2020 SYSTEM CAPACITY PLAN UPDATE

SACRAMENTO AREA SEWER DISTRICT

SACRAMENTO AREA SEWER DISTRICT

SYSTEM CAPACITY PLAN 2020 UPDATE

December 2020

SACRAMENTO AREA SEWER DISTRICT
SERVING YOU 24/7

10060 Goethe Road
Sacramento, CA 95827

Table of Contents

1. Introduction 1
1.1 Objectives and Scope 1
1.2 Background 1
1.3 Disclaimer 2
1.4 Project Team and Technical Oversight 3
1.5 Abbreviations 3
2. Land Use Update 7
2.1 SASD 2020 SCP Study Area 7
2.2 Planning Updates 7
2.3 Land Use Map and Projections 8
3. Flow Assumptions and Criteria 13
3.1 Flow Parameters 13
3.1.1 SASD Design Storm and Performance Storm 13
3.1.2 Wastewater Flow Components 15
3.1.3 Peak Wet Weather Flows 18
3.1.4 Flow Parameter Summary 18
3.2 Performance Criteria 19
4. Hydraulic Modeling 21
4.1 Introduction 21
4.2 Model Construction 21
4.2.1 2020 SCP SASD Hydraulic Models 21
4.2.2 Basic Components of Model Data 22
4.2.3 Best Information Available for Model Construction 23
4.2.4 Flow Monitoring and Model Calibration 23
4.2.5 Hydraulic Boundary Conditions 24
5. Infill Area Evaluation 28
5.1 Introduction 28
5.2 System Capacity Evaluation and Results 28
5.2.1 Planning Period 1 Results 28
5.2.2 Planning Period 2 Results 29

TABLE OF CONTENTS

5.3 Relief Solution Development 30
6. Expansion Area Evaluation 36
6.1 Introduction 36
6.2 SASD Expansion Area Definition 36
6.3 Delineation of Expansion Trunk Sheds 36
6.4 Design Criteria for Expansion Project Development 37
6.5 Development of Expansion Trunk Projects 37
6.6 Expansion Trunk Shed Plans 38
7. 2020 SCP Capital Funding Projections 44
7.1 Construction Cost Assumptions and Criteria 44
7.2 Infill Area Capital Funding Projections 46
7.3 Expansion Area Capital Funding Projections 47
7.4 Cost Allocation to Existing and Future Users 48
8. Appendices 50
8.1 Appendix A: Expansion Area Trunk Shed Plans 50
8.2 Appendix B: Cost Criteria Evaluation Technical Memorandum 51

List of Figures

Figure 1-1. SASD Existing Service Area and City Limits 5
Figure 1-2. SASD and Regional San Existing Sewer Systems 6
Figure 2-1. 2020 SCP Study Area 10
Figure 2-2. Buildout ESD Density Map 11
Figure 2-3. Sacramento County Corridor Redevelopment Areas 12
Figure 3-1. SASD Design Storm 14
Figure 3-2. SASD Performance Storm 14
Figure 4-1. 2020 Existing Modeled System 26
Figure 4-2. Buildout Modeled System 27
Figure 5-1. 2020 Model Results For SASD Design Storm Without Relief Projects 32
Figure 5-2. 2020 Model Results For SASD Performance Storm Without Relief Projects 33
Figure 5-3. Buildout Model Results For SASD Design Storm Without Relief Projects 34
Figure 5-4. Buildout Model Results For SASD Performance Storm Without Relief Projects 35
Figure 6-1. SASD Trunk Sheds in 2020 SCP Study Area 40
Figure 6-2. Future Expansion Trunk Facilities and Interceptors at Buildout 41
Figure 6-3. Example of an Expansion Shed’s Sewer Shed and Facilities Map 42
Figure 6-4. Example of an Expansion Shed’s Sub-Sheds and Connection Manholes Map 43
Figure 7-1. Cost Estimate Sheet Example 44

List of Tables

Table 1-1. SASD Collection System Statistics (Existing Conditions) 2
Table 3-1. 2020 SCP’s Domestic Flow Factor and Diurnal Curve Criteria 15
Table 3-2. 2020 SCP Groundwater Infiltration Rates 16
Table 3-3. 2020 SCP Rain-Dependent Infiltration/Inflow Rates 17
Table 3-4. 2020 SCP Flow Parameters 19
Table 3-5. 2020 SCP’s Performance Criteria 20
Table 5-1. Summary of Potentially Capacity-deficient Systems for Each Planning Period 30
Table 6-1. Expansion Trunk Sheds Identified by the 2020 SCP 39
Table 7-1. 2020 SCP’s Summary of Estimated Unit Cost 45
Table 7-2. Summary of Potential Relief Projects and Their Estimated Costs 47
Table 7-3. Summary of Expansion Trunk Projects and Their Estimated Costs 48
Table 7-4. 2020 SCP’s Trunk System Capital Funding Projections 49

1. Introduction

1.1 Objectives and Scope

The primary objective of the Sacramento Area Sewer District (SASD)'s 2020 System Capacity Plan (SCP) update was to develop a comprehensive plan that addresses existing and buildout sewer capacity needs. Existing capacity needs are based on SASD's current sewer system conditions. Buildout capacity needs are based on providing sewer service to the entire SASD service area in the future.

One of the 2020 SCP goals was to provide updated capital costs and capacity-based funding projection information for SASD's service areas. According to SASD's Sewer Ordinance, the service area is divided into two geographical areas: the infill area and the expansion area.

In SASD's infill area, the focus of the 2020 SCP was to identify potential capacity deficiencies and develop preliminary solutions to alleviate the deficiencies. The preliminary solutions were mainly developed so that capital costs can be estimated for funding projections. A more in-depth evaluation for restoring system performance will be conducted using SASD's Under Capacity Failure Mode Strategy (UCFMS) and SASD's project development process.

In SASD's expansion area, the focus of the 2020 SCP was to update the conceptual plans for providing sewer service to future developments. The expansion trunk plans were updated from previous SASD planning documents (e.g., 2010 SCP and its 2015, 2017, and 2018 expansion trunk shed plan amendments). The expansion trunk alternatives identified in the 2020 SCP will then be further evaluated through more detailed sewer studies.

The 2020 SCP considered previous trunk system planning efforts, as presented in the 2010 SCP, as well as revisions to the following:

- SASD's planning criteria (e.g., flow generation parameters)
- Performance criteria for SASD's existing sewer systems
- SASD trunk shed delineations
- SASD's infill area trunk sewer systems due to potential capacity deficiencies
- SASD's expansion area trunk sewer systems

1.2 Background

SASD provides wastewater collection and conveyance to the urbanized, unincorporated areas of Sacramento County, the cities of Citrus Heights, Elk Grove, and Rancho Cordova, portions of the cities of Sacramento and Folsom, and the delta communities of Freeport, Courtland, and Walnut Grove. The existing service area, shown in *Figure 1-1*, covers 278 square miles and serves 1.2 million people.

SASD is the largest of the four contributing agencies of the Sacramento Regional County Sanitation District (Regional San). Wastewater from SASD is discharged into Regional San's interceptor system and treated at the Sacramento Regional Wastewater Treatment Plant (SRWTP).

The main SASD collection system includes over 3,100 miles of sewer pipelines ranging from 1.25 to 75 inches in diameter. The collection system pipelines are categorized based on size, function, and hydraulic capacity. Sewer collectors generally receive flow directly from individual homes and businesses and are designed to carry less than one million gallons per day (mgd) of peak wet-weather flow (PWWF). In general, collector sewers are 10 inches or smaller in diameter and comprise the majority (over 85 percent) of the pipes in the SASD system. Trunk sewers carry 1 to 10 mgd of PWWF to the Regional San interceptor system. Trunk sewers are generally 12 inches in diameter or larger. However, some of SASD existing pipes carry more than 10 mgd of PWWF. *Figure 1-2* shows the existing SASD collection system and the Regional San interceptor system. *Table 1-1* summarizes the SASD collection system statistics.

Table 1-1. SASD Collection System Statistics (Existing Conditions)

Sewer System Component	Statistic
SASD Service Area	278 square miles
Main Lines	3,100 miles
Force Mains	80 miles
Manholes	67,000
Pump Stations	106
Lower Laterals*	1,500 miles
Service Connections	299,000
Total Equivalent Single-Family Dwelling Units (ESDs)	419,000

** Lower lateral is the portion of the sewer lateral from the main line to the SASD cleanout.*

1.3 Disclaimer

For the expansion area, the future sewer flows were estimated based on future development and land use assumptions. The system capacities considered for each development area are not guaranteed and were used only for planning purposes. SASD does not reserve capacity for any development until sewer impact fees are paid.

Because the 2020 SCP is a high-level planning document, the expansion trunk projects developed in this study may not be the final projects. Expansion project alternatives may be further evaluated and developed as needed.

1.4 Project Team and Technical Oversight

The 2020 SCP was conducted and accomplished entirely by SASD staff. The following staff contributed to the preparation of this report:

- Xuyen Phung, Associate Civil Engineer
- Li-Kai Huang, Associate Civil Engineer
- Mark Wilcox, Assistant Civil Engineer
- Chris Penales, Assistant Civil Engineer
- Daniel Oleshko, Assistant Civil Engineer
- Hilary Masters, Associate Civil Engineer
- Salam Khan, Associate Civil Engineer
- Alex Dubinets, Engineer Student Intern

The 2020 SCP's evaluations and report were completed under the guidance of a Technical Advisory Committee. Members of the Technical Advisory Committee are listed below:

- Rosemary Clark, Director of SASD Operations
- Patrick Schroeder, Principal Civil Engineer
- Jason Lofton, Senior Civil Engineer
- Dillon Miele, Senior Civil Engineer
- Stephen Norris, Senior Civil Engineer
- Luisa Gómez, Senior Civil Engineer
- My Huynh, Senior Civil Engineer
- James P. Morris, Sanitation District M&O Superintendent

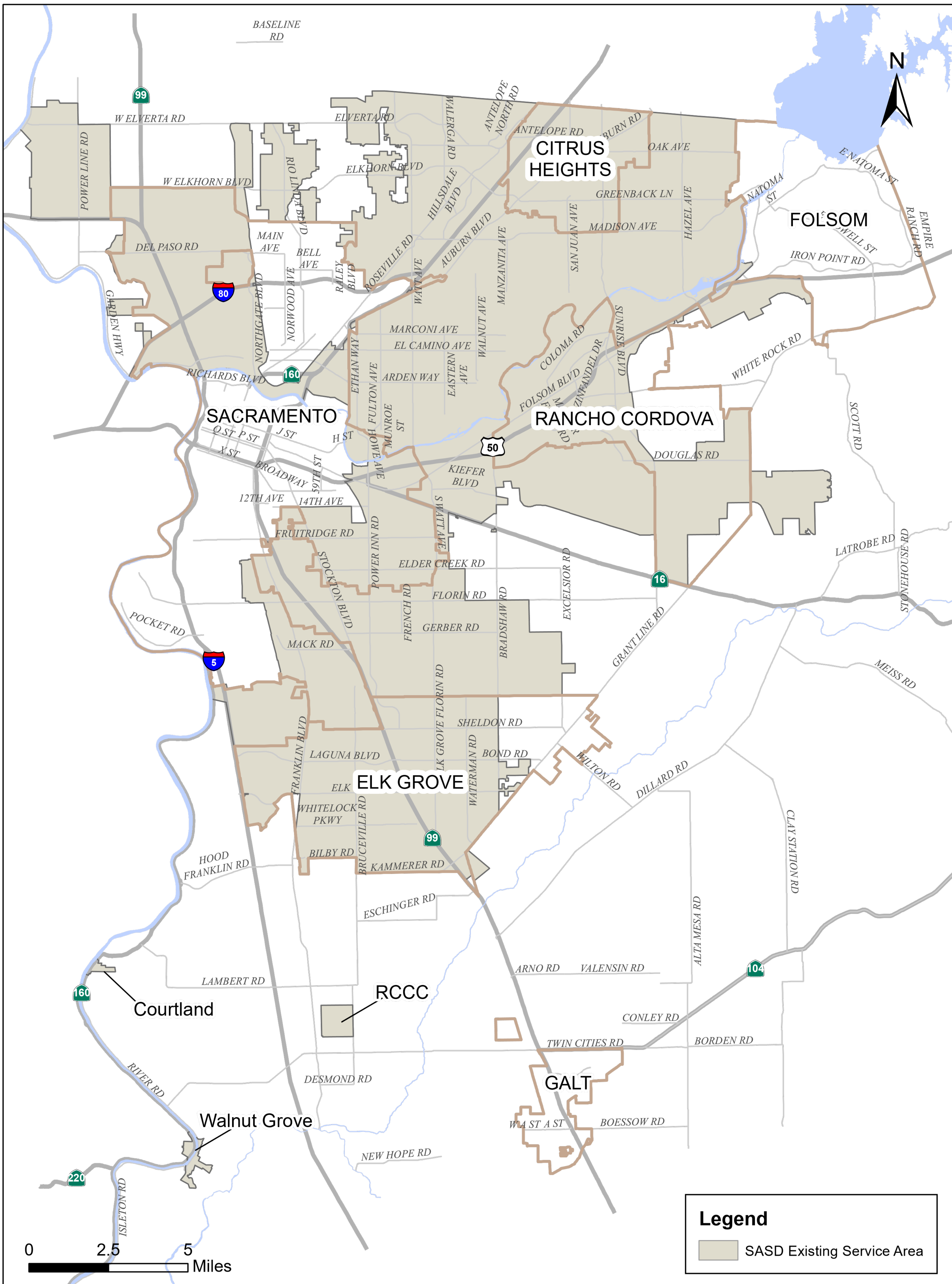
1.5 Abbreviations

To conserve space and ease readability, the following abbreviations have been used in this report:

ADWF	Average Dry-Weather Flow
APN	Assessor Parcel Number
CFP	Capital Funding Projections
CUBS	Consolidated Utility Billing and Services
d/D	Ratio of Flow Depth to Pipe Diameter
ENR	Engineering News Record
ESD	Equivalent Single-Family Dwelling Unit
GIS	Geographic Information System
gpd	Gallons Per Day
GWI	Groundwater Infiltration
I/I	Infiltration and Inflow
ID	Identifier Number

IDF	Intensity-Duration-Frequency
M&O	Maintenance and Operations
mgd	Million Gallons Per Day
PP1	Planning Period 1
PP2	Planning Period 2
PWWF	Peak Wet-Weather Flow
RCCC	Rio Cosumnes Correctional Center
RDI/I	Rainfall-Dependent Infiltration and Inflow
Regional San	Sacramento Regional County Sanitation District
SASD	Sacramento Area Sewer District
SCP	System Capacity Plan
SOI	Sphere of Influence
SRWTP	Sacramento Regional Wastewater Treatment Plant
SSO	Sanitary Sewer Overflow
UCFMS	Under-Capacity Failure Mode Strategy
USB	Urban Services Boundary

