PREPARED FOR:

Midvalley Improvement District

PREPARED BY:

BOWEN COLLINS & ASSOCIATES

SEWER MASTER PLAN

AUGUST 2022

SEWER MASTER PLAN

August 2022

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CHAPTER 1
INTRODUCTION

INTRODUCTION

Midvalley Improvement District has retained Bowen Collins & Associates (BC&A) to prepare a master plan for the District's wastewater collection system. The purpose of this sewer master plan report is to identify recommended improvements that will resolve existing and projected future deficiencies in the wastewater collection system throughout the District's service area.

SCOPE OF SERVICES

The general scope of this project involved a thorough analysis of the District's sewer collection system and its ability to meet the present and future wastewater needs of its residents. As part of the Sewer Master Plan, BC&A completed the following tasks.

Task 1: Collected information as needed to develop the Sewer Master Plan based on Midvale City, Murray City, and Sandy City's general plan and existing facilities. This included meeting with City's to identify planned redevelopment areas within the District.

Task 2: Updated population projections and estimated growth in sewer flow to evaluate future system needs.

Task 3: Updated a hydraulic computer model of the District's collection system to evaluate existing and projected future system deficiencies. This included calibrating the model using data from the District's existing GIS database and water meter data from the cities within the District.

Task 4: Identified existing operating deficiencies.

Task 5: Identified projected future operating deficiencies.

Task 6: Evaluated alternative improvements for resolving deficiencies identified in Tasks 4 and 5.

Task 7: Developed a comprehensive capital facilities plan incorporating all required improvements identified for the collection system.

In conjunction with the master plan, an impact fee facilities plan, impact fee analysis, and rate study were also completed by BC&A. The results of these activities are documented in separate reports.

ACKNOWLEDGMENTS

The BC&A team wishes to thank the following individuals from Midvalley Improvement District and adjacent cities for their cooperation and assistance in working with us in preparing this report:

Bradley Powell	Midvalley Improvement District – General Manager
Jared Syme	Midvalley Improvement District – GIS Specialist
Adam Olsen	Midvale City – Planning Director
Chris Butte	Midvale City – Economic Development Director
Jared Hall	Murray City – City Planner
Brian McCuistion	Sandy City – Planning Director

PROJECT STAFF

The project work was performed by the BC&A's team members listed below. Team member's roles on the project are also listed. The project was completed in BC&A's Draper, Utah office. Questions may be addressed to Brent Packer, Project Manager at (801) 495-2224.

Wyatt Andersen	Project Engineer
Andrew McKinnon	Project Engineer
Brent Packer	Project Manager
Keith Larson	Senior Review

CHAPTER 2
EXISTING SYSTEM FEATURES

INTRODUCTION

As part of this Master Plan, BC&A has assembled an inventory of existing infrastructure within the sewer collection system. The purpose of this chapter is to present a summary of the facilities in the Midvalley Improvement District (MID) existing sewer collection system that can be used as a reference for future studies.

SERVICE AREA

MID's sewer collection service area is shown in Figure 2-1 and includes portions of Midvale City (65 percent of service area), Sandy City (33 percent of service area), and Murray City (2 percent of service area). There are some areas in the District that are in the unincorporated portions of the county; however, these areas are served by either the Sandy or Midvale City water systems. For simplicity in the presentation of this report, these areas have been included as part of the City by which they are served. The MID sewer system service area is approximately 4 square miles.

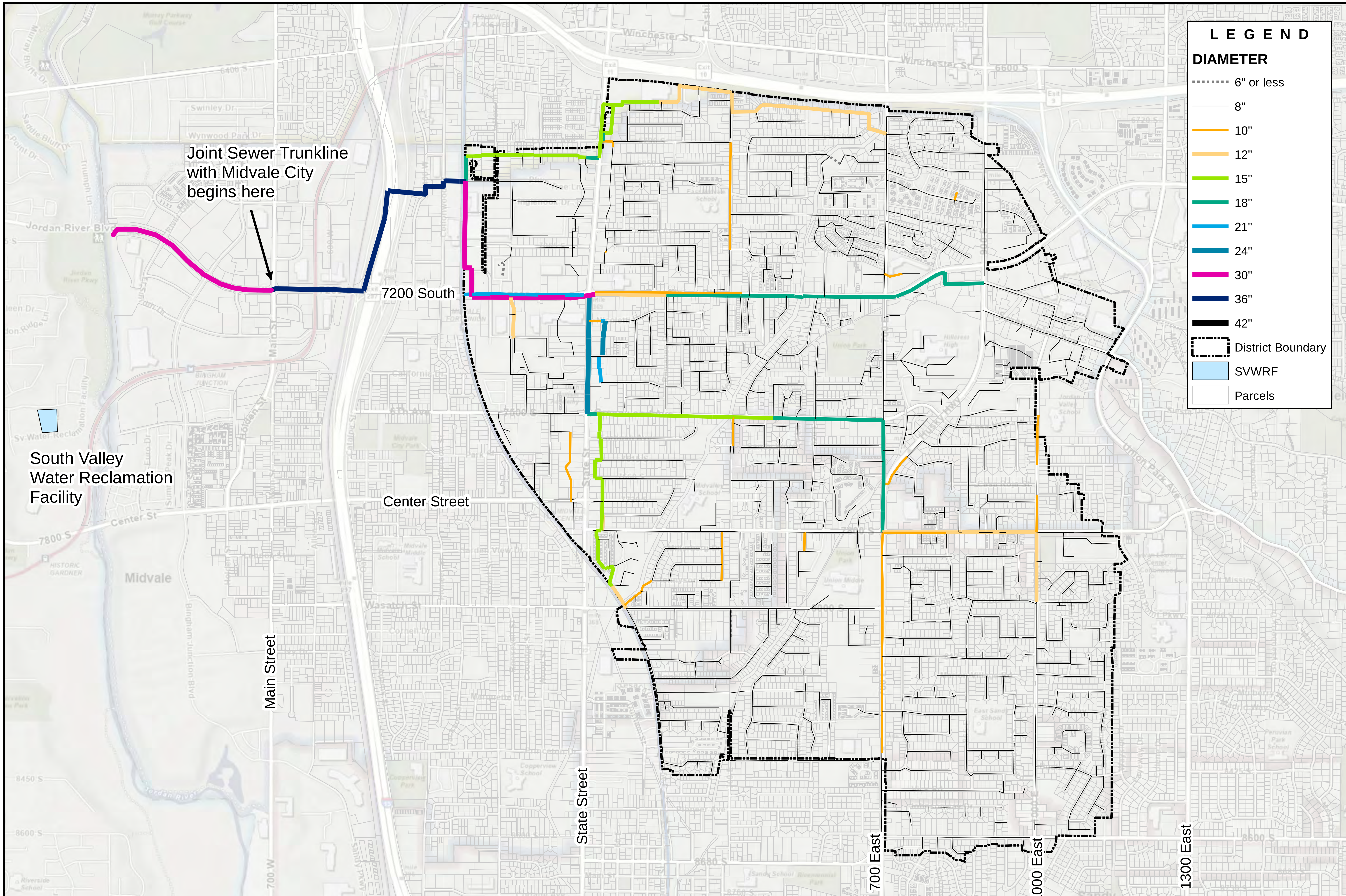
Wastewater from the District's collection system service area is treated at the South Valley Water Reclamation Facility (SVWRF) west of the Jordan River at 7495 South and 1300 West. The service area is generally bounded by the TRAX line on the west and 1200 East, between approximately 8600 South and I-215. The topography of the District generally slopes from southeast to northwest with all flow eventually reaching the SVWRF.

COLLECTION SYSTEM

Major attributes of the various components of the collection system are summarized in the following sections.

Sewer Collection Pipes

There are about 407,000 feet (77 miles) of sewer pipe and about 1,900 manholes in the MID Sewer System that are cataloged in the GIS database. Table 2-1 contains a summary of the sewer pipes for the MID sewer collection system. As can be seen in the table, about 84.4 percent of the pipe in the system is less than or equal to 8 inches in diameter. This represents the vast network of small collection mains in neighborhoods throughout the District.



SCALE: 1 in. = 1,500 ft.

NORTH:

EXISTING COLLECTION SYSTEM

MIDVALLEY IMPROVEMENT DISTRICT
SEWER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
2-1

Table 2-1
Sewer Collection System Sizes and Lengths

Diameter	Length (ft)	Length (mi)	Percentage
≤ 8	343,687	65.1	84.4%
10	16,030	3.0	3.9%
12	11,348	2.1	2.8%
15	11,237	2.1	2.8%
16	838	0.2	0.2%
18	9,906	1.9	2.4%
21	2,533	0.5	0.6%
24	2,758	0.5	0.7%
30	4,080	0.8	1.0%
33	318	0.1	0.1%
36	4,593	0.9	1.1%
Total	407,328	77.1	100.0%

The District's pipe materials are shown in Table 2-2. As can be seen in the table most pipe is made of clay, concrete, polyvinyl chloride (PVC) or cured-in-place pipe (CIPP).

Table 2-2
Sewer Collection System Materials

Material	Length (ft)	Length (mi)	Percentage
Clay	144,768	27.4	35.5%
Concrete	83,464	15.8	20.5%
PVC	110,244	20.9	27.1%
CIPP	67,450	12.8	16.6%
HDPE	838	0.2	0.2%
Cast Iron	564	0.1	0.1%
Total	407,328	77.1	100.0%

CIPP includes either concrete or clay pipes that have been rehabilitated with a long-lasting liner that reduces the original pipe diameter slightly, but also reduces roughness characteristics of the original pipe.

Diversions

The District does not have any mechanical diversions in its collection system. There are some locations where two pipelines exit a common manhole. In these locations, flow is normally in a single direction, but may overflow into the second pipe in a different direction if surcharging occurs at the manhole.

Joint Sewer Lines

There are some gravity sewer mains and a siphon in the collection system that are jointly owned with Midvale City. The joint trunk line begins at 700 West 7200 South and runs west along Jordan River Blvd to a siphon structure that crosses the Jordan River as shown in Figure 2-1. The section of trunk line west of Jordan River is jointly owned with both Midvale City and West Jordan. Based on design drawings provided by Midvalley Improvement District, the joint trunk line was constructed in 1987 using 36-inch reinforced concrete pipe (RCP) at a slope of 0.15%. The siphon consists of two 18-inch and one 24-inch parallel RCP pipes. Estimated capacity of the joint trunk line is approximately 22.4 cfs (14.5 mgd) under full flow conditions based on 1987 design drawings. Some modifications to the trunk line have occurred since first constructed to accommodate development, but no new survey data was available as part of this study. Estimated capacity of the siphon structure itself is estimated to be approximately 31 cfs (20 mgd) for clean well-maintained conditions.

TREATMENT FACILITIES

All wastewater from MID is currently treated at the South Valley Water Reclamation Facility (SVWRF). The facility's permitted capacity is 50 MGD. Based on this capacity and MID's percentage of treatment rights in the facility, MID's capacity in the facility is 3.84 MGD.

The SVWRF is owned and operated by five member entities including West Jordan City, Midvale City, Midvalley Improvement District, Sandy Suburban Improvement District and the South Valley Sewer District. Table 2-3 summarizes capacity and percent capacity rights for each member entity.

