

# Sewer Master Plan

June 2019

Prepared for:

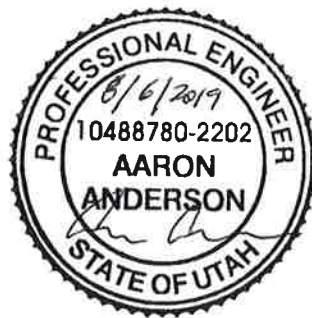


Prepared by:



# 2019 SEWER MASTER PLAN

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## **EXECUTIVE SUMMARY**

### **INTRODUCTION**

The City of St. George (City) contracted the services of Bowen, Collins & Associates, Inc. (BC&A) to complete a Sewer System Master Plan. The purpose of this study is to provide the City with an updated plan to maintain a viable and efficient sewer collection and treatment system capable of meeting the future demands of its service area and satisfying customer expectations.

### **SERVICE AREA**

The City of St. George sewer system service area is shown in Figure ES-1. The service area includes the City of St. George, Washington City, Ivins City, and City of Santa Clara.

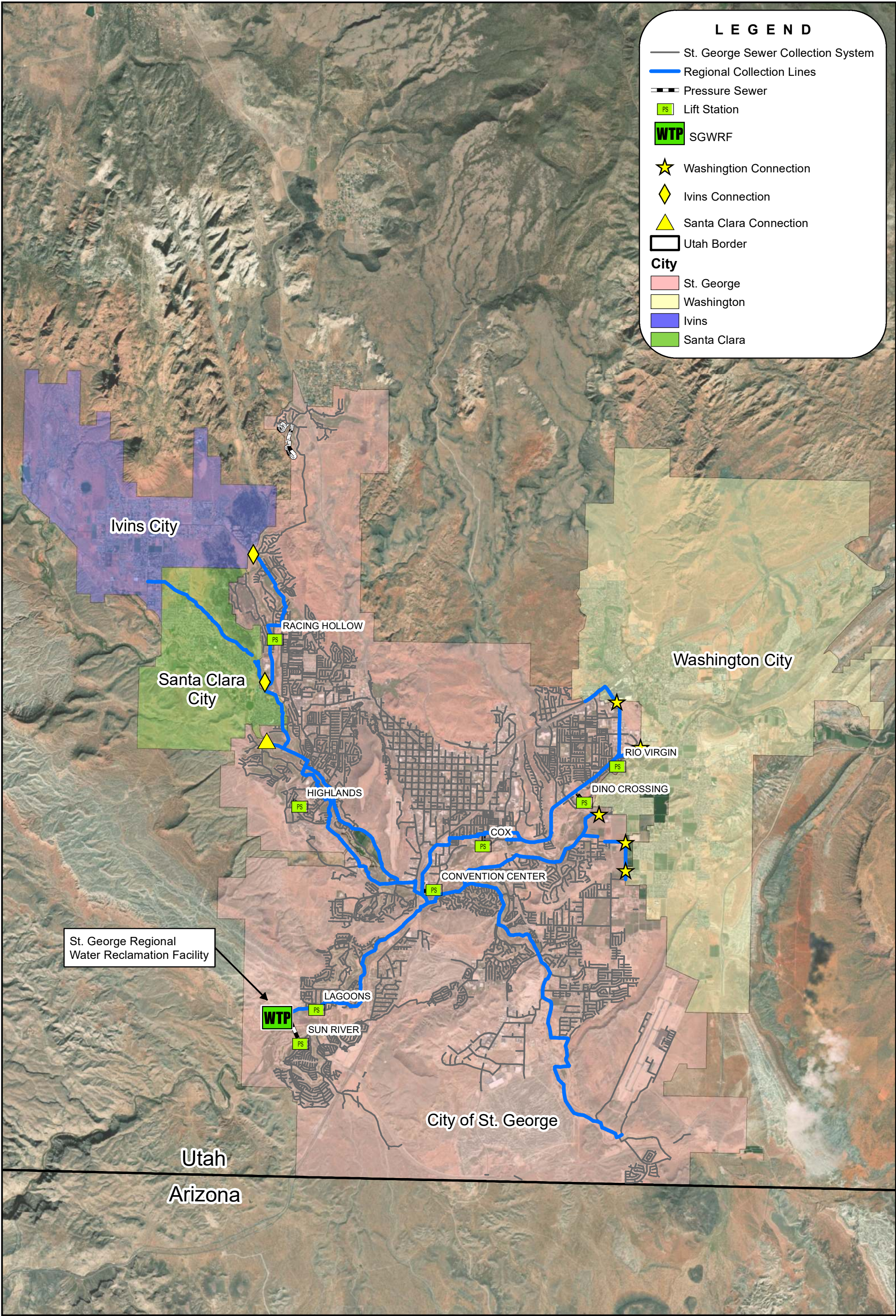
### **PROJECTED GROWTH AND WATER USE**

Sewer system growth projections were developed using the City's current land use and zoning plans in conjunction with the population projections developed by the Governor's Office of Management and Budget. To project future wastewater production, historical water use records were evaluated to estimate indoor water usage and wastewater production rates. These water use records were used to estimate the volume of wastewater produced by an Equivalent Residential Unit, or ERU, providing a method of evaluating all user types as if they represented an equivalent residential population. Wastewater production projections for Washington City, Ivins City, and Santa Clara City were extracted from the most recent sewer master plan from each respective city and integrated into the overall wastewater production estimates. Projected wastewater flows for the St. George sewer collection and treatment system are summarized in Table ES-1.

These customer classes were then converted into Equivalent Residential Units (ERUs), providing a method of evaluating all user types as if they represented an equivalent residential population. The results of this evaluation are shown in Table ES-1.

### **10-YEAR CAPITAL FACILITIES PLAN**

Using the wastewater production estimates for existing and future conditions, the City's local and regional sewer collection and treatment facilities were evaluated. With the aid of a hydraulic computer model, projects were identified to address existing and future deficiencies in the system. Using the results of this analysis, a 10-Year Capital Facilities Plan was developed, which outlines the capital facilities projects that will be needed over the next 10 years in order to provide the needed service to existing and future customers. Table ES-2 provides a summary of the projects included in the 10-Year Capital Facilities Plan.



**Table ES-1**  
**City of St. George Sewer Service Area Wastewater Flow Projections**

| Year | St George<br>ERUs          | Washington<br>ERUs        | Ivins<br>ERUs            | Santa Clara<br>ERUs      | Total Sewer<br>ERUs | Peak Month, Average<br>Day Flow (MGD,<br>Domestic & Infiltration) |
|------|----------------------------|---------------------------|--------------------------|--------------------------|---------------------|-------------------------------------------------------------------|
| 2017 | 40,827                     | 8,979                     | 3,717                    | 2,054                    | 55,577              | 13.73                                                             |
| 2018 | 41,974                     | 9,428                     | 3,979                    | 2,156                    | 57,537              | 14.21                                                             |
| 2019 | 43,170                     | 9,899                     | 4,138                    | 2,264                    | 59,471              | 14.69                                                             |
| 2020 | 44,466                     | 10,394                    | 4,241                    | 2,377                    | 61,478              | 15.19                                                             |
| 2021 | 46,071                     | 10,914                    | 4,411                    | 2,496                    | 63,891              | 15.78                                                             |
| 2022 | 47,734                     | 11,459                    | 4,587                    | 2,621                    | 66,401              | 16.40                                                             |
| 2023 | 49,457                     | 12,032                    | 4,771                    | 2,752                    | 69,012              | 17.05                                                             |
| 2024 | 51,242                     | 12,634                    | 4,961                    | 2,890                    | 71,727              | 17.72                                                             |
| 2025 | 53,092                     | 13,266                    | 5,160                    | 3,034                    | 74,552              | 18.41                                                             |
| 2026 | 55,009                     | 13,929                    | 5,197                    | 3,186                    | 77,320              | 19.10                                                             |
| 2027 | 56,995                     | 14,625                    | 5,405                    | 3,345                    | 80,371              | 19.85                                                             |
| 2028 | 59,052                     | 15,357                    | 5,567                    | 3,512                    | 83,488              | 20.62                                                             |
| 2029 | 61,184                     | 16,124                    | 5,734                    | 3,688                    | 86,731              | 21.42                                                             |
| 2030 | 63,393                     | 16,931                    | 5,835                    | 3,872                    | 90,031              | 22.24                                                             |
| 2031 | 65,192                     | 17,777                    | 6,010                    | 4,066                    | 93,045              | 22.98                                                             |
| 2032 | 67,042                     | 18,666                    | 6,190                    | 4,269                    | 96,168              | 23.75                                                             |
| 2033 | 68,945                     | 19,599                    | 6,376                    | 4,483                    | 99,403              | 24.55                                                             |
| 2034 | 70,901                     | 20,579                    | 6,567                    | 4,707                    | 102,755             | 25.38                                                             |
| 2035 | 72,913                     | 21,608                    | 6,764                    | 4,942                    | 106,228             | 26.24                                                             |
| 2036 | 74,983                     | 22,689                    | 6,995                    | <b>5,189<sup>1</sup></b> | 109,856             | 27.13                                                             |
| 2037 | 77,051                     | 23,823                    | 7,205                    | 5,189                    | 113,268             | 27.98                                                             |
| 2038 | 79,175                     | 25,014                    | 7,421                    | 5,189                    | 116,799             | 28.85                                                             |
| 2039 | 81,230                     | 26,265                    | 7,644                    | 5,189                    | 120,328             | 29.72                                                             |
| 2040 | 83,340                     | 27,578                    | 7,768                    | 5,189                    | 123,875             | 30.60                                                             |
| 2041 | 85,167                     | 28,957                    | 8,001                    | 5,189                    | 127,314             | 31.45                                                             |
| 2042 | 87,037                     | 30,405                    | 8,241                    | 5,189                    | 130,872             | 32.33                                                             |
| 2043 | 88,808                     | 31,925                    | 8,488                    | 5,189                    | 134,411             | 33.20                                                             |
| 2044 | 90,546                     | 33,521                    | 8,743                    | 5,189                    | 138,000             | 34.09                                                             |
| 2045 | 92,249                     | 35,197                    | 9,005                    | 5,189                    | 141,641             | 34.99                                                             |
| 2046 | 93,546                     | 36,957                    | <b>9,477<sup>1</sup></b> | 5,189                    | 145,169             | 35.86                                                             |
| 2047 | 94,717                     | 38,805                    | 9,477                    | 5,189                    | 148,188             | 36.60                                                             |
| 2048 | 95,835                     | 40,745                    | 9,477                    | 5,189                    | 151,247             | 37.36                                                             |
| 2049 | 96,900                     | 42,783                    | 9,477                    | 5,189                    | 154,349             | 38.12                                                             |
| 2050 | 97,910                     | 44,922                    | 9,477                    | 5,189                    | 157,498             | 38.90                                                             |
| 2051 | 98,864                     | 47,168                    | 9,477                    | 5,189                    | 160,699             | 39.69                                                             |
| 2052 | 99,840                     | 49,526                    | 9,477                    | 5,189                    | 164,033             | 40.52                                                             |
| 2053 | 100,759                    | 52,003                    | 9,477                    | 5,189                    | 167,428             | 41.35                                                             |
| 2054 | 101,701                    | 54,603                    | 9,477                    | 5,189                    | 170,970             | 42.23                                                             |
| 2055 | <b>102,797<sup>1</sup></b> | 56,787                    | 9,477                    | 5,189                    | 174,250             | 43.04                                                             |
| 2056 | 102,797                    | 59,058                    | 9,477                    | 5,189                    | 176,522             | 43.60                                                             |
| 2057 | 102,797                    | 61,421                    | 9,477                    | 5,189                    | 178,884             | 44.18                                                             |
| 2058 | 102,797                    | 63,878                    | 9,477                    | 5,189                    | 181,341             | 44.79                                                             |
| 2059 | 102,797                    | 66,433                    | 9,477                    | 5,189                    | 183,896             | 45.42                                                             |
| 2060 | 102,797                    | <b>68,916<sup>1</sup></b> | 9,477                    | 5,189                    | 186,379             | 46.04                                                             |

<sup>1</sup>Bold text indicates the estimated buildout year for each city.

Table ES-2  
10-Year Capital Facilities Plan

| Project       | Description                                            | Estimated<br>2018 Cost | 2019 | 2020         | 2021         | 2022        | 2023        | 2024      | 2025      | 2026        | 2027         | 2028         | 2029        | Total<br>(Inflated<br>Cost) |
|---------------|--------------------------------------------------------|------------------------|------|--------------|--------------|-------------|-------------|-----------|-----------|-------------|--------------|--------------|-------------|-----------------------------|
| L2 - Reach 2  | Tonaquint Dr. Sewer Main Replacement and Realignment   | \$173,000              |      | \$180,000    |              |             |             |           |           |             |              |              |             | \$180,000                   |
| L4            | Commerce Drive Sewer Line Diversion                    | \$460,000              |      | \$469,000    |              |             |             |           |           |             |              |              |             | \$469,000                   |
| L7            | Sun River Lift Station Upgrades                        | \$800,000              |      |              |              |             |             |           | \$901,000 |             |              |              |             | \$901,000                   |
| R1            | Entrada Sewer Main Replacement (North Reach)           | \$323,000              |      |              |              | \$343,000   |             |           |           |             |              |              |             | \$343,000                   |
| R7            | South Woodsvieview Circle Sewer Line Replacement       | \$466,000              |      |              |              |             |             | \$515,000 |           |             |              |              |             | \$515,000                   |
| R11 - Reach 1 | Riverside Drive Sewer Main Replacement                 | \$863,000              |      |              | \$898,000    |             |             |           |           |             |              |              |             | \$898,000                   |
| R14 - Reach 1 | Seegmiller Marsh/1450 S Sewer Line Replacement         | \$1,369,000            |      |              |              |             |             |           |           |             | \$1,604,000  |              |             | \$1,604,000                 |
| R16 - Reach 3 | Fort Pierce Sewer Main Replacement                     | \$1,415,000            |      |              |              |             | \$1,532,000 |           |           |             |              |              |             | \$1,532,000                 |
| R16 - Reach 4 | Fort Pierce Sewer Main Replacement                     | \$2,864,000            |      |              |              | \$3,039,000 |             |           |           |             |              |              |             | \$3,039,000                 |
| R16 - Reach 5 | Fort Pierce Sewer Main Replacement                     | \$1,610,000            |      |              | \$1,675,000  |             |             |           |           |             |              |              |             | \$1,675,000                 |
| R17           | Bloomington Hills Sewer Main Parallel Line             | \$1,811,000            |      |              |              |             |             |           |           | \$2,122,000 |              |              |             | \$2,122,000                 |
| R18           | Bloomington Hills Siphon Expansion Project             | \$1,380,000            |      |              |              |             |             |           |           |             |              |              | \$1,682,000 | \$1,682,000                 |
| R19           | Virgin River/Bloomington Sewer Interceptor Replacement | \$12,075,000           |      |              |              |             |             |           |           |             | \$14,148,000 |              |             | \$14,148,000                |
| R20           | Bloomington Interceptor Sewer Main Replacement Project | \$1,447,000            |      |              |              |             |             |           |           |             |              |              | \$1,764,000 | \$1,764,000                 |
| R21           | South Bloomington Interceptor Project                  | \$11,960,000           |      |              |              |             |             |           |           |             |              | \$14,293,000 |             | \$14,293,000                |
| R22           | SGWRF Sewer Interceptor Replacement Project            | \$874,000              |      | \$874,000    |              |             |             |           |           |             |              |              |             | \$874,000                   |
| T1            | SGWRF Expansion Project (Phase 1)                      | \$29,670,000           |      | \$29,670,000 |              |             |             |           |           |             |              |              |             | \$29,670,000                |
| T2            | SGWRF Expansion and Process Conversion                 | \$41,500,000           |      |              | \$41,500,000 |             |             |           |           |             |              |              |             | \$41,500,000                |
|               | Total Improvements                                     | \$111,060,000          | \$0  | \$31,193,000 | \$44,073,000 | \$3,382,000 | \$1,532,000 | \$515,000 | \$901,000 | \$2,122,000 | \$15,752,000 | \$14,293,000 | \$3,446,000 | \$117,209,000               |

<sup>1</sup>A 2% annual inflation rate has been applied to estimated future projects costs.

## **CHAPTER 1 INTRODUCTION**

### **INTRODUCTION**

The City of St. George (City) has retained Bowen Collins & Associates (BC&A) to prepare a master plan for the wastewater collection system. The purpose of this collection system master plan is to identify solutions for existing deficiencies and a clear path forward for accommodating future growth. Tasks required to achieve this purpose include evaluating the existing sewer collection system, understanding the cause of existing deficiencies, developing viable solutions, projecting future wastewater production from growth, and planning for the future wastewater collection system needs.

The master plan is a working document. The recommended improvements identified in this report are based on the assumption that development will occur in a certain manner. If future growth or development patterns change significantly from those assumed and documented in this report, recommendations may need to be revised. The status of development and an update to the master plan should be reviewed and carried out every five years.

### **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 present and future wastewater collection needs. As part of the Sewer Master Plan, BC&A completed the following tasks:

- **Task 1:** Collect and reviewed data needed to develop the master plan.
- **Task 2:** Develop estimates for existing sewer flow patterns and volumes. This was coordinated with the Water Master Plan.
- **Task 3:** Project future sewer connections and estimated future wastewater production for the City. This was coordinated with the Water Master Plan.
- **Task 4:** Develop a hydraulic computer model of the City of St. George sewer collection system using the InfoSWMM software to evaluate existing and future system deficiencies. This included calibrating the model using available flow data.
- **Task 5:** Evaluated viable improvements for resolving deficiencies identified in Tasks 4. This included evaluating alternatives.
- **Task 6:** Identified a set of recommended system improvements and developed a capital facilities plan incorporating all required improvements identified for the collection and treatment system.
- **Task 7:** Documented results in this master plan report.

## **ACKNOWLEDGMENTS**

The BC&A team wishes to thank the following individuals from the City of St. George for their cooperation and assistance in completing this report:

|                 |                                |
|-----------------|--------------------------------|
| Scott Taylor    | Water Services Director        |
| Kade Bringhurst | Special Projects Manager       |
| Jason Crow      | Sewer Collections Manager      |
| Ben Ford        | SGWRF Manager                  |
| Eric Richins    | SGWRF Superintendent           |
| John Willis     | Community Development Director |
| Wes Jenkins     | Planning and Zoning            |
| David Evans     | GIS Administrator              |

## **PROJECT STAFF**

This project 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 Todd Olsen or Aaron Anderson at (435) 656-3299.

|                |                     |
|----------------|---------------------|
| Keith Larson   | Principle in Charge |
| Todd Olsen     | Project Manager     |
| Aaron Anderson | Project Engineer    |
| Roland Rocha   | Project Engineer    |
| Mike Hilbert   | Clerical            |

## **CHAPTER 2**

### **EXISTING SYSTEM INVENTORY**

#### **INTRODUCTION**

As part of this Master Plan, BC&A has assembled an inventory of existing infrastructure within the St George City sewer collection system. The purpose of this chapter is to present a summary of the City's existing sewer collection system that can be used as a reference for City personnel or future studies.

#### **SERVICE AREA**

The St. George City wastewater collection and treatment service area encompasses all of the City of St. George City as well as Washington City, Ivins City, and Santa Clara City, as shown in Figure 2-1. Wastewater flow from Washington, Ivins, and Santa Clara is conveyed through each city's respective sewer collection system and into the St. George sewer collection system at various locations. Sewer lines located within St. George City boundaries that convey flow from St. George and at least one other municipality are considered "Regional Facilities", while lines that service only St. George are considered "Local Facilities". Regional and local sewer collection lines are identified in Figure 2-1.

#### **TOPOGRAPHY**

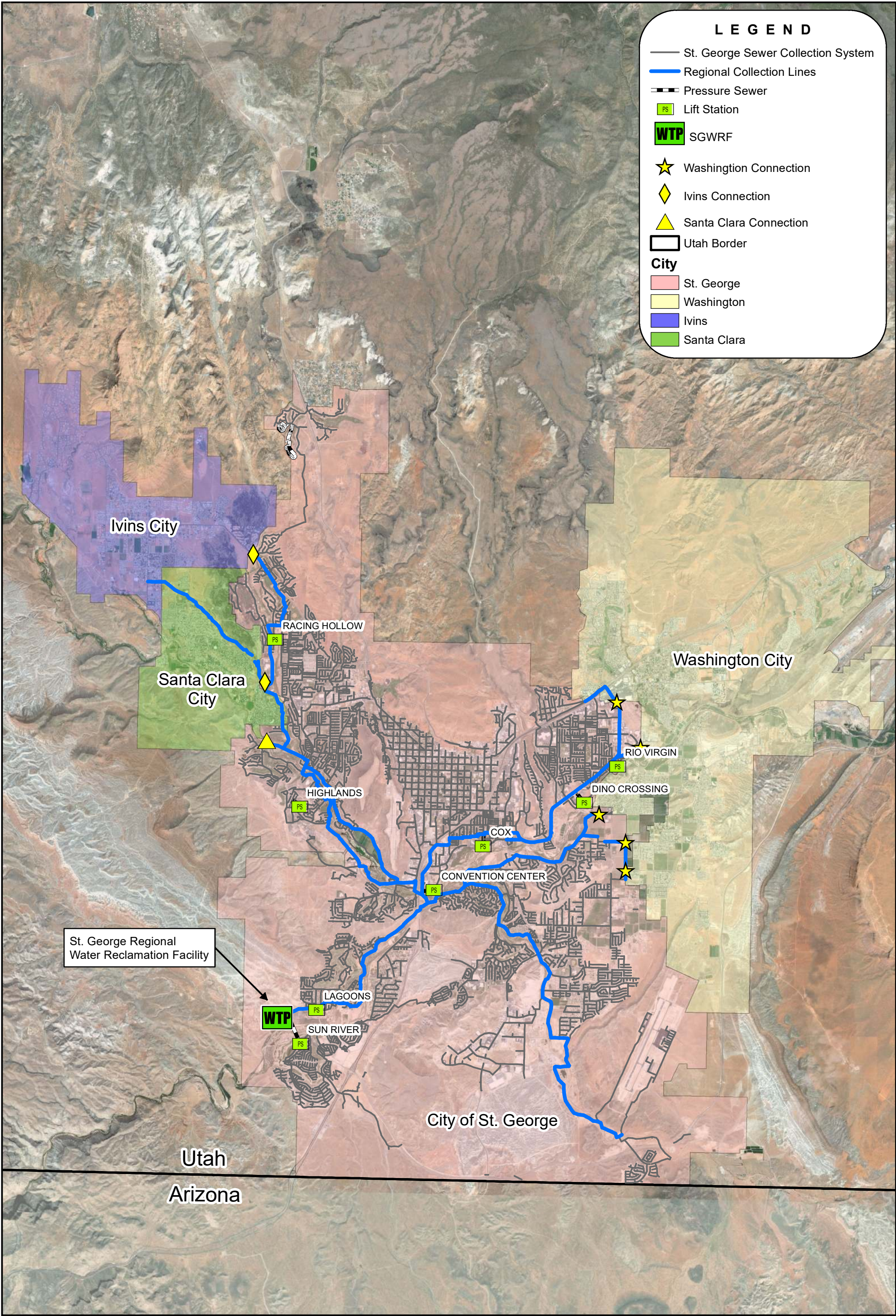
The City generally slopes from north to south and toward the Virgin River. Most of the City collection system flows by gravity with the exception of a few areas that require pumping via a lift station.

#### **COLLECTION SYSTEM**

The components of the St George City sewer collection system are summarized in the following sections.

##### **Sewer Collection Pipes**

There are over 2.4 million feet (459 miles) of gravity sewer collection pipe and over 14,000 feet of pressurized sewer pipe along with more than 10,000 manholes in the St. George City sewer system that are cataloged in the City's GIS database. Table 2-1 contains a summary of the sewer pipes that currently make up the St. George City sewer collection system. As shown in the table, over 75 percent of the gravity collection system is 8-inches in diameter or smaller. This represents the vast network of small collector pipes in neighborhoods throughout the City. Roughly 82% of collection pipes are made of PVC.