Figure 1-1. SASD Existing Service Area and City Limits

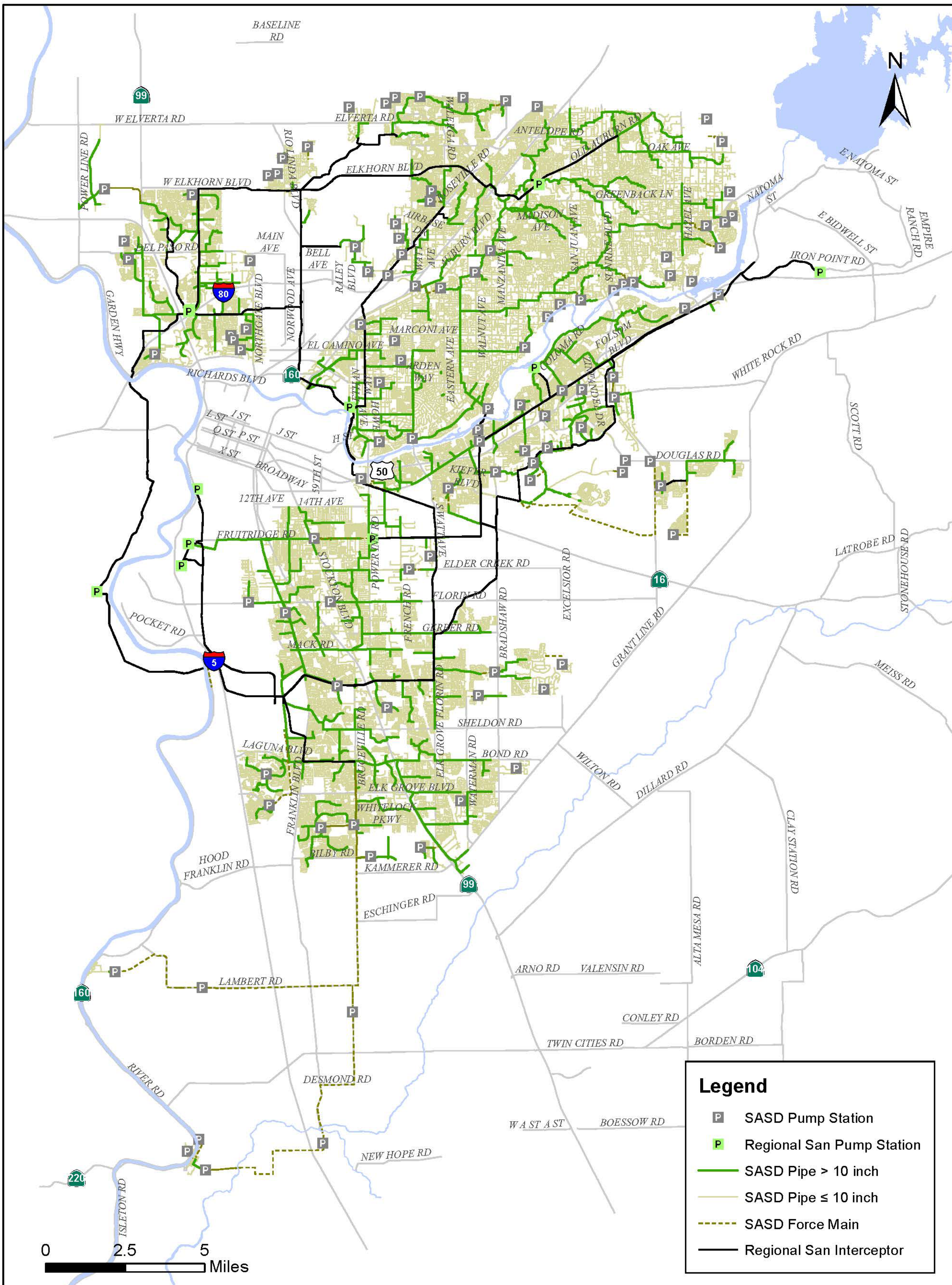


2020 SASD SYSTEM CAPACITY PLAN

SASD Existing Service Area
and City Limits
FIGURE 1-1

Updated: 12/10/2020

Figure 1-2. SASD and Regional San Existing Sewer Systems



2020 SASD SYSTEM CAPACITY PLAN

SACRAMENTO AREA SEWER DISTRICT

SASD and Regional San Existing Sewer Systems
FIGURE 1-2

Updated: 12/2/2020

2. Land Use Update

Planning for future SASD facilities begins with updating future land use information in the SASD service area. The service area's wastewater flow rates are directly related to the type of land use. SASD does not have jurisdiction to make land use planning decisions within its service area. Instead, SASD relies on the land use plans created by jurisdictions within its boundaries, including the County of Sacramento and the Cities of Sacramento, Citrus Heights, Rancho Cordova, and Elk Grove. SASD used the jurisdictions' latest land use plans and growth projections to estimate the sewer system's future capacity needs and identify locations where development may require new trunk facilities.

2.1 SASD 2020 SCP Study Area

The first step in developing future land use projections was to define the boundary of SASD's future service area. This future service area boundary represents the study area for the 2020 SCP.

The following criteria were used to establish the 2020 SCP study area:

- Include all of SASD's current service area
- Include areas inside the Sacramento County's Urban Services Boundary (USB) unless sewer service is currently or anticipated to be provided by a city or private development that will not connect to the SASD system
- Include the approved Elk Grove Sphere of Influence (SOI) areas
- Include existing service-by-contracts connections

SASD's current service area includes areas that are outside of the USB, such as the Rio Cosumnes Correctional Center (RCCC) and the delta communities of Courtland, Walnut Grove, and Freeport. Additionally, SASD does not provide service to some areas within the USB where sewer service is currently or anticipated to be provided by other municipal agencies. These areas include most of the City of Folsom, significant portions of the City of Sacramento, and the community of Rancho Murieta. The 2020 SCP study area also includes the recently approved Elk Grove SOI, which is located immediately south of the current City of Elk Grove's southern boundary, south of Kammerer Road.

See *Figure 2-1* for the study area considered in the 2020 SCP.

2.2 Planning Updates

While SASD has based this update on the most current land use planning documents and information available at present, SASD has no control over the planning decisions made by the County or by the cities within its service area. These changes include potential annexations of land currently outside of the SASD 2020 SCP study area and the possible future incorporation of other communities. SASD will respond to those planning decisions as they arise, and changes in planning boundaries and land use plans will be reflected in future updates of the SCP.

For this SCP update, future land use and development information was compiled through the following methods:

- *Review the 2010 SCP and its 2015, 2017, and 2018 amendments.* These documents serve as a starting point for this update.
- *Review current planning documents.* These documents include the latest General Plans and Specific Plans adopted by the County and cities and the sewer studies that have been approved by SASD or are currently undergoing the review and approval process. The General Plans were used to gain an overall picture of land use composition. Specific Plans and sewer studies provided detailed information on the proposed land uses in each planned development area.
- *Create digital land use mapping in geographic information system (GIS) format.* Staff compiled GIS land use information from the County's and cities' planning departments and developers' sewer studies to develop a comprehensive land use map for the entire 2020 SCP study area.

2.3 Land Use Map and Projections

The types of land use and their respective densities are used to estimate unit wastewater flow rates for future developments. For this SCP update, a new land-use-based density map was created using the latest land use information from the planning documents. The density map in *Figure 2-2* shows assumed densities for the land use categories under buildout conditions. The densities are expressed in units of equivalent single-family dwelling units (ESDs) per acre, where one ESD represents the wastewater generation equivalent of one single-family residence.

For the 2020 SCP, the buildout ESD densities were selected based on the following criteria:

- Use 0 ESD/acre for dedicated open spaces
- Use the greater of 6 ESDs/acre or assumed ESD density data from the latest sewer studies and planning documents
- Use 15 ESDs/acre for Sacramento County's proposed corridor redevelopment areas

The areas that were considered to be open spaces (non-sewered areas) in the 2020 SCP are listed below:

- Natural preserve areas identified in the County of Sacramento's General Plan 2030
- Existing preserve areas identified in the South Sacramento Habitat Conservation Plan
- Existing park, roadway, railroad, detention basin, landscape corridor, levee, drainage ditch, and cemetery within developed areas
- Areas within approved sewer studies that have been designated as 0 ESD areas
- Rural residential "Sheldon" area in the City of Elk Grove

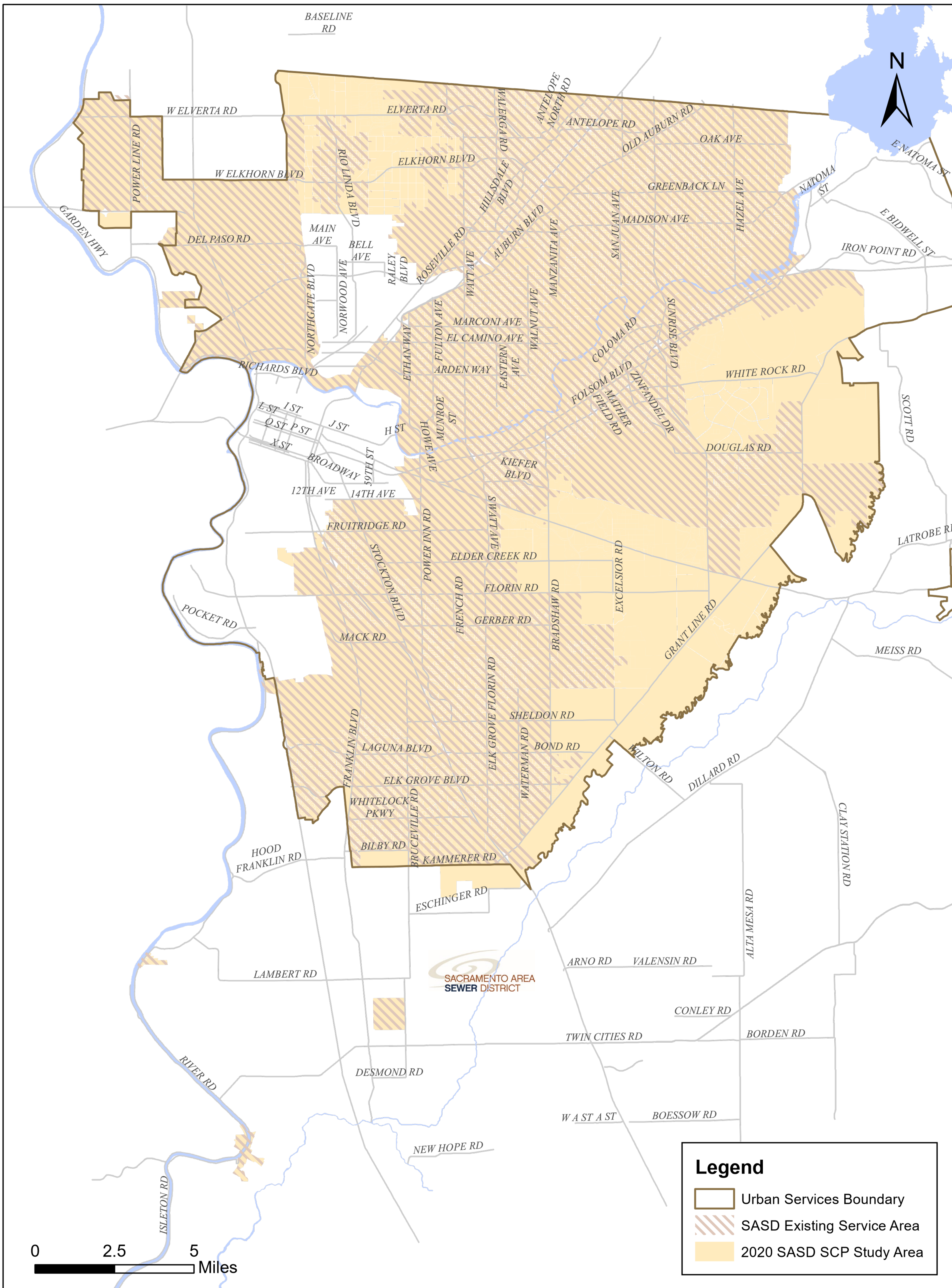
For purposes of developing wastewater flow estimates at buildout conditions, a minimum of 6 ESDs/acre was assumed for future developments when specific density information is not available or when the projected densities are lower than 6 ESDs/acre. Note that this minimum density assumption does not apply to open spaces. When a range of densities was given for a land use category presented in a planning document, the average density of that range was used for the SCP density map.

A density of 15 ESDs/acre was assumed for the corridor redevelopment areas proposed by the County of Sacramento. The corridor land use category applies to special planning zones that include mixed-use developments and sustainable communities. *Figure 2-3* shows the locations and names of the proposed corridor areas.

The ESD densities from the buildout density map in *Figure 2-2* will only be applied to parcels currently vacant or planned for redevelopment (e.g., corridors). At buildout, it was assumed that all currently vacant parcels would be developed to receive sewer service, except those designated as open space. The ESD densities will be used to estimate wastewater flows from these parcels under buildout conditions.

No densification to parcels currently connected to the SASD system was assumed unless redevelopment plans are proposed. Therefore, buildout density equals the existing density for currently connected parcels. The total existing ESDs for each currently connected parcel (including sub-parcels associated with the parcel) were determined from the ESD data contained in the County's utility billing system.

