this may not be a significant concern when evaluating the capacity of downstream trunk sewers and interceptors, it could be an issue for more localized capacity evaluations. Therefore, an override feature has been added to ArcSNAP to allow the user to input a different RDI/I rate in any given model area. The override feature would be used wherever there is evidence that the standard RDI/I computations could be generating flows that are significantly high or low. That evidence could be from flow monitoring data analyzed during the recent calibration process or from future targeted flow monitoring. This feature would allow the user to readily determine if a higher or lower RDI/I rate would result in the addition or elimination of a capacity deficiency.

3.3.4 Assumed Changes to BWF, GWI, and RDI/I Rates in the Future

BWF rates are assumed to remain the same in the future, and the same rates are used for future development. For GWI, the rates in each model area are assumed to remain the same in the future (no increase due to sewer deterioration), and the same rates are used for future development in each model

area. For RDI/I, the curve relating design RDI/I to sewer construction year is assumed to remain the same (no increase due to sewer deterioration) and apply to future development as well. The 5-year design RDI/I rate on the curve (100 gpd/acre) remains the same for all sewers built after about 1980.

3.4 ArcSNAP Model Flow Parameters

The District's ArcSNAP model is a "steady-state" model, in that it computes the peak flow at each point in the system, rather than a time-varying flow hydrograph. (Note: The District is considering the future development of a "dynamic" model, which is discussed in the TM on "Conceptual Approach for Future Dynamic Modeling," included in **Appendix D**.) Therefore, the input flow data for the ArcSNAP model represent constant flow values: average BWF, design GWI, and peak RDI/I. BWF peaking factor and RDI/I attenuation curves (discussed below) are used to fine tune the flow rates to more accurately approximate the peak flows that would result from the actual routing of flows through the system.

In the ArcSNAP model, every parcel in the District contributes flow to the sewer network at the upstream manhole of the pipe to which it is connected (or, for currently unconnected parcels, the most upstream pipe in the existing system to which the flow from that parcel is assumed to be tributary in the future). The BWF, GWI, and peak RDI/I are computed for each parcel based on unit flow parameters as described in the following paragraphs. The model includes parcel data sets for two basic scenarios: current (base case) and ultimate. The base case is the year represented by the most recent HTE data download (in the case of this Master Plan Update, 2009), and ultimate has been defined to be 2040, as discussed in Chapter 2 of this report (the ultimate year for the previous 1986 and 2000 Master Plans was 2035). Flow scenarios for intermediate years between the base year and 2040 are simulated by straight line interpolation; however, "override" land use information can be provided on a parcel-specific basis and associated with a designated development year.

The following paragraphs describe how parcel BWF, GWI, and RDI/I flows are calculated in ArcSNAP, and how the parcel flows are aggregated in the model to compute flows in each modeled sewer segment for the various flow scenarios.

3.4.1 BWF Calculations

Parcel ABWF is determined for existing connected parcels based on data in the District's HTE database. For residential parcels, the database includes the number and type (RSF or RMF) of dwelling units. The ABWF for residential parcels is therefore calculated as the number of dwelling units times the appropriate residential BWF unit factor (195 gpd for RSF and 105 gpd for RMF). For non-residential parcels, the HTE database includes the actual estimated wastewater flow based on winter water consumption. These values are used directly in the model.

Currently vacant parcels that are designated in HTE with a non-open space land use code are assumed to be fully developed at ultimate conditions. For large parcels (greater than 5 acres) and specific known development or redevelopment areas, land use information for future connections are contained in the "override land use table" in ArcSNAP, as discussed in Chapter 2. This data includes the number and type of potential future dwelling units and/or the type and building square footage or parcel acreage of non-residential development. The unit flow rates shown in **Table 3-1** are applied to the future land use quantities to generate the future parcel ABWF. Note that the data in the override land use table *replaces* the HTE data, which allows parcels projected for future redevelopment to be accurately accounted for.

The City of Concord and Town of Clayton are not included in the HTE database and are identified as "point sources" in the model. Actual estimated BWF is input to the model for these users.

Table 3-1: Average Base Wastewater Flow Unit Factors

Land Use Category	Units	BWF Unit Flow Factor (gpd/unit)
Residential Single Family (RSF)	Dwelling Unit	195
Residential Multi-Family (RMF)	Dwelling Unit	105
Commercial/Office(1)	Square Feet (building space)	0.1
Commercial/Office/Public(1)	Acres (lot size)	1,000
High Density Office(1)	Acres (lot size)	4,400
Industrial(1)	Acres (lot size)	1,000
Schools(2)	Student	25
Hotels(2)	Square Feet (building space)	0.34

Notes:
(1) Used only for future development or redevelopment (ABWF for existing non-residential development based on actual consumption in HTE database).
(2) Used for Concord Naval Weapons Station redevelopment area (Concord Community Reuse Project).

3.4.2 Diurnal BWF Variations

BWF varies throughout the day in a typical way, generally peaking early in the morning in upstream sewers and later and less sharply in larger downstream sewers. While typical hourly peaks from small residential areas tend to be about twice the average flow, higher peaks can occur over shorter durations (e.g., 15 minutes) within the peak hour or on atypical days of the year (e.g., on major holidays such as Thanksgiving or at halftime on Super Bowl Sunday).

A typical way of expressing the expected magnitude of the peak BWF is by a "peaking factor," which relates the PBWF to the ABWF. Peaking factors for the District's service area were developed as part of the 1986 Master plan based on monitored flows in the collection system. A BWF peaking factor (PF) curve, defined by the equation below and shown in **Figure 3-3**, was established for use in collection system planning and is incorporated into the ArcSNAP model.

$$PF = 3.15 \times (ABWF)^{-0.104}$$

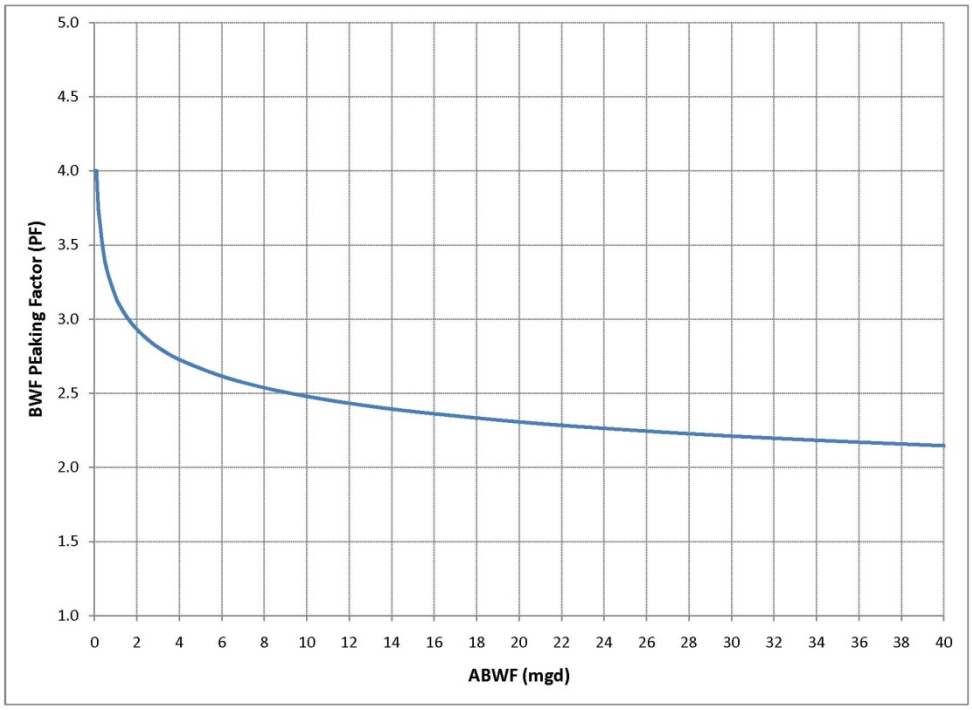
where:

ABWF = Average BWF (mgd)

PBWF = PF x ABWF

The maximum peaking factor was set to 4.0 (for ABWF of 0.1 mgd or less). Note that this peaking factor curve represents a maximum possible PBWF condition, rather than a typical daily peak. The paragraph on "Design Flow Rules" later in this section discusses more specifically how this peaking factor is applied in computing total design flows for pipes in the model.

Figure 3-3: BWF Peaking Factor Curve



3.4.3 GWI and RDI/I Calculations

As discussed in the previous section on the Design Flow Criteria Update, GWI and peak RDI/I rates are based on per-acre unit flow factors that vary based on location (for GWI) or equivalent parcel age (for RDI/I). The unit factors are applied to the parcel sewered area, which is assumed to be the parcel lot size, except for large parcels, in which case a maximum sewered area of 3.5 acres (except for certain land uses such as hotels/motels and mobile home parks) is assumed to determine each parcel's GWI and peak RDI/I contribution to the system. GWI from future parcels are based on location (model area). Peak 5-year event RDI/I is calculated from the RDI/I curve in Figure 3-2, based on the equivalent parcel connection year for the parcel.

3.4.4 Flow Routing in ArcSNAP

Based on the calculations described above, ABWF, GWI, and peak RDI/I flows are input to the ArcSNAP model for each parcel. The model then aggregates these parcel flows for each pipe and totals the flows from upstream to downstream as the flows for each sewer segment are calculated. The model keeps account of the total cumulative ABWF, GWI, peak RDI/I, and sewered parcel area, and calculates the PBWF and attenuated RDI/I for each modeled pipe.

The PBWF is calculated as the cumulative ABWF times the BWF peaking factor as determined from the peaking factor curve described above. The purpose of applying the peaking factor curve is to approximate the attenuation of peak flows as they move downstream through the system.

For similar reasons, the model applies an attenuation factor to the cumulative peak RDI/I flows to determine the attenuated RDI/I (ARDI/I). The attenuation factor (AF) is determined by a relationship based on total sewered area, defined by the equation:

$$AF = 1.31 \times (A)^{-0.036}$$

where:

A = cumulative tributary sewered area (acres)

and

ARDI/I = AF x cumulative peak RDI/I

The attenuation curve was developed in the 1980s by simulating the routing of flows in the system for 5- and 20-year design events using a "semi-dynamic" model of the major sewer interceptors. A semi-dynamic model is one that time routes flow hydrographs through the network and accounts for the storage attenuation in the pipes. (A "semi-dynamic" model is distinguished from a "fully dynamic" model in that it does not account for backwater effects in the system.) The routed flows were plotted against the cumulative peak RDI/I flows to determine the equation of the curve.

3.4.5 Design Flow Rules

ArcSNAP calculates peak design flow in each sewer for two flow conditions. The first condition represents peak wet weather flow during the 5- or 20-year design event, defined as follows:

PWWF = ABWF + GWI + ARDI/I

As noted in Section 3.3.3, the 20-year event peak RDI/I rates are computed as 1.58 times the 5-year event peak RDI/I rates.

The second flow condition represents peak dry weather flow, defined as follows:

PDWF = PBWF + GWI

ArcSNAP compares the two peak flow calculations (PWWF versus PDWF) and selects the greater of the two as the modeled segment design flow. In general, the PWWF condition determines the design flow in areas with high RDI/I rates (older areas of the system), and the PDWF is higher in relatively new areas or in areas with higher density development.

3.5 Wastewater Flow Estimates

The ArcSNAP model was used to generate the design wastewater flow projections for the CCCSD collection system for 2010 and 2040 (ultimate) development of the service area. The projected flows are presented in **Table 3-2** for the total service area (including Concord and Clayton), and **Table 3-3** presents the combined flow estimates for Concord and Clayton. The estimated 2010 5-year event peak flow of 195 mgd for the entire service area is about 17 percent lower than the previous estimate of 234 mgd from the 2000 Master Plan Update, and the projected ultimate 20-year event design peak flow of 310 mgd is about 21 percent lower than the 2000 Master Plan projection of 392 mgd. While there has been a small (about 3 mgd) decrease in the projected ultimate BWF, the primary reason for the decreased flow projections is the re-calibration of the RDI/I rates in the model and the elimination of the assumption that I/I will increase in the future due to sewer deterioration.

Table 3-4 and Table 3-5 summarize the model-predicted flows for the 2010 and 2040 flow scenarios at key locations in the collection system.

Table 3-2: CCCSD Design Flows

Flow Scenario	Predicted Flow (mgd)
Average Base Wastewater Flow	
2008	35.8[(1)]
2010	37.2
2040 (Ultimate)	45.4
Peak Wet Weather Flow	
2008, 5-year Design Event	192
2010, 5-year Design Event	195
2010, 20-year Design Event	278
2040, 5-year Design Event	218
2040, 20-year Design Event	310

Note:
(2) Dry weather flow in 2009 was 32.5 mgd, which is typical of the lower flows that many agencies in the Bay Area have seen in the past few years.

Table 3-3: Estimated Flows for Concord and Clayton

Location	ABWF (mgd)		Predicted PWWF (mgd)		
	2010	2040	2010 5-year event	2040 5-year event	2040 20-year event
Concord Pump Station	8.1	8.7	33.7	34.3	49.4
North Meter	1.1	1.1	4.7	4.7	6.8
West Meter	0.2	0.2	0.2	0.2	0.3
Total	**9.4**	**10.0**	**38.6**	**39.2**	**56.5**

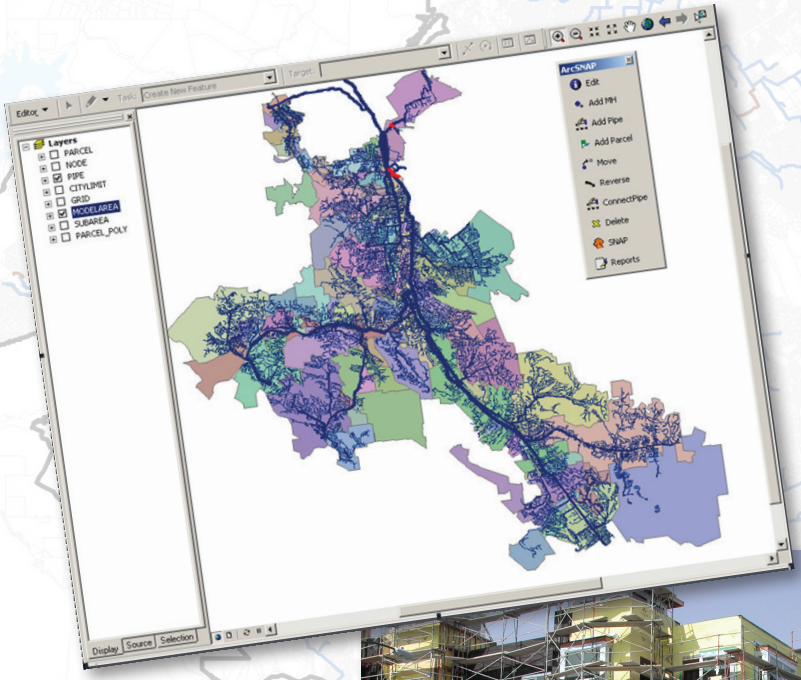
Table 3-4: Summary of Interceptor Flows

Interceptor	Diam. (in.)	Downstream MH	ABWF (mgd)		Predicted PWWF (mgd)		
			2010	2040	2010 5-year event	2040 5-year event	2040 20-year event
Moraga	27	72D4-M34	1.8	2.7	18.0	20.8	30.6
Lamorinda	45	75A3-JS87	5.0	7.1	55.4	62.3	93.4
San Ramon Valley	36	75C6-M66	1.1	1.8	9.4	13.3	24.1
Walnut Creek Bypass	66	75C1-JS81	10.2	12.2	36.4	42.6	56.0
Contra Costa Blvd.	39	47B1-JS24	1.8	1.9	7.5	7.6	10.6
Martinez	42	13B5-M31	1.0	1.7	6.5	10.4	15.1
North Concord	39	13B5-JS22	1.4	1.8	5.3	5.8	7.9
Pleasant Hill/A-Line Relief	102	13B5-JS25	12.6	15.2	61.5	71.1	125
A-Line	90	13B5-JS1	22.2	26.3	124	134	164

Table 3-5: Summary of Flows at Major Pump Stations

Pump Station	ABWF (mgd)		Predicted PWWF (mgd)		
	2010	2040	2010 5-year event	2040 5-year event	2040 20-year event
Concord Industrial	0.1	0.2	0.35	0.5	0.7
Lower Orinda	0.6	0.9	10.2	11.6	17.8
Orinda Crossroads	1.0	1.6	18.0	20.2	30.9
Moraga	1.3	1.8	13.1	14.7	22.0
San Ramon	3.0	3.6	3.8	4.8	6.1
Martinez	1.0	1.5	6.4	10.1	15.0
Fairview	1.0	1.5	6.5	10.1	15.1
Maltby	1.0	1.6	6.5	10.3	15.4

CHAPTER FOUR
Capacity Analysis



Chapter 4 Capacity Analysis

This chapter presents the approach and methodology used to evaluate the District's system hydraulic performance for the Master Plan Update, which include defining model analysis (hydraulic) and capacity deficiency criteria, conducting model simulations, and identifying capacity deficiencies in the existing sewer system under existing and future flow conditions. The capacity analysis was performed using the re-calibrated ArcSNAP model using the updated collection system design flow criteria documented in Chapter 3.

4.1 Modeled Sewer System

The capacity analysis addresses primarily only the 10-inch and larger sewers (called the "modeled system"), although the smaller pipes are still included in the ArcSNAP model database and flows are computed for all pipes in the model. The total length of the modeled system is 1,530,800 feet (approximately 290 miles, or 19 percent of the total system), of which 95 percent are sewers that are 10 inches or greater in diameter. The modeled system was defined by tracing downstream of 10-inch or larger pipes in the ArcSNAP database. Any 8-inch lines that effectively serve as trunk sewers (e.g. serve relatively large tributary areas, or are located downstream of larger diameter pipes) are also included in the modeled system. **Figure 4-1** presents the modeled system for this Master Plan Update. Note that the model does not include any future sewers to serve new developments; rather, for future scenarios, flows from currently unconnected parcels are "loaded" to the model at the nearest existing sewer.

4.2 Model Scenarios

The ArcSNAP model calculates the design flows in each pipe in the modeled network by injecting the flow from each parcel into its "load manhole" and routing the flows through the system. The design flow for each pipe is compared to its full pipe and design capacity. If the flow exceeds design capacity, then ArcSNAP calculates the size of the required parallel or replacement pipe at the same slope as the existing pipe. ArcSNAP also makes it possible to determine pipes with flow velocities that do not meet specified minimum and maximum velocity criteria. **Table 4-1** lists the hydraulic criteria used for the Master Plan Update.

Table 4-1: Hydraulic Criteria Used in Master Plan Update

Criteria	Value	Assumptions
Manning's n	0.013	For all pipe diameters and materials
Pipe Design Capacity	77% of full pipe capacity(1)	For 10-inch and smaller pipes
	Full pipe	For 12-inch and larger pipes
Minimum Flow Velocity	3.0 fps	For all pipe diameters
Size-Down Allowance(2)	10 percent	

Notes:
(1) Approximately equivalent to a d/D ratio of 0.67.
(2) Maximum amount that a required relief pipe diameter can be "sized down" to a standard pipe diameter.