**Table 2-1**  
**Sewer Collection System Sizes and Lengths**

| <i>Gravity Sewer Collection Pipe</i>     |                    |                    |                   |
|------------------------------------------|--------------------|--------------------|-------------------|
| <b>Diameter (in.)</b>                    | <b>Length (ft)</b> | <b>Length (mi)</b> | <b>Percentage</b> |
| 4                                        | 1,244              | 0.24               | 0%                |
| 6                                        | 28,610             | 5.42               | 1%                |
| 8                                        | 1,880,146          | 356.09             | 78%               |
| 10                                       | 140,629            | 26.63              | 6%                |
| 12                                       | 102,831            | 19.48              | 4%                |
| 15                                       | 60,806             | 11.52              | 3%                |
| 18                                       | 70,601             | 13.37              | 3%                |
| 21                                       | 46,438             | 8.8                | 2%                |
| 24                                       | 17,377             | 3.29               | 1%                |
| 27                                       | 20,187             | 3.82               | 1%                |
| 30                                       | 12,931             | 2.45               | 1%                |
| 36                                       | 19,385             | 3.67               | 1%                |
| 38                                       | 865                | 0.16               | 0%                |
| 48                                       | 20,912             | 3.96               | 1%                |
| <b>Subtotal</b>                          | <b>2,422,961</b>   | <b>458.9</b>       | <b>100%</b>       |
| <i>Pressurized Sewer Collection Pipe</i> |                    |                    |                   |
| 1.5                                      | 1,862              | 0.35               | 13%               |
| 2                                        | 2,736              | 0.52               | 19%               |
| 3                                        | 5,075              | 0.96               | 34%               |
| 4                                        | 1,116              | 0.21               | 8%                |
| 8                                        | 1,164              | 0.22               | 8%                |
| 12                                       | 2,819              | 0.53               | 19%               |
| <b>Subtotal</b>                          | <b>14,772</b>      | <b>2.80</b>        | <b>100%</b>       |
| <b>Total</b>                             | <b>2,437,733</b>   | <b>461.70</b>      |                   |

## Sewer Lift Stations

There are eight lift stations in the City's collection system. Table 2-2 provides a summary of the lift station facilities.

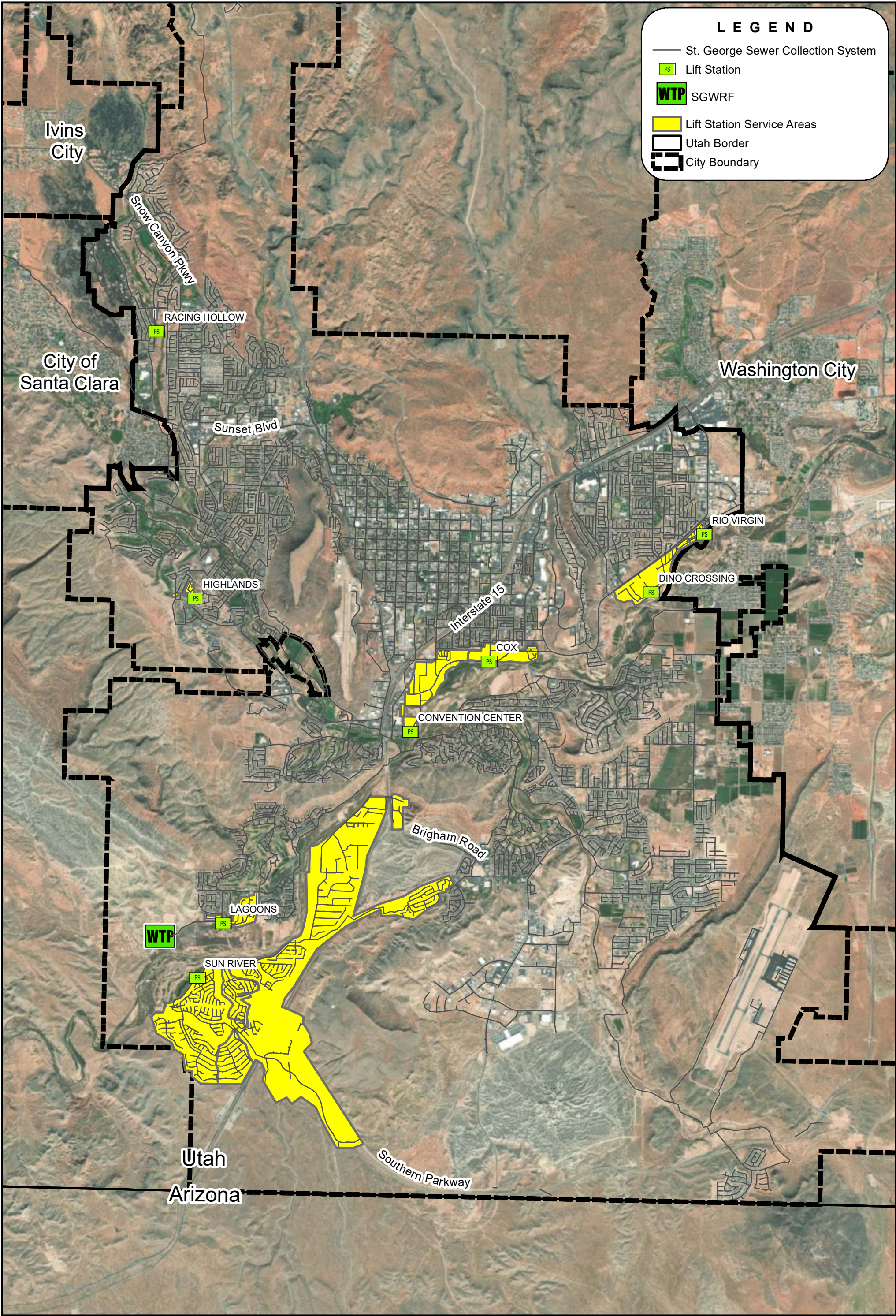
**Table 2-2**  
**Sewer Lift Station Summary**

| <b>Lift Station Name</b> | <b>Approximate Lift Station Service Area (acres)</b> | <b>Percentage of Total Service Area</b> |
|--------------------------|------------------------------------------------------|-----------------------------------------|
| Sun River                | 2,157                                                | 10.58%                                  |
| Convention Center        | 162                                                  | 0.79%                                   |
| Dino Crossing            | 127                                                  | 0.62%                                   |
| Cox                      | 87                                                   | 0.43%                                   |
| Lagoons                  | 56                                                   | 0.27%                                   |
| Rio Virgin               | 19                                                   | 0.09%                                   |
| Highlands                | 14                                                   | 0.07%                                   |
| Racing Hollow            | 5                                                    | 0.02%                                   |
| <b>Total</b>             | <b>2,627</b>                                         | <b>12.90%</b>                           |

Figure 2-2 highlights the areas within the City's service area that are serviced by lift stations. Due to the infrastructure and ongoing resources required, these areas likely represent the highest service costs per connection for the system.

## ST. GEORGE WATER RECLAMATION FACILITY

Wastewater produced in St. George, Washington, Ivins, and Santa Clara is treated at the St. George Regional Water Reclamation Facility located in the southwest end of St. George (see Figure 2-1). The plant currently treats approximately 14 million gallons per day (MGD) and has a capacity of 17 MGD. Wastewater that has undergone the treatment process through the plant is discharged to the Virgin River. During the irrigation season, the St. George Reuse Facility has the capability of treating up to 7.0 MGD of treatment plant effluent to Type 1 reuse quality standards. Water treated at the reuse facility is pumped into the City's irrigation system to be used on golf course, parks, etc.



**LEGEND**

St. George Sewer Collection System

PS

Lift Station

WTP

SGWRF

Lift Station Service Areas

Utah Border

City Boundary

## CHAPTER 3

### WASTEWATER FLOW EVALUATION AND GROWTH PROJECTIONS

#### INTRODUCTION

A key aspect of the master planning process is developing projections of population growth within the City's service area. Population projections have a direct impact on important components of the master plan, including the projected timing of capital improvements. Over-estimating population growth projections may lead to poorly timed capital improvement projects for the City, which results in aggressive future rate and impact fee increases that may not actually be necessary. The opposite is true for under-estimating growth, which could leave the City without the necessary financial backing to carry out required capital improvements as well as not providing sufficient lead time for projects.

The purpose of this chapter is to develop growth projections for the City by analyzing historical growth trends as well as reviewing population projections developed by local planning authorities and other national and state planning agencies. Since the City of St. George provides sewer collection and treatment services to the Washington, Santa Clara, and Ivins, growth projections from each respective community has been incorporated into this study based on the information found in each communities respective Sewer Master Plan or Impact Fee Facilities Plan. These projections, together with an analysis of existing wastewater production trends, have been used to project future wastewater production demand on the City's system.

#### HISTORICAL GROWTH TRENDS

The City of St. George has seen significant growth in the last few decades. Table 3-1 summarizes population growth for St. George from the year 1990 to 2010 based on data available from the United States Census Bureau.

**Table 3-1**  
**U.S. Census Bureau Historical Population Growth for St. George**

| <b>Year</b> | <b>City of St. George<br/>Population</b> | <b>% Growth</b> |
|-------------|------------------------------------------|-----------------|
| 1990        | 28,572                                   |                 |
| 2000        | 49,663                                   | 73.8%           |
| 2010        | 72,897                                   | 46.8%           |

As shown in Table 3-1, the City of St. George saw a significant boom in growth from 1990 to 2000, continuing on into the following decade. Using the information provided in Table 3-1, Table 3-2 shows the average yearly growth rate for St. George over each respective decade.

**Table 3-2**  
**Average Annual Growth Rate<sup>1</sup> in St. George from 1990 to 2010**

| <b>Time Period</b> | <b>Average Annual Growth Rate<sup>1</sup></b> |
|--------------------|-----------------------------------------------|
| 1990-2000          | 5.7%                                          |
| 2000-2010          | 3.3%                                          |

<sup>1</sup> Represents the average annual growth rate based on U.S. Census records

While the data from the census provides a reliable, high-level overview of growth information for the City in historic 10-year increments, historic annual growth in the area can be monitored in more detail by looking at the increase in new service connections each year (determined by the City approving building permits). Multiplying the number of new service connections by the average household size in the City provides an estimate for population growth from year to year. The most recent U.S. Census Bureau estimate for average household size in St. George is 2.88 persons/household. To see how this compares to other communities near St. George, Table 3-3 provides a summary of average household size estimates for other cities in the Southern Utah/Southern Nevada area. As shown in the table, St. George is just below the average for household size in the region.

**Table 3-3**  
**Average Household Size Comparison**

| <b>City</b>           | <b>U.S. Census Estimate for Average Household Size</b> |
|-----------------------|--------------------------------------------------------|
| <b>St. George, UT</b> | <b>2.88</b>                                            |
| Washington City, UT   | 2.99                                                   |
| Ivins City, UT        | 2.78                                                   |
| Hurricane, City, UT   | 2.9                                                    |
| Santa Clara City, UT  | 3.75                                                   |
| Cedar City, UT        | 3.0                                                    |
| Mesquite, NV          | 2.34                                                   |
| <b>Average</b>        | <b>2.95</b>                                            |

Table 3-4 shown below shows the records of new building permits issued within the City from 2014 to 2018.

**Table 3-4**  
**Building Permits Issued in the City of St. George (2014 – 2017)**

|                                   | <b>2014</b>  | <b>2015</b>  | <b>2016</b>  | <b>2017</b>  | <b>2018</b>  |
|-----------------------------------|--------------|--------------|--------------|--------------|--------------|
| Single Family                     | 576          | 741          | 790          | 944          | 942          |
| Townhomes                         | 110          | 46           | 46           | 102          | 274          |
| Apartment/Duplex                  | 2            | 2            | 1            | 15           | 11           |
| Mobile Homes                      | 1            | 3            | 1            | 1            | 6            |
| Condos                            | 12           | 0            | 1            | 35           | 20           |
| Commerical/Industrial             | 119          | 109          | 25           | 117          | 201          |
| Miscellaneous/Additions*          | 655          | 685          | 900          | 742          | 805          |
| Hospital/Interior Finish          | 0            | 1            | 2            | 3            | 18           |
| Institutes/Schools/Day Care       | 1            | 1            | 0            | 0            | 0            |
| Public/Airport/Parks              | 12           | 6            | 16           | 1            | 3            |
| Religious                         | 0            | 3            | 1            | 1            | 2            |
| <b>Subtotal – All Permits</b>     | <b>1,488</b> | <b>1,597</b> | <b>1,783</b> | <b>1,961</b> | <b>2,282</b> |
| Residential                       | 701          | 792          | 839          | 1,097        | 1,253        |
| Non-Residential                   | 132          | 120          | 44           | 122          | 224          |
| <b>Total, Excluding Home Add.</b> | <b>833</b>   | <b>912</b>   | <b>883</b>   | <b>1,219</b> | <b>1,477</b> |

\*Miscellaneous/Home Additions were not included in total number considering that they typically do not represent an increase in the population or water use.

Detailed water meter records from the City and data from the Washington County Recorder indicate that at the end of 2017 there were a total of 33,107 residential connections and 2,293 permanent non-residential connections (commercial, industrial, institutional, etc.). Using the U.S. Census Bureau estimate for household size in St. George, the estimated total residential population in St. George as of 2017 was:

$$33,107 \text{ residential connection} \times 2.88 \frac{\text{persons}}{\text{household}} = 95,349 \text{ residents}$$

**Note that this estimate does include the transient population in the area (i.e. second homes, short term rental units, etc.), but for the purposes of sewer system master planning, all of these units will be treated as if they were a primary residence.** It should be noted that, based on County Recorder records, St. George is home to over 6,500 secondary residences that may be occupied for only a portion of the year. However, when comparing water use between primary residences and secondary residences, meter data records indicate that secondary homes use only 10% less water over the course of the year than primary residences, which supports to approach of treating all connections as if they were primary residences.

Table 3-5 outlines the estimated growth rate for St. George from the 2014-2018.

**Table 3-5**  
**Summary of Recent Historical Growth in the City of St. George (2014 – 2017)**

| <b>Year</b>                     | <b>2014</b> | <b>2015</b>  | <b>2016</b>  | <b>2017</b>  | <b>2018</b> |
|---------------------------------|-------------|--------------|--------------|--------------|-------------|
| New Residential Connections     | 701         | 792          | 839          | 1097         | 1253        |
| Total Residential Connections   | 30,379      | 31,171       | 32,010       | 33,107       | 34,360      |
| <b>Growth Rate</b>              |             | <b>2.6%</b>  | <b>2.7%</b>  | <b>3.4%</b>  | <b>3.8%</b> |
| New Non-Residential Connections | 132         | 120          | 44           | 122          | 224         |
| Non-Residential Connections     | 2,037       | 2,157        | 2,201        | 2,323        | 2,547       |
| <b>Growth Rate</b>              |             | <b>5.89%</b> | <b>2.04%</b> | <b>5.54%</b> | <b>9.6%</b> |

As shown in Table 3-5, the residential growth rate steadily increased over the past 5 years, with an estimated rate of 3.43% from 2016 – 2017 and 3.8% from 2017-2018, while non-residential growth fluctuated from year to year. Growth in St. George recently caught national attention as it was identified as the fastest growing metropolitan area in the country, in which the US Census estimated a 4% growth rate from 2016 – 2017 (which included not only St. George but also the majority of Washington County).

Considering that there are a number of large developments currently planned or under construction in the area, including the large master-planned South Block area, it is reasonable to assume that the City will continue to grow at a relatively aggressive rate into the foreseeable future. Through correspondence with City management, the City has elected to use the population projections developed for the Governor’s Office of Management and Budget (GOMB), which match historical growth trends relatively well. Table 3-6 summarizes the growth projections from the GOMB for St. George. These projections form the basis of growth projections used in this report, with a minor modification that is discussed in the following section.

**Table 3-6**  
**GOMB Growth Projections for St. George City**

| <b>Year</b>                | <b>2010</b> | <b>2020</b> | <b>2030</b> | <b>2040</b> | <b>2050</b> | <b>2060</b> |
|----------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| St. George Population      | 72,897      | 103,851     | 148,078     | 196,206     | 249,421     | 307,037     |
| Average Annual Growth Rate |             | 3.60%       | 3.61%       | 2.85%       | 2.43%       | 2.10%       |

## **ESTIMATED BUILDOUT POPULATION**

The build-out population (the population when all developable land in the City has been developed) of St. George has been estimated using the City’s current land use and zoning plans. The land use and zoning plans identify the location and type of development that has been approved for specific areas throughout the City. The City’s General Plan describes the difference between the zoning map and land use map:

*The Zoning Map...and the Land Use Plan...work hand-in-hand with each other. The Land Use Plan indicates general density ranges and indicates how development is to be located on the land, with special regard to preserving special natural features. The Zones in the Zoning Map are legal designations that assign a specific overall density to a specific tract of land.*

Through coordination with City management, the buildout population estimate for St. George was developed using portions of each plan. In some areas, the Land Use Plan provides a more accurate representation of future development density, while the Zoning Plan provides more detailed information in other areas. In this sense, buildout population estimates were developed using a “composite” land use/zoning plan. In addition to the general Land Use and Zoning plans, another component considered in this analysis are Planned Development Areas, or “PD”s, which are specific areas of the City that have an established and approved number of development units. PD’s have been accounted for in the estimation of buildout population.

In order to estimate the service area population at full buildout for the City, the currently undeveloped areas of the City needed to be identified and separated from the currently developed areas. This was done using Geographic Information System (GIS) mapping tools to “clip out” areas of the City which are currently developed from the overall land use and zoning plan, leaving only the undeveloped areas with their associated land use and zoning type and respective area. This is illustrated in Figure 3-1 (colored areas are those have are yet to be developed or that represent permanent open space or other preservation areas. Using the result of this exercise, Table 3-7 provides a summary of the estimated service area population that will added when all undeveloped land in the City is developed.

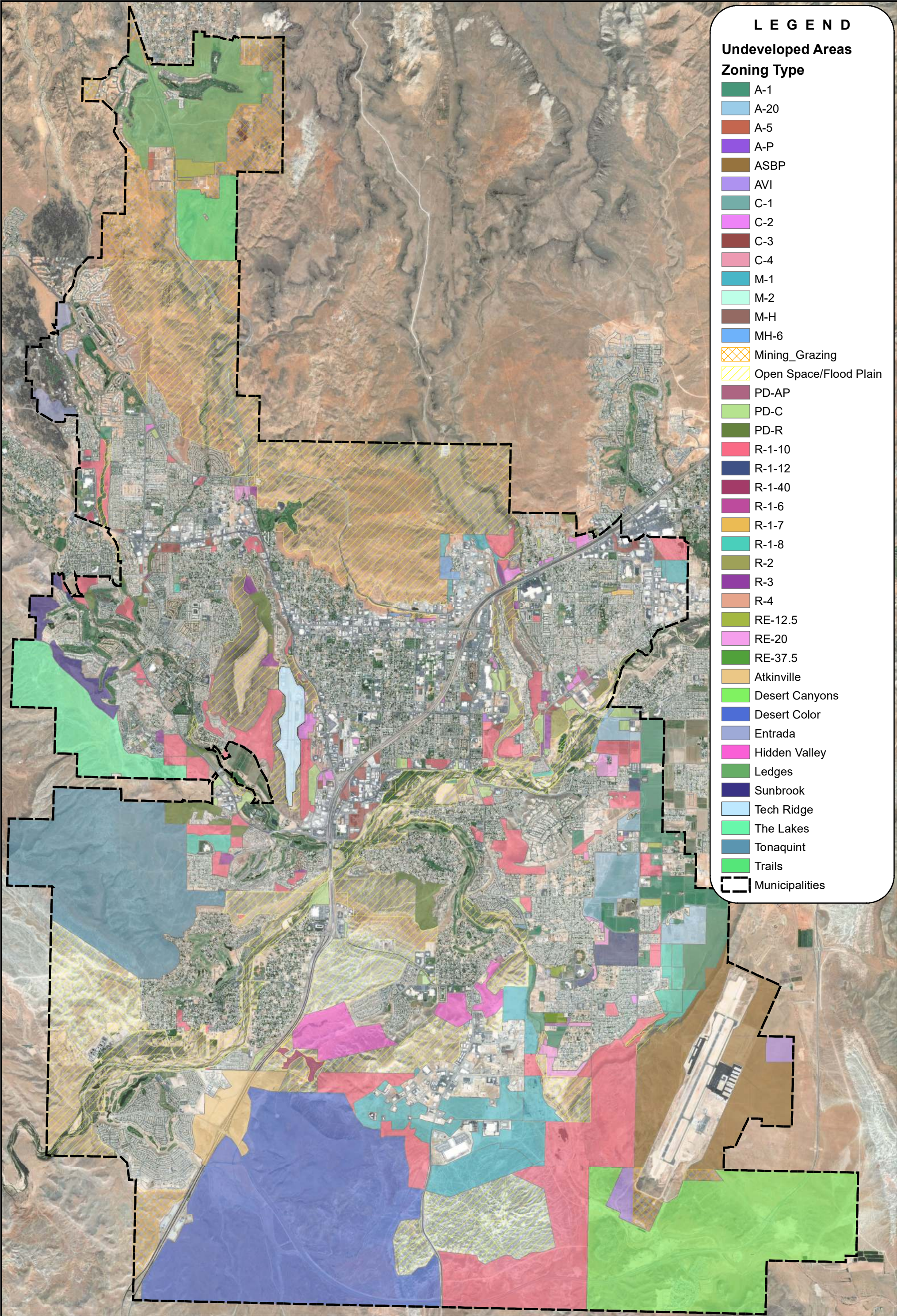


Table 3-7  
Evaluation of Undeveloped Land by Land Use/Zoning Category

| Zoning Code              | Development Description                           | Area (Acres)   | Density (Units Per Acre) | Number of Units | Estimated Added Residential Population <sup>1</sup> |
|--------------------------|---------------------------------------------------|----------------|--------------------------|-----------------|-----------------------------------------------------|
| A-1                      | Agricultural Use, Min. 40,000 SF                  | 776.3          | 1.00                     | 776.3           | 2,236                                               |
| A-20                     | Agricultural Use, Min 20 Acres                    | 408.4          | 0.05                     | 20.4            | 59                                                  |
| A-5                      | Agricultural Use, Min 5 Acres                     | 10.3           | 0.20                     | 2.1             | 6                                                   |
| A-P                      | Administrative and Professional, No Min Area      | 4.0            | 5.00                     | 19.8            |                                                     |
| ASBP                     | Airport Supporting Business Park                  | 1,118.4        | 2.00                     | 2,236.7         |                                                     |
| AVI                      | Airport Vicinity Industrial                       | 134.1          | 1.00                     | 134.1           |                                                     |
| C-1                      | Commercial, No Min Area                           | 5.7            | 2.00                     | 11.5            |                                                     |
| C-2                      | Commercial, No Min Area                           | 99.4           | 2.50                     | 248.5           |                                                     |
| C-3                      | Commercial, No Min Area                           | 161.3          | 3.00                     | 483.9           |                                                     |
| C-4                      | Commercial, No Min Area                           | 0.0            | 3.50                     | 0.2             |                                                     |
| M-1                      | Manufacturing, No Min Area                        | 1,025.9        | 0.50                     | 513.0           |                                                     |
| M-2                      | Manufacturing, Min 40,000 SF                      | 0.1            | 7.50                     | 0.7             |                                                     |
| M-H                      | Mobile Home                                       | 2.3            | 6.00                     | 13.8            | 40                                                  |
| MH-6                     | Mobile Home Min 6,000 SF                          | 33.3           | 6.00                     | 199.9           | 576                                                 |
| Mining_Grazing           | Mining/Grazing, No Area Min                       | 1,252.9        | 0.00                     | 0.0             |                                                     |
| OS                       | Open Space, No Min Area                           | 9,824.6        | 0.00                     | 0.0             |                                                     |
| PD-AP                    | Planned Development - Admin & Professional Office | 12.9           | 2.00                     | 25.9            |                                                     |
| PD-C                     | Planned Development - Comm                        | 239.2          | 2.00                     | 478.3           |                                                     |
| PD-R                     | Planned Development - Res                         | 341.9          | 4.00                     | 1,367.5         | 3,938                                               |
| R-1-10                   | Single Family Res. Min 10,000 SF                  | 3,044.7        | 3.20                     | 9,743.1         | 28,060                                              |
| R-1-12                   | Single Family Res. Min 12,000 SF                  | 130.7          | 2.80                     | 366.1           | 1,054                                               |
| R-1-40                   | Single Family Res. Min 40,000 SF                  | 39.0           | 1.00                     | 39.0            | 112                                                 |
| R-1-6                    | Single Family Res. Min 6,000 SF                   | 7.0            | 7.00                     | 49.0            | 141                                                 |
| R-1-7                    | Single Family Res. Min 7,000 SF                   | 9.6            | 6.00                     | 57.5            | 166                                                 |
| R-1-8                    | Single Family Res. Min 8,000 SF                   | 216.0          | 3.70                     | 799.0           | 2,301                                               |
| R-2                      | Multi-Unit Res. Min 6,000 SF                      | 32.9           | 7.00                     | 230.0           | 663                                                 |
| R-3                      | Multi-Unit Res. Min 6,000 SF                      | 97.5           | 13.00                    | 1,267.3         | 3,650                                               |
| R-4                      | Multi-Unit Res. Min 6,000 SF                      | 0.0            | 20.00                    | 0.0             | 0                                                   |
| RE-12.5                  | Residential Estate Min 12,500 SF                  | 113.7          | 3.00                     | 341.1           | 982                                                 |
| RE-20                    | Residential Estate Min 20,000 SF                  | 132.3          | 2.00                     | 264.5           | 762                                                 |
|                          | Vacant Lots Not in a Planned Development          | NA             | NA                       | 758             | 2,183                                               |
|                          | <b>TOTAL</b>                                      | <b>19,275</b>  |                          | <b>20,447</b>   | <b>46,929</b>                                       |
| Atkinville               | Planned Development                               | Not Applicable | varies                   | 1,057           | 3,044                                               |
| Desert Canyons           | Planned Development                               | Not Applicable | varies                   | 7,267           | 18,193                                              |
| Desert Color             | Planned Development                               | Not Applicable | varies                   | 10,108          | 26,173                                              |
| Entrada                  | Planned Development                               | Not Applicable | varies                   | 324             | 933                                                 |
| Hidden Valley            | Planned Development                               | Not Applicable | varies                   | 400             | 1,152                                               |
| Ledges                   | Planned Development                               | Not Applicable | varies                   | 2,125           | 6,120                                               |
| Stone Cliff              | Planned Development                               | Not Applicable | varies                   | 211             | 608                                                 |
| Sunbrook                 | Planned Development                               | Not Applicable | varies                   | 593             | 1,708                                               |
| Sun River                | Planned Development                               | Not Applicable | varies                   | 100             | 288                                                 |
| Tech Ridge (Old Airport) | Planned Development                               | Not Applicable | varies                   | 3,500           | 6,912                                               |
| The Lakes                | Planned Development                               | Not Applicable | varies                   | 3,196           | 9,204                                               |
| Tonaquint                | Planned Development                               | Not Applicable | varies                   | 1,445           | 4,162                                               |
| Trails                   | Planned Development                               | Not Applicable | varies                   | 923             | 2,658                                               |
|                          | <b>TOTAL</b>                                      |                |                          | <b>31,249</b>   | <b>81,156</b>                                       |
|                          | <b>GRAND TOTAL</b>                                |                |                          | <b>51,696</b>   | <b>128,085</b>                                      |

<sup>1</sup>Non-residential land use do not represent an increase is residential population. However, non-residential development does increase water use, which is accounted for using the ERU methodology.

