ORDINANCE NO. 2024-27
AN ORDINANCE OF WASHINGTON CITY APPROVING AND ADOPTING THE WASHINGTON CITY SEWER MASTER PLAN TO ADDRESS THE WASTEWATER SYSTEM NEEDS OF THE CITY

WHEREAS, the City Council of Washington City ("City Council") finds and determines that growth and development activity in the City will create additional demand and need for the wastewater system in the City and will require that the City's wastewater system be improved and enlarged to support said growth and development in the City; and

WHEREAS, the City has had a study and analysis performed addressing wastewater needs in the City to determine existing wastewater system conditions and needs, and to determine projected needs as the City grows during the next 20 years, which study and analysis shall serve as a Wastewater Capital Improvements Plan, for the wastewater system; and

WHEREAS, the City Council desires to give formal acceptance and approval of said Sewer Master Plan for the wastewater system; and

WHEREAS, the City Council, after a public notice as required by law, held in a public hearing on December 11, 2024, to consider the adoption of this Ordinance, a copy of the Sewer Master Plan for the wastewater system, has been made available for public inspection online at the Washington City Office Building, for a period of 10 days prior to such public hearing.

NOW THEREFORE, BE IT HEREBY ORDAINED by City Council as follows:

1. Washington City hereby approves and adopts the following Washington City Sewer Master Plan, dated November 2024, prepared by Bowen Collins & Associates.
2. This Ordinance supersedes and/or repeals the provision(s) of any ordinance(s) or resolution(s) that is/are inconsistent with the provision of this Ordinance.
3. This Ordinance shall take effect immediately, upon publication or posting, as required by law.

PASSED AND ORDERED POSTED on this 11th Day of December, 2024.

Washington City

Kress Staheli, Mayor

Attest by:

Tara Pentz, City Recorder

PREPARED FOR:

Washington City
Where Dixie Begins

PREPARED BY:

BOWEN COLLINS
& ASSOCIATES

NOVEMBER 2024

WASHINGTON CITY SEWER MASTER PLAN

WASHINGTON CITY SEWER MASTER PLAN

November 2024

PROFESSIONAL ENGINEER
11-27-2024
10488780-2202
AARON ANDERSON
STATE OF UTAH

Prepared for:

Washington City
Where Dixie Begins

Prepared by:

BOWEN COLLINS
& ASSOCIATES

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

Page No.

TABLE OF CONTENTS (continued)

Page No.

LIST OF APPENDICES

LIST OF FIGURES

No. Title **Page No.**

TABLE OF CONTENTS
(continued)

LIST OF TABLES

EXECUTIVE SUMMARY

INTRODUCTION

Washington City (city) has contracted the services of Bowen Collins & Associates, Inc. (BC&A) to complete a Sewer System Master Plan (master plan). The purpose of this study is to evaluate the city's existing sewer collection system, project future wastewater production as a result of growth, and identify improvements that will resolve existing and projected future deficiencies in the system within a 20-year planning window.

SERVICE AREA

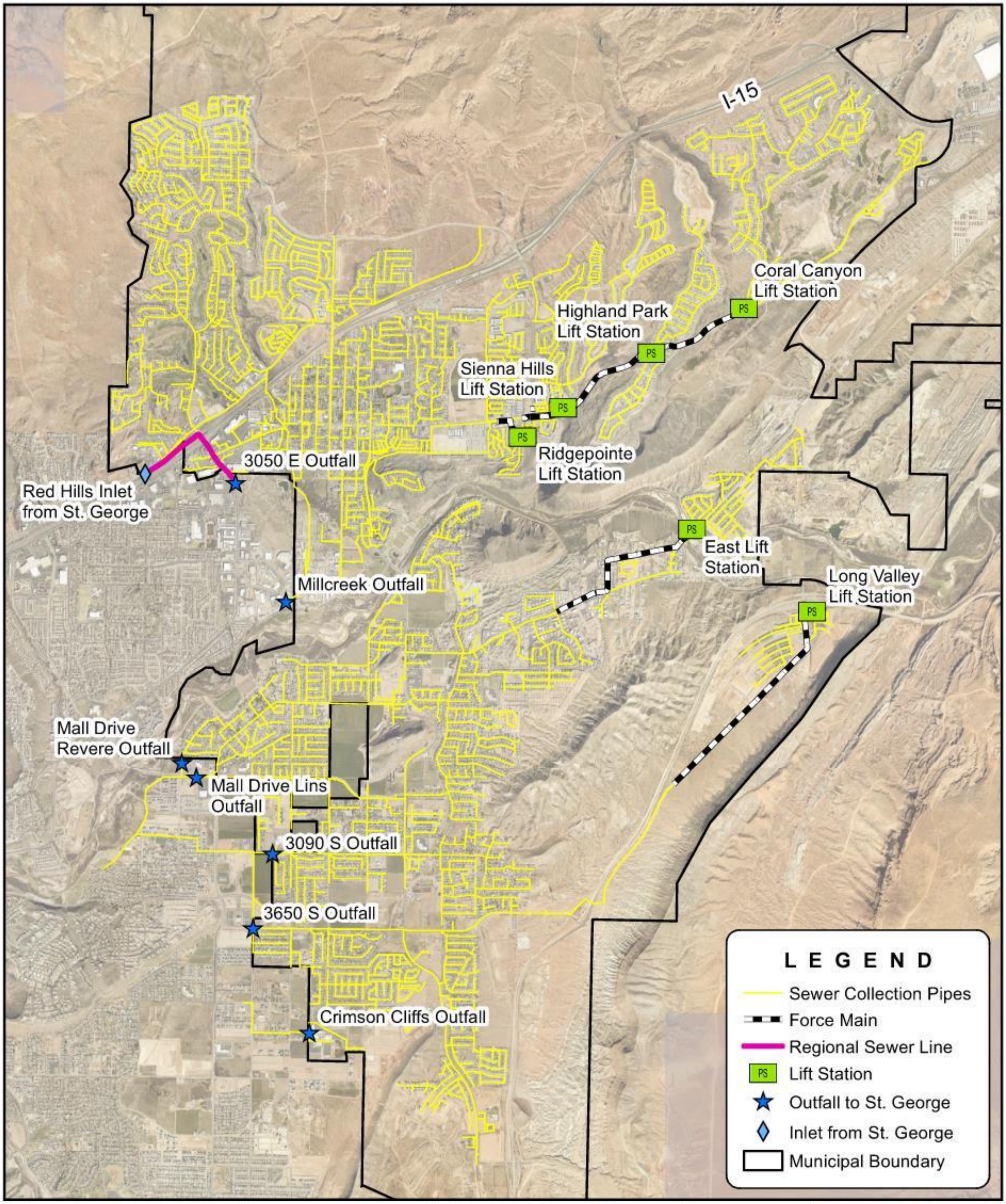
The city's existing system and service area are shown in Figure ES-1. The system is composed of over 1 million feet of sewer collection piping and 6 lift stations.

PROJECTED CONNECTIONS AND GROWTH

Growth projections for sewer service connections in the city are based on the recently developed growth projections included in the 2024 Washington City Culinary Water Master Plan. Projected growth in Equivalent Residential Units (ERU) is shown in Table ES-1

Table ES-1
Washington City Sewer System Growth Projections

Year	Estimated Growth Rate	Estimated Population	ERU	Domestic Sewer Flow (gpd)	Infiltration (gpd)	Total Flow (gpd)
2023		43,395	17,421	3,275,148	801,366	4,076,514
2024	6.9%	46,389	18,623	3,501,133	841,034	4,342,167
2025	6.9%	49,590	19,908	3,742,711	883,438	4,626,150
2026	5.5%	52,318	21,003	3,948,561	919,571	4,868,132
2027	5.5%	55,195	22,158	4,165,731	957,692	5,123,423
2028	5.5%	58,231	23,377	4,394,847	997,909	5,392,755
2029	4.0%	60,560	24,312	4,570,640	1,028,766	5,599,407
2030	4.0%	62,982	25,284	4,753,466	1,060,858	5,814,324
2031	4.0%	65,502	26,296	4,943,605	1,094,233	6,037,838
2032	4.0%	68,122	27,348	5,141,349	1,128,944	6,270,293
2033	3.5%	70,506	28,305	5,321,296	1,160,530	6,481,826
2034	3.5%	72,974	29,295	5,507,541	1,193,222	6,700,764
2035	3.5%	75,528	30,321	5,700,305	1,227,059	6,927,364
2036	3.5%	78,171	31,382	5,899,816	1,262,079	7,161,895
2037	3.5%	80,907	32,480	6,106,310	1,298,325	7,404,635
2038	3.5%	83,739	33,617	6,320,031	1,335,840	7,655,871
2039	3.5%	86,670	34,794	6,541,232	1,374,668	7,915,899
2040	3.5%	89,703	36,012	6,770,175	1,414,855	8,185,029
2041	3.5%	92,843	37,272	7,007,131	1,456,448	8,463,579
2042	3.5%	96,092	38,576	7,252,380	1,499,497	8,751,878
2043	3.5%	99,456	39,927	7,506,214	1,544,053	9,050,267



BOWEN COLLINS & ASSOCIATES

EXISTING SERVICE AREA

WASHINGTON CITY

SEWER MASTER PLAN

NORTH:

NORTH

SCALE: 0 2,500 5,000 Feet

FIGURE NO. ES-1

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\FULL SIZE FIGURES\Figure ES-1 - Existing System Map.mxd aanderson 8/5/2024

Sewer flow per ERU was estimated using metered sewer flow data from the city's collection system in conjunction with culinary water meter data from winter months. Table ES-2 summarizes the recommended level of service per ERU for the sewer collection system. New sewer system construction materials and methods have made improvements to limit the amount of infiltration entering a sewer collection system. For this reason, a lower level of service for new development that includes a smaller amount of infiltration per ERU is recommended.

Table ES-2
Recommended Level of Service per ERU

Existing Users	
Flow Component	**Flow (gpd)**
Domestic Flow	188
Infiltration	46
Total	***234***
New Users	
Domestic Flow	188
Infiltration	33
Total	**221**

CAPITAL IMPROVEMENTS PLAN

With the aid of a hydraulic computer model of the city's sewer collection system, projects were identified to meet the existing and future needs of the system. The recommended improvements to be constructed over the next 10 years are shown in Table ES-3.

Table ES-3
Recommended 10-Year Sewer System Improvements[1]

Project ID	Project Name	Description	Estimated 2024 Cost	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total (Inflated Cost)
C2	George Washington Boulevard Parallel Line	Install 3,000 feet of 12-inch pipe and 2,400 feet of 15-inch pipe	$2,461,000										$3,211,000	$3,211,000
C3	Washington Fields Road Bypass Line	Install 900 feet of 18-inch pipe	$456,000	$456,000										$456,000
C4	2000 S Bypass Line	Install 1,400 feet of 18-inch pipe	$709,000	$709,000										$709,000
C5	20 E Bypass Line	Install 2,650 feet of 18-inch pipe	$1,341,000		$1,381,000									$1,381,000
C6	Merrill Road Parallel Line	Install 4,000 feet of 18-inch pipe	$2,024,000		$2,085,000									$2,085,000
C7	Sienna Hills South Parallel Line	Install 850 feet of parallel 15-inch pipe	$401,000					$452,000						$452,000
C9	Main Street North Parallel Line	Install 750 feet of 8-inch pipe and 200 feet of 10-inch pipe	$368,000							$440,000				$440,000
C10	Main Street South Parallel Line	Install 1,550 feet of 10-inch pipe and 500 feet of 12-inch pipe	$1,050,000								$1,292,000			$1,292,000
C11	100 E Parallel Line	Install 775 feet of 8-inch pipe, 1,150 feet of 10-inch pipe, 1,500 feet of 12-inch pipe, 725 feet of 15-inch pipe, and two connections	$1,687,000									$2,138,000		$2,138,000
E1	Airport Sewer Main	Install 6,840 feet of 8-inch pipe, 3,530 feet of 10-inch pipe and 1,370 feet of 12-inch pipe	$1,262,000	$1,262,000										$1,262,000
E3 (A and B)	1900 E Lift Station and Force Main	Install 25 gpm lift station and 4,100 feet of 4-inch force main	$827,000				$904,000							$904,000
R&R	Ongoing Rehab and Replacement	System Rehab and Replacement		$1,100,000	$1,100,000	$1,100,000	$1,100,000	$1,100,000	$1,100,000	$1,100,000	$1,100,000	$1,100,000	$1,100,000	$11,000,000
		Total Improvements	**$12,586,000**	**$3,527,000**	**$4,566,000**	**$1,100,000**	**$2,004,000**	**$1,552,000**	**$1,100,000**	**$1,540,000**	**$2,392,000**	**$3,238,000**	**$4,311,000**	**$25,330,000**

[1]A 3% annual inflation rate has been applied to future project costs

CHAPTER 1
INTRODUCTION

INTRODUCTION

Washington City (city) has retained Bowen Collins & Associates (BC&A) to prepare a master plan update for the city's wastewater collection system. The purpose of this master plan report is to evaluate the existing sewer collection system, forecast future wastewater production as a result of growth, and identify improvements that will resolve existing and projected future deficiencies in the wastewater collection system within the city's service area.

BACKGROUND

Washington City provides wastewater collection services for a variety of users within city limits. The active sewer service area covers over 36 square miles of land and contains over 1 million feet of piping and 6 sewer lift stations. Wastewater is currently conveyed into the St. George City wastewater collection system at 7 connection points and treated at the St. George Regional Water Reclamation Facility (SGRWRF).

SCOPE OF SERVICES

The general scope of this project involved a thorough analysis of the city's sewer collection system and its ability to meet the current and future wastewater needs of the service area. As part of this master plan, BC&A completed the following tasks.

Task 1: Collect information as needed to develop the sewer master plan, including previous studies, population growth data, general land use and zoning maps, water meter data, and sewer flow data.

Task 2: Project population and estimate future wastewater flows.

Task 3: Update the hydraulic computer model of the Washington City sewer collection system to evaluate existing and projected future system deficiencies.

Task 4: Identify existing operating deficiencies in the sewer collection system.

Task 5: Identify projected future operating deficiencies in the sewer collection system within a 10-year planning window and at an extended 20-year planning window.

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

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

Task 8: Document results of the previous tasks in a report.

It should be noted that the primary focus of this report is the city's collection system. Washington City has evaluated decentralized wastewater treatment options, but there are no current plans to construct wastewater treatment facilities in the city. However, the possibility of decentralized wastewater treatment plants are being explored for areas that are likely to be annexed in the future.

PROJECT STAFF

The project work was performed by the BC&A team members listed below. Team members' roles on the project are also listed. The project was completed in BC&A's St. George, Utah office. Questions may be addressed to Aaron Anderson, Project Manager at (435) 656-3299.

Todd Olsen	Principal-In-Charge
Aaron Anderson	Project Manager
Bridger Clymore	Project Engineer

WASHINGTON CITY STAFF

BC&A worked closely with city staff to complete this master plan. BC&A would like to recognize and express appreciation to the following Washington City staff members for their guidance and assistance in completing this study:

Blake Fonnesbeck	Public Works Director
Lester Dalton	Assistant Public Works Director
Dalton Smitherman	Wastewater Supervisor

WASHINGTON CITY COUNCIL

The following elected officials participated in the review and approval of this master plan:

Kress Staheli	Mayor
Kimberly Casperson	City Council Member
Kurt Ivie	City Council Member
Craig Coats	City Council Member
Brett Henderson	City Council Member
Troy Belliston	City Council Member

CHAPTER 2
EXISTING SYSTEM INFRASTRUCTURE

INTRODUCTION

As part of this master plan, BC&A has assembled an inventory of existing infrastructure within the city's sewer collection system. The purpose of this chapter is to present an overview of the city's service area along with an inventory of the city's s existing sewer collection system.

SERVICE AREA

The city sewer service area covers the entirety of the Washington City municipal boundary as shown in Figure 2-1. The active service area is relatively large, covering over 36 square miles of terrain. Wastewater from the collection system is conveyed into the St. George City sewer collection system and treated at the SGRWRF. The city provides wastewater collection for approximately 35,000 residents and about 527 commercial/institutional/industrial connections.

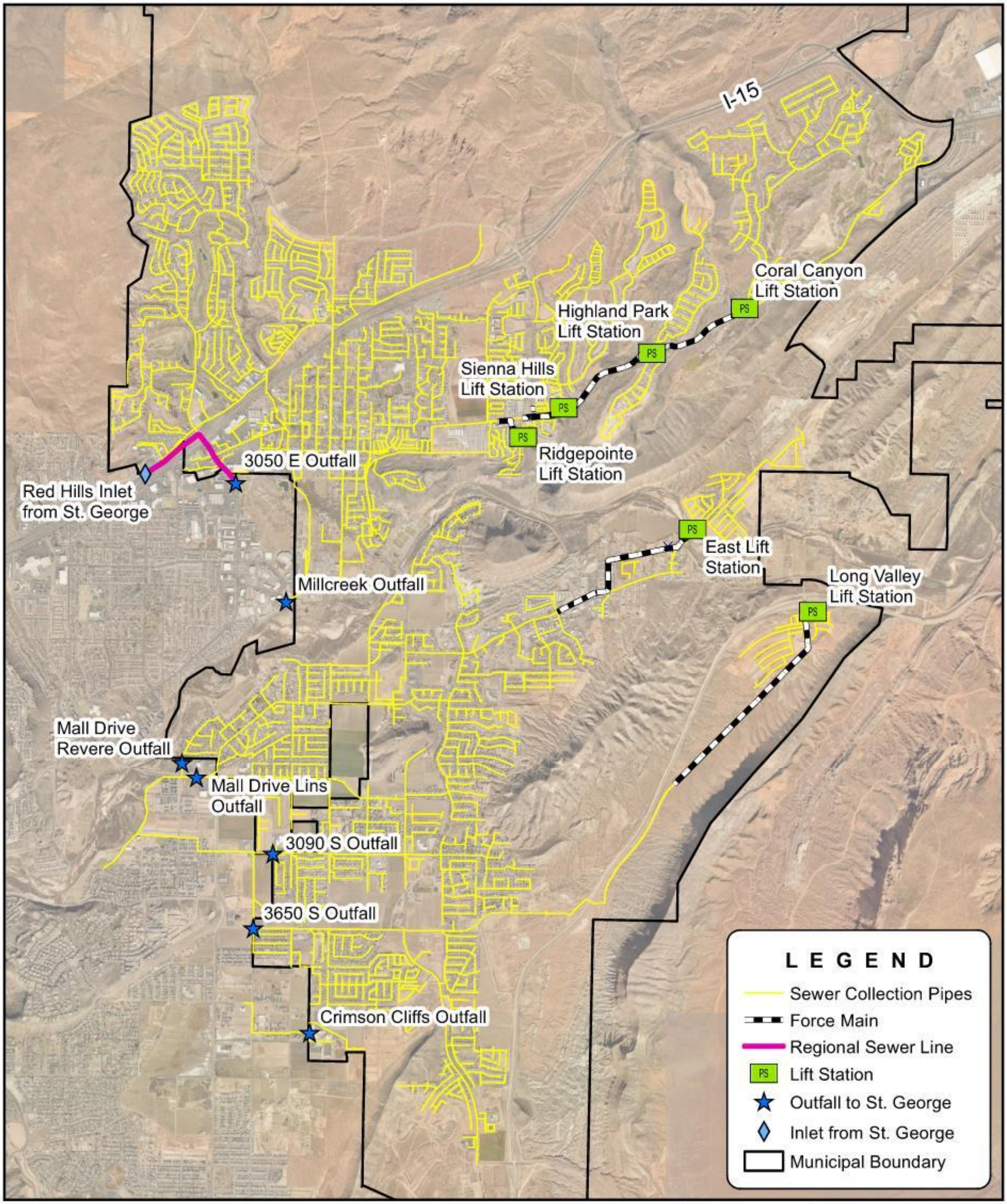
The city's annexation plan includes adding a significant amount of land in the Warner Valley area into the city boundary. Potential growth within the next 20 years from the Warner Valley area has been included in this master plan. However, it has been assumed that sewer collection and treatment for the Warner Valley area will be serviced by a decentralized, local treatment facility and that sewer flows from this area will not go into the existing Washington City sewer collection system and into the SGRWRF.

COLLECTION SYSTEM

Washington City's wastewater collection system is composed of gravity collection pipes, lift stations, and force mains. The attributes of the various components of the collection system are summarized in the following sections.

Sewer Collection Pipes

Figure 2-1 displays the city's existing sewer collection system. There are over 204 miles of sewer piping and over 4,700 manholes in the city's sewer system that are cataloged in a Geographic Information System (GIS) database. Table 2-1 contains a summary of the gravity sewer pipes that make up the majority of the city's sewer collection system. As can be seen in the table, about 87% percent of the pipe in the system is 8 inches in diameter or smaller. This represents the vast network of small collection lines in neighborhoods throughout the city's service area.



BOWEN COLLINS & ASSOCIATES

EXISTING SERVICE AREA

WASHINGTON CITY

SEWER MASTER PLAN

NORTH:

SCALE: 0 2,500 5,000 Feet

FIGURE NO. 2-1

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\Figure 2-1 - Existing System Map.mxd aanderson 7/25/2024

Table 2-1
Gravity Sewer Pipe Summary

Diameter (in)	Length (ft)	Length (miles)	Percentage
4	383	0.1	<1%
6	6,119	1.2	<1%
8	924,042	175.0	85.75%
10	45,178	8.6	4.19%
12	37,034	7.0	3.44%
14	1,516	0.3	<1%
15	36,193	6.9	3.36%
16	81	0.0	<1%
18	13,325	2.5	1.24%
21	5,848	1.1	<1%
24	7,875	1.5	<1%
Total	**1,077,595**	**204.1**	

*Service laterals are not included in the collection system lengths.

Along with gravity collection pipes, the city has several sections of pressurized sewer pipe, also referred to as a force main, in its system. A summary of force main lengths and diameters is shown in Table 2-2.

Table 2-2
Pressurized Sewer Pipe Summary

Diameter (in)	Length (ft)	Percentage
4	1,313	4.9%
8	6,682	25.0%
10	1,527	5.7%
12	17,191	64.4%
Total	**26,713**	

Table 2-3 provides a summary of the different types of pipe material found in the city's system. As indicated in the table, the majority of the system consists of PVC pipe, and as the city continues to rehabilitate and replace older existing lines, it is anticipated that the percentage of PVC will continue to increase (as this is the preferred material for the construction of most new sewer lines).

Table 2-3
Sewer Collection Pipe Material

Material	Percentage
PVC (Polyvinyl Chloride)	95.53%
RPM (Reinforced Plastic Mortar)	3.26%
AC (Asbestos Cement)	0.83%
RCP (Reinforced Concrete Pipe)	0.31%
CP (Concrete Pipe)	0.07%

Sewer Lift Stations

Due to the topographic characteristics of the service area, there are 6 lift stations in the sewer collection system. The lift stations range in capacity from 80 gallons per minute (gpm) to over 1,300 gpm. Available pump curve information for these lift stations is located in Appendix A for reference. A summary of the lift station characteristics is listed in Table 2-4.

Table 2-4
Washington City Sewer Lift Stations

Name	TDH (feet)	Capacity[1] (gpm)	Pump R.P.M.	Wet Well Volume (cf)	Power (HP)	No. Pumps[1]
Ridgepointe Lift Station	40	80	1,170	239	5	2
Highland Park Lift Station	23.5	870	950	1,775	30.12	2
East Lift Station	128	281	3,510	1,130	23	2
Long Valley Lift Station	202	1,000	1,603	1,440	107.22	3
Coral Canyon Lift Station	165	1,300	1,540	1,608	60.02	2
Sienna Hills Lift Station	73	1,300	1,220	1,824	62.73	2

[1] Includes both duty and backup pumps. Each pump station must include one back up pump. Thus, if two pumps are listed this includes 1 duty and 1 back up. Listed capacity is for duty pump(s) only.

WASHINGTON CITY WASTEWATER TREATMENT

Washington City does not treat its own wastewater. Wastewater collected in the system is treated by St. George City at the SGRWRF.

CHAPTER 3
FUTURE GROWTH AND FLOW PROJECTIONS

INTRODUCTION

A key aspect of the master planning process is identifying the current utilization of existing sewer collection facilities and developing projections for future system utilization. Growth projections have a direct impact on important components of this master plan and other city planning studies. The purpose of this chapter is to evaluate current wastewater flow trends, estimate future growth, and project future wastewater production within the city's service area.