Figure 2-1. 2020 SCP Study Area



2020 SASD SYSTEM CAPACITY PLAN

SACRAMENTO AREA SEWER DISTRICT

2020 SCP Study Area
FIGURE 2-1

Updated: 12/10/2020

Figure 2-2. Buildout ESD Density Map

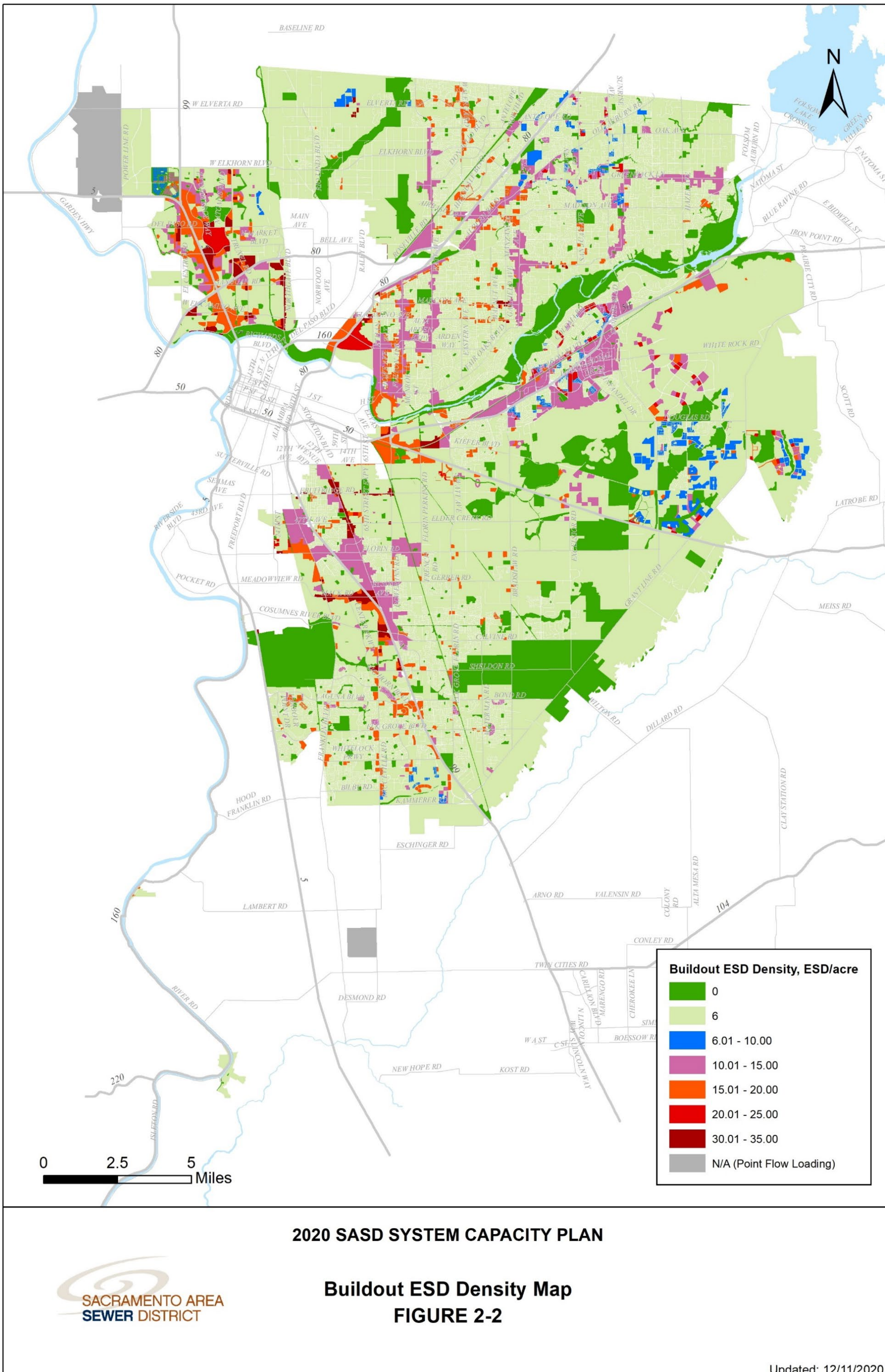
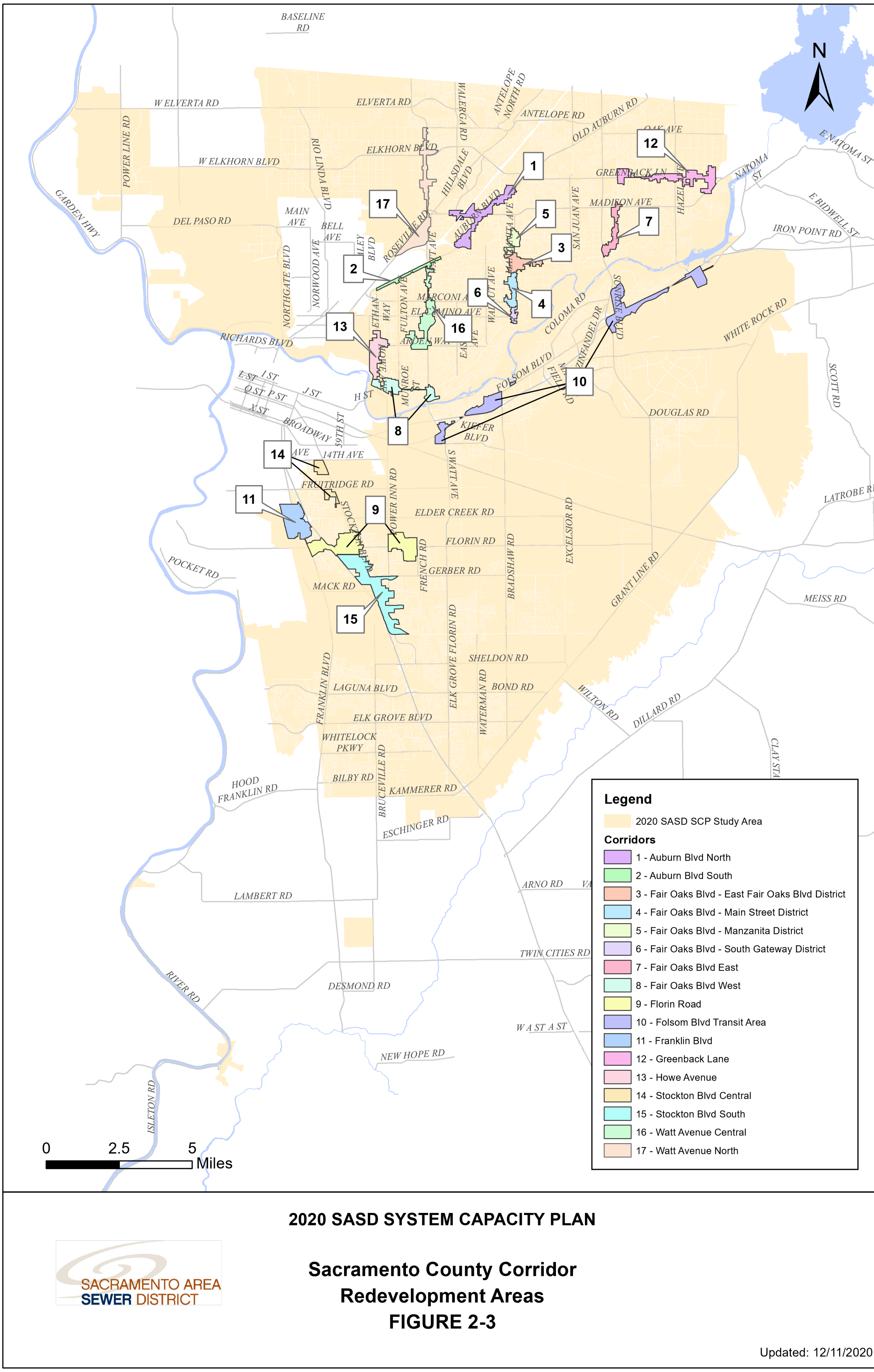


Figure 2-3. Sacramento County Corridor Redevelopment Areas



3. Flow Assumptions and Criteria

This section presents the assumptions and criteria established for the 2020 SCP's flow parameters and performance measures. Establishing these capacity criteria is necessary for determining the following:

- Where sewer improvements are needed in SASD's existing facilities to meet SASD's performance criteria
- Which new facilities may be needed in SASD's service area
- What design sizes should be considered for sewer improvements and new facilities

3.1 Flow Parameters

In the 2020 SCP, wastewater flow rates were estimated based on the following two factors:

- Land use density projections
- Flow parameters developed for the 2020 SCP

The land use density projections are described in Section 2 of this report. Flow parameters are used to estimate sewer flows generated from domestic wastewater, rainfall, and groundwater. Flow parameters of an existing sewer system can be estimated through flow monitoring and model calibration.

3.1.1 SASD Design Storm and Performance Storm

Design Storm

Wastewater collection systems are typically sized for a specific "design" condition, often associated with a design storm event. The design storm is based on long-term rainfall data. Typically, rainfall intensity-duration-frequency (IDF) relationships are available through county flood control districts to develop appropriate design rainfall amounts and intensities for drainage facilities.

SASD has historically used a 6-hour duration, 10-year frequency synthetic rainfall event as the Design Storm for sewer system planning. See *Figure 3-1* for the hydrograph of the SASD Design Storm. SASD Design Storm is based on the methodology outlined in the Hydrology Standards of the Sacramento City/County Drainage Manual (December 1996). SASD believes that using the Design Storm to size new development's sewer systems adequately reduces the risk of overflows during wet weather events.

Performance Storm

The performance storm is used to establish SASD's minimum capacity performance level. The performance storm provides a realistic measurement of the system performance, and it is used to determine relief project needs and size relief projects to eliminate sewer overflows. Unlike the synthetic design storm, the SASD Performance Storm is a real storm event that occurred on January 22, 1997. The storm was selected through continuous simulation modeling and statistical analysis of the SASD system's response to actual storms. The SASD Performance Storm was considered a 5-year return frequency event based on the overall system response. See *Figure 3-2* for the hydrograph of the SASD Performance Storm.

Figure 3-1. SASD Design Storm

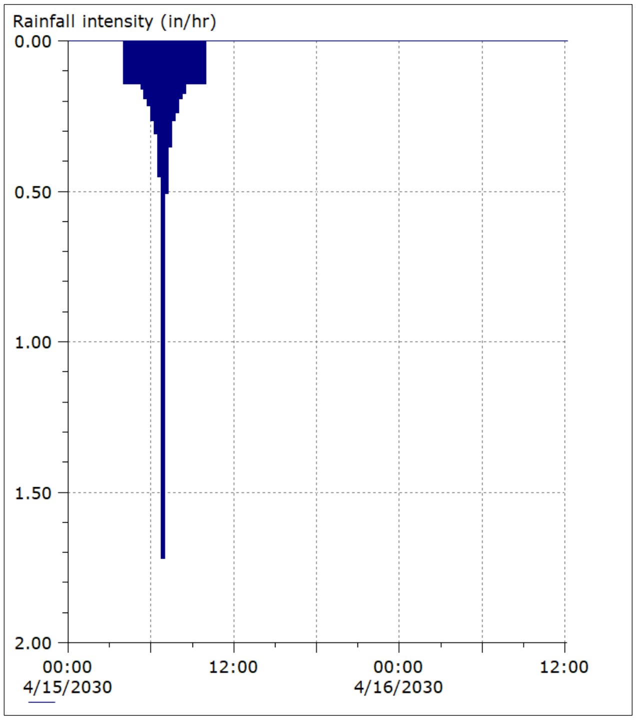
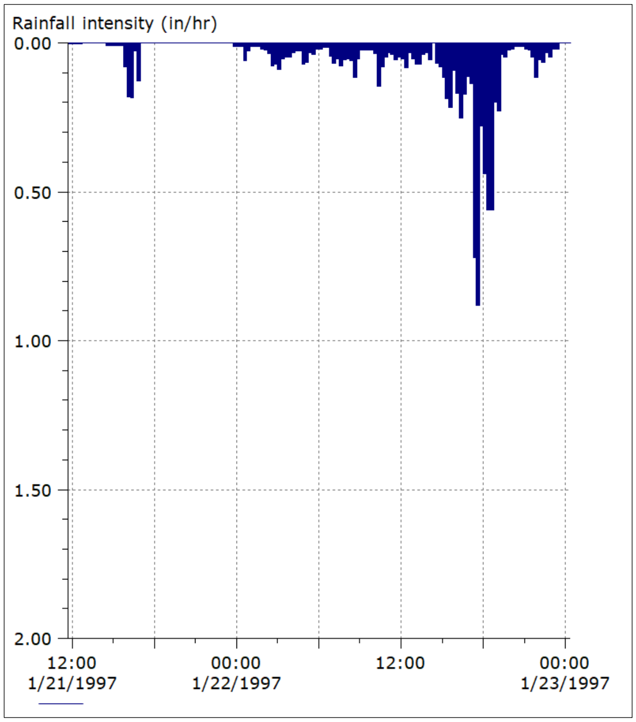


Figure 3-2. SASD Performance Storm



3.1.2 Wastewater Flow Components

Wastewater flows are composed of several components:

- Domestic flows
- Groundwater infiltration (GWI)
- Rainfall-dependent infiltration/inflow (RDI/I)

The latter two components are collectively referred to as infiltration/inflow (I/I). Infiltration is extraneous groundwater and stormwater runoff that indirectly enters the collection system. Inflow is stormwater that enters into the collection system at points of direct connection.

Domestic Flows

Domestic wastewater flows originate from residential, commercial, industrial, and institutional users. The domestic flow rates (excluding industrial discharges described in Section 4) are defined in terms of the average wastewater flow contribution from one single-family dwelling. Domestic flows are determined by the type of land use and are affected by the service area's growth and development. Domestic flows may also be impacted by water use practices such as water conservation. Domestic wastewater flows vary in magnitude throughout the day but generally follow predictable diurnal patterns - normally peaking early in the morning in upstream sewers and peaking less sharply in larger downstream sewers later in the day. For the 2020 SCP, the domestic flow factor and diurnal curve criteria are defined as noted in *Table 3-1*.

Table 3-1. 2020 SCP's Domestic Flow Factor and Diurnal Curve Criteria

SASD Service Area Description	Domestic Flow Factor	Diurnal Curve
Future Development and Redevelopment Parcels	310 gpd/ESD	SASD's Standard Residential Diurnal Curve
Currently Connected Parcels *(with recent flow monitoring & model calibration)*	Flow factors determined from the latest model calibration	Curves developed from the latest model calibration
Currently Connected Parcels *(without recent flow monitoring & model calibration)*	310 gpd/ESD	SASD's Standard Residential Diurnal Curve

The design domestic flow factor of 310 gpd per ESD is higher than most of the measured flows in the SASD system.

For currently connected parcels with *recent flow monitoring data*, the daily variations in domestic wastewater flow rates can be represented by various diurnal curves developed from model calibration. For future development and redevelopment parcels, as well as currently connected parcels whose hydraulic model was *not recently calibrated to flow monitoring data*, the 2020 SCP applied SASD's standard residential diurnal curve.

Groundwater Infiltration

GWI is groundwater that indirectly enters the sewer system, usually through joints in pipes and manhole walls. The magnitude of GWI depends on the condition of the sewers and the depth of the groundwater table with respect to the elevation of the local sewer system. Therefore, GWI is highly dependent on location and topography. Sewers in low-lying areas, particularly along streams and near rivers, typically exhibit higher GWI rates.

In Sacramento, GWI varies seasonally (lowest in summer and early fall, highest in late winter and spring) and from year to year depending on rainfall patterns, but it may not vary significantly on a day-to-day basis. For SCP purposes, GWI is considered to be infiltration that occurs during non-rainfall periods to distinguish it from RDI/I. However, rainfall has long-term impacts on GWI rates, as evidenced by measurable increases in GWI after prolonged periods of rainfall.

GWI can be determined from flow monitoring data. GWI is expressed on a unit area basis (gpd per acre) by dividing the estimated GWI flow by the sewer-contributing acreage of the monitored area. For future development and redevelopment, a zero GWI rate was assumed (i.e., no additional GWI above the base infiltration included in the 310 gpd per ESD domestic flow). *Table 3-2* summarizes the GWI rates considered in the 2020 SCP.

Table 3-2. 2020 SCP Groundwater Infiltration Rates

SASD Service Area Description	Groundwater Infiltration Rates
Future Development and Redevelopment Parcels	0
Currently Connected Parcels *(with recent flow monitoring and model calibration)*	GWI rates developed from the latest model calibration
Currently Connected Parcels *(without recent flow monitoring and model calibration)*	GWI rates used in the 2010 SCP

Note that for computing GWI and RDI/I flows, contributing acreage includes only land uses considered to contribute wastewater flows and does not include non-sewered open space uses.

Rainfall-Dependent Infiltration/Inflow

RDI/I is infiltration and inflow that is directly related to rainfall events. RDI/I may also enter the sewer system through joints in pipes and manholes, as well as through direct surface drainage connections such as illegally connected roof and yard drains or storm drain cross-connections. The magnitude of RDI/I flows are related to the following:

- Intensity and duration of the rainfall

- Relative soil moisture at the time of the rainfall event
- Condition of the sewers

In most areas, peak flows during rainfall events are the highest flow rates that occur in the collection system. Peak design flows for new development's sewers include the projected RDI/I expected to be generated by SASD's Design Storm (6-hour, 10-year recurrence frequency). RDI/I flows are generated by applying runoff parameters (RDI/I volume percentages and hydrograph shapes) to a simulated storm rainfall using the hydrologic routines in the hydraulic model. The runoff parameters are represented as a set of three volume percentages:

- Fast RDI/I response to rainfall
- Medium RDI/I response to rainfall
- Slow RDI/I response to rainfall

Each runoff parameter represents the volume of RDI/I as a percentage of the total volume of rainfall falling on an area. Each runoff parameter also has a corresponding hydrograph shape.