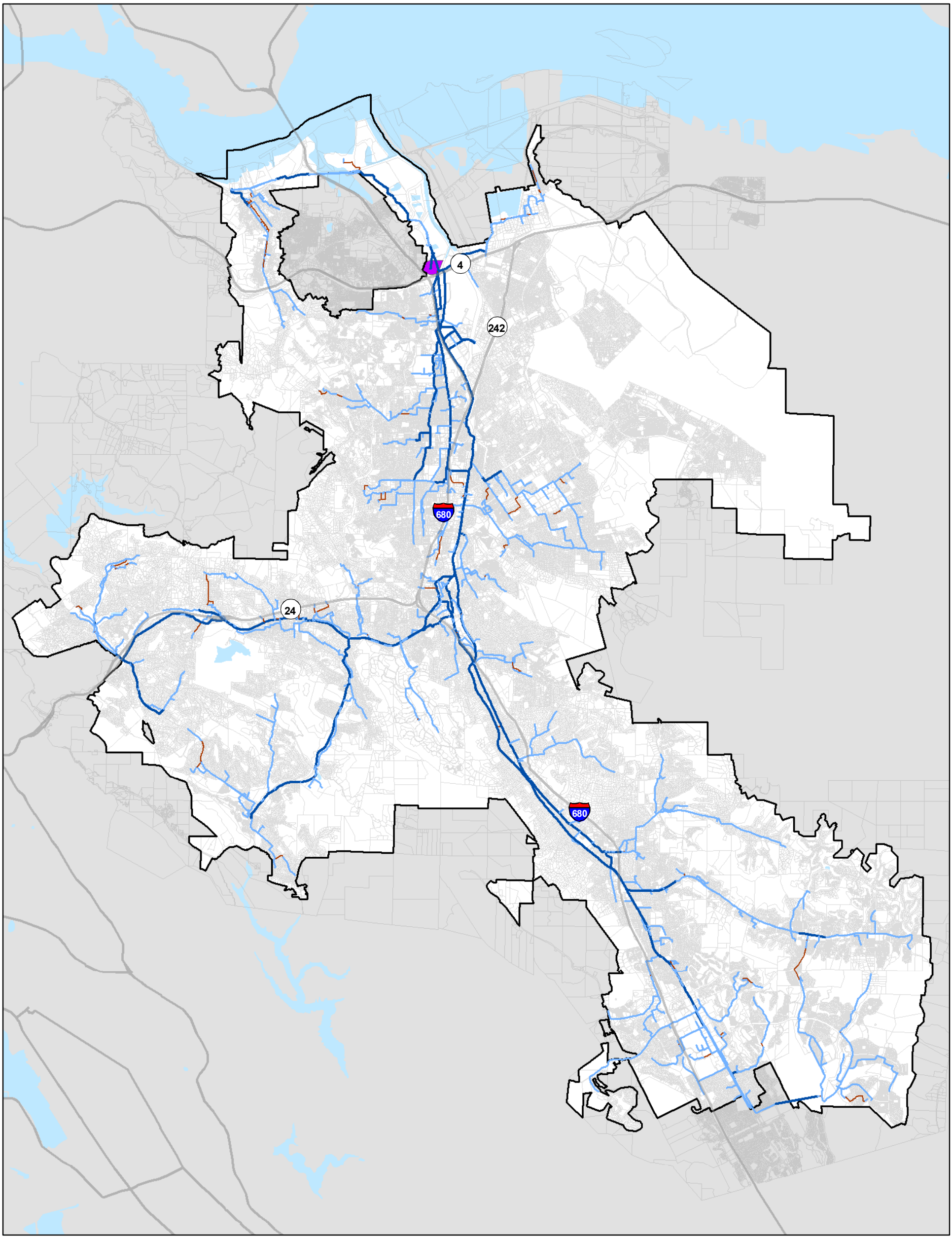


Figure 4-1: Modeled System

CCCSD Collection System Master Plan Update 2010

Legend

Modeled Pipe

- Smaller than 10"
- Trunk (10" - 24")
- Interceptor (>24")

- Study Area Boundary
- CCCSD WWTP

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

4.3 Model Scenarios

The ArcSNAP model was run for four scenarios, defined by near-term (2010) and ultimate (2040) conditions. ArcSNAP can be run for two design storm conditions, defined by the District's 5- and 20-year wet weather events. Model runs for the following scenarios were conducted:

- Scenario 1: 2010 development with 5-year event
- Scenario 2: 2010 development with 20-year event
- Scenario 3: Ultimate (2040) development with 5-year event
- Scenario 4: Ultimate (2040) development with 20-year event

4.4 Capacity Deficiency Criteria

In the 1986 Collection System Master Plan and the 2000 Update, the 5-year event was used as the 'trigger' for identifying and prioritizing capacity deficiencies, and the Ultimate 20-year event was used primarily as design criteria for sizing improvement projects (i.e. determining the required pipe sizes). A similar approach has been used for this study, except that deficiencies under the 20-year event are also presented; however improvements for those deficiencies are not included in the Master Plan Update and will not be included in the Capital Improvement Plan (CIP) because the triggering event for improvements is exceedance of the 5-year, not the 20-year, event.

For the purpose of this evaluation, pipeline capacity deficiencies in modeled trunk sewers have been defined as sewers where the percentage of full pipe capacity is greater than 100 percent. A higher percentage of full pipe capacity of 130 percent and greater was also included to highlight pipes that have more significant insufficient capacity to convey the design events. In most sewers, some amount of flow greater than 100 percent of full pipe capacity can generally be handled, as long as surcharging is limited and the risk of an overflow is not high. A hydraulic gradeline (HGL) analysis is a more precise way to determine this risk; however, the ArcSNAP model has limited capabilities and generally lacks sufficient data (i.e., pipe invert and manhole rim elevations) with which to analyze HGL. Therefore, percent full capacity presents a reasonable approach for assessing capacity deficiency risk.

The ranges for categorizing capacity deficiencies are as follows:

- No capacity deficiency (percent full pipe capacity ≤100%)
- Minor to moderate capacity deficiency (percent full pipe capacity >100% to ≤130%)
- Significant capacity deficiency (percent full pipe capacity >130%)

4.5 Capacity Analysis Results

The results of the model runs indicating deficiencies in the District's sewer network are presented in **Figures 4-2 through 4-5** and summarized in **Table 4-2**. The capacity deficiencies, which are represented by the percentage of full pipe capacity, are categorized into the general ranges described above and denoted by different colors in the figures. Note that almost all of these areas of capacity deficiencies were identified in the 2000 Master Plan Update, although the specific deficient pipe segments within each area may have been slightly different. Descriptions of each of the areas of capacity deficiencies (for the 5-year event) are included in the discussion of potential improvements in the following chapter.