Table 2-3
South Valley Water Reclamation Facility Capacity Rights

Member Entity	Capacity Rights (MGD)	Capacity Percentage (%)
Midvale City	3.08	6.16
Midvalley Improvement District	**3.84**	**7.68**
Sandy Suburban Improvement District	8.66	17.32
South Valley Sewer District	16.20	32.40
West Jordan City	18.22	36.44
Total	**50.00**	**100.0**

CHAPTER 3
FUTURE GROWTH AND FLOW PROJECTIONS

INTRODUCTION

Before attempting to hydraulically model and evaluate the District's sewer collection facilities, one must first have an accurate understanding of wastewater flows. This includes an estimate of both the quantity and distribution of existing and future flows. The purpose of this chapter is to summarize the results, assumptions, and process of calculating both existing and future wastewater flows.

There are three major components of wastewater flow: domestic wastewater, infiltration, and inflow. Each of these is discussed in detail in this chapter.

ESTIMATING EXISTING WASTEWATER FLOWS

Domestic Flow

Domestic flow consists of the wastewater contributions of residential, commercial, and industrial customers. Domestic flow from residential and commercial customers varies throughout the day. Peak flows are generated during the morning hours as residents shower and prepare for the day. There is a smaller peak in the early evening as residents return from work. Domestic sewer flows are generally lower throughout the remainder of the day and are just a trickle during the early morning hours when most residents are asleep. Flow from industrial customers may vary from this pattern depending on the type of industry. For the purposes of this study, industrial flow is assumed to be constant throughout the day.

Two major challenges are encountered when estimating domestic flow. First, the quantity of wastewater produced varies from area to area depending on the type of water user in the area and the density of development. Second, domestic flow is not a constant value, but varies in time.

To address the first issue, this study examined winter water use records as an estimate of indoor water use (and corresponding wastewater flow generation). Detailed indoor water use measurements were available from Sandy City and Murray City in 2016, but data for Midvale City was not complete enough in 2016 to adequately estimate domestic flow in the Midvale City portions of the District. As a result, domestic wastewater contributions from Sandy City and Murray City can be directly estimated based on the relatively accurate measurements of indoor water use for these cities. For the portions of the District within Midvale City, domestic wastewater contribution were estimated using geographic information system (GIS) data of equivalent residential units from the District in combination with average indoor water use data from the other cities. Table 3-1 summarizes the estimates of wastewater production by water service provider.

Table 3-1
Domestic Wastewater Production Estimates by Water Provider

Water Provider Service Area	2016 Domestic Wastewater Production (gpd)	2022 Domestic Wastewater Production (gpd) [2]
Sandy City[1]	519,106	502,805
Murray City[1]	20,684	15,821
Midvale City[2]	1,296,639	1,486,661
Total	1,836,429	2,005,286

[1] Wastewater production estimated as 95 percent of indoor water use
[2] Wastewater production estimated using MID's GIS distribution of equivalent residential units (ERUs) within the District.

For the purpose of this study, MID GIS data of equivalent residential units (ERUs) was used to distribute wastewater production estimates within the Midvale City area. For this master plan update, District accounting of new ERUs added to its service area since 2016 was used to update the distribution of wastewater within the District or to supplement the billing data previously collected.

Domestic Flow Variation

Once total flow is distributed through the system, the second challenge of estimating domestic wastewater flow is understanding how it varies in time. For this study, the only flow monitoring data available to observe daily flow variations is data from the District's flow meter that flows to the South Valley Water Reclamation Facility. This data was used to develop a daily flow pattern in the District (also known as a diurnal pattern) that is the cumulative representation of all users (the majority of which consists of residential flow). This is discussed in more detail in Chapter 4.

Infiltration

Infiltration is the intrusion of groundwater into the sewer system through cracked pipes, broken and offset joints, improper connections, leaky manholes, etc. In areas with aging sewer lines and high groundwater, infiltration can actually be the largest component of flow being conveyed in the sewer. Infiltration is very difficult to measure because it varies across the service area based on climate conditions, water table levels, pipe diameter, and pipe condition. Because flow monitoring data is only available at the treatment plant, the distribution of infiltration in the District's collection system is assumed to be uniformly distributed throughout the District.

Total infiltration for the District was estimated by subtracting the estimate of domestic flow from the maximum historical average monthly flow measured at the treatment plant over the last 10 years. The maximum average monthly flow is used because infiltration varies from year to year and seasonally within each year. This is a function of fluctuating ground water levels associated with changes in the season and annual climate conditions. To provide sufficient capacity in the system for the full range of expected conditions, it is important to use the maximum month to estimate infiltration, even though average system flows will generally be lower. Table 3-2 summarizes estimates of existing domestic flow and peak infiltration in the MID collection system.

Table 3-2
Existing Wastewater Production

Parameter	Wastewater Production (gpd)	Percentage
Total Wastewater (Max. Month)	2,605,286	100%
Domestic	2,005,286	77%
Peak Infiltration*	600,000	23%
Ratio of Infiltration to Domestic	0.30	

*based on 2015 max month flow (2.43 mgd) less 2015 estimated domestic flow (1.83 mgd).

Based on Table 3-2 and Table 2-1 (from Chapter 2), the maximum historic infiltration rate in the MID collection system was calculated to be approximately 800 gallons per day per inch-diameter of pipe per mile of pipe. For new construction, recommended allowable infiltration should range between 400 and 600 gpd/in-diam/mile[1] compared to a range of 1,000 to 4,000 gpd/in-diam/mile expected for older construction based on BC&A studies for similar communities along the Wasatch Front. This would indicate that infiltration in the MID collection system is relatively low. This is likely the result of the District's location on the east bench with a relatively low ground water table. It may also be a function of recent rehabilitation efforts in MID where some of the older collection pipes with the highest potential for infiltration were lined with newer cured-in-place pipe (CIPP).

Inflow

The third and final component of wastewater flow that must be considered for wastewater master planning is inflow. Inflow is defined as any water that enters into the sewer system which is directly or indirectly related to a storm event. It can come directly from storm runoff through improper connections to the storm water system, missing or leaky manhole covers, roof drains connected to the system, etc. Storm events can also cause the ground water to raise temporarily, which can cause an increase in flow in the sewer system through the same mechanisms that result in groundwater infiltration during dry weather (cracked pipes, leaky laterals, etc.). Any temporary increase in sewer flow due to raising levels of ground water as a result of snowmelt or rain is considered inflow.

The magnitude and distribution of inflow can be very difficult to predict because it occurs only during storm events and can vary greatly depending on the intensity and distribution of precipitation. Long term flow monitoring can be useful for developing inflow responses if compared to specific precipitation events. However, this data is not available for the District. As a result, inflow has not been included directly in flow projections. Instead, it will be important for the District to include extra hydraulic capacity in its collection and treatment system above and beyond projected domestic and infiltration flows to account for inflow events.

[1] "Chapter 3 Quantity of Wastewater." *Gravity Sanitary Sewer Design and Construction*. NY, NY: American Society of Civil Engineers.

PROJECTING FUTURE WASTEWATER FLOWS

Domestic Flows

There are several methods that can be used to estimate domestic wastewater flow into the future. This study develops domestic wastewater flow projections based on two factors: residential and nonresidential populations. Projections for the District have been mostly developed using population projections from the Wasatch Front Regional Council. BC&A also coordinated with Midvale City and Sandy City to verify that the regional projections include the most current development information for each of the cities. Potential redevelopment has also been considered based on input from District personnel.

The methodology of this study can be summarized as follows:

1. Define the service area.
2. Divide the service area into a number of smaller sub-areas using geographical information system (GIS) mapping.
3. Project residential and non-residential populations for each sub-area based on existing and projected patterns of development.
4. Estimate the domestic wastewater contribution of each factor (residential and non-residential) based on available indoor water use data.
5. Convert projections of residential and non-residential development to wastewater flow rates based on their historic contributions.

Each step of this process is summarized in the sections below.

Study Area. The study area for this analysis is based on the District's service area as shown in Chapter 2 with contributions from parts of Murray, Midvale, and Sandy Cities. The District does not expect to expand its boundaries but is committed to providing quality service to all of its users within its current boundary.

Sub-Areas. Division of the service area into smaller sub-areas is important for two reasons. First, it increases the accuracy of the population and flow projections by examining land use and development patterns at a smaller scale. Second, it yields projections that are distributed spatially across the service area, an important requirement for future modeling efforts.

For this study, sub-areas were defined based on Traffic Analysis Zones (TAZs). A TAZ is the smallest geographic unit used for residential and non-residential population projections developed by the Wasatch Front Regional Council (WFRC). Non-residential population data includes employees (retail, business, and industrial) and other non-residents. TAZ boundaries are established on an arbitrary basis by the WFRC for travel demand modeling.

TAZ boundaries were used in part for this analysis because population projections have already been developed from census data for TAZ areas by the WFRC. The projections are provided every year starting in 2015 and continuing to 2050. TAZ boundaries were also used because they are small enough to give an adequate distribution of flow across the service area for use in modeling. The TAZ boundaries are not always consistent with the District's service area boundaries, for this reason TAZ data was clipped to the District's boundary. If a TAZ was only partially in the study area boundary, then the percentage inside the boundary was determined. WFRC projections were multiplied by this percentage to determine the portion of the TAZ projection within the study area boundary.

Redevelopment Areas. Conversations with planning personnel from the District and the cities served by the District provided additional information about specific redevelopment areas. These areas were identified within individual City parcels where possible or within the general vicinity of the development if specific parcels could not be identified. Each development was assigned a land use type and timeline for development: within the next 10 years, or beyond 10-years.

Growth within redevelopment areas was identified either with a known density based on land use type or by an exact number of units. The planning density of equivalent residential units (ERU) per acre was used with the acreage of the parcels to calculate how many ERU's would be added at each location. For apartment (high density residential) and hotel developments, the following conversions were used:

- Apartments - For planning purposes, each apartment unit was estimated as 80% of a single ERU. The typical household size within the Midvale City area is 2.57 persons/household and many of the apartment developments proposed within the District include a mix of one and two room apartments that would likely have net lower household size. A higher mix of two room apartments would likely require treating each apartment as a higher percentage (up to 100%) of a single ERU.
- Hotels – Each hotel room proposed within redevelopment areas was estimated as 60% of a single ERU. This was based on an estimated average production from hotel rooms of 100 gpd per room. This use rate is based on approximately 20% conservation from the State of Utah published 125 gpd/unit (Table 3 of State of Utah Administrative Rules R317-4-13). It is also consistent with references from other States.

A summary of total ERU's added to the District up to 2050 buildout by land use type can be seen below in Table 3-3.

Table 3-3
Redevelopment Land Use

Land Use Type	Total ERUs*
Apartments	824
Commercial	130
Hotel	162
Mixed Single and Multi-family	722
Multi-family	277
Office	15
Single family	57
Total	2,186

*additional ERU's to be added within the entire District from 2022 to 2050. This table does not include additional ERUs from the TAZ analysis described in the next section.

The specific redevelopment areas identified by planning personnel from Sandy City and Midvale City can be seen in Figure 3-1.