As shown in Table 3-7, the remaining areas of the City to be developed are estimated to increase the City population by **128,085**, resulting in a total build-out population of:

$$95,349 \text{ residents (existing)} + 128,085 \text{ (future)} = \mathbf{223,434 \text{ residents}}$$

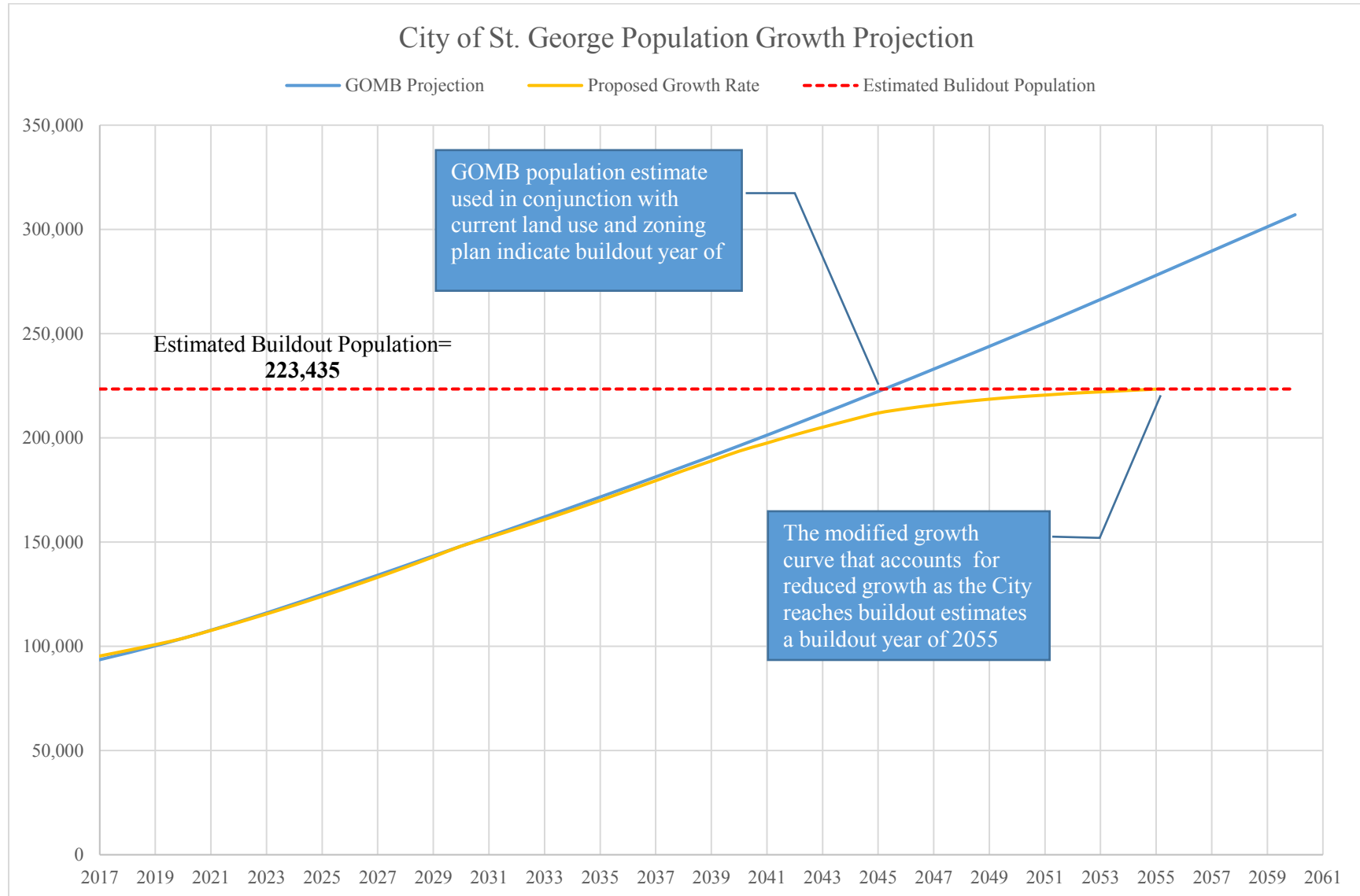
Using this build-out population estimate, Table 3-8 and Figure 3-2 provide the estimated population growth projection for the City. As previously mentioned, the City has elected to utilize the population projections development for the GOMB. Based on the GOMB growth estimates and the City's current land use plan, St. George would reach its full buildout capacity by approximately 2043. However, in reality, population growth tends to slow as it reaches its full carrying capacity (i.e. growth does not abruptly stop at full buildout; the growth rate will gradually slow as buildout is approached). This considered, Table 3-8 and Figure 3-2 display 2 growth curves for reference:

- **Governor's Office of Management and Budget:** This growth curve displays the actual growth projection developed for the GOMB. As shown, the full buildout population is reach by the year 2043. Based on the current land use evaluation for the City, it appears that the GOMB growth projections may over-estimate the total buildout population of the City, so some adjustment of the projection as it reaches the estimated buildout population is necessary.
- **Modified GOMB Project Adjusted after 2030 (Recommended for Planning):** This modified growth curve uses the growth projections developed for the GOMB through the year 2030 followed by a gradual decrease in the annual growth rate to produce a more realistic outlook through buildout. Using this approach, it is estimated that the City will reach buildout by the year 2055. It should be emphasized that buildout estimates are just that – an estimate. Changes in land use and zoning plans, City annexations, etc. will all influence how large the City will actually become. For this reason, master plans should be updated frequently enough to keep up with revised development plans in the City.

**Table 3-8  
St. George Population Growth Estimate**

| <b>Year</b> | <b>Population</b> | <b>Notes</b>                                              |
|-------------|-------------------|-----------------------------------------------------------|
| 2017        | 95,349            |                                                           |
| <b>2018</b> | <b>98,028</b>     | <b>Existing Population</b>                                |
| 2019        | 100,822           |                                                           |
| 2020        | 103,851           |                                                           |
| 2021        | 107,600           |                                                           |
| 2022        | 111,484           |                                                           |
| 2023        | 115,509           |                                                           |
| 2024        | 119,679           |                                                           |
| 2025        | 123,999           |                                                           |
| 2026        | 128,475           |                                                           |
| 2027        | 133,113           |                                                           |
| <b>2028</b> | <b>137,919</b>    | <b>10-Year Growth Projection</b>                          |
| 2029        | 142,898           |                                                           |
| 2030        | 148,056           |                                                           |
| 2031        | 152,202           |                                                           |
| 2032        | 156,463           |                                                           |
| 2033        | 160,844           |                                                           |
| 2034        | 165,348           |                                                           |
| 2035        | 169,978           |                                                           |
| 2036        | 174,737           |                                                           |
| 2037        | 179,455           |                                                           |
| 2038        | 184,300           |                                                           |
| 2039        | 188,908           |                                                           |
| 2040        | 193,631           |                                                           |
| 2041        | 197,503           |                                                           |
| 2042        | 201,453           |                                                           |
| 2043        | 205,079           |                                                           |
| 2044        | 208,566           |                                                           |
| <b>2045</b> | <b>211,903</b>    | <b>GOMB Projection - Estimated Buildout Year</b>          |
| 2046        | 214,022           |                                                           |
| 2047        | 215,734           |                                                           |
| 2048        | 217,244           |                                                           |
| 2049        | 218,548           |                                                           |
| 2050        | 219,640           |                                                           |
| 2051        | 220,519           |                                                           |
| 2052        | 221,401           |                                                           |
| 2053        | 222,065           |                                                           |
| 2054        | 222,731           |                                                           |
| <b>2055</b> | <b>223,435</b>    | <b>Modified GOMB Projection - Estimated Buildout Year</b> |

**Figure 3-2**  
**Population Growth Projections for the City of St. George**



## EVALUATION OF HISTORICAL WATER USE IN THE CITY

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 codes 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 the code are typically conservative when compared to actual sewer flows in a collection system. For this reason, sewer flows specific to the City of St. George have been developed and used in this master plan study. As previously mentioned, per capita sewer flows from other communities that utilize the St. George City collection and treatment system will be incorporated into this study based on their respective current sewer master plans.

In order to estimate and project future sewer flows for the system, historical water use data was analyzed in order to determine per capita wastewater production rates. Like most public sewer collection and treatment systems, St. George provides service to both residential and non-residential customers. This considered, the residential population of the City only represents a portion of the wastewater production on the system. For this reason, it often makes sense to represent and evaluate wastewater production in terms of Equivalent Residential Units (ERUs) rather than on the basis of population (i.e. per capita). An Equivalent Residential Unit represents the wastewater production of a typical residential sewer connection. Upon defining the amount of wastewater produced by 1 ERU, non-residential water users, such as hotels, retail outlets, restaurants, industrial facilities, etc. can be converted into ERUs based on their respective water usage. In essence, using the ERU as a wastewater production measurement allows the City to convert non-residential water users into an “equivalent” residential population.

Sewer flows are the combination of three components:

- Domestic flow
- Infiltration
- Inflow

The following sections of this chapter outline how each of these flow components has been accounted for in this study.

### ***Domestic Wastewater Flow***

Domestic wastewater is categorized as flow that intentionally enters the collection system from a home, business, or other connection. Ideally, domestic wastewater should make up the majority of flow in the sewer collection system. Wastewater flow from individual homes is not metered, but it can be estimated as a percentage of the metered culinary water use during winter months when outdoor irrigation is not occurring. To identify an estimate for the amount of water used by a residential connection, metered water use data from the year 2017 was evaluated. St. George’s “residential” meter category contains all types of residential housing, including single family homes, apartments, townhomes, and duplexes. When evaluating total overall water use (indoor

and outdoor), there is a significant difference between these different types of dwellings. However, when evaluating only indoor water use, the difference is assumed to be negligible. Table 3-9 contains the total metered culinary water use data for St. George from the year 2017.

**Table 3-9**  
**Summary of St. George City Meter Data**

| <b>Description</b>                                                             | <b># of Meters</b> | <b>Culinary Water Use<br/>(gallons/year)</b> |
|--------------------------------------------------------------------------------|--------------------|----------------------------------------------|
| Agricultural                                                                   | 30                 | 6,011,280                                    |
| Commercial - Permanent User                                                    | 1,659              | 1,111,940,781                                |
| Commercial - Construction Water<br>(contractor hydrant)                        | 279                | 129,827,690                                  |
| Government (City Facilities,<br>including municipal golf courses<br>and parks) | 314                | 172,917,860                                  |
| Industrial                                                                     | 42                 | 136,760,390                                  |
| Residential (includes master<br>metered communities)                           | 28,872             | 5,917,297,117                                |
| Wholesale (Ivins and Santa Clara)                                              | 9                  | 1,279,895,340                                |
| Institutional                                                                  | 278                | 412,269,130                                  |
| <b>Total</b>                                                                   | <b>31,483</b>      | <b>7,887,024,248*</b>                        |

As shown in Table 3-9, the City had 28,872 residential meters in the system (which includes single-family units, multi-family units, and master metered communities) in 2017. Records from the County Recorder's Office and GIS tools were used to estimate the actual number of residential service connections in the system at this time, which was estimated to be 33,107 connections.

Using the meter data shown in Table 3-9, average daily water demand per residential connection is estimated to be:

$$\frac{5,956,917,917 \text{ gallons}}{33,107 \text{ connections}} = 179,929.25 \frac{\text{gallons/connection}}{\text{year}} = 493 \frac{\text{gallons/connection}}{\text{day}}$$

Since this value represents average daily water use over the course of the year, 493 gpd includes both indoor and outdoor water use. In order to determine the amount of water which contributes to flow in the wastewater collection and treatment system, only the indoor component of water use should be considered. Water use records indicate that over the course of the year, for the system as a whole, approximately 51% of water is used outdoors and 49% of water is used indoors. Under these assumptions, average annual wastewater production per residential connection is estimated to be:

$$\text{Average Daily Indoor Water Use (per ERU)} = 493 \text{ gpd} \times 0.49 = 242 \text{ gpd}$$

Based on BC&A's experience with sewer collections systems, it is estimated that approximately 90-95% of indoor water use is non-consumptive and directly enters the sewer system after use. For this master plan, it has been assumed that 90% of estimated indoor use enters the sewer collection system. Under this assumption, average daily domestic wastewater flow per ERU is:

$$\text{Average Daily Domestic Sewer Flow (per ERU)} = 242 \text{ gpd} \times 0.9 = \mathbf{217 \text{ gpd}}$$

As shown above, it is estimated that the average daily domestic wastewater flow per ERU is 217 gpd. In wastewater planning, it is typical to project sewer flow in terms of "peak month, average day" (PMAD) production, which is the average daily production during the peak flow month of the year. Through an evaluation of the City's flow data at the SGWRF, it is estimated that peak month, average day flow is 3% higher than average daily flow. This considered, the estimated peak month, average day flow per ERU is:

$$\text{PMAD Domestic Sewer Flow (per ERU)} = 217 \text{ gpd} \times 1.03 = \mathbf{224 \text{ gpd}}$$

### ***Infiltration***

Beyond domestic wastewater production, the second component of wastewater flow that must be considered is 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 as a result of open pipe joints, cracks in pipes, pipes poorly connected at manholes, leaky 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 may 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 will be considered as 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. Temporary flow monitoring at various locations in the system can help identify areas of excessive groundwater infiltration. For planning purposes, infiltration in the St. George system was estimated using the ASCE recommended daily infiltration allowance for new sewer systems of 400 gallons per inch diameter of pipe per mile of pipe. From previous planning experience, this equates to approximately 10% - 20% of domestic wastewater flows. For this study, it has been estimated that infiltration is equal to approximately 10% of domestic flow per residential connection, which equates to 23 gpd per connection. Therefore, the combined sewer flow (domestic & infiltration) per ERU is estimated to be:

$$\text{Total WW Flow per ERU} = 224 \text{ gpd} + 23 \text{ gpd} = \mathbf{247 \text{ gallons per day}}$$

### ***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 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 raising levels of ground water as a result of rain is considered inflow. Without a significant amount of rainfall and sewer flow monitoring data, it is difficult to accurately identify the quantity and location of inflow in the system. For this reason, inflow has not been directly included in wastewater projections. Instead, a conservative amount of capacity will be reserved in collection pipes to account for inflow events. This is discussed in further detail in Chapter 4.

### **DETERMINING TOTAL SERVICE AREA ERUS**

Total wastewater production is a combination of flows from not only residential connections, but includes flow from commercial, industrial, and institutional connections as well. The total number of ERUs for the sewer collection and treatment service area are shown in Table 3-10. The ERU count for St. George is based on converting the metered water use found in Table 3-9 into an equivalent number of sewer system ERUs. The following should be noted about the development of sewer system ERUs in St. George:

- Non-residential sewer ERUs have been adjusted to reflect a 75% non-consumptive water use rather than the 90% non-consumptive use assumed for residential connections.
- Meter categories that do not contribute to sewer flows have been excluded from the total ERU count. This includes the following categories:
  - Construction Water – construction water is used for watering roads, washing equipment, and other activities that do not directly contribute to sewer flows.
  - Government – Per discussion with City personnel, this category is primarily irrigation for golf courses and parks. While a small portion of water use may contribute to wastewater flows, such as park bathrooms, the vast majority of water used from category is for irrigation and therefore does not directly enter the sewer collection system.

Sewer ERUs for Washington, Ivins, and Santa Clara have been taken from each City's respective sewer master plan.

**Table 3-10**  
**Total ERUs on St. George Sewer Service Area (Baseline 2017)**

| <b>City</b>  | <b>ERUs</b>   |
|--------------|---------------|
| St. George   | 40,827        |
| Washington   | 8,979         |
| Ivins        | 3,717         |
| Santa Clara  | 2,054         |
| <b>Total</b> | <b>55,577</b> |

### PROJECTED WASTEWATER FLOWS

Table 3-11 provides a summary of wastewater flow projections (domestic flow and infiltration) for the sewer service area through buildout. ERU projections in the table are based upon the individual growth projections and buildout years for each respective City in the service area. It should be noted that the total peak month, average day sewer flow shown in the table is higher than the recorded flows at the SGWRF. Indoor water use estimates as well as temporary sewer monitoring efforts carried out by the City provide compelling evidence that the recorded flows at the plant are lower than they actually are. While the exact source of this error is not known exactly, it could be attributed in part to the following:

- The flow measurement apparatus at the treatment plant may be inaccurate.
- There may be exfiltration in certain areas of the collection system where wastewater is leaking out of pipes.

Whatever the cause may be, it was decided to use the more conservative total flow estimate for planning. As part of the ongoing upgrades at the SGWRF, the City will be installing new metering equipment that will provide a more accurate read on flows entering the plant.

**Table 3-11**  
**Wastewater Flow Projections for St. George Service Area<sup>1</sup>**

| <b>Year</b> | <b>St. George ERUs</b>     | <b>Washington ERUs</b>    | <b>Ivins ERUs</b>        | <b>Santa Clara ERUs</b>  | <b>Total Sewer ERUs</b> | <b>Peak Month, Average Day Flow (MGD, Domestic &amp; Infiltration)</b> |
|-------------|----------------------------|---------------------------|--------------------------|--------------------------|-------------------------|------------------------------------------------------------------------|
| 2017        | 40,827                     | 8,979                     | 3,717                    | 2,054                    | 55,577                  | 13.73                                                                  |
| 2018        | 41,974                     | 9,428                     | 3,979                    | 2,156                    | 57,537                  | 14.21                                                                  |
| 2019        | 43,170                     | 9,899                     | 4,138                    | 2,264                    | 59,471                  | 14.69                                                                  |
| 2020        | 44,466                     | 10,394                    | 4,241                    | 2,377                    | 61,478                  | 15.19                                                                  |
| 2021        | 46,071                     | 10,914                    | 4,411                    | 2,496                    | 63,891                  | 15.78                                                                  |
| 2022        | 47,734                     | 11,459                    | 4,587                    | 2,621                    | 66,401                  | 16.40                                                                  |
| 2023        | 49,457                     | 12,032                    | 4,771                    | 2,752                    | 69,012                  | 17.05                                                                  |
| 2024        | 51,242                     | 12,634                    | 4,961                    | 2,890                    | 71,727                  | 17.72                                                                  |
| 2025        | 53,092                     | 13,266                    | 5,160                    | 3,034                    | 74,552                  | 18.41                                                                  |
| 2026        | 55,009                     | 13,929                    | 5,197                    | 3,186                    | 77,320                  | 19.10                                                                  |
| 2027        | 56,995                     | 14,625                    | 5,405                    | 3,345                    | 80,371                  | 19.85                                                                  |
| 2028        | 59,052                     | 15,357                    | 5,567                    | 3,512                    | 83,488                  | 20.62                                                                  |
| 2029        | 61,184                     | 16,124                    | 5,734                    | 3,688                    | 86,731                  | 21.42                                                                  |
| 2030        | 63,393                     | 16,931                    | 5,835                    | 3,872                    | 90,031                  | 22.24                                                                  |
| 2031        | 65,192                     | 17,777                    | 6,010                    | 4,066                    | 93,045                  | 22.98                                                                  |
| 2032        | 67,042                     | 18,666                    | 6,190                    | 4,269                    | 96,168                  | 23.75                                                                  |
| 2033        | 68,945                     | 19,599                    | 6,376                    | 4,483                    | 99,403                  | 24.55                                                                  |
| 2034        | 70,901                     | 20,579                    | 6,567                    | 4,707                    | 102,755                 | 25.38                                                                  |
| 2035        | 72,913                     | 21,608                    | 6,764                    | 4,942                    | 106,228                 | 26.24                                                                  |
| 2036        | 74,983                     | 22,689                    | 6,995                    | <b>5,189<sup>1</sup></b> | 109,856                 | 27.13                                                                  |
| 2037        | 77,051                     | 23,823                    | 7,205                    | 5,189                    | 113,268                 | 27.98                                                                  |
| 2038        | 79,175                     | 25,014                    | 7,421                    | 5,189                    | 116,799                 | 28.85                                                                  |
| 2039        | 81,230                     | 26,265                    | 7,644                    | 5,189                    | 120,328                 | 29.72                                                                  |
| 2040        | 83,340                     | 27,578                    | 7,768                    | 5,189                    | 123,875                 | 30.60                                                                  |
| 2041        | 85,167                     | 28,957                    | 8,001                    | 5,189                    | 127,314                 | 31.45                                                                  |
| 2042        | 87,037                     | 30,405                    | 8,241                    | 5,189                    | 130,872                 | 32.33                                                                  |
| 2043        | 88,808                     | 31,925                    | 8,488                    | 5,189                    | 134,411                 | 33.20                                                                  |
| 2044        | 90,546                     | 33,521                    | 8,743                    | 5,189                    | 138,000                 | 34.09                                                                  |
| 2045        | 92,249                     | 35,197                    | 9,005                    | 5,189                    | 141,641                 | 34.99                                                                  |
| 2046        | 93,546                     | 36,957                    | <b>9,477<sup>1</sup></b> | 5,189                    | 145,169                 | 35.86                                                                  |
| 2047        | 94,717                     | 38,805                    | 9,477                    | 5,189                    | 148,188                 | 36.60                                                                  |
| 2048        | 95,835                     | 40,745                    | 9,477                    | 5,189                    | 151,247                 | 37.36                                                                  |
| 2049        | 96,900                     | 42,783                    | 9,477                    | 5,189                    | 154,349                 | 38.12                                                                  |
| 2050        | 97,910                     | 44,922                    | 9,477                    | 5,189                    | 157,498                 | 38.90                                                                  |
| 2051        | 98,864                     | 47,168                    | 9,477                    | 5,189                    | 160,699                 | 39.69                                                                  |
| 2052        | 99,840                     | 49,526                    | 9,477                    | 5,189                    | 164,033                 | 40.52                                                                  |
| 2053        | 100,759                    | 52,003                    | 9,477                    | 5,189                    | 167,428                 | 41.35                                                                  |
| 2054        | 101,701                    | 54,603                    | 9,477                    | 5,189                    | 170,970                 | 42.23                                                                  |
| 2055        | <b>102,797<sup>1</sup></b> | 56,787                    | 9,477                    | 5,189                    | 174,250                 | 43.04                                                                  |
| 2056        | 102,797                    | 59,058                    | 9,477                    | 5,189                    | 176,522                 | 43.60                                                                  |
| 2057        | 102,797                    | 61,421                    | 9,477                    | 5,189                    | 178,884                 | 44.18                                                                  |
| 2058        | 102,797                    | 63,878                    | 9,477                    | 5,189                    | 181,341                 | 44.79                                                                  |
| 2059        | 102,797                    | 66,433                    | 9,477                    | 5,189                    | 183,896                 | 45.42                                                                  |
| 2060        | 102,797                    | <b>68,916<sup>1</sup></b> | 9,477                    | 5,189                    | 186,379                 | 46.04                                                                  |

<sup>1</sup> Bold text indicates the estimated buildout year for each city.