The 2020 SCP's RDI/I rates are summarized in *Table 3-3*.

Table 3-3. 2020 SCP Rain-Dependent Infiltration/Inflow Rates

SASD Service Area Description	Rainfall-Dependent Infiltration/Inflow Rates
Future Development and Redevelopment Parcels	0.7% fast RDI/I response
Currently Connected Parcels *(with recent flow monitoring and model calibration)*	RDI/I rates developed from the latest model calibration (0.7% minimum fast RDI/I response)
Currently Connected Parcels *(without recent flow monitoring and model calibration)*	RDI/I rates used in the 2010 SCP

For future development and redevelopment areas, the RDI/I rate was assumed to be 0.7 percent fast RDI/I response, which would result in flow rates similar in magnitude as calculated by SASD Standards' design equations.

Runoff parameters for the currently connected parcels with recent flow monitoring data were established based on model calibration to actual flow monitoring data. A minimum of 0.7 percent fast RDI/I response was assumed.

For the 2020 SCP, it has been assumed that future I/I rates in the existing system will remain similar to existing rates. In reality, some areas may deteriorate quicker, resulting in increased I/I flow. Conversely, as SASD increases its rehabilitation efforts, some segments of the existing system may experience slower deterioration rates and less I/I. SASD will continue to monitor flows in the system and calibrate its hydraulic model using the latest flow monitoring data to reflect the changes in the pipe conditions.

3.1.3 Peak Wet Weather Flows

Per SASD Standards, new sewer systems are designed to have the capacity (without surcharge) to accommodate the PWWF. The SASD Standards calculate design PWWF rates using static wastewater equations. These equations are based on average dry-weather flow (ADWF) and I/I factors.

In the 2020 SCP evaluations, PWWF rates were determined using the hydraulic model to simulate the flows in the system during the SASD Design Storm and the Performance Storm. The hydraulic model determined the PWWF rates for both existing and buildout condition scenarios (see discussions on the development of the hydraulic models in Section 4 and presentation of model results in Section 5).

3.1.4 Flow Parameter Summary

Table 3-4 summarizes the flow parameters used in the 2020 SCP. For future development and redevelopment areas, the flow parameters result in flow rates similar in magnitude to applying the SASD Standards' design wastewater equations.

For currently connected parcels, the 2020 SCP's flow parameters were based on the best available information from recent flow monitoring data. By using actual flow monitoring data, the domestic flow factors for currently connected parcels may be higher or lower than the design 310 gpd/ESD flow factor. For currently connected parcels with no recent flow monitoring data, the 310 gpd/ESD domestic flow factor was uniformly applied.

The 2020 SCP flow parameters were entered into SASD's dynamic sewer hydraulic models. The results of these modeling evaluations are presented in Sections 5 and 6 of this report.

Table 3-4. 2020 SCP Flow Parameters

SASD Service Area Description	Domestic Flow Factor	Diurnal Curve	Groundwater Infiltration Rates	Rainfall-Dependent Infiltration/Inflow Rates
Future Development and Redevelopment Parcels	310 gpd/ESD	SASD's Standard Residential Diurnal Curve	0	0.7% fast RDI/I response
Currently Connected Parcels *(with recent flow monitoring and model calibration)*	Flow factors determined from the latest model calibration	Curves developed from the latest model calibration	GWI rates developed from the latest model calibration	RDI/I rates developed from the latest model calibration *(0.7% minimum fast RDI/I response)*
Currently Connected Parcels *(without recent flow monitoring and model calibration)*	310 gpd/ESD	SASD's Standard Residential Diurnal Curve	GWI rates used in the 2010 SCP	RDI/I rates used in the 2010 SCP

3.2 Performance Criteria

The 2020 SCP established performance criteria for the following purposes:

- Evaluate system performance and identify potentially capacity-deficient locations in SASD's system.
- Develop preliminary solutions to improve performance in SASD's system.
- Size new facilities in SASD's expansion area.

The performance criteria adopted for the 2020 SCP is appropriate for a planning level evaluation. The sewer systems identified as "potentially capacity deficient" in the 2020 SCP will eventually undergo a more in-depth investigation through the UCFMS, which is part of SASD's Sewer System Management Plan. The potentially deficient sheds will be monitored and calibrated with flow data from at least one wet weather season (usually from multiple wet weather seasons). The design and construction of a relief project may not occur until capacity deficiencies have been verified through field observations and flow monitoring.

Table 3-5 presents the performance criteria used for the 2020 SCP. For relief projects, the *SCP's performance criteria focus on eliminating model-predicted SSOs*. This approach is consistent with SASD's asset management principles that *"manage assets at the optimal cost of ownership* *while delivering the level of service customers' desire, and considering risk and impacts to future generations."* Unlike the previous SCPs when only the SASD Design Storm was used to evaluate the relief projects, the 2020 SCP utilized both the SASD Design Storm and the SASD Performance Storm to identify potential capacity deficiencies under existing and buildout conditions and to develop preliminary relief solutions. For the expansion projects, the SASD Design Storm was continued to be used to size new sewer facilities based on the no-surcharging criteria.

The 2020 SCP's performance criteria were applied in the hydraulic modeling evaluations performed for SASD's infill area and expansion area. The results of these modeling evaluations are presented in Sections 5 and 6 of this report.

Table 3-5. 2020 SCP's Performance Criteria

Project Type	Purpose	Performance Criteria *(based on hydraulic modeling results)*	Storm Event Used for Evaluation
Relief Project	*Identify* potential capacity deficiencies	Model-predicted SSOs	SASD Design Storm and Performance Storm
	Develop preliminary solutions to improve system performance	Eliminate predicted SSOs	
Expansion Project	*Size* new facilities	No surcharging in new sewer system	SASD Design Storm

4. Hydraulic Modeling

4.1 Introduction

Developing dynamic hydraulic models of the SASD sewer system was a major component of the 2020 SCP. The SCP sewer models were used for the following purposes:

- Assess the hydraulic performance of the SASD sewer system
- Identify potential capacity deficiencies in the SASD system
- Develop preliminary solutions to improve the performance of potentially capacity-deficient systems
- Develop expansion projects to serve future development areas

SASD currently uses InfoWorks Integrated Catchment Modeling (InfoWorks ICM) software, a product offered by Innovyze, to provide SASD's hydraulic modeling needs. This section describes the efforts to construct and calibrate the SASD hydraulic models.

4.2 Model Construction

4.2.1 2020 SCP SASD Hydraulic Models

To achieve the goals of the 2020 SCP, the following sets of SASD hydraulic models were created:

- 2020 existing model and 2020 existing *trunk* model
- Buildout model and buildout *trunk* model
- Solution/buildout *trunk* model

The 2020 existing model simulated flows in the existing SASD system, and it was constructed based on existing land use conditions. The basic steps to create the 2020 existing model are listed below:

- Import GIS sewer data for manholes and pipes with relevant attribute data to be modeled
- Incorporate special structures (pumps, weirs, orifices) and related data to the model
- Use sewer account information from the Consolidated Utility Billing and Services (CUBS) database to identify parcels currently connected to the SASD collection system
- Import GIS parcel data and populate parcels with CUBS ESD data
- Use Assessor Parcel Number (APN) and SASD asset data to associate parcels with model loading manholes
- Populate model flow parameters and calibrate the model using the best available flow meter data

The 2020 existing *trunk* model was then created by removing most of the pipes smaller than 10 inches in diameter from the 2020 existing model. For the potentially capacity-deficient systems, all of the pipes, regardless of their sizes, were kept in the trunk model to allow for a more accurate prediction of the system hydraulic performance. In addition, to accurately model flow splits in the SASD system, all pipes downstream of flow split manholes were included in the trunk model.

The buildout model reflected the service area's projected buildout land use conditions and included both existing facilities and future expansion facilities. Below are the steps for creating the buildout model:

- ❖ Starting with the 2020 existing model, add all parcels and areas within the SCP Study Area to the model. The SCP Study Area is defined in Section 2 of this report.
- ❖ Densify all parcels that do not currently have existing ESDs in CUBS, except for open space and industrial parcels with existing trade flows for both infill and expansion areas. Densify the proposed corridor redevelopment parcels. The ESD densification is based on the buildout ESD density map presented in Section 2 of the report.
- ❖ Develop future expansion trunk facilities to serve future developments in the expansion area.

The buildout *trunk* model was then created by omitting smaller pipes from the buildout network, similar to how the 2020 existing *trunk* model was created.

Next, the 2020 existing *trunk* model and the buildout *trunk* model were used to evaluate the system performance and identify the potential capacity deficiencies at existing and buildout conditions.

Preliminary relief solutions were developed to improve system performance in potentially capacity-deficient systems under both existing and buildout conditions.

The preliminary relief solutions were then incorporated into the buildout *trunk* model to create the last model – the solution/buildout *trunk* model that simulated buildout flows in the ultimate SASD facilities.

Figure 4-1 and *Figure 4-2* show the modeled systems for the existing and buildout conditions. They are the map views of the 2020 existing *trunk* model and the buildout *trunk* model.

4.2.2 Basic Components of Model Data

The model data consist of three basic components:

- ❖ **Nodes**: This component includes manholes and pump station wet wells. The primary data for nodes is ground elevation. Pump station wet wells also have other attribute data like chamber roof elevations, chamber floor elevations, and cross-sectional areas.
- ❖ **Links**: The model represents physical connections between two nodes as links. Links are mostly pipes but also include flow control structures such as pumps, weirs, sluice gates, and orifices. A model link requires an upstream and a downstream node. Attribute data for pipes also include pipe type (gravity or force main), length, diameter, upstream and downstream invert elevations, Manning's roughness coefficient, and headloss coefficient.

Modeling pump operation requires discharge flow rate data and pump on and off levels. For other flow control structures, the model also requires dimensional inputs.

- **Subcatchments**: These are the sewer sheds tributary to a node, and they can be as small as individual parcels. Attribute data for subcatchments include loading node identification (ID), ESDs, contributing acreage, and land use ID. Land use ID information consists of a specific wastewater diurnal flow pattern, ESD flow factor, GWI, and RDI/I parameters assigned to a particular shed. Wastewater flows are generated from the subcatchments and routed through the piping network.

The domestic flow component of the wastewater is generated from ESDs, ESD flow factor, and wastewater diurnal flow pattern. The GWI and RDI/I flow components of the wastewater are generated from contributing acreage, GWI, and RDI/I parameters. The contributing area of each parcel was determined based on the parcel size in GIS. For large connected but under-developed parcels, it was assumed that, at most, one acre per ESD represented the current contributing area of the parcel. This assumption was made so as not to overestimate the I/I-contributing portion of the parcel.

In addition to the wastewater flow components generated by the subcatchments, flows from permitted industrial dischargers also enter the SASD sewer system. They are referred to as trade flows and are modeled as point source loads based on their locations, permitted discharge rates, and duration.

4.2.3 Best Information Available for Model Construction

The best available information was used to construct the SASD hydraulic models. The following summarizes how the best available information was obtained:

- SASD's GIS database provided the latest node, pipe, and parcel data for modeling the existing sewer system.
- Questionable asset data was corrected or verified by SASD's Information Management team.
- Existing pump station data was obtained from SASD's SCADA system, as-built drawings, and SASD's Operations Support staff most familiar with SASD pump stations' operations.
- Flow diversion structure information (including weirs, sluice gates, orifices, and plugs) were taken from previous SASD models, as-built drawings, and field memos. Attribute data for many of these structures was verified by SASD's Information Management team.
- Industrial discharge data was provided by the SASD's Capacity Management group, who performed capacity analyses for all industrial discharge permits.

4.2.4 Flow Monitoring and Model Calibration

A critical component of model development is determining the system flow parameters from flow monitoring and model calibration. Flow parameters include domestic flow factors, diurnal curves, GWI factors, and percentages of fast, medium, and slow RDI/I responses. These parameters affect how flows are generated in the models.

During model calibration, rainfall data (from the same flow monitoring period) is run through the hydraulic model to compare the model's simulated flows against the measured flows from flow monitoring. The model flow parameters are adjusted until the simulated flows match well with the measured flows. SASD staff performed the model calibrations using at least one season of flow data, which contains both dry and wet weather flow data. In addition to flow meter data, SASD also used rainfall information to simulate the storm events that occurred during the flow monitoring periods to calibrate the models. SASD previously purchased gauge-adjusted radar rainfall data for model calibration. However, SASD currently develops model rainfall files using only Sacramento County or SASD rain gauges. In 2020, SASD operates and maintains approximately 30 rain gauges and 90 flow meters.

Since 2003, SASD has installed over 300 meters in various locations throughout SASD's service area. SASD rotates its meters throughout the service area based on the following strategy:

- First, install meters to monitor the critical systems (e.g., the systems identified as potentially capacity deficient in the previous SCP)
- Next, move meters to less critical systems
- Install meters in areas needed for specific SASD projects

About 86 percent of SASD's sewer system has been calibrated with the best available data. These data include flow meter data, pump station force main electromagnetic meter data, and pump station inflow rates calculated from SCADA data. The critical systems identified as "Planning Period 1" systems in the 2010 SCP have been monitored. SASD continues to rotate its meters and plans to eventually collect sufficient flow data from its entire system so that the entire SASD service area has a calibrated hydraulic model.

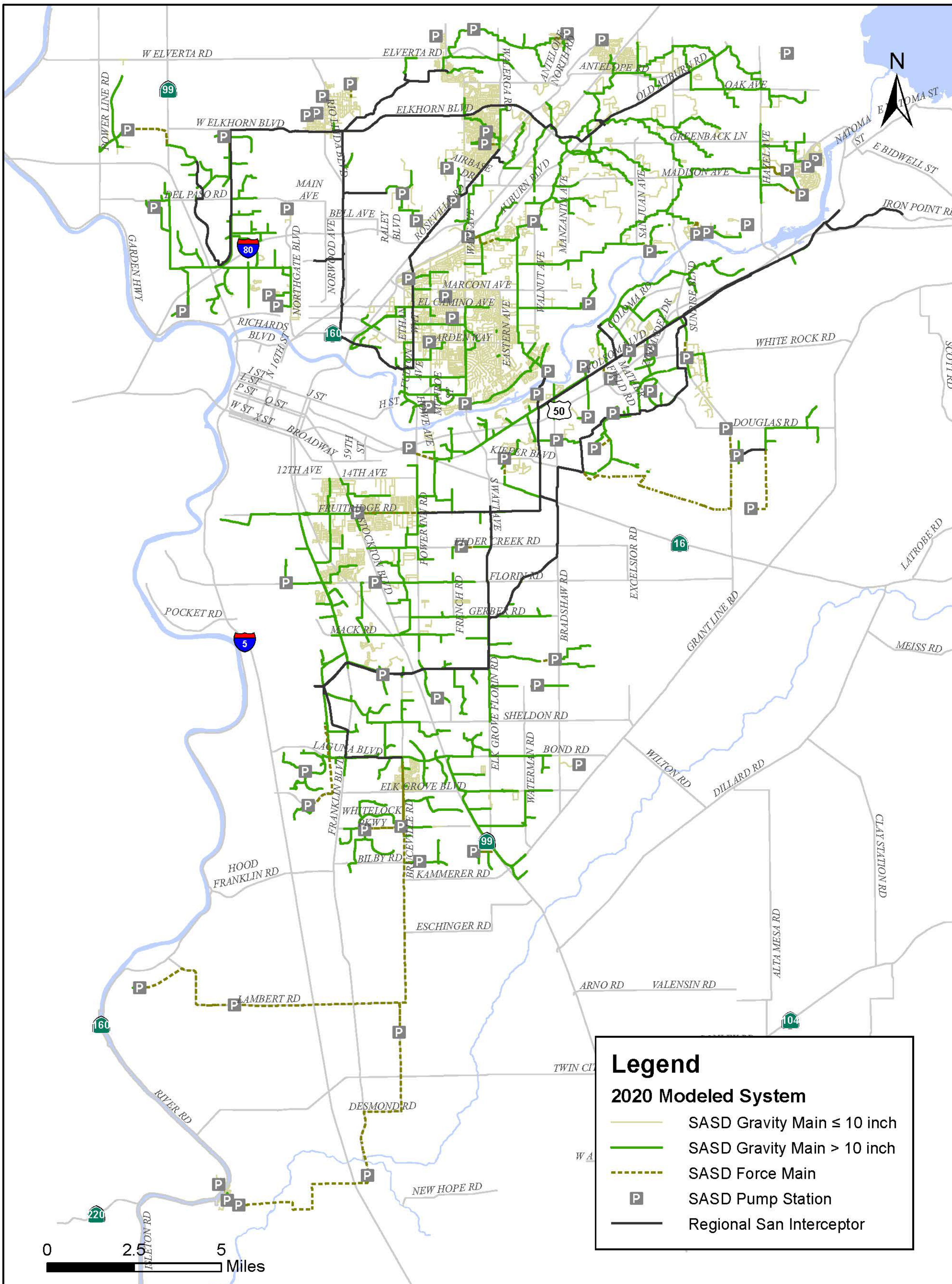
4.2.5 Hydraulic Boundary Conditions

Partial Regional San interceptor systems were included in the SASD SCP models to provide network connectivity. *Figure 4-1* and *Figure 4-2* show the interceptor systems included in the 2020 SCP models.