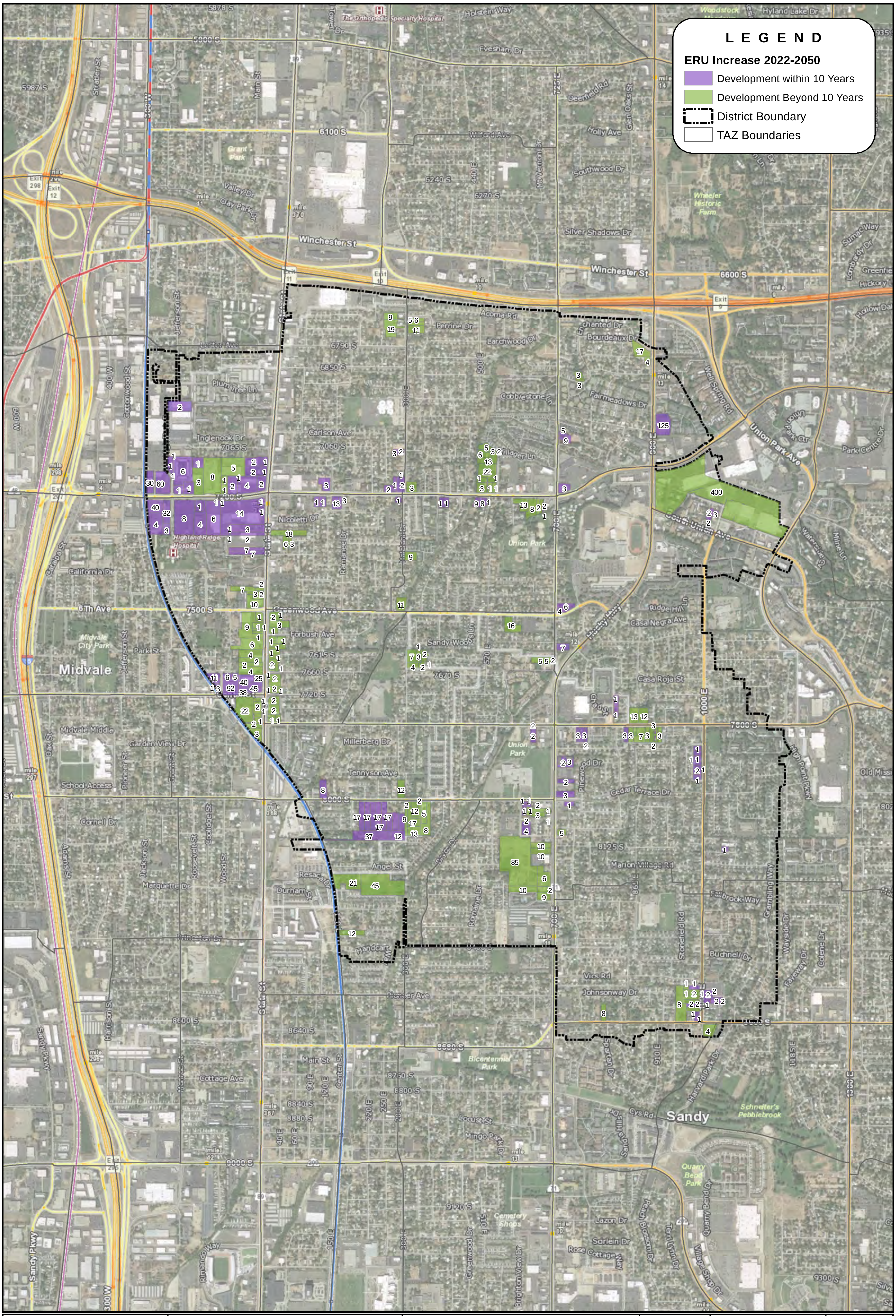
WFRC Residential and Non-Residential Populations. Wasatch Front Regional Council residential and non-residential projections were developed from present to 2050. The residential population projections were calculated by multiplying the residential units from the WFRC Household Projections Report, 2019 Baseline by the average household size from the US Census Bureau for the District. Non-residential populations were taken directly from the WFRC All Jobs Projections Report, 2019 Baseline. Residential and non-residential populations were converted to equivalent residential units (ERU's) to be compared with city projections of redevelopment. Figure 3-2 shows the ratio of existing population compared to projections of future population in 2050 to highlight where growth is expected to occur in the District according to the WFRC.

The population increases taken from WFRC were compared with city planning redevelopment area population estimates. ERU projections developed from WFRC and from city planning personnel within the District were compared by TAZ boundary. The greater of the two growth projections was used within the District for each TAZ. The comparison of these values can be seen in Figure 3-3 in which the WFRC projections are labeled as TAZ and the redevelopment projections are labeled RD.

The results of the residential and non-residential projections described above are summarized in Table 3-4.

Table 3-4
Growth Projections

Year	Total ERUs
2022	12,168
2025	12,456
2030	12,962
2032	13,170
2035	13,663
2040	14,503
2045	15,092
2050	15,604



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MIDVALLEY IMPROVEMENT DISTRICT
SEWER MASTER PLAN

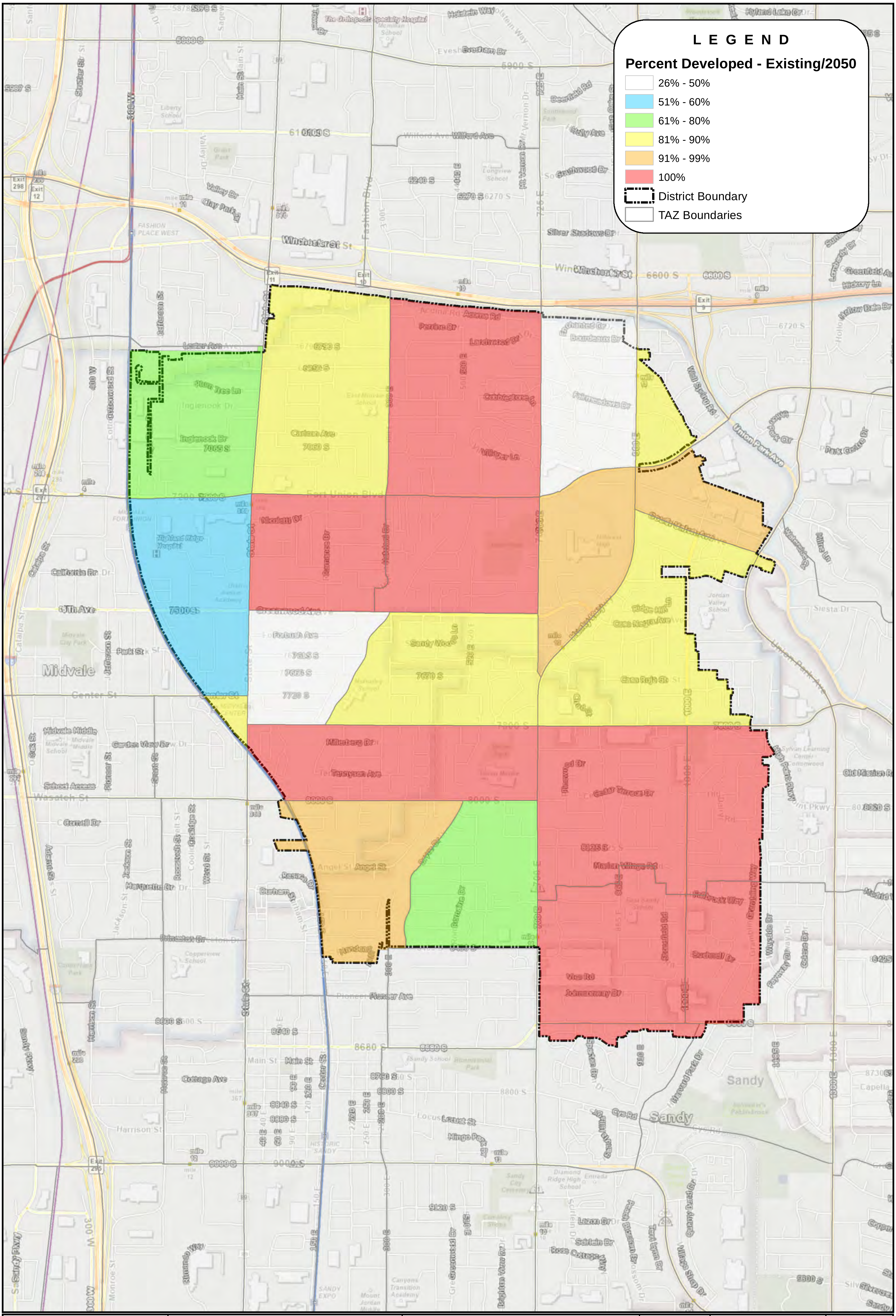
REDEVELOPMENT
ERU INCREASE 2022-2050

NORTH:

SCALE: 0 750 1,500 Feet

FIGURE NO.
3-1

P:\Midvalley Improvement District\353-22-01 2022 IFFP-IFA Update\4.0 GIS\Figure 3-1 - Redevelopment ERU Increase.mxd wandersen 8/4/2022



BOWEN COLLINS & ASSOCIATES

MIDVALLEY IMPROVEMENT DISTRICT
SEWER MASTER PLAN

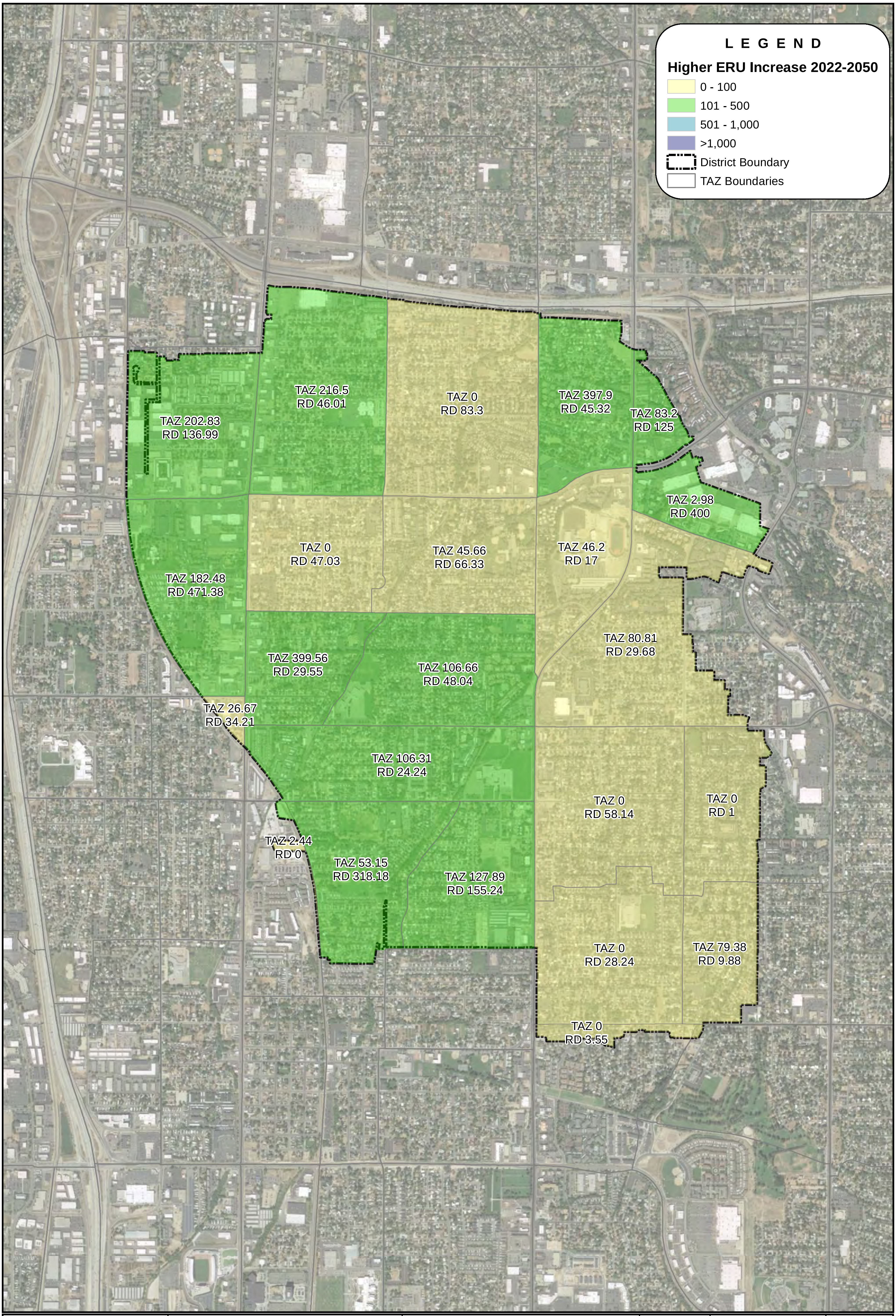
TAZ - RESIDENTIAL PERCENT DEVELOPED

NORTH:

SCALE: 0 750 1,500 Feet

FIGURE NO. 3-2

P:\Midvalley Improvement District\353-22-01 2022 IFFP-IFA Update\4.0 GIS\Figure 3-2 - TAZ Residential Percent Developed.mxd wandersen 8/4/2022



BOWEN COLLINS & ASSOCIATES

MIDVALLEY IMPROVEMENT DISTRICT
SEWER MASTER PLAN

TAZ AND REDEVELOPMENT PROJECTION COMPARISON

NORTH:

NORTH

SCALE:

0 750 1,500 Feet

FIGURE NO.