EVALUATING EXISTING WASTEWATER PRODUCTION

The city provides sewer service to a variety of customers, including single-family residences, multifamily housing complexes, commercial businesses, institutional establishments, and industrial facilities. Each type of user has unique water demand and wastewater production characteristics. For example, a sewer connection servicing a 100 room hotel will likely produce different flow volumes than a restaurant, medical clinic, or professional office. A method often used to help simplify the planning process and facilitate system administration is the use of the Equivalent Residential Unit, or ERU. The ERU is a unit of measurement that represents the amount of wastewater produced by a typical single-family residence, which is the predominant housing type in Washington City. Upon defining the amount of wastewater produced by a typical single-family residential unit, all other system users (multifamily, commercial, institutional, industrial) can be converted into an "equivalent" number of single-family homes based on their respective estimated wastewater production. This ERU approach has been selected for the purposes of this master plan. Therefore, wastewater flow projections are presented in terms of ERUs.

ESTIMATING AVERAGE WASTEWATER FLOW PER ERU

Utah Administrative Code R317-3 titled, "Design Requirements for Wastewater Collection, Treatment and Disposal Systems" provides guidelines for estimating per capita wastewater production for the purpose of sizing sewer collection and treatment systems. The code states that, *"New sewer systems shall be designed on the basis of an annual average daily rate of flow of 100 gallons per capita per day unless there are data to indicate otherwise. The per capita rate of flow includes an allowance for infiltration/inflow*".

The design guidelines presented in UAC R317-3 are typically conservative when compared to actual sewer flows in a collection system. Since water use and sewer flow data is available from the city, sewer flow estimates specific to the Washington City system were developed and used for this master plan. Two sources of data were used to determine estimated flows per ERU within the city's service area: metered sewer flows at several locations in the system and municipal culinary water meter billing data.

System Effluent Flow Records

Wastewater flows are metered at the points of connection between the Washington City collection system and the St. George City collection system. This allows the city to track the total outflow from the wastewater system. Table 3-1 provides a summary of the average daily flows measured at different meter points in the system.

Table 3-1
System Inflow and Outflow Metered Sites

Metered Connections to St. George	Average Daily Flow (MGD)[2]
3050 E	0.475
Crimson Cliffs	0.007
Revere	0.025
3650 S.	0.293
Lins	0.83
Millcreek	2.359
3090 S	0.176
Red Hills Parkway[1]	-0.094
Total flow	**4.071**

[1] The Red Hills Parkway meter measures flow that comes from the Millcreek area of St. George into a "regional" (i.e. shared by 2 or more cities) section of sewer pipe located within Washington City. Because these flows do not originate in Washington City and are not attributable to users in Washington City, they have been subtracted from the total flows produced by the city. These flows from St. George City are included in the hydraulic computer model of the collection system.
[2]Data shown was collected between September – October 2023.

Total wastewater flows in a sewer collection system can consist of 3 different components: domestic wastewater, infiltration, and inflow. The following sections describe how each of these components are accounted for in the master plan.

Domestic Sewer Flow and Infiltration

Domestic wastewater is categorized as flow that *intentionally* enters the collection system from a home, business, or other sewer connection. Ideally, domestic wastewater should make up the majority of flow in the sewer collection system. Wastewater flow produced from individual homes or businesses is not metered, but it can be estimated by evaluating flow patterns from sewer collection system metering locations in conjunction with culinary water meter data from winter months. The city maintains a count of residential and non-residential sewer connections within the system, and as of the end of the year 2023, the city provided service to an estimated 13,858 residential connections and 527 commercial/institutional/industrial/government connections. To estimate the flow that an average residential and non-residential connection contributes to the sewer system, culinary water meter reads from Washington City were evaluated.

Washington City classifies water service connections by user type (i.e. residential, commercial, etc.). Since water meters measure both indoor and outdoor water use for a given unit, indoor water use that would contribute to sewer flow cannot be directly measured for any given month. However, indoor water use for a given home or business can be estimated by evaluating demand in the winter months when most or all water passing through the meter is used indoors (little to no irrigation occurring). For this master plan, indoor water use has been estimated to be equal to the water use in the month of January. Taking a sample[1] set of data from Washington City's 2021[2] meter records, Table 3-2 summarizes the estimated indoor water use per residential connection.

Table 3-2
Estimated Indoor Water Use per Residential Connection

Total Number of Residential Connections Sampled	Estimated Average Daily Indoor Water Use per Connection (gal/day)
6,683	198

The values shown in Table 3-2 represent the average metered indoor water use per 5/8" residential connection, but do not represent the amount of water that these connections discharge into the sewer system. While the majority of metered water use in the winter directly enters the sewer collection system after use (such as water used for toilets, showers, washing machines, dishwashers, etc., hereafter referred to as "non-consumptive" water use), a small portion does not. Water used for drinking or cooking, watering plants, or water that is lost through internal leaks within the unit's plumbing system on the customer's side of the meter will not enter the sewer. For a residential unit, it is estimated that 90 – 95% of metered winter water use will be discharged into the sewer collection system. For the purpose of this master plan it was assumed that 95% of overall indoor water use would ultimately enter the sewer collection system. Under this assumption, Table 3-3 summarizes the estimated total domestic wastewater flow for residential and non-residential connections under an average daily demand scenario.

[1] The sample set used to estimate average daily indoor water use per connection was developed using all 5/8" meters under the classification "residential" from Washington City's 2021 meter data. The sample set excluded any meters that had a "0" value for water use in the month of January. These zero read meters were excluded to provide a more accurate estimate of average daily indoor water usage per connection for occupied units.

[2] It was decided through coordination with city staff to use the highest demand year from the last three years of meter records that were compared. This was done to provide a conservative number while also accurately representing the needed level of service for each ERU.

Table 3-3
Estimated Domestic Wastewater Flow, Existing Conditions

User	Total Sewer Connections[1]	Average Metered Indoor Water Use Per Connection (gal)	Estimated % of Non-Consumptive Indoor Water Use	Estimated Daily Wastewater Production per Connection (gal)	ERU per Connection	Total ERUs	Total Estimated, Average Daily[2] Domestic Sewer Flow (gal)
⅝" Residential Meters	13,751[1]	198	95%	188	1.00	13,751	2,585,188
Residential Meters Larger Than ⅝	143	1,118	95%	1,062	5.65	808	151,827
Non-Residential	527	1,075	95%	1,021	5.43	2,862	538,133
Total	**14,421**	**NA**	**NA**	**NA**	**NA**	**17,421**	**3,275,148**

[1]According to billing data provided by the city for 2023 billing period. As this is a list of all connections without eliminating meters with low winter flows, the quantity of connections will be higher than those listed in Tables 3-2.
[2]The variation in daily indoor water use throughout the year is unknown. While some seasonal variation in indoor demand per ERU may occur, average daily sewer flows are assumed to be driven more by occupancy rate rather than significant changes in indoor water use trends at different times of year.

As shown in Table 3-3, existing average daily domestic wastewater flow is estimated to be approximately 3,275,148 gallons per day, while the total measured flow through the combined meters leaving the system was 4,070,379 gallons (see Table 3-1). The difference between total estimated domestic flow and total measured flow leaving the Washington City system is assumed to be attributed to system infiltration. Infiltration is defined as water that enters into the sewer system which is not directly or indirectly related to either domestic wastewater or to a specific storm event. This flow can enter the collection system as a result of poorly sealed pipe joints, cracks in pipes, pipes poorly connected at manholes, leaky manhole joints, leaky service lateral connections, root damage, etc. Infiltration is generally a function of the groundwater level, which typically fluctuates depending on the climate and season. While infiltration rates will change seasonally, they generally remain constant during a single 24-hour period. Temporary increases in the amount of water that enters the system after a storm because of an increase in ground water is considered inflow (as discussed in a subsequent section).

Factors that can affect infiltration include pipe age, material, and the number and condition of lateral connections. Age can contribute to infiltration in two ways. First, older pipes are more likely to be in poor condition. Cracks, separated joints, and other defects can contribute significantly to increased infiltration. Second, older pipes do not have the benefit of improvements in construction techniques that have occurred over time. Gasketed pipe joints, rubber boots at manholes and laterals, and other improvements have contributed greatly to reducing system infiltration.

Due to the many factors that influence infiltration rates, it can be a difficult aspect of sewer flow to accurately quantify. It is also difficult to identify specific locations in the collection system that are most susceptible to infiltration. However, using total estimated domestic flow along with measured total outflows from the system, it is possible to estimate the overall infiltration throughout the system, as shown below.

$$4{,}070{,}379\ gpd\ (total\ flow) - 3{,}275{,}148\ gpd\ (estimated\ domestic\ flow)$$
$$= \mathbf{795{,}231 gpd}\ (\boldsymbol{estimated\ infiltration})$$

Based on this assumption, infiltration is estimated to make up approximately 20% of the total flow in the sewer collection system. Dividing total system infiltration by the total number of ERUs serviced equates to an infiltration flow of **46 gpd per ERU**.

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 the sewer system which is directly or indirectly related to a storm event. It can come directly from storm water runoff through improper connections to the storm water drainage system, missing or leaky manhole covers, roof drains connected to the system, etc. Storm events can also cause the ground water level 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 rising levels of ground water as a result of rainfall is considered inflow.

Without a significant amount of rainfall and sewer flow monitoring data, it is difficult to accurately identify the quantity and potential locations of inflow in the city's collection system. For this reason, inflow has not been directly included in the wastewater projections. Instead, a conservative amount of capacity will be reserved in the system to accommodate inflow events. This is discussed in further detail in Chapter 4.

LEVEL OF SERVICE PER ERU FOR EXISTING CONNECTIONS

Having evaluated the different components of wastewater flow, Table 3-4 provides the recommended level of service per ERU for this master plan.

Table 3-4
Recommended Level of Service per ERU for Existing Users

Flow Component	Flow (gpd)
Domestic Flow	188
Infiltration	46
Total Level of Service	**234**

PROPOSED LEVEL OF SERVICE PER ERU FOR NEW USERS

The previous sections have described the estimated sewer collection system demand per ERU based on historical data. Understanding that new construction methods will likely result in new sewer collection system components being less prone to infiltration, it has been assumed that the sewer flow per ERU for future users will be less than the average flow of existing users. Based on BC&A's previous planning experience, it is recommended that the city assume that 15% of sewer flows from new development are attributable to infiltration. Using this assumption, Table 3-5 shows the proposed level of service per ERU for new development in Washington City assuming that infiltration constitutes 15% of total flows per ERU rather than the historical estimate of 20%.

Table 3-5
Recommended Level of Service per ERU for Future Users

Flow Component	Flow (gpd)
Domestic Flow	188
Infiltration[1]	33
Total Level of Service	**221**

[1]Assumed to constitute 15% of total sewer flow.

ESTIMATED DISTRIBUTION OF EXISTING ERUS

As shown in Table 3-3, as of the end of 2023, the city provided sewer service to an estimated 17,421 ERUs. For planning purposes, it is important to not only understand how many ERUs are being serviced by the system, but also to understand how sewer connections are distributed throughout the system. To accomplish this, water meter data in a GIS format was used to allocate demand to the different areas of the system. This process is described in greater detail in Chapter 4.

GROWTH PROJECTIONS

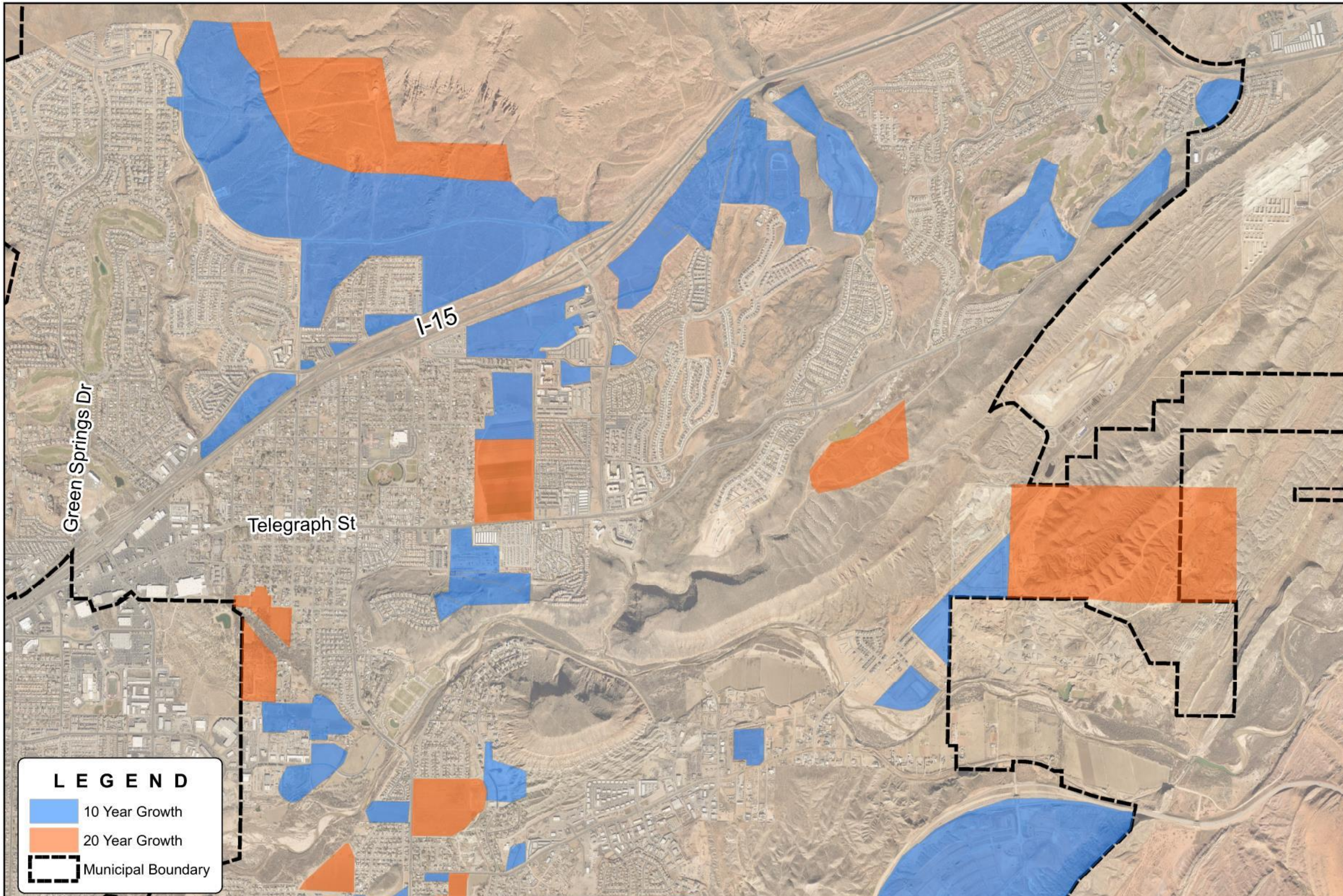
Future growth projections for the Washington City sewer system have been estimated using the recently developed growth projections used in the 2024 Washington City Culinary Water Master Plan completed by Sunrise Engineering. Through coordination with city staff it was decided to utilize these growth projections to ensure consistency between the different utility master plans. Table 3-6 provides the projected growth in ERUs over the 20-year planning window.

Table 3-6
Growth Projections for Washington City

Year	Estimated Growth Rate	Population	ERU	Domestic Sewer Flow (gpd)	Infiltration (gpd)	Total Flow (gpd)
2023		43,395	17,421	3,275,148	801,366	4,076,514
2024	6.9%	46,389	18,623	3,501,133	841,034	4,342,167
2025	6.9%	49,590	19,908	3,742,711	883,438	4,626,150
2026	5.5%	52,318	21,003	3,948,561	919,571	4,868,132
2027	5.5%	55,195	22,158	4,165,731	957,692	5,123,423
2028	5.5%	58,231	23,377	4,394,847	997,909	5,392,755
2029	4.0%	60,560	24,312	4,570,640	1,028,766	5,599,407
2030	4.0%	62,982	25,284	4,753,466	1,060,858	5,814,324
2031	4.0%	65,502	26,296	4,943,605	1,094,233	6,037,838
2032	4.0%	68,122	27,348	5,141,349	1,128,944	6,270,293
2033	3.5%	70,506	28,305	5,321,296	1,160,530	6,481,826
2034	3.5%	72,974	29,295	5,507,541	1,193,222	6,700,764
2035	3.5%	75,528	30,321	5,700,305	1,227,059	6,927,364
2036	3.5%	78,171	31,382	5,899,816	1,262,079	7,161,895
2037	3.5%	80,907	32,480	6,106,310	1,298,325	7,404,635
2038	3.5%	83,739	33,617	6,320,031	1,335,840	7,655,871
2039	3.5%	86,670	34,794	6,541,232	1,374,668	7,915,899
2040	3.5%	89,703	36,012	6,770,175	1,414,855	8,185,029
2041	3.5%	92,843	37,272	7,007,131	1,456,448	8,463,579
2042	3.5%	96,092	38,576	7,252,380	1,499,497	8,751,878
2043	3.5%	99,456	39,927	7,506,214	1,544,053	9,050,267

ESTIMATED DISTRIBUTION OF FUTURE GROWTH

While it is impossible to predict when and where new development will occur within the system, city staff have a good general idea of where new projects are occurring and how new development will unfold in the future. Through coordination with city staff, Figures 3-1 through 3-3 display the estimated distribution of new growth within the 10-year planning window and the 20-year planning window. This exercise helps to prioritize which sewer collection system projects will need to be built to accommodate the needs of future growth. If the city observes significant deviations from these assumptions with respect to the locations of new development, updates should be made in subsequent master planning efforts.



SCALE:
1 in. = 2,000 ft.

NORTH:
NORTH

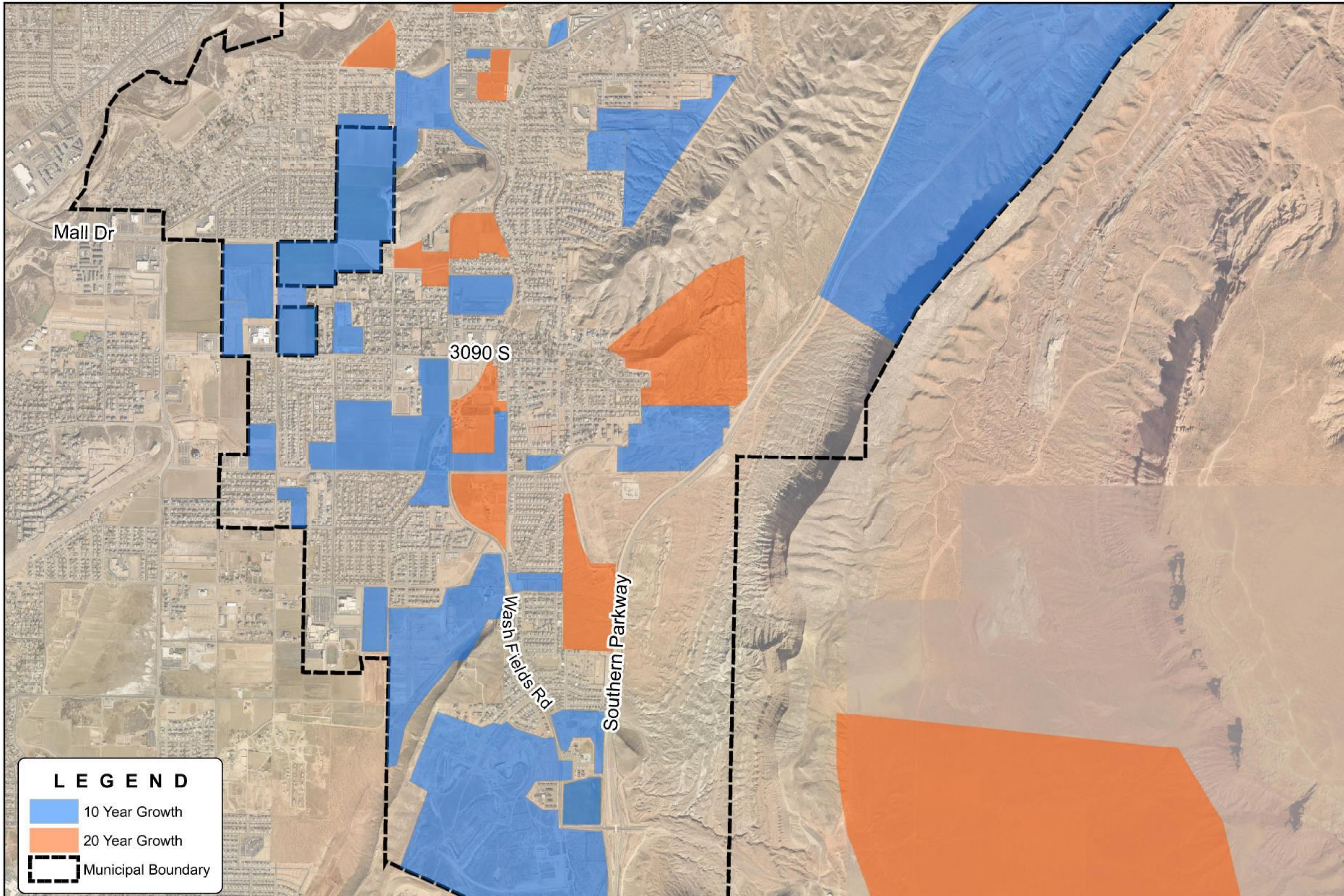
FORECASTED GROWTH
AREAS - NORTH REGION

WASHINGTON CITY
SEWER MASTER
PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
3-1

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\Figure 3-1 - Growth Hotspots Segment A.mxd aanderson 6/17/2024



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NORTH: NORTH

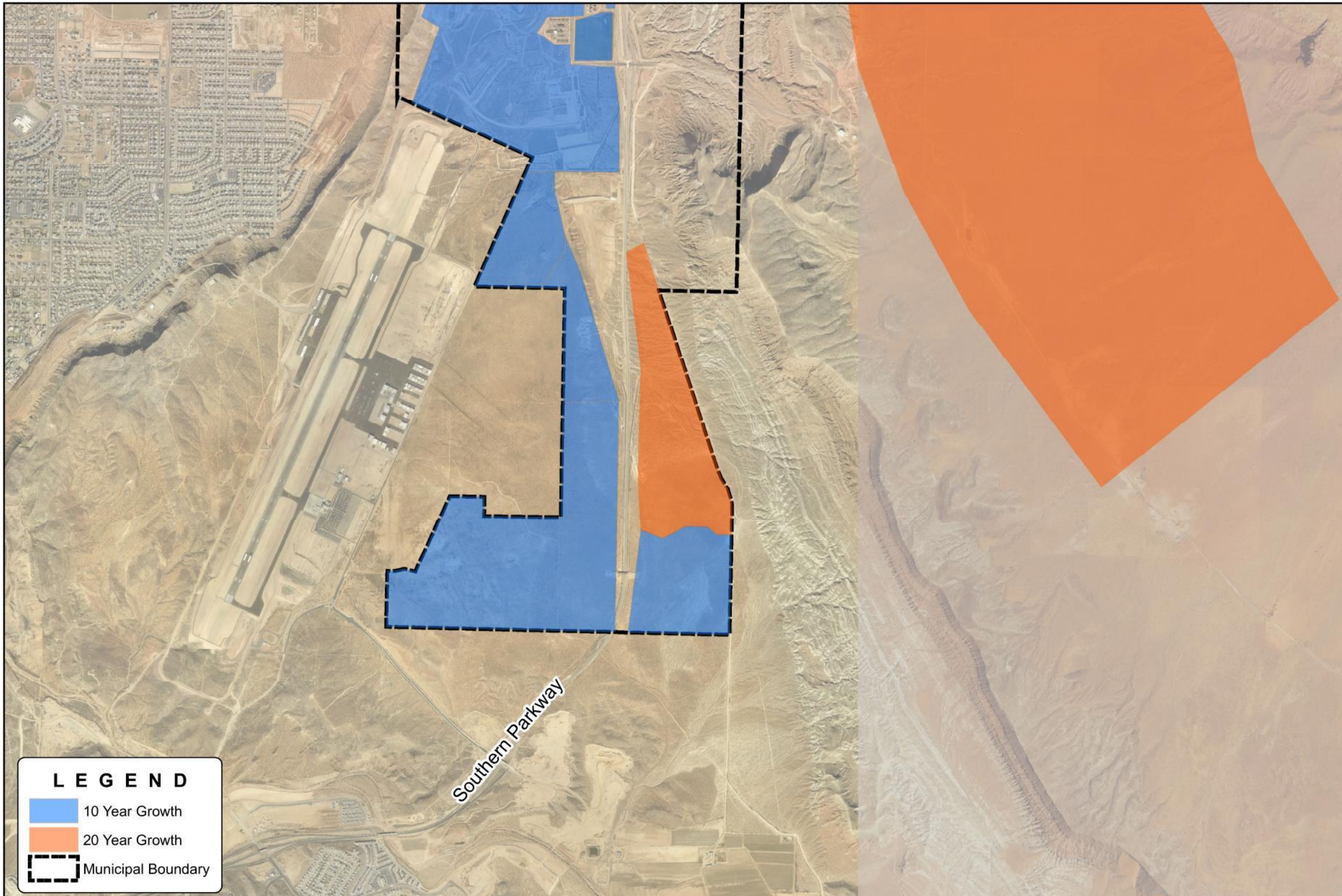
FORECASTED GROWTH AREAS - CENTRAL REGION

WASHINGTON CITY
SEWER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 3-2

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\Figure 3-2 - Growth Hotspots Segment B.mxd aanderson 6/17/2024



SCALE:
1 in. = 2,000 ft.

