CHAPTER 1
INTRODUCTION

INTRODUCTION

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

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 three to five years.

SCOPE OF SERVICES

The general scope of this project involved a thorough analysis of Ivins 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 review data needed to develop the master plan.
- **Task 2:** Utilize city-provided land use and population growth projections to forecast future system growth .
- **Task 3:** Develop a hydraulic computer model of the city's sewer collection system to evaluate existing and projected future system deficiencies. This included calibrating the model using available flow data.
- **Task 4:** Identify existing and future operating deficiencies.
- **Task 5:** Evaluate alternative improvements for resolving deficiencies identified in Tasks 4. This included evaluating alternatives such as sewer diversions.
- **Task 6:** Identified a set of recommended system improvements and developed a capital facilities plan incorporating all required improvements identified for the collection system.
- **Task 7:** Documented results in this master plan report.

PROJECT STAFF

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

Keith Larson	Principal-In-Charge
Aaron Anderson	Project Manager
Wyatt Andersen	Project Engineer
Mike Hilbert	Technical Writer

IVINS CITY STAFF

Ivins City staff worked closely with BC&A personnel in collecting data associated with this master plan. The following city personnel were influential in the completion of this master plan:

Chuck Gillette	Public Works Director/City Engineer
Tom Jorgensen	Assistant Public Works Director of Administration

CHAPTER 2
EXISTING SYSTEM FACILITIES

INTRODUCTION

As part of this Master Plan, BC&A has assembled an inventory of existing infrastructure within the Ivins 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

Ivins City is located approximately 8 miles northwest of the City of St. George to the south of Snow Canyon State Park. Figure 2-1 displays the municipal boundary for Ivins City as well as the current sewer service area. As shown in Figure 2-1, Ivins City provides sewer collection service for most of its residents, but does not currently provide service for the majority of the area known as Kayenta. Kayenta is a low density, master planned housing development on the west side of Ivins. The majority of homes within Kayenta currently use individual septic systems to treat wastewater. However, there are a few areas in Kayenta that are connected to the sewer collection system using a septic tank effluent gravity (STEG) or septic tank effluent pump (STEP) system. Unlike a conventional septic system which discharges septic tank effluent into a leech field, the STEG/STEP system discharges septic tank effluent into the sewer collection system.

The majority of wastewater collected in Ivins is conveyed in three sewer trunk lines that connect into the St. George sewer collection system (a very small portion of flow from an area in the south of Ivins flows directly into the Santa Clara sewer collection system near 400 E and Pioneer Parkway). Wastewater from Ivins is treated at the St. George Regional Water Reclamation Facility (SGRWRF) located at the south end of St. George City. The regional plant treats wastewater from Ivins, St. George, Santa Clara, and Washington City and currently treats approximately 13 million gallons per day (MGD). The treatment plant is nearing the completion of a major expansion project and will have a treatment capacity of 25.4 MGD.