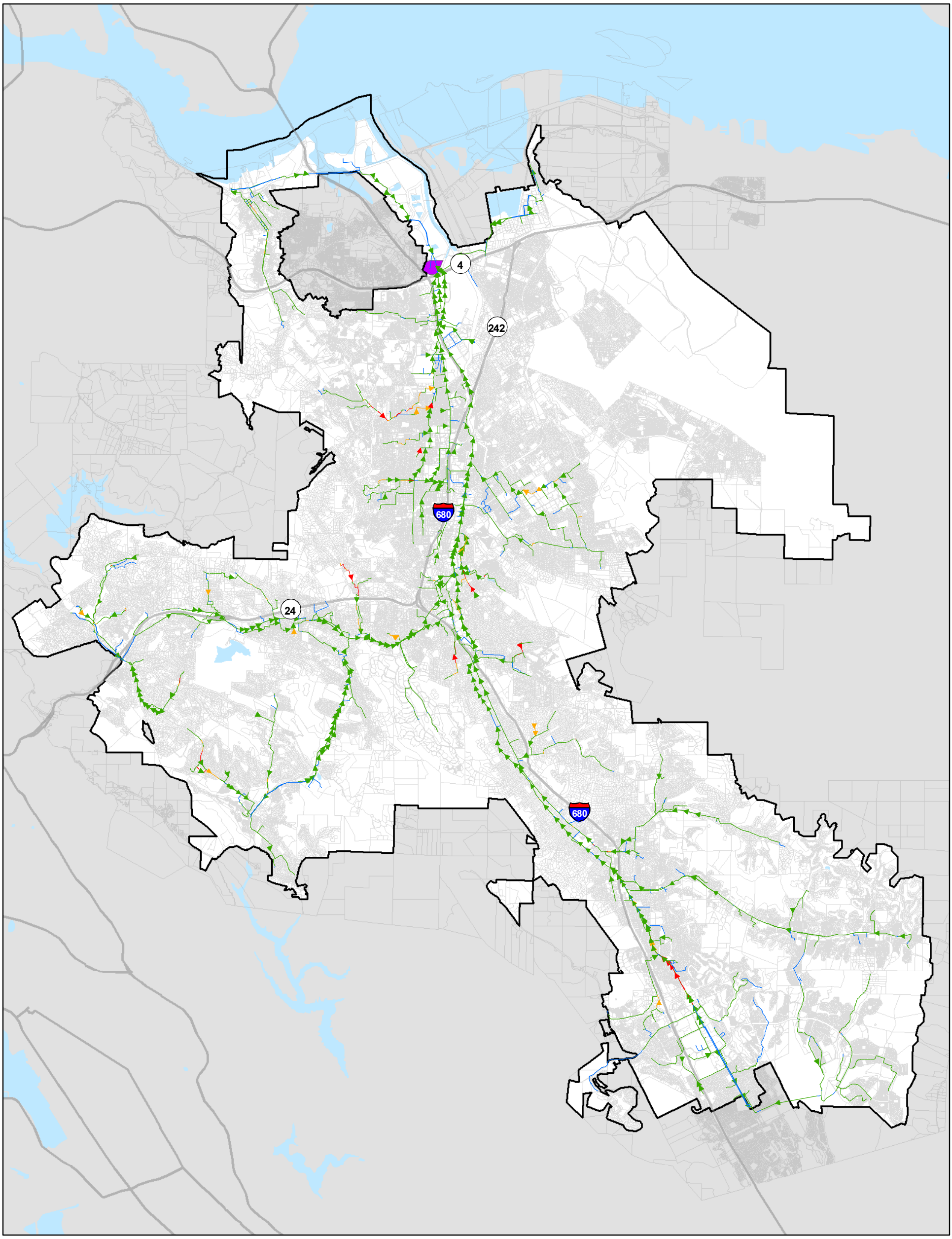


Figure 4-2: Capacity Deficiencies in 2010 Development, 5-Year Event

CCCSD Collection System Master Plan Update 2010

Legend

Percent Full Pipe Capacity

- No Slope or Invert
- <= 100%
- >100% to <=130%
- >130%

- Study Area Boundary
- CCCSD WWTP

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

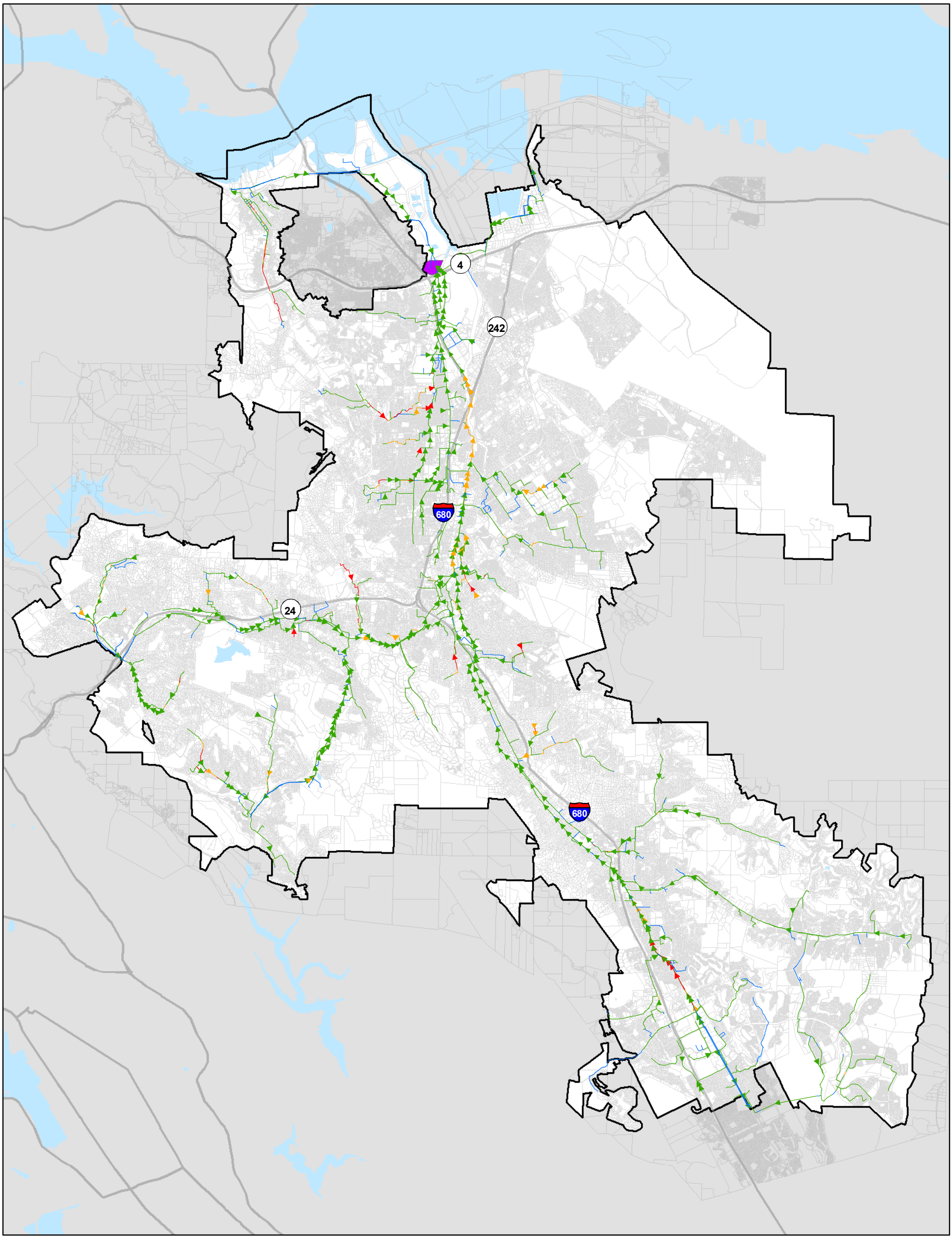


Figure 4-3: Capacity Deficiencies in 2040 Development, 5-Year Event

CCCSD Collection System Master Plan Update 2010

Legend

Percent Full Pipe Capacity

- No Slope or Invert
- <= 100%
- >100% to <=130%
- >130%

- Study Area Boundary
- CCCSD WWTP

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

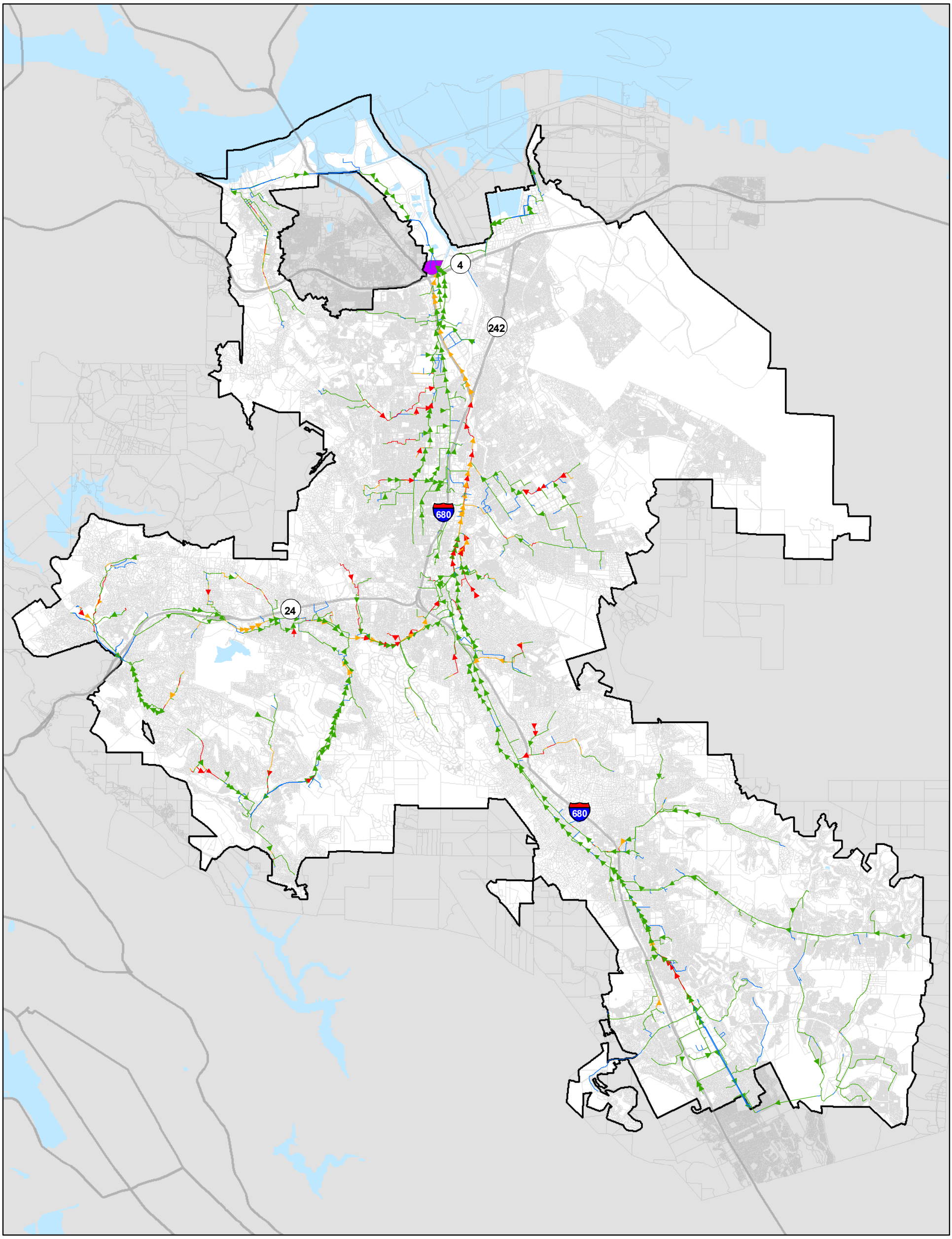


Figure 4-4: Capacity Deficiencies in 2010 Development, 20-Year Event

CCCSD Collection System Master Plan Update 2010

Legend

Percent Full Pipe Capacity

- No Slope or Invert
- <= 100%
- >100% to <=130%
- >130%

- Study Area Boundary
- CCCSD WWTP

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

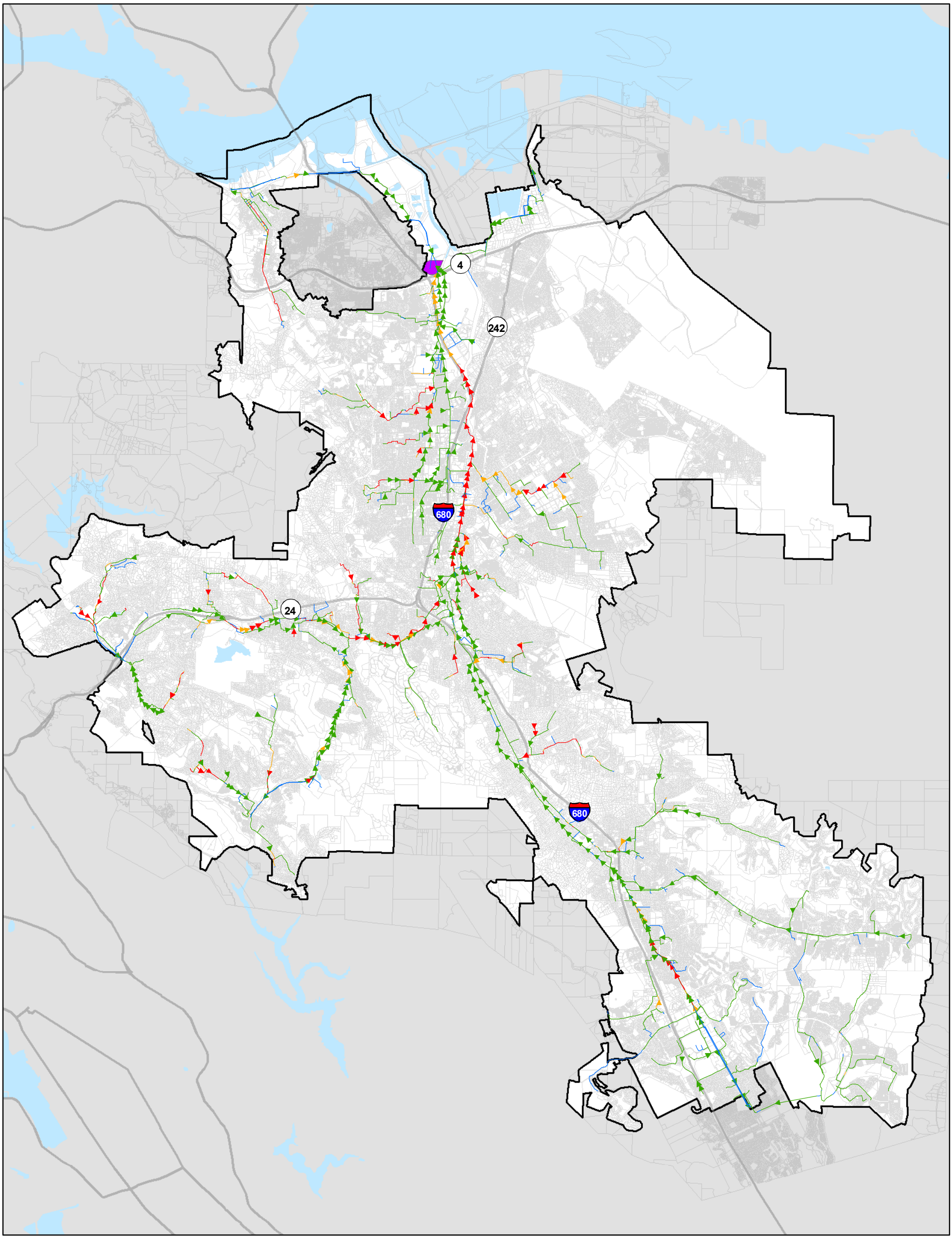


Figure 4-5: Capacity Deficiencies in 2040 Development, 20-Year Event

CCCSD Collection System Master Plan Update 2010

Legend

Percent Full Pipe Capacity

- No Slope or Invert
- <= 100%
- >100% to <=130%
- >130%

- Study Area Boundary
- CCCSD WWTP

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

Table 4-2: Summary of ArcSNAP Capacity Deficiencies

Flow Scenario	Deficiency Criteria[1]	Deficient Pipe in Modeled System	
		Length (feet)	Percent of ModeledSystem
2010 Development, 5-year Design Event	> 100% to ≤130% full pipe	46,304	3%
	>130% full pipe	27,703	2%
2040 Development, 5-year Design Event	> 100% to ≤130% full pipe	79,444	5%
	>130% full pipe	51,348	3%
2010 Development, 20-year Design Event	> 100% to ≤130% full pipe	108,896	7%
	>130% full pipe	109,722	7%
2040 Development, 20-year Design Event	> 100% to ≤130% full pipe	98,919	7%
	>130% full pipe	162,228	10%

Notes:
(1) Based on design flow, which is maximum of peak dry weather flow (PDWF) and design event peak wet weather flow (PWWF).

4.6 Identification of Project Corridors

The sewers identified as capacity deficiencies were grouped together by similar deficiency level and proximity to each other, and potential project areas were delineated. Project areas were identified based on the following indicators:

- Sewers that indicated peak flows of over 130 full pipe capacity under the 2010 level of development, 5-year event scenario with nearby (upstream or downstream) pipes showing over 100 percent full pipe capacity.
- Sewers that indicated peak flows of over 130 full pipe capacity under the 2040 level of development, 5-year event scenario with nearby (upstream or downstream) pipes showing over 100 percent full pipe capacity, but not showing significant deficiencies under the 2010 level of development, 5-year event.

The above deficiencies were identified as project corridors and considered for the development of capacity improvement projects because the exceedances were predicted to occur under a 5-year event, which is defined as the triggering event in the Master Plan Update. Corridors that indicated capacity deficiencies under the 20-year event scenario for either the 2010 or 2040 level of development, but which did not show significant deficiencies in the 5-year event, were considered lower level deficiencies, and therefore, were not identified as project corridors or included in the development of capacity improvement projects.

The locations of the project corridors are shown in **Figure 4-6**. The project corridors were given unique IDs based on their location within the District (map grid number), and were further analyzed to develop recommended capacity improvement projects, described in Chapter 5.

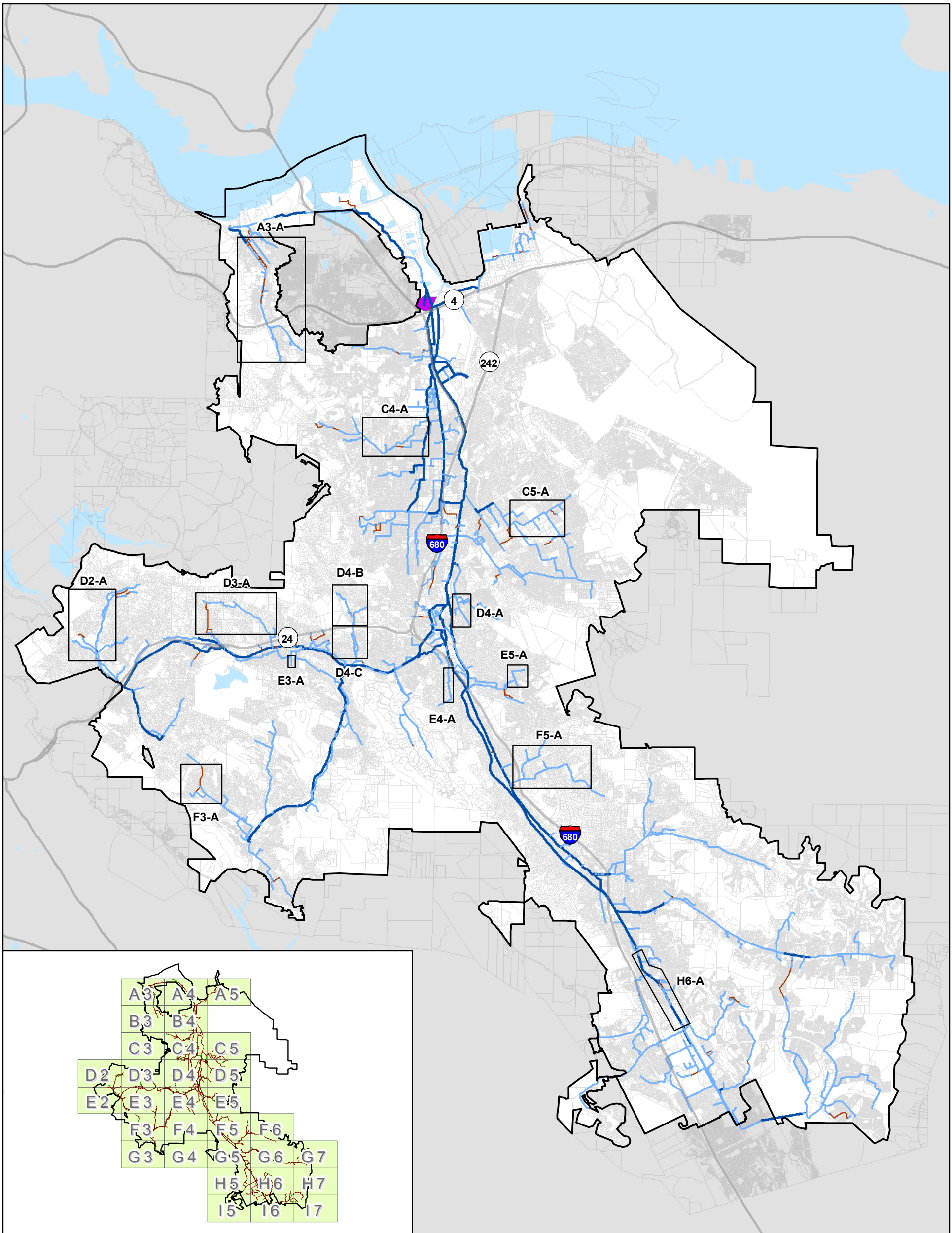


Figure 4-6: Location of Corridor Project Areas

CCCSD Collection System Master Plan Update 2010

Legend

Modeled Pipe

- Smaller than 10"
- Trunk (10" - 24")
- Interceptor (>24")

- Project Corridor
- Study Area Boundary
- CCCSD WWTP

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

4.7 Hydraulic Gradeline Analysis

Based on consultation with District staff, HGL analysis using flow conditions for the 2010 development, 5-year event was performed on five selected project corridor areas. The areas were selected based on need for increased confidence in the model results and better understanding of potential risks. The primarily purpose of the HGL analysis was to assess the likely severity and extent of sewer surcharge for potential use in helping to prioritize capacity improvement projects.

The HGL analysis involves calculating the backwater caused by a downstream capacity deficiency. Due to the static nature of the ArcSNAP model, the calculations assume that all peak flows occur at the same time, and that there is no reduction in peak flows due to pipe or manhole storage or overflow. Therefore, the analysis can be assumed to be conservative. The HGL analysis requires manhole rim and pipe invert elevations, which are not available for all pipes in the model. Therefore, HGL analysis was conducted for reaches within the selected project corridors that contained sufficient manhole rim and pipe invert elevation data.

Results of the HGL analysis are summarized in **Table 4-3**. It should be noted that HGL analysis may be of limited usefulness for pipes where design flows greatly exceed the existing pipe capacities over long reaches, such that the HGL rises far above the ground surface. In the latter case, HGL analysis can only show the increased potential for overflows to occur, but cannot quantify their amount or location. Additional details of the HGL analysis are included in the TM in **Appendix E**.

Table 4-3: Project Corridors Identified for Hydraulic Gradeline (HGL) Analysis

Project Corridor ID	Project Corridor Name	Segment Analyzed (US to DS MH)	Results(1), (2)
A3-A	Martinez – Alhambra Avenue	44A1 M 3 to 10A6 M13	Predicted overflows.
E3-A	Moraga – Moraga Road	72B4 M 51 to 72B3 M 43	HGL within 1 feet of ground surface at MH 72B4 M 47.
E4-A	Walnut Creek – Lancaster Road	75B6 M 26 to 75C4 M 16	Predicted overflows.
E5-A	Walnut Creek – Palmer Road	75E4 M 32 to 75E5 M 18	HGL within 0.5 feet of ground surface at MH 75E5 M32.
F3-A	Moraga – Moraga Way	73C3 M 1 to 73D5 M 6	Some predicted overflows; HGL at or close to ground surface along most of the segment length.

Notes:
(1) Based on 2010 development, 5-year event scenario.
(2) Areas with predicted overflows or HGL very close to ground will be further investigated and monitored during field surveys.

4.8 Impact of Concord Naval Weapons Station Reuse Project Flows

A sensitivity analysis was conducted using ArcSNAP to assess the impact of future additional flows from potential development in the former Concord Naval Weapons Station site. The proposed Concord Community Reuse Plan, which represents the "Cluster Villages" preferred alternative, would include over 12,000 residential units and associated community facilities located on about 5,000 acres of land.

The methodology and results of the sensitivity analysis are summarized below. Details of the analysis can be found in the TM on Concord Naval Weapons Station Loads & Sensitivity Analysis in **Appendix B**.

4.8.1 Estimated Wastewater Flows from Concord Community Reuse Plan

Land use data listed in the Final Environmental Report (EIR) for the Concord Community Reuse Plan were used as a basis for estimating wastewater flows. For estimating flows for this sensitivity analysis, unit wastewater flow rates were derived primarily from the unit flow rates used in this Collection System Master Plan Update, with specific rates for hotels and educational institutions taken from the Final EIR.

The projected flows for the "Clustered Villages" preferred alternative is 2.7 mgd average dry weather flow. Of the total 2.7 mgd, approximately 1.9 mgd (70 percent) is included in the first phase of the development (area in the vicinity of the North Concord BART station), with the remaining 0.8 mgd (30 percent) in the second phase (area southwest of Willow Pass Road).

The calculated wastewater flow estimate of 2.7 mgd for the preferred alternative is relatively close to the estimate provided in the Final EIR, which is 2.9 mgd. The difference between the estimates is due to different flow estimation methodologies being applied. It should be noted that since the CNWS development is still in the planning phase, the flow estimates will likely be adjusted closer to the time thatthe development nears construction phase.

4.8.2 Incorporation of Concord Community Reuse Plan Flow Projections into ArcSNAP

Wastewater flow projections for the Reuse Plan were incorporated into the ArcSNAP model to conduct a sensitivity analysis of the impact of these flows on the District's existing collection system. In anticipation of increased capacity requirements due to the CNWS development, the District is considering relocating the Concord Industrial Pump Station closer to the CNWS development and deepening and upsizing sewers to accommodate future flows. Since most of the development is occurring close to the Concord Industrial Pump Station area, the District's northern line could be extended to receive flows from the CNWS development when the pump station is moved. The District also considered the option of routing flows from the CNWS via the City of Concord's sewers to the District's A-Line Relief Interceptor, but noted that the City of Concord would need to construct a significant amount of new infrastructure for that option.[7]

The District has identified three preliminary potential locations where wastewater flows from the CNWS development could be discharged into the District's collection system. These locations are shown in **Figure 4-7**. Location A indicates the general location where a new pumping station is proposed. However, the topography in this area is steeper and there is a hill between Location A and WWTP. Locations B and C are two other possible load points for the CNWS flows. Location B is the discharge point of the current Concord Industrial Pump Station force mains on Bates Avenue, and Location C is at the upstream end of the 39-inch North Concord trunk sewer on Arnold Industrial Highway east of Solano Way. The route from the Location B to the WWTP is flatter compared to that from Location A. Based on direction from the District, two locations (B and C) were modeled as load points for CNWS flow in separate model runs.

It should be noted that the sensitivity analysis is based on a conservative assumption that all CNWS future flows would be discharged directly into the District's collection system at a single location. However, it is probable that a portion of the CNWS flows would be conveyed through the City of Concord collection system, and enter the District system at the A-line Intertie near Home Depot, thereby reducing the flows that would need to be handled by other District facilities. The A-line is believed to have sufficient capacity for any CNWS flows that would be routed that way, although this analysis will be documented in the parallel study (beginning in FY 2010-11) to be conducted on sewer flows.

[7] Discussed during District meeting on March 5, 2009.

4.8.3 Sensitivity Analysis Results

The sensitivity analysis evaluated the impacts of the CNWS development on capacity requirements in the District's trunk sewer system for the following scenarios:

- 2025 development with 5-year event (assumed to represent buildout of first phase)
- 2040 development with 5-year event (assumed to represent buildout of second phase)
- 2040 development with 20-year event (for sizing of new or relief facilities)

More recent information obtained from the Concord Planning Department, which took into consideration findings from the completed Project EIR and the current decline in the housing market, indicates that above assumptions regarding rate of development may be aggressive, as the currently anticipated start of development is 2020, with buildout occurring over an approximate 30-year period.[8]

The results of the model runs indicate that when additional flows generated by the CNWS development are discharged into the District's system at Location B, these flows would cause an exceedance in capacity in portions of the existing trunk sewer between the discharge point and WWTP, and would require capacity improvements to handle the increased flows (refer to TM on CNWS Development Sensitivity Analysis for discussion of the maximum flows that could be conveyed without triggering any deficiencies). In the 2025 (Phase 1) development with 5-year event scenario, the discharge of additional flows from the CNWS development at Location B would result in peak flows exceeding full pipe capacity in the 18-inch gravity sewer in Bates Avenue to Nelson Avenue (approximately 4,000 feet of sewers). In the 2040 development with 5-year event scenario, the entire segment between Locations B and C, as well as the 39-inch trunk from the east side of Walnut Creek to the junction with the A-Line Relief Interceptor at the Grayson Creek crossing would be capacity deficient (a total of over 7,700 feet). With the discharge of CNWS flows to Location C, only the 39-inch segment noted above (approximately 2,500 feet of pipe) would require capacity relief. Note that there is no increase in peak design flow under a 20-year event scenario because, in this case, the governing ArcSNAP design flow rule is peak dry weather flow rather than wet weather flow.

Based on the model results, it would appear that conveying the CNWS Reuse Project flows to Location C on the 39-inch North Concord trunk would have the least impact on the District's system by minimizing the amount of capacity relief that would need to be provided and potentially delaying the need for improvements until the later phases of the development.

[8] Per email communication with Michael Wright, Director of the Concord Community Reuse Project on March 8, 2010.