## LOCATION OF GROWTH OVER 10 YEAR PLANNING WINDOW

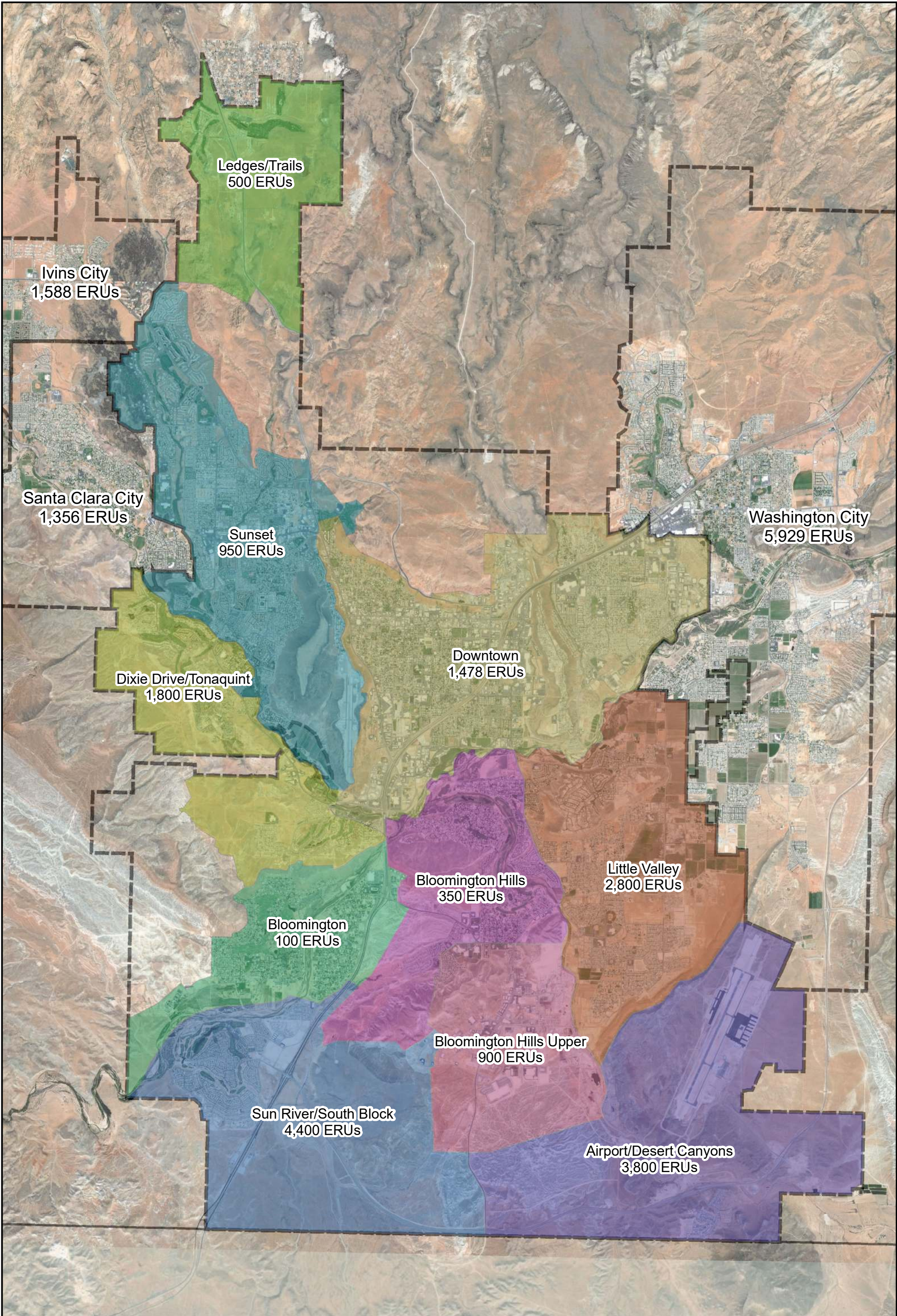
To the extent possible, it is helpful in planning to understand the timing and location of growth within the service area, particularly within the 10-year growth window. While it is impossible to predict the exact location and timing of all growth which will occur in the City, reasonable estimates can be made by evaluating recent growth trends and identifying “hotspots” in the system (areas experiencing development). Through discussions with City staff, hotspots within the City service area have been identified and growth has been divided between different regions. The estimated distribution of growth for St. George is shown in Table 3-12. Distribution of growth for Washington, Ivins, and Santa Clara was estimated using engineering and planning judgment. The regions shown in Table 3-12 are represented in Figure 3-3.

**Table 3-12**  
**Estimated Distribution of Growth over 10-Year Planning Window**

| <b>Region</b>           | <b>10 Year Growth<br/>in ERUs</b> | <b>% of 10 Year<br/>Growth</b> |
|-------------------------|-----------------------------------|--------------------------------|
| Ledges/Trails           | 500                               | 2%                             |
| Sunset                  | 950                               | 4%                             |
| Dixie Drive/Tonaquint   | 1,800                             | 7%                             |
| Downtown                | 1,478                             | 6%                             |
| Bloomington             | 100                               | 1%                             |
| Bloomington Hills       | 350                               | 1%                             |
| Little Valley           | 2,800                             | 11%                            |
| Bloomington Hills Upper | 900                               | 3%                             |
| Sun River/South Block   | 4,400                             | 17%                            |
| Airport/Desert Canyons  | 3,800                             | 15%                            |
| Washington City         | 5,929                             | 23%                            |
| Ivins City              | 1,588                             | 6%                             |
| Santa Clara City        | 1,356                             | 5%                             |
| <b>Total</b>            | <b>25,951</b>                     |                                |

## STATE OF UTAH WATER CONSERVATION GOAL

The State of Utah set a water conservation goal in the year 2000 to reduce per capita water usage by 25% by the year 2025, measured from usage in the year 2000. Because water conservation is typically achieved primarily through the reduction of outdoor water use, no further reduction in sewer flows due to conservation was assumed for the planning window of this study. It is recommended that the City continue to track city-wide water usage and adjust projections accordingly in future master plans to account for any changes in per capita water use patterns.



## **CHAPTER 4**

### **HYDRAULIC MODELING**

#### **INTRODUCTION**

The St. George City sewer collection system has been evaluated with the aid of a hydraulic computer model and the flow projections outlined in Chapter 3. An extended period simulation (EPS) hydraulic model was developed using Innovyze's InfoSWMM software. This chapter presents a summary of the methodology used to develop and run 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, pipe invert elevations, pipe slope, pipe diameters, manhole rim elevations, pump settings in lift stations, and a description of any diversions present. This information has been collected from GIS system inventory data and direct field observation provided by St. George City personnel. Where discrepancies appeared in the GIS data (i.e. manhole inverts that resulted in unreasonable adverse pipe slopes), manhole inverts in the model were adjusted to produce a constant grade slope between manholes. The following sections describe how geometric data was assembled for use in the hydraulic model.

##### **Pipeline and Manhole Locations**

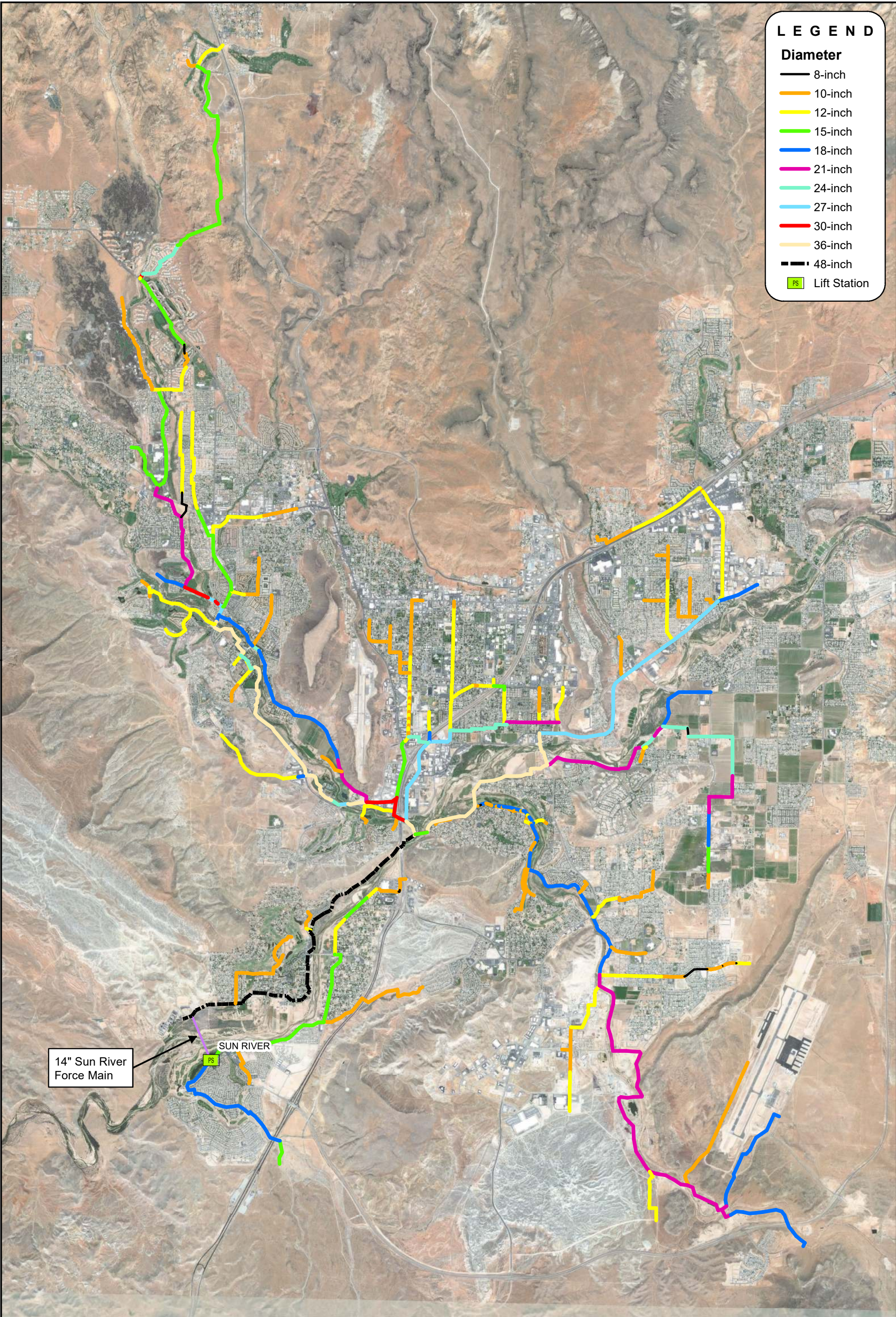
St. George City has put considerable effort into assembling an up-to-date GIS inventory of its existing sewer facilities. This database includes information on the location and size of manholes and pipelines in the collection system. Based on direction from City personnel, pipeline and manhole data was taken directly from the GIS database for use in the model. In some areas where data was incomplete or suspect, values were adjusted to provide a more realistic representation of the system. Given the size and complexity of the collections system, there may still be inaccuracies in the model that will need to be refined as more information becomes available. It is recommended that the City provide periodic updates to the model to maintain it as an effective short-term planning, operations, and system management tool.

##### **Scope of Modeled Pipelines**

The hydraulic model includes pipelines 10-inches and larger as well as some smaller diameter pipes that are necessary for general system connectivity. Figure 4-1 displays the set of pipes and lift stations that were included in the hydraulic model evaluation. This allows the analysis to focus on the central and more critical elements of the collection system network. The model can be readily expanded in the future to include all piping as site specific questions arise.

##### **Energy Loss Considerations**

As wastewater flows through the system, whether it be by gravity or through a pumped force main, energy is lost through pipe friction, bends through manholes, excessive buildup of debris, etc. This energy loss is accounted for by assigning appropriate loss coefficients in fundamental flow equations. Pipe flow coefficients used throughout the hydraulic model were assigned to have a



LEGEND

Diameter

8-inch

10-inch

12-inch

15-inch

18-inch

21-inch

24-inch

27-inch

30-inch

36-inch

48-inch

PS Lift Station

14" Sun River  
Force Main

SUN RIVER

Manning's coefficient of 0.013. An energy loss coefficient (K) of 0.3 was applied to each reach of pipe to account for potential dynamic entry and exit energy losses through manholes.

### **Accounting for Sediment, Debris, and Other Obstructions**

Underground sewer mains are commonly filled with sediment, debris, and other semi-permanent obstructions like tree roots. These obstructions decrease, sometimes severely, the capacity of the pipelines. These issues are often identified and resolved with regular pipeline maintenance. These types of obstructions have not been modeled and the system has been evaluated under a "clean pipe" scenario.

### **Lift Stations**

St. George City has 7 small lift stations that generally serve single streets or small subdivisions. There is also one larger lift station (Sun River) that serves a portion of the southeast corner of the City. The Sunriver lift station is the only lift station included in the sewer collection model. City staff ran a series of pump tests at Sun River to verify the actual pumping capacity of the installed pumps. The original manufacturers pump curves were modified to match the current pumping capacity. The on/off setpoints for the pumps have been modeled so that the pumps react as they would in the field during extended period simulations.

### **FLOW DATA**

Once all required geometric data was collected and a virtual model of the system was developed, flow data was input to model the system hydraulics. Three characteristics of wastewater flow are required for hydraulic modeling. These include peak day flow volumes, diurnal patterns, and spatial distribution of flow sources. Each of these flow characteristics is discussed below.

#### **Peak Flow Rates/Diurnal Flow Pattern**

Wastewater flow projections outlined in Chapter 3 provide flow estimates in terms of peak month, average day flows. However, the more critical flow condition in the collection system is that of a peak flow condition. Water use varies throughout the course of the day, resulting in variable flows through the collection system as a function of time. Peak flow rates in the system can be estimated by looking at the diurnal flow patterns through the collection system pipes.

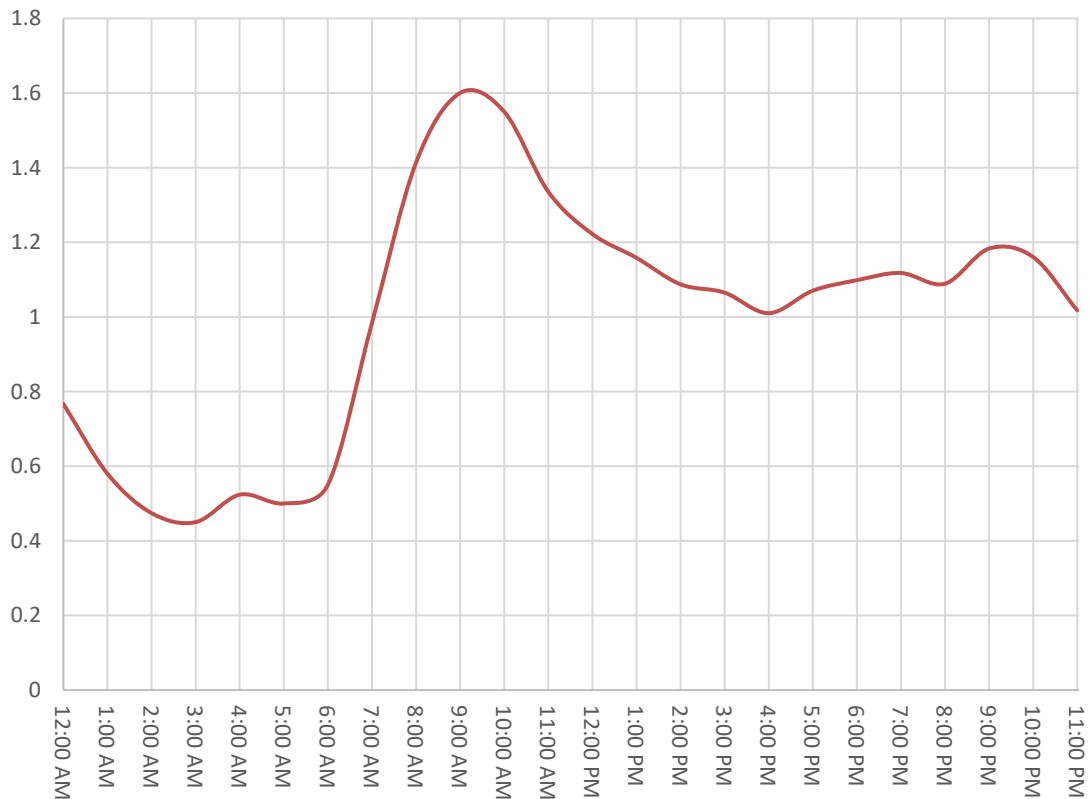
The hourly pattern of wastewater discharge from sewer users is the "diurnal" pattern of the collection system. Diurnal flow patterns vary from one community to the next but tend to follow a general trend of peaking in the morning as the City wakes up and again in the evening as the City prepares to end the day. Commercial connections may exhibit different diurnal wastewater patterns that are unique to their specific wastewater discharge such as a wash down and cleaning cycles between regimented production periods.

The ratio of the average diurnal curve value to the peak curve value is termed the "peaking factor". Utah Administrative Code R317-3 – "Design Requirements for Wastewater Collections, Treatment and Disposal Systems" requires that sewer systems apply a 2.5 peaking factor to trunklines. However, if reliable flow data suggests otherwise, customized peaking factors for a system can be developed and used for planning. From experience, the UAC requirement of 2.5 is

generally conservative, and actual measured collections system flows tend to have a lower peaking factor.

To estimate the wastewater peaking factor for the St. George City collection system, flow data from various flow meters throughout the system were evaluated. An averaged pattern from this data is shown in Figure 4-2.

**Figure 4-2**  
**Averaged Diurnal Pattern from Wastewater Flow Meters in St. George, UT.**



The data shown in Figure 4-2 indicates that peak flows are 1.6 times higher than average flows. This is the peaking value applied to the St. George sewer model. Based on this assumed peaking factor, Table 4-1 display the projected peak combined system flow for the St. George collection system.

**Table 4-1  
Projected Peak Wastewater Flows**

| <b>Year</b> | <b>Total Sewer ERUs</b> | <b>Peak Month, Average Day Flow (MGD, Domestic &amp; Infiltration)</b> | <b>Domestic Flow (cfs)</b> | <b>Infiltration (cfs)</b> | <b>Combined Peak System Flow (cfs)</b> | <b>Combined Peak System Flow (MGD, Domestic &amp; Infiltration)</b> |
|-------------|-------------------------|------------------------------------------------------------------------|----------------------------|---------------------------|----------------------------------------|---------------------------------------------------------------------|
| 2017        | 55,577                  | 13.73                                                                  | 30.82                      | 1.98                      | 32.8                                   | 21.2                                                                |
| 2018        | 57,537                  | 14.21                                                                  | 31.91                      | 2.05                      | 33.95                                  | 21.9                                                                |
| 2019        | 59,471                  | 14.69                                                                  | 32.98                      | 2.12                      | 35.09                                  | 22.7                                                                |
| 2020        | 61,478                  | 15.19                                                                  | 34.09                      | 2.19                      | 36.28                                  | 23.4                                                                |
| 2021        | 63,891                  | 15.78                                                                  | 35.43                      | 2.27                      | 37.7                                   | 24.4                                                                |
| 2022        | 66,401                  | 16.4                                                                   | 36.82                      | 2.36                      | 39.18                                  | 25.3                                                                |
| 2023        | 69,012                  | 17.05                                                                  | 38.27                      | 2.46                      | 40.72                                  | 26.3                                                                |
| 2024        | 71,727                  | 17.72                                                                  | 39.77                      | 2.55                      | 42.33                                  | 27.4                                                                |
| 2025        | 74,552                  | 18.41                                                                  | 41.34                      | 2.65                      | 43.99                                  | 28.4                                                                |
| 2026        | 77,320                  | 19.1                                                                   | 42.88                      | 2.75                      | 45.63                                  | 29.5                                                                |
| 2027        | 80,371                  | 19.85                                                                  | 44.57                      | 2.86                      | 47.43                                  | 30.7                                                                |
| 2028        | 83,488                  | 20.62                                                                  | 46.3                       | 2.97                      | 49.27                                  | 31.8                                                                |
| 2029        | 86,731                  | 21.42                                                                  | 48.09                      | 3.09                      | 51.18                                  | 33.1                                                                |
| 2030        | 90,031                  | 22.24                                                                  | 49.92                      | 3.2                       | 53.13                                  | 34.3                                                                |
| 2031        | 93,045                  | 22.98                                                                  | 51.6                       | 3.31                      | 54.91                                  | 35.5                                                                |
| 2032        | 96,168                  | 23.75                                                                  | 53.33                      | 3.42                      | 56.75                                  | 36.7                                                                |
| 2033        | 99,403                  | 24.55                                                                  | 55.12                      | 3.54                      | 58.66                                  | 37.9                                                                |
| 2034        | 102,755                 | 25.38                                                                  | 56.98                      | 3.66                      | 60.64                                  | 39.2                                                                |
| 2035        | 106,228                 | 26.24                                                                  | 58.91                      | 3.78                      | 62.69                                  | 40.5                                                                |
| 2036        | 109,856                 | 27.13                                                                  | 60.92                      | 3.91                      | 64.83                                  | 41.9                                                                |
| 2037        | 113,268                 | 27.98                                                                  | 62.81                      | 4.03                      | 66.84                                  | 43.2                                                                |
| 2038        | 116,799                 | 28.85                                                                  | 64.77                      | 4.16                      | 68.92                                  | 44.5                                                                |
| 2039        | 120,328                 | 29.72                                                                  | 66.73                      | 4.28                      | 71.01                                  | 45.9                                                                |
| 2040        | 123,875                 | 30.6                                                                   | 68.69                      | 4.41                      | 73.1                                   | 47.2                                                                |
| 2041        | 127,314                 | 31.45                                                                  | 70.6                       | 4.53                      | 75.13                                  | 48.6                                                                |
| 2042        | 130,872                 | 32.33                                                                  | 72.57                      | 4.66                      | 77.23                                  | 49.9                                                                |
| 2043        | 134,411                 | 33.2                                                                   | 74.53                      | 4.78                      | 79.32                                  | 51.3                                                                |
| 2044        | 138,000                 | 34.09                                                                  | 76.52                      | 4.91                      | 81.44                                  | 52.6                                                                |
| 2045        | 141,641                 | 34.99                                                                  | 78.54                      | 5.04                      | 83.58                                  | 54.0                                                                |
| 2046        | 145,169                 | 35.86                                                                  | 80.5                       | 5.17                      | 85.67                                  | 55.4                                                                |
| 2047        | 148,188                 | 36.6                                                                   | 82.17                      | 5.27                      | 87.45                                  | 56.5                                                                |
| 2048        | 151,247                 | 37.36                                                                  | 83.87                      | 5.38                      | 89.25                                  | 57.7                                                                |
| 2049        | 154,349                 | 38.12                                                                  | 85.59                      | 5.49                      | 91.08                                  | 58.9                                                                |
| 2050        | 157,498                 | 38.9                                                                   | 87.34                      | 5.6                       | 92.94                                  | 60.1                                                                |
| 2051        | 160,699                 | 39.69                                                                  | 89.11                      | 5.72                      | 94.83                                  | 61.3                                                                |
| 2052        | 164,033                 | 40.52                                                                  | 90.96                      | 5.84                      | 96.8                                   | 62.6                                                                |
| 2053        | 167,428                 | 41.35                                                                  | 92.84                      | 5.96                      | 98.8                                   | 63.9                                                                |
| 2054        | 170,970                 | 42.23                                                                  | 94.81                      | 6.08                      | 100.89                                 | 65.2                                                                |
| 2055        | 174,250                 | 43.04                                                                  | 96.63                      | 6.2                       | 102.83                                 | 66.5                                                                |
| 2056        | 176,522                 | 43.6                                                                   | 97.89                      | 6.28                      | 104.17                                 | 67.3                                                                |
| 2057        | 178,884                 | 44.18                                                                  | 99.2                       | 6.37                      | 105.56                                 | 68.2                                                                |
| 2058        | 181,341                 | 44.79                                                                  | 100.56                     | 6.45                      | 107.01                                 | 69.2                                                                |
| 2059        | 183,896                 | 45.42                                                                  | 101.98                     | 6.54                      | 108.52                                 | 70.1                                                                |
| 2060        | 186,379                 | 46.04                                                                  | 103.35                     | 6.63                      | 109.98                                 | 71.1                                                                |

### **Infiltration and Inflow**

Estimated infiltration flow rates in the system are discussed in Chapter 3. Since infiltration typically does not vary over the course of a day, baseline infiltration values were distributed throughout the modeled system and held constant over the course of the extended period model simulation. As discussed in Chapter 3, inflow has not been explicitly included in the hydraulic computer model, but has rather been accounted for in the evaluation criteria for the collection system (see Chapter 5).