3-3

P:\Midvalley Improvement District\353-22-01 2022 IFFP-IFA Update\4.0 GIS\Figure 3-3 - TAZ and Redevelopment ERU Increase.mxd wandersen 8/4/2022

Underdeveloped Properties. MID personnel are also concerned with identifying potential areas of redevelopment that could affect the District if developed at higher densities. These are not properties that are currently planned to develop, but could develop based on development trends that the District has observed. Figure 3-1 shows the underdeveloped properties identified based on Salt Lake County assessor data and MID personnel feedback. For planning purposes, the District wanted to consider the effects of the identified areas redeveloping at 12 units/acre. These developments have been assumed to occur near the end of the planning window and will not be included in short-term planning needs.

Residential and Non-Residential Flow Contributions. The process of using residential and non-residential population data to develop wastewater flow rates was completed by relating the residential and nonresidential indoor water use to wastewater flow rates. Records of indoor water use by residential and non-residential customers was only available for the Sandy City and Murray City portions of the MID service area. Based on the data provided for the Sandy City portions of the service area (which represents roughly one-third of the District), an estimate of wastewater contributions by component type was developed as shown in Table 3-5.

Table 3-5
Contribution of Wastewater by User Type

Component	Estimated Sandy City Population Within MID Service Area	Wastewater Contribution (gpd)	Per Capita Wastewater Contribution (gpcd)[1]
Residents	9,124	417,071	45.7
Nonresidents	1,658	101,845	61.4

[1]Based on 2015 water meter data

Note that the per capita estimates from Table 3-5 will only be used for estimating growth in future wastewater. For comparison purposes, the per capita wastewater contributions calculated in Table 3-5 were used to estimate what domestic flow in the District would be based on TAZ population estimates. Table 3-6 shows the projected domestic contributions from residential and nonresidential use for existing conditions using the Sandy City per capita data.

Table 3-6
Estimated Wastewater for Existing Conditions using Sandy City Water Use Data

Component	Total Population Within MID Service Area	Wastewater Contribution (gpd)	Estimate of Domestic Wastewater for MID[1] (gpd)	Percent Difference
Residents	26,518	1,211,873		
Total Nonresidents	9,088	558,003		
Total	35,606	1,769,876	1,902,200	7%

[1] The estimate of domestic wastewater in the District is discussed in “Wastewater Flow Distribution”.

While the calculated wastewater based on population does not exactly match the total domestic wastewater estimated for the District, the simulation is very close (within 7 percent). If accurate Midvale City indoor water use data was available, a District wide average would be developed and used for future growth projections. In the absence of accurate District wide data, the per capita values listed in Table 3-5 were considered adequate for projecting future domestic flows.

Infiltration and Inflow

It is expected that infiltration in the District will also experience modest growth over time. As more lateral connections are connected to the collection system, there is increased potential for leakage as a result of additional joints and/or cracks in the pipe or growth of roots into pipes over time. Because of the relatively low infiltration rate in MID's existing collection system, it is anticipated that new growth will also have relatively low infiltration. For the purpose of this study, it is estimated that future infiltration will be approximately equal to the recommended infiltration rate for new construction (400 gpd/inch-diameter mile), which equates to roughly 48 percent of the existing infiltration rate (or approximately 25 gpd/equivalent residential unit).

As was done for existing wastewater flows, future inflow has not been projected directly, but a capacity allowance will be included for this purpose in the evaluation of the collection system.

Total Wastewater Flow Projections

Table 3-7 and Figure 3-4 show future projections of domestic wastewater and infiltration within the District.

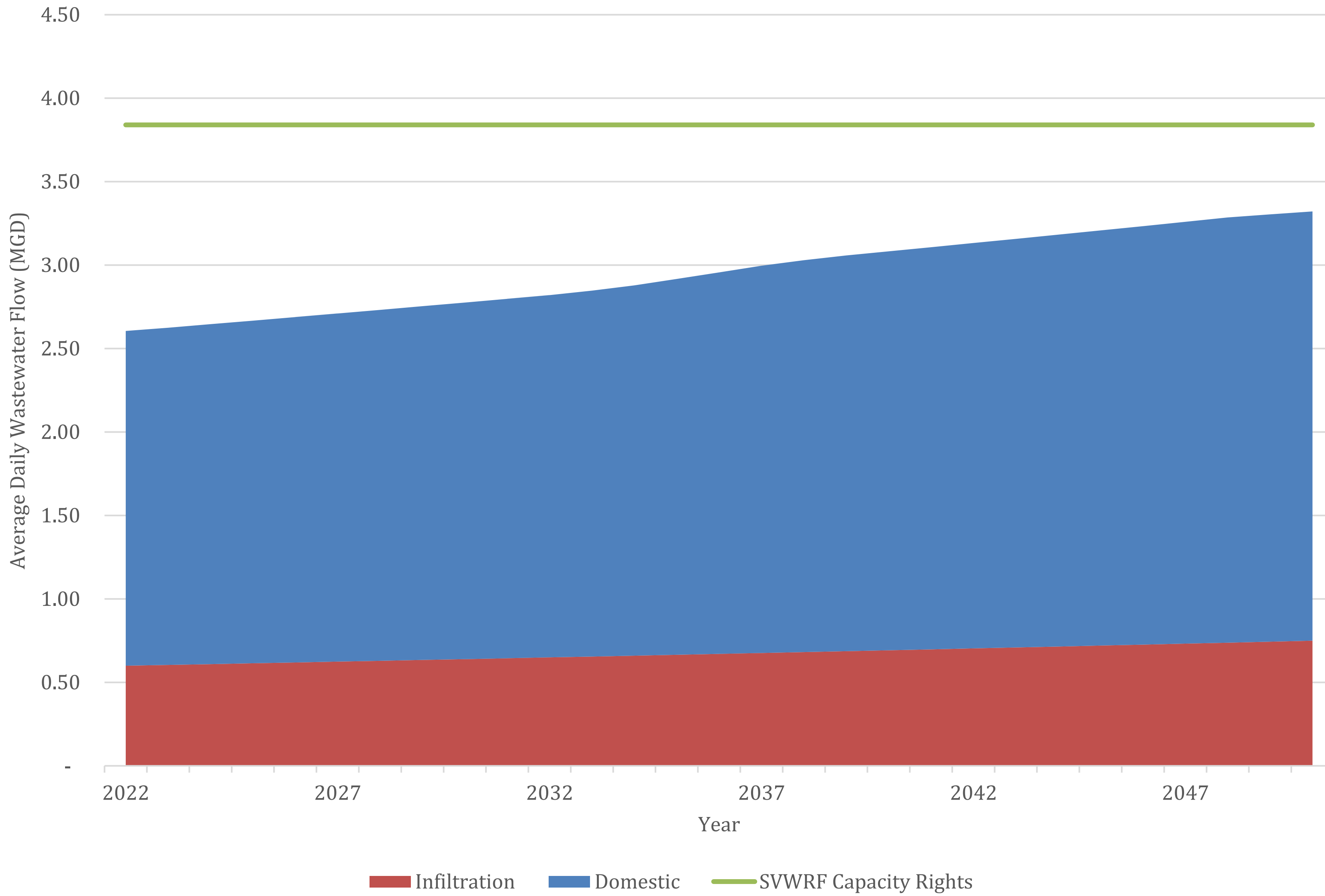
Table 3-7
Projected Max Month, Average Day Wastewater Flows

Year	Infiltration (mgd)	Domestic Wastewater (mgd)	Total Wastewater (mgd)
2022	0.60	2.01	2.61
2025	0.61	2.05	2.67
2030	0.64	2.14	2.78
2032	0.65	2.17	2.82
2035	0.67	2.25	2.92
2040	0.69	2.39	3.08
2045	0.72	2.49	3.21
2050	0.75	2.57	3.32

WATER RECLAMATION FACILITY CAPACITY

As summarized in Table 3-7, growth projections through 2050 for the MID sewer service area result in a projected total max month, average day wastewater flow of 3.32 mgd. With available capacity rights of 3.84 mgd, MID does currently own sufficient capacity rights at the South Valley Water Reclamation Facility to accommodate projected growth through 2050.

Figure 3-4
Projected Average Daily Wastewater



CHAPTER 4
HYDRAULIC MODELING

INTRODUCTION

A critical component in identifying required areas in the MID collection system where pipes have capacity deficiencies is the development of a hydraulic computer model. An extended period simulation (EPS) hydraulic model was developed using Innovyze's InfoSewer software using data provided by MID. The purpose of this chapter is to present a summary of the methodology used to develop this model.

MODEL HISTORY

The current model used by the District was originally setup by a consulting engineering firm. However, District personnel currently maintain the existing model and update the model whenever changes in the collection system are constructed. As pipes are lined or replaced, MID personnel update geometry of the model accordingly.

GEOMETRIC MODEL DATA

There are two major types of data required to develop a hydraulic model of a sewer system: geometric data and flow data. Geometric data consists of information on the location and size of system facilities including pipes, manholes, and lift stations. It also includes the physical characteristics of the facilities including pipe roughness, invert elevations at manholes, pump settings in lift stations, and a description of any diversions present. This information is generally collected from system inventory data or through direct field measurement. The following sections describe how geometric data was assembled for use in the hydraulic model.

Pipeline and Manhole Locations

MID has spent considerable time assembling a GIS inventory of its existing sewer facilities. As such, the existing model reflects the geometry of its existing GIS inventory. All manholes and pipes in the District's collection system are included in its hydraulic model.

Pipe Flow Coefficients

Pipe flow coefficients used throughout the hydraulic model were assumed to have a Manning's coefficient of 0.013. This is approximately equal to the roughness coefficient of concrete or clay pipe. While there are other materials in the system with lower published roughness coefficients (e.g. PVC), 0.013 was used throughout the system as a conservative approach for estimating pipe capacity. In addition, most collection pipes can develop thin layers of bacteria and solids (a slime layer) that result in a relatively uniform flow coefficient despite varying materials.

Sediment and Debris

Because of the transportable nature of grease and debris in a sewer collection system, it is very difficult to identify the exact location and quantity of grease or debris accumulation in the system at any specific point in time. Similarly, the build-up and erosion rates of sediment in sanitary sewer systems are not always well understood. As a result, the detailed modeling of sediment, grease, and debris on a system wide basis is not possible because of continually changing conditions. Therefore, no sediment was included in the various runs of the hydraulic model. Instead, the design and evaluation criteria for the MID collection system is based on "clean" pipes, with an allowance for capacity lost to the accumulation of sediment (see Chapter 5).