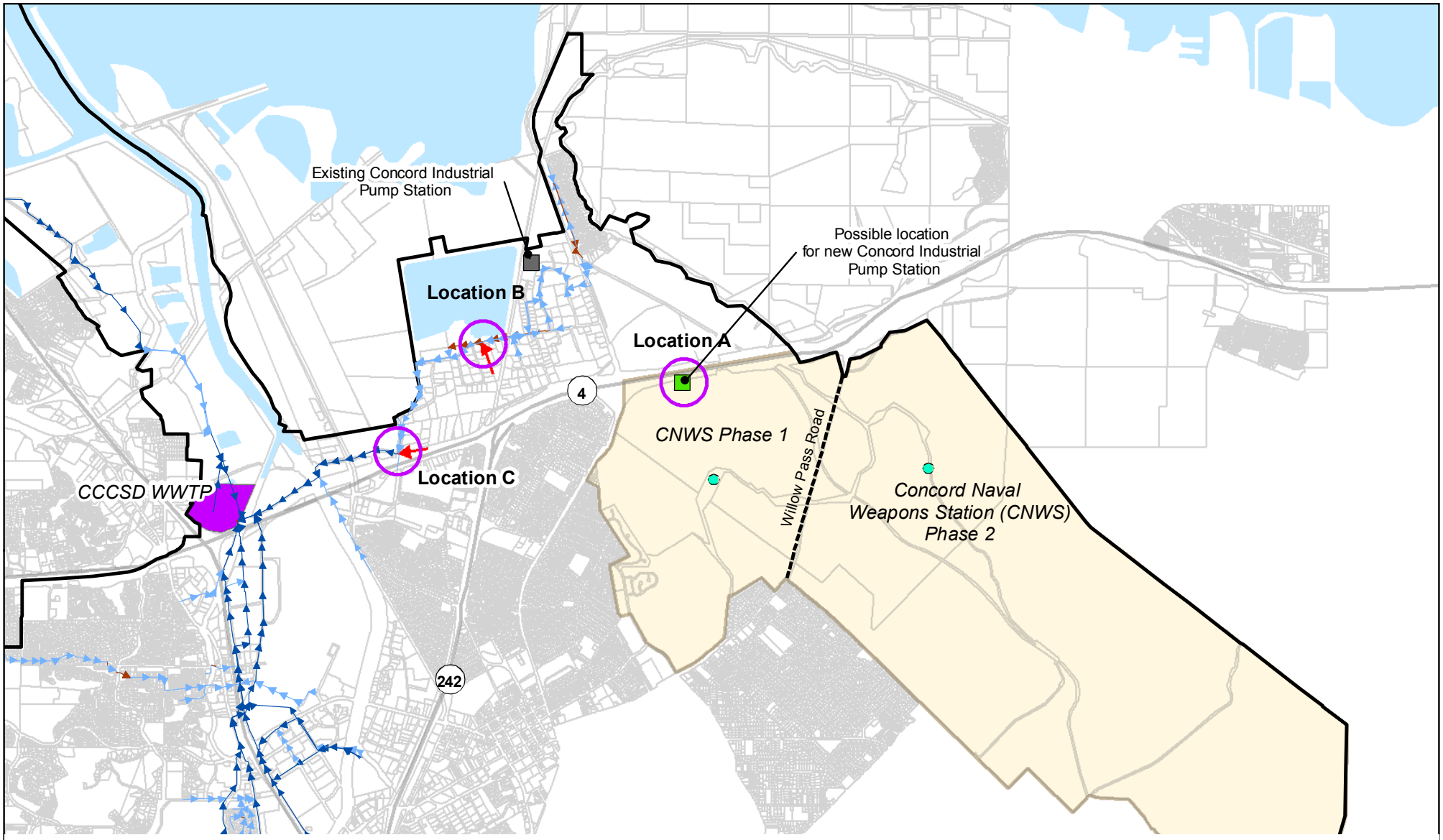


Figure 4-7

Potential Load Points from CNWS Development

Study Area Boundary

CCCSD WWTP

Modeled Sewers

Smaller than 10"

Trunk (10" - 24")

Interceptor (>24")

'Temporary' CNWS Load Pipe

Potential Discharge Location

CCCSD Collection System Master Plan Update 2010

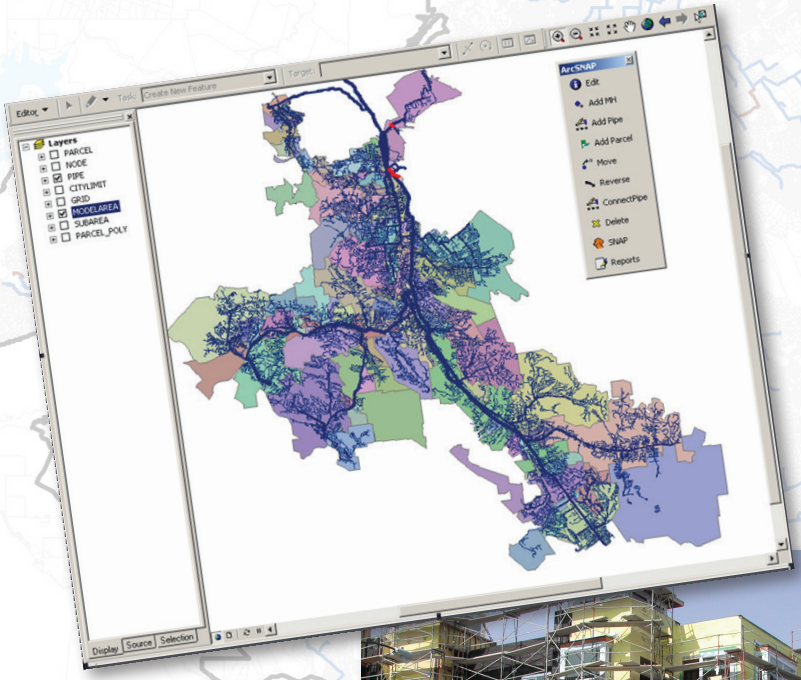
N

0 2,500 5,000 10,000 Feet

RMC Water and Environment, 2010

CHAPTER FIVE

Development of Capacity Improvements Projects



Chapter 5 Development of Capacity Improvement Projects

As described in Chapter 4, the capacity deficiencies identified in ArcSNAP were grouped into project corridors based on the degree of capacity deficiency under existing or future conditions for the 5-year design event. This section describes the development of a preliminary solutions model to address these areas of capacity deficiencies. The solutions model consists of potential improvements (e.g. relief or replacement sewers) to meet the District's collection system needs through the year 2040, which is designated as the ultimate or buildout year within the planning horizon of this Master Plan Update report.

5.1 Preliminary Solutions Model

A preliminary solutions model was developed to identify capacity relief solutions for alignments that were identified as deficient under the 5-year design events for the 2010 and 2040 development scenarios. Only deficient sewers in the modeled network were considered for capacity improvements. Specifically, the project corridor areas shown in **Figure 5-1** were identified for capacity improvements to be included in the preliminary solutions model.

5.1.1 Preliminary Solutions Model Criteria

The following assumptions were made in the preliminary solutions model:

- Pipes in the modeled system that are deficient (i.e. more than 100% full) during the 5-year storm events for the 2010 and/or 2040 level of development would be improved.
- Short segments that were not identified as deficient but are located between deficient segments would be improved together with the deficient segments.
- Isolated, single-pipe deficiencies that do not have any capacity deficiency issues upstream or downstream of the pipe would not be addressed. These segments, including other isolated segments outside of the project corridors that are predicted to be capacity deficient under the 5-year event, are indicated in the model results tables in **Appendix G**.
- Capacity improvements were developed assuming pipe replacement (upsizing) unless the deficiency was also identified in the 2000 Master Plan Update and a specific new alignment was proposed in that report.

Sewer Design Criteria

Improvements in the preliminary solutions model were developed based on the District's standard design criteria, which was also used in the 2000 Master Plan Update. The capacity improvements were sized according to the following design criteria:

- Design event
  - 20-year event
  - Ultimate (2040) level of development
- Maximum flow depth
  - 8-inch and 10-inch pipes flowing 2/3 full ($d/D \leq 0.67$)[9]
  - 12-inch and larger pipes flowing full without surcharge ($d/D \leq 1.0$)

[9] Equivalent to approximately 77% of full pipe capacity.

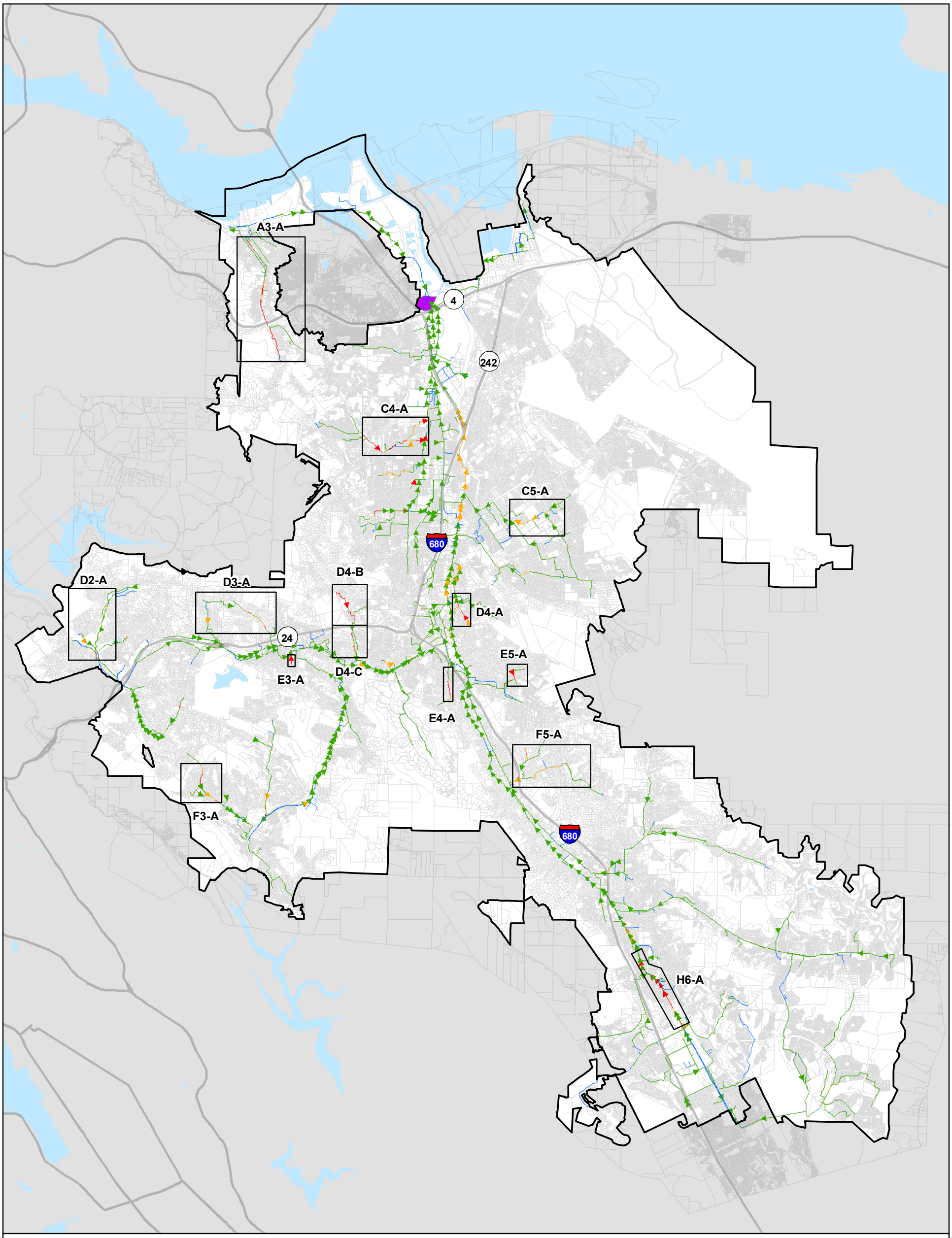


Figure 5-1: Capacity Deficiency Corridors Identified for Projects

Legend

CCCSD Collection System Master Plan Update 2010

Percent Full Pipe Capacity

2040 Development, 5-Year Event

- No Slope or Invert
- <= 100%
- >100% to <=130%
- >130%

Project Corridor

Study Area Boundary

CCCSD WWTP

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

- Diameter of gravity sewers determined based on Manning's equation, using a roughness coefficient (n) of 0.013
- Design Velocity
  - Minimum velocity of 3 fps for all pipes when flowing full
  - Maximum velocity of 15 fps for all pipes

The improvements identified in this section are based on the size of pipes required to convey the design peak flow, which in many areas of the system represents a large (20-year frequency) wet weather event. Pipes sized for these flows may not be able to provide the required minimum flushing velocities under dry weather flow conditions. Therefore, during the design of these projects, consideration of potential low flow conditions will be appropriate. There may be a need to consider modifications to the proposed improvements to better achieve flushing velocities, or identify the need for more frequent cleaning of these pipes.

Flow Split Updates

Flow splits were changed from the default setting when there was an obvious need to redirect flow. This occurred in two situations:

- A new alignment (relief sewer) was added to the network and the flow split was changed at the upstream node to direct flow into the relief sewer.
- In some corridors where there are two parallel sewers, flow was directed away from the smaller pipe into the larger pipe to avoid having to upsize both pipes.

Locations in the modeled system where changes to flow splits were made are indicated in the individual project maps in the following section.

5.2 Recommended Projects

Table 5-1 lists the grouped areas of capacity deficiencies that were considered for improvements in the solutions model, the name of the corridor or street alignment, and the preliminary solution.

Table 5-1: Identified Project Corridors and Preliminary Solutions

Project ID	Name of Corridor	Figure No.	Improvements Incorporated into Solutions Model
A3-A	Martinez - Alhambra Ave	5-2	Pipes upsized along Kim Ct., Haag Rd., and Alhambra Ave [(1)]. At several points along Alhambra Ave, between K St. and D St., manholes and interconnecting pipes reconfigured to direct flow into the larger of the two parallel pipes in order to mitigate downstream deficiencies.
C4-A	Pleasant Hill -Pleasant Hill Rd/Grayson Creek	5-3	Pipes upsized along Pleasant Hill Rd. Pipes along Grayson Creek upsized and flow redirected to a new alignment as recommended in the 2000 Master Plan update. Proposed project will need to be verified for inclusion in the planned renovation/rehabilitation program.
C5-A	Walnut Creek - Contra Costa Canal Trail	5-4	Pipes upsized to 24" along Contra Costa Canal.

Table 5-1 continued on following page

Project ID	Name of Corridor	Figure No.	Preliminary Solution to Capacity Deficiencies
D2-A	Orinda - Miner Road/Camino Pablo	5-5	Pipes upsized to 15" along Camino Pablo. The existing pipe crossing San Pablo Creek is identified as a deficiency; however, because it is built into the bridge, and because the pipes upstream and downstream are not deficient, it is unlikely to have any significant risk of overflow. Therefore, it is recommended that District monitor the situation and evaluate need for a project, if necessary, in the next Master Plan update. For further confirmation, District could obtain rim and invert elevations so that ArcSNAP HGL analysis can be run.
D3-A	Lafayette - Happy Valley Road	5-6	Two segments of pipe upsized along Happy Valley Road to 15" and 18". The District recently completed improvements between these two segments; therefore, those pipes would not need to be improved.
D4-A	Walnut Creek - Walnut Blvd.	5-7	New pump station and new alignment as recommended in the 2000 Master Plan update. Project recommended for future flow verification.
D4-B	Lafayette - Pleasant Hill Road (Phase I – north of Hwy 24)	5-8	Flow directed to a new alignment along Pleasant Hill Rd based on the recommendations in the 2000 Master Plan update, and pipes upsized along Nogales St.
D4-C	Lafayette – Pleasant Hill Road (Phase II – south of Hwy 24)	5-8	Pipes upsized to 21" along Buchan Dr. and Pleasant Hill Rd. A small segment along this alignment that crosses through private easements is not deficient and would not be upsized.
E3-A	Lafayette – Moraga Road	5-9	Pipes upsized to 15". Project recommended for future flow verification.
E4-A	Walnut Creek – Lancaster Road	5-10	Pipes upsized. The District has identified this project as high priority because there is a sewer line crossing a storm drain.
E5-A	Walnut Creek – Palmer Road	5-11	Pipes upsized to 15". A small pipe also upsized at Sylvan and Palmer Road, and the flow split modified in order to divert flow to the 15" pipe. The District indicated that work in this project corridor may be driven by renovation needs.
F3-A	Orinda – Moraga Way	5-12	Pipes upsized to 12" and 15". The District noted that there is a 5-year moratorium on this road, and only part of the sewer next to the school was fixed.
F5-A	Alamo – Stone Valley Road	5-13	Pipes upsized to 15", 21" and 27".
H6-A	San Ramon – San Ramon Schedule C	5-14	This project is part of the San Ramon Schedule C interceptor relief project – installation of a 36" parallel pipe from the upstream end to St. James Rd.

Notes:
(1) Deficiencies identified in this update are not all in the same portion of corridor as in the 2000 Master Plan Update.

Figures 5-2 through 5-14 show each of the project corridors and preliminary solutions. The figures show the pipes that are deficient under 2040 development, 5-year design event, and the location of improvements needed to address those deficiencies. Except as noted, the solutions are based on replacing the existing pipe with a pipe sized to convey the 2040 development, 20-year event peak flow, as determined by the ArcSNAP model. The solution for San Ramon – San Ramon Schedule C (Corridor H6-A, Figure 5-14) is based on the current District design for the San Ramon Interceptor Schedule C- Phase 2 project. The solutions for Pleasant Hill-Grayson Creek (Corridor C4-A, Figure 5-3), Walnut Creek – Walnut Boulevard (Corridor D4-A, Figure 5-7) and Lafayette - Pleasant Hill Road (Corridor D4-B, Figure 5-8) are based on new alignments, as proposed in the 2000 Master Plan Update.

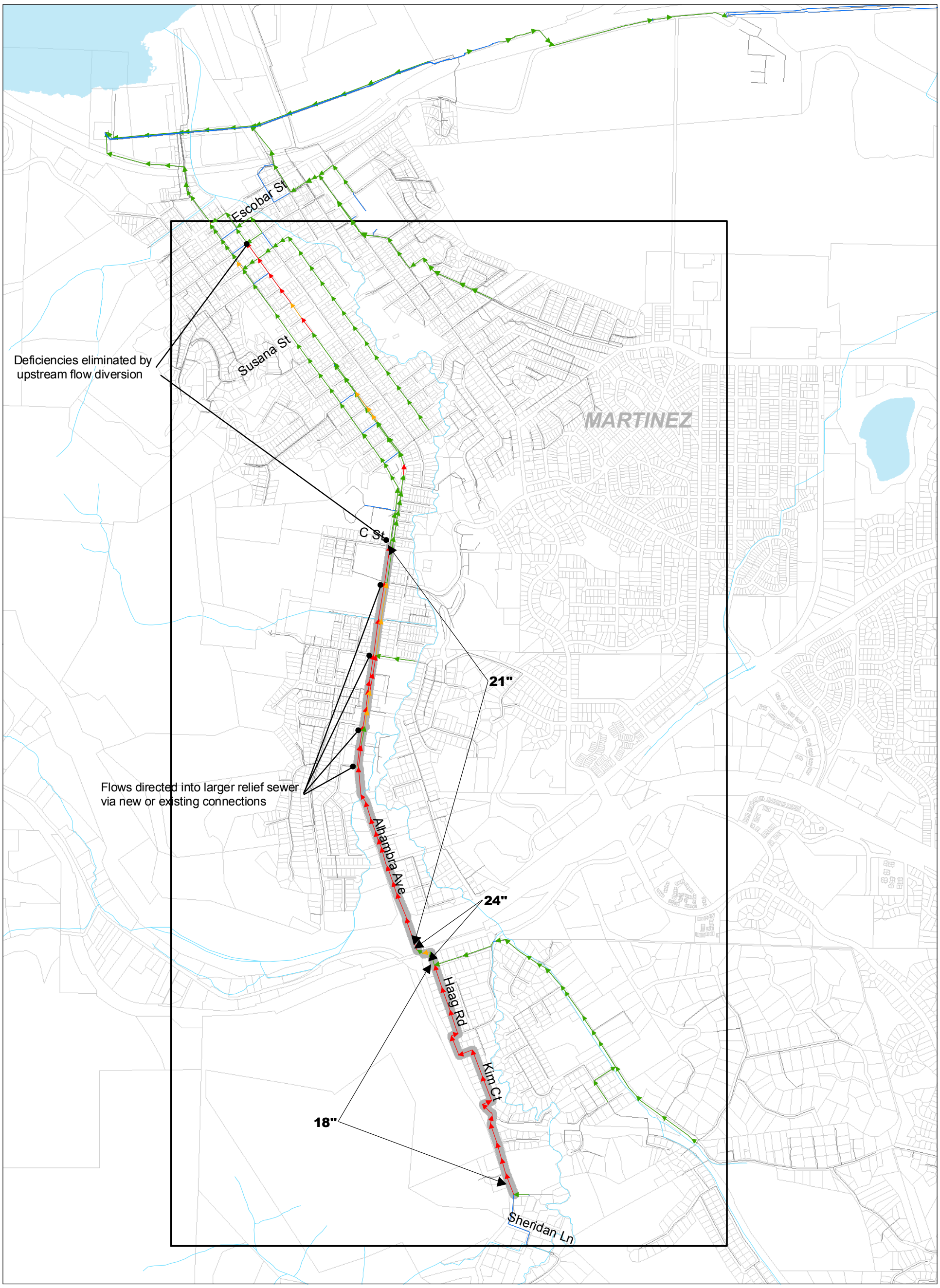


Figure 5-2 **Capacity Deficiencies and Improvements for Corridor A3-A: Martinez-Alhambra Avenue**

Percent Full Pipe Capacity
2040 Development, 5-year Event
- No Slope or Invert Elev
- <=100%
- >100% to <=130%
- >130%