### **Distribution of Flow**

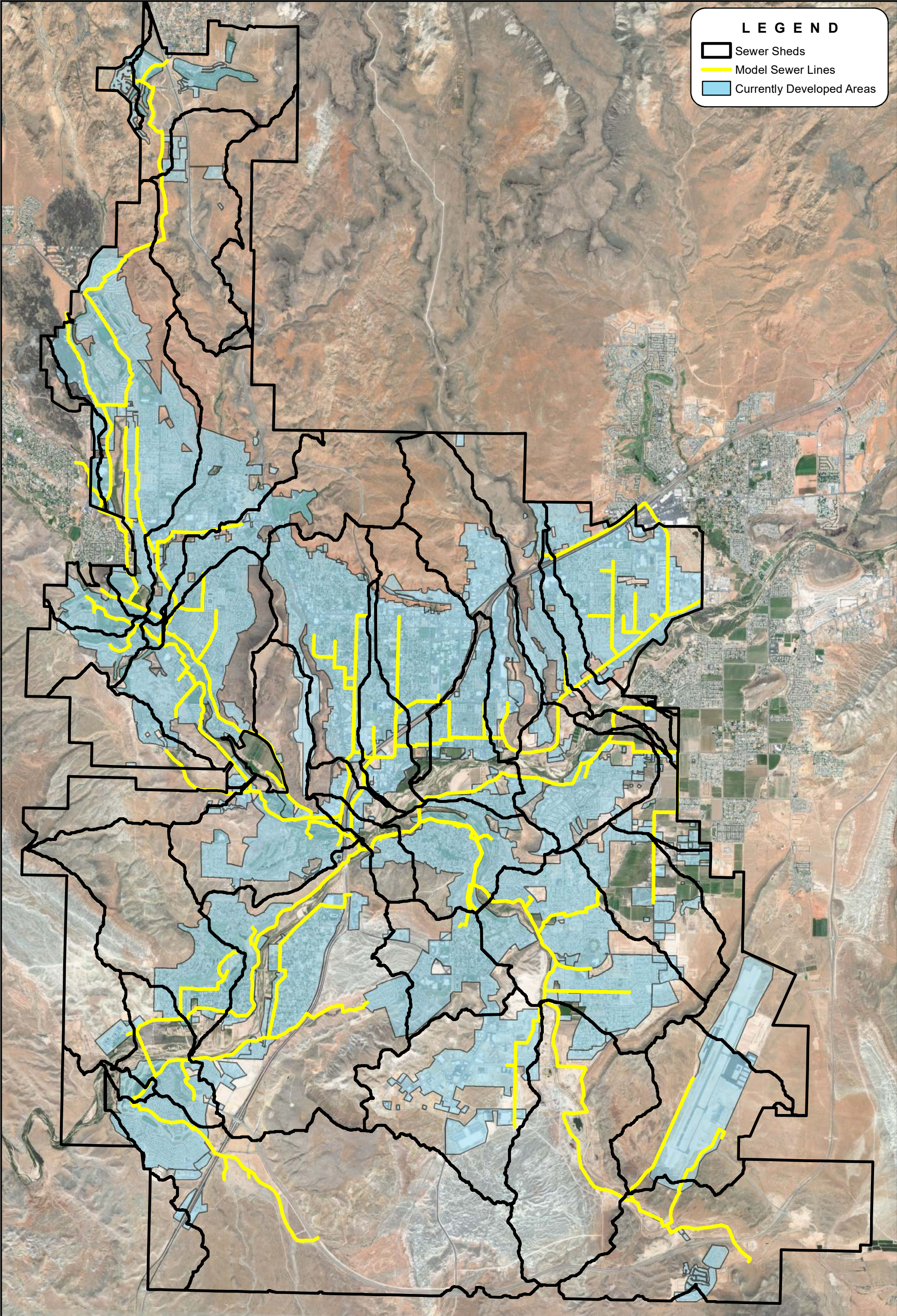
Existing sewer flows were distributed throughout the modeled system by first delineating sewersheds based on contours and pipe connectivity. Using a map of culinary water meters overlaid on a map of the sewer system manholes, each water meter was assigned to the nearest manhole in the meter's sewershed. The system-wide design flows were divided proportionally among the water meters and subsequently assigned to the manholes. The model then routes manhole inflows through the collection system to the outfall at the wastewater treatment plant.

Flow distribution in the future demand scenario for the hydraulic model as estimated by delineating the City into a series of sewersheds as shown in Figure 4-3. Using the current zoning plans, a total number of ERUs to be developed in the future was assigned to each respective sewershed and routed to the point where sewer flows are anticipated to connect to the existing system. Flow routing from Washington City, Ivins City, and Santa Clara City were allocated to the future model based on the sewer master plan from each respective City (refer to each city's respective sewer master plan for more detailed information). Where applicable, new sewer lines were added to the model to extend service into the large, undeveloped regions of the City.

For the 10-year growth model, "hotspots", or areas with high potential for growth in the near future, were identified by St. George. The general land use plan and GIS were used to estimate the amount of growth that would occur in these hotspots over the next 10 years, as well as growth that will likely occur as infill in areas that are currently partially developed. Upon determining where growth will most likely occur, the flow from new development was then assigned to the appropriate sewer manhole in the model. This same method was employed for developing a model for buildout of the service area, filling in any remaining region within the service area that is yet to be developed.

### **MODEL 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. Model results have been checked against the recorded flow data from Washington, Ivins, and Santa Clara. To the extent possible, model inputs have been adjusted to match the recorded flows in the system.



LEGEND

Sewer Sheds

Model Sewer Lines

Currently Developed Areas

## CHAPTER 5

### SEWER SYSTEM EVALUATION

With the development of a hydraulic sewer model, it is possible to simulate sewer system operating conditions for both existing and future conditions. The purpose of this chapter is to evaluate the hydraulic performance of the collection system and identify potential hydraulic 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 what the model estimates. For example, infiltration during extremely wet years could be more than estimated in the model (e.g. high precipitation years can lead to higher sustained ground water levels and greater potential for system infiltration). 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 system:

- **Pipeline Capacity** – The most important deficiency to identify in the sewer collection system is inadequate 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 have been deemed deficient.
- **Lift Station Capacity** – A lift station capacity deficiency is defined as anytime peak dry weather flows into the lift station 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 Velocities** – Excessively high velocities 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. If a force main regularly operates above this range, it is recommended that its capacity be increased.

## COLLECTION SYSTEM ANALYSIS

### Existing System Collection System Conditions

Figure 5-1 displays the hydraulic capacity 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 full depth. As shown in the figure, the majority of the system has ample flow capacity. However, there are a few isolated areas in which the model simulation indicates peak flows that exceed the maximum allowable flow depth. These "deficient" reaches of pipe are caused by flat slopes and undersized segments of pipe. These areas are discussed in further detail below.

#### **Deficiency #1 – Snow Canyon Parkway/Entrada Trunkline**

A 15-inch pipe which collects flow from the Ledges, Entrada, and a small portion of Ivins runs down Snow Canyon Parkway and then cuts across Entrada Golf Course and connects into Tuweap Drive. As the line crosses through the golf course, the 15-inch line necks down into segments of 8-inch and 10-inch pipe, causing a bottleneck in the system. While this deficiency may not lead to sewer backups or flooding at this time, this area will see a significant increase in flow as development continues in the Ledges and the Trails.

#### **Deficiency #2 – Washington Millcreek Connection**

The existing 18-inch line in Millcreek which collects a large portion of the flow from Washington is simulated to have some sections in which the flow exceeds the maximum capacity. This deficiency is caused by the piping through the industrial area being relatively flat.

#### **Deficiency #3 – Fort Pierce Dr./St. George Golf Club Trunkline**

An 18-inch line runs along the St. George Golf Club from Fort Pierce Drive to the pedestrian trail south of St. James Park. A segment of this pipe is flat (slope = 0.14%) and is shown as flowing over capacity during peak flows.

### **Sun River Lift Station**

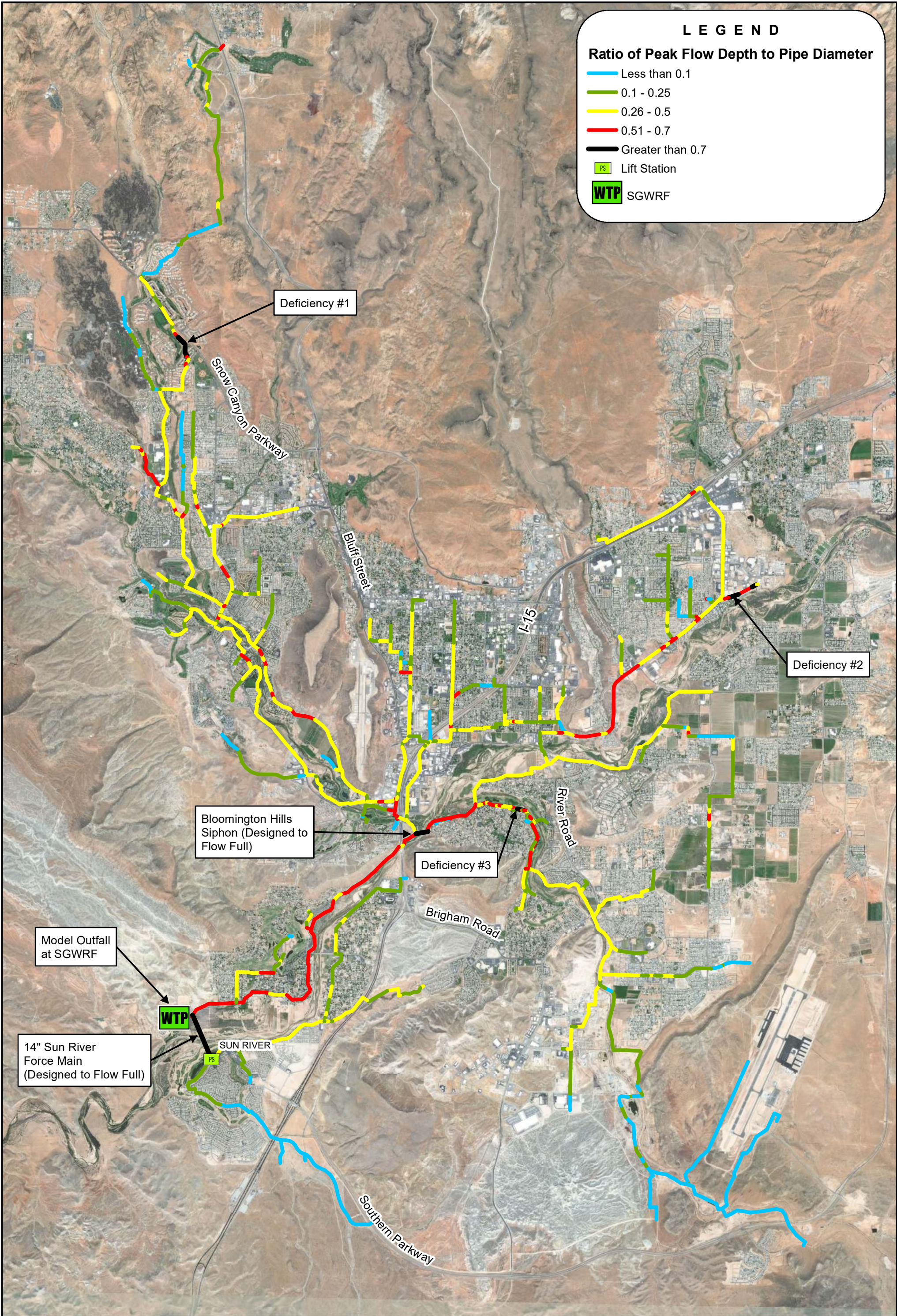
Based on information provided by a City operator, Table 5-1 provides a summary of the Sun River Lift Station pumping capacity.

**Table 5-1 Sun River Lift Station Capacity**

|                           | <b>Flow Capacity (at 50 Hz<br/>Impellor Speed)<sup>1</sup></b> |
|---------------------------|----------------------------------------------------------------|
| Pump 1 alone              | 1,065                                                          |
| Pump 2 alone              | 887                                                            |
| <b>Combined Pump Flow</b> | <b>1,352</b>                                                   |

<sup>1</sup> Flow capacity based on reported numbers from City sewer operations.

Model simulations indicate that the peak flow into the Sun River Lift Station wet well is 692 gpm. Based on the established evaluation criteria for the lift station, the lift station is currently at



approximately 60% of its capacity. Under peak flow conditions, flow velocity in the force main is 3.3 feet per second (1,352 gpm), which is within the recommended range of flow velocities.

## **10-YEAR GROWTH CONDITIONS**

### **10-Year Growth Collection System Conditions**

Modeling projected sewer system growth within a 10 year planning window is of particular interest when assembling a 10 year Capital Facilities Plan, Impact Fee Facilities Plan, and Impact Fee Analysis. Chapter 3 identifies the projected service area growth over the next 10 years as well as the anticipated locations in which this growth is estimated to occur. Figure 5-2 displays the results of the hydraulic model for the 10 year growth scenario. As shown in the figure, there are a number of areas that are anticipated to have capacity deficiencies within the 10-year growth window. The following is a description of each area predicted to experience capacity deficiencies in the next 10 years.

#### **Deficiency #1 – Snow Canyon Parkway/Entrada Trunkline**

As identified in the evaluation of the system under existing conditions, a section of 8-inch and 10-inch pipe creates a bottleneck in the collection system near Entrada Golf Course. As growth continues, this bottleneck will create larger problems, causing manholes to surcharge and flood, which will also cause backups into sewer laterals.

#### **Deficiency #2 – Washington City Millcreek Connection**

The existing capacity deficiency in the 18-inch Washington Millcreek line is anticipated to become more severe as growth continues. While no flooding has been shown in the hydraulic model, the capacity deficiencies do lead to surcharging in manholes.

#### **Deficiency #3 – Fort Pierce Dr./St. George Golf Club Trunkline**

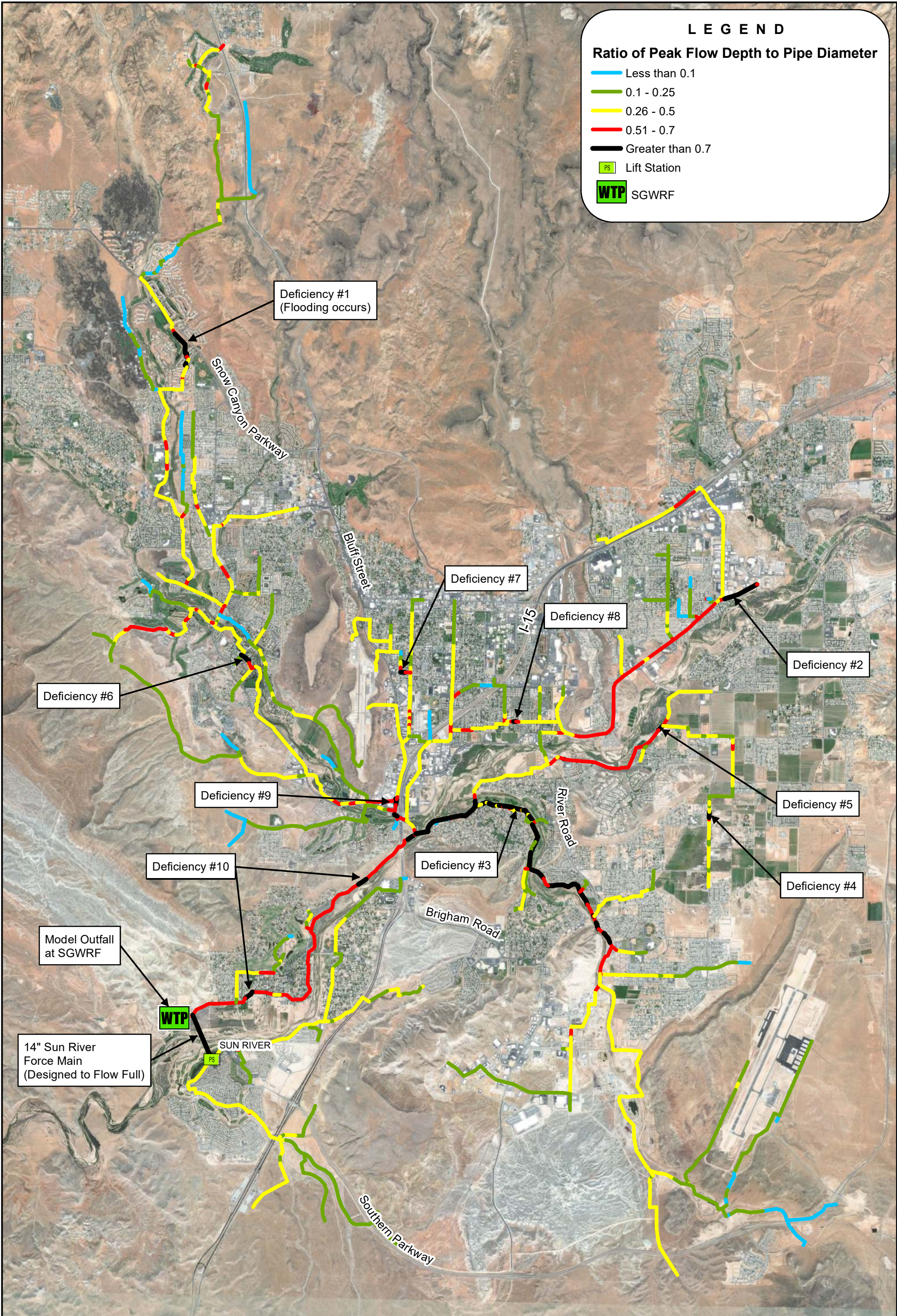
Under existing conditions, a short section of pipe along the Fort Pierce Dr./St. George Golf Club trunkline is simulated to have a deficiency. With 10 years of added growth, this capacity deficiency will expand over a much longer reach of pipe. This projected capacity deficiency extends from the Bloomington Hills siphon to near the intersection of River Road and Horseman Park Drive.

#### **Deficiency #4 – 3000 E & 1900 S**

10-year growth is projected to create a capacity deficiency in a short reach of pipe along 3000 East near 1900 South. The deficiency is caused by a flat reach of pipe.

#### **Deficiency #5 – Seegmiller Marsh Trunk Line**

Near Seegmiller Marsh, a 24-inch line and an 18-inch line come together into a 21-inch line. Model results indicate that the first reach of 21-inch pipe is over capacity with the combined flows from the two upstream sewer mains.



LEGEND

Ratio of Peak Flow Depth to Pipe Diameter

Less than 0.1

0.1 - 0.25

0.26 - 0.5

0.51 - 0.7

Greater than 0.7

PS Lift Station

WTP SGWRF

**Deficiency #6 – Dixie Drive Trunkline through Woodsvie Circle**

Once the existing 36-inch trunkline in Dixie Drive crosses the Santa Clara River at Mathis Bridge, the line turns east and cuts through the residential neighborhoods adjacent to the Santa Clara River. When the line crosses Valley View Drive, it necks down to a 24-inch pipe as it runs through Woodsvie Circle. Model results indicate that this section of 24-inch pipe does not have adequate capacity for growth within the next 10 years.

**Deficiency #7 – 600 S & 100 W**

As the “Tech Ridge” area develops (old airport site), additional wastewater flow will be added to the existing collection piping through the downtown area. The section of 10-inch pipe which runs along 600 S between 100 W and Main Street is shown as being deficient under the 10-year growth scenario.

**Deficiency #8 – 1010 S Trunkline**

An existing 21-inch line runs along 1010 S along the backside of several properties near the intersection of River Road and Riverside Drive. Model results indicate that a short section of this pipe is deficient under 10-year growth conditions. It should be noted that a manhole in Riverside Drive has the ability to divert flow out of this line, which could be used in the future if capacity issues become a problem in this line.

**Deficiency #9 – Hilton Drive Trunkline**

A 30-inch and a 15-inch line in Hilton Drive come together into a 30-inch line at the northeast corner of the Ken Garff Ford car lot. This 30-inch line continues to the south and then crosses I-15. The section of 30-inch pipe just downstream of where the 30-inch and 15-inch pipes come together is shown as being deficient under projected 10-year flows.

**Deficiency #10 – 48-inch Virgin River Interceptor**

The majority of sewer flow in the system collection system comes together near Crosby Family Confluence Park (Dixie Center) and flows into a 48-inch interceptor. This interceptor runs along the west side of the Virgin River through the Bloomington area and on to the SGWRF. As shown in Figure 5-2, the majority of this pipe is shown as red, which indicates that the pipe is approaching its full capacity. A few of the flatter sections are shown as being over capacity.