NORTH:
NORTH

FORECASTED GROWTH
AREAS - SOUTH REGION

WASHINGTON CITY
SEWER MASTER
PLAN

BOWEN COLLINS
& ASSOCIATES

FIGURE NO.
3-3

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\Figure 3-3 - Growth Hotspots Segment C.mxd aanderson 6/17/2024

ESTIMATED LAND USE FOR 20-YEAR PLANNING WINDOW

Based on the forecasted quantity and location of future growth within the city, Table 3-7 summarizes the zoning/land use categories of the areas anticipated to be developed over the next 20 years.

Table 3-7
Washington City Undeveloped Land 20-Year ERU Estimates

Zoning Classification	Undeveloped Acres	Zoning Description	Estimated 20 Year ERUs
BUS	41	Business	284
CCOM	577	Community Commercial	4,042
CV	12	Civic	24
EST	9	Estate	11
HCOM	0	Historic Downtown	0
HD	18	High Density	285
IND	256	Industrial	513
LD	1,592	Low Density	6,368
MD	136	Medium Density	845
MHD	169	Medium High Density	2,030
NCOM	133	Neighborhood Commercial	266
NYD	112	Not Yet Determined	224
OS	170	Open Space	0
P	123	Park	0
POND	0	Pond	0
PUD	52	Planned Unit Development	314
PUD-C	273	PUD-Commercial	545
PUD-R/C	12	PUD-Residential/Commercial	59
RCOM	124	Regional Commercial	248
VLD	126	Very Low Density	315
Subtotal Area	**3,935**	**Subtotal ERUs**	**16,373**
PCDs[1]		**Planned Community Developments**	
Sienna Hills	233	1,571 Total ERUs	1,571
Solente	514	2,231 Total ERUs	1,516[2]
Subtotal Area	747	**4,802 Total ERUs**	**3,087**
Other Areas			
Warner Valley Development	1167	3,046 Total ERUs[3]	3,046
Subtotal Area	**1,914**	**Subtotal ERUs**	**3,046**
Total	**5849**		**22,506**

[1]Information regarding Planned Community Developments was obtained from Washington City staff. Note that the Stucki Farms and Coral Canyon PCD's have also been included in this master plan based on the approved land use densities for each development.
[2]While the entirety of the Solente Master Planned area will have a higher ERU count then what is provided in this table it is assumed that it will be not be completed in its entirety within the 20-year planning window.
[3]Estimated number of ERUs to be developed within the 20-year planning window within the Warner Valley area.

CHAPTER 4
COLLECTION SYSTEM HYDRAULIC MODELING

INTRODUCTION

The Washington City sewer collection system has been evaluated with the aid of a hydraulic computer model and the flow projections developed in Chapter 3. An extended period simulation (EPS) hydraulic model was developed using Innovyze's InfoSWMM software which simulates the operation of the collection system over a specified period of time. In this case, a 24-hour simulation was used. This chapter presents a summary of the methodology used to develop the hydraulic model.

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 in the system. Geometric data for the hydraulic model was extracted from the city's existing sewer model file, GIS records, and other survey data provided by the city. The following sections describe how geometric data was assembled for use in the hydraulic model.

Pipeline and Manhole Locations

Washington City maintains a GIS inventory of its existing sewer facilities. This database includes information on the location and size of manholes, sewer pipes, and lift stations in the collection system. The city provided BC&A with a copy of the existing sewer model in EPA Storm Water Management Model (SWMM) format. The geometric data in the model was updated based on survey data provided by the city.

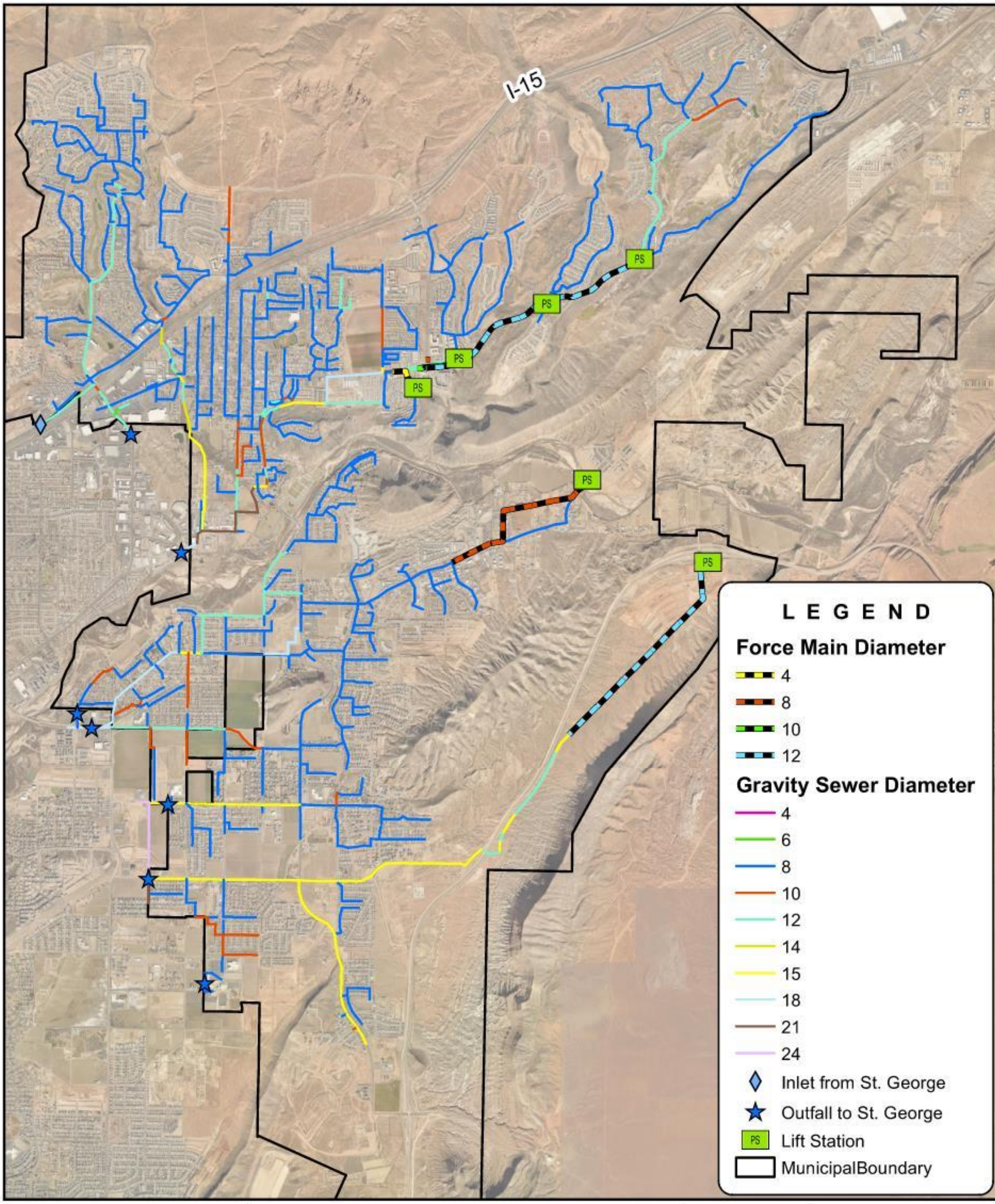
Modeled Pipelines

It is not necessary to include each and every pipeline in the city's collection system within the hydraulic model to provide accurate and useful results. For planning purposes, it is common to focus modeling efforts on the infrastructure that forms the "backbone" of the system. Based on typical residential densities in the city service area, most 8-inch collector pipes will have more than enough capacity to reliably convey typical sewer flows. As a result, modeling these pipes does not substantially improve the accuracy or quality of the results.

Pipes to be included in the hydraulic model were discussed and coordinated with city personnel. To optimize the analysis, it was decided to model all pipes 10-inch diameter and greater, as well as some 8-inch diameter pipes in key areas of the system. Figure 4-1 displays the set of pipes and lift stations which were included in the existing system hydraulic model. The set of pipes modeled represents the main collector and interceptor trunk lines for the city.

Pipe Flow Coefficients

Pipelines throughout the hydraulic model were assigned a Manning's coefficient of 0.013. This is approximately equal to the flow coefficient of concrete and clay pipe. While the majority of the city's system is comprised of PVC which has a lower published Manning's coefficient, a conservative value of 0.013 was chosen for modeling purposes. In reality, most collection pipes will develop thin layers



BOWEN COLLINS & ASSOCIATES

MODELED PIPES

WASHINGTON CITY

SEWER MASTER PLAN

NORTH:

SCALE: 0 2,500 5,000 Feet

FIGURE NO. 4-1

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\Figure 4-1 - Modeled Pipelines.mxd aanderson 7/25/2024 of bacteria and solids (a slime layer) that results 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 not possible to identify the exact location and quantity of grease or debris accumulation for 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 was not conducted in this study. All model pipes have been assumed to be “clean” and free of major debris and sediment. Washington City has a maintenance routine to regularly check and clean the sewer mains in the system.

Lift Stations

Washington City has 6 sewer lift stations in its collection system. The city provided pump performance data for each lift station which was input into the model to simulate actual pump performance over the course of a 24-hour period. Lift station information has been summarized in Chapter 2, and performance curves for the city’s lift stations are included in Appendix A of this report.

FLOW DATA

Once all required geometric data was collected and a physical model of the system was updated, flow data was input to the model to evaluate system hydraulics. Three types of flow information were required for hydraulic modeling: total magnitude of flow, timing of flow, and distribution of flow throughout the system. Each of these flow characteristics is discussed in the following sections.

TOTAL FLOW

Flow projections for the city service area are presented in detail in Chapter 3. Total flow for modeling scenarios is summarized in Table 4-1.

Table 4-1
Average Daily Flow Rates for Hydraulic Model

Scenario	2023	2033	2043
Average Day Flow (MGD, domestic flow plus infiltration)	4.08	6.48	9.05

TIMING OF FLOW

The volumes shown in Table 4-1 represent the total flow collected and conveyed through the system over a 24-hour period. Sewer collection system flows vary throughout the course of the day, and it is important to have a general understanding of these variations so that pipes can adequately convey peak system flows. The different components of total wastewater flow have unique diurnal characteristics. The following sections describe how the timing of flow has been estimated for each component of total wastewater flow.

Domestic Wastewater Flow Timing

Diurnal wastewater flow patterns tend to vary based on the nature of water use. For example, residential connections will typically produce peak flows between 8:00 am – 11:00 am as people shower and prepare for the day, with another peak occurring in the evening as people prepare to go to bed. Commercial, institutional, or industrial connections may produce peak flows at different times of the day. For instance, a restaurant may produce most wastewater during lunch or dinner, while an industrial manufacturing facility may discharge process water at a constant rate throughout the day. Unfortunately, the city does not have data available to develop specific commercial water usage patterns. For this reason, and because the majority of the city's customers are residential users, a single composite diurnal flow pattern was assigned to all domestic flows in the system.

The diurnal flow pattern for this model was developed using metered flow data collected from several manholes throughout the city. While some variation was present in the diurnal flow pattern of these manholes, a high and low peaking factor of 1.92 and 0.45, respectively, was in line with most of the data that had been collected. The remaining hourly multipliers were set to closely follow the average of the measured curves while resulting in an overall average multiplier of 1.0. The resulting modeled flows were then compared to the measured meter data and found to be reasonably in line with the measured flow data. Figure 4-2 displays the diurnal flow pattern used for the model, and Table 4-2 shows the hourly multipliers used for each time step in the model.

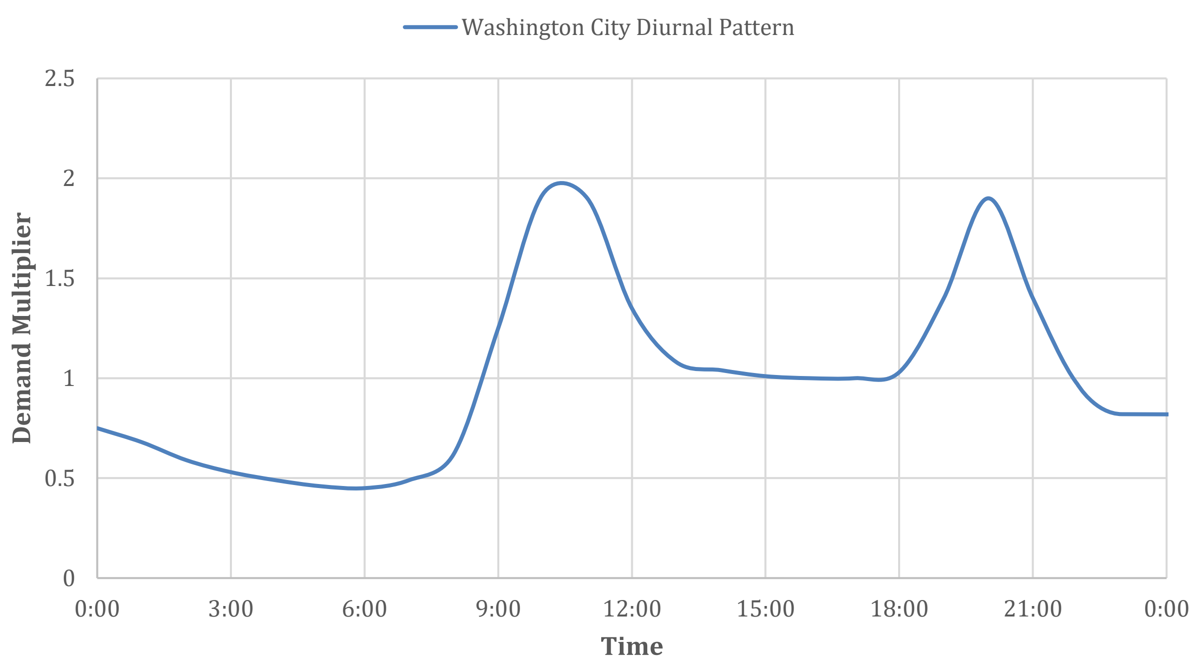


Figure 4-2. Average Diurnal Flow Pattern for Washington City Sewer Collection System

Table 4-2
Diurnal Peaking Factors Comparison

Hour	Peaking Factor	Hour	Peaking Factor
12:00 AM	0.75	1:00 PM	1.08
1:00 AM	0.68	2:00 PM	1.04
2:00 AM	0.59	3:00 PM	1.01
3:00 AM	0.53	4:00 PM	1.00
4:00 AM	0.49	5:00 PM	1.00
5:00 AM	0.46	6:00 PM	1.03
6:00 AM	0.45	7:00 PM	1.40
7:00 AM	0.49	8:00 PM	1.90
8:00 AM	0.62	9:00 PM	1.40
9:00 AM	1.25	10:00 PM	0.97
10:00 AM	**1.92**	11:00 PM	0.82
11:00 AM	1.90	12:00 AM	0.75
12:00 PM	1.35	Average	1.00

Infiltration

As discussed in Chapter 3, infiltration may vary on a seasonal basis but does not generally vary on a daily basis. Therefore, it has been assumed that infiltration remains constant throughout the day in the collection system model. As new pipes and manholes area added to the system in the future, so are potential locations for system infiltration. For this reason, infiltration is increased in future model scenarios proportional to the number of projected ERUs being serviced. As discussed in Chapter 3, a lower amount of infiltration per ERU has been allocated to new system growth to account for modern advances in sewer system construction that will likely reduce the amount of groundwater that will enter the sewer system in newly developed areas.

Inflow

For this study, inflow has not been modeled directly because of the wide variability in storm events and inflow response possible in the system. For planning purposes, a capacity allowance has been included in the evaluation criteria to account for inflow into the collection system. This reserved capacity is equal to 25% of full pipe capacity. Hence, dry weather flows (domestic and infiltration without inflow) should not occupy more than 75% of the total pipe capacity at any point during the day.

DISTRIBUTION OF FLOW

With flow magnitude and timing estimated, the final step in developing the model is distributing flow spatially across the city. Flow distribution for the existing system was achieved using the following methodology:

- **Domestic Wastewater –** As part of the master plan, BC&A gathered and organized culinary water meter records from the city. Using GIS tools, this data was used to estimate the distribution of the total sewer system flow to the various junctions in the model.

- **Infiltration –** Since it is difficult to know which areas in the system are most susceptible to infiltration, infiltration was distributed evenly throughout the model. Additional flow monitoring to identifying areas in the system that are more susceptible to infiltration may help improve the accuracy of modeling efforts for future master plan updates.

Distribution of Future Flows

Flow distribution for future model scenarios was accomplished using zoning/land use maps and master planned development reports in conjunction with discussions with city personnel. For planning purposes, two future scenarios are of particular interest: a short term 10-year growth scenario and a longer term 20-year growth. Modeling projected system growth within the next 10 years is necessary to develop a 10-year Capital Facilities Plan, Impact Fee Facilities Plan, and Impact Fee Analysis. The 20-year growth scenario helps provide a bigger picture of major projects to be carried out further into the future.

10-Year Growth. Chapter 3 identified the projected growth of sewer connections within the city through a 20-year timeline. Based on these projections, it is estimated that the city will service an additional 10,884 new ERUs by the end of 2033. BC&A coordinated with city personnel to identify the most probable areas of new growth, or "hot spots", within the service area. These are presented in Chapter 3. These areas were used to allocate projected demand in the 10-year growth window.

20 Year Growth. The city service area is likely to expand within the 20-year timeframe to include a portion of the Warner Valley area, which has been accounted for in this study. As mentioned previously, this area will be serviced by its own localized collection and treatment system and will not utilize the Washington City sewer collection system. Like the 10-year growth scenario, future sewer flows were allocated to the model based on the assumed "hotspots" of future development. As needed, new pipelines were extended into these new areas to provide the city with a general concept of future pipeline improvements that will be needed as the city continues to grow in the next 20 years.

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. The metered sewer flow data provided by the city was compared against the model results and was found to match reasonably well at most locations in the system.

SIMULATED PEAK FLOWS AT MODEL OUTFALLS

Based on the methods described to determine total flow, timing of flow, and distribution of flow in the model, peak flows as simulated in the model are summarized in Table 4-3. The values shown in Table 4-3 represent the peak flows at model outfalls, which account for flow attenuation within the system.

Table 4-3
Hydraulic Modeling Scenario Peak Hour Flows

Scenario	2023	2033	2043
Dry Weather Flow (MGD)	7.64	14.38	17.82

CHAPTER 5
COLLECTION SYSTEM EVALUATION

With the update and calibration of the hydraulic sewer model, the Washington City sewer collection system has been evaluated under existing and projected future growth conditions. The purpose of this chapter is to evaluate the capacity of the existing sewer collection system and to identify existing and future system deficiencies. Recommended improvements to address identified system deficiencies are discussed in Chapter 6.

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. 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. 2019 was a wet year that led to high infiltration/inflow and flooding in many areas). The criteria established for identifying deficiencies should be sufficiently conservative to account for occasional flows higher than those estimated in the model. The following criteria have been established to identify capacity deficiencies in the collection system:

- **Pipeline Capacity –** The most important deficiency to identify in the sewer collection system is inadequate hydraulic capacity. For this master plan, it was decided to define a capacity deficiency as any point where the dry weather peak flow in a given pipe is greater than 75 percent of the pipe's full flow capacity, which occurs when flow exceeds a depth of approximately 70 percent of the pipe's diameter. The remaining 25 percent of pipe hydraulic capacity is reserved for inflow, unaccounted for fluctuations in domestic flow and infiltration, and/or temporary reductions in capacity associated with sediment or debris. Therefore, sections of pipe with a peak flow depth that exceeds 70 percent of the diameter are deemed deficient. In some cases, model results will show small, intermittent sections of pipe that exceed the maximum allowable depth (70 percent of pipe diameter). In these cases, the model results were further examined to confirm whether these sections truly warrant action, such as a pipe upsize or parallel pipeline.
- **Lift Station Capacity –** A lift station capacity deficiency is defined as anytime peak dry weather flows exceed 85 percent of the lift station's primary pumping capacity. This provides the lift station with a 15 percent capacity buffer for large inflow events or other unanticipated flows. Note that all lift stations are required to have at least one backup pump in case of mechanical failure or significant inflow from wet weather events.
- **Force Main Velocity –** Excessively high velocity in a force main can have detrimental effects on piping and can increase stress on lift station pumps as a result of increased dynamic head loss. Ideally, force main velocities should range between 3 and 7 feet per second (fps). If a force main regularly operates above this range, it is recommended that its capacity be increased.

COLLECTION SYSTEM ANALYSIS

Existing Collection System Conditions

Figure 5-1 displays the hydraulic capacity analysis of the sewer system under existing peak flow conditions. Pipes in the figure are color coded to show the ratio of peak flow depth in the pipe to the pipe's diameter. As shown in the figure, the model results indicate that a couple of pipe segments in the Washington Fields area have existing capacity deficiencies.

Existing Lift Station Conditions

Table 5-1 provides a summary of the results of the hydraulic model analysis of the city's lift stations under existing flow conditions. As shown in the table, all lift stations appear to currently be operating below the recommended limits (i.e. no lift station is operating at greater than 85% of its pumping capacity).

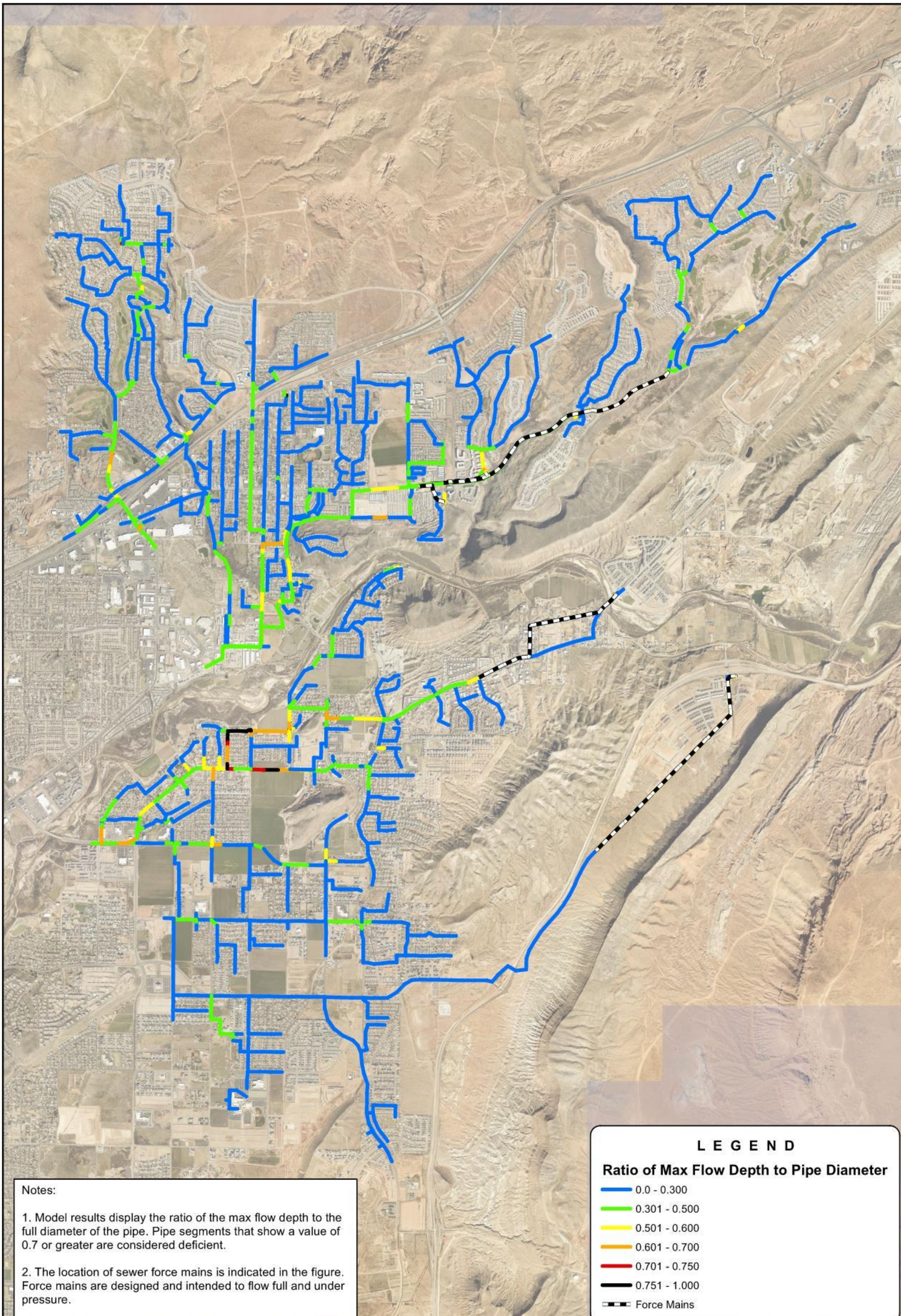
Table 5-1
Operation of Existing Lift Stations – Existing Conditions

Lift Station	TDH (feet)	Capacity (gpm)	Pump R.P.M.	Wet Well Volume (cf)	Power (HP)	No. Pumps	Current Peak Flow into Lift Station (gpm)	% Capacity Used[1]
Ridgepointe	40	80	1,170	239	5	2	30.5	38%
Highland Park	23.5	870	950	1,775	30.12	2	106.8	12%
East Lift Station	128	281	3,510	1,130	23	2	129.3	46%
Long Valley Lift Station	202	1000	1,603	1,440	107.22	3	6.7	1%
Coral Canyon	165	1,300	1,540	1,608	60.02	2	364.5	28%
Sienna Hills	73	1,300	1,220	1,824	62.73	2	320.9	25%

[1]Lift station pumps operating above 85% of design capacity are considered deficient.