New Pipe Diameter 24"
(sized for 2040 development, 20-year event)
New or Modified Pipe
Existing Pipe Diameter 12"
Creek
Waterbody

Project Corridor

CCCSD Collection System Master Plan Update 2010

0 500 1,000 2,000 Feet

RMC Water and Environment, 2010

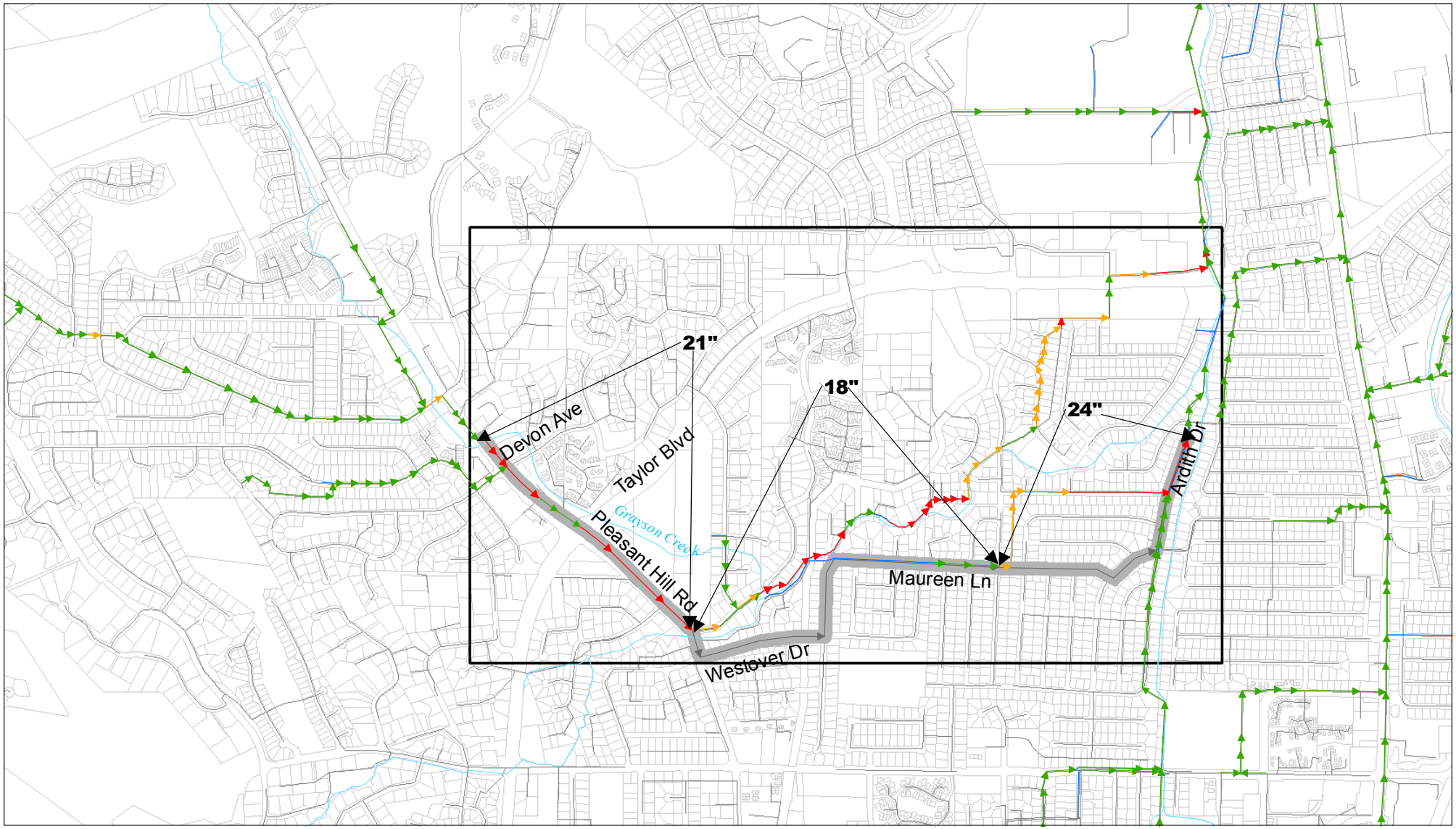


Figure 5-3 Capacity Deficiencies and Improvements for Corridor C4-A: Pleasant Hill - Pleasant Hill Road/Grayson Creek

Percent Full Pipe Capacity
2040 Development, 5-year Event
- No Slope or Invert Elev
- <=100%
- >100% to <=130%
- >130%

New Pipe Diameter 24"
(sized for 2040 development, 20-year event)
New or Modified Pipe
Existing Pipe Diameter 12"
Creek
Waterbody

Project Corridor

CCCSD Collection System Master Plan Update 2010

0 500 1,000 2,000 3,000 Feet

RMC Water and Environment, 2010

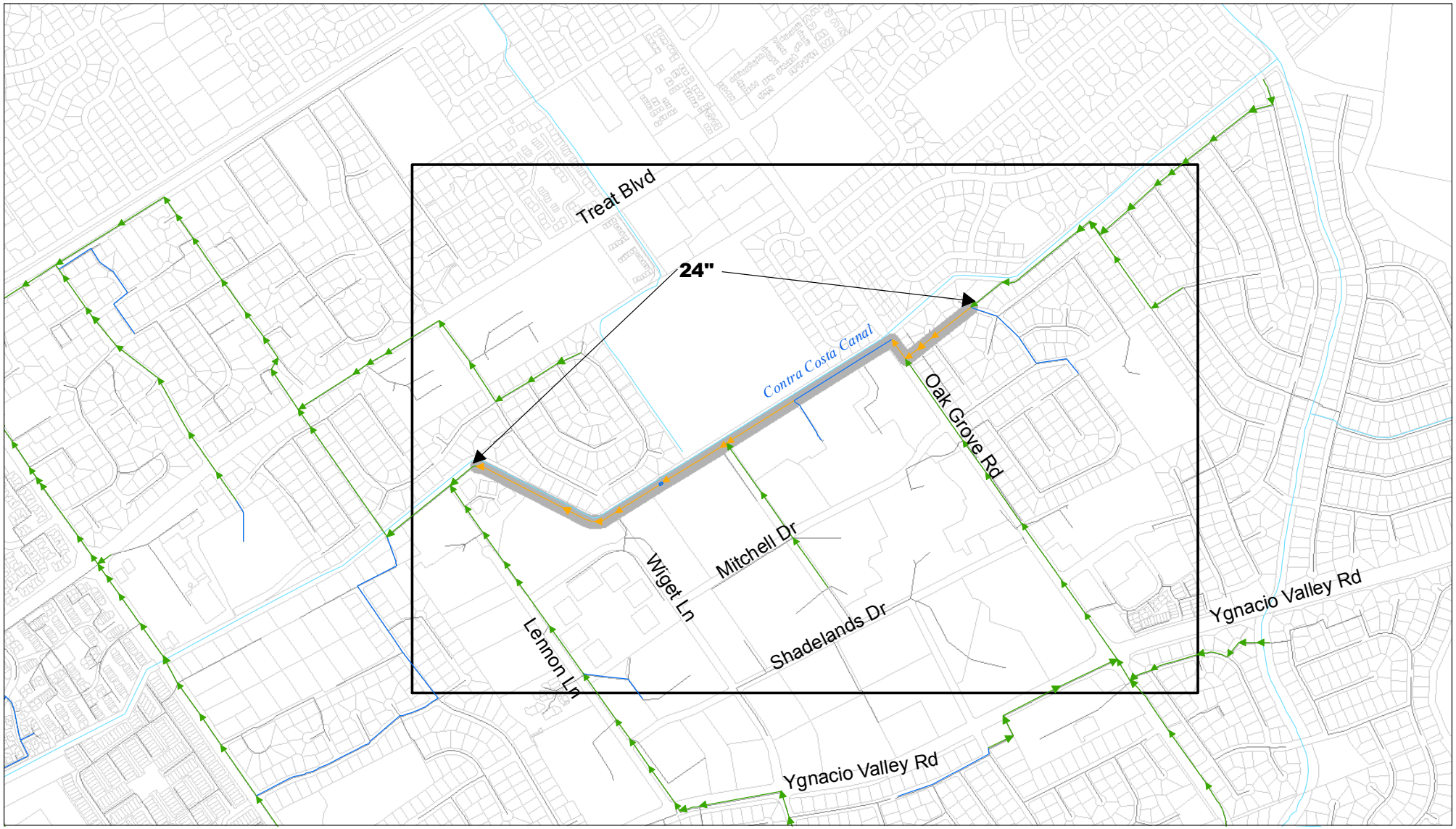


Figure 5-4 **Capacity Deficiencies and Improvements for Corridor C5-A: Walnut Creek - Contra Costa Canal Trail**

Percent Full Pipe Capacity
2040 Development, 5-year Event
- No Slope or Invert Elev
- <=100%
- >100% to <=130%
- >130%

New Pipe Diameter 24"
(sized for 2040 development, 20-year event)
New or Modified Pipe
Existing Pipe Diameter 12"
Creek
Waterbody

Project Corridor

CCCSD Collection System Master Plan Update 2010

0 500 1,000 2,000 Feet

RMC Water and Environment, 2010

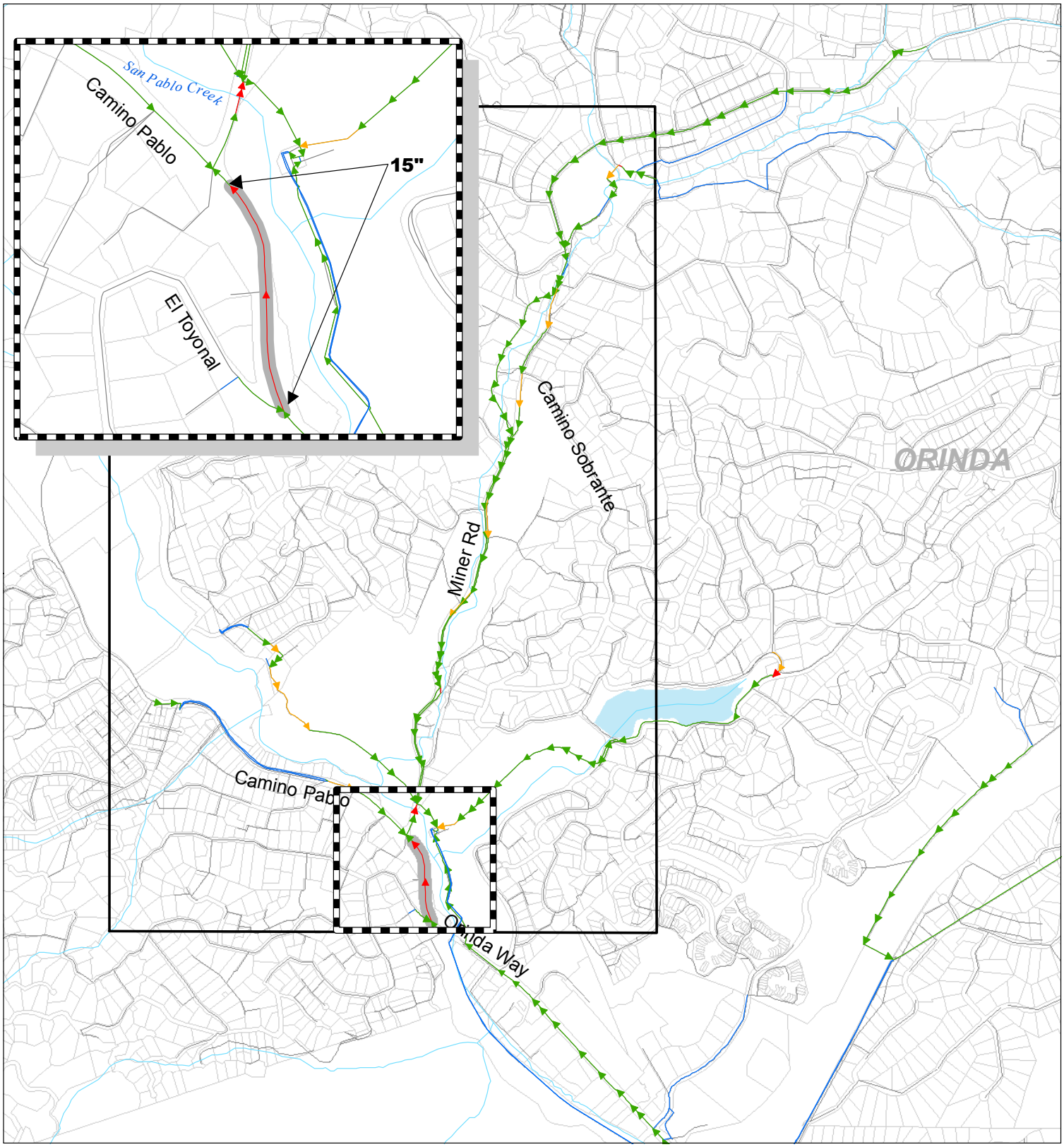


Figure 5-5 **Capacity Deficiencies and Improvements for Corridor D2-A: Orinda - Miner Road/Camino Pablo**

Percent Full Pipe Capacity
2040 Development, 5-year Event
- No Slope or Invert Elev
- <=100%
- >100% to <=130%
- >130%

New Pipe Diameter ← **24"**
(sized for 2040 development, 20-year event)
New or Modified Pipe
Existing Pipe Diameter 12"
Creek
Waterbody

Project Corridor

CCCSD Collection System Master Plan Update 2010

N

0 500 1,000 Feet

RMC Water and Environment, 2010

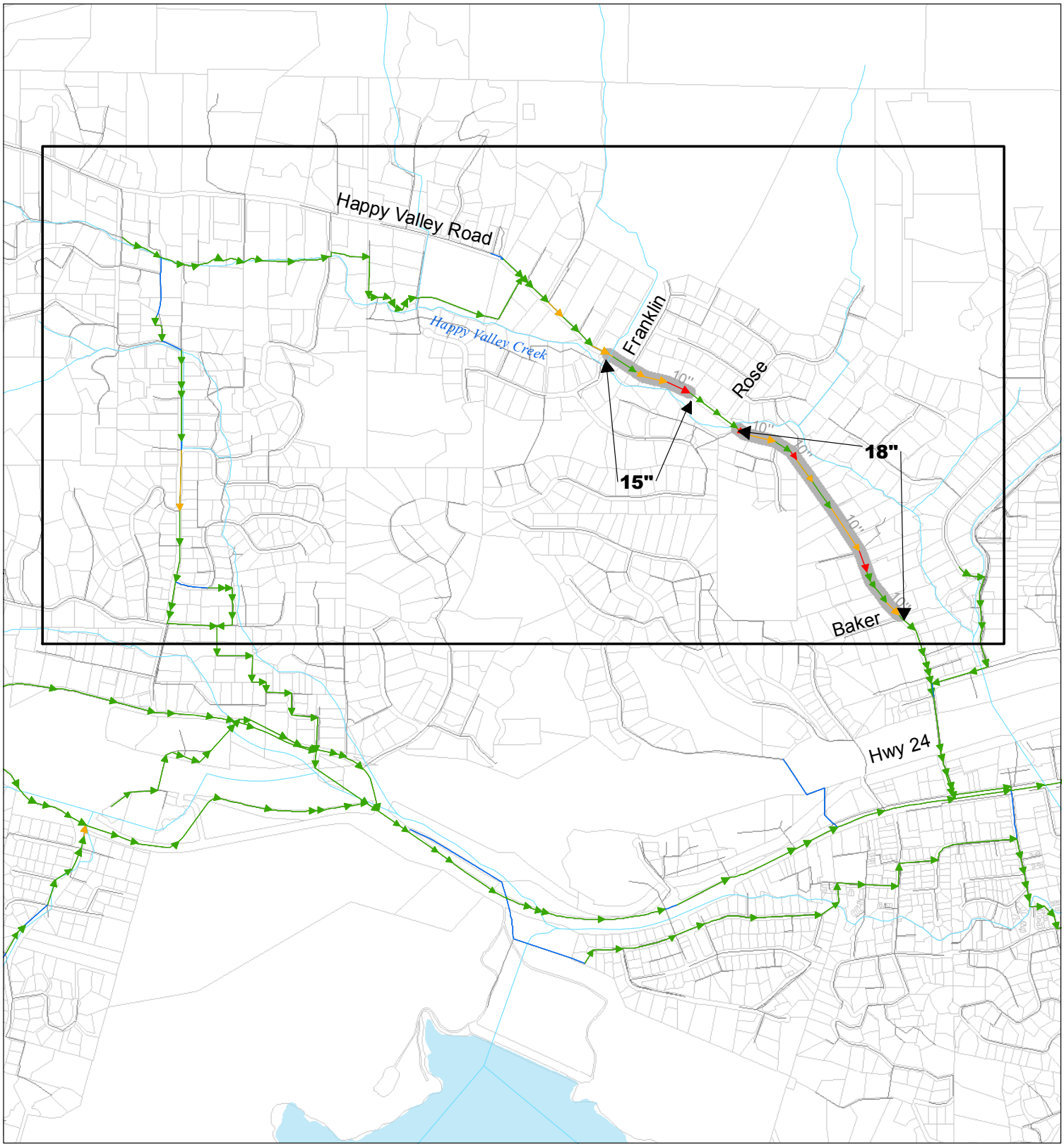


Figure 5-6 **Capacity Deficiencies and Improvements for Corridor D3-A: Lafayette - Happy Valley Road**

Percent Full Pipe Capacity
2040 Development, 5-year Event
No Slope or Invert Elev
<=100%
>100% to <=130%
>130%

New Pipe Diameter 24"
(sized for 2040 development, 20-year event)
New or Modified Pipe
Existing Pipe Diameter 12"
Creek
Waterbody