**Sun River Lift Station – 10 Year Growth**

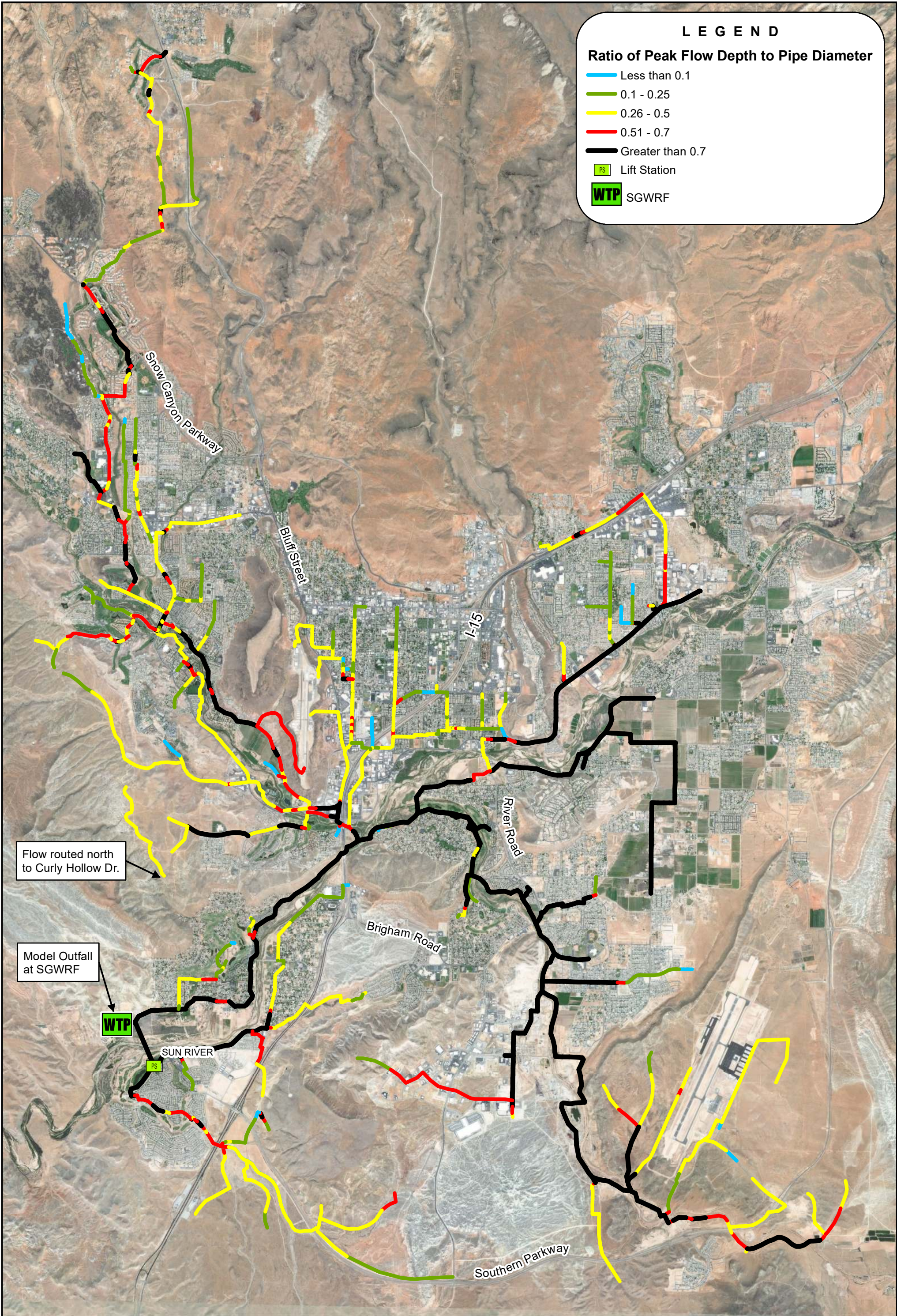
Model simulations indicate a peak flow rate into the Sun River Lift Station of 1,887 gpm. This indicates that the Sun River Lift Station does not have adequate capacity to meet growth over the next 10 years. Peak flow velocity through the force main is modeled to be 5.5 fps.

**BUILDOUT SYSTEM ANALYSIS****Buildout Collection System Conditions**

As discussed in Chapter 4, the wastewater production associated with future growth through buildout has been estimated and distributed in a “buildout” model scenario. The location and

magnitude of wastewater flow was estimated using the City's land use and zoning plan in conjunction with the sewer sheds delineated in Figure 4-3. Figure 5-3 provides the model results for the sewer collection system at buildout based on these assumptions (i.e. flow is routed into the existing system based on the natural contours of the delineated sewer sheds).

As shown in the figure, the system clearly does not possess sufficient capacity to meet system demands at buildout, and documenting each individual deficiency is unnecessary. The majority of the major interceptors are over capacity, which results in severe manhole surcharging and flooding in several areas of the system. This figure helps illustrate where improvements will be needed through buildout to provide sufficient wastewater flow capacity.



## CHAPTER 6

### WASTEWATER SYSTEM IMPROVEMENTS

The hydraulic model results have identified potential deficiencies in the sewer system under existing and future conditions. This chapter presents a list of system improvements intended to address these deficiencies as well as a set of recommended system level improvements to expand the service area of the City. Projects are organized based on the type of system improvement.

The improvements outlined in the chapter have been developed under the assumption that the City will continue to treat all wastewater at the location of the existing SGWRF and that future treatment expansion will be located adjacent to the existing treatment plant. This considered, all sewer lines presented in this chapter have been sized to adequately convey wastewater flows to the existing treatment plant site. As part of this study, BC&A evaluated potential locations for a “satellite” plant (a new, smaller scale treatment facility at a new location in the system). While this may be a viable option for the City in the future, it is not certain at this point in time that a satellite plant would be the best solution to the City’s future treatment needs. Thus, the improvements presented in this report do not account for any reduction in flow in the collection system that would come as a result of the construction of a decentralized plant (i.e. flow being treated at a new plant upstream of the existing plant, reducing flow to the existing plant).

This approach to this sewer master plan does not mean that the City should abandon the idea of constructing a satellite treatment plant. While the capital cost to design and construct a satellite plant would likely be higher than the cost to construct the same amount of treatment capacity at the existing SGWRF site, a satellite plant would provide the benefit of providing “reuse” water (wastewater that has been treated and filtered to meet irrigation-quality standards) closer to where it is used, providing savings in the pumping costs to deliver water to end users. If the City decides to expand the secondary irrigation system and the demand for irrigation water increases, a satellite treatment plant would become a more viable option.

#### COMPARISON OF COLLECTION SYSTEM CAPACITY IMPROVEMENTS

The following is a description of system level sewer collection system improvements intended to address existing and future capacity deficiencies in the system identified in Chapter 5. All other sewer collection system expansion needed to service future growth will be constructed as a project level improvement at the cost of the developer. System level projects have been grouped into one of two categories:

- **Local Improvements**: Local improvements are projects that provide service to only the City of St. George. A “local” sewer line does not convey flow from Washington, Ivins, or Santa Clara.
- **Regional Improvements**: Regional improvements are projects that provide service to the City of St. George and at least one other City in the service area. The majority of large sewer collection mains and the SGWRF are “regional” facilities.

Figures 6-1 provides a reference for the location of the recommended improvements and the approximate timing of the project. Table 6-1 contains a summary of all recommended collection system improvements through buildout with the estimated 2018 construction cost.

## **LOCAL COLLECTION SYSTEM CAPACITY IMPROVEMENTS**

### **L1. Curly Hollow Dr. Sewer Main Replacement**

**Project Year: 2030+**

To accommodate future growth in the western region of the Tonaquint area, the existing 2,300 feet of 8-inch pipe along Curly Hollow Drive from 1300 W (west end of Tonaquint Intermediate School) to Tonaquint Drive needs to be upsized. Replacing the existing 8-inch pipe with a new 12-inch pipe will provide adequate capacity for wastewater flows through buildout.

### **L2. Tonaquint Dr. Sewer Main Replacement and Realignment**

**Project Year: 2020 - 2030**

The existing sewer collection piping along Tonaquint Drive from Lava Pointe Dr. to 2025 S. Circle is composed of a section of 12-inch pipe and 8-inch pipe. The existing line runs through some areas near the golf course that make it difficult to access and maintain. In order to provide adequate capacity for future growth and to provide improved access for City maintenance crews, the existing line should be replaced with 2,300 feet of 15-inch line from Lava Pointe Dr. to the connection point in Dixie Drive. This project will require a crossing through the Santa Clara River and will require the installation of 500 feet of 8-inch pipe to connect the existing sewer collection infrastructure near the Southgate Golf Course club house to the new 15-inch sewer main. This project has been separated into 3 reaches:

- **Reach 1 (2030+)** – Replace 1,200 feet of 12-inch pipe along Tonaquint Drive from Lava Pointe Drive to Fairway Hills Drive with a new 15-inch pipe.
- **Reach 2 (2020)** – Install 500 feet of 15-inch pipe along Tonaquint Drive from Fairway Hills Drive to the end of Tonaquint Drive (golf course) and install 500 feet of 8-inch pipe on 2025 S Circle from the Southgate Golf Course clubhouse to Tonaquint Drive.
- **Reach 3 (2030+)** – Replace 600 feet of 12-inch pipe through Southgate Golf Course to Dixie Drive with a new 15-inch pipe.

### **L3. 1630 E Sewer Line Replacement**

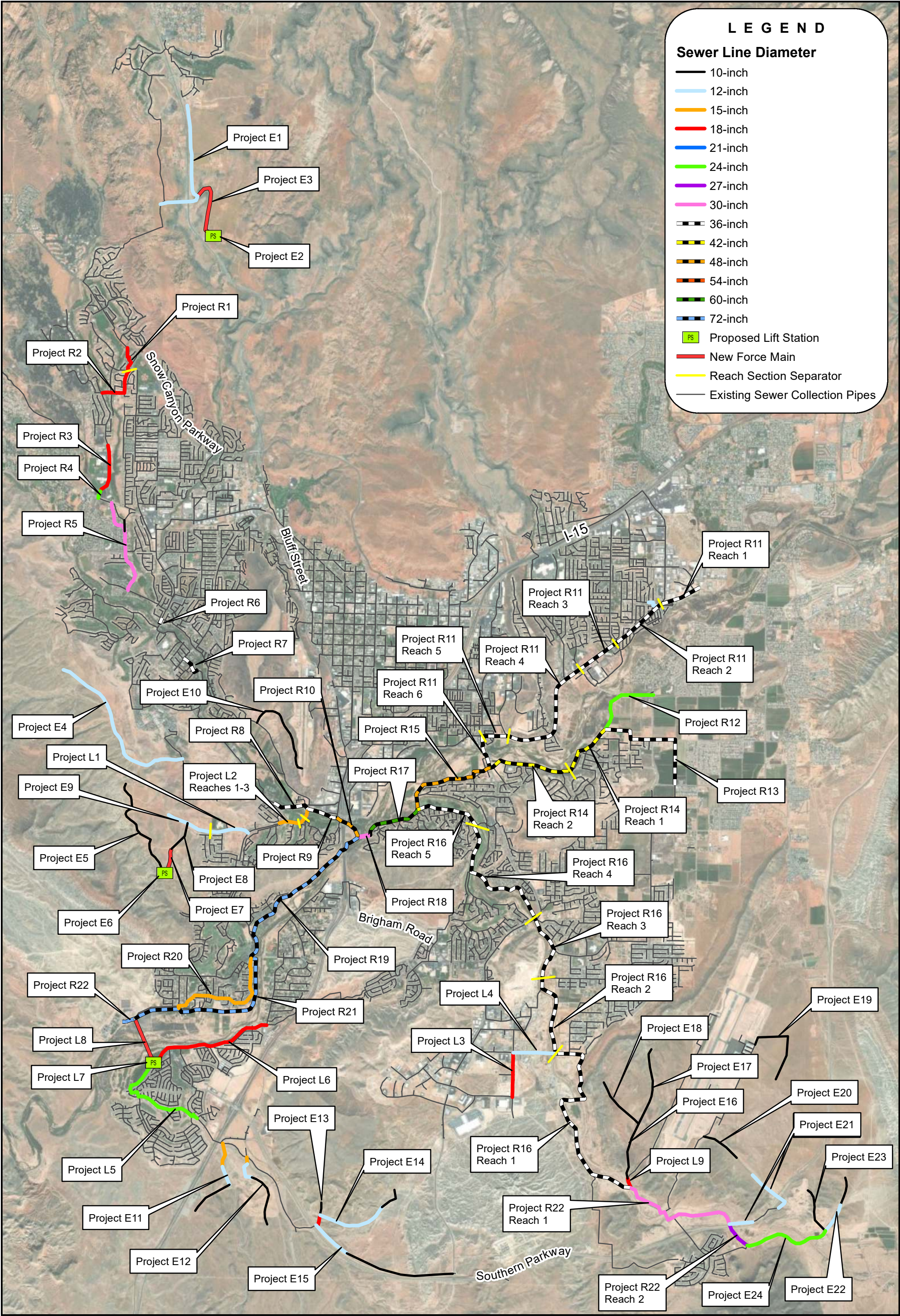
**Project Year: 2030+**

The existing sewer collection infrastructure in the industrial area along 1630 E consists of a 12-inch and 10-inch sewer main. As this industrial area continue to grow, this existing piping will need to be upsized. This replacement project involves the installation of 2,650 feet of 18-inch pipe along 1630 W from Venture Dr. to Commerce Drive.

### **L4. Commerce Drive Sewer Line**

**Project Year: 2020**

As growth progresses in this industrial area of the City, additional capacity will be needed in the sewer line that runs north of Commerce Drive along 1630 E and 3950 S and connects into the



major trunk line next to the Fort Pierce Wash. The City of St. George is in the process of improving the road along Commerce Drive across the Fort Pierce Wash, and rather than upsizing this reach of existing pipe in the future, it makes sense to install a new sewer diversion line in Commerce Drive when the new road improvements go in (freeing up capacity in the existing line). This 12-inch line (2,500 feet) will run along Commerce Drive from 1630 E to the existing sewer trunk line on the east side of Fort Pierce Wash.

#### **L5. Sunstar Drive Sewer Main Replacement**

**Project Year: 2030+**

As growth occurs in the Desert Color development, the existing 18-inch sewer collection line that runs through Sun River will need to be upsized. This project includes the replacement of 7,050 feet of 18-inch pipe with a new 24-inch pipe.

#### **L6. North Sun River Sewer Line Replacement**

**Project Year: 2030+**

An existing 15-inch sewer line runs along the north edge of Sun River that collects flow from Sun River as well as development upstream. As growth continues in the Sun River area and particularly in the Hidden Valley area to the east, this line will need to be upsized. The project will require the installation of 7,500 feet of 18-inch pipe.

#### **L7. Sun River Lift Station Upgrades**

**Project Year: 2025**

The Sun River lift station pumps wastewater across the Virgin River from the Sun River area and other surrounding areas in the southern region of the City. With a significant amount of growth slated for this area in the Desert Color community, this lift station will require pumping upgrades. Model simulations for buildout conditions estimate a peak flow through the lift station of 4,100 gpm, requiring pump upgrades to keep up with flows into the lift station.

#### **L8. Sun River Force Main Addition**

**Project Year: 2030+**

With the planned upgrades to the Sun River Lift Station, additional capacity in the Sun River force main will also be required to provide capacity for growth. The existing force main is a 14-inch line which runs across the river from the lift station, discharging into the gravity collection system just upstream of the SGWRF. To provide capacity for future growth, an additional 14-inch parallel force main should be installed (2,860 feet).

#### **L9. West Airport Sewer Main Replacement**

**Project Year: 2030+**

As growth occurs around the St. George Airport, added sewer flows will exceed the capacity of an existing collection line on the southwest end of the airport. It is recommended that approximately 625 feet of 10-inch pipe be replaced with new 18-inch pipe near the location where the west airport sewer line ties into the existing 21-inch sewer line which runs along Fort Pierce Wash.

## **REGIONAL COLLECTION SYSTEM CAPACITY IMPROVEMENTS**

### **R1. Entrada Sewer Main Replacement (North Reach)**

**Project Year: 2022**

As indicated in the hydraulic modeling results, a section of undersized sewer pipe through the Entrada development that runs across the golf course and ties into Supai Trail Road creates a bottleneck in the collection system. In order to prevent future surcharging and flooding of the sewer system through this reach of pipe, the existing 8-inch and 10-inch pipe should be upsized with 1,560 feet of 18-inch pipe.

### **R2. Entrada Sewer Main Replacement (South Reach)**

**Project Year: 2030+**

Immediately downstream of Project R1 exists another reach of sewer pipe that does not have adequate capacity to convey projected flows through buildout. The existing 12-inch line which runs south on Tuweap Dr. to 2000 N and then west on 2000 N to 2400 W will need to be replaced with 2,750 feet of 18-inch pipe.

### **R3. 2400 W Sewer Main Replacement**

**Project Year: 2030+**

A 15-inch sewer main runs along 2400 W next to Snow Canyon H.S. and Snow Canyon Middle School. To provide the necessary capacity for future growth, this line needs to be replaced with 2,800 feet of 18-inch pipe.

### **R4. 2400 W (South Reach) Sewer Main Replacement**

**Project Year: 2030+**

Just to the south of Snow Canyon Middle School, a 15-inch sewer line comes together with another 15-inch line that conveys the majority of sewer flow from Ivins City and a portion of Santa Clara. From this point, the sewer flow enters a 21-inch line. To meet the needs of future growth, 560 feet of pipe from the south side of Snow Canyon Middle School to the south side of Sunset Boulevard should be upsized with a 24-inch diameter pipe.

### **R5. Country Lane Sewer Line Replacement Project**

**Project Year: 2030+**

As growth continues in Ivins City, Santa Clara and the northwest region of St. George, the existing 21-inch sewer main that runs along Country Lane from Sunset Boulevard to Stonebridge Drive will need to be upsized. As development occurred in Santa Clara around the sewer main, homes and other features were built around the line, making it difficult to access. When this line is upsized in the future, it is recommended that the line be relocated so that it stays in Country Lane starting at the intersection with Sunset Boulevard. Since the existing line that runs behind and through a number of residential lots picks up an 8-inch line that flows from an area to the east, it may be advantageous to keep a section of the existing 21-inch line in service to continue conveying this flow through the system. In order to maintain ideal velocities in the pipe to keep solids moving through the pipe, the City should plan to place a smaller diameter line (10-inch) into the existing

21-inch. The project will require the installation of 5,900 feet of 30-inch pipe and the rehabilitation of 650 feet of existing 21-inch pipe with a smaller 10-inch pipe.

#### **R6. Dixie Drive & Bridge Pointe Way Sewer Line Replacement**

**Project Year: 2030+**

At the intersection of Stonebridge Drive and Dixie Drive, a 27-inch line and 15-inch line come together into a 27-inch line that runs south on Dixie Drive toward the bridge over the Santa Clara River. However, when this line reaches the intersection with Bridge Pointe Way, the line necks down to an 24-inch line, with an overflow diversion that flows into a separate 18 –inch line that runs east along the north side of the Santa Clara River. It is recommended that this 420-foot section of 24-inch pipe in Dixie Drive be upsized to a 36-inch pipe to match the diameter of the pipe in Dixie Drive downstream of this point.

#### **R7. South Woodsvie Circle Sewer Line Replacement**

**Project Year: 2024**

Once the 36-inch sewer line in Dixie Drive crosses the Santa Clara River bridge, it turns east and cuts through the residential neighborhoods adjacent to the Santa Clara River. When the line crosses Valley View Drive, it necks down to a 24-inch pipe as it runs through Woodsvie Circle. The line then transitions back to a 36-inch line as it leaves Woodsvie Circle. To provide adequate capacity for future growth, this 1,350-foot reach of 24-inch pipe should be replaced with a 36-inch pipe.

#### **R8. South Dixie Drive to Hilton Drive Sewer Main Replacement**

**Project Year: 2030+**

As the 36-inch sewer main along Dixie Drive approaches the bridge over the Santa Clara River, the line shrinks down to a section of 24-inch pipe and 27-inch pipe. To provide capacity for growth, this 1,100-foot section of pipe should be replaced and upsized to 36-inch pipe.

#### **R9. South Dixie Drive Sewer Main Replacement and Relocation**

**Project Year: 2030+**

As the Dixie Drive sewer main continues to the east, the line turns down Hilton Drive to I-15 and then turns south along the east side of the Ken Garff car lot. Rather than upsizing this line in its current location, it is recommended that a new 36-inch line be installed that continues along Dixie Drive to I-15. The existing 30-inch line in Hilton Drive should stay in operation to continue collecting flow from Indian Hills Drive and Hilton Drive from the north. This project will require 2,100 feet of 36-inch pipe to be installed from the intersection of Dixie Drive and Hilton Drive to I-15.

#### **R10. I-15/Crosby Family Confluence Park Sewer Line Replacement**

**Project Year: 2030+**

All sewer flow from Ivins, Santa Clara, and area of the City of St. George that is west of the Virgin River and north of the Tonaquint area drains to a location near the Dixie Drive/I-15 overpass. The existing line runs along the north side of the Santa Clara River under I-15, then crosses the river and follows the pedestrian trail to the connection point with the Bloomington Hills Siphon.

To provide adequate sewer capacity for future growth through buildout, this 1,790-foot section of 30-inch and 36-inch pipe will need to be upsized to a 48-inch line.

### **R11. Riverside Drive Sewer Main Replacement (Reaches 1-5)**

The Riverside Sewer Main serves as the sewer collection backbone for the northeast region of St. George and also conveys a large portion of wastewater flow from Washington City. While only a small amount of undeveloped land remains in St. George that will utilize this line, there is a significant amount of undeveloped land in Washington City that will utilize this line in the future. This considered, the Riverside Drive sewer main will need to be upsized to accommodate future flows. This project has been broken into 5 reaches:

- **Reach 1 (2021)** – Replace 2,500 feet of 18-inch pipe through the industrial area from the Washington City Millcreek outfall to Riverside Drive with a new 36-inch pipe.
- **Reach 2 (2030+)** – Replace 3,600 feet of 27-inch pipe along Riverside Drive from the end of Reach 1 to the intersection of 2450 E with a new 36-inch pipe.
- **Reach 3 (2030+)** – Replace 2,600 feet of 27-inch pipe along Riverside Drive from the intersection of 2450 E to the intersection of Mall Drive with a new 36-inch pipe.
- **Reach 4 (2030+)** – Replace 7,300 feet of 27-inch pipe along Riverside Drive from the intersection of Mall Drive to west end of Foremaster Hill (at the point that the line splits into a 27-inch line that continues west on Riverside and a 21-inch line that runs north along the base of Foremaster Hill) with a new 36-inch pipe.
- **Reach 5 (2030+)** – Replace 1,600 feet of 27-inch pipe along Riverside Drive from the end of Reach 4 to the intersection with River Road with a new 36-inch pipe.
- **Reach 6 (2030+)** – Replace 2,050 feet of 24-inch pipe along River Road from the Riverside Drive to south of the River Road/1450 South intersection with a new 36-inch pipe.

### **R12. Mall Drive Sewer Line Replacement Project**

**Project Year: 2030+**

One of Washington City's primary connection points to the St. George collection system is located near the intersection of Mall Drive and 3000 East. An 18-inch line runs west along Mall Drive and turns south prior to crossing the Mall Drive Bridge, running next to Seegmiller Marsh and tying into a 24-inch line at approximately 1100 South. To provide the necessary capacity to meet the needs of future growth, this 4,400-foot reach of 18-inch pipe will need to be replaced with a new 24-inch pipe.

### **R13. 3210 E/1140 S Sewer Line Replacement**

**Project Year: 2030+**

The Washington Fields area is serviced by an existing 24-inch sewer main that runs north along 3120 E and turns west on 1140 S, tying into the end of the line described in project R9. This line provides service to good portion of St. George, but also services two connection points from Washington City (at 1140 S and 1580 S). While the Washington City connections provide a relatively small amount of flow at this time into the collection system, additional growth in Washington will significantly increase flows through these connections. In order to provide the

necessary capacity for future development, this reach of pipe should be replaced with 7,300 feet of 36-inch pipe.

#### **R14. Seegmiller Marsh/1450 S Sewer Line Replacement**

The sewer lines described in project R12 and R13 flow into a 21-inch and 24-inch reach of sewer pipe that continues to run south past Seegmiller Marsh and on to 1450 S, at which point the line turns west along 1450 S towards River Road. This sewer line replacement project has been broken into 2 reaches:

- **Reach 1 (2027)** – Replace 3,400 feet of 21-inch and 24-inch pipe with a new 42-inch pipe from the end of project R12 & R13 to 1450 S.
- **Reach 2 (2030+)** – Replace 5,000 feet of 21-inch pipe with a new 42-inch pipe from the point that the line reaches 1450 S (west of S. Springs Dr.) to River Road.