Lift Stations

The District has no existing lift stations.

Diversions

The District has no existing diversions.

Flow Data

Once all required geometric data was verified for the physical model of the system, flow data was entered into model to evaluate the system hydraulics. Three types of flow information were required for hydraulic modeling: total magnitude of flow, timing of flow, and distribution of flow across the District service area. Each of these flow characteristics is discussed below.

Total Flow

Flow projections for the MID service area were presented in detail in Chapter 3. Total flow for modeling scenarios examined here are summarized in Table 4-1.

Table 4-1
Hydraulic Modeling Scenario Average Daily Flow Rates (mgd)

Scenario	2022	2032	2050
Average Daily Flow (mgd)	2.61	2.82	3.32

Timing of Flow

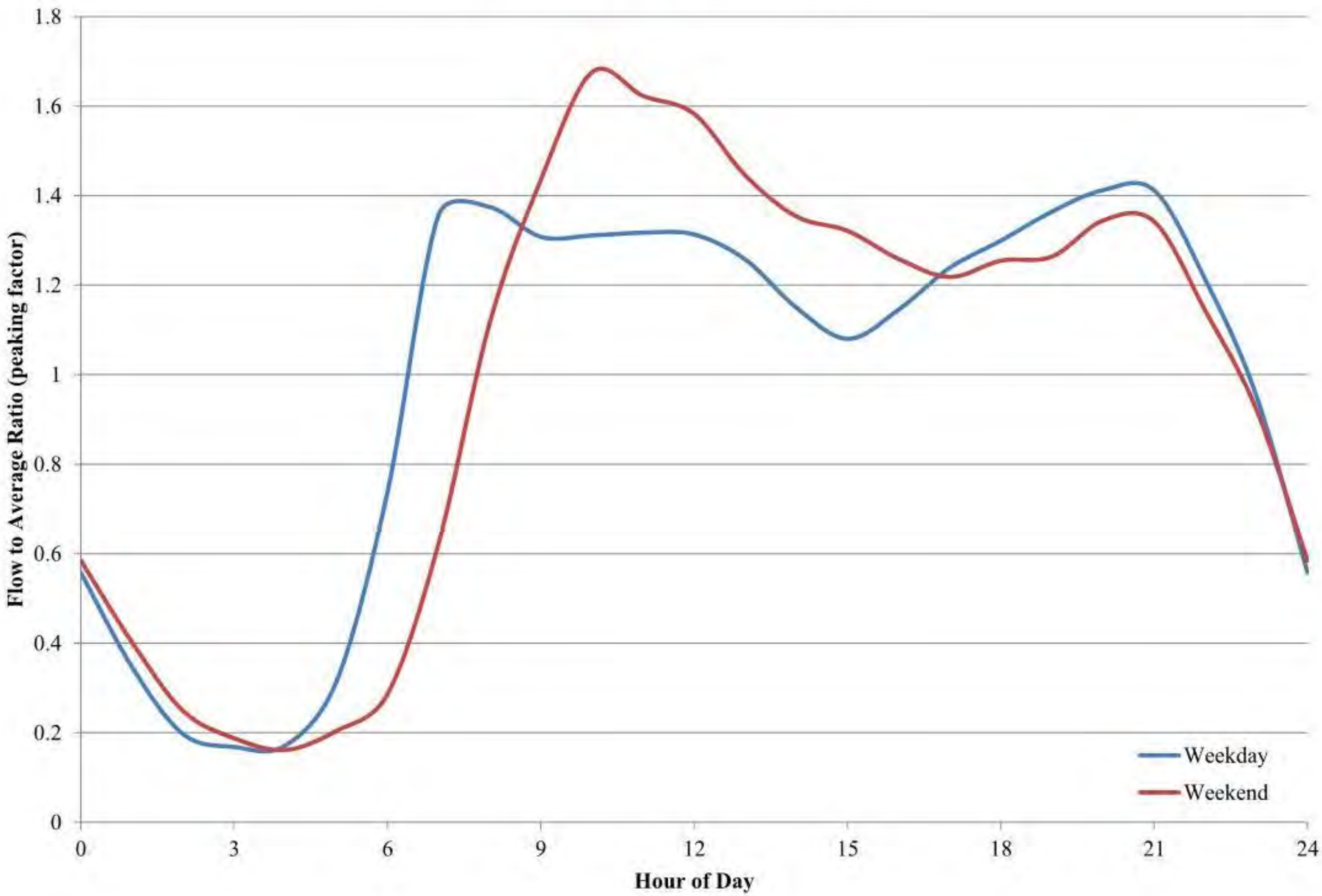
It will be noted that the flow rates shown in Table 4-1 represent average flow over a 24-hour period. Since sanitary sewer flows vary throughout the day with varying indoor water demands, of much greater importance for the purposes of modeling collection system capacity is the calculation of peak flows that occur during the day. To predict the magnitude and timing of peak flows in the model, it is important to understand how flow varies throughout the day. This is different for each component of wastewater flow.

- ***Domestic Wastewater –*** The pattern of fluctuating domestic water use is often referred to as a diurnal pattern. These patterns vary depending on the type of user. The typical diurnal pattern for weekday and weekend wastewater production at the treatment plant is shown on Figure 4-1. Based on these patterns, a diurnal pattern for weekend flows was determined to be the most conservative and was used in hydraulic model simulations. This pattern was applied to all users throughout the District with the exception of Hillcrest High School and Union Middle School. A separate diurnal pattern was created based off of typical school daily flow patterns. Table 4-2 shows the two sets of peaking factors used throughout the day in the hydraulic model.

Table 4-2
Hydraulic Model Diurnal Pattern

Hour	Hourly Factors	
	Weekend Residential	Expected School
0	0.585	0.000
1	0.249	0.000
2	0.187	0.000
3	0.161	0.000
4	0.204	0.000
5	0.286	0.562
6	0.623	1.407
7	1.116	2.252
8	1.436	2.591
9	1.600	2.523
10	1.600	3.470
11	1.560	2.050
12	1.385	1.983
13	1.354	1.955
14	1.321	1.915
15	1.259	1.712
16	1.218	1.577
17	1.255	0.000
18	1.264	0.000
19	1.345	0.000
20	1.342	0.000
21	1.143	0.000
22	0.922	0.000
23	0.585	0.000
24	0.585	0.000

Figure 4-1
Weekday and Weekend Diurnal Patterns



It should be noted that Innovyze's InfoSewer hydraulic model has no way to input an "initial" flow in pipes. This can potentially result in inaccurate flow predictions at some pipes as the pipes fill over time. This limitation can be overcome two ways: by using a steady state model and/or filling the pipes with a base flow at the start of the model. Because steady state models with a constant high peaking factor can be overly conservative in predictions of deficiencies (because of unaccounted for attenuation), the method used for the InfoSewer model was the latter approach. Pipes in the InfoSewer Model were filled over 24 hours using 0.585 as the peaking factor to prepare the model to start at the correct flow after which the diurnal pattern in Table 4-2 was applied.

- ***Infiltration* –** As discussed in Chapter 3, infiltration may vary on a seasonal basis but does not generally vary on a daily basis. Thus, it has been assumed that infiltration remains constant throughout the day in the collection system model.
- ***Inflow* –** For this study, inflow has not been modeled directly because of the wide variability in storm events and inflow response possible in the District. For design purposes, MID has included a capacity allowance in its design criteria to account for inflow into its collection system.

Based on the diurnal patterns used above, peak flows simulated in the model are summarized in Table 4-3.

Table 4-3
Hydraulic Modeling Scenario Peak Hour Flows (mgd)

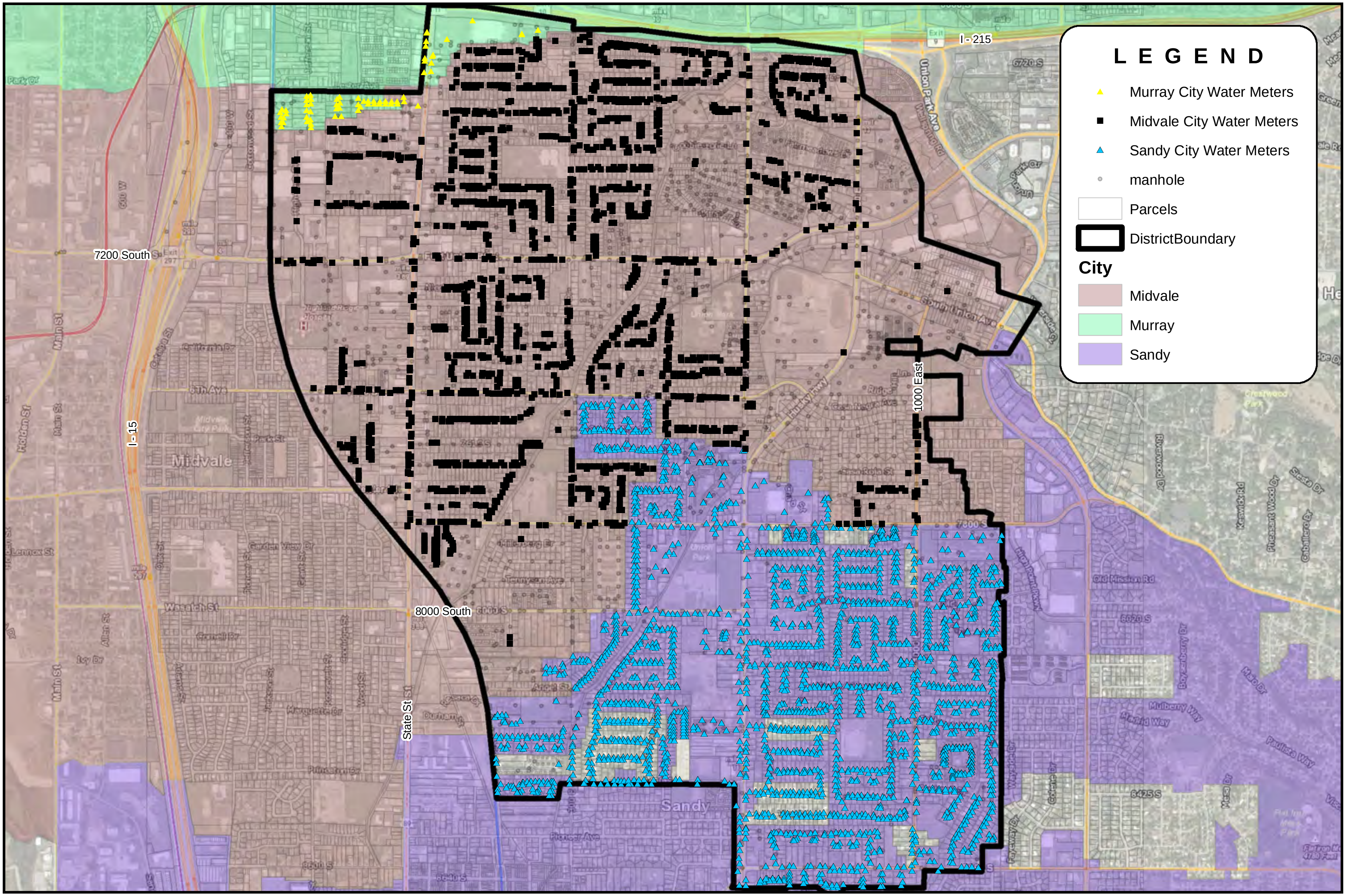
Scenario	2022	2032	2050
Dry Weather Flow (mgd)	3.77	4.06	4.80

*Peak hour WWTP inflow from extended period simulation which accounts for attenuation in the system.