Project Corridor

CCCSD Collection System Master Plan Update 2010

N
0 500 1,000 Feet

RMC Water and Environment, 2010

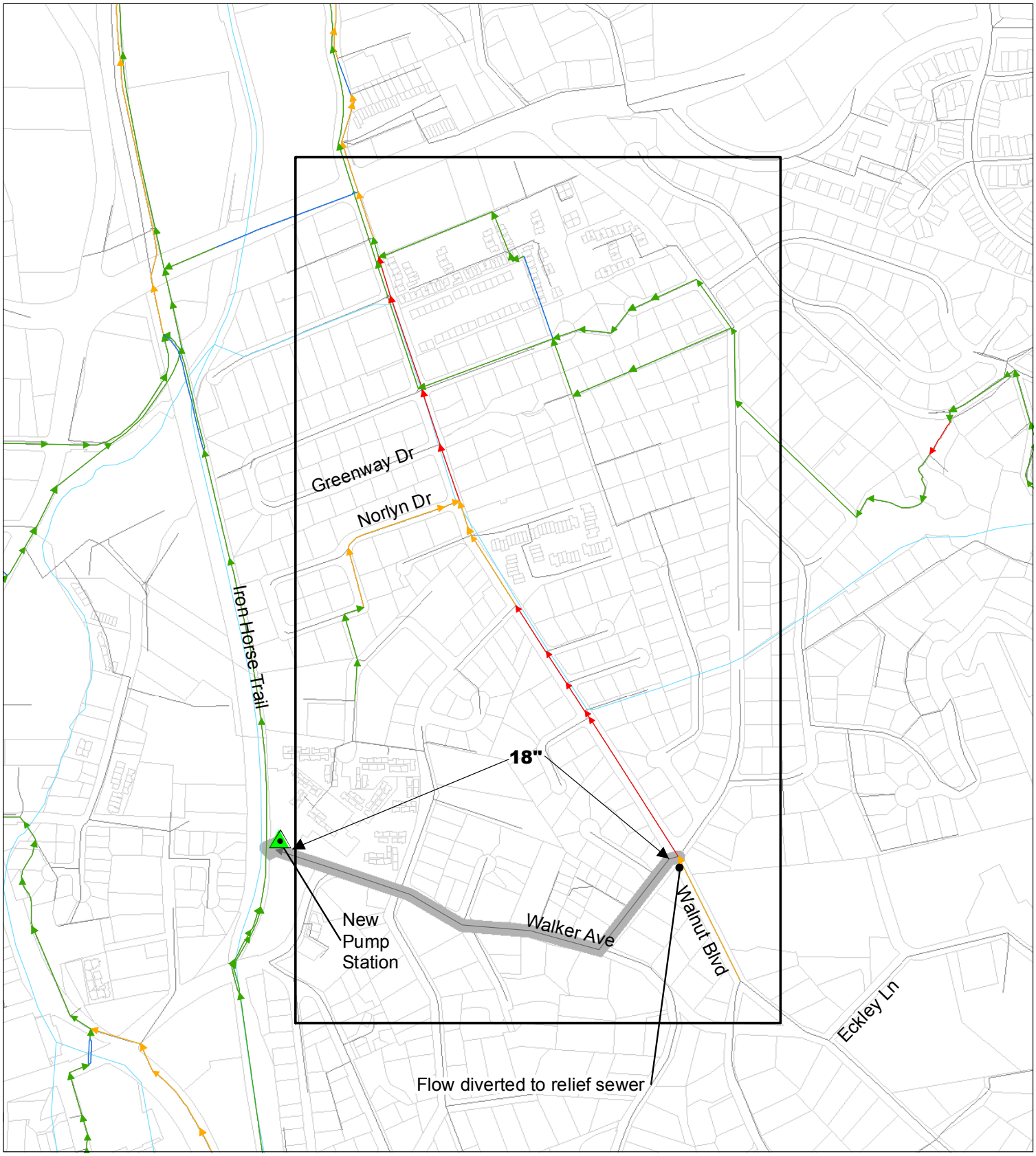


Figure 5-7 **Capacity Deficiencies and Improvements for Corridor D4-A: Walnut Creek - Walnut Boulevard**

Percent Full Pipe Capacity

2040 Development, 5-year Event

- No Slope or Invert Elev
- <=100%
- >100% to <=130%
- >130%

New Pipe Diameter 24"

(sized for 2040 development, 20-year event)

New or Modified Pipe

Existing Pipe Diameter 12"

Creek

Waterbody

Project Corridor

CCCSD Collection System Master Plan Update 2010

N

0 250 500 Feet

RMC Water and Environment, 2010

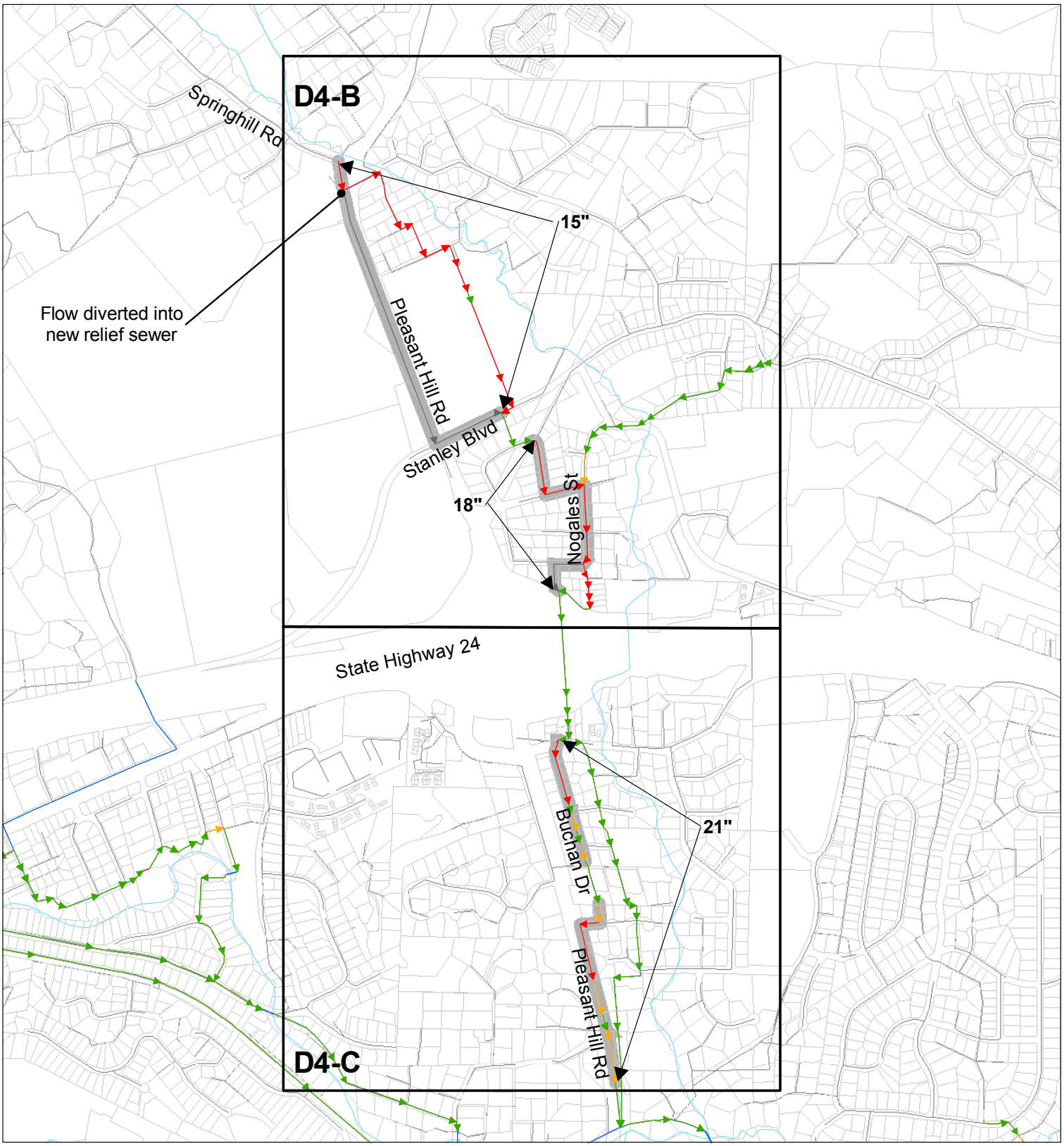


Figure 5-8 **Capacity Deficiencies and Improvements for Corridor D4-B and D4-C: Lafayette - Pleasant Hill Road**

Percent Full Pipe Capacity
2040 Development, 5-year Event
- No Slope or Invert Elev
- <=100%
- >100% to <=130%
- >130%

New Pipe Diameter 24"
(sized for 2040 development, 20-year event)
New or Modified Pipe
Existing Pipe Diameter 12"
Creek
Waterbody

Project Corridor

CCCSD Collection System Master Plan Update 2010

0 500 1,000 Feet

RMC Water and Environment, 2010

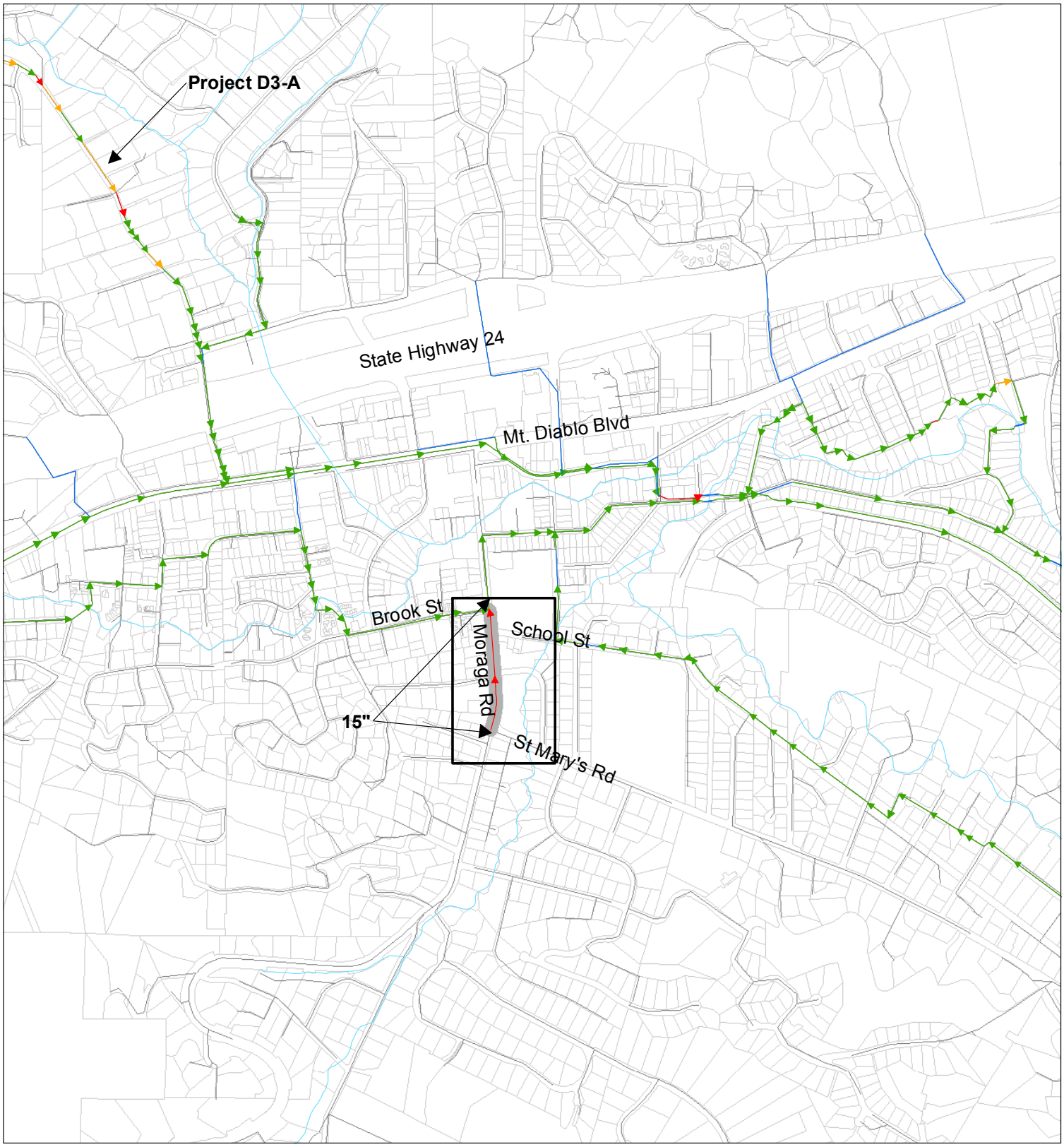


Figure 5-9 **Capacity Deficiencies and Improvements for Corridor E3-A: Lafayette - Moraga Road**

Percent Full Pipe Capacity
2040 Development, 5-year Event
- No Slope or Invert Elev
- <=100%
- >100% to <=130%
- >130%

New Pipe Diameter 24"
(sized for 2040 development, 20-year event)
New or Modified Pipe
Existing Pipe Diameter 12"
Creek
Waterbody

Project Corridor

CCCSD Collection System Master Plan Update 2010

0 500 1,000 Feet

RMC Water and Environment, 2010

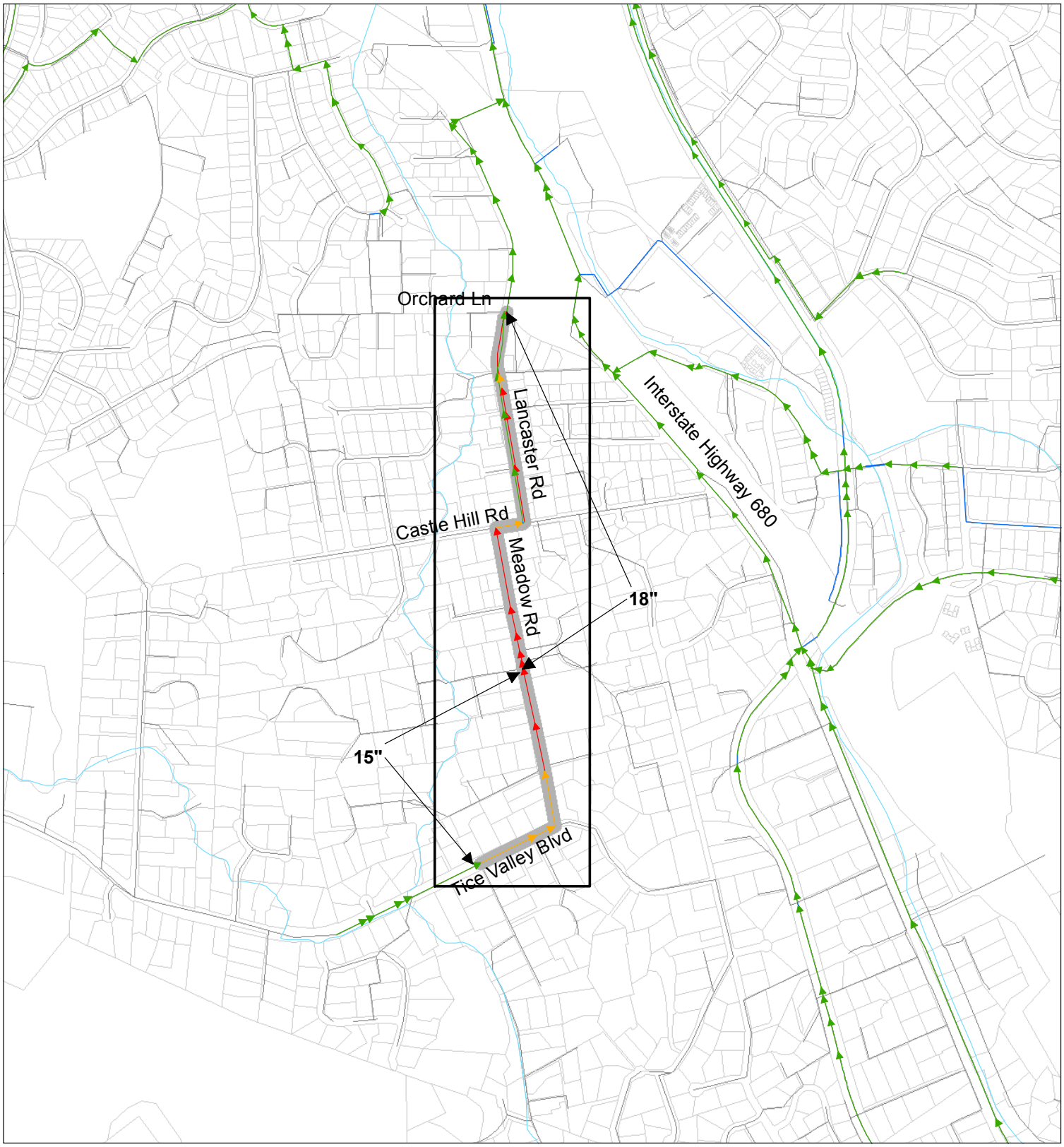


Figure 5-10 **Capacity Deficiencies and Improvements for Corridor E4-A: Walnut Creek - Lancaster Road**

Percent Full Pipe Capacity
2040 Development, 5-year Event
- No Slope or Invert Elev
- <=100%
- >100% to <=130%
- >130%

New Pipe Diameter ← **24"**
(sized for 2040 development, 20-year event)
New or Modified Pipe
Existing Pipe Diameter 12"
Creek
Waterbody

Project Corridor

CCCSD Collection System Master Plan Update 2010

N
0 500 1,000 Feet

RMC Water and Environment, 2010

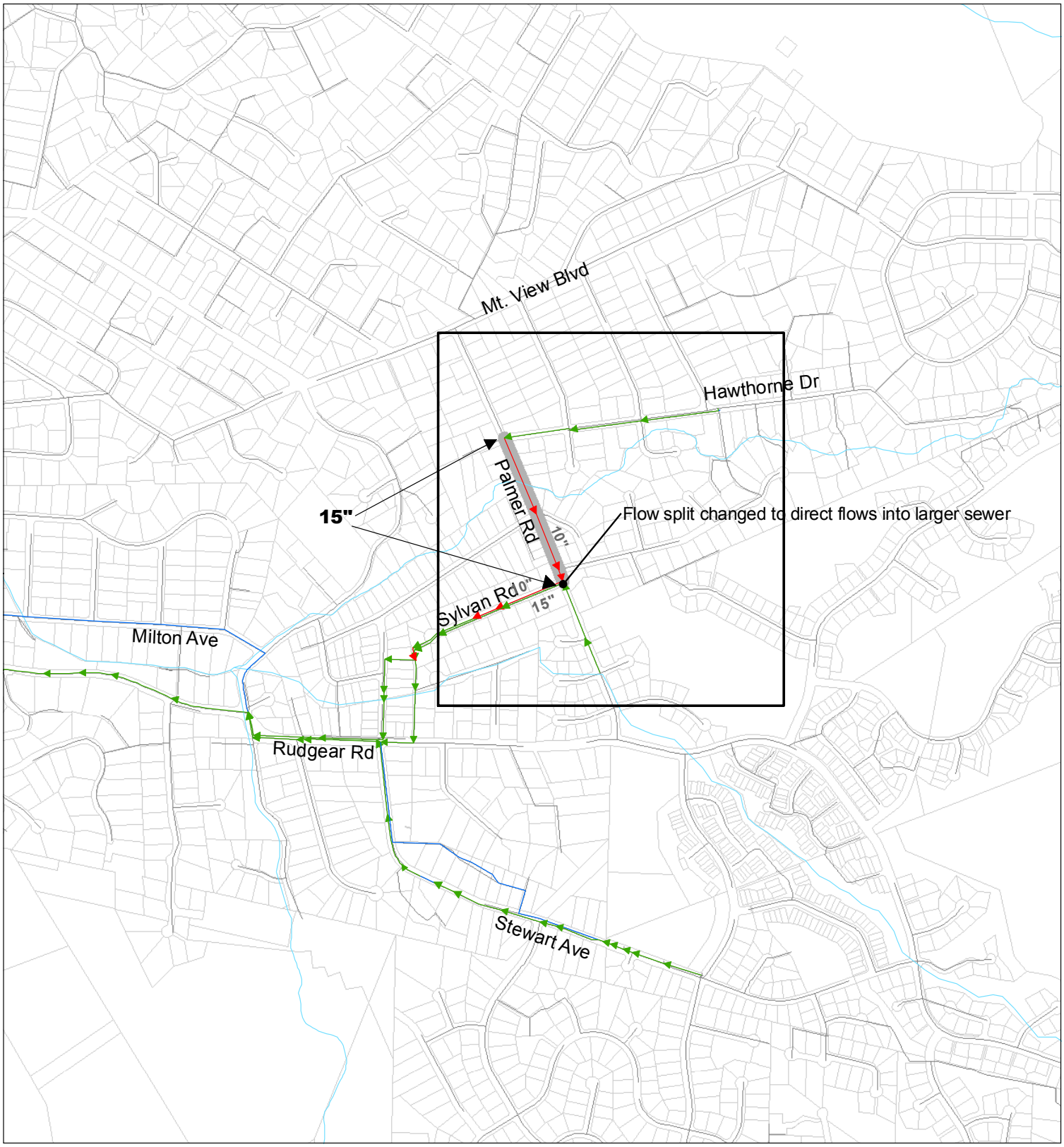


Figure 5-11 **Capacity Deficiencies and Improvements for Corridor E5-A: Walnut Creek-Palmer Rd**