The 2020 SCP models did not include flows from Regional San's other contributing agencies (that contribute to the interceptor system flows), including the City of Folsom, City of Sacramento, and City of West Sacramento. As a result, several interceptors in the 2020 SCP models (such as the Bradshaw, Central, Folsom, Folsom East, and Lower Dry Creek Interceptors) do not include all of the anticipated interceptor flows. Therefore, the 2020 SCP models may not reflect the actual hydraulic boundary conditions at the SASD trunk discharge locations into the interceptors.

SASD developed infill area preliminary solutions and expansion area projects using the 2020 SCP models that do not have all of the anticipated flows in the interceptor systems. This means that free outfall conditions were assumed for some SASD trunk connections into the interceptor systems. Expansion trunks were sized to carry flows generated by their contributing areas regardless if there is back-up surcharge from the interceptors.

Figure 4-1. 2020 Existing Modeled System



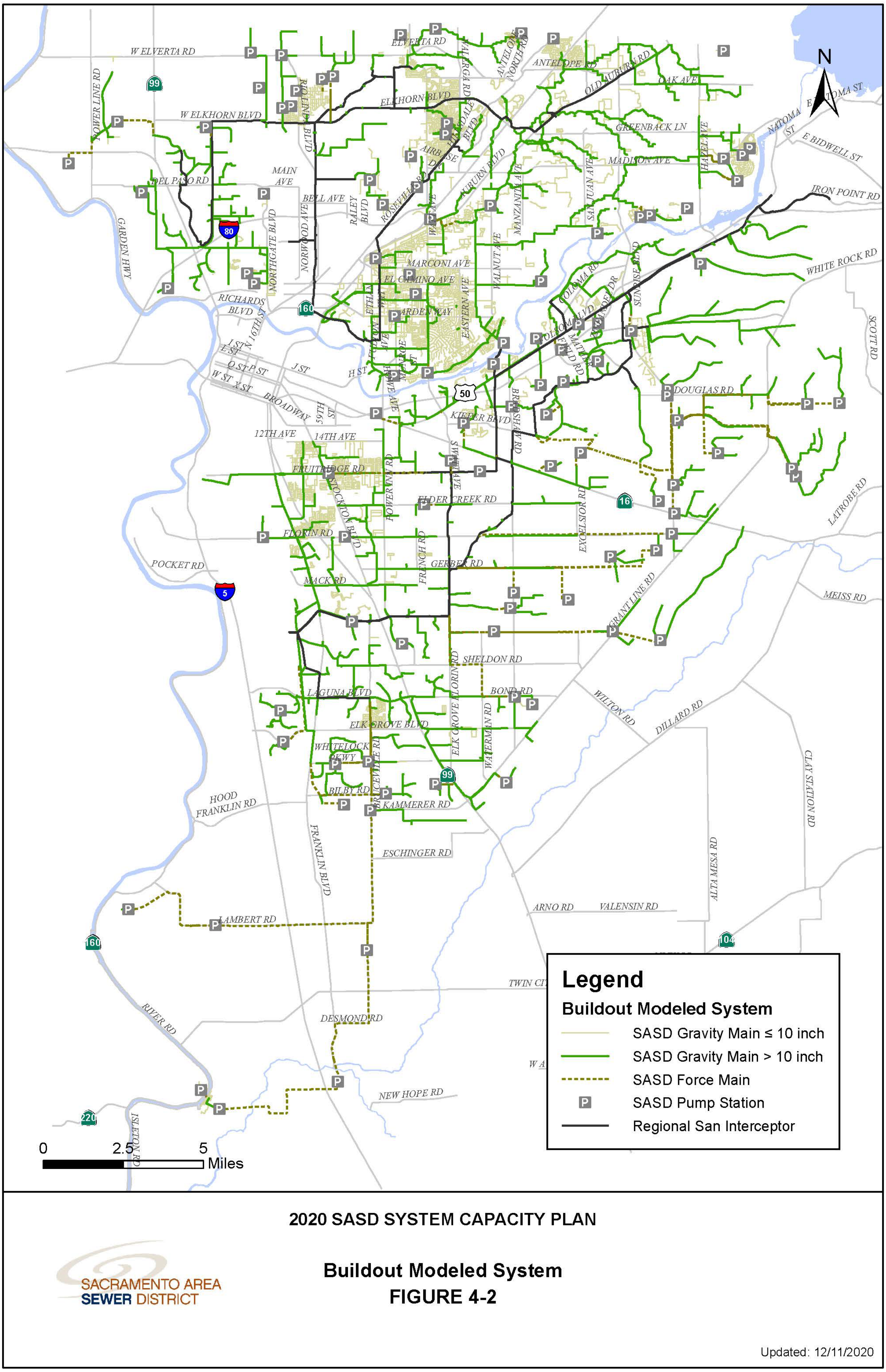
2020 SASD SYSTEM CAPACITY PLAN

SACRAMENTO AREA SEWER DISTRICT

2020 Modeled System
FIGURE 4-1

Updated: 12/11/2020

Figure 4-2. Buildout Modeled System



5. Infill Area Evaluation

5.1 Introduction

The 2020 SCP had three main objectives for the SASD infill area evaluation, and they are as follows:

- Assess the hydraulic performance of the SASD system
- Identify potential capacity deficiencies
- Develop preliminary solutions for this SCP's capital funding projections (CFP)

The 2020 SCP did not include detailed information on potential relief projects. Instead, the 2020 SCP primarily identified potentially capacity-deficient systems in the SASD infill area and then developed preliminary solutions to meet system performance criteria. The preliminary solutions were developed to estimate planning-level relief project costs for SASD's updated CFP. The systems flagged to be potentially capacity deficient will be further investigated through SASD's UCFMS.

This section presents the results of the system hydraulic performance evaluations and the 2020 SCP's approach to developing preliminary solutions in SASD's infill area.

5.2 System Capacity Evaluation and Results

To assess the hydraulic performance of the SASD system, the capacity analysis was performed by applying the SASD Design Storm and the SASD Performance Storm through the models to see how the system performs under existing and buildout conditions. As discussed in Section 3.2 (Performance Criteria), the 2020 SCP defined system capacity deficiency as model-predicted overflows under either the SASD Design Storm or the SASD Performance Storm. Potentially capacity-deficient systems were organized into two different planning periods:

- ***Planning Period 1:*** Model-predicted overflows under existing conditions
- ***Planning Period 2:*** Model-predicted overflows under buildout conditions (excluding Planning Period 1 systems)

5.2.1 Planning Period 1 Results

Figure 5-1 and *Figure 5-2* present the 2020 trunk model results showing how the SASD system performed hydraulically under the existing PWWF conditions for the SASD Design Storm and Performance Storm, respectively. Back-up surcharged pipes are shown in orange, and throttle surcharged pipes are shown in red. Back-up surcharge is due to flows being backed-up from downstream-constrained systems. Throttle surcharge occurs when the system is undersized (capacity-constrained) to convey peak flows. The pink and black target symbols represent model-predicted overflow locations.

For systems with model-predicted overflows, the 2020 SCP flagged them as potentially capacity deficient, and each system was labeled with a unique identifier (e.g., RIO-3, ARD-10). The model results indicated more potentially capacity-deficient systems in the northern area of the SASD system (especially within the ARD trunk shed) compared to the southern area. A total of 19 systems were identified for Planning Period 1.

Some predicted overflows shown in *Figure 5-1* and *Figure 5-2* were not labeled with the deficient system identifiers because these systems currently have their relief projects underway (e.g., the Watt/Don Julio sewer project, Sailor Bar pump station project). In addition, there are model-predicted overflows in the Upper Dry Creek area that were not labeled because they are caused by the potential capacity deficiency in the Regional San's interceptor system (not the SASD's system). Regional San already has this system monitored and has plans to address the deficiency once it is confirmed.

5.2.2 Planning Period 2 Results

The buildout trunk model results are presented in *Figure 5-3* and *Figure 5-4.* Only *additional* potentially capacity-deficient systems were labeled in these figures. The model predicted seven *additional* systems as potentially capacity deficient under buildout conditions. The buildout trunk model predicted more surcharging and overflows due to infill development and densification projected to occur between 2020 and buildout.

Table 5-1 summarizes the potentially capacity-deficient systems flagged for each planning period listed above.

Table 5-1. Summary of Potentially Capacity-deficient Systems for Each Planning Period

ID	Planning Period 1 (PP1)	Planning Period 2 (PP2)*
1	RIO-3	ARD-20
2	ARD-10	CEI-3
3	ARD-11	FOI-5
4	ARD-12	NEA-19
5	ARD-17	NEA-22
6	ARD-21	NEA-40
7	ARD-24	RCCC-1
8	ARD-25	
9	ARD-26	
10	ARD-27	
11	ARD-28	
12	MCL-1	
13	MCL-2	
14	NEA-51	
15	NEA-63	
16	SEA-9	
17	SEA-11	
18	SEA-20	
19	WG-1	
	Total 19 PP1 systems	**Total 7 PP2 systems**

*Excluding PP1 systems

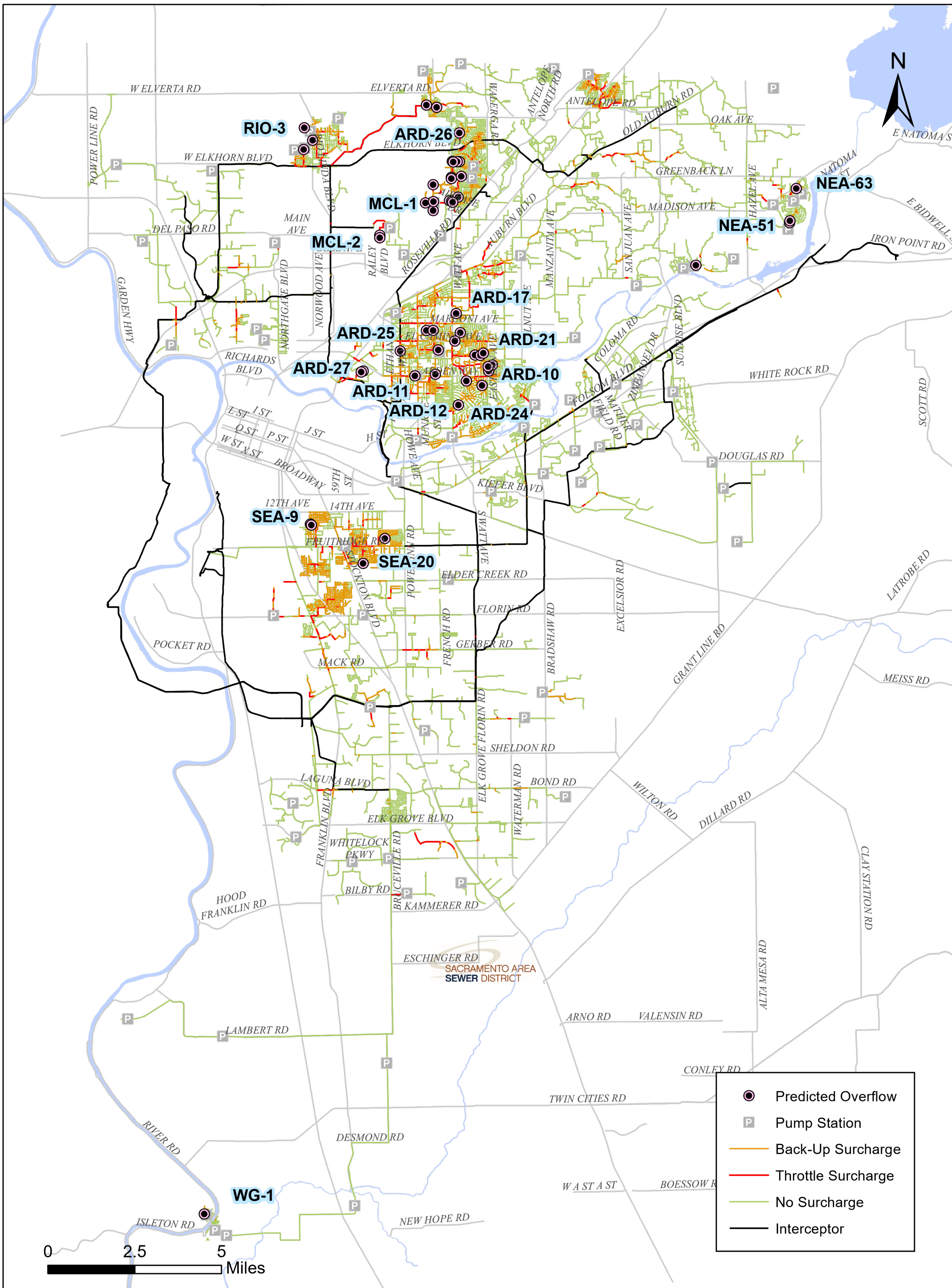
5.3 Relief Solution Development

To make cost information available for funding projections, SASD developed preliminary solutions to improve system performance after flagging potentially capacity-deficient systems. See Section 7 for cost information associated with each flagged system in SASD's infill area. The following approach was used to develop the preliminary solutions:

- Develop a valid relief solution that returns the system hydraulic performance to no predicted overflows under buildout conditions for both the SASD Design Storm and the Performance Storm. Refer to Section 3.2 for details of the performance criteria established for the 2020 SCP.
- Check that the preliminary solution first relieves the smaller upstream sewer branches, then relieves the downstream branches that feed into the major trunks. This ensures that all of the upstream sewer flows can reach the downstream pipes without overflowing.