Existing Force Main Operating Conditions

Based on the design pumping capacities of each lift station, Table 5-2 contains a summary of the estimated flow velocity through each respective force main. As shown in the table, all flow velocities are less than 7 feet per second. Ideally, all flow velocities would be greater than 3 feet per second to better move solids through the pipe. However, having an operational velocity less than 3 feet per second does not necessarily mean the pipe is deficient. If the city finds that a particular force main is prone to frequent clogging or other related issue, options for remediation should be considered.



Notes:

1. Model results display the ratio of the max flow depth to the full diameter of the pipe. Pipe segments that show a value of 0.7 or greater are considered deficient.

2. The location of sewer force mains is indicated in the figure. Force mains are designed and intended to flow full and under pressure.

BOWEN COLLINS & ASSOCIATES	WASHINGTON CITY SEWER MASTER PLAN	EXISTING SEWER SYSTEM EVALUATION	NORTH: NORTH	SCALE: 0 1,500 3,000 Feet	FIGURE NO. 5-1

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\Figure 5-1 - Existing Conditions Model Results.mxd aanderson 8/6/2024

Table 5-2
Operation of Existing Force Mains – Existing Conditions

Lift Station	Capacity (gpm)	Force Main Diameter (in.)	Pipe Area (ft^2)	Design Velocity (fps)
Ridgepointe	80	4	0.087	2.04
Highland Park	870	12	0.785	2.47
East Lift Station	281	8	0.349	1.79
Long Valley Lift Station	1,000	12	0.785	2.84
Coral Canyon	1,300	12	0.785	3.69
Sienna Hills	1,300	12	0.785	3.69

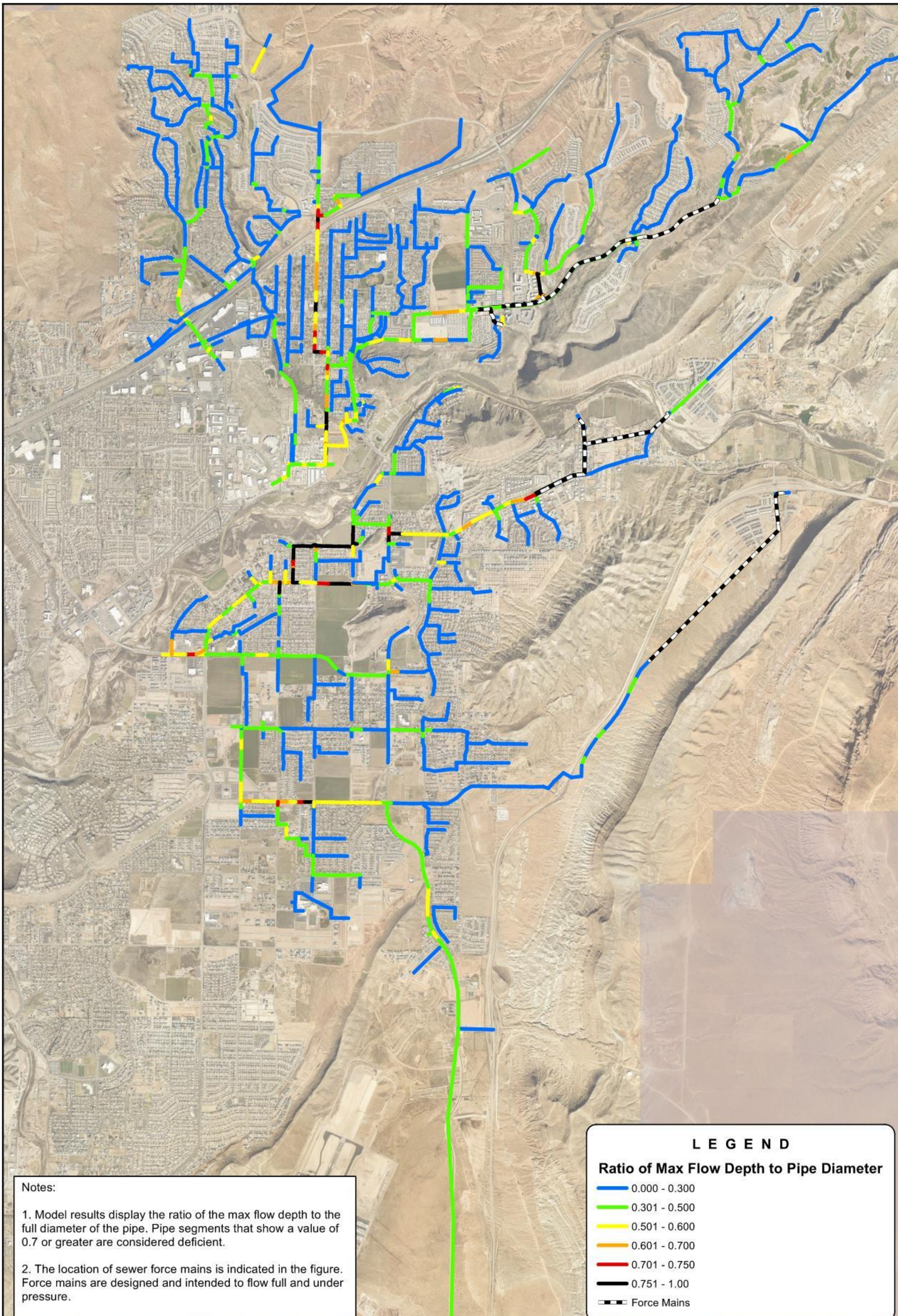
10-YEAR GROWTH CONDITIONS

10-Year Growth Collection System Conditions

Chapters 3 and 4 identify the projected Washington City service area growth over the next 10 years as well as the anticipated locations in which this growth will likely be concentrated. Figure 5-2 displays the results of the hydraulic model for the 10-year growth scenario. The results show system performance when adding future sewer flows to the existing collection system (without upsizing or adding any new parallel pipes). New pipes have been added to the model as needed to extend sewer service into new areas of the system. As shown in the figure, the majority of the system is anticipated to have enough capacity to reliably convey estimated flows through the year 2033. However, there are several smaller lines that will be deficient in capacity as well as several large stretches of pipe that will need increased capacity.

10-Year Growth Lift Station and Force Main Conditions

Table 5-3 summarizes the lift station results from the 10-year growth hydraulic sewer model and Table 5-4 summarizes the force main velocity results from the 10-year growth hydraulic sewer model. As shown in the tables, it is estimated that the city's lift station pumps and force mains will have adequate capacity through the next 10 years.



Notes:

1. Model results display the ratio of the max flow depth to the full diameter of the pipe. Pipe segments that show a value of 0.7 or greater are considered deficient.

2. The location of sewer force mains is indicated in the figure. Force mains are designed and intended to flow full and under pressure.

BOWEN COLLINS & ASSOCIATES	WASHINGTON CITY SEWER MASTER PLAN	10-YEAR GROWTH SEWER SYSTEM EVALUATION	NORTH:	SCALE: 0 1,500 3,000 Feet	FIGURE NO. 5-2

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\Figure 5-2 - 10-Year Model Results.mxd aanderson 8/6/2024

Table 5-3
Operation of Existing Lift Stations – 10-Year Growth Conditions

Lift Station	TDH (feet)	Capacity (gpm)	Pump R.P.M.	Wet Well Volume (cf)	Power (HP)	No. Pumps	Peak Flow into Lift Station at 2033(gpm)	% Capacity Used*
Ridgepointe	40	80	1,170	239	5	2	30.1	38%
Highland Park	23.5	870	950	1,775	30.12	2	151.3	17%
East Lift Station	128	281	3,510	NA	23	2	226.2	81%
Long Valley Lift Station	202	1,000	1,603	1,440	107.22	3	338.0	34%
Coral Canyon	165	1,300	1,540	1,608	60.02	2	436.7	34%
Sienna Hills	73	1,300	1,220	1,824	62.73	2	606.4	47%

Table 5-4
Operation of Existing Force Mains – 10-Year Conditions

Lift Station	Design Pumping Capacity (gpm)	Peak Flow into Lift Station at 2033(gpm)	Force Main Diameter (in.)	Pipe Area (ft^2)	Design Velocity (fps)
Ridgepointe	80	30.1	4	0.087	2.04
Highland Park	870	151.3	12	0.785	2.47
East Lift Station	281	226.2	8	0.349	1.79
Long Valley Lift Station	1,000	338.0	12	0.785	2.84
Coral Canyon	1,300	436.7	12	0.785	3.69
Sienna Hills	1,300	606.4	12	0.785	3.69

20-YEAR SYSTEM ANALYSIS

20-Year Collection System Conditions

Figure 5-3 shows the sewer collection system performance as calculated by the hydraulic model for sewer flows under projected 20-year growth conditions. This scenario was developed by loading the model of the existing sewer collection system with the projected future sewer flows at the 20-year growth scenario without changing the size of any piping, similar to the evaluation of 10-year growth. In other words, this model scenario represents system operation if growth were to occur to the 20-year timeframe without making any improvements to the system. For this scenario, model nodes (manholes) were allowed to surcharge without flooding, forcing all flow to stay within the system. This was done to observe the impact of future flows on all pipelines in the system.

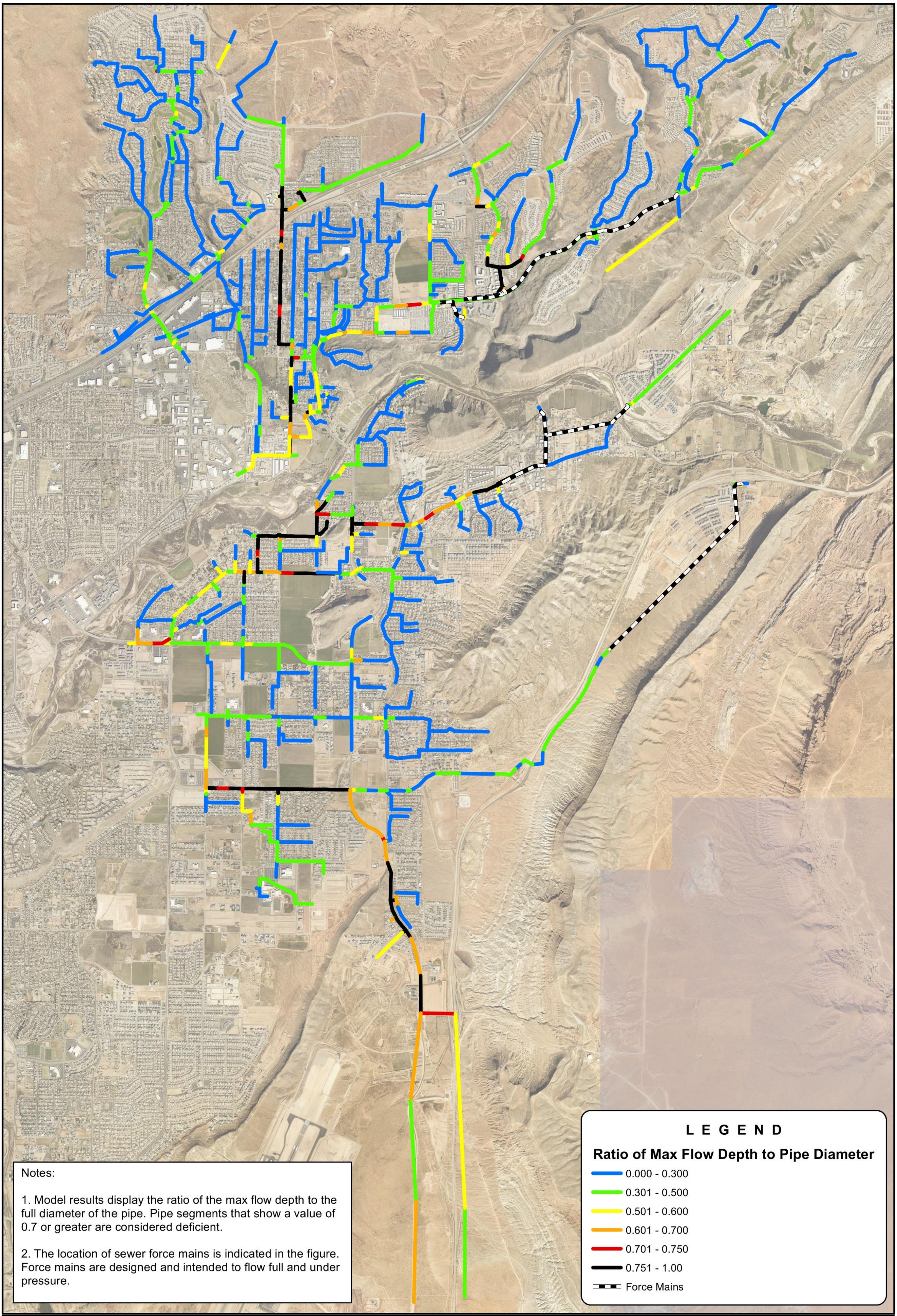
As shown in the figures, a significant portion of the system is projected to be deficient under the 20-year conditions. These results are to be expected considering the high rate of growth expected within the city.

20-Year Growth Lift Station and Force Main Conditions

Table 5-5 provides a summary of estimated lift station influent flows under projected 20-year conditions. As shown in Table 5-5, it is estimated that the East Lift Station will require an upsize in the future. As shown in Table 5-6, force mains are anticipated to have adequate capacity to convey flows through the 20-year planning window.

Table 5-5
Operation of Existing Lift Stations – 20-Year Growth Conditions

Lift Station	TDH (feet)	Capacity (gpm)	Pump R.P.M.	Wet Well Volume (cf)	Power (HP)	No. Pumps	Peak Flow into Lift Station at 2043(gpm)	% Capacity Used*
Ridgepointe	40	80	1,170	239	5	2	30.1	38%
Highland Park	23.5	870	950	1,775	30.12	2	171.5	20%
East Lift Station	128	281	3,510	NA	23	2	379.3	135%
Long Valley Lift Station	202	1,000	1,603	1,440	107.22	3	423.2	42%
Coral Canyon	165	1,300	1,540	1,608	60.02	2	488.8	38%
Sienna Hills	73	1,300	1,220	1,824	62.73	2	746.4	57%



Notes:

1. Model results display the ratio of the max flow depth to the full diameter of the pipe. Pipe segments that show a value of 0.7 or greater are considered deficient.

2. The location of sewer force mains is indicated in the figure. Force mains are designed and intended to flow full and under pressure.

BOWEN COLLINS & ASSOCIATES

WASHINGTON CITY
SEWER MASTER PLAN

20-YEAR GROWTH SEWER SYSTEM EVALUATION

NORTH: NORTH

SCALE: 0 1,500 3,000 Feet

FIGURE NO. 5-3

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\Figure 5-3 - 20-Year Model Results.mxd bclymore 10/3/2024

Table 5-6
Operation of Existing Force Mains – 20-Year Growth Conditions

Lift Station	Design Pumping Capacity (gpm)	Peak Flow into Lift Station at 2043(gpm)	Force Main Diameter (in.)	Pipe Area (ft^2)	Peak Force Main Velocity[1] (fps)
Ridgepointe	80	30.1	4	0.087	2.04
Highland Park	870	171.5	12	0.785	2.47
East Lift Station	281	379.3	8	0.349	2.42
Long Valley Lift Station	1000	423.2	12	0.785	2.84
Coral Canyon	1,300	488.8	12	0.785	3.69
Sienna Hills	1,300	746.4	12	0.785	3.69

[1]Calcuated using the greater of the existing peak pumping capacity or peak flow into lift station at buildout.

CHAPTER 6
WASTEWATER SYSTEM IMPROVEMENTS

Based on the sewer flow projections discussed in Chapter 3 and the results of the hydraulic computer model for existing and future scenarios, this chapter presents a list of recommended system improvements to address both existing and estimated future system deficiencies. The recommended system improvements are divided into the following categories:

- Growth related upsizing/parallel pipes for existing sewer collection infrastructure
- Growth related expansion/extension of the sewer collection system

GROWTH RELATED UPSIZING OF EXISTING SEWER COLLECTION INFRASTRUCTURE

The following is a description of growth related sewer collection system improvements intended to address existing or future capacity deficiencies in the system identified in Chapter 5. Figures 6-1 provides a reference for the location and construction year for the recommended improvements. Table 6-1 contains a summary of the recommended collection system improvements through 2043 with estimated 2024 construction costs. Projects described in this section (with a "C" designation) involve upgrades to the existing sewer collection system. Projects discussed later in this chapter that involve an expansion or extension of the system into newly developed areas have been given the "E" designation.

C1. Washington Fields Road Parallel Line
Estimated Construction Date: 2033+

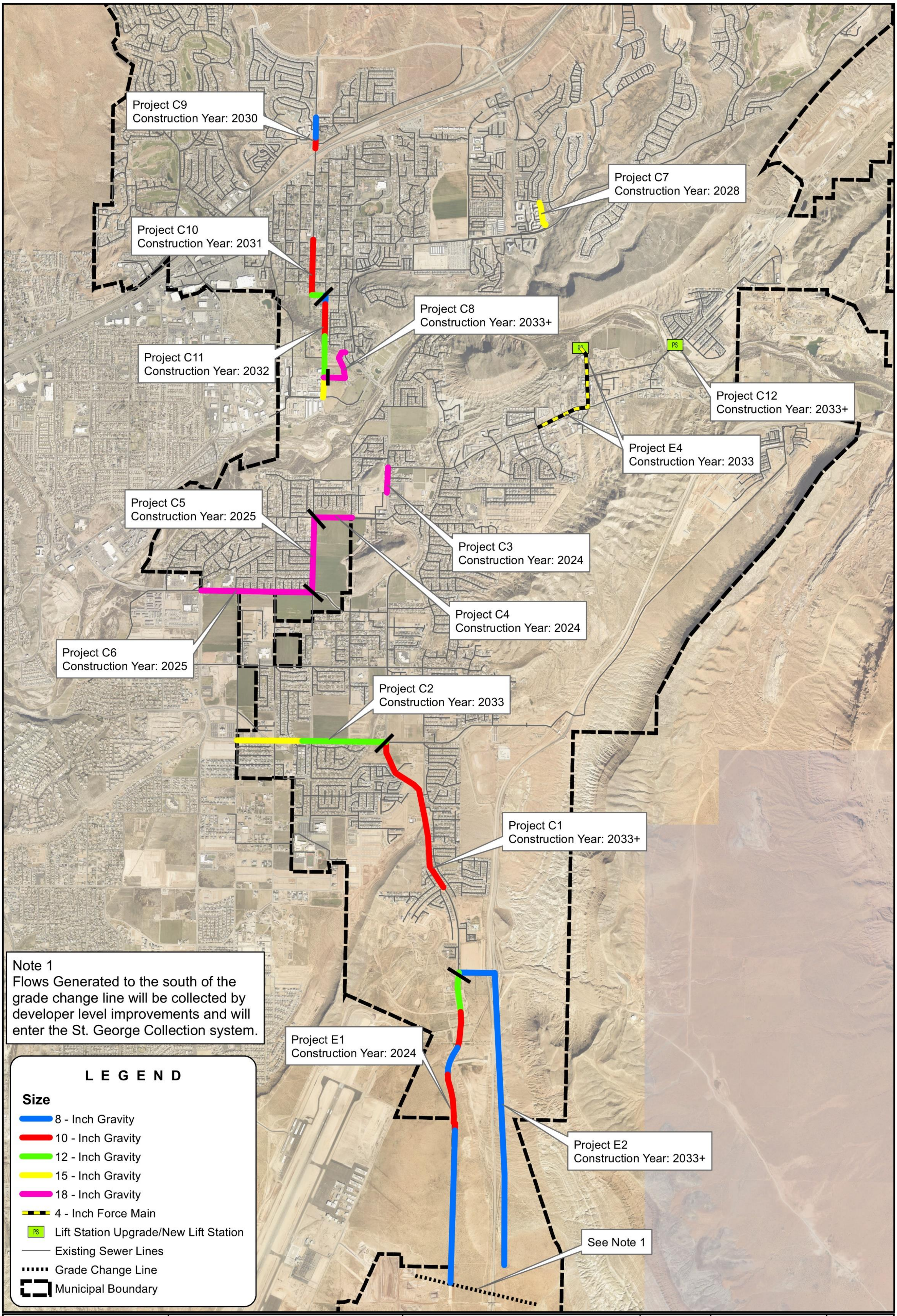
An existing 15-inch line runs the length of Washington Fields Road from Warner Valley Road to 3650 S. The majority of this stretch of pipe has a fairly shallow slope which plays a large role in the need for added capacity. This project consists of installing 5,935 feet of parallel 10-inch pipe.

C2. George Washington Boulevard Parallel Line
Estimated Construction Date: 2033

The existing 15-inch line runs the length of George Washington Boulevard from Washington Fields Road to 515 W Street. The entire length of this segment will require additional capacity as a result of future growth. This project begins with 3,000 feet of 12-inch parallel pipe beginning at Washington Fields Road and then an additional 2,400 feet of 15-inch parallel pipe to 515 W Street.

C3. Washington Fields Road Bypass Line
Estimated Construction Date: 2024

This project is designed to divert water from the Washington Dam Road/Washington Field Road intersection into a new pipe to mitigate capacity issues in the existing downstream piping. The project involves installing an approximately 900 foot section of 18-inch pipe running along Washington Fields Road beginning at Washington Dam Road heading south.



BOWEN COLLINS & ASSOCIATES

WASHINGTON CITY
SEWER SYSTEM MASTER PLAN

RECOMMENDED SYSTEM IMPROVEMENTS

NORTH:

SCALE: 0 1,500 3,000 Feet

FIGURE NO. 6-1

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\Figure 6-1 Recommended Collection System Projects.mxd bclymore 11/27/2024

C4. 2000 S Bypass Line
Estimated Construction Date: 2024

This project is associated with Project C3 and involves the next stretch of this sewer bypass project. This project involves installing approximately 1,400 feet of 18-inch pipe. It will run along 2000 S from Franklin Drive to 20 E. There is an existing 8-inch line already in this road. However, this project will neither increase or decrease flows in this line.

C5. 20 E Bypass Line
Estimated Construction Date: 2025

Project C5 is the next stretch involved in re-routing flows to avoid problematic areas described in the previous two projects. It involves installing 2,650 feet of 18-inch pipe along 20 E. This will run from the end of project C4 southbound until reaching Merrill Road.

C6. Merrill Road Parallel Line
Estimated Construction Date: 2025

An existing 12-inch line runs the length of Merrill Road from 20 E to the connection to the St. George system at 3000 E. Additional capacity is needed to convey the flows from Projects C3-C5 as well as other local flows in this part of the system. This project includes installing an 18-inch parallel pipe running a total of 4,000 feet along Merrill Road from 20E to 3000 E.

C7. Sienna Hills South Parallel Line
Estimated Construction Date: 2028

An existing 8-inch line runs from Sandy Talus Drive to the Sienna Hills Lift Station. This project consists of installing about 850 feet of parallel 15-inch pipe.