Distribution of Flow

With flow magnitude and timing estimated, the final step in developing flow data for the model is distributing it spatially across the District:

- ***Domestic Wastewater* –** For Murray City and Sandy City, existing domestic sewer flows included in the hydraulic model were distributed based on indoor water use data. Figure 4-2 shows the locations in the District where flow meter data was available for input into the model. For Murray City and Sandy City service area, meter coverage appeared to be 100 percent for available connections. For Midvale City, however, there are large gaps in the available data. In addition, some of the meter reads in the Midvale City data appeared erroneous. As a result, the distribution of domestic flow for the Midvale City area was distributed using MID estimates of equivalent residential units developed previously. Where accurate data was available from Midvale City, the ERUs in some areas were adjusted to be more representative of measured flows.



BOWEN COLLINS & ASSOCIATES

Midvalley Improvement District

SEWER MASTER PLAN

WATER METER SERVICES FOR DISTRIBUTION OF WASTEWATER PRODUCTION

NORTH:

SCALE: 0 1,000 2,000 Feet

FIGURE NO. 4-2

\\bowencollins.com\Shares\Draper\Projects\Midvalley Improvement District\353-19-01 2019 Masterplan Update\6.0 Reports and Memos\6.2 Draft Report\Figures\Figure 4-2 - Meters.mxd egillespie 7/9/2019

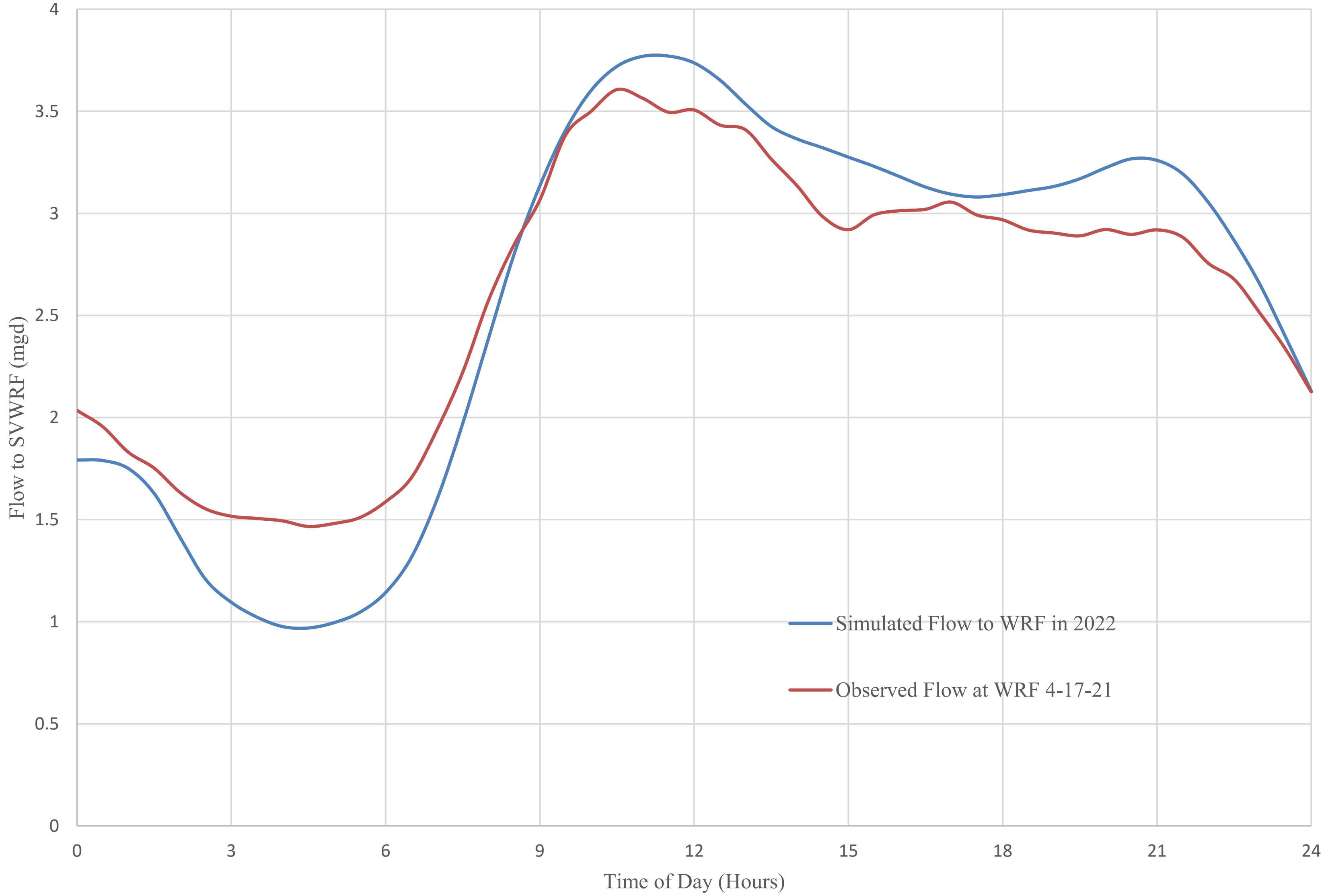
Future growth of domestic sewer flow was distributed evenly throughout all manholes within the TAZ based on ERU growth projections by TAZ or to individual manholes most likely to take flow from future redevelopment discussed by city planning personnel as described in Chapter 3.

- ***Infiltration* –** Existing infiltration was distributed using flow monitoring data collected by MID. Because flow monitoring data was only available at the treatment plant, existing infiltration in the District was distributed uniformly among existing manholes to represent proportionate infiltration by length and size of pipe. Future infiltration was assigned proportionally to increases in domestic flow as described in Chapter 3.

CALIBRATION

The process of model calibration involves adjusting or modifying certain model parameters in order to better match the actual conditions of the sewer system. Calibration of the model was performed using available historical flow meter data at the SVWRF. A comparison of model results against the historic flow monitoring results appears to indicate that, in general, the model is reproducing system conditions within a reasonable level of accuracy. Figure 4-3 shows flows at the treatment plant in 2021 compared to the model simulations. Simulated flows indicate a more aggressive diurnal pattern compared to recent flow data. This suggests the model is a little conservative with respect to attenuation in the system. Additional flow monitoring in other parts of the collection system could potentially improve the model calibration. Additional flow monitoring can be justified if the initial calibration indicates a large number of deficiencies that should be verified before recommending capital improvements.

Figure 4-3
Model Calibration



CHAPTER 5
SYSTEM EVALUATION

With the development and calibration of a hydraulic sewer model, it is possible to simulate sewer system operating conditions for both present and future conditions. The purpose of this chapter is to evaluate hydraulic performance of the collection system and identify potential hydraulic deficiencies.

EVALUATION CRITERIA

In defining what constitutes a hydraulic deficiency, it is important to consider the assumptions made in estimating sewer flows in the model. As described in Chapters 3 and 4, the sewer flow included in the model is composed of two parts: domestic sewer flow and infiltration. These inputs are based on available historic data. Because these estimates are based on average values and a limited data set, actual flows will fluctuate and may be greater than the model estimates. For example, infiltration during extremely wet years could be more than estimated in the model (e.g. 1983 was a statewide historically wet year that led to high infiltration and flooding in many areas). Additionally, it will be noted that the projections do not include a direct estimate of potential flows associated with inflow. While this component occurs infrequently, it must be accommodated in the system when it does occur to avoid costly sewer backups. As a result of these several issues, the criteria established for identifying deficiencies should be sufficiently conservative to account for occasional flows higher than those estimated in the model.

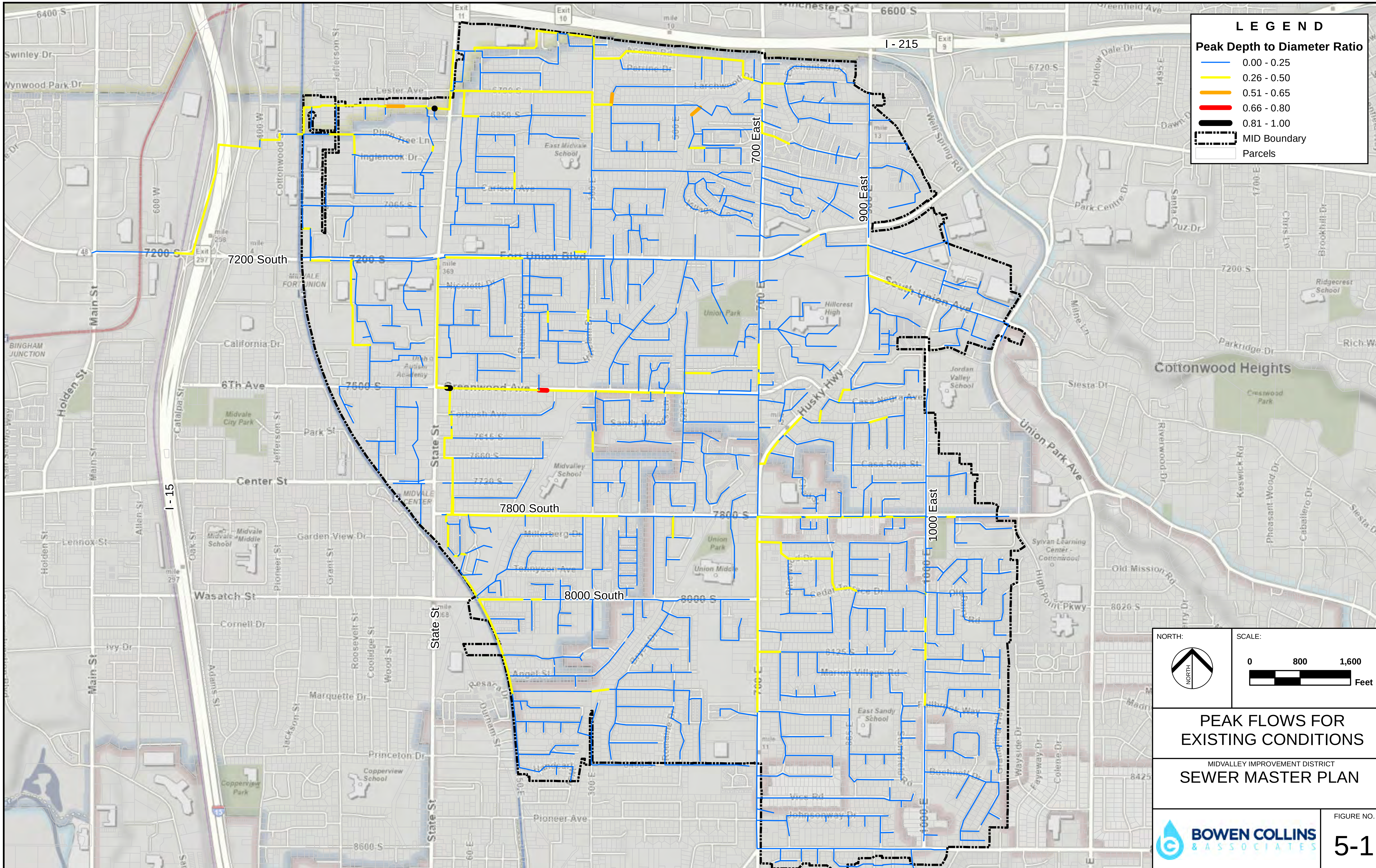
To account for these issues, the following criterion has been established to identify capacity deficiencies in the system:

- **Pipeline Capacity (12-inch and smaller) –** Peak flow in the pipe must be less than 50 percent of the full flow pipe capacity.
- **Pipeline Capacity (15-inch and larger)** – Peak flow in the pipe must be less than 75 percent of the full flow pipe capacity or the peak flow depth must be less than 65 percent of the pipe diameter.