#### **R15. Lizzy Lane to St. James Park Sewer Line Replacement**

**Project Year: 2030+**

The Lizzy Lane sewer line is a 6,000 foot reach of 36-inch pipe beginning near the intersection of River Road and 1450 S and ending south of St. James Park near the St. George Golf Club. The line runs along the base of the hill to the north of Lizzy Lane and turns south at St. James Park. To provide capacity for projected buildout sewer flows, this 36-inch line will need to be upsized to a 48-inch line.

#### **R16. Fort Pierce Sewer Main Replacement (Reach 1-5)**

One of the largest undeveloped regions of St. George is the region around the airport. As this area continues to develop, increasing wastewater flow rates will exceed the capacity of the existing 18-inch and 21-inch sewer line that runs along the Fort Pierce Wash and connects into the downstream end of the Lizzy Lane sewer line. The Fort Pierce sewer main will need to be replaced in order to provide adequate capacity for future growth. Based on the length of this overall project, it has been broken into 5 separate reaches:

- **Reach 1 (2030+)** – Replace 13,000 feet of 21-inch pipe with 36-inch pipe from a point south of the Airport (near the St. George Wakeboard Park) to 4150 S (Commerce Drive). This line crosses the Fort Pierce Wash, and the City may investigate a modified alignment of this line when it comes time for replacement.
- **Reach 2 (2030+)** – Replace 5,100 feet of 21-inch pipe along the east side of Fort Pierce Wash from Commerce Drive to Crimson Ridge Drive with new 36-inch pipe.
- **Reach 3 (2023)** – Replace 4,200 feet of 18-inch and 21-inch pipe along the east side of Fort Pierce Wash from Crimson Ridge Drive to the intersection of River Road and Horseman Park Drive with a new 36-inch pipe.
- **Reach 4 (2022)** – Replace 8,300 feet of 18-inch pipe along Fort Pierce Wash from River Road to Fort Pierce Drive with a new 36-inch pipe.
- **Reach 5 (2021)** – Replace 4,000 feet of 18-inch pipe along the north end of Bloomington Hills from Fort Pierce Drive to the connection point at the downstream end project R15. This project includes the installation of 3,800 feet of 36-inch pipe and 200 feet of 42-inch

pipe. The larger pipe diameter at the end of the line is necessary to provide capacity for a 10-inch collection line that ties into this sewer main from the Bloomington Hills area.

**R17. Bloomington Hills Sewer Main Replacement****Project Year: 2026**

The Lizzy Lane sewer main and Fort Pierce sewer main come together into an existing 36-inch pipe. This line runs along the pedestrian trail north of Bloomington Hills and ties into the Bloomington Hills sewer siphon (sewer line crossing under the Virgin River). Like most of the sewer collection piping upstream from this point, this 36-inch line will need to be upsized to provide sufficient capacity for future growth. Since the existing 36-inch sewer line is relatively new (less than 15 years old) and because there is room for a parallel line, it is recommended that a parallel 48-inch line be installed rather replacing the existing line with a new 60-inch pipe.

**R18. Bloomington Hills Siphon Expansion Project****Project Year: 2029**

The Bloomington Hills siphon is an “inverted siphon” sewer line that runs beneath the Virgin River. Wastewater flows through the closed conduit under low pressure from the east side of the river to the west side of the river. In order to provide the needed capacity for growth through buildout, 2 additional 36-inch barrels (approximately 800 feet) will need to be added parallel to the existing 15-inch and 21-inch barrels. This project will require modifications to the existing access structures on the upstream and downstream side of the siphon.

**R19. Virgin River/Bloomington Sewer Interceptor Replacement****Project Year: 2027**

Wastewater flows from the west side of the service area come together with the flows from the east side of the service area into the Virgin River/Bloomington Sewer Interceptor. The existing 48-inch trunk line begins south of Crosby Family Confluence Park and follows the west wide of the Virgin River south to the Bloomington area. The line then continues to the SGWRF through the Bloomington area. This project includes the replacement of 10,500 feet of 48-inch pipe from Crosby Family Confluence Park to Man of War Road with a new 72-inch pipe.

**R20. Bloomington Interceptor Sewer Main Replacement Project****Project Year: 2029**

Once the Virgin River interceptor crosses Man of War Road, the line runs along Mulberry Drive/Baneberry Drive through the Bloomington residential area. Mulberry Drive is particularly crowded with underground utilities, holding as many as three sewer lines in some locations. This considered, there is not room in the road to continue project R19 through Bloomington with a 72-inch line to the plant.

This considered, a new alignment will be required to construct the new upsized line. Project R21 provides a description of the conceptual location of this future sewer line. However, because parts of the Bloomington area feed directly into the existing 48-inch sewer line, this line cannot be simply abandoned, nor should it remain as a 48-inch line (low flow velocity would create a high risk of solids accumulation in the line which may lead to odor issues and frequent maintenance). This considered, with the completion of project R21, the existing 48-inch line from Man of War

Road to Christensen Park should be replaced with 7,400 feet of new 15-inch pipe that is appropriately sized for servicing the Bloomington area.

**R21. Bloomington Parallel Interceptor Project****Project Year: 2028**

In conjunction with Project R20, Project R21 will increase sewer flow capacity through the Bloomington area by installing a new 72-inch sewer line from Man of War Road to the outfall of the Sun River force main just upstream of the SGWRF. Because Mulberry Drive/Baneberry Drive is a crowded utility corridor, Project R21 will take the new 72-inch interceptor along a new alignment around the east and south side of Bloomington (conceptual alignment shown on Figure 6-1). Assuming this approximate alignment, this project will require the installation of 10,400 feet of 72-inch pipe.

**R22. SGWRF Sewer Interceptor Replacement Project****Project Year: 2020**

This improvement project is an upsize of the last reach of pipe in the St. George sewer collection system prior to reaching the SGWRF. The project includes the installation of 760 feet of 72-inch pipe from the Sun River force main outfall to the inlet of the treatment plant.

**R23. Airport Sewer Main Replacement – Reach 1**

To meet the needs of growth in the southeastern region of St. George as well as the southern region of Washington City (Warner Valley), the existing sewer collection infrastructure in the Desert Canyons area will need to be upsized. This project has been broken into 2 reaches (see Figure 6-1 for project location):

- **Reach 1 (2030+)** – Replace 7,400 feet of 18-inch and 21-inch pipe with a new 30-inch pipe.
- **Reach 2 (2030+)** – Replace 1,700 feet of 18-inch pipe with a new 27-inch pipe.

Table 6-1  
Recommended Sewer Collection System Improvements through Buildout

| Project Identifier                 | Project Description                                                                                                                          | Estimated Construction Date | Measurement Unit | Unit Price  | Quantity | Estimated Construction Cost (2018 Dollars) | Estimated Total Cost (15% Increase for Engineering, Admin, etc. |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------|-------------|----------|--------------------------------------------|-----------------------------------------------------------------|
| Local Sewer Collection Projects    |                                                                                                                                              |                             |                  |             |          |                                            |                                                                 |
| L1                                 | Replace 2,300 feet of 8-inch pipe with 12-inch pipe                                                                                          | 2030+                       | LF               | \$160       | 2,300    | \$368,000                                  | \$423,000                                                       |
| L2                                 | Tonaquint Sewer Line Replacement                                                                                                             |                             |                  |             |          |                                            |                                                                 |
| Reach 1                            | Replace 1,200 feet of 12-inch pipe with 15-inch pipe                                                                                         | 2030+                       | LF               | \$170       | 1,200    | \$204,000                                  | \$235,000                                                       |
| Reach 2                            | Install 500 feet of 15-inch pipe and 500 feet of 8-inch pipe (relocate sewer main)                                                           | 2020                        | LF               | \$150       | 1,000    | \$150,000                                  | \$173,000                                                       |
| Reach 3                            | Replace 600 feet of 12-inch pipe with 15-inch pipe                                                                                           | 2030+                       | LF               | \$170       | 600      | \$102,000                                  | \$117,000                                                       |
| L3                                 | Replace 2,650 feet of 10-inch and 12-inch pipe with 18-inch pipe                                                                             | 2030+                       | LF               | \$180       | 2,650    | \$477,000                                  | \$549,000                                                       |
| L4                                 | Install 2,500 feet of 12-inch pipe                                                                                                           | 2020                        | LF               | \$160       | 2,500    | \$400,000                                  | \$460,000                                                       |
| L5                                 | Replace 7,050 feet of 18-inch pipe with 24-inch pipe                                                                                         | 2030+                       | LF               | \$220       | 7,050    | \$1,551,000                                | \$1,784,000                                                     |
| L6                                 | Replace 7,500 feet of 15-inch pipe with 18-inch pipe                                                                                         | 2030+                       | LF               | \$180       | 7,500    | \$1,350,000                                | \$1,553,000                                                     |
| L7                                 | Upgrade Sun River Lift Station to 4,100 gpm capacity                                                                                         | 2025                        | LS               | \$800,000   | 1        | \$800,000                                  | \$920,000                                                       |
| L8                                 | Install 2,860 feet of 14-inch force main from Sun River to Treatment Plant Road                                                              | 2030+                       | LF               | \$250       | 2,860    | \$715,000                                  | \$822,000                                                       |
| L9                                 | Replace 625 feet of 10-inch pipe with 18-inch pipe                                                                                           | 2030+                       | LF               | \$180       | 625      | \$112,500                                  | \$129,000                                                       |
| Regional Sewer Collection Projects |                                                                                                                                              |                             |                  |             |          |                                            |                                                                 |
| R1                                 | Replace 1,560 feet of 8-inch and 10-inch pipe with 18-inch pipe                                                                              | 2022                        | LF               | \$180       | 1,560    | \$280,800                                  | \$323,000                                                       |
| R2                                 | Replace 2,750 feet of 12-inch pipe with 18-inch pipe                                                                                         | 2030+                       | LF               | \$180       | 2,750    | \$495,000                                  | \$569,000                                                       |
| R3                                 | Replace 2,800 feet of 15-inch pipe with 18-inch pipe                                                                                         | 2030+                       | LF               | \$180       | 2,800    | \$504,000                                  | \$580,000                                                       |
| R4                                 | Replace 560 feet of 21-inch pipe with 24-inch pipe                                                                                           | 2030+                       | LF               | \$220       | 560      | \$123,200                                  | \$142,000                                                       |
| R5                                 | Replace and realign existing 21-inch pipe with 5,900 feet of 30-inch pipe and 650 of rehabilitated 21-inch pipe (slip lined down to 10-inch) | 2030+                       | LF               | \$280       | 6,550    | \$1,834,000                                | \$2,109,000                                                     |
| R6                                 | Replace 420 feet of 24-inch pipe with 36-inch pipe                                                                                           | 2030+                       | LF               | \$300       | 420      | \$126,000                                  | \$145,000                                                       |
| R7                                 | Replace 1,350 feet of 24-inch pipe with 36-inch                                                                                              | 2024                        | LF               | \$300       | 1,350    | \$405,000                                  | \$466,000                                                       |
| R8                                 | Replace 1,100 feet of 24-inch and 27-inch pipe with 36-inch pipe                                                                             | 2030+                       | LF               | \$300       | 1,100    | \$330,000                                  | \$380,000                                                       |
| R9                                 | Install 2,100 feet of 36-inch pipe                                                                                                           | 2030+                       | LF               | \$300       | 2,100    | \$630,000                                  | \$725,000                                                       |
| R10                                | Replace 1,790 feet od 30-inch and 36-inch pipe with a 48-inch pipe                                                                           | 2030+                       | LF               | \$450       | 1,790    | \$805,500                                  | \$926,000                                                       |
| R11                                | Riverside Drive Sewer Main Replacement                                                                                                       |                             |                  |             |          |                                            |                                                                 |
| Reach 1                            | Replace 2,500 feet of 18-inch pipe with 36-inch pipe                                                                                         | 2021                        | LF               | \$300       | 2,500    | \$750,000                                  | \$863,000                                                       |
| Reach 2                            | Replace 3,600 feet of 27-inch pipe with 36-inch pipe                                                                                         | 2030+                       | LF               | \$300       | 3,600    | \$1,080,000                                | \$1,242,000                                                     |
| Reach 3                            | Replace 2,600 feet of 27-inch pipe with 36-inch pipe                                                                                         | 2030+                       | LF               | \$300       | 2,600    | \$780,000                                  | \$897,000                                                       |
| Reach 4                            | Replace 7,300 feet of 27-inch pipe with 36-inch pipe                                                                                         | 2030+                       | LF               | \$300       | 7,300    | \$2,190,000                                | \$2,519,000                                                     |
| Reach 5                            | Replace 1,600 feet of 27-inch pipe with 36-inch pipe                                                                                         | 2030+                       | LF               | \$300       | 1,600    | \$480,000                                  | \$552,000                                                       |
| Reach 6                            | Replace 2,050 feet of 24-inch pipe with 36-inch pipe                                                                                         | 2030+                       | LF               | \$300       | 2,050    | \$615,000                                  | \$707,000                                                       |
| R12                                | Replace 4,400 feet of 18-inch pipe with 24-inch pipe                                                                                         | 2030+                       | LF               | \$220       | 4,400    | \$968,000                                  | \$1,113,000                                                     |
| R13                                | Replace 7,300 feet of 24-inch pipe with 36-inch pipe                                                                                         | 2030+                       | LF               | \$300       | 7,300    | \$2,190,000                                | \$2,519,000                                                     |
| R14                                | Seegmiller Marsh/1450 S Sewer Line Replacement                                                                                               |                             |                  |             |          |                                            |                                                                 |
| Reach 1                            | Replace 3,400 feet of 21-inch and 24-inch pipe with 42-inch pipe                                                                             | 2027                        | LF               | \$350       | 3,400    | \$1,190,000                                | \$1,369,000                                                     |
| Reach 2                            | Replace 5,000 feet of 21-inch pipe with 42-inch pipe                                                                                         | 2030+                       | LF               | \$350       | 5,000    | \$1,750,000                                | \$2,013,000                                                     |
| R15                                | Replace 6,000 feet of 36-inch pipe with 48-inch pipe                                                                                         | 2030+                       | LF               | \$450       | 6,000    | \$2,700,000                                | \$3,105,000                                                     |
| R16                                | Fort Pierce Sewer Main Replacement                                                                                                           |                             |                  |             |          |                                            |                                                                 |
| Reach 1                            | Replace 13,000 feet of 21-inch pipe with 36-inch pipe                                                                                        | 2030+                       | LF               | \$300       | 13,000   | \$3,900,000                                | \$4,485,000                                                     |
| Reach 2                            | Replace 5,100 feet of 21-inch pipe with 36-inch pipe                                                                                         | 2030+                       | LF               | \$300       | 5,100    | \$1,530,000                                | \$1,760,000                                                     |
| Reach 3                            | Replace 4,200 feet of 18-inch and 21-inch pipe with 36-inch pipe                                                                             | 2023                        | LF               | \$300       | 4,200    | \$1,260,000                                | \$1,449,000                                                     |
| Reach 4                            | Replace 8,300 feet of 18-inch pipe with 36-inch pipe                                                                                         | 2022                        | LF               | \$300       | 8,300    | \$2,490,000                                | \$2,864,000                                                     |
| Reach 5                            | Replace 4,000 feet of 18-inch pipe with 3,800 feet of 36-inch pipe and 200 feet of 42-inch pipe                                              | 2021                        | LF               | \$350       | 4,000    | \$1,400,000                                | \$1,610,000                                                     |
| R17                                | Install 3,500 feet of 48-inch pipe parallel to existing 36-inch pipe                                                                         | 2026                        | LF               | \$450       | 3,500    | \$1,575,000                                | \$1,811,000                                                     |
| R18                                | Install (2) 800-foot, 36-inch parallel lines to the Bloomington Hills Siphon with inlet/outlet structure modifications                       | 2029                        | LS               | \$1,200,000 | 1        | \$1,200,000                                | \$1,380,000                                                     |
| R19                                | Replace 10,500 feet of 48-inch pipe with 72-inch pipe                                                                                        | 2027                        | LF               | \$1,000     | 10,500   | \$10,500,000                               | \$12,075,000                                                    |
| R20                                | Replace 7,400 feet of 48-inch pipe with 15-inch pipe                                                                                         | 2029                        | LF               | \$170       | 7,400    | \$1,258,000                                | \$1,447,000                                                     |
| R21                                | Install 10,400 feet of 72-inch pipe                                                                                                          | 2028                        | LF               | \$1,000     | 10,400   | \$10,400,000                               | \$11,960,000                                                    |
| R22                                | Replace 760 feet of 48-inch pipe with 72-inch pipe                                                                                           | 2020                        | LF               | \$1,000     | 760      | \$760,000                                  | \$874,000                                                       |
| R23                                | Desert Canyons Sewer Main Replacement                                                                                                        |                             |                  |             |          |                                            |                                                                 |
| Reach 1                            | Replace 7,400 feet of 18-inch and 21-inch pipe with 30-inch pipe                                                                             | 2030+                       | LF               | \$280       | 7,400    | \$2,072,000                                | \$2,383,000                                                     |
| Reach 2                            | Replace 1,700 feet of 18-inch pipe with 27-inch pipe                                                                                         | 2030+                       | LF               | \$260       | 1,700    | \$442,000                                  | \$508,000                                                       |
|                                    |                                                                                                                                              |                             |                  |             | TOTAL    | \$65,243,000                               | \$75,035,000                                                    |

## **LOCAL COLLECTION SYSTEM EXPANSION PROJECTS**

Figure 6-1 displays a number of “expansion” projects (projects with an “E” prefix) that represent system expansion into undeveloped or partially development areas of the City. These projects are “project level” improvements that will be funded by developers. These conceptual sewer system expansion projects were developed in order to model the impacts of future growth on the existing sewer collection system. Therefore, the location, alignment, and size of these projects is a concept and is subject to change based upon actual development activity. The following section provides a summary description of these projects.

### **E1. The Ledges/Trails Sewer Main Expansion**

With growth slated for The Ledges and the Trails area, additional sewer collection infrastructure will be needed. This project involves the installation of 7,950 feet of 12-inch pipe along the east side of SR-18 and then crossing SR-18 to tie into the existing 15-inch sewer line on the west side of SR-18.

### **E2. The Trails Lift Station**

In order to provide sewer service to The Trails, a sewer lift station will be necessary. Based on the current development plans for The Trails, this lift station will require a capacity of 50 – 100 gpm.

### **E3. The Trails Force Main**

Project E3 involves the construction of a force main to connect the Trails lift station to the gravity collection system on the east side of SR-18. Based on the conceptual location of the lift station, the force main will need to be approximately 4,000 feet long with a diameter of 4 to 6 inches.

### **E4. The Lakes to Plantation Drive Sewer Main Expansion**

The Lakes is a master planned community north of the Tonaquint area. This project establishes the sewer collection backbone through the development by installing 10,300 feet of 12-inch sewer pipe that ties into the existing collection system in Plantations Drive.

### **E5. West Tonaquint Sewer Main Expansion**

With new development planned for the western region of the Tonaquint area, Project E5 will provide the main sewer collection line through the development area. Due to the topography of the area, the line does not drain by gravity to the nearby existing collection system and will require a lift station to pump wastewater into the collection system in Curly Hollow Drive. This project involves the construction of 6,700 feet of 10-inch pipe.

### **E6. West Tonaquint Lift Station**

The West Tonaquint Lift Station will be needed to pump wastewater flow from the west side of the Tonaquint area to the collection system to the east. Based on the model simulation for buildout conditions, the lift station will need to have a 425 gpm pumping capacity.

**E7. West Tonaquint Force Main**

In conjunction with Project E6, a pressure sewer force main will need to be installed to connect the lift station to the gravity sewer collection system. This project requires the installation of approximately 1,550 feet of 6-inch pressure sewer pipe from the lift station to top of the ridge to the north, at which point the wastewater will flow through a new gravity sewer line that ties into the existing sewer collection system.

**E8. West Tonaquint Lift Station Outfall Line**

This sewer collection project will connect the proposed Tonaquint Lift Station force main to the existing system in Curly Hollow Drive. In addition, this line will provide sewer service to adjacent development in the Tonaquint area. The project consists of the installation of 1,900 feet of 10-inch pipe.

**E9. Curly Hollow Drive Sewer Line Expansion**

The Curly Hollow Drive sewer line expansion extends the existing sewer line in Curly Hollow Dr. to the west into the undeveloped area of Tonaquint. This project involves the installation of 2,700 feet of 12-inch pipe.

**E10. Tech Ridge to Indian Hills Drive Sewer Line Expansion**

As the redevelopment of the old airport site (Tech Ridge) occurs on the south end of the site, additional sewer infrastructure will be needed to convey flow to the sewer collection system below. Upon evaluating different options, it is recommended that 5,400 feet of 10-inch sewer pipe be constructed down the west side of the ridge to tie into the sewer collection line in Indian Hills Drive.

**E11. Desert Color Sewer Expansion – Reach 1**

Desert Color is a large, master planned community located at the south end of St. George. Project E11 is one of two projects that extend sewer collection service into the southern region of Desert Color (region south of Southern Parkway). This project involves the construction of 2,600 feet of 10-inch pipe, 1,200 feet of 12-inch pipe, and 1,450 feet of 15-inch pipe, connecting into an existing 18-inch line adjacent to the Southern Parkway.

**E12. Desert Color Sewer Expansion – Reach 2**

Project E12 is the second project that extends sewer service into the southern region of Desert Color. This project includes the construction of 3,400 feet of 10-inch pipe, 1,250 feet of 12-inch pipe, and 400 feet of 15-inch pipe, tying into the existing 18-inch sewer line adjacent to the Southern Parkway.

**E13. Desert Color Sewer Expansion – Reach 3**

Project E13 is the first of two projects that extend sewer service into the northern region of Desert Color (area north of the Southern Parkway). The project includes the installation of 750 feet of 10-inch pipe and 725 feet of 12-inch pipe, connecting into the existing 18-inch pipe at the Southern Parkway.

**E14. Desert Color Sewer Expansion – Reach 4**

The second project that will extend sewer service into the northern region of Desert Color includes the installation of 1,500 feet of 10-inch pipe and 4,250 feet of 12-inch pipe into the area near the intersection of Southern Parkway and South River Road.

**E15. Southern Parkway Sewer Line Expansion**

To extend sewer service to new development on the east side of Desert Color, Project E15 consists of installing 6,500 of 10-inch and 2,500 of 12-inch pipe along the Southern Parkway from S. River Road to the downstream end of Project E13.

**E16. West Airport Sewer Expansion – Reach 1**

Project E16 is the first of three sewer system expansion projects into the undeveloped area west of the St. George Airport. The project includes the construction of 3,400 feet of 10-inch sewer pipe which connects into the existing collection system near the southwest corner of the airport.

**E17. West Airport Sewer Expansion – Reach 2**

The second west airport sewer expansion project includes the installation of 4,650 feet of 10-inch pipe, connecting into the upstream end of Project E16.

**E18. West Airport Sewer Expansion – Reach 3**

The third west airport sewer expansion project extends sewer service into the further western region of this undeveloped area. The project will consist of installing 3,250 feet of 10-inch sewer pipe, connecting into the upstream side of Project E16.

**E19. East Airport Sewer Expansion**

Project E19 extends sewer service into the area on the northeast side of the airport. The project includes the installation of 4,950 feet of 10-inch pipe.

**E20. North Airport Parkway Sewer Line Expansion**

To extend sewer service into the northern area of Desert Canyons, Project E20 includes a new 10-inch pipe along Airport Parkway from the high point in the parkway toward the roundabout at Airport Parkway and Desert Canyons Parkway. The project includes the installation of 2,400 feet of 10-inch pipe.

**E21. South Airport Parkway Sewer Line Expansion**

Project E21 will connect the sewer collection system into the southern portion of Airport Parkway. This project includes installing 3,000 feet of 12-inch pipe starting near the high point in the parkway and running south across the Southern Parkway, tying into an existing 12-inch pipe (currently not in service) that runs along the Southern Parkway. The second phase of this project includes installing 1,400 feet of 12-inch pipe to connect the existing 12-inch line into the collection system near the Southern Parkway Bridge over the Fort Pierce Wash.