- Check that the preliminary solution eliminates model-predicted overflows under the buildout scenario, assuming that all of the necessary future trunks and interceptors will be constructed.
- Consider different types of relief alternatives, including the following options:
  - Pipe upsizing or additional pipes
  - Diversion to other existing or future sewers or interceptors
  - Pipe storage
  - Sealing manholes
  - Pump station upgrades
- Consider the SASD Standards when developing preliminary solutions.
- Look for ways to restore system performance that avoided long relief pipes and existing alignments that may present difficult construction challenges.

Figure 5-1. 2020 Model Results For SASD Design Storm Without Relief Projects



2020 SASD SYSTEM CAPACITY PLAN

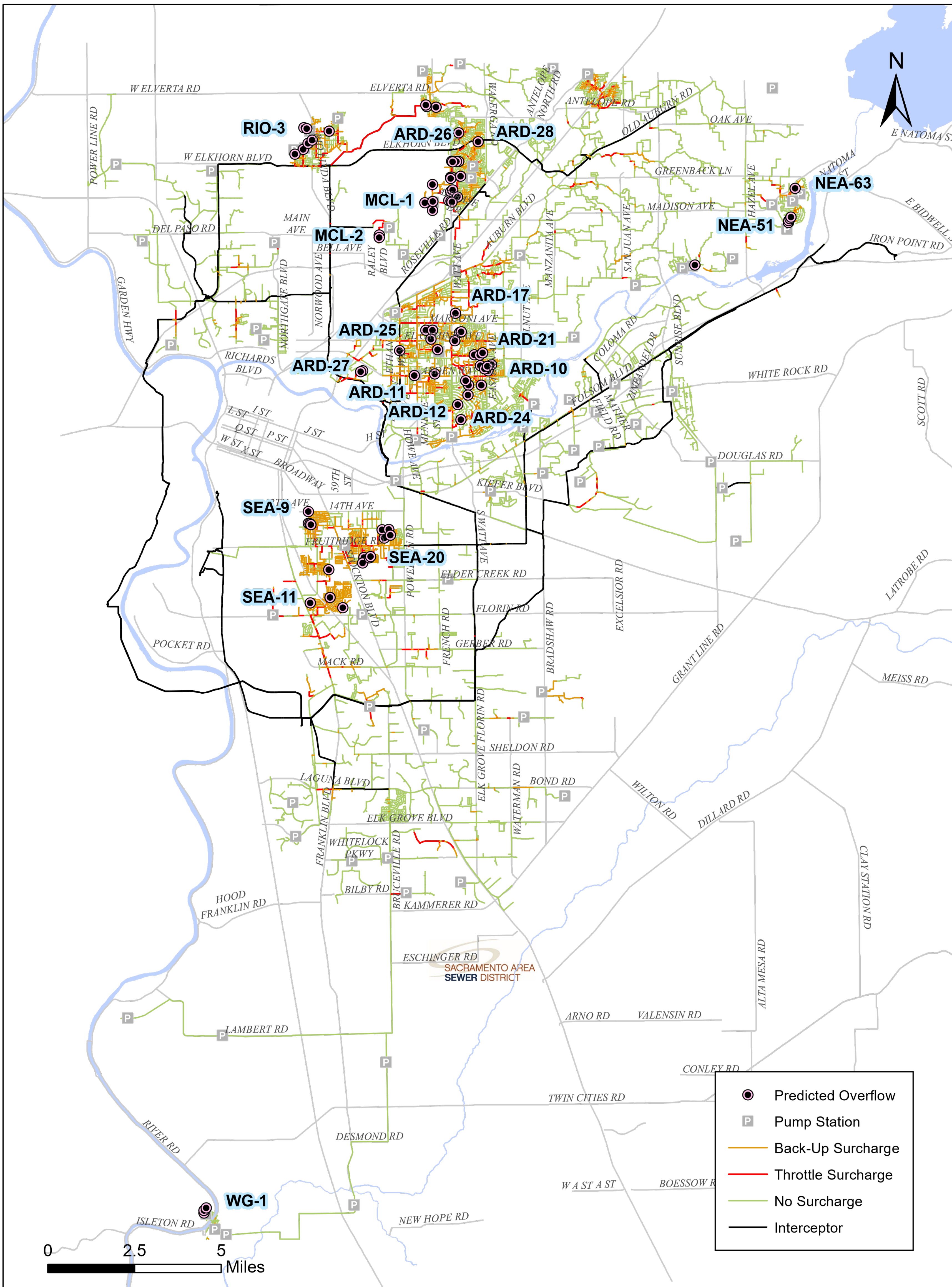
SACRAMENTO AREA SEWER DISTRICT

2020 Model Results for SASD Design Storm Without Relief Projects

FIGURE 5-1

Updated: 10/5/2020

Figure 5-2. 2020 Model Results For SASD Performance Storm Without Relief Projects



2020 SASD SYSTEM CAPACITY PLAN

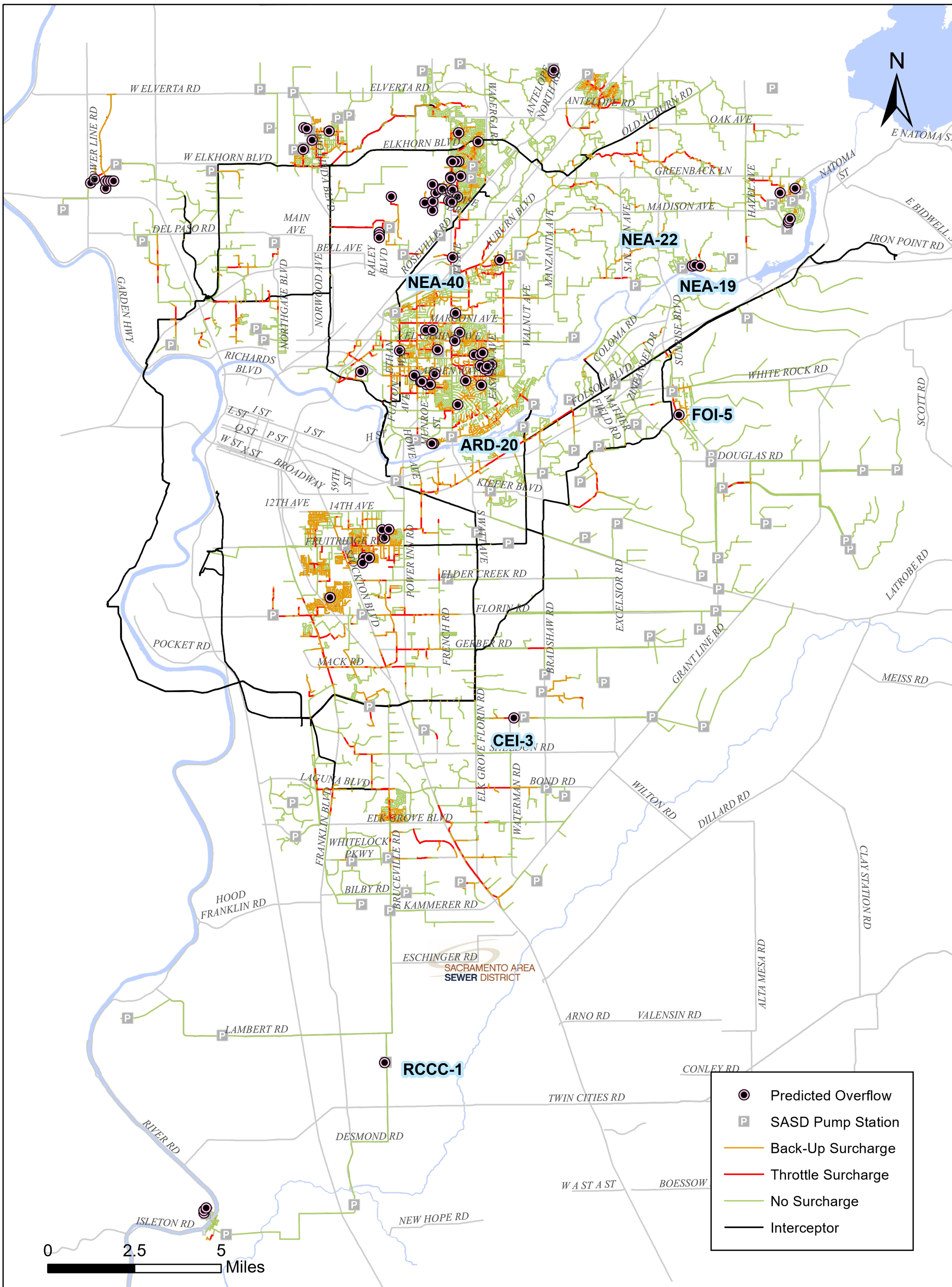
SACRAMENTO AREA SEWER DISTRICT

2020 Model Results for SASD Performance Storm Without Relief Projects

FIGURE 5-2

Updated: 9/29/2020

Figure 5-3. Buildout Model Results For SASD Design Storm Without Relief Projects



2020 SASD SYSTEM CAPACITY PLAN

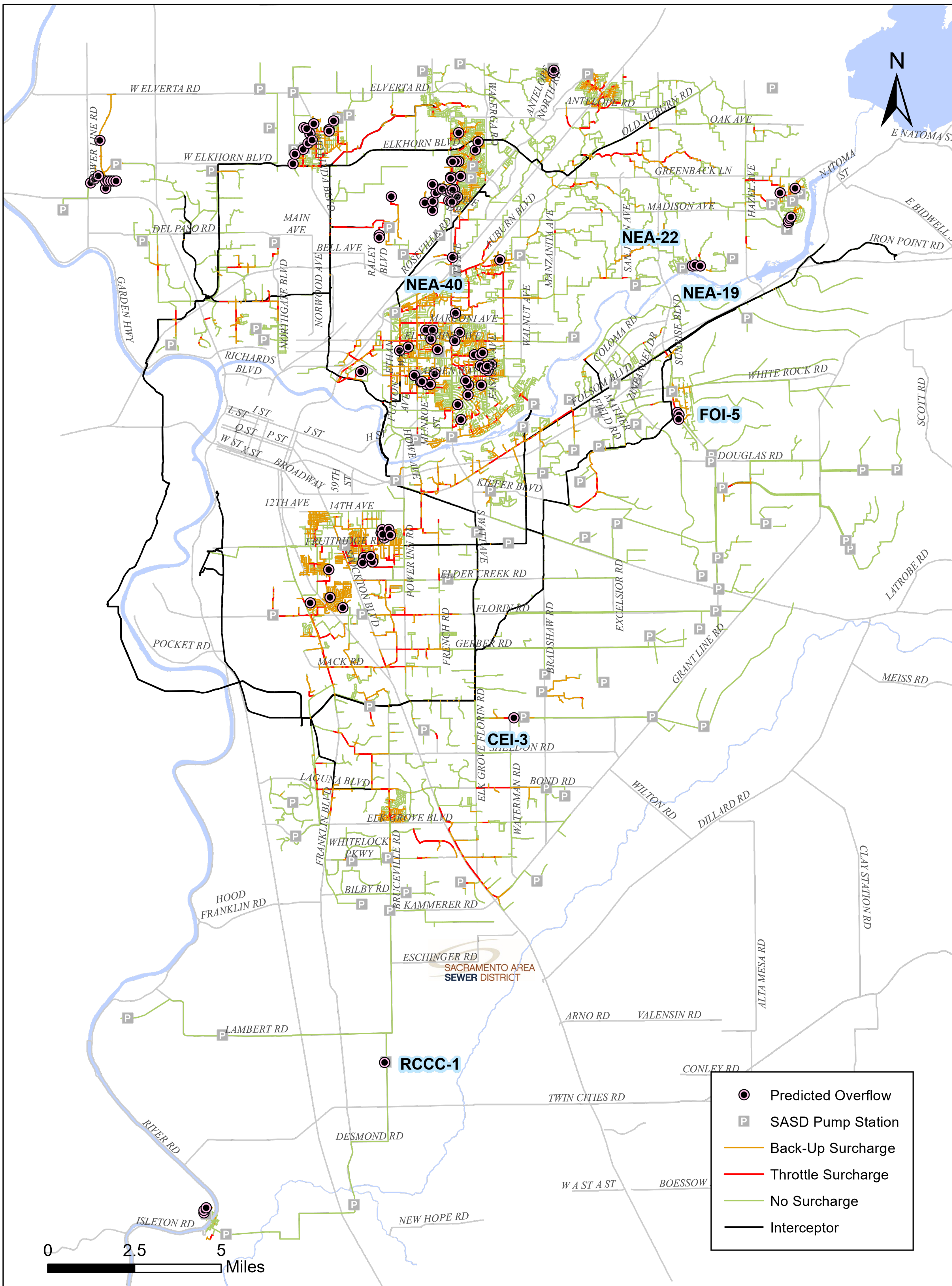
SACRAMENTO AREA SEWER DISTRICT

Buildout Model Results for SASD Design Storm Without Relief Projects FIGURE 5-3

Only Planning Period 2 Systems are Labeled

Updated: 10/5/2020

Figure 5-4. Buildout Model Results For SASD Performance Storm Without Relief Projects



SACRAMENTO AREA SEWER DISTRICT

2020 SASD SYSTEM CAPACITY PLAN

Buildout Model Results for SASD Performance Storm Without Relief Projects

FIGURE 5-4

Only Planning Period 2 Systems are Labeled

Updated: 9/29/2020

6. Expansion Area Evaluation

6.1 Introduction

The 2020 SCP is a comprehensive planning document that provides a vision for how SASD is planning for its future capacity needs in the SCP study area, as defined in *Figure 2-1*.

To plan for the orderly and systematic expansion of the sewer system, the SASD expansion area was organized into many expansion trunk sheds. A trunk system expansion plan was developed for each shed. In this 2020 SCP, the expansion trunk sheds are defined based on their discharge points into the existing Regional San interceptor system.

This section presents the methodology used to develop the Expansion Trunk Shed Plans. The detailed plans are presented in *Appendix A*.

6.2 SASD Expansion Area Definition

According to the SASD Sewer Ordinance, the SASD service area is divided into two geographical areas: the infill area and the expansion area. The infill area is the geographical area within the SASD service area that discharges or has been planned to discharge to the 1999 trunk sewer collection system, as defined in the SASD Sewer Ordinance. The expansion area is the geographical area within the SASD planning area that is not part of the infill area, as also presented in the ordinance.

6.3 Delineation of Expansion Trunk Sheds

The SASD expansion area was divided into individual trunk sheds by sewer tracing. Each expansion trunk shed was characterized by its downstream connections to the existing interceptors.

Starting from its discharge points into the existing interceptors, a sewer shed was determined by performing upstream traces. In the 2020 SCP, an expansion trunk shed name consists of 1) its corresponding existing interceptor abbreviation and 2) the shed location. For example, the trunk shed name of "*BR East Rancho*" indicates that this trunk system discharges into the existing *Bradshaw Interceptor,* and it is located in the *East Rancho area*.

Figure 6-1 shows all of the trunk sheds within the 2020 SCP study area. SASD expansion area trunk sheds are labeled in red. SASD infill area trunk sheds are labeled in blue. For this SCP, there are 13 trunk sheds in the infill area and 32 trunk sheds in the expansion area.