The remaining capacity is reserved for inflow and/or unaccounted fluctuations in domestic flow and infiltration. A manning's roughness value of 0.013 was used for all collection pipes to conservatively calculate capacity.

EXISTING SYSTEM ANALYSIS

Figure 5-1 displays the hydraulic capacity of the sewer system under existing peak hour flow conditions. Pipes in the figure are color coded to show the ratio of maximum depth in the pipe to the pipe's diameter. Based on peak flow and pipe capacities alone, there are a few isolated deficiencies scattered throughout the system. These deficiencies are generally due to pipes being laid on a flat slope, which decreases the full flow capacity.



P:\Midvalley Improvement District\353-22-01 2022 IFFP-IFA Update\4.0 GIS\Figure 5-1 - Peak Flow 2022.mxd wandersen 8/11/2022

Short sections of flat pipe often do not represent a significant operational or maintenance issue for the system. The results shown in Figure 5-1 represent the maximum flow depth at any point along the length of the pipe. As long as the neighboring pipes have sufficient capacity, the extra depth caused by the flat slope over short distances may not result in surcharging problems for the system. Based on closer examination of these few pipelines, it appears that the deficiencies observed in the existing system model do not appear to pose a significant surcharge risk at this time, but will require monitoring as sewer flows continue to increase.

FUTURE SYSTEM ANALYSIS

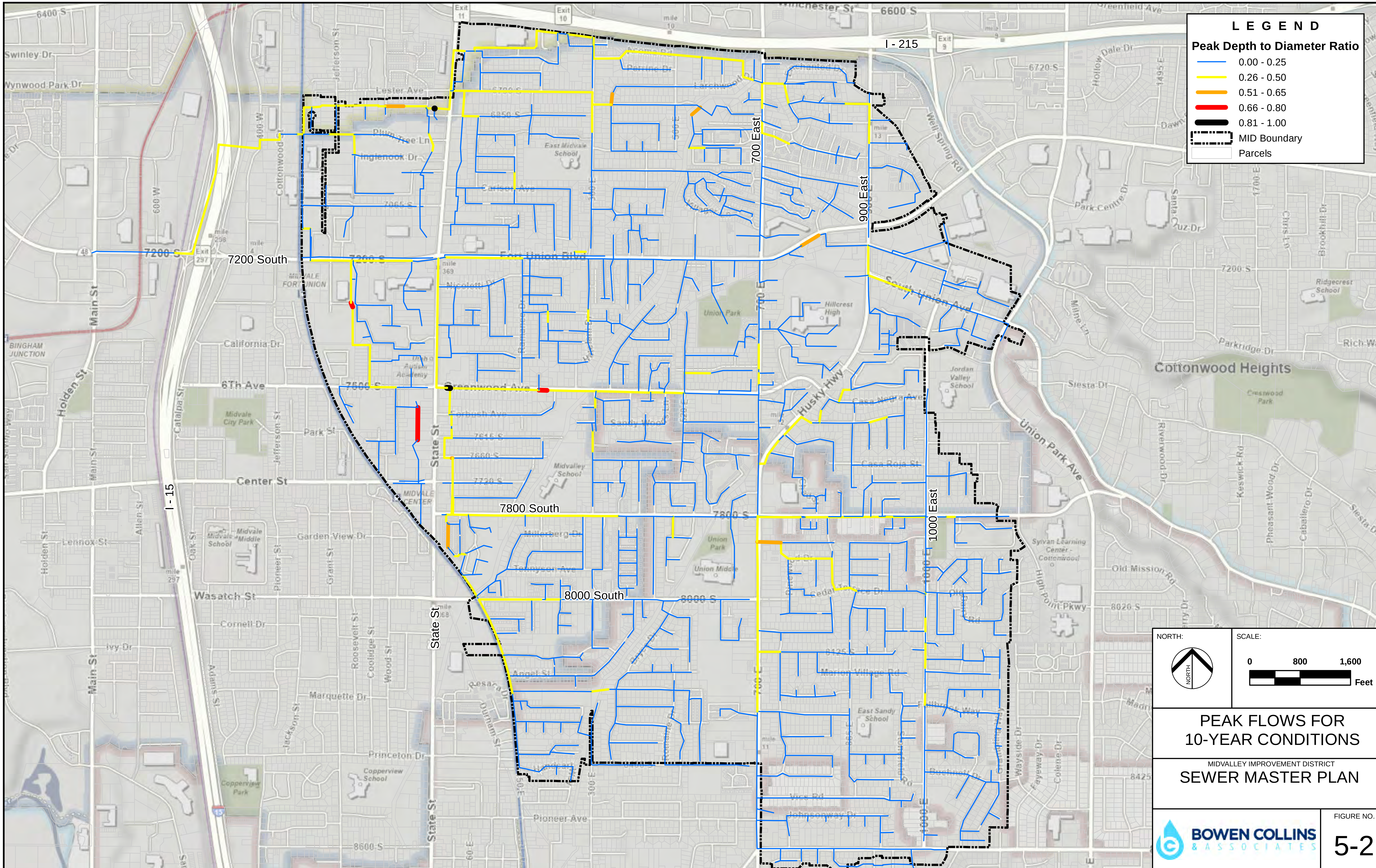
Figures 5-2 and 5-3 show the hydraulic performance as calculated in the hydraulic model for future sewer flows for 2032 and 2050 development conditions as projected using methods described in Chapters 3 and 4 if no improvements are made to the existing system. As seen in these figures, there are substantial changes from existing to future development conditions. Some of the bottle necks identified for existing conditions have increased depths.

South Valley Water Reclamation Facility

As discussed in Chapter 3, growth projections through 2050 for the MID sewer service area result in a projected total wastewater flow of 3.32 MGD. With an available capacity right of 3.84 MGD, MID does currently own sufficient capacity at the South Valley Water Reclamation Facility to accommodate projected growth through 2050.

OTHER DEFICIENCIES

It should be noted that Figures 5-1, 5-2, and 5-3 focus primarily on hydraulic deficiencies predicted in the system based on pipe roughness and calculated slopes between manholes. MID personnel have also identified areas of its collection system that may need improvements to reduce potential backups as a result of condition related problems. Offset joints, roots, cracks in pipes, corroded pipes, and bellies in pipes are all potential deficiencies that are identified through regular pipe inspections that may not be identified through a hydraulic analysis. Proposed projects to resolve condition related deficiencies are discussed in Chapter 6.



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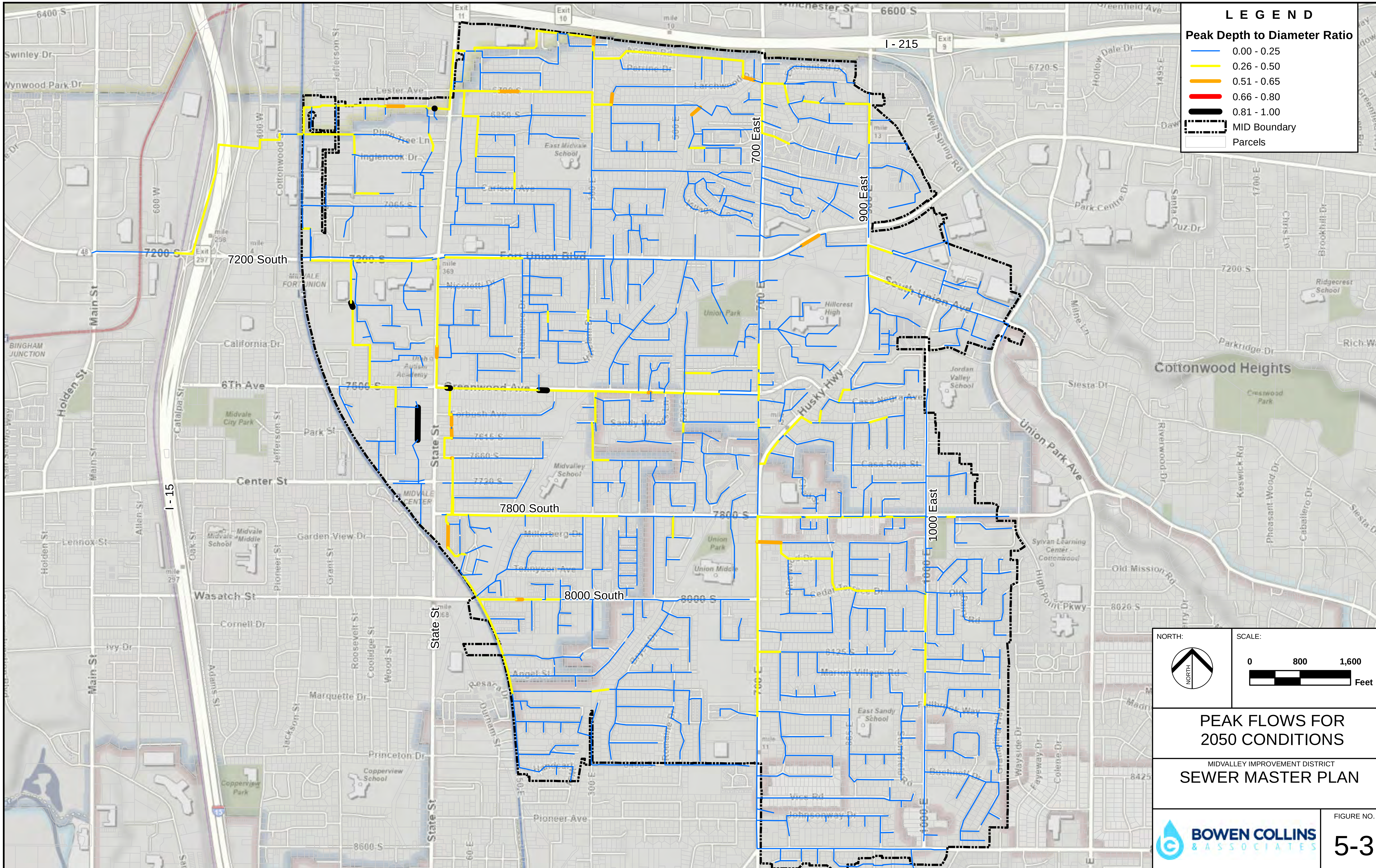

PEAK FLOWS FOR
2050 CONDITIONS

MIDVALLEY IMPROVEMENT DISTRICT
SEWER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
5-3

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CHAPTER 6
CAPITAL FACILITY PLAN

The hydraulic model results have identified potential deficiencies in the sewer system under existing and build-out conditions. This chapter covers system improvements intended to resolve existing deficiencies.

COLLECTION SYSTEM IMPROVEMENTS

A number of system improvements have been identified to resolve hydraulic deficiencies related to existing or projected sewer flows. Many of these projects resolve hydraulic deficiencies in the collection system as identified in Chapter 5. In addition to hydraulic deficiencies, MID personnel have identified condition related maintenance projects that will require improvements. Table 6-1 summarizes costs for each maintenance related project.