**E22. West Desert Canyons Sewer Expansion – Reach 1**

As growth expands into the east end of Desert Canyons, additional sewer collection infrastructure will need to be constructed. Project E22, which establishes the main connection for this region, includes the installation of 5,200 feet of 24-inch sewer pipe along Fort Pierce Wash, tying into the existing collection infrastructure at Desert Canyons.

**E23. West Desert Canyons Sewer Expansion – Reach 2**

Project E23 will extend a branch off of the upstream end of project E22, extending service further north into the area with 1,800 feet of 12-inch pipe and 1,700 feet of 10-inch pipe.

**E24. West Desert Canyons Sewer Expansion – Reach 3**

The third project in the eastern area of Desert Canyons includes the installation of 2,800 feet of 10-inch sewer pipe.

**WASTEWATER TREATMENT IMPROVEMENTS**

Planning to meet the future treatment needs of the service area has been a major focus for City management in recent years. As discussed at the beginning of this chapter, the current plan for expansion of the City's wastewater treatment facilities is to construct the additional capacity at or near the location of the existing SGWRF. As Washington County continues to develop, secondary irrigation water may play a larger role in the overall water use portfolio of not only St. George, but the County as a whole. If the demand for secondary irrigation (untreated) water increases, it may be advantageous for the City to construct a decentralized wastewater treatment plant that can treat and deliver reuse-quality irrigation water closer to where it is needed.

The following is a summary of the recommended wastewater treatment improvements through buildout. The proposed timing of improvements is based on the assumed growth rate for the City of St. George and the surrounding communities that contribute to the system. Figure 6-2 compares the proposed timing of treatment expansion projects with the proposed increase in wastewater production through 2060. The estimated cost of each expansion is summarized in Table 6-2 in estimated 2018 dollars.

**T1. SGWRF Expansion Project (Phase 1)****Estimated Construction Date: 2018 - 2020**

The ongoing wastewater treatment improvements at the SGWRF represent the first phase of an overall expansion project to increase the plant's treatment capacity from 17 MGD to 25.4 MGD. The first phase includes the replacement and upgrade of the existing headworks and UV treatment facilities, along with improvements to flow metering and odor control.

**T2. SGWRF Expansion and Process Conversion****Estimated Construction Date: 2020 – 2021**

The second phase of the expansion of the existing SGWRF will complete to capacity upgrades, bringing the overall treatment capacity to 25.4 MGD. The project includes a conversion of the treatment process aimed at improved nutrient removal from wastewater to meet State of Utah

requirements. The project will convert the existing oxidation ditches into a plug-flow, staged aeration treatment process.

### **T3. Construct 8 MGD Wastewater Treatment Facility (Expandable)**

**Estimated Construction Date: 2033 – 2034**

With the completion of Project T2, the existing SGWRF site will be at its full capacity. At this point, additional wastewater treatment capacity will need to come from a new wastewater treatment facility. The City owns a large area of land around the existing site that will serve as the location of the new treatment facility. At this point in the planning process, it has been assumed that the new facility will utilize the same conventional treatment methods utilized by the existing plant.

### **T4. Construct 8 MGD Wastewater Treatment Facility**

**Estimated Construction Date: 2042 – 2043**

Project T4 will add an additional 8 MGD of treatment capacity to the system. This project will be either an expansion to Project T3 or a satellite, decentralized treatment plant. One potential location for a decentralized plant is the Fort Pierce Industrial area (near Commerce Drive/Fort Pierce Wash). This satellite plant would treat flow from the south east region of St. George and a large portion of the Warner Valley area of Washington City. For cost estimating purposes, it has been assumed that a decentralized plant location would possess a large enough footprint to implement the same type of treatment process utilized by the SGWRF.

### **T5. Construct 5 MGD Wastewater Treatment Facility**

**Estimated Construction Date: 2052 - 2053**

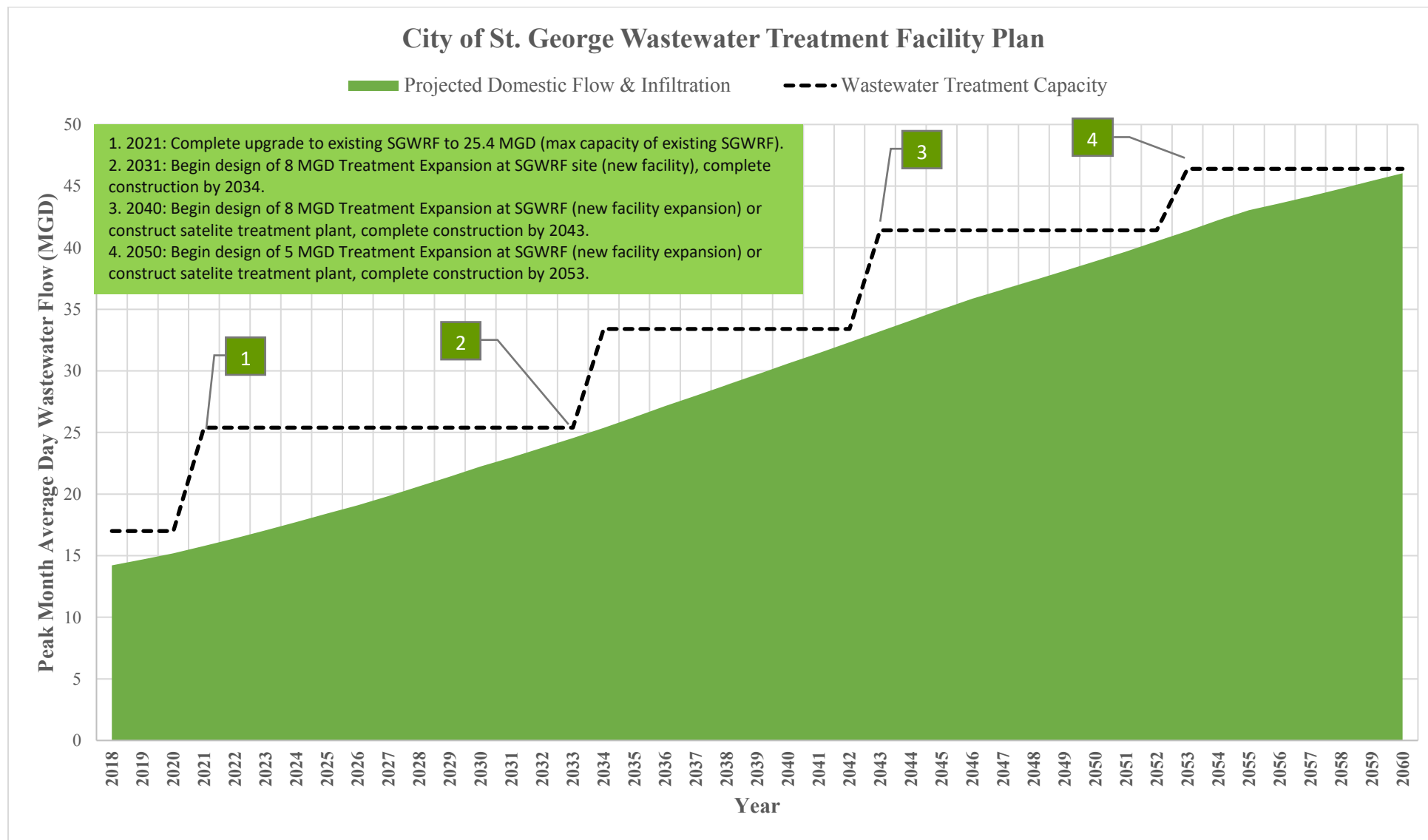
The final treatment facility expansion will require an additional 5 MGD of treatment capacity. This added capacity will come either via an expansion to Project T3 & T4 or as a new satellite facility. Like Project T4, the cost estimate for this project assumes that the same treatment process used at the SGWRF will be used in this expansion phase.

**Table 6-2**  
**Estimated Cost of Future Treatment Facilities**

| <b>Project Description</b>                       | <b>Treatment Capacity Added</b> | <b>Estimated Construction Year</b> | <b>Estimated Construction (2018 dollars)</b> | <b>Estimated Total Cost (15% Increase for Engineering, Admin, etc.)</b> |
|--------------------------------------------------|---------------------------------|------------------------------------|----------------------------------------------|-------------------------------------------------------------------------|
| SGWRF Expansion Project (Phase 1)                | *                               | 2020                               | \$25,800,000                                 | \$29,670,000                                                            |
| SGWRF Expansion and Process Conversion (Phase 2) | 8.4 MGD                         | 2021                               | \$36,100,000                                 | \$41,500,000                                                            |
| 8 MGD Future Treatment Expansion                 | 8 MGD                           | 2034                               | \$72,000,000                                 | \$82,800,000                                                            |
| 8 MGD Future Treatment Expansion                 | 8 MGD                           | 2043                               | \$72,000,000                                 | \$82,800,000                                                            |
| 5 MGD Future Treatment Expansion                 | 5 MGD                           | 2053                               | \$45,000,000                                 | \$51,750,000                                                            |
|                                                  |                                 | <b>TOTAL</b>                       | <b>\$250,900,000</b>                         | <b>\$288,520,000</b>                                                    |

\*The first phase of the expansion does not increase the overall treatment capacity of the SGWRF.

**Figure 6-2**  
**Proposed Wastewater Treatment Improvements Through Buildout**



## **CHAPTER 7**

### **10 YEAR CAPITAL FACILITIES PLAN**

Chapter 6 of this report identifies system improvements which address existing and future deficiencies in the St. George wastewater collection and treatment system. The purpose of this chapter is to assemble a detailed 10-year capital facilities plan to implement the recommended improvements.

#### **DEVELOPING AN ANNUAL BUDGET**

Before establishing a 10-year capital facilities plan, it is useful to determine how much funding should be budgeted each year for capital projects and 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 system 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 2.4 million feet of gravity pipe, 15,000 feet of pressurized pipe, and 8 lift stations. Table 7-1 summarizes the estimated replacement value of the City's wastewater collection and treatment system. The total cost to replace all pipes, lift stations, and treatment facilities in the St. George system is estimated to be approximately \$600 million based on estimated 2019 construction costs.

**Table 7-1**  
**Estimated Sewer Collection/Treatment System Replacement Value**

| <b>System Component</b>                     | <b>Quantity</b> | <b>Unit Installation Price</b> | <b>Estimated Replacement Value</b> |
|---------------------------------------------|-----------------|--------------------------------|------------------------------------|
| <b><i>Gravity Sewer Collection Pipe</i></b> |                 |                                |                                    |
| 8 inch*                                     | 1,910,000       | \$165                          | \$315,150,000                      |
| 10 inch                                     | 140,629         | \$175                          | \$24,610,000                       |
| 12 inch                                     | 102,831         | \$190                          | \$19,538,000                       |
| 15 inch                                     | 60,806          | \$220                          | \$13,377,000                       |
| 18 inch                                     | 70,601          | \$250                          | \$17,650,000                       |
| 21 inch                                     | 46,438          | \$260                          | \$12,074,000                       |
| 24 inch                                     | 17,377          | \$325                          | \$5,647,000                        |
| 27-inch                                     | 20,187          | \$340                          | \$6,864,000                        |
| 30 inch                                     | 12,931          | \$400                          | \$5,172,000                        |
| 36-inch                                     | 20,249          | \$450                          | \$9,112,000                        |
| 48-inch                                     | 20,912          | \$750                          | \$15,684,000                       |
|                                             |                 | <b>Subtotal</b>                | <b>\$444,878,000</b>               |
| <b><i>Pressurized Sewer Pipe</i></b>        |                 |                                |                                    |
| 1.5                                         | 1,862           | \$25                           | \$47,000                           |
| 2                                           | 2,736           | \$30                           | \$82,000                           |
| 3                                           | 5,075           | \$35                           | \$178,000                          |
| 4                                           | 1,116           | \$40                           | \$45,000                           |
| 8                                           | 1,164           | \$85                           | \$99,000                           |
| 12                                          | 2,819           | \$150                          | \$423,000                          |
|                                             |                 | <b>Subtotal</b>                | <b>\$874,000</b>                   |
| <b><i>Lift Stations</i></b>                 |                 |                                |                                    |
| Sun River                                   | 1               | \$1,000,000                    | \$1,000,000                        |
| Convention Center                           | 1               | \$250,000                      | \$250,000                          |
| Dino Crossing                               | 1               | \$250,000                      | \$250,000                          |
| Cox                                         | 1               | \$250,000                      | \$250,000                          |
| Lagoons                                     | 1               | \$250,000                      | \$250,000                          |
| Rio Virgin                                  | 1               | \$250,000                      | \$250,000                          |
| Highlands                                   | 1               | \$250,000                      | \$250,000                          |
| Racing Hollows                              | 1               | \$250,000                      | \$250,000                          |
|                                             |                 | <b>Subtotal</b>                | <b>\$2,750,000</b>                 |
| <b><i>Treatment Facilities</i></b>          |                 |                                |                                    |
| St. George Water Reclamation Facility       | 1               | \$153,000,000                  | \$153,000,000                      |
|                                             |                 | <b>Subtotal</b>                | <b>\$153,000,000</b>               |
|                                             |                 | <b>Grand Total</b>             | <b>\$601,502,000</b>               |

\* Includes 28,000 feet of 6-inch sewer pipe that would be replaced with 8-inch pipe

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 (typically 40% 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” to \$380 million (assuming rehabilitation methods for gravity sewer pipes cost 50% of full replacement costs, while force mains, lift stations, and treatment facility replacement prices remain at the full replacement cost). Unfortunately, it is generally not possible to rehabilitate all system components due to either condition or capacity issues. Some pipes are beyond restoring with rehabilitation, while others may require upsizing or correction of grade issues; all of these scenarios would warrant a full 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, 50 years for treatment facilities, and 40 years for lift stations. Table 7-2 shows 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 cover the City’s expenses for capital improvement projects and system renewal.

**Table 7-2**  
**Recommended Annual Sewer Collection/Treatment System Budget**

| <b>System Component</b> | <b>Service Life</b> | <b>Full Replacement</b> | <b>Rehabilitation<sup>1</sup></b> | <b>50% Replacement<br/>50% Rehabilitation<br/>(Recommended System Valuation)<sup>2</sup></b> | <b>Recommended Annual Budget<sup>3</sup></b> |
|-------------------------|---------------------|-------------------------|-----------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------------|
| Gravity Pipes           | 80 Years            | \$444,878,000           | \$222,439,000                     | \$333,658,500                                                                                | \$4,170,731.25                               |
| Pressure Pipes          | 80 Years            | \$874,000               | \$874,000                         | \$874,000                                                                                    | \$10,925                                     |
| Lift Stations           | 40 Years            | \$2,750,000             | \$2,750,000                       | \$2,750,000                                                                                  | \$68,750                                     |
| Treatment Facilities    | 50 Years            | \$153,000,000           | \$153,000,000                     | \$153,000,000                                                                                | \$3,060,000                                  |
| <b>TOTAL</b>            |                     | <b>\$601,502,000</b>    | <b>\$379,063,000</b>              | <b>\$490,282,500</b>                                                                         | <b>\$7,310,406</b>                           |

<sup>1</sup> 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.). Other system components, such as pressure pipes, lift stations, and treatment facilities have been assumed to require a full replacement, hence values shown in this column are the same as the “full replacement” cost.

<sup>2</sup> “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.

<sup>3</sup> Calculated by dividing the recommended system valuation by the estimated service life

As shown in Table 8-2, the ideal level of annual system funding is \$7.3 million, which equates to about 1.2% of the total estimated system replacement value. This value should be kept in mind as the City budgets future sewer system improvements and rehabilitation.

## 10-YEAR CAPITAL IMPROVEMENT PLAN

Based on the City’s identified project needs and recommended level of capital investment, BC&A has developed a Capital Facilities Plan (CFP) covering the next 10 years of sewer system

improvements. Table 7-3 provides a detailed outlay of the recommended projects to be completed in the next 10 years, and Figure 7-1 provides a visual reference for the projects included in the 10-year CFP. The projects included in the CFP are those projects that are anticipated to be needed within the next 10 years based on the estimated distribution of future growth in the City. If growth patterns deviate from what was assumed in this report, the CFP may need to be revised and updated to meet the City's needs.

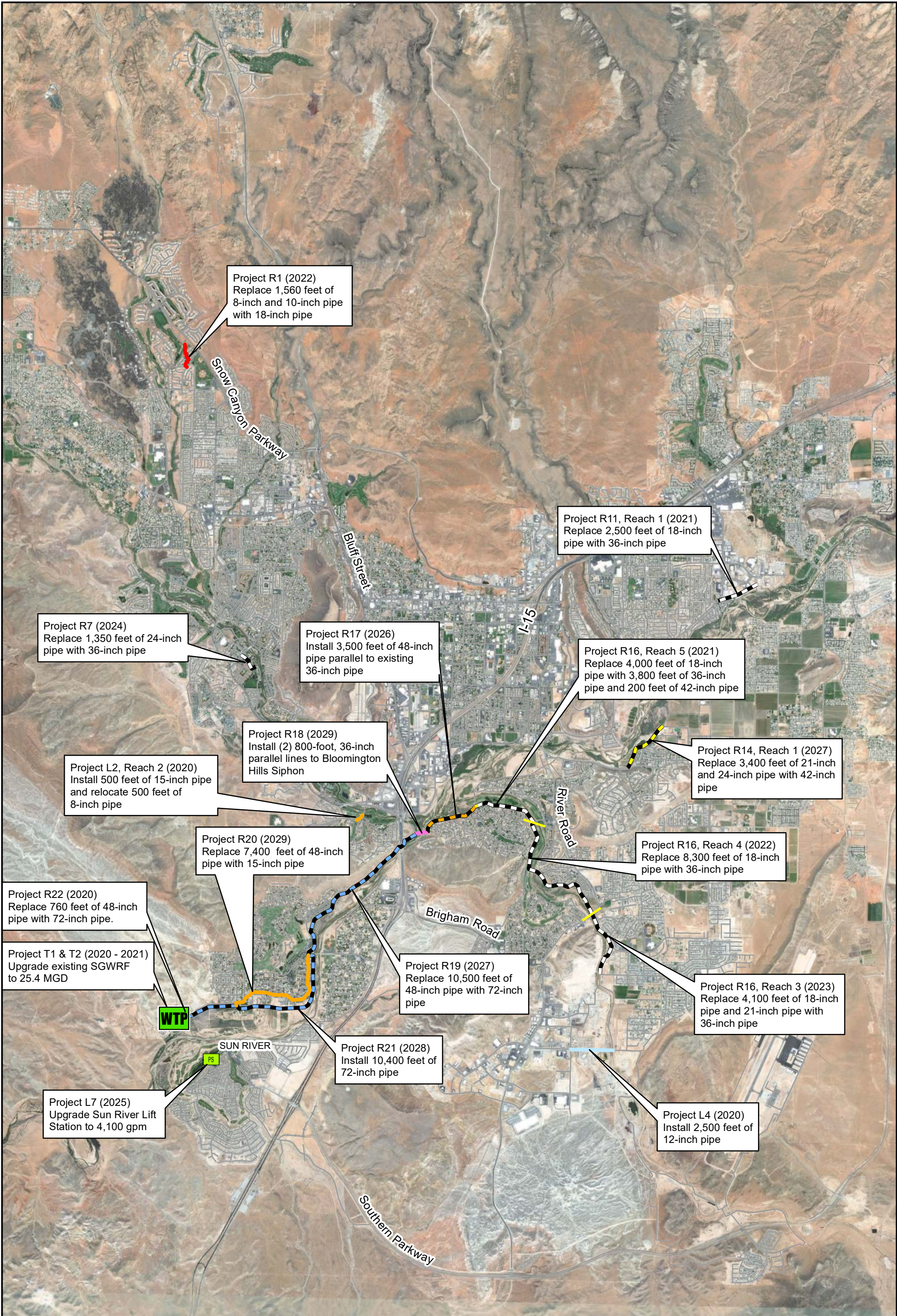


Table 7-3  
Recommended 10-year Capital Improvement Plan

| Project       | Description                                            | Estimated 2018 Cost | 2019 | 2020         | 2021         | 2022        | 2023        | 2024      | 2025      | 2026        | 2027         | 2028         | 2029        | Total (Inflated Cost) |
|---------------|--------------------------------------------------------|---------------------|------|--------------|--------------|-------------|-------------|-----------|-----------|-------------|--------------|--------------|-------------|-----------------------|
| L2 - Reach 2  | Tonaquint Dr. Sewer Main Replacement and Realignment   | \$173,000           |      | \$180,000    |              |             |             |           |           |             |              |              |             | \$180,000             |
| L4            | Commerce Drive Sewer Line Diversion                    | \$460,000           |      | \$469,000    |              |             |             |           |           |             |              |              |             | \$469,000             |
| L7            | Sun River Lift Station Upgrades                        | \$800,000           |      |              |              |             |             |           | \$901,000 |             |              |              |             | \$901,000             |
| R1            | Entrada Sewer Main Replacement (North Reach)           | \$323,000           |      |              |              | \$343,000   |             |           |           |             |              |              |             | \$343,000             |
| R7            | South Woodsvieview Circle Sewer Line Replacement       | \$466,000           |      |              |              |             |             | \$515,000 |           |             |              |              |             | \$515,000             |
| R11 - Reach 1 | Riverside Drive Sewer Main Replacement                 | \$863,000           |      |              | \$898,000    |             |             |           |           |             |              |              |             | \$898,000             |
| R14 - Reach 1 | Seegmiller Marsh/1450 S Sewer Line Replacement         | \$1,369,000         |      |              |              |             |             |           |           |             | \$1,604,000  |              |             | \$1,604,000           |
| R16 - Reach 3 | Fort Pierce Sewer Main Replacement                     | \$1,415,000         |      |              |              |             | \$1,532,000 |           |           |             |              |              |             | \$1,532,000           |
| R16 - Reach 4 | Fort Pierce Sewer Main Replacement                     | \$2,864,000         |      |              |              | \$3,039,000 |             |           |           |             |              |              |             | \$3,039,000           |
| R16 - Reach 5 | Fort Pierce Sewer Main Replacement                     | \$1,610,000         |      |              | \$1,675,000  |             |             |           |           |             |              |              |             | \$1,675,000           |
| R17           | Bloomington Hills Sewer Main Parallel Line             | \$1,811,000         |      |              |              |             |             |           |           | \$2,122,000 |              |              |             | \$2,122,000           |
| R18           | Bloomington Hills Siphon Expansion Project             | \$1,380,000         |      |              |              |             |             |           |           |             |              |              | \$1,682,000 | \$1,682,000           |
| R19           | Virgin River/Bloomington Sewer Interceptor Replacement | \$12,075,000        |      |              |              |             |             |           |           |             | \$14,148,000 |              |             | \$14,148,000          |
| R20           | Bloomington Interceptor Sewer Main Replacement Project | \$1,447,000         |      |              |              |             |             |           |           |             |              |              | \$1,764,000 | \$1,764,000           |
| R21           | South Bloomington Interceptor Project                  | \$11,960,000        |      |              |              |             |             |           |           |             |              | \$14,293,000 |             | \$14,293,000          |
| R22           | SGWRF Sewer Interceptor Replacement Project            | \$874,000           |      | \$874,000    |              |             |             |           |           |             |              |              |             | \$874,000             |
| T1            | SGWRF Expansion Project (Phase 1)                      | \$29,670,000        |      | \$29,670,000 |              |             |             |           |           |             |              |              |             | \$29,670,000          |
| T2            | SGWRF Expansion and Process Conversion                 | \$41,500,000        |      |              | \$41,500,000 |             |             |           |           |             |              |              |             | \$41,500,000          |
|               | Total Improvements                                     | \$111,060,000       | \$0  | \$31,193,000 | \$44,073,000 | \$3,382,000 | \$1,532,000 | \$515,000 | \$901,000 | \$2,122,000 | \$15,752,000 | \$14,293,000 | \$3,446,000 | \$117,209,000         |

<sup>1</sup> Future project costs have been adjusted for inflation using a 2% annual inflation rate

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