C8. Mill Creek Crossing Parallel Line
Estimated Construction Date: 2033+

The existing 21-inch line begins at Old Mill Lane and connects to 100 E after crossing a small stream and a field. The entire length of pipe from Old Mill Lane to 100 E will need added capacity to meet the needs of future growth. This project consists of installing 1,900 feet of parallel 18-inch pipe.

C9. Main Street North Parallel Line
Estimated Construction Date: 2030

An existing 8-inch line runs the length of Main Street from Washington Parkway to Buena Vista Blvd. The section that needs a parallel line begins at Arrowweed Way and runs to the overpass of I-15. This project consists of 750 feet of parallel 8-inch pipe as well as 200 feet of parallel 10-inch pipe that ties into the existing 10-inch dry sewer line in Main Street.

C10. Main Street South Parallel Line
Estimated Construction Date: 2031

An existing 8-inch line runs the length of Main Street from the I-15 overpass to 400 S and then turns East for one block connecting to the 100 E line. The city recently installed a parallel 10-inch line from the I-15 overpass to Telegraph Street (which is currently dry and not in use). This project includes making a connection to the existing 10-inch line and installing 2,000 feet of 10-inch parallel pipe from Telegraph Street to 400 S and an additional 500 feet of parallel 12-inch pipe from Main Street to 100 E along 400 S.

C11. 100 E Parallel Line
Estimated Construction Date: 2032

An existing 10-inch and 12-inch line runs the length of 100 E beginning at 400 S down to Industrial Road. To meet the demands of future growth, the entire length of pipe will need added capacity. Due to additional flow entering the line at several points, this project will involve several sizes of pipes as flows increase along the length of the pipe. Beginning at 400 S there will be 400 feet of parallel 8-inch pipe, then 1,150 feet of parallel 10-inch pipe, 1,500 feet of parallel 12-inch pipe, and then a final stretch of 725 feet of parallel 15-inch pipe. The project will also involve making 2 specific connections into the line on Industrial Road to split flows between the two pipes.

C12. East Lift Station Upsize
Estimated Construction Date: 2033+

The East Lift Station has a current pumping capacity of 281 gpm. Projected peak flows into the East Lift Station are estimated to reach 380 gpm within the 20-year planning window. These increased flows will require a pump upgrade for the facility. To maintain a 15% capacity buffer, it is recommended that the pumps be upgraded to 450 gpm.

Table 6-1
Recommended Sewer Collection System Upsizes Through 20-Year Planning Window

Project Identifier	Project Name	Project Description	Estimated Construction Date	Measurement Unit	Quantity	Unit Price	Estimated Construction Cost (2024 Dollars)	Estimated Total Cost (15% Increase for Engineering, Admin, Legal, 2024 Dollars)
C1	**Washington Fields Road Parallel Line**	**Install 6,000 feet 10-inch pipe**	2033+	LF	6,000	$360.00	$2,160,000.00	$2,484,000.00
C2	**George Washington Blvd Parallel Line**							
	Reach 1	Install 3,000 feet parallel 12-inch pipe	2033	LF	3,000	$385.00	$1,155,000.00	$1,329,000.00
	Reach 2	Install 2,400 feet parallel 15-inch pipe	2033	LF	2,400	$410.00	$984,000.00	$1,132,000.00
C3	**Washington Fields Road Bypass Line**	**Install 900 feet 18-inch pipe**	2024	LF	900	$440.00	$396,000.00	$456,000.00
C4	**2000 S Bypass Line**	**Install 1,400 feet 18-inch pipe**	2024	LF	1,400	$440.00	$616,000.00	$709,000.00
C5	**20 E Bypass Line**	**Install 2,650 feet 18-inch pipe**	2025	LF	2,650	$440.00	$1,166,000.00	$1,341,000.00
C6	**Merrill Road Parallel Line**	**Install 4,000 feet of 18-inch pipe**	2025	LF	4,000	$440.00	$1,760,000.00	$2,024,000.00
C7	**Sienna Hills South Parallel Line**	**Install 850 feet parallel 15-inch pipe**	2028	LF	850	$410.00	$348,500.00	$401,000.00
C8	**Mill Creek Crossing Parallel Line**	**Install 1,900 feet parallel 18-inch pipe**	2033+	LF	1,900	$440.00	$836,000.00	$962,000.00
C9	**Main Street North Parallel Line**							
	Reach 1	Install 750 feet parallel 8-inch pipe	2030	LF	750	$330.00	$247,500.00	$285,000.00
	Reach 2	Install 200 feet parallel 10-inch pipe	2030	LF	200	$360.00	$72,000.00	$83,000.00
C10	**Main Street South Parallel Line**							
	Reach 1	Install 2,000 feet parallel 10-inch pipe	2031	LF	2,000	$360.00	$720,000.00	$828,000.00
	Reach 2	Install 500 feet parallel 12-inch pipe	2031	LF	500	$385.00	$192,500.00	$222,000.00
C11	**100 E Parallel Line**							
	Reach 1	Install 400 feet parallel 8-inch pipe	2032	LF	400	$330.00	$132,000.00	$152,000.00
	Reach 2	Install 1,150 feet parallel 10-inch pipe	2032	LF	1,150	$360.00	$414,000.00	$477,000.00
	Reach 3	Install 1,500 feet parallel 12-inch pipe	2032	LF	1,500	$385.00	$577,500.00	$665,000.00
	Reach 4	Install 725 feet parallel 15-inch pipe	2032	LF	725	$410.00	$297,250.00	$342,000.00
	Major Connection 1	Install 50 feet parallel 12-inch pipe	2032	LF	50	$385.00	$19,250.00	$23,000.00
	Major Connection 2	Install 50 feet parallel 21-inch pipe	2032	LF	50	$470.00	$23,500.00	$28,000.00
C12	**East Lift Station Upsize**	**Upgrade pumps to 450 gpm**	2033+		1	$1,100,000.00	$1,100,000.00	$1,265,000.00
							$13,217,000	**$15,208,000**

GROWTH RELATED EXPANSION OF THE SEWER COLLECTION SYSTEM

The projects presented to this point address existing and future deficiencies within existing sewer collection pipes or lift stations. In addition to these projects, improvements will also be required to expand the system and establish the sewer collection backbone in new areas. It is important to note that the city only funds the construction of *system level* improvements, which are those projects that provide service to the system as a whole, not to an individual development. Sewer lines needed to service individual developments are *project level* improvements and are funded by the developer. In some cases, new developments may be located within proximity of a major sewer drainage corridor, and the pipes constructed for that specific development will need to convey additional pass-through flows from adjacent areas in the future. In such instances, the city may identify the project as a system level improvement and pay the difference in cost to *upsize* the sewer line from the size identified by the individual development to the size required to meet future needs of the area as a whole. The projects described in this master plan are those that have been identified as system level improvements; any projects not identified in this master plan are currently considered project level improvements to be funded in full by developers.

To provide the city staff with a general idea of the location and size of future growth related sewer expansion projects, BC&A populated the undeveloped areas of the sewer collection system model with conceptual pipelines. Where detailed information for a given development was available, such as the location of future roads or even a detailed sewer collection system layout, the information was used for said area. Otherwise, conceptual pipelines and lift stations were added into undeveloped areas based on natural topography and proximity to the existing collection system. It is important to reiterate that many of the lines identified in this section are conceptual and subject to change based on the specific development plans throughout the service area. Figures 6-1 shows the growth related expansion improvements that were conceptualized in the sewer collection system model.

The following is a description of recommended growth related system expansion improvements. Estimated project costs in 2024 dollars are shown in Table 6-2.

E1. Airport Sewer Main
Estimated Construction Date: 2024

To meet demands of new growth on the west side of the Southern Parkway near the St. George Airport, it will be necessary to extend a sewer main to these areas. This project consists of installing approximately 6,840 feet of 8-inch pipe, 3,530 feet of 10-inch pipe, and 1,370 feet of 12-inch pipe.

E2. Southern Parkway Sewer Main
Estimated Construction Date: 2033+

As growth occurs on the east side of the Southern Parkway towards the south end of the city, it will become necessary to extend a line to the east side of the parkway. Due to the topography of this area, a portion may need to flow to the south to connect into the St. George City collection system. This project includes approximately 10,400 feet of 8-inch pipe.

E3. 1900 E Lift Station and Force Main
Estimated Construction Date: 2027

As the area near 1900 E is developed, there will be locations that are unable to gravity flow into the rest of the system or the nearby lift station. Due to these topographic limitations, it will be necessary to install a lift station and force main to tie into the system. The lift station will cover a small area, and the ultimate sizing will depend on the type of development that ultimately goes in. For the purpose of this master plan, it has been assumed that a 25 gpm lift station and 4-inch force main (approximately 4,100 feet) will be used to service this area. The force main will run to the intersection of Washington Dam Road and Sandhill Drive.

Table 6-2
Recommended Sewer System Expansion Projects

Project Identifier	Project Name	Project Description	Estimated Construction Date	Measurement Unit	Quantity	Unit Price	Estimated Construction Cost (2024 Dollars)	Estimated Total Cost (15% increase for Engineering, Admin., etc.)
E1	Airport Sewer Main[1]							
	Reach 1	**Install 6,840 feet of 8-inch pipe**	2024	LF	6,840	$90	$616,000	$709,000
	Reach 2	**Install 3,530 feet of 10-inch pipe**	2024	LF	3,530	$95	$336,000	$387,000
	Reach 3	**Install 1,370 feet of 12-inch pipe**	2024	LF	1,370	$105	$144,000	$166,000
E2	Southern Parkway Sewer Main	**Install 13,100 feet of 8-inch pipe**	2033+	LF	13,100	$250	$3,275,000	$3,767,000
E3A	1900 E Lift Station	**Construct 25 gpm lift station**	2033	LS	1	$165,000	$165,000	$190,000
E3B	1900 E Lift Station Force Main	**Install 4,100 feet of 4-inch pressure pipe**	2033	LF	4,100	$135	$554,000	$637,000
						Total	**$5,090,000**	**$5,856,000**

[1]This project was completed during the time this study was completed. Project costs reflect the actual costs of the project. It should be noted that the project was completed as part of a larger utility/road improvement project and was installed through a green field area with no utilities, traffic control, or other factors that significantly increase project costs. For this reason, the unit price for the project is significantly lower than the estimated cost of future sewer projects.

CHAPTER 7
10-YEAR CAPITAL IMPROVEMENT PLAN

Chapter 6 of this report identifies system improvements which address existing and future deficiencies in the Washington City wastewater collection system. The purpose of this chapter is to assemble a 10-year capital improvement plan to implement the recommended improvements. This will include recommendations regarding levels of funding for system rehabilitation, replacement, and capital improvement projects.

DEVELOPING AN ANNUAL BUDGET

Before establishing a 10-year capital improvement plan, it is necessary to determine how much funding should be budgeted each year for system renewal. One of the best ways to identify a recommended level of funding is to look at the estimated cost to replace the various components of the system and then consider each component's respective service life. Funding can then be based on the anticipated annual cost to replace the different components of the system.

As with all utilities, each component of a sewer system has a finite service life. Therefore, it is necessary to continually set aside and invest money toward the rehabilitation or replacement of these components. If adequate funds are not set aside for regular system renewal, the collection system will fall into a state of disrepair and be incapable of providing the level of service that the city's customers have come to expect.

The city's sewer collection system is composed of about 1,078,000 feet of gravity sewer mains, 27,000 feet of pressurized sewer pipe, and 6 lift stations. Table 7-1 summarizes the estimated replacement value of the city's wastewater collection system. The total cost to replace all pipes and lift stations is estimated to be approximately $238 million based on estimated 2024 construction costs.

Table 7-1
Estimated Sewer Collection System Replacement Value

System Component	Quantity	Unit Installation Price	Estimated Replacement Value
Gravity Sewer Pipe			
8 inch*	930,544	$200	$186,108,800
10 inch	45,178	$220	$9,939,160
12 inch	37,034	$240	$8,888,160
14 inch	1,516	$250	$379,000
15 inch	36,193	$275	$9,953,075
16 inch	81	$300	$24,300
18 inch	13,325	$350	$4,663,750
21 inch	5,848	$400	$2,339,200
24 inch	7,875	$425	$3,346,875
		Subtotal	**$225,642,320**
Pressurized Sewer Pipe			
4	1,313	$110	$144,430
8	6,682	$150	$1,002,300
10	1,527	$175	$267,225
12	17,191	$200	$3,438,200
		Subtotal	**$4,852,155**
Lift Stations			
Ridgepointe Lift Station	1	$1,000,000	$1,000,000
Highland Park Lift Station	1	$1,150,000	$1,150,000
East Lift Station	1	$1,100,000	$1,100,000
Long Valley Lift Station	1	$1,400,000	$1,400,000
Coral Canyon Lift Station	1	$1,250,000	$1,250,000
Sienna Hills Lift Station	1	$1,250,000	$1,250,000
		Subtotal	**$7,150,000**
		Grand Total	**$237,644,475**

*The city currently has 383 ft of 4 in. pipe and 6,119 ft of 6 in. pipe. These lengths of small diameter pipe have been included in the total length of 8 in. pipe. This is because if these pipes were to be replaced, they would be installed at the minimum diameter of 8-inch.

In reality, it will not be necessary to completely replace the entire system as it ages because of rehabilitation technologies (e.g. slip lining, cast-in-place pipe, etc.). Rehabilitation costs are much lower than replacement costs (20% to 60% depending on pipe diameter). If the city were able to rehabilitate the entire system rather than replace components, it would drastically reduce the "replacement value." Unfortunately, it is generally not possible to rehabilitate all system components due to either condition or capacity issues. Some pipes are beyond saving with rehabilitation, while others may require upsizing or correction of grade issues; all of these scenarios would require a replacement.

To account for the limitations on rehabilitation, BC&A recommends an annual system investment budget derived from a combination of rehabilitation and replacement using a design life of 80 years for pipes and 40 years for lift stations. Table 7-2 provides a comparison of the required annual budget based on replacement, rehabilitation, and the recommended combination of both values. This recommended annual budget is intended to provide a guideline for the city's expenses for system renewal, not including capital projects.

Table 7-2
Recommended Annual Sewer Collection System Budget

System Component	Service Life	Full Replacement	Rehabilitation[1]	50% Replacement 50% Rehabilitation (Recommended System Valuation)[2]	Recommended Annual Budget[3]
Gravity Pipes	80 Years	$225,642,320	$90,256,928	$157,949,624	$1,974,370
Pressure Pipes	80 Years	$4,852,155	$4,852,155	$4,852,155	$60,652
Lift Stations	40 Years	$7,150,000	$7,150,000	$7,150,000	$178,750
TOTAL		**$237,644,475**	**$102,259,083**	**$169,951,779**	**$2,213,772**

[1] Rehabilitation techniques can at times be used on gravity piping to avoid the cost of a full replacement (slip lining, cast-in-place pipe, etc.) at an estimated cost of 40% of replacement cost. Other system components, such as pressure pipes and lift stations, have been assumed to require a full replacement, hence the values shown in this column are the same as the "full replacement" cost.
[2] "Recommended System Valuation" is a combination of full replacement and rehabilitation techniques. Gravity pipes have been assumed to be 50% full replacement and 50% rehab, while all other system components have been assumed to require a full replacement at the end of their respective service life.
[3] Calculated by dividing the recommended system valuation by the estimated service life

As shown in Table 7-2, the recommended annual budget for system renewal and rehabilitation is approximately $2.2 million. However, because the city's system is relatively new, investing or setting aside this much every year for system renewal is excessive. This considered, it is recommended that the city invest 50% of this value ($1,100,000) per year for system renewal (or save that amount each year for future system renewal). As the system continues to age, the city will want to re-evaluate how much is being set aside for the replacement of the existing system and adjust plans as needed.

10-YEAR CAPITAL IMPROVEMENT PLAN

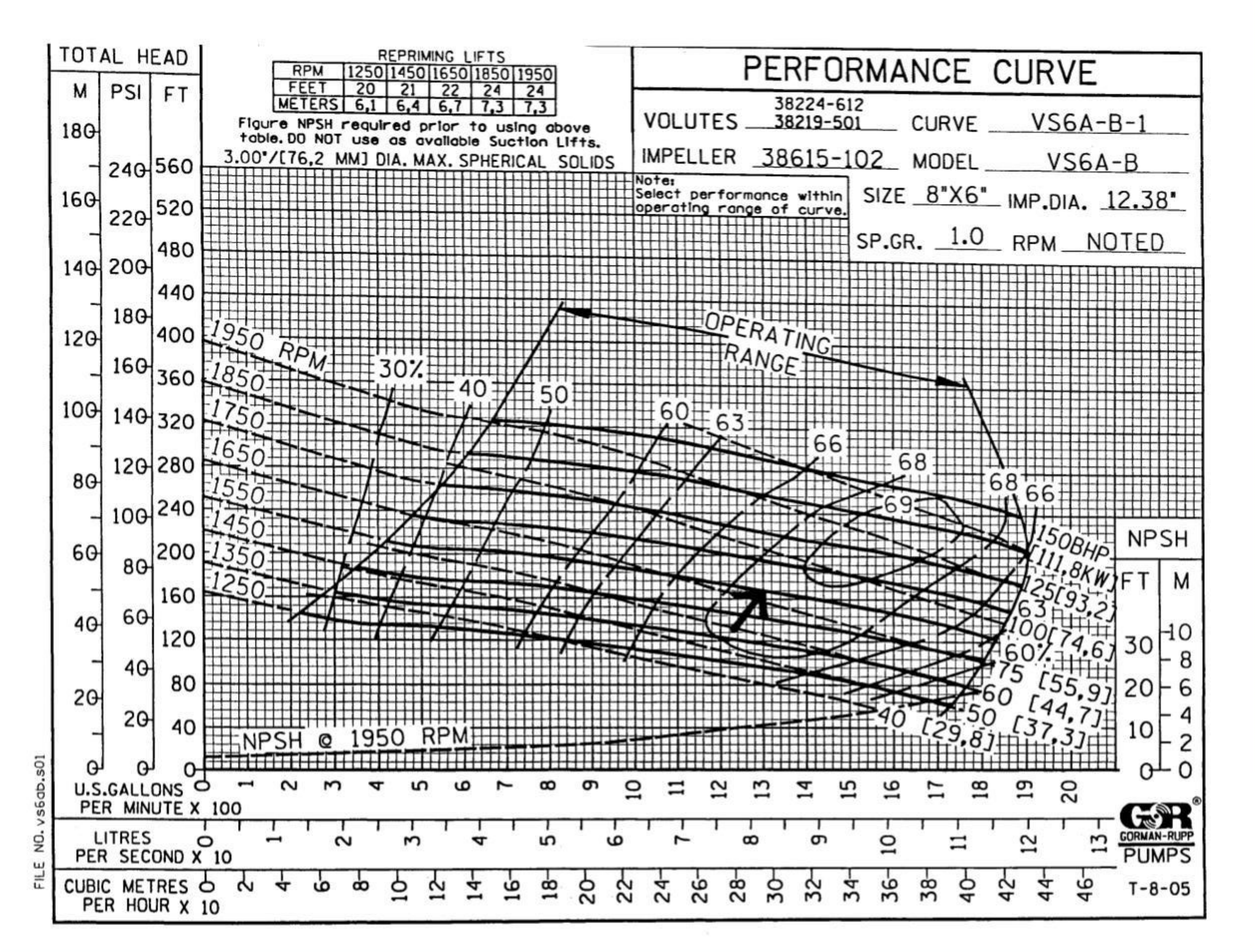
Table 7-3 provides an outlay of the recommended projects to be completed within the next 10 years. As shown in the table, the city will need to take on a number of projects over the 10-year window. The city has retained BC&A to conduct a user rate analysis that will determine how the city will meet its future funding needs, including O&M, system renewal, and capital projects.

Table 7-3
Recommended 10-year Capital Improvement Plan

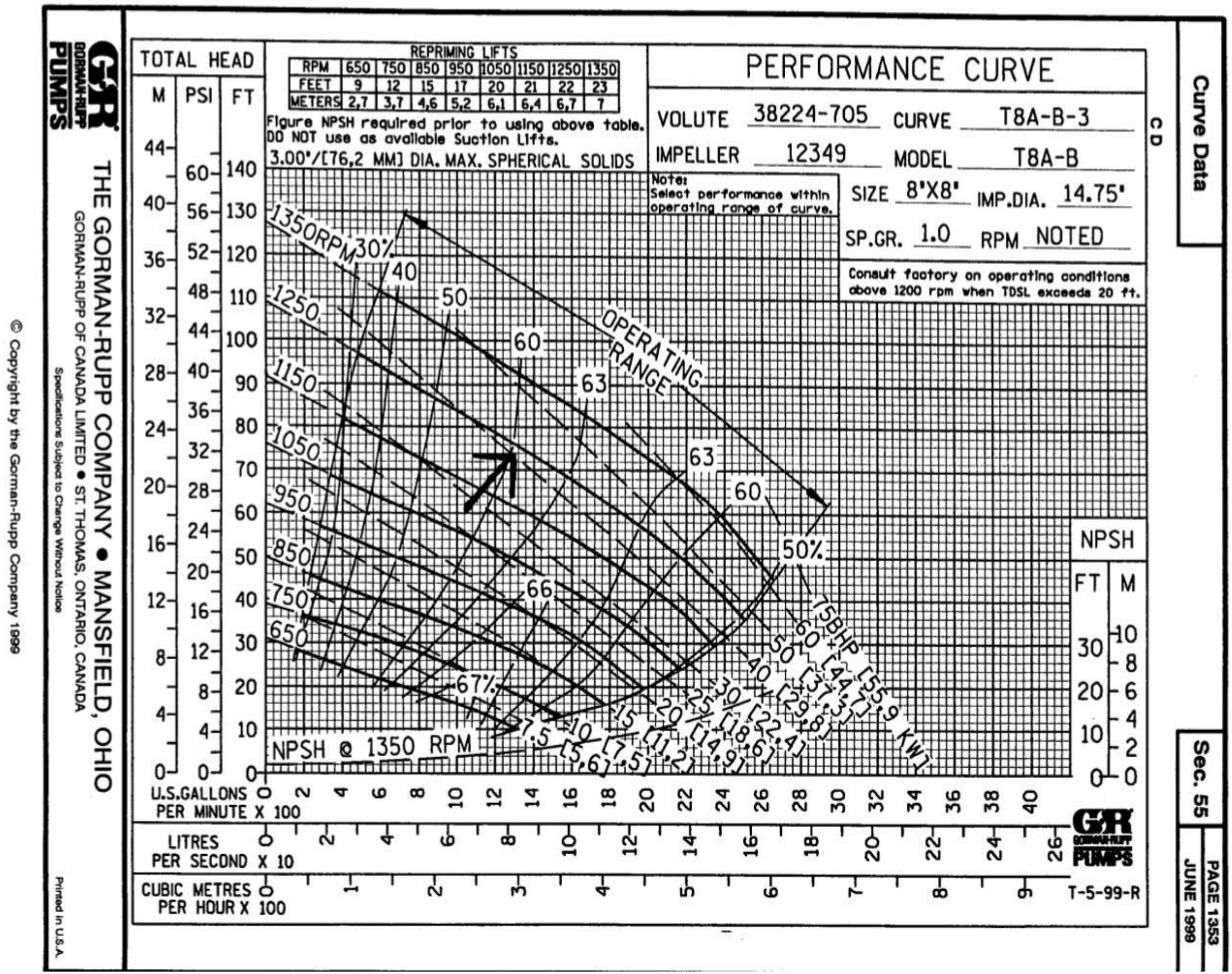
Project ID	Project Name	Description	Estimated 2024 Cost	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total (Inflated Cost)
C2	George Washington Boulevard Parallel Line	Install 3,000 feet of 12-inch pipe and 2,400 feet of 15-inch pipe	$2,461,000										$3,211,000	$3,211,000
C3	Washington Fields Road Bypass Line	Install 900 feet 18-inch pipe	$456,000	$456,000										$456,000
C4	2000 S Bypass Line	Install 1,400 feet 18-inch pipe	$709,000	$709,000										$709,000
C5	20 E Bypass Line	Install 2,650 feet 18-inch pipe	$1,341,000		$1,381,000									$1,381,000
C6	Merrill Road Parallel Line	Install 4,000 feet of 18-inch pipe	$2,024,000		$2,085,000									$2,085,000
C7	Sienna Hills South Parallel Line	Install 850 feet parallel 15-inch pipe	$401,000					$452,000						$452,000
C9	Main Street North Parallel Line	Install 750 feet of 8-inch pipe and 200 feet of 10-inch pipe	$368,000							$440,000				$440,000
C10	Main Street South Parallel Line	Install 1,550 feet of 10-inch pipe and 500 feet of 12-inch pipe	$1,050,000								$1,292,000			$1,292,000
C11	100 E Parallel Line	Install 775 feet of 8-inch pipe, 1,150 feet of 10-inch pipe, 1,500 feet of 12-inch pipe, 725 feet of 15-inch pipe, and two connections	$1,687,000									$2,138,000		$2,138,000
E1	Airport Sewer Main	Install 6,840 feet of 8-inch pipe, 3,530 feet of 10-inch pipe and 1,370 feet of 12-inch pipe	$1,262,000	$1,262,000										$1,262,000
E3 (A and B)	1900 E Lift Station and Force Main	Install 25 gpm lift station and 4,100 feet of 4-inch force main	$827,000				$904,000							$904,000
R&R	Ongoing Rehab and Replacement	System Rehab and Replacement		$1,100,000	$1,100,000	$1,100,000	$1,100,000	$1,100,000	$1,100,000	$1,100,000	$1,100,000	$1,100,000	$1,100,000	$11,000,000
		Total Improvements	**$12,586,000**	**$3,527,000**	**$4,566,000**	**$1,100,000**	**$2,004,000**	**$1,552,000**	**$1,100,000**	**$1,540,000**	**$2,392,000**	**$3,238,000**	**$4,311,000**	**$25,330,000**

[1]A 3% annual inflation rate has been applied to future estimated project costs.