Table 6-1
Costs for Maintenance Projects

Project No.	Proposed Year	Project Description	Total Cost
M1	2023	Fairmeadows Drive between 700 E and 900 E, Replace existing 8-inch pipe with new 8-inch pipe for condition related concerns	$814,000
M2	2023	Laser profile and sonar inspection of 36-inch outfall under Interstate 15, between MH-A001 and MH-A014	$84,000
M3	2023	Union Woods Drive between MH-E129 and MH-E130, Replace existing 8-inch pipe with new 8-inch pipe to reduce infiltration issues	$750,000
		Total	$1,648,000

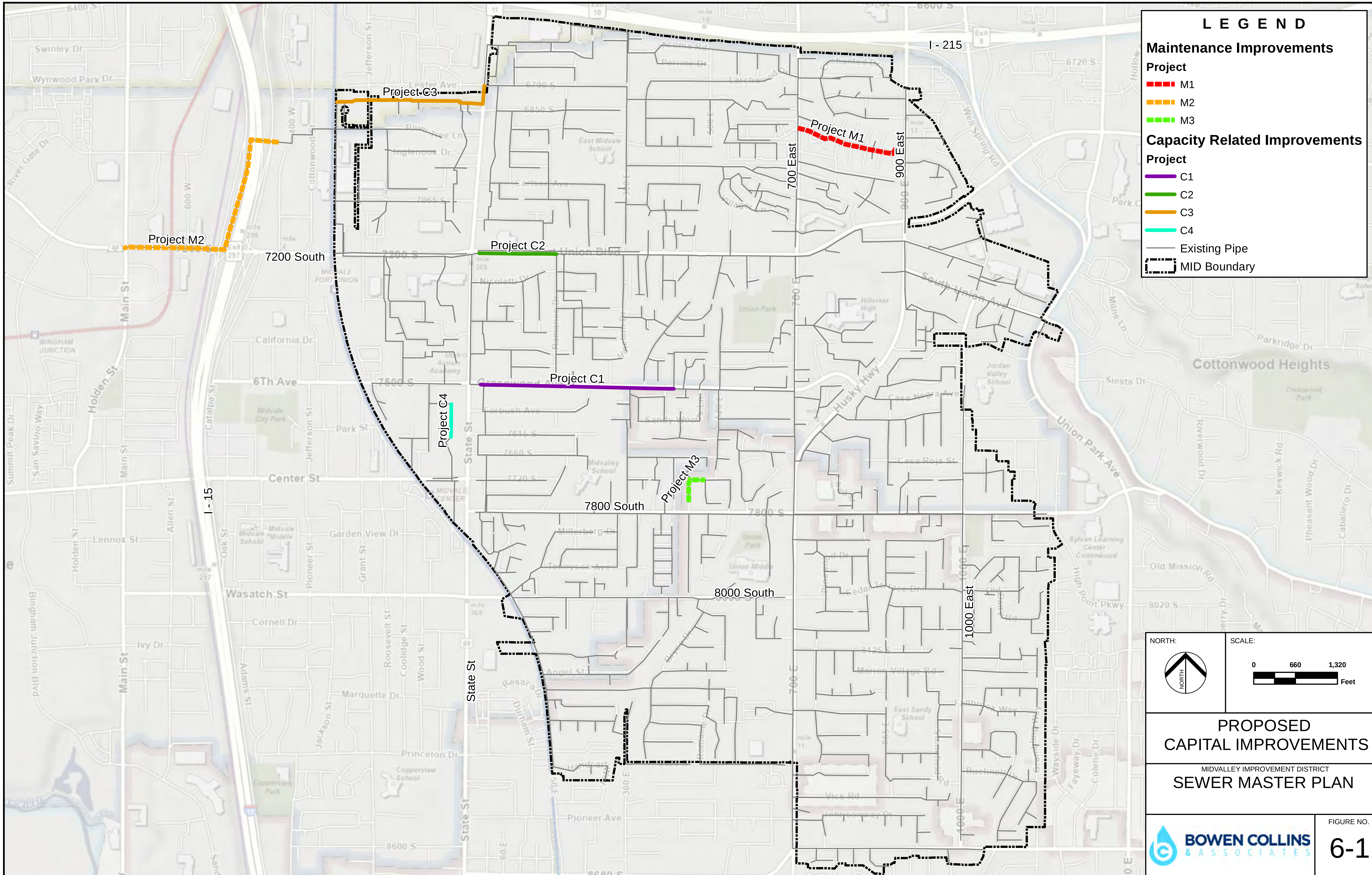
Figure 6-1 shows the location of projects required for capacity related deficiencies. Table 6-2 summarizes costs and schedule for each capacity related project.

It should be noted that unit costs for replacing short sections of pipe can often be higher than unit costs for longer replacement projects because the ratio of mobilization costs to material and other construction costs is relatively high. It should also be noted that the diameters given for new projects in the table are for planning and budgeting purposes only. Once detailed design of each sewer mains commences, it is expected that the designer engineer will verify total existing flow, peaking characteristics, potential service area (with corresponding projected build-out flows), and available slope before selecting the final pipe size.

Table 6-2
Project Costs for Capacity Deficiencies

Project No.	Proposed Year	Address	Project Description	Proposed Diam (in)	Length (ft)	Pipe Replacement Unit Cost ($ / LF)[1]	Asphalt Restoration Unit Cost ($ / LF)	Canal Crossing Cost	Engineering / Admin Cost (15%)	Total Cost
C1	2024	7500 S between State St & 410 E	Replace Existing 15-inch Pipe with 18-inch Pipe & Correct Drop Manhole	18	3042	468	130	$150,000[2]	$493,000	$2,463,000
C2	2033	7200 S between State St & Ramanee Dr	Replace Existing 12-inch Pipe with New 18-inch Pipe	18	1220	468	130		$183,000	$913,000
C3	2027	6830 S. between Railroad & State St.	Replace Existing 15-inch Pipe with 18-inch Pipe	18	2649	468	130		$397,000	$1,982,000
C4	2024	State St. between 7640 S. & 7554 S.	Replace Existing 10-inch Pipe with 15-inch Pipe	15	519	423	124		$71,000	$355,000
									Total	**$5,713,000**

[1]Pipe replacement costs include manhole costs
[2]Canal crossing costs estimated using 75 LF, 36" casing @ $2000/ LF installed by trenchless construction



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WATER RECLAMATION FACILITY IMPROVEMENTS

Table 6-3 summarizes some of the projects that will be required at SVWRF within the next 10 years (and beyond). These projects were provided directly from staff at SVWRF.

Table 6-3
SVWRF Projects and MID Cost Share

Project No.	Design Year / Construction Year	Project	Capacity Rights for MID (% of total)	Total Cost to MID*
1	2023/2024	MCC Replacement	7.68%	$269,000
2	2023/2024	VFD Replacement	7.68%	$65,000
3	2023/2024	Main 5G Protective Relays	7.68%	$29,000
4	2024/2025	Bio5 Floating Mixers	7.68%	$24,000
5	2024/2025	Bio5 Process Control	7.68%	$179,000
6	2023/2026	UV Replacement	7.68%	$350,000
7	2024/2026	Effluent Channel	7.68%	$57,000
8	2026/2027	BB2 Discharge	7.68%	$21,000
9	2024/2028	Plant-Wide Standby Power	7.68%	$969,000
10	2027/2028	Bio 1-4 Diffuser and Piping Replacement	7.68%	$611,000
11	2025/TBD	Biosolids Master Plan	7.68%	$20,000
12	2027/2030	Step Screen Replacement	7.68%	$269,000
13	2027/2030	Grit Chamber Rehab	7.68%	$204,000
14	2030/2031	SCADA System	7.68%	$11,000
15	2030/2031	Fiber Optic	7.68%	$20,000
16	2029/2031	Entrance Bridge	7.68%	$58,000
17	2029/2032	Influent Flow Meter	7.68%	$98,000
18	2029/2032	Tertiary Filters	7.68%	$1,376,000
19	2031/2034	Reuse Pump Station	7.68%	$0
20	2032/2034	48-inch Interceptor	7.68%	$293,000
21	2035/2036	Bio1 A20	7.68%	$244,000
22	2030/TBD	Tier 2 Seismic Evaluation of Bioreactors No. 1-4	7.68%	$16,000
		Subtotal 10-Year Window		**$4,786,800**
		Total		**$5,183,000**

*Based on relative percentage of total SVWRF capacity owned by MID. Project cost estimates and completion dates provided by SVWRF personnel.

PLANNING PROJECTS

In addition to capital facility projects, the District will need to update its sewer master plan, impact fee facility plan, and sewer rates approximately every 3-5 years. Planning costs for MID are anticipated to be approximately $60,000 every 3-5 years based on past historical planning study costs. As part of the next master plan update, some flow monitoring may also be warranted based on recent observations in some parts of the system. This may require an additional $15,000 to be included as part of the next master plan update.

CAPITAL IMPROVEMENT BUDGET

As part of a master plan, it is necessary to determine how much funding will be set aside each year for capital improvements. This may include both capacity upgrades to support future growth and maintenance level project improvements to prevent pipe and manhole failures or a reduction in the District's level of service. The District's highest priority for maintenance related projects include rehabilitating concrete and clay pipes within the District that are likely to deteriorate faster than PVC pipes. The District has already made efforts to rehabilitate concrete and clay pipes in the system and 15% of the existing system has been rehabilitated with CIPP.

MID's sewer collection system is composed of about 407,000 feet of pipe, of which 36% is clay and 21% is concrete. The District's internal goal is to rehabilitate 90 percent of all existing clay and concrete pipe with CIPP over the next 20 years. Based on this internal rehabilitation goal, the District will need to budget approximately $991,000/year as shown in Table 6-4.

Table 6-4
CIPP Costs to Rehabilitate Concrete and Clay Pipe

Diameter (in)	Unit Cost ($/LF)	Length (ft)	Total Cost	Annual Budget (2022 Dollars)[1]
8	78	198,493	$15,483,000	$775,000
10	86	4,759	$410,000	$21,000
12	95	4,602	$438,000	$22,000
15	119	5,889	$701,000	$36,000
18	156	525	$82,000	$5,000
21	195	2,533	$494,000	$25,000
24	233	2,758	$643,000	$33,000
30	350	4,080	$1,428,000	$72,000
36	486	4,593	$2,233,000	$112,000
	Total	229,000	$21,912,000	$1,101,000
	90% of Total[2]	**207,000**	**$19,721,000**	**$991,000**

[1]Annual budget to complete CIPP projects over 20 years
[2]The District's goal is to rehabilitate 90% of all existing concrete and clay pipes

The District's sewer collection system consists of about 1,900 manholes, which almost all are made of concrete material. The District's internal goal is to rehabilitate 25 existing concrete manholes per year. Based on this internal rehabilitation goal, the District will need to budget approximately $500,000/year.

It is also recommended that the District budget approximately $50,000/year for building repairs and maintenance.

ASSET MANAGEMENT

The $991,000/year is a budgetary estimate based on the District's goal to rehabilitate 90% of all existing concrete and clay pipe in the collection system with CIPP in the next 20 years. The District has adopted a rigorous pipe inspection program utilizing principles from the Pipeline Assessment Certification Program (a national standard for pipeline defect identification and assessment). The District currently completes video inspection of its entire collection system every 18-months. The District also cleans 95 percent of its collection pipes (pipes with diameters less than or equal to 21-inch) every 12 months. Pipelines larger than 21-inch are difficult to clean regularly due to limits of typical pipe cleaning equipment. Based on the pipe inspection results, the District can prioritize which pipelines require rehabilitation first and develop their annual rehabilitation project list.

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