Percent Full Pipe Capacity
2040 Development, 5-year Event
- No Slope or Invert Elev
- <=100%
- >100% to <=130%
- >130%

New Pipe Diameter ← **24"**
(sized for 2040 development, 20-year event)
New or Modified Pipe
Existing Pipe Diameter 12"
Creek
Waterbody

Project Corridor

CCCSD Collection System Master Plan Update 2010

N
0 500 1,000 Feet

RMC Water and Environment, 2010

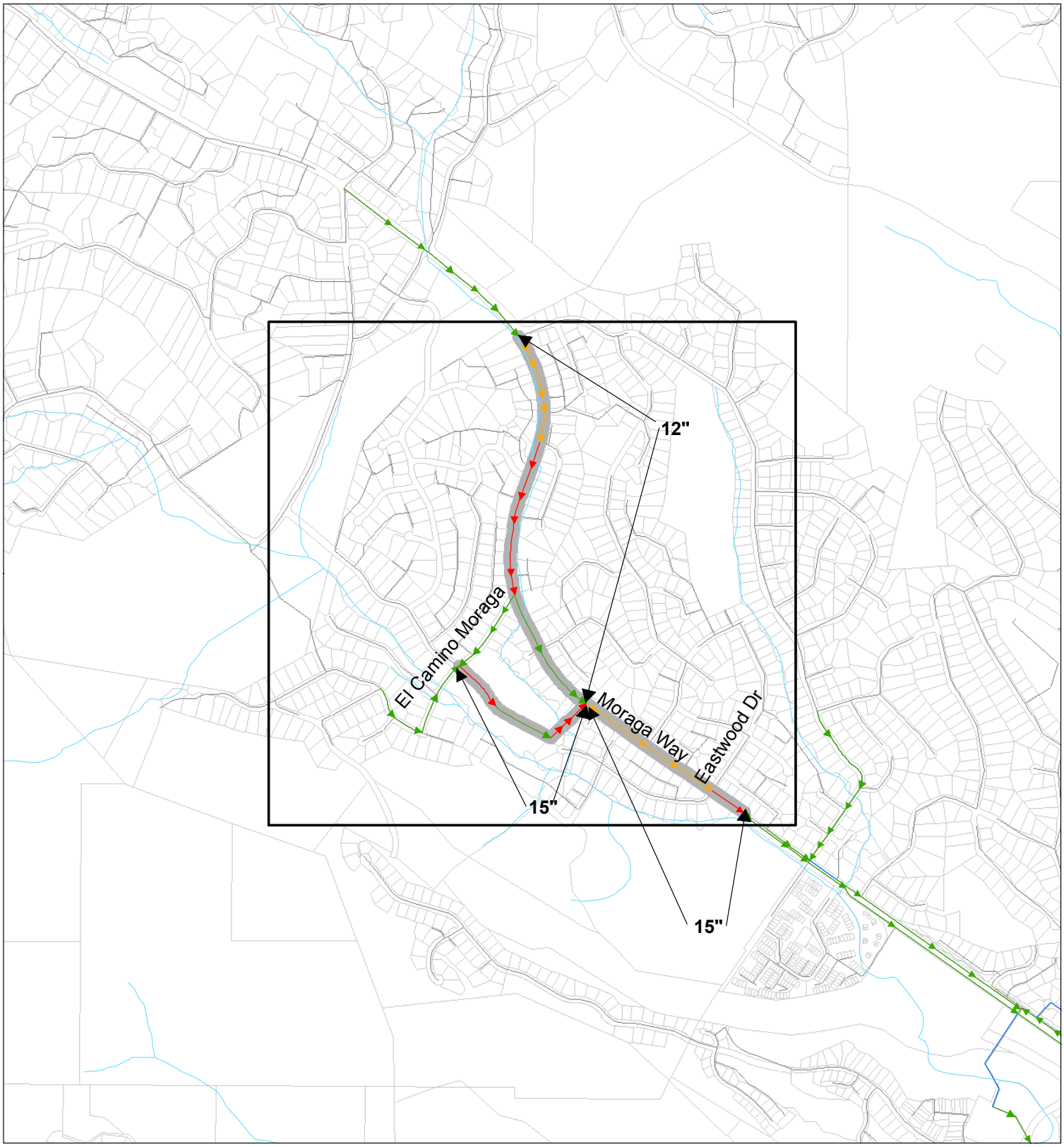


Figure 5-12 **Capacity Deficiencies and Improvements for Corridor F3-A: Orinda - Moraga Way**

Percent Full Pipe Capacity
2040 Development, 5-year Event
- No Slope or Invert Elev
- <=100%
- >100% to <=130%
- >130%

New Pipe Diameter 24"
(sized for 2040 development, 20-year event)
New or Modified Pipe
Existing Pipe Diameter 12"
Creek
Waterbody

Project Corridor

CCCSD Collection System Master Plan Update 2010

N

0 500 1,000 Feet

RMC Water and Environment, 2010

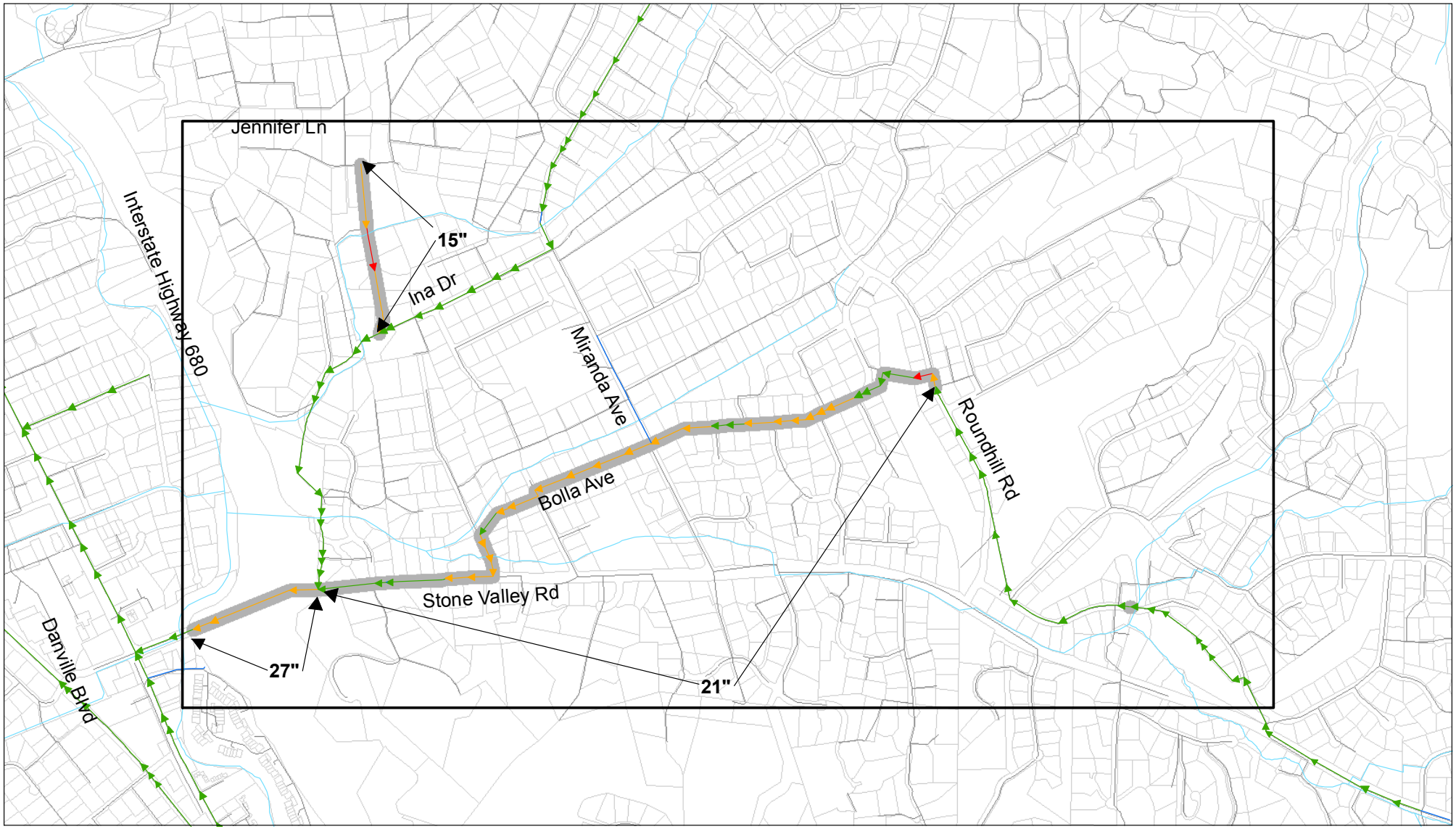


Figure 5-13 **Capacity Deficiencies and Improvements for Corridor F5-A: Alamo - Stone Valley Road**

Percent Full Pipe Capacity
2040 Development, 5-year Event
- No Slope or Invert Elev
- <=100%
- >100% to <=130%
- >130%

New Pipe Diameter ← **24"**
(sized for 2040 development, 20-year event)
New or Modified Pipe
Existing Pipe Diameter 12"
Creek
Waterbody

Project Corridor

CCCSD Collection System Master Plan Update 2010

N

0 500 1,000 2,000 Feet

Created by: RMC Water and Environment, 2010

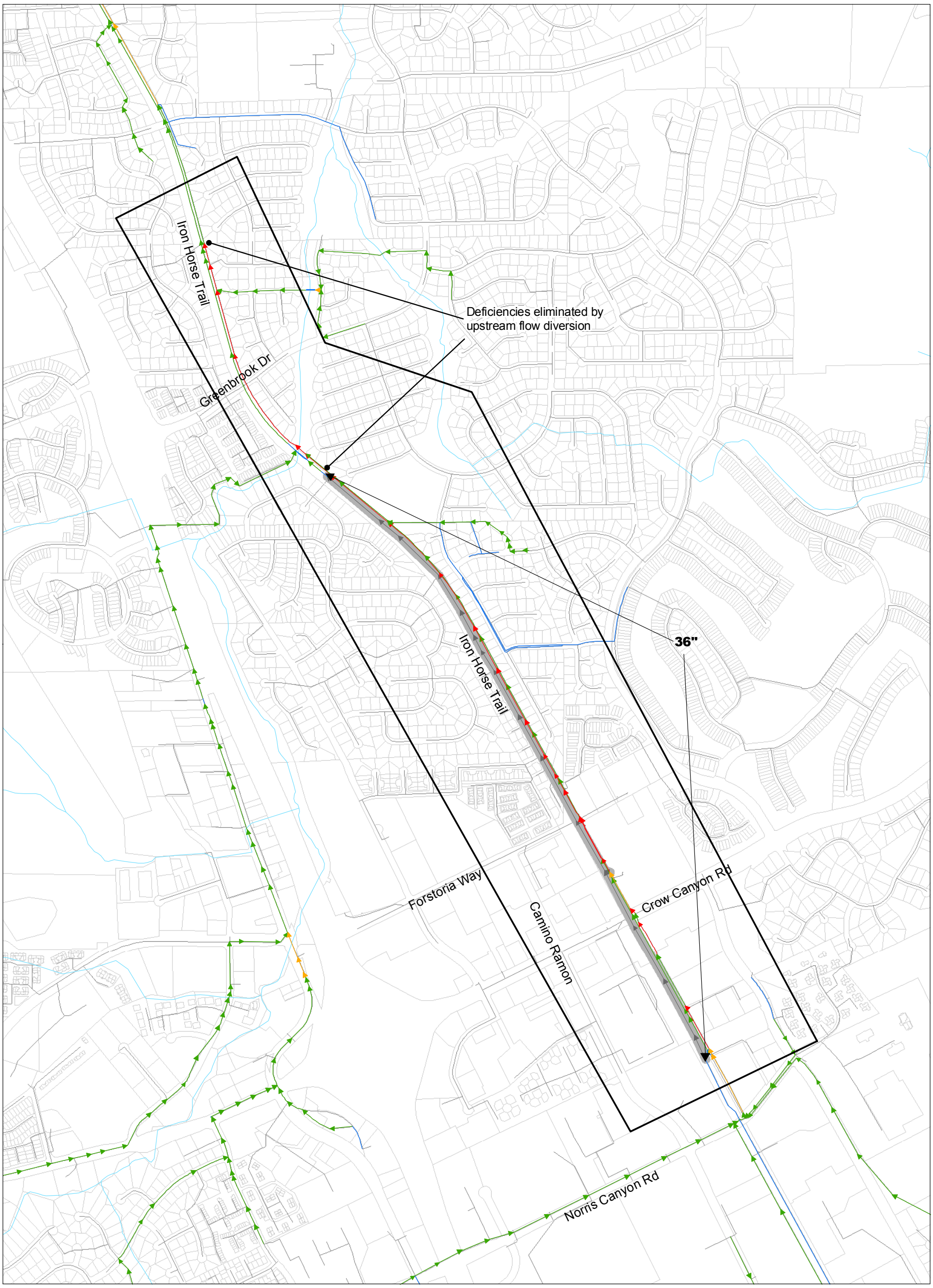


Figure 5-14

Capacity Deficiencies and Improvements for Corridor H6-A: San Ramon – San Ramon Schedule C

Percent Full Pipe Capacity
2040 Development, 5-year Event
- No Slope or Invert Elev
- <=100%
- >100% to <=130%
- >130%

New Pipe Diameter ← **24"**
(sized for 2040 development, 20-year event)

New or Modified Pipe

Existing Pipe Diameter 12"

Creek

Waterbody

Project Corridor

CCCSD Collection System Master Plan Update 2010

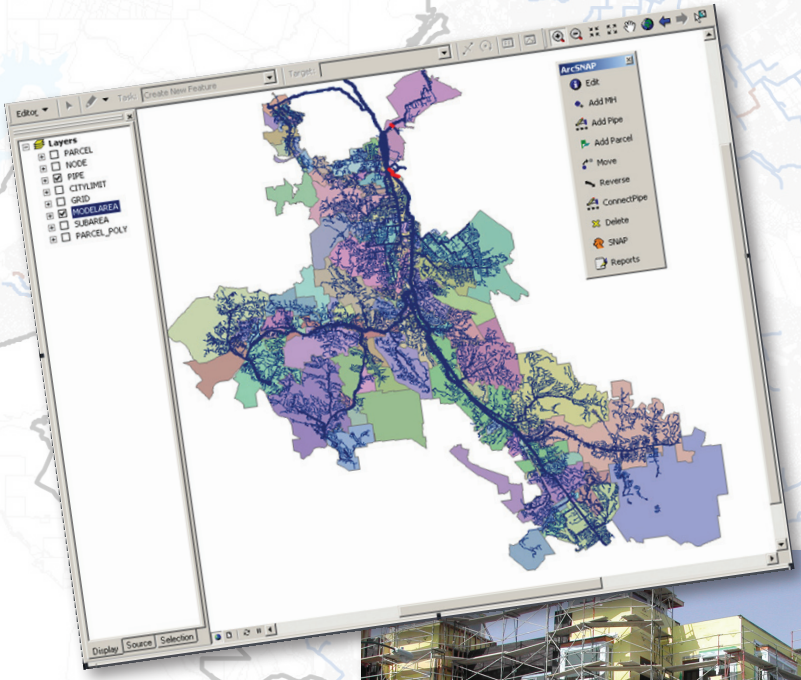
N

0 500 1,000 Feet

RMC Water and Environment, 2010

CHAPTER SIX

Recommended Capital Improvement Program



Chapter 6 Recommended Capital Improvement Program

Chapter 5 described the preliminary solutions model that was developed to address the high-priority capacity areas, or project corridors, for capacity improvement projects. This chapter presents the recommended Capital Improvement Plan (CIP) for the trunk sewer and interceptor system, including estimated capital costs, the proposed prioritization and phasing of the recommended projects, and guidelines and recommendations for implementing the CIP.

6.1 Trunk and Interceptor Improvement Projects

The recommended projects include improvements to correct identified capacity deficiencies in the CCCSD trunk and interceptor system under the flow conditions and based on the design and capacity criteria defined in this report.[10] The recommended projects are shown in **Figure 6-1**.

6.2 Project Capital Costs

Capital costs for the recommended projects were estimated based on input from the District and cost data from similar projects in other Bay Area communities. These costs are planning or conceptual level estimates, and are considered to have an estimated accuracy range of -30 to +50 percent. This level of accuracy corresponds to an "order of magnitude" or "Class 5" cost estimate as defined by the American Association of Cost Estimators. These estimates are suitable for use for budget forecasting, CIP development, and project evaluations, with the understanding that refinements to the project details and costs would be necessary as projects proceed into the design and construction phases. Costs represent current costs for the San Francisco Bay Area.

The general cost criteria include baseline construction costs for gravity trunk sewers using open-cut methods, assuming that the existing pipe will be removed and replaced. Exceptions to the pipe replacement approach are noted in individual project capital cost estimates provided in **Appendix F**. It is assumed that the District will conduct groundtruthing surveys prior to project design and implementation, and will consider other construction techniques, more feasible pipeline alignments and flow routing alternatives based on further project analysis.

Unit costs for gravity trunk sewers were developed based on input from the District and vary with pipe diameter and are assumed to include manholes, mobilization/demobilization, bypass pumping, pavement restoration, and traffic control. These unit costs are appropriate for sewers less than 15 feet deep, and therefore would apply to the proposed projects, which are generally between 7 and 12 feet deep. An additional lump sum allowance was added for trenchless creek and traffic crossings which will likely require special construction. A 30 percent planning level contingency allowance for unknown conditions was also included for all projects, as well as an allowance of 25 percent of construction cost for engineering design and construction administration. **Table 6-1** summarizes the general cost criteria. The itemized cost estimate for each project is detailed on the individual project information sheets in **Appendix F**.

[10] Not including potential future flows from the Concord Community Reuse Project at the Concord Naval Weapons Station site.