6.4 Design Criteria for Expansion Project Development

Design criteria serve as a basis for establishing the alignments, sizes, and elevations of future facilities, including gravity trunk pipes, pump stations, and force mains. Below are the elements that made up the design criteria for developing the expansion projects in this 2020 SCP:

- Performance criteria from Section 3.2
- Flow parameter criteria from Section 3.1.4
- Buildout ESD assumptions from Section 2.3
- SASD Standards and Specifications

Based on the performance criteria from Section 3.2, future expansion trunk facilities should perform with no surcharging under the SASD Design Storm conditions. In other words, the future expansion trunk facilities should be sized to accommodate design PWWFs within their full pipe capacities.

Flow generation parameters for new developments are summarized in *Table 3-4*. The SASD Design Storm was run through the buildout model to generate design PWWFs in the system. Future expansion facilities were sized for their buildout PWWF rates.

To aid in the development of the future expansion facilities, the 2020 SCP referred to the latest SASD Standards and Specifications. The proposed facilities were verified that they meet SASD's hydraulic design criteria (e.g., pipe diameter, velocity, pipe slope, and depth requirements) specified in the Standards. In the 2020 SCP, gravity pipes were developed with minimum schematic slopes instead of fixed slopes. However, minimum fixed slope criteria were sometimes used when a proposed sewer alignment was placed in an established road right-of-way.

6.5 Development of Expansion Trunk Projects

Before developing the expansion projects, the latest planning information from multiple sources was consolidated into the 2020 SCP hydraulic buildout model. Information used to construct the base model for the expansion project development included the 2010 SCP, the amendments to the 2010 SCP, sewer studies, and other relevant planning documents. Below is a list of the completed 2010 SCP amendments:

- BR East Rancho 2015 Amendment
- BR Elder Creek 2017 Amendment
- BR Florin 2017 Amendment
- BR Gerber 2017 Amendment
- BR Jackson 2017 Amendment
- LA Laguna Ridge 2018 amendment
- LA Elk Grove 2018 Amendment

After construction of the base model, SASD planning staff reviewed the consolidated expansion trunk shed plans with the following questions in mind:

- Are there better ways to serve the community?
- Are the flows routed efficiently through the system according to the topography?
- Are SASD's expansion plans flexible in serving new developments?

For developments with approved sewer studies, the studies' recommended expansion facilities were mostly retained in the 2020 SCP buildout model. For developments that did not have detailed studies completed or approved, the 2020 SCP considered any previous sewer system plans and re-designed the plans, if necessary, to better serve the community.

After developing the expansion area trunk shed plans and determining the loadings for each expansion trunk shed, the sewer facility alignments, sizes, and elevations were adjusted to comply with the SASD Standards.

Figure 6-2 shows all of the anticipated future expansion facilities and future interceptors in the 2020 SCP buildout model. The future interceptors include the Dry Creek Relief Interceptor, Zinfandel Interceptor, and two planned interceptors identified as BR East Rancho Outfall Location #1 and BR East Rancho Outfall Location #2. These two designated outfall locations are where expansion trunk facilities are planned to drain into future unspecified interceptors. Both of these interceptors will ultimately connect to the Bradshaw Interceptor. Outfall Location #1 is located at the S132 Chrysanthy Pump Station, and Outfall Location #2 is located near White Rock Road, east of Sunrise Boulevard. Details for these two future interceptors, including their alignments, have yet to be decided.

6.6 Expansion Trunk Shed Plans

Presented in *Figure 6-1* and *Table 6-1* are all 32 expansion trunk sheds identified by the 2020 SCP. In ten of these sheds, all the trunks have already been constructed; therefore, their trunk systems are not discussed in the 2020 SCP report. For the remaining 22 trunk sheds, their Expansion Trunk Shed Plans are included in *Appendix A*. These plans are not intended to be final; instead, they provide guidance for planning and designing sewer facilities for new developments.

Each Expansion Trunk Shed Plan includes the following:

- Summary description of the trunk shed, including a description of the shed boundary and the proposed expansion trunk facilities
- Table showing the attribute data (e.g., pipe diameters, lengths, inverts, slopes, capacities) and model results (e.g., peak flows, d/D ratios) for the proposed trunk sewers
- Sewer Shed and Facilities Buildout Expansion Plan map, showing the overall sewer shed and the proposed buildout expansion facilities

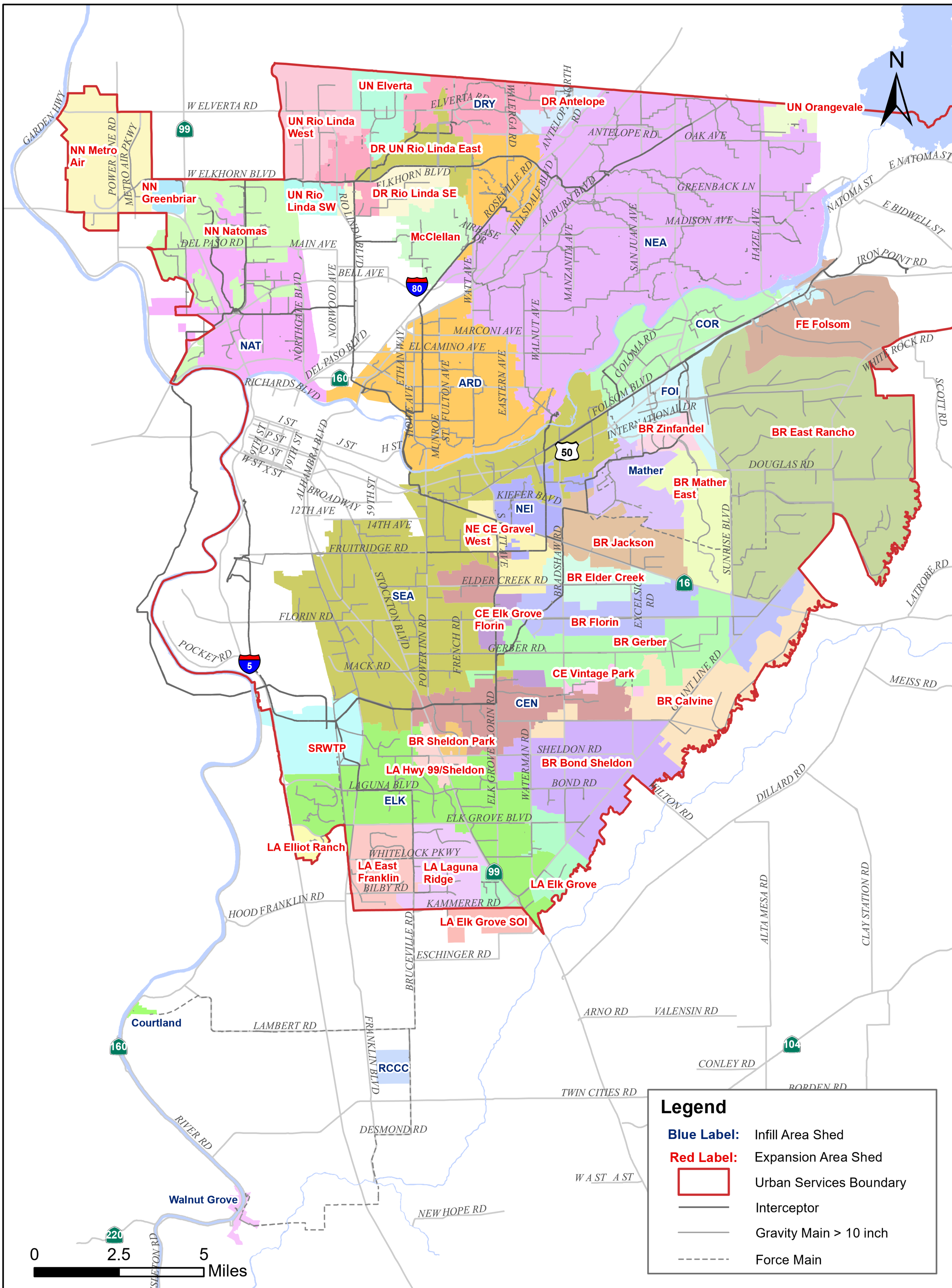
❖ Sub-Sheds and Connection Manholes Buildout Expansion Plan map, showing the individual sub-sheds and their planned connection manholes

An example of the Sewer Shed and Facilities map is shown in *Figure 6-3*, and an example of the Sub-Sheds and Connection Manholes map is shown in *Figure 6-4*.

Table 6-1. Expansion Trunk Sheds Identified by the 2020 SCP

ID	Expansion Trunk Sheds - All Trunks Constructed	Expansion Trunk Sheds - Need Future Trunks
1	BR Zinfandel	BR Bond Sheldon
2	BR Sheldon Park Bruceville	BR Calvine
3	CE Vintage Park	BR East Rancho
4	DR Antelope	BR Elder Creek
5	LA Elliot Ranch	BR Florin
6	LA Hwy 99/Sheldon	BR Gerber
7	NN Greenbriar	BR Jackson
8	NN Natomas	BR Mather East
9	McClellan	CE Elk Grove Florin
10	SRWTP	DR Rio Linda SE
11		DR UN Rio Linda East
12		FE Folsom
13		LA East Franklin
14		LA Elk Grove
15		LA Elk Grove SOI
16		LA Laguna Ridge
17		NE CE Gravel West
18		NN Metro Air
19		UN Elverta
20		UN Orangevale
21		UN Rio Linda SW
22		UN Rio Linda West

Figure 6-1. SASD Trunk Sheds in 2020 SCP Study Area



SACRAMENTO AREA SEWER DISTRICT

2020 SASD SYSTEM CAPACITY PLAN

SASD Trunk Sheds
FIGURE 6-1

Updated: 6/2/2025

Figure 6-2. Future Expansion Trunk Facilities and Interceptors at Buildout

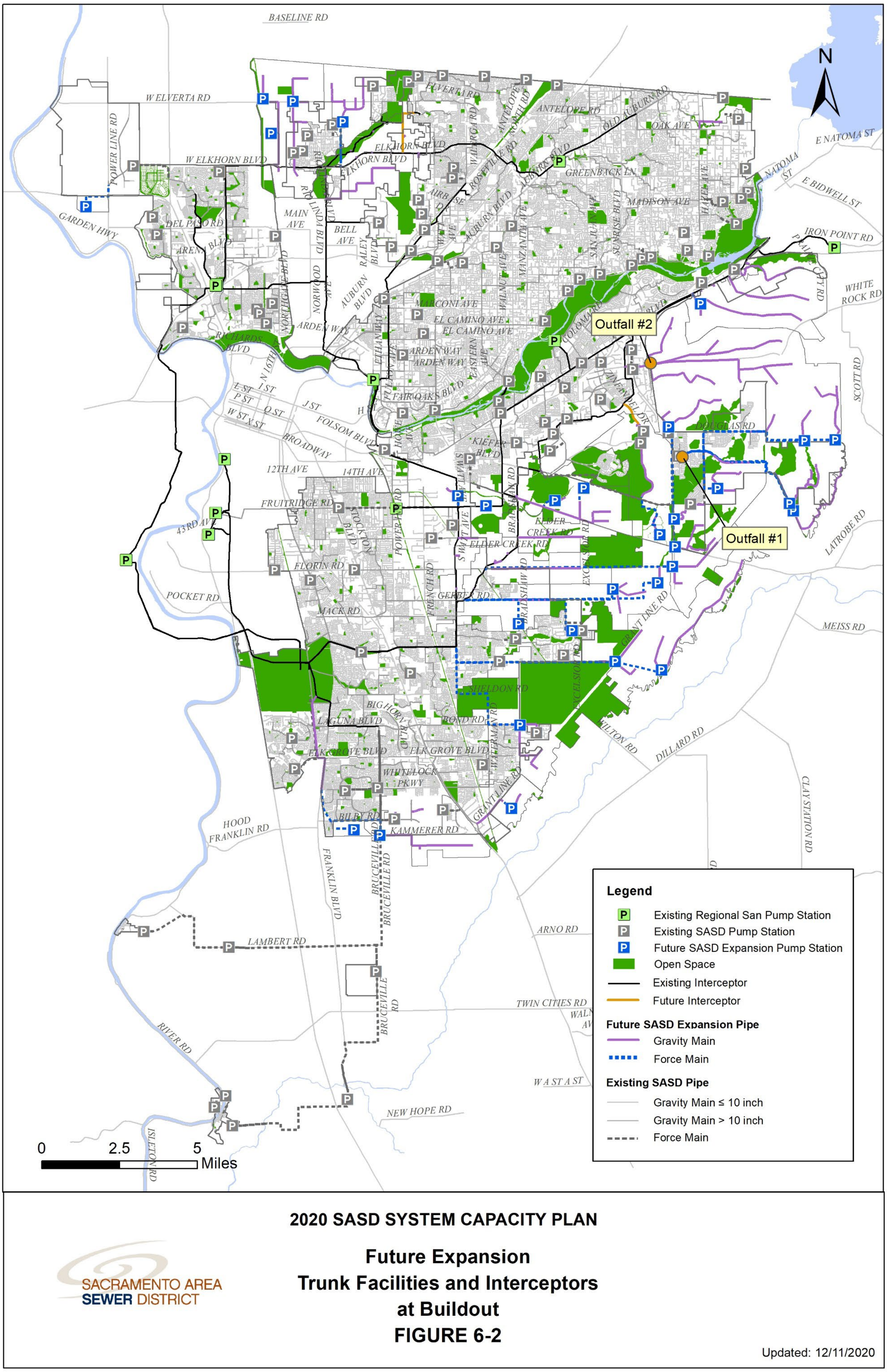
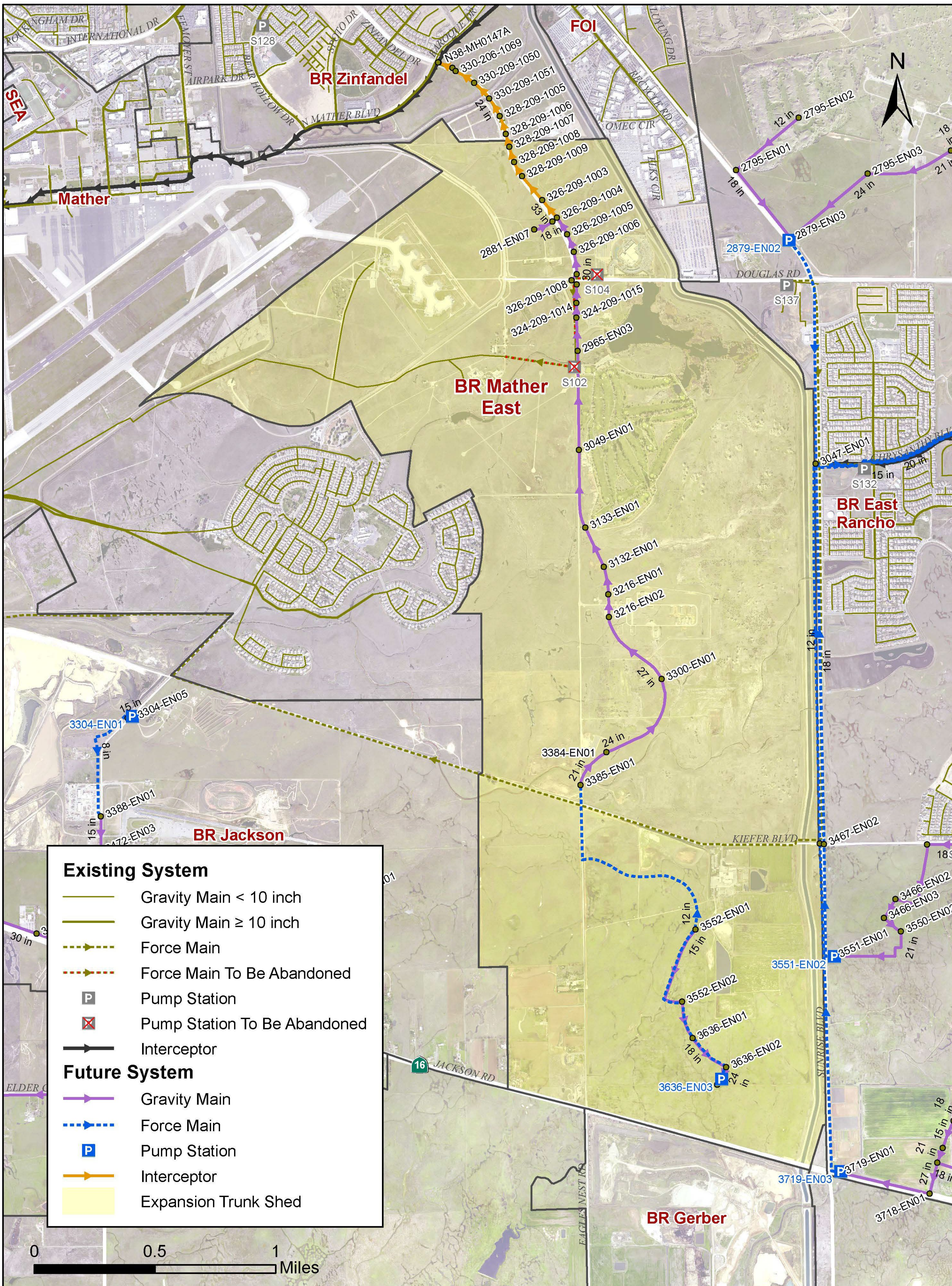