APPENDIX A
LIFT STATION PUMP CURVES



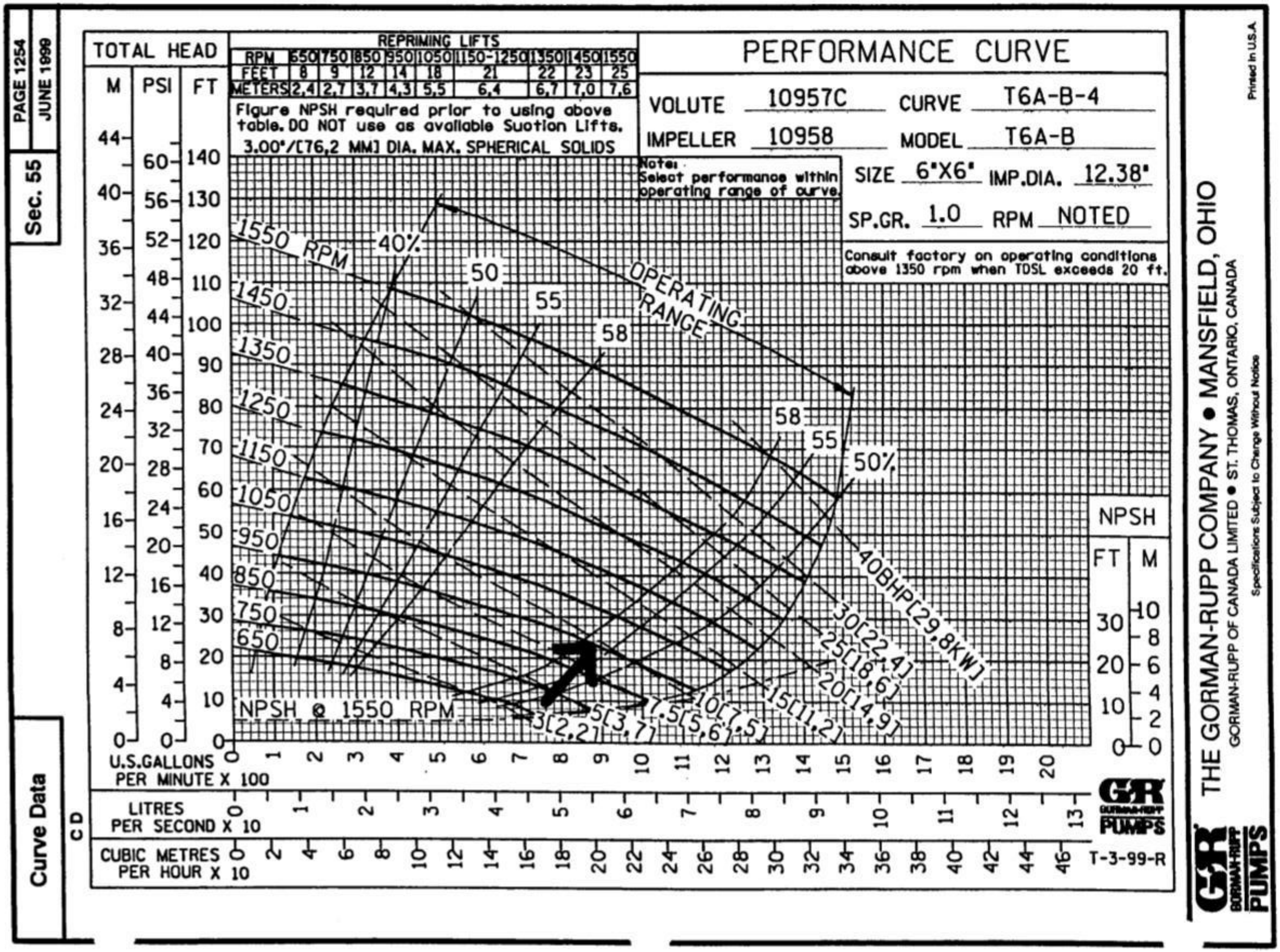
Coral Canyon Lift Station



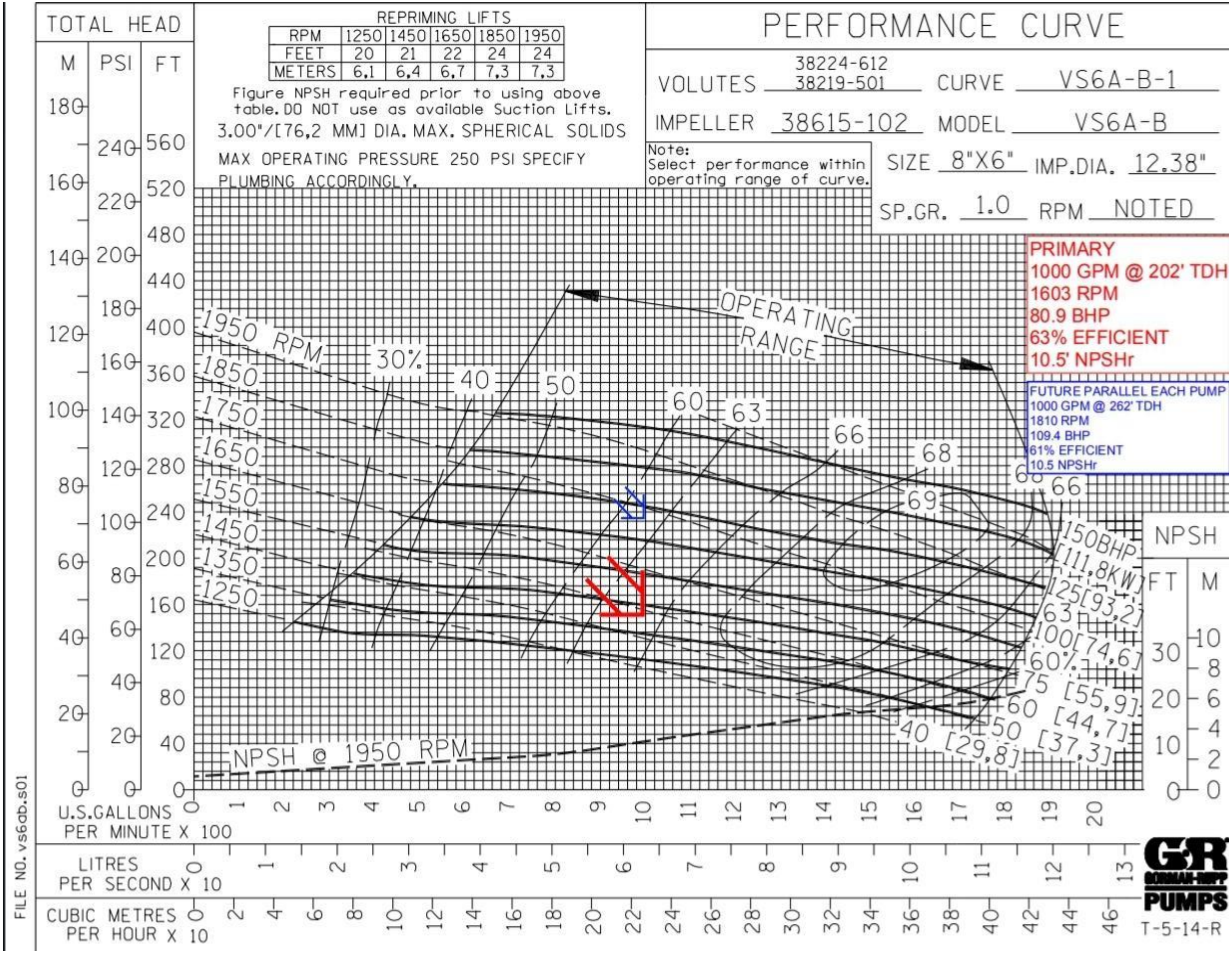
REPRIMING LIFTS

RPM	650	750	850	950	1050	1150	1250	1350
FEET	9	12	15	17	20	21	22	23
METERS	2,7	3,7	4,6	5,2	6,1	6,4	6,7	7

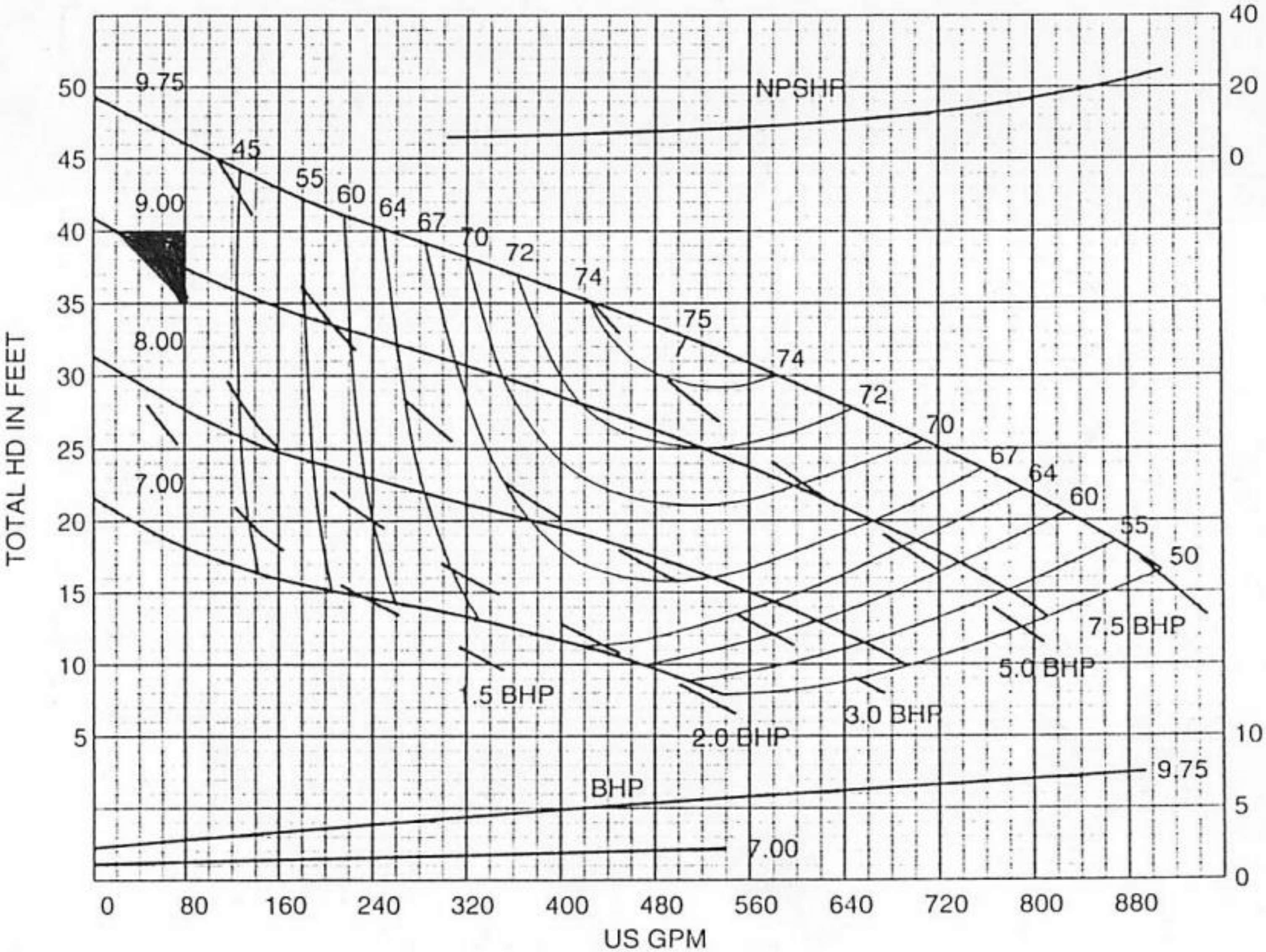
Sienna Hills Lift Station



Highlands Lift Station



Long Valley Lift Station



4"

5412
VERTICAL FOR FLEXIBLE SHAFTING

5422
HORIZONTAL

5432
VERTICAL BILTOGETHER

5432M&W
SUBMERSIBLE

5442
VERTICAL CLOSE COUPLED

1170 RPM
NO. OF VANES 2

SUCTION SIZE
5422:4"
OTHER: 4" OR 6"

IMPELLER T4B1A

INLET AREA
26.22 SQ.IN.

MAX.SPHERE 3"

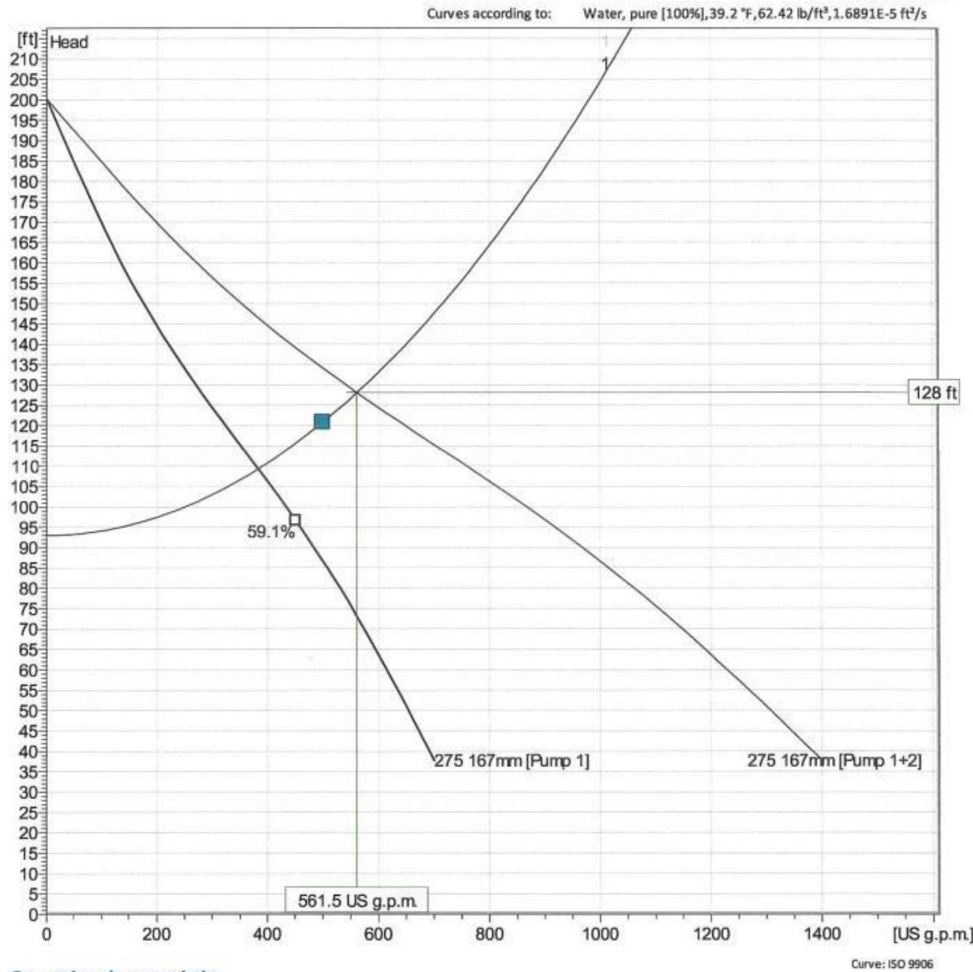
1/1/92

Fairbanks Morse Pump Corporation

Ridgepoint Lift Station

NP 3153 SH 3~ 275

Duty Analysis



Operating characteristics

Pumps/Systems	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHr
2 / 1	281 US g.p.m.	128 ft	17.4 hp	562 US g.p.m.	128 ft	34.8 hp	52.2 %	839 kWh/US M(	13.6 ft
1 / 1	383 US g.p.m.	109 ft	18.3 hp	383 US g.p.m.	109 ft	18.3 hp	58 %	645 kWh/US M(	15.1 ft

Project
Block

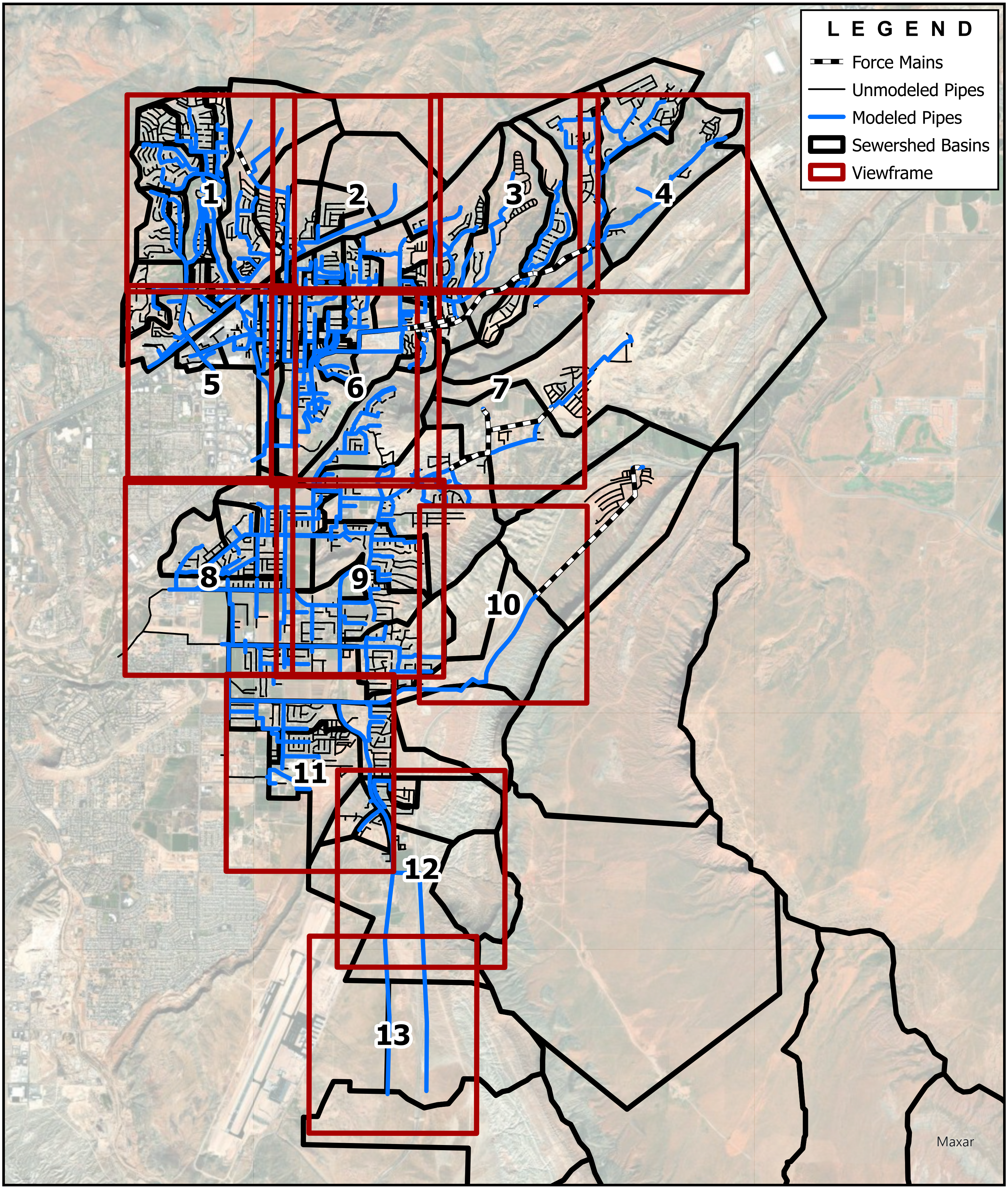
Created by
Created on 11/7/2019

Last update

East Lift Station

APPENDIX B

MODEL FLOW ROUTING MAP



BOWEN COLLINS & ASSOCIATES

SEWERSHED BASINS
FLOW ROUTING

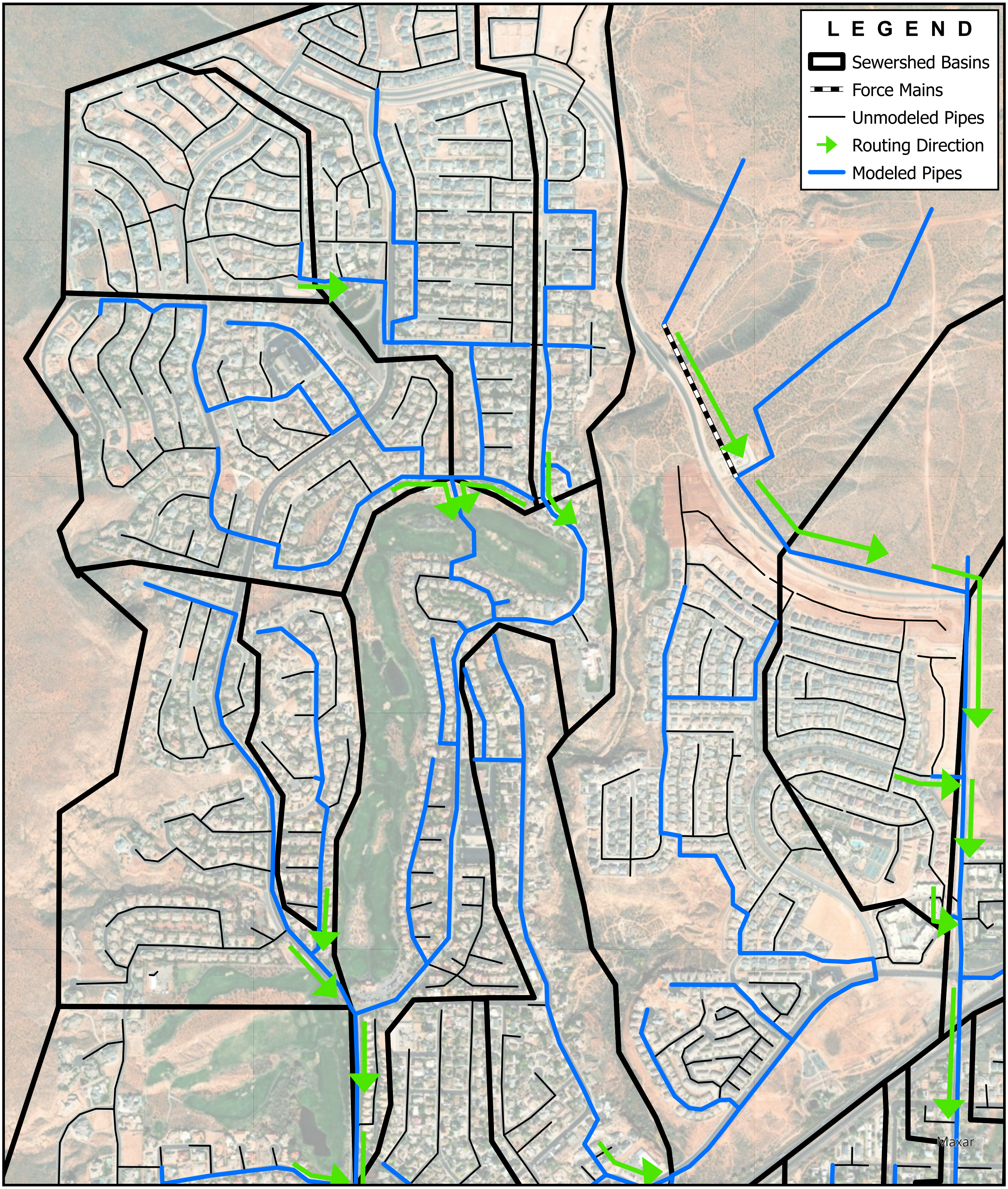
WASHINGTON CITY
SEWER MASTER PLAN

NORTH:

SCALE: 0 3,000 6,000 Feet

FIGURE NO.
0-0

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\working2.aprx bclymore 10/2/2024



BOWEN COLLINS & ASSOCIATES

SEWERSHED BASINS
FLOW ROUTING

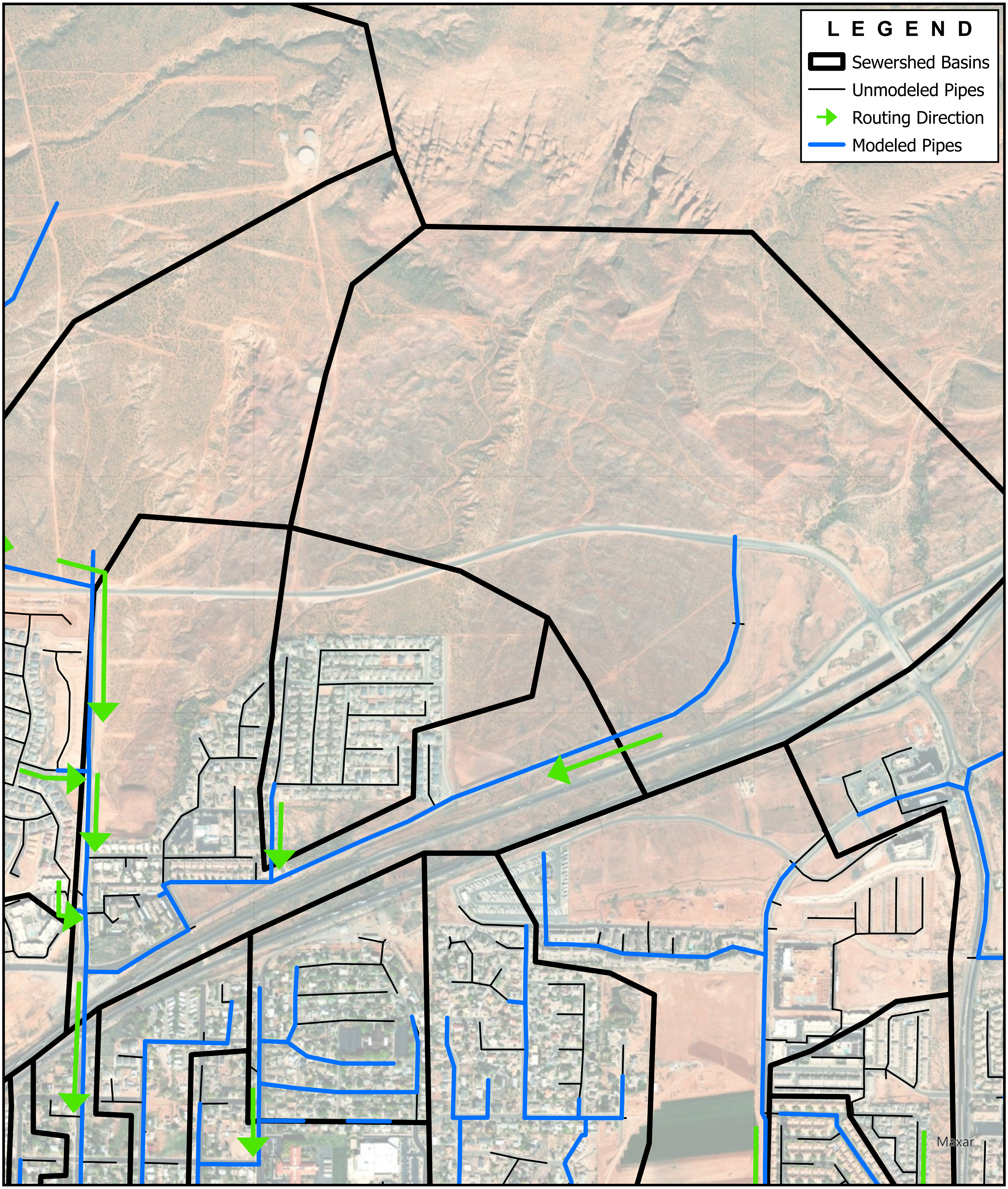
WASHINGTON CITY
SEWER MASTER PLAN

NORTH: NORTH

SCALE: 0 500 1,000 Feet

FIGURE NO.
1

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\working2.aprx bclymore 10/2/2024



BOWEN COLLINS & ASSOCIATES

SEWERSHED BASINS
FLOW ROUTING

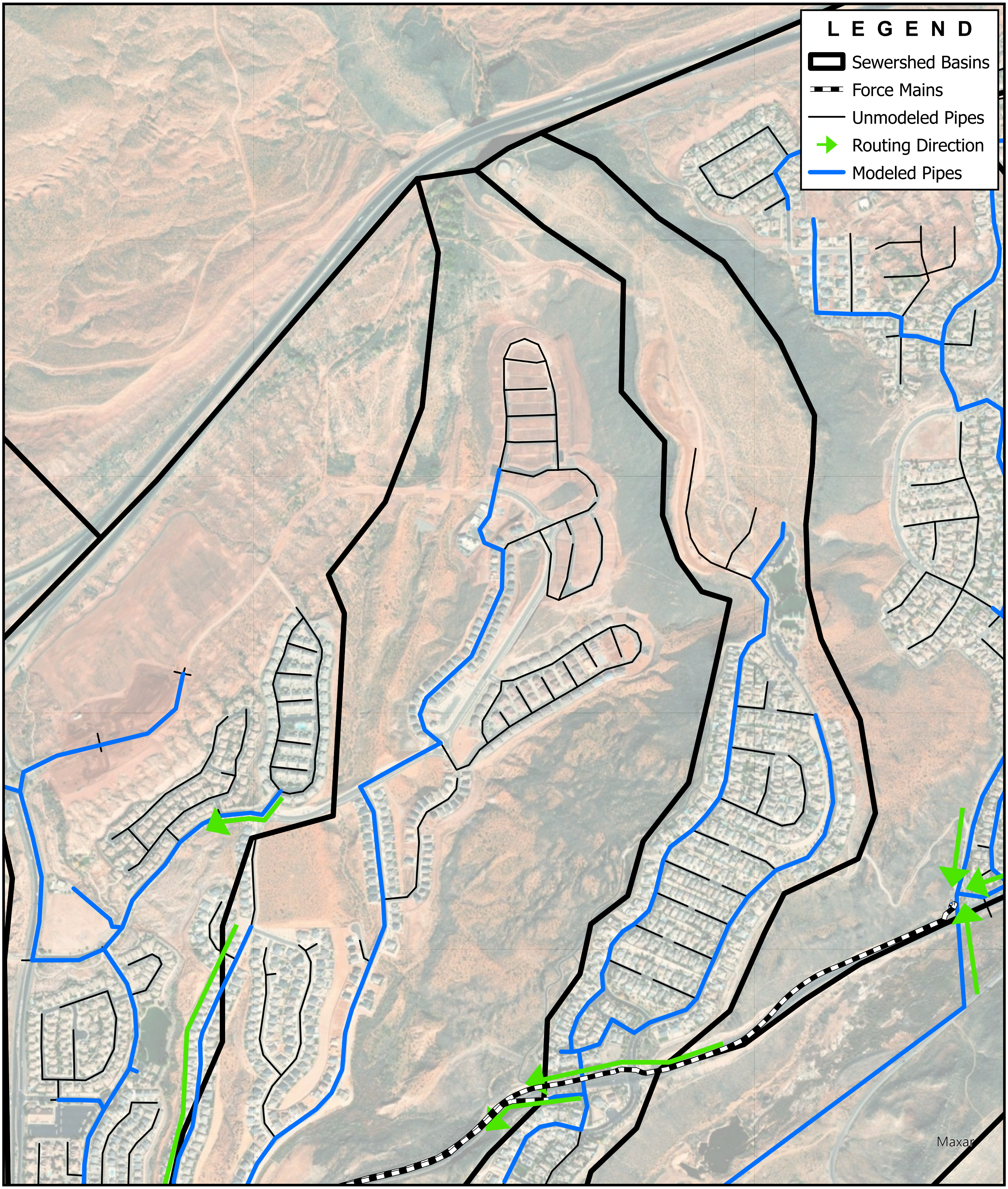
WASHINGTON CITY
SEWER MASTER PLAN

NORTH:

SCALE: 0 500 1,000 Feet

FIGURE NO. 2

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\working2.aprx bclymore 10/2/2024



BOWEN COLLINS & ASSOCIATES

SEWERSHED BASINS
FLOW ROUTING

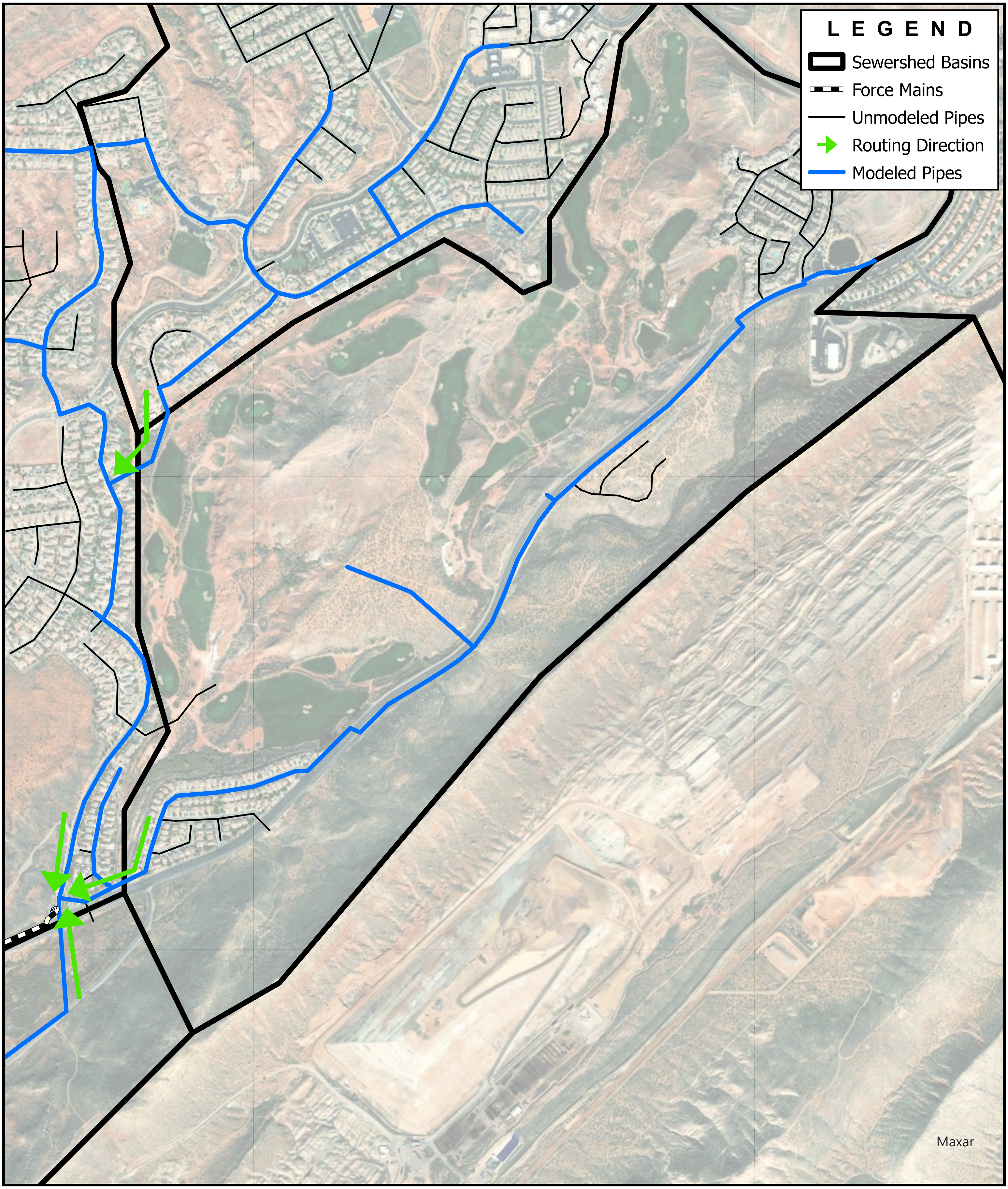
WASHINGTON CITY
SEWER MASTER PLAN

NORTH:

SCALE:
0 500 1,000
Feet

FIGURE NO.
3

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\working2.aprx bclymore 10/2/2024



BOWEN COLLINS & ASSOCIATES

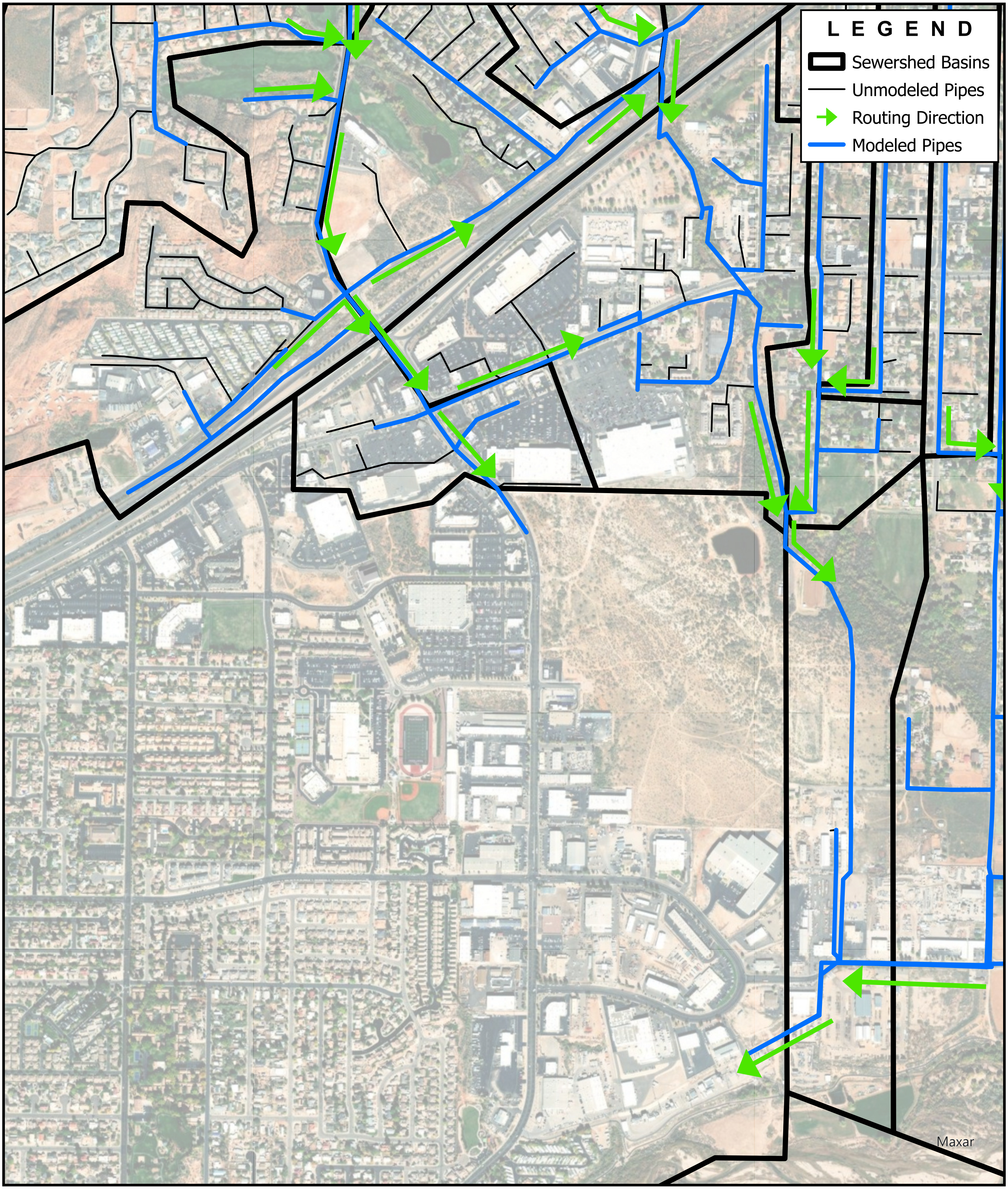
SEWERSHED BASINS
FLOW ROUTING

WASHINGTON CITY
SEWER MASTER PLAN

NORTH:

SCALE:
0 500 1,000
Feet

FIGURE NO.
4



BOWEN COLLINS & ASSOCIATES

SEWERSHED BASINS
FLOW ROUTING

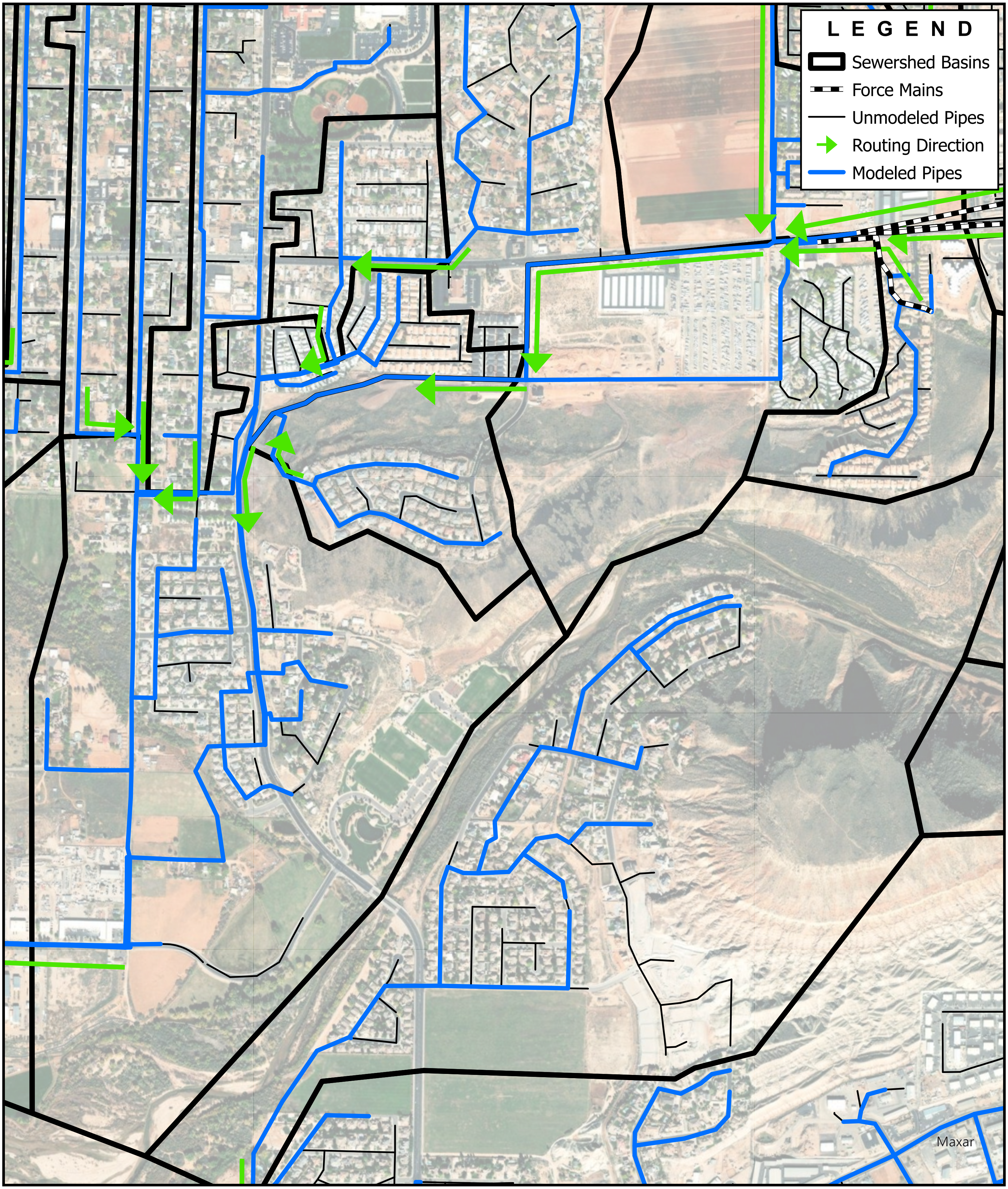
WASHINGTON CITY
SEWER MASTER PLAN

NORTH:

SCALE:
0 500 1,000
Feet

FIGURE NO.
5

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\working2.aprx bclymore 10/2/2024



BOWEN COLLINS & ASSOCIATES

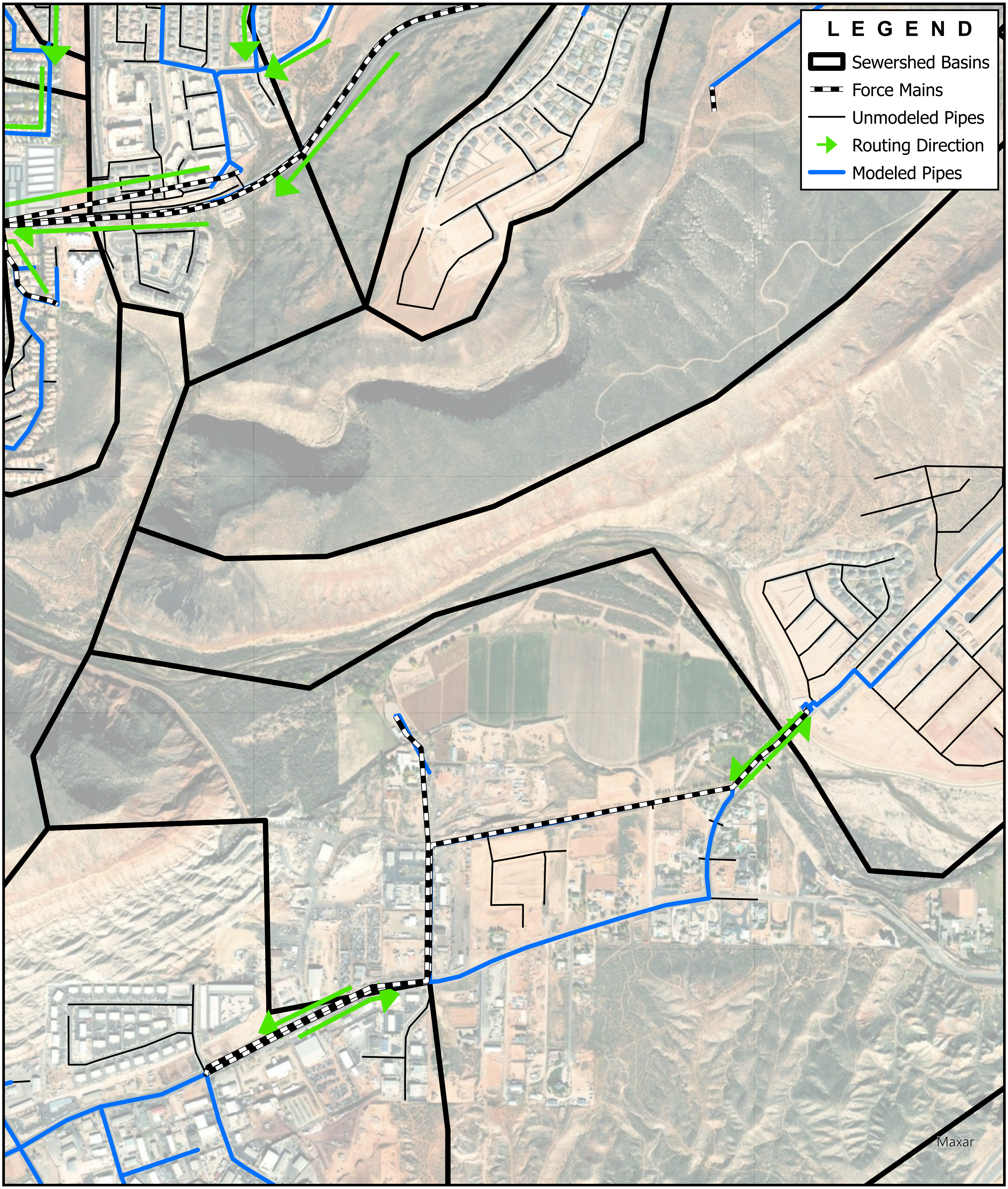
SEWERSHED BASINS
FLOW ROUTING

WASHINGTON CITY
SEWER MASTER PLAN

NORTH:

SCALE:
0 500 1,000
Feet

FIGURE NO.
6



BOWEN COLLINS & ASSOCIATES

SEWERSHED BASINS
FLOW ROUTING

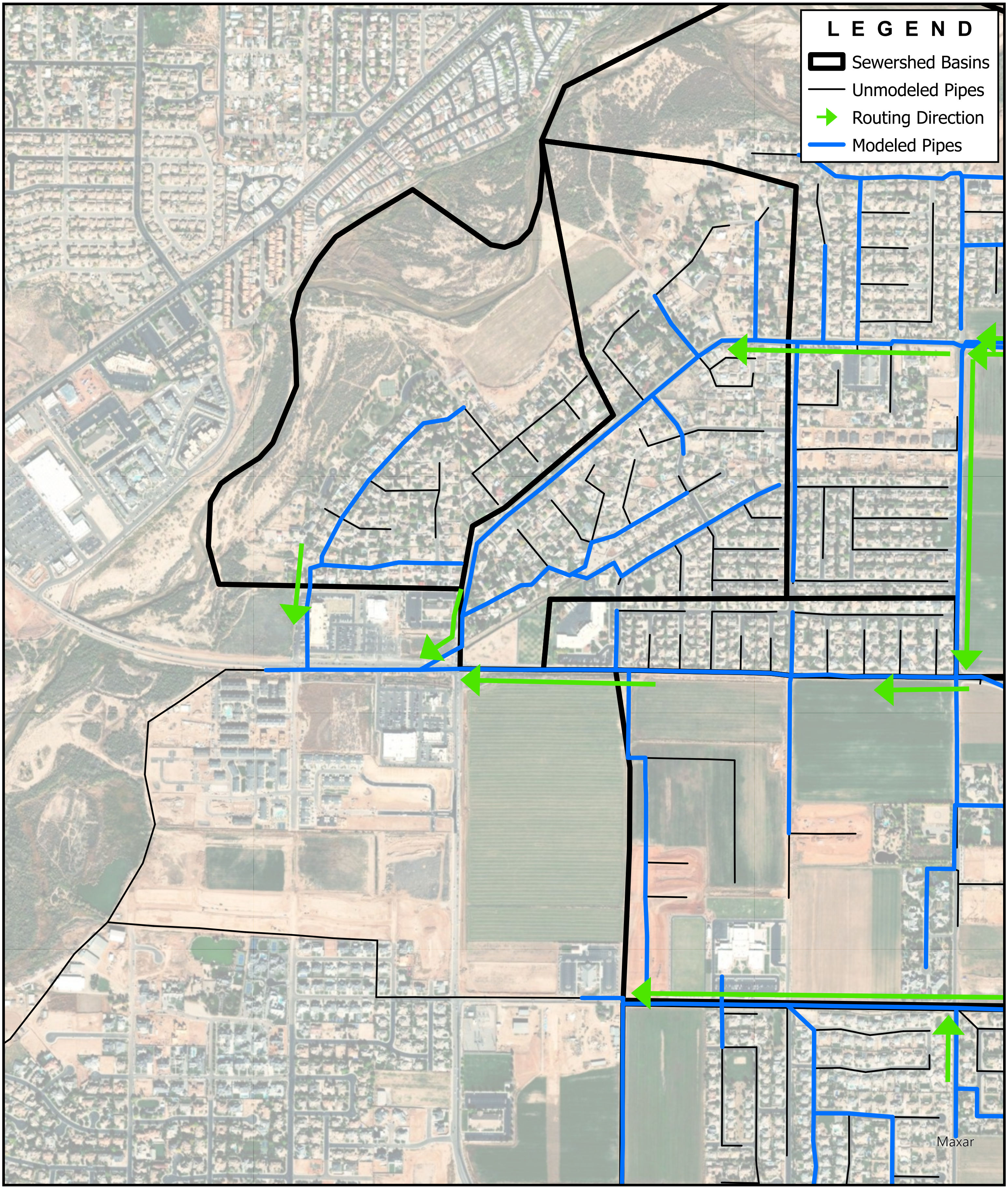
WASHINGTON CITY
SEWER MASTER PLAN

NORTH:

SCALE: 0 500 1,000 Feet

FIGURE NO. 7

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\working2.aprx bclymore 10/2/2024



BOWEN COLLINS & ASSOCIATES

SEWERSHED BASINS
FLOW ROUTING

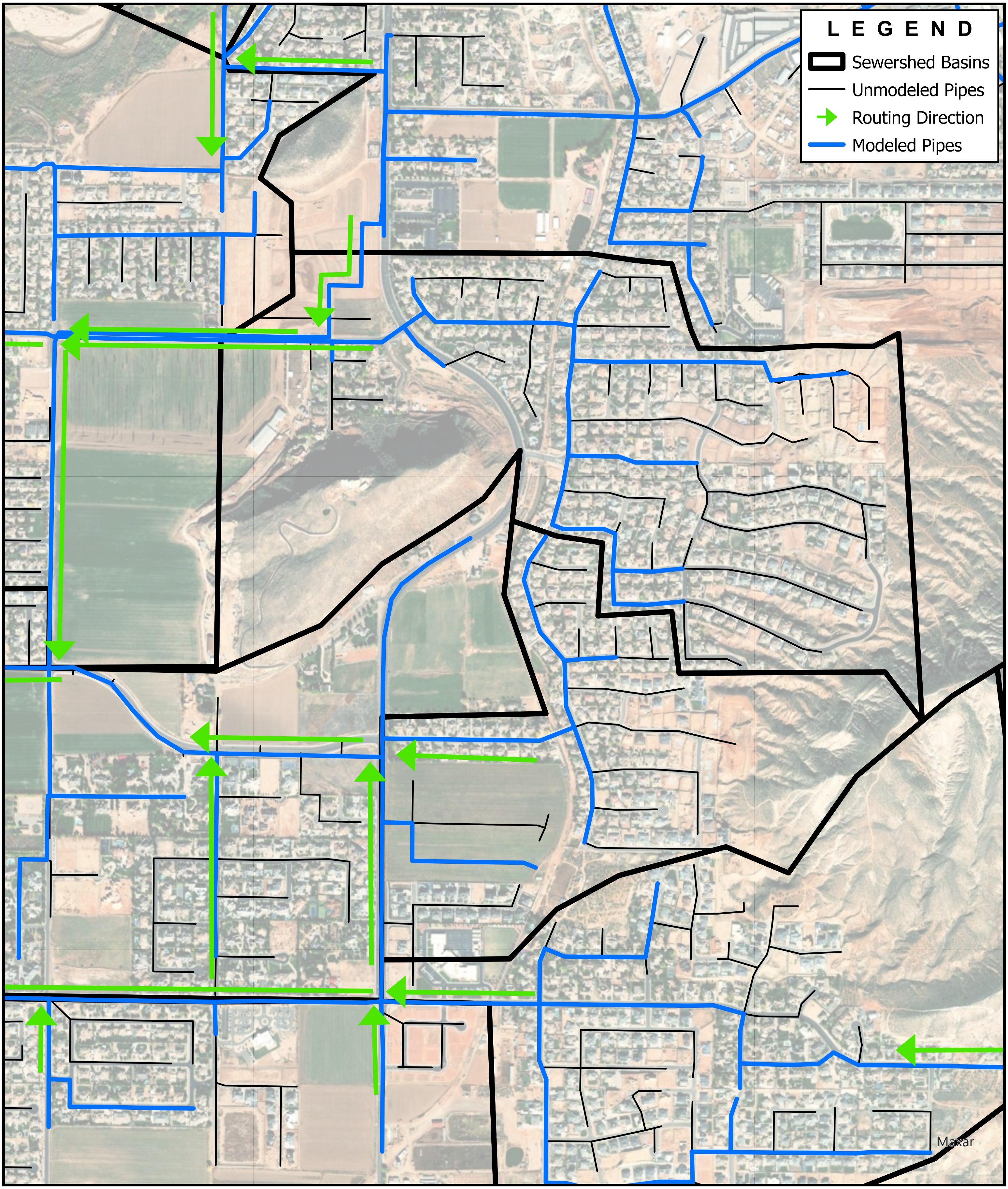
WASHINGTON CITY
SEWER MASTER PLAN

NORTH:

SCALE: 0 500 1,000 Feet

FIGURE NO. 8

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\working2.aprx bclymore 10/2/2024



BOWEN COLLINS & ASSOCIATES

SEWERSHED BASINS
FLOW ROUTING

WASHINGTON CITY
SEWER MASTER PLAN

NORTH:

SCALE: 0 500 1,000 Feet

FIGURE NO. 9

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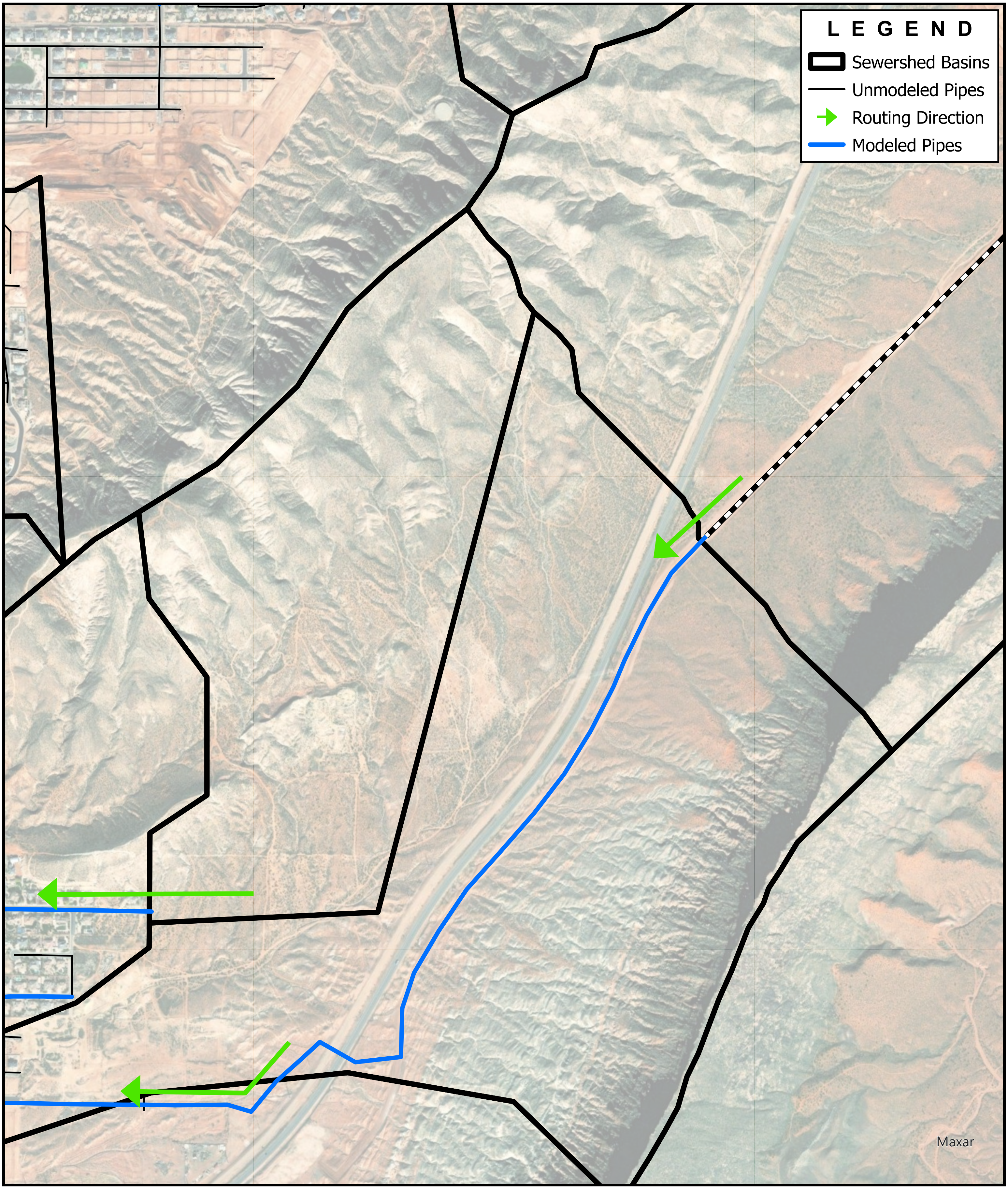


BOWEN COLLINS & ASSOCIATES

SEWERSHED BASINS
FLOW ROUTING

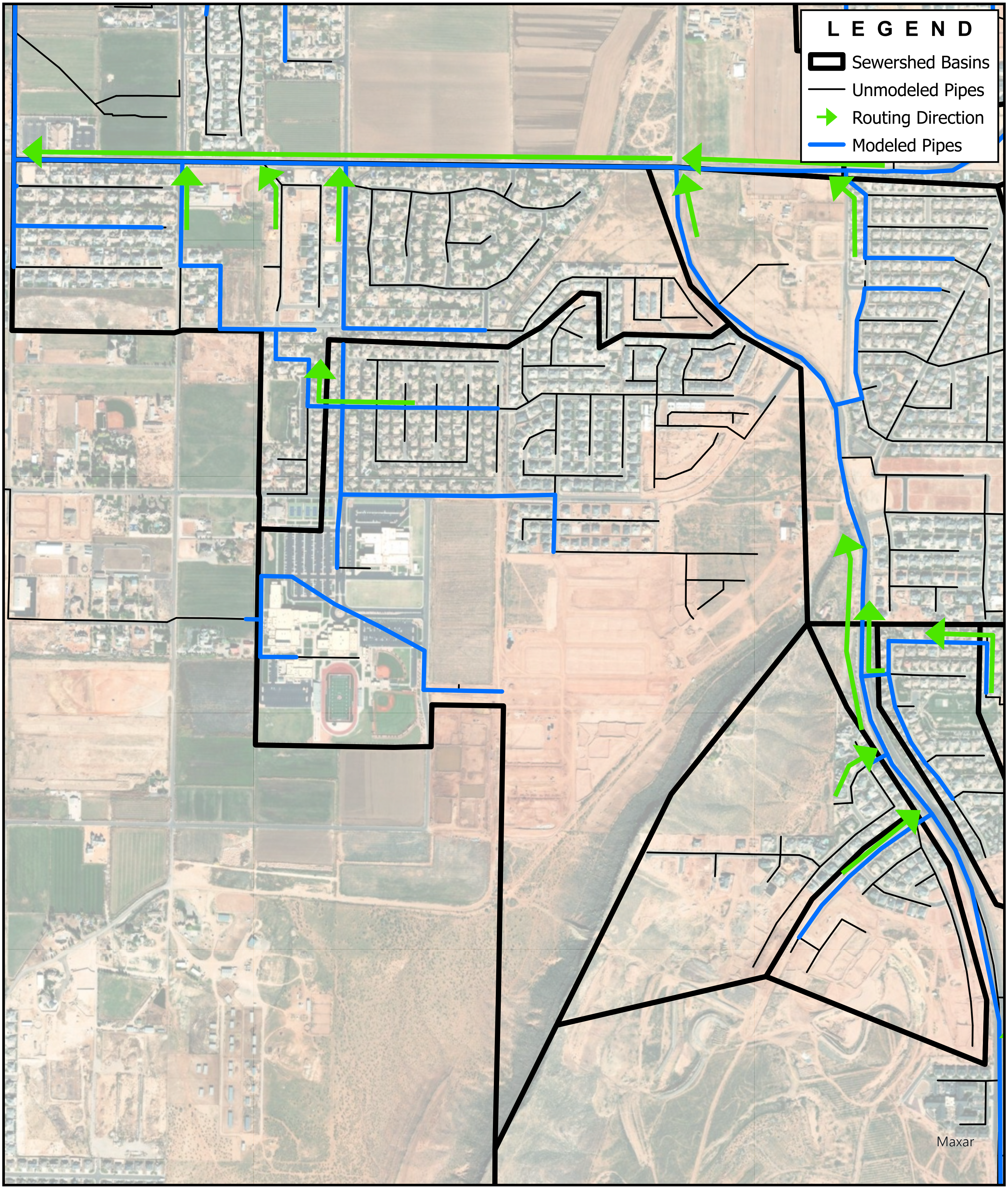
WASHINGTON CITY
SEWER MASTER PLAN

NORTH:

SCALE: 0 500 1,000 Feet

FIGURE NO. 10

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\working2.aprx bclymore 10/2/2024



BOWEN COLLINS & ASSOCIATES

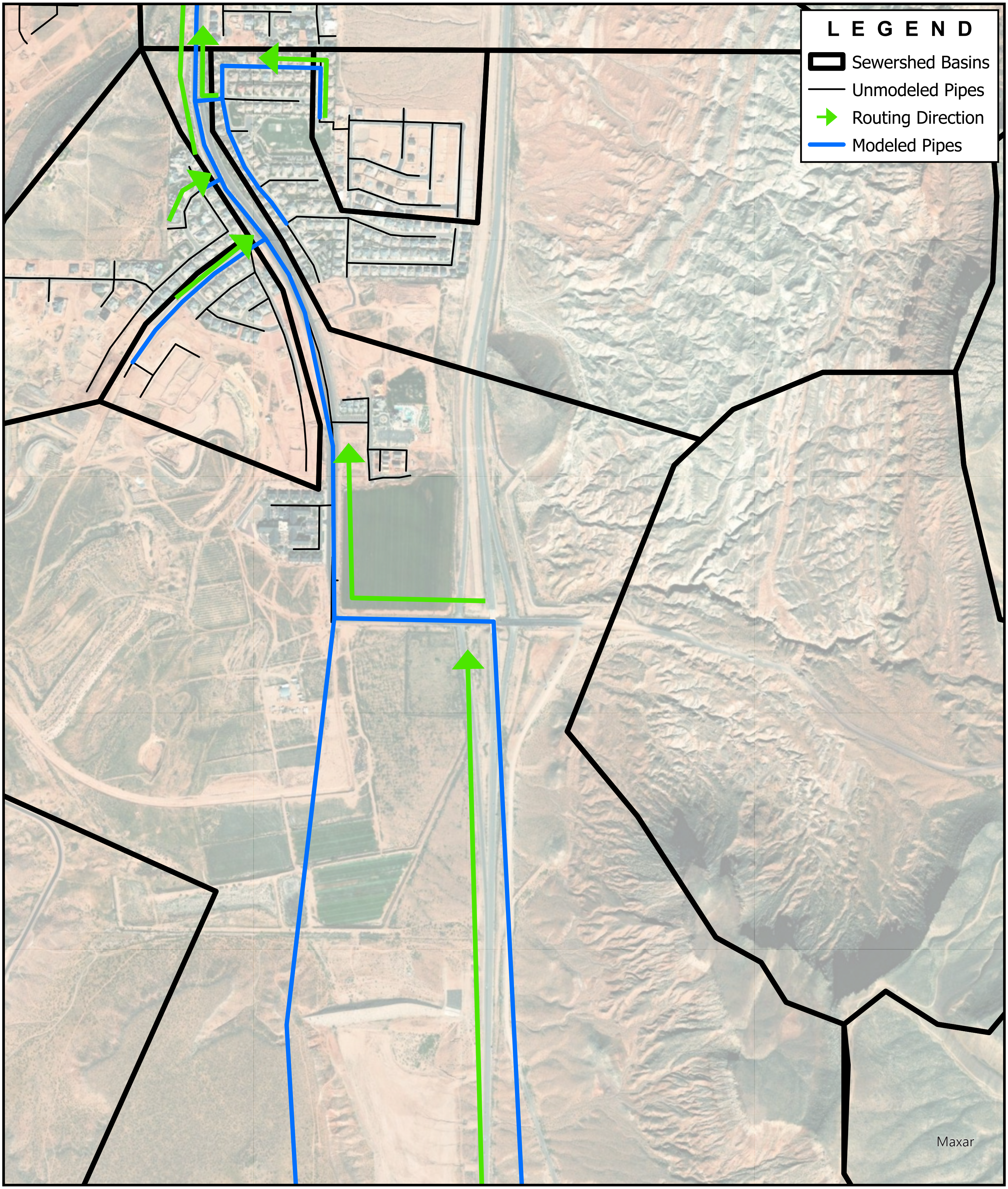
SEWERSHED BASINS
FLOW ROUTING

WASHINGTON CITY
SEWER MASTER PLAN

NORTH:

SCALE:
0 500 1,000
Feet

FIGURE NO.
11



BOWEN COLLINS & ASSOCIATES

SEWERSHED BASINS
FLOW ROUTING

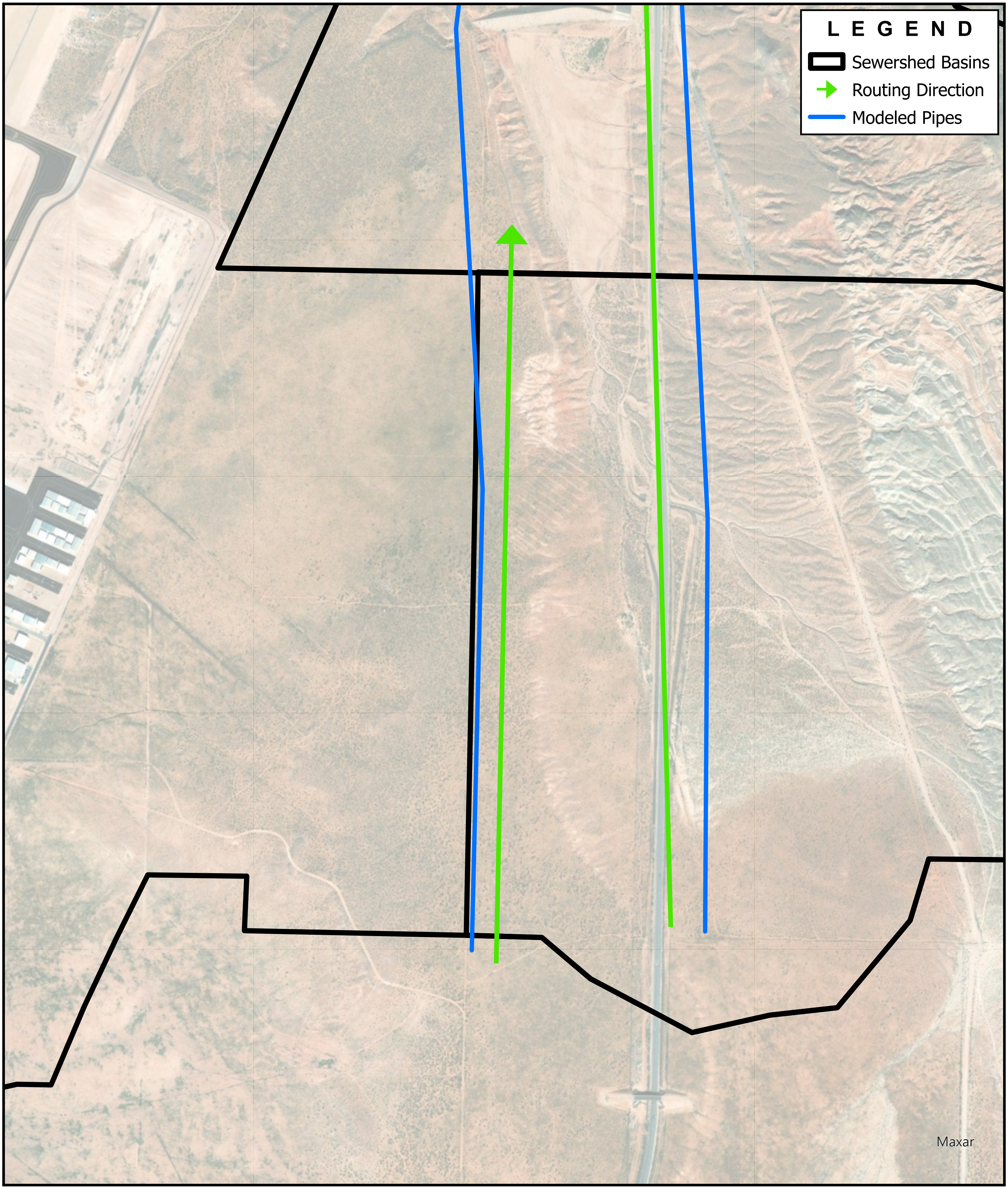
WASHINGTON CITY
SEWER MASTER PLAN

NORTH:

SCALE:
0 500 1,000
Feet

FIGURE NO.
12

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\working2.aprx bclymore 10/2/2024



SEWERSHED BASINS
FLOW ROUTING

WASHINGTON CITY
SEWER MASTER PLAN

BOWEN COLLINS & ASSOCIATES

NORTH:

SCALE: 0 500 1,000 Feet

FIGURE NO. 13

S:\Washington City\446-23-02 Washington City Sewer Master Plan\4.0 GIS\4.3 Figures\working2.aprx bclymore 10/2/2024

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DRAPER, UTAH 84020
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