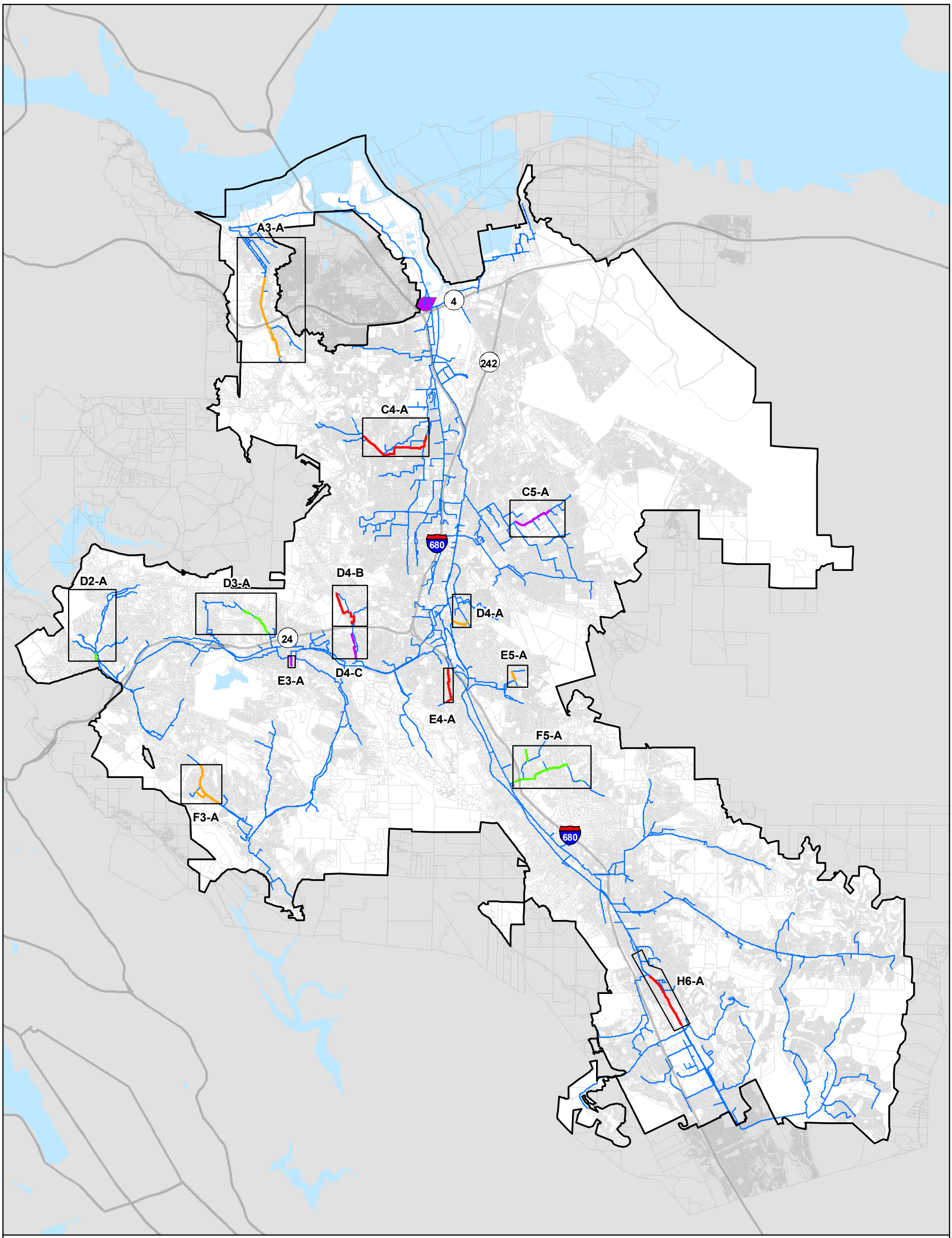


Figure 6-1: Recommended Capacity Improvement Projects

Legend

CCCSD Collection System Master Plan Update 2010

Project Priority

- Priority 1
- Priority 2
- Priority 3
- Priority 4

- Project Corridor
- Study Area Boundary
- CCCSD WWTP

N

0 5,000 10,000 20,000 Feet

Data Sources: CCCSD, Contra Costa County Mapping Information Center, 2008

RMC Water and Environment, 2010

Table 6-1: Cost Criteria

Item	Description/Assumptions	Unit Cost[(1),(2)]
Baseline Pipeline Construction Costs		
Open-cut gravity sewer (includes Mobilization, Bypass Pumping, and Traffic Control)	10-inch	$200
	12-inch	$210
	15-inch	$220
	18-inch	$230
	21-inch	$240
	24-inch	$250
	27-inch	$270
	30-inch	$310
Trenchless Crossing	Lump sum contingency for trenchless crossings/special construction	$200,000 ea
Temporary Easement $/Lf	80ft wide	$350
Permanent Easement $/Lf	30 ft wide	$400
Cost Allowances		
Construction Contingency	% of Baseline Construction Subtotal	30%
Engineering Design and Construction Administration Costs	% of Baseline Construction Subtotal	25%

Notes:
(1) Engineering New Record Construction Cost Index (ENR-CCI) 9781. San Francisco Bay Area, September 2009.
(2) Unit costs based on input from District.

6.3 Project Prioritization

To develop the appropriate project phasing for the CIP, the recommended sewer improvement projects were divided into four Priority Groups. The priorities reflect the relative need for the projects in terms of the severity of existing or projected capacity deficiencies. The projects were categorized into the respective Priority Groups based on the extent of the capacity deficiencies, that is, the length of pipe in the project corridor that was deficient or had predicted peak flows greater than 130 percent of full pipe capacity, primarily under the 5-year triggering event for 2010. The projects identified for Priority Group 1 had a significant length of capacity deficient pipe during a 2010, 5-year event, compared to the other projects.

The remaining 10 projects were then analyzed based on percent full pipe capacities under an Ultimate (2040) 5-year event for categorization into Priority Groups 2, 3, and 4. Projects identified for Priority Group 2 had the highest length of capacity deficient pipe and more severe deficiencies in the 2040, 5-year event, followed by projects in Priority Group 3 and lastly, Priority Group 4.

During the project validation phase, field verification and additional hydraulic modeling studies will be undertaken. Hydraulic modeling and hydraulic gradeline analysis of the 2010, 20-year event will be used for confirmation of the order of the 10 projects in Priority Groups 2, 3 and 4. Several isolated high-flow segments that did not show up in one of the project corridors will also be considered.

Other considerations, such as the need for sewer renovation to address known maintenance problems, structural defects, or other issues, were not included in the ranking of projects, although these factors will be considered by the District as the timing of the projects is clarified.

Table 6-2 lists the recommended projects by priority group, along with their estimated total project cost.

Table 6-2: Recommended Sewer Improvement Projects by Priority Group

Project ID	Project Name	New Pipe Length[1] (feet)	New Pipe Diameter[1] (inches)	Estimated Total Project Cost[2] ($'000)
Priority Group 1 Projects				
C4-A	Pleasant Hill - Pleasant Hill Rd/Grayson Creek	9,552	18 - 24	4,155
D4-B	Lafayette - Pleasant Hill Road (Phase I – north of Hwy 24)	4,829	15 - 18	1,676
E4-A	Walnut Creek – Lancaster Road	4,067	15 - 18	1,424
H6-A	San Ramon – San Ramon Schedule C	6,628	36	3,300
	Priority Group 1 Subtotal	**25,076**		**10,555**
Priority Group 2 Projects				
A3-A	Martinez - Alhambra Ave	9,976	18 - 24	3,964
D4-A	Walnut Creek - Walnut Blvd.	2,005	18	1,901
E5-A	Walnut Creek – Palmer Road	1,026	15	350
F3-A	Orinda – Moraga Way	6,702	12 - 15	2,592
	Priority Group 2 Subtotal	**19,709**		**8,807**
Priority Group 3 Projects				
D2-A	Orinda - Miner Road/Camino Pablo	826	15	282
D3-A	Lafayette - Happy Valley Road	3,172	15 - 18	1,118
F5-A	Alamo – Stone Valley Road	8,430	15 - 27	3,483
	Priority Group 3 Subtotal	**12,428**		**4,883**
Priority Group 4 Projects				
C5-A	Walnut Creek - Contra Costa Canal Trail	4,539	24	1,820
D4-C	Lafayette – Pleasant Hill Road (Phase II – south of Hwy 24)	3,159	21	1,175
E3-A	Lafayette – Moraga Road	982	15	335
	Priority Group 4 Subtotal	**8,680**		**3,330**
			TOTAL	**27,575**

Notes:
(1) District will refine project alignments and pipe sizes during project implementation.
(2) Engineering New Record Construction Cost Index (ENR-CCI) 9781. San Francisco Bay Area, September 2009.

The total estimated capital cost for the recommended CIP is approximately $27.6 million. Projects in Priority Group 1 consist of approximately 40 percent of the total capital cost, or about $10.6 million. The recommended projects in Priority Group 1 have been included in the District's Ten-year Program, and are scheduled to start in late 2011.

6.4 Project Validation Plans

At the master planning level, there is always a certain degree of uncertainty regarding the required design flows for a project and, in some cases, when, or whether or not the project will actually be needed. Therefore, it is good practice to conduct further validation of recommended CIP projects prior to implementation. For near-term projects, project validation will provide additional information useful for alignment studies and project design; for longer-term projects, project validation will provide information that can be incorporated into future updates of the District's Collection System Master Plan and capital improvement plans.

Project validation should address such issues as:

- Confirmation of flows
- Confirmation of pipe capacity (pipe slopes)
- Confirmation of degree of capacity deficiency (extent of surcharge)
- Confirmation of development projections

The level of confidence in the need for, timing of, or sizing of a specific project depends on the degree to which reliable information is available to provide these confirmations.

Table 6-3 summarizes the currently available information that provides the basis for each project, in terms of proximity of the project to flow monitors used for model calibration; completeness of the pipe slope and invert data for the project reach; and extent of future development (in terms of percentage increase in BWF and tributary sewered area between 2010 and 2040). The table also shows recommended locations for future flow monitors to validate project flows. This is particularly important because all but one of the projects (Project H6-A) are driven by the need for capacity to handle peak wet weather flows, and the ArcSNAP model does not simulate RDI/I flows based on area-specific flow measurements but uses a generalized curve to calculate RDI/I as a function of sewer age (year of installation) based on a best fit to flow data from meters throughout the entire District.

For all projects, pipe slope and invert data should be validated through survey or as-built research in order to confirm the extent of the project deficiency (including level of predicted surcharge through HGL analysis) and sizing of relief or replacement sewers. For projects that have a large percentage flow increase due to projected future growth, the District should closely monitor the progress of development and coordinate closely with the planning jurisdictions to update development and redevelopment estimates.

Table 6-3: Project Validation Information

Project ID	Nearest 2005 Flow Meter	Flow Meter Proximity (% of meter area) and Confidence[1]	Slope/Invert Data in ArcSNAP Database	BWF/Tributary Area Increase	Proposed Flow Meter Location
Priority Group 1 Projects					
C4-A	PH-H	Downstream (27%); ~20% lower than RDI/I curve	Some missing slopes; few inverts	0.15 mgd (20%) 217 ac. (25%)	44E6-M33 (12" in Pleasant Hill Rd. at Linda Ln.) 47B5-M62 (18" in Taylor Blvd. w/o Grayson Creek)
D4-B	WC-B	Downstream (61%); ~20% lower than RDI/I curve	No missing slopes; no inverts	0.19 mgd (70%) 195 ac. (30%)	72D2-M46 (12" in Nogales Ln. n/o Circle Creek Ln.)
E4-A	WC-F	Downstream (26%); very close to RDI/I curve	No missing slopes; most inverts	0.04 mgd (20%) 51 ac. (10%)	75C4-M16 (18" in Lancaster Rd. n/o Orchard Ln.)
H6-A[2]	SR-D,E, G,H, I	Upstream; slightly higher than RDI/I curve	Some missing slopes; few inverts	0.92 mgd (15%) 1,650 ac. (40%)	99E1-M83 and 99E1-M18 (30" and 15" in Iron Horse Trail s/o San Ramon Creek)
Priority Group 2 Projects					
A3-A	MZ-B	Immediately downstream (98%); ~30% higher than RDI/I curve	No missing slopes (on trunk); most inverts	0.48 mgd (65%) 630 ac. (85%)	10A6-M8.6 (12" in Alhambra Ave. n/o Walnut Ave.) 10A3-M21 and 10A3-M14 (12" and 8" in Alhambra Ave. at C St.)
D4-A	None	--	No missing slopes; no inverts	Negligible	49C7-M56 (18" in Walnut Ave. s/o Ygnacio Valley Rd.)
E5-A	SR-M	Downstream (65%); ~30% higher than RDI/I curve	No missing slopes or inverts	Negligible	75E5-M19 (10" in Palmer Rd. at Sylvan Rd.)
F3-A	MR-A,C OR-D	In vicinity; MR-A & OR-D very close to RDI/I curve, MR-C ~50% higher	No missing slopes or inverts	0.06 mgd (30%) 95 ac. (20%)	73D5-M6 (18" in Moraga Way s/o Eastwood Dr.)
Priority Group 3 Projects					
D2-A	OR-B	Downstream (60%); not used for RDI/I curve	No missing slopes; some inverts	0.12 mgd (200%) 170 ac. (130%)	69D4-M7 (10" in Camino Pablo s/o Miner Rd.)
D3-A	OR-A	In vicinity; ~50% lower than RDI/I curve	No missing slopes; few inverts	0.12 mgd (130%) 235 ac. (55%)	72A2-M70 (16" in Happy Valley Rd. s/o Baker Ln.)
F5-A	SR-L	In project area; ~30% lower than RDI/I curve	No missing slopes (on trunk); no inverts	0.19 mgd (35%) 230 ac. (15%)	77E4-M17 (21" in Stone Valley Rd. at I-680) 78A4-M14 (15" in Stone Valley Rd. w/o Austin Ln.)

Table 6-3 continued on following page

Project ID	Nearest 2005 Flow Meter	Flow Meter Proximity (% of meter area) and Confidence[1]	Slope/Invert Data in ArcSNAP Database	BWF/Tributary Area Increase	Proposed Flow Meter Location
Priority Group 4 Projects					
C5-A	None	--	Some missing slopes; few inverts	0.09 mgd (15%) 144 ac. (20%)	49E3-M61 (18" along Contra Costa Canal e/o Lennon Ln.)
D4-C	WC-B	Downstream (70%); ~20% lower than RDI/I curve	No missing slopes; no inverts	0.21 mgd (60%) 215 ac. (25%)	72D4-M19 (15" in Pleasant Hill Rd. s/o Station Rd.)
E3-A	WC-E	In vicinity; ~10% higher than RDI/I curve	No missing slopes or inverts	0.07 mgd (60%) 85 ac. (30%)	72B4-M43 (10" in Moraga Rd. at Brook St.)

Notes:
(1) Larger percentage indicates that meter data is more representative of project area.
(2) Project design flow based on peak dry weather flow.

6.5 Overall Recommendations

The following are suggested guidelines that should be considered in project scheduling and design, and in future updates of the Master Plan.

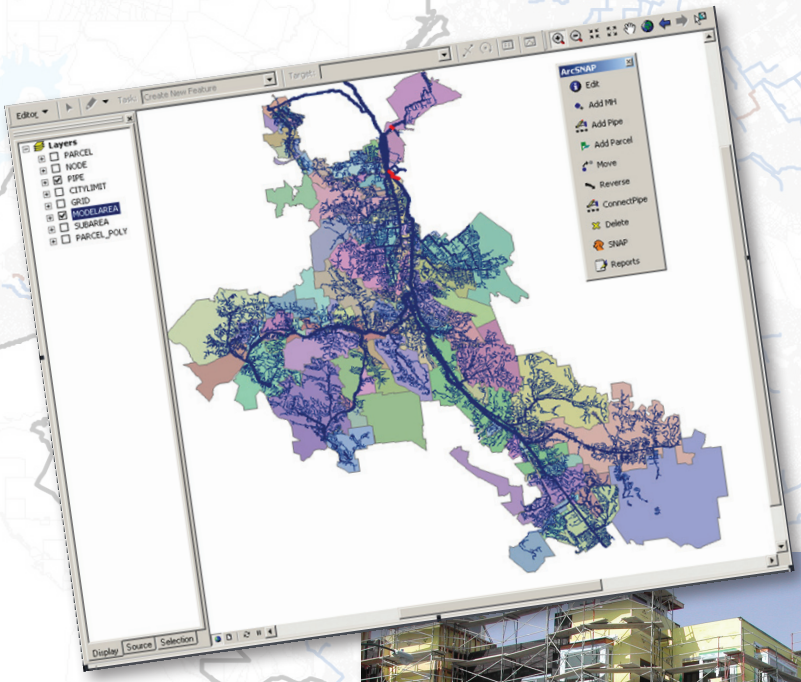
- Perform flow monitoring to verify modeled flows and capacity deficiencies for specific project areas, particularly for projects in Priority Groups 1 and 2. Prior to the District's next update of the Master Plan, a more extensive flow monitoring program should be performed focused on verifying the accuracy of model results in key trunk and interceptor facilities.
- Conduct additional review of hydraulic modeling results for the 2010 development, 20-year event to confirm the order of projects in Priority Groups 2, 3 and 4.
- Review and analyze isolated capacity deficiencies not included in defined project corridors as part of project validation.
- Consider installing surcharge meters to confirm if any project reaches are likely exceeding full pipe capacity during large storm events.
- In cases where peak wet weather flow is driving the need for the project (as is the case for all but one of the identified projects), review available information on the nature of the I/I response and likely sources of I/I, and consider performing source detection activities such as smoke testing and manhole and pipe inspections to identify I/I sources that may be cost-effective to correct.
- Review and verify the slope and invert data for existing sewers in the project areas, including verifying any critical flow diversions. Perform field inspections and surveying as needed.
- Review the basis for future flow projections in the model for the areas upstream of CIP projects, with particular attention to any proposed new developments or redevelopment projects for which plans (timing, density, or type of development) may change or any new ones that may not have been identified in this Master Plan Update.
- Obtain and review available information on the condition of the sewers in the project areas, and consider any plans and/or need for rehabilitation or replacement of the sewers.

- Coordinate with other City, County, and utility agencies to identify opportunities for combining or co-locating projects (e.g. major construction projects or before street repaving) to minimize construction impacts within neighborhoods.
- Conduct appropriate alignments studies, topographic surveys, geotechnical investigations, utility research, and constructability reviews to determine the most viable and cost-effective solutions to identified capacity deficiencies for each project area.
- Keep the ArcSNAP model database up-to-date by periodic downloads from GIS and HTE, including making necessary updates to the land use override tables to reflect parcel subdivisions, completed developments, or changes in development plans.
- Continue to improve the ArcSNAP database by incorporating and validating additional slope and invert data.
- Ensure that trained staff are available to maintain and effectively use the ArcSNAP model to meet the District's needs for sewer planning and design.

6.6 Conceptual Approach for Future Dynamic Modeling

As discussed in previous chapters of this report, the District's ArcSNAP model is a *static* model that was developed originally in the mid-1980s. While the model, and its current version, have served the District well over the years, and the program is formulated to provide some degree of flexibility and realism in simulating system flows, the modeling technology used in ArcSNAP is now outdated. Current technology utilizes *fully dynamic* models that solve complex hydraulic equations and therefore more accurately and realistically compute time-varying flows, depths, and velocities in sewer pipes; calculate hydraulic gradelines; and simulate the effects of flow attenuation, storage in pipes and manholes, backwater, flow splits, reverse flow situations, and pressurized flow (e.g., surcharged pipes and force mains). Almost all large wastewater agencies now use dynamic models.

As part of this Master Plan Update, a conceptual approach was developed for potential future dynamic modeling by the District (see TM in **Appendix D**). Should the District decide to implement a dynamic model, it is envisioned that ArcSNAP would continue to be used for flow estimating and capacity analysis for at least a portion of the collection system (e.g., the smaller pipes), and the dynamic model would be developed for the trunk sewers and interceptors. Much of the functionality of ArcSNAP could continue to be used, including the storage of pipe and manhole attribute data, updates of parcel and network data from GIS, use of HTE to generate existing base wastewater flows, capture of future land use estimates in the ArcSNAP land use override table, etc. The dynamic model would require additional data, including complete manhole rim and pipe invert elevations for the modeled system, pump station wet well dimensions and pump operating parameters, and flow and rainfall monitoring data to calibrate the model. Once calibrated, the reporting and graphic output capabilities of the dynamic model (output of time-varying flow, level, and velocity hydrographs for various flow scenarios; display of pipeline profiles and hydraulic gradelines, etc.) would provide useful information for planning and design of major improvement projects and evaluation of system operations and performance.


Editor
Task: Create New Feature
Target:
Layers
PARCEL
NODE
PIPE
CITYLIMIT
GRID
MODELAREA
SUBAREA
PARCEL_POLY
ArcSNAP
Edit
Add MH
Add Pipe
Add Parcel
Move
Reverse
ConnectPipe
Delete
SNAP
Reports
Display
Source
Selection