Figure 6-3. Example of an Expansion Shed's Sewer Shed and Facilities Map



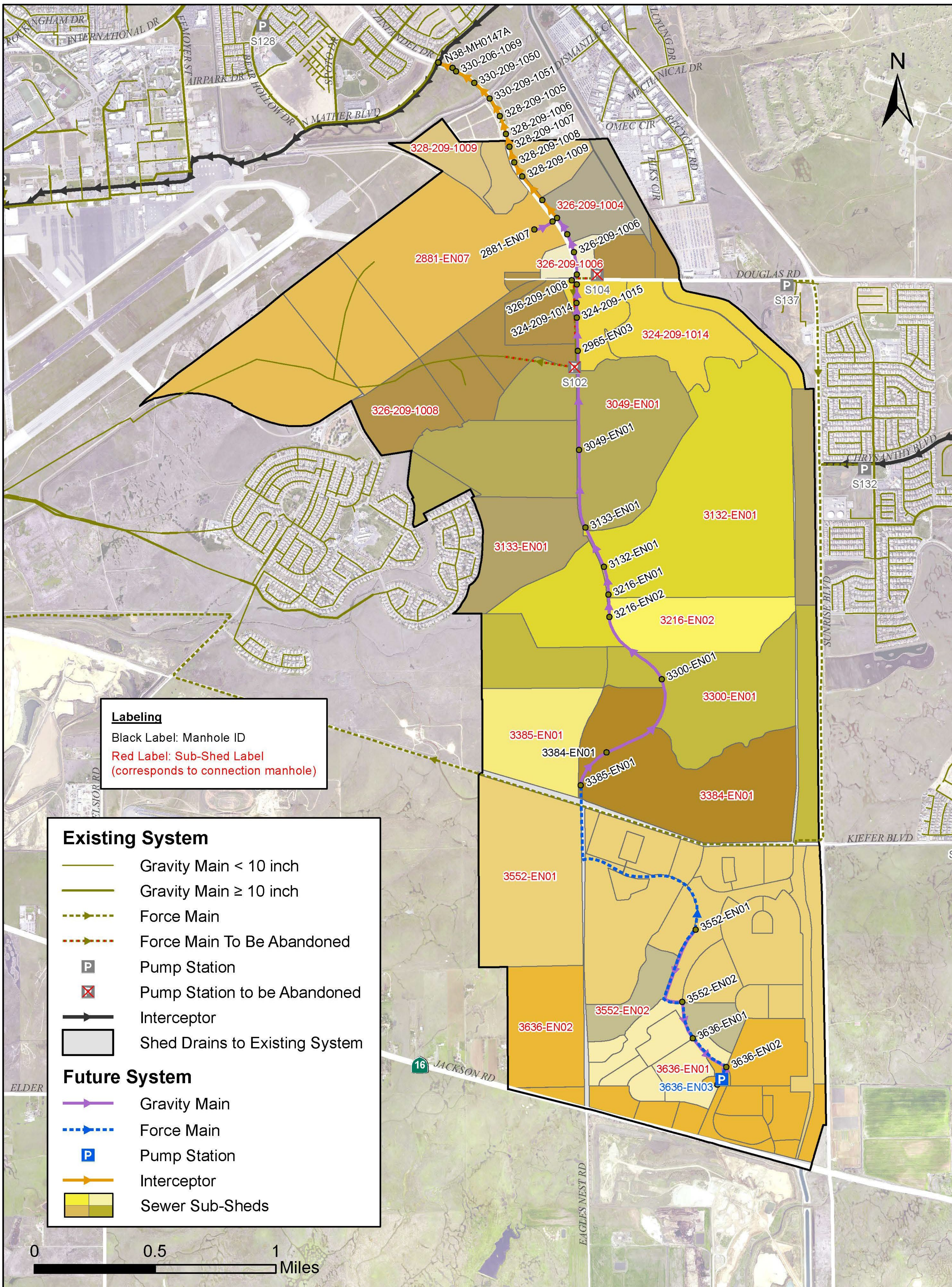
2020 SASD SYSTEM CAPACITY PLAN

BR Mather East
Sewer Shed and Facilities
Buildout Expansion Plan
FIGURE 6-3

SACRAMENTO AREA SEWER DISTRICT

Updated: 9/24/2020

Figure 6-4. Example of an Expansion Shed's Sub-Sheds and Connection Manholes Map



2020 SASD SYSTEM CAPACITY PLAN

SACRAMENTO AREA SEWER DISTRICT

BR Mather East
Sub-Sheds and Connection Manholes
Buildout Expansion Plan
FIGURE 6-4

Updated: 9/24/2020

7. 2020 SCP Capital Funding Projections

This section presents the methodology used to develop the 2020 SCP's Capital Funding Projections (CFP). The 2020 SCP CFP is based on ***planning level*** construction cost estimates for capacity-related sewer system improvements in SASD's infill and expansion areas. Note that non-capacity-related capital requirements for sewer system rehabilitation and other facilities improvements are not addressed in the SCP. The preliminary capacity-related solutions in the infill area are discussed in Section 5 of this report. The capacity-related projects in the expansion area are presented in Section 6.

7.1 Construction Cost Assumptions and Criteria

The 2020 SCP cost criteria are based on the 2010 SCP cost criteria. The 2010 SCP costs were originally adjusted to the Engineering News Record (ENR) construction cost index of 9527, which represents the average of the January 2011 ENR cost indexes for the San Francisco area (10116) and the "20-Cities" ENR average (8938). The 2020 SCP costs presented in this report have been escalated from the January 2011 cost index of 9527 to the January 2019 cost index of 11661.

For the SCP, the estimated capital costs are *order-of-magnitude estimates*. An order-of-magnitude estimate is one that is made without detailed engineering data and uses techniques such as cost curves and scaling factors from similar projects. *The overall expected level of accuracy of the cost estimates is approximately ±30 percent*.

The estimated costs were developed using a baseline pipe construction cost with added costs and markups for related items. An example cost estimate sheet is presented in *Figure 7-1*.

Figure 7-1. Cost Estimate Sheet Example

	Baseline Pipe Construction Costs
+	Additional Costs for Geotechnical Factors
+	Additional Costs for Traffic Control
+	Additional Costs for Productivity Factors
+	Surface Restoration Costs
+	Costs for Special Structures and Pump Stations
=	Subtotal
+	5% Mobilization/Demobilization
=	Estimated Construction Cost Subtotal
+	30% Contingencies for Unknown Conditions
=	**ESTIMATED CONSTRUCTION COST**
+	Right-of-Way/Easement Acquisition (if applicable)
+	25% Engineering, Administration, and Legal Cost
=	**TOTAL PROJECT COST**

The construction and total project costs were estimated based on cost criteria developed specifically for this SCP update. The unit cost criteria are summarized in *Table 7-1*. More details on the cost criteria development can be found in *Appendix B*.

Table 7-1. 2020 SCP's Summary of Estimated Unit Cost

Item	Description	Unit Cost Range
Baseline Construction		
Open Cut Gravity Sewer	8 to 42-inch diameter, 8 to 28 feet deep	$195 to $830/lf
Open Cut DIP Force Main	4 to 18-inch diameter, 4 to 16 feet deep	$170 to $525/lf
Trenchless Pipe Construction	Bore and Jack, Microtunnel, Pipe Ramming. With and without casing	$370 to $2,075/lf
Geotechnical Factors		
Additional Dewater	Deep well system	$55 to $75/lf
Additional Sheeting and Shoring	Trench boxes, solid shoring, and sheet piles	$35 to $865/lf
Cobble Areas	Developed Areas	100% of baseline cost
	Undeveloped Areas	20% of baseline cost
Hard Rock Areas	Northeastern part of service area	100% of baseline cost
Traffic Control		
Additional Traffic Control	For pipe alignments along major roads with four or more lanes of traffic.	$55/lf
Productivity Factors		
Congested Traffic/Utility Corridor	For pipe alignments along major roads with four or more lanes of traffic.	15% of baseline cost
Remove and Replace Delay Factor	For pipe alignments to be upsized in place.	25% of baseline cost
Surface Restoration		
Pavement Restoration	Final Paving and patch paving 15 feet width	$120/lf
Landscape Restoration	Replanting in medians and landscaped area 40 feet width	$5.00/sf
Revegetation	Hydroseeding in open areas 80 feet width	$0.30/sf

Item	Description	Unit Cost Range
Creek Restoration	Replanting and minor bank erosion control 40 feet width	$15/sf
Sewer Structures		
Junction Structures	Junction, transition, and turning structure	$30,000 to $1,035,000 per structure
Pump Stations	10 mgd or less firm capacity Based on low, medium, and high total dynamic heads.	$0.7 to $7.4M
Mobilization/Demobilization	% of Subtotal	5%
Contingencies	% of Estimated Construction Cost Subtotal	30%
Easement Acquisition		
Acquisition Cost	Title reports, appraisals, real estate staff time	$8,500 per parcel
Easements in Newly Constructed Development	Granted to SASD as condition of development	No Cost to SASD
Temporary Construction Easements	80 feet width	$1.00/sf
Permanent Easement	20 feet width	$5.00/sf
Engineering, Administration, and Legal Costs	% of Estimated Construction Cost	25%

7.2 Infill Area Capital Funding Projections

As described in Section 5, SASD's infill area was evaluated to identify sewer systems that are potentially capacity deficient. Each deficient system was then assigned to either Planning Period 1 (existing flow conditions) or Planning Period 2 (buildout flow conditions). Preliminary relief solutions were developed to alleviate the potential capacity constraints, and their costs were estimated using the 2020 SCP cost criteria. *Table 7-2* summarizes the potential relief projects in the SASD infill area and their respective estimated capital costs.

Table 7-2. Summary of Potential Relief Projects and Their Estimated Costs

ID	Planning Period 1 (PP1) (Existing Conditions)		Planning Period 2 (PP2)* (Buildout Conditions)	
	Potential Relief Project	Estimated Capital Cost	Potential Relief Project	Estimated Capital Cost
1	RIO-3	$6,600,000	ARD-20	$1,800,000
2	ARD-10	$6,400,000	CEI-3	$1,900,000
3	ARD-11	$5,400,000	FOI-5	$1,300,000
4	ARD-12	$3,900,000	NEA-19	$4,600,000
5	ARD-17	$5,600,000	NEA-22	$4,800,000
6	ARD-21	$6,800,000	NEA-40	$15,300,000
7	ARD-24	$2,100,000	RCCC-1	$31,900,000
8	ARD-25	$3,800,000		
9	ARD-26	$500,000		
10	ARD-27	$500,000		
11	ARD-28	$56,000		
12	MCL-1	$3,800,000		
13	MCL-2	$9,800,000		
14	NEA-51	$2,500,000		
15	NEA-63	$1,900,000		
16	SEA-9	$4,000,000		
17	SEA-11	$4,300,000		
18	SEA-20	$23,600,000		
19	WG-1	$800,000		
	19 PP1 systems	**$92,356,000**	**7 PP2 systems**	**$61,600,000**
Total	**$153,956,000**			

*Excluding Planning Period 1 systems

7.3 Expansion Area Capital Funding Projections

Table 7-3 lists each expansion trunk shed that needs future trunk projects in SASD's expansion area and its respective estimated capital cost. *Appendix A* of this report provides details of the Expansion Trunk Shed Plans for these expansion trunk sheds. *Figure 6-2* in Section 6 shows all the anticipated future expansion trunk facilities and future interceptors.

Table 7-3. Summary of Expansion Trunk Projects and Their Estimated Costs

ID	Expansion Trunk Shed	Estimated Capital Cost
1	BR Bond Sheldon	$47,300,000
2	BR Calvine	$133,500,000
3	BR East Rancho	$393,200,000
4	BR Elder Creek	$20,300,000
5	BR Florin	$77,500,000
6	BR Gerber	$107,000,000
7	BR Jackson	$30,800,000
8	BR Mather East	$33,300,000
9	CE Elk Grove Florin	$600,000
10	DR Antelope	$900,000
11	DR Rio Linda SE	$17,000,000
12	DR UN Rio Linda East	$1,000,000
13	FE Folsom	$48,600,000
14	LA East Franklin	$4,300,000
15	LA Elk Grove	$12,100,000
16	LA Elk Grove SOI	$74,400,000
17	LA Laguna Ridge	$3,100,000
18	NE CE Gravel West	$15,800,000
19	NN Metro Air	$13,300,000
20	UN Elverta	$42,400,000
21	UN Orangevale	$15,400,000
22	UN Rio Linda SW	$2,400,000
23	UN Rio Linda West	$49,000,000
	Total	**$1,143,200,000**

7.4 Cost Allocation to Existing and Future Users

The costs for relief projects are allocated to existing and future users within the SASD infill area. In contrast, the costs of future expansion trunk projects are 100 percent allocated to future users. The relative percentages of the relief project costs to be allocated to current and future users are determined from the numbers of existing and future ESDs in the SASD infill area identified for this SCP update.

Table 7-4 summarizes the 2020 SCP CFP. This table includes the total estimated costs for the potential relief projects and expansion trunk projects and the cost allocation to existing and future users.

Table 7-4. 2020 SCP's Trunk System Capital Funding Projections

Potential Projects	Estimated Capital Cost	Percent Allocation		Cost Allocation	
		Existing User	Future User	Existing User	Future User
Relief Projects	$153,956,000	61%	39%	$93,913,160	$60,042,840
Expansion Projects	$1,143,200,000	0%	100%	$0	$1,143,200,000

8. Appendices

8.1 Appendix A: Expansion Area Trunk Shed Plans

8.2 Appendix B: Cost Criteria Evaluation Technical Memorandum