TOPOGRAPHY

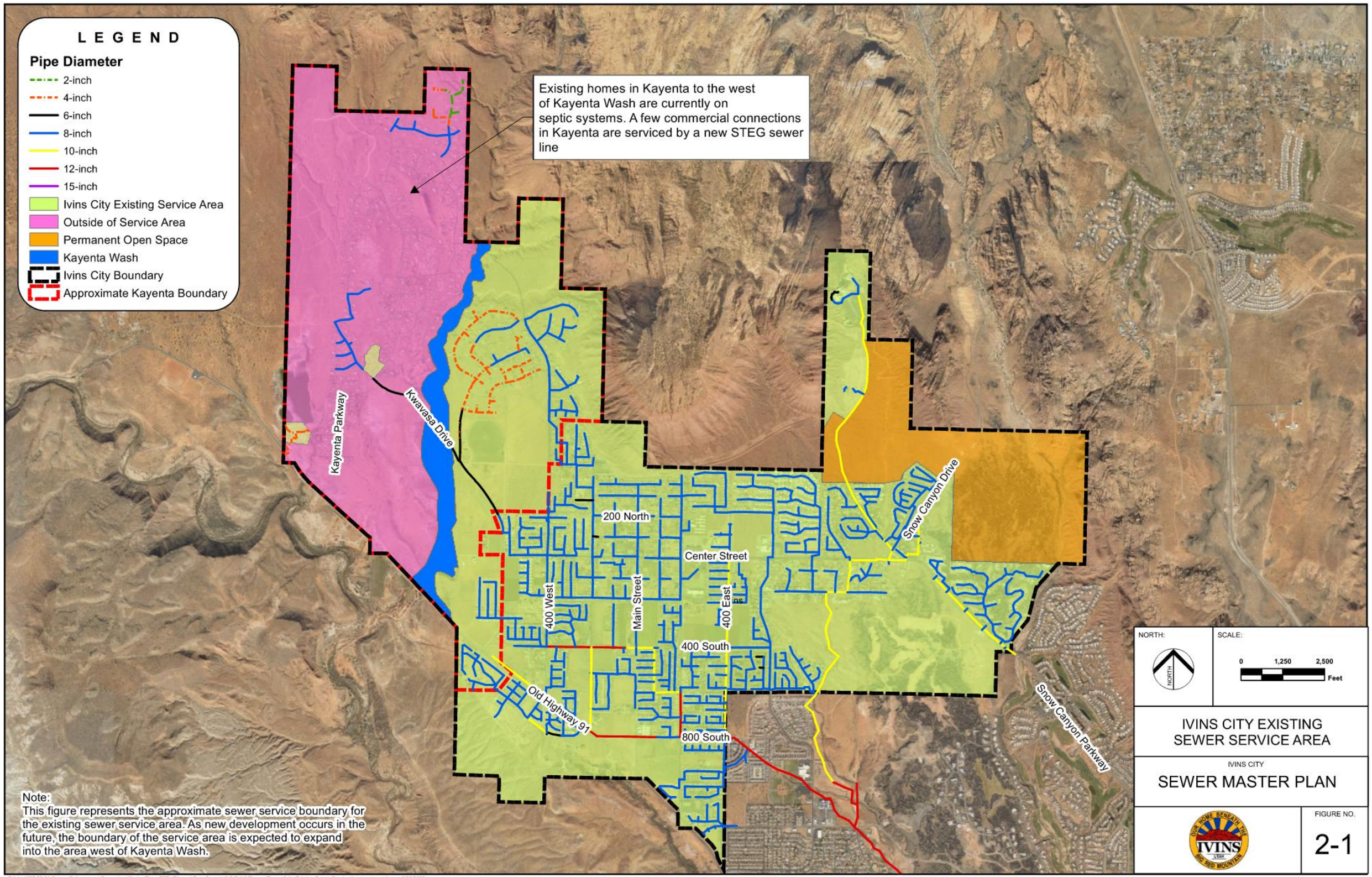
Ivins City is located at the base of a large red rock mountain range. The city generally slopes from north to south toward the Santa Clara River. Most of the city collection system flows by gravity with the exception of one small area to the southwest which utilizes a lift station.

COLLECTION SYSTEM

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

Sewer Collection Pipes

There are over 359,000 feet (68 miles) of sewer collection pipe and more than 1,400 manholes in the 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 Ivins City sewer collection system. As can be seen in the table, over 80 percent of the pipe in the system is 8 inches in diameter or smaller. This represents the vast network of small collector pipes in neighborhoods throughout the city. The majority of collection pipes are made of PVC.



S:\Ivins\235-22-01 Sewer, Culinary, and Secondary Master Plan, IFFP, IFA, and Rate Study\4.0 GIS\4.3 Figures\Figure 2-1 - Existing Sewer Service Area.mxd aanderson 9/30/2023

Table 2-1
Sewer Collection System Sizes and Lengths

Diameter	Length (ft)	Length (mi)	Percentage
STEP/STEG Sewer			
2	647	0.1	0.2%
4	10,798	2.0	3.0%
Gravity Sewer			
6	7,858	1.5	2.2%
8*	277,671	52.6	77.2%
10	38,795	7.3	10.8%
12**	18,544	3.5	5.2%
15	5,157	1.0	1.4%
Total	**359,470**	**68.1**	**100.0%**

*Pipes without size information were assumed to be 8-inch.
**Includes pipes north of Pioneer Parkway in Santa Clara which are currently maintained by Ivins City, but does not include the piping south of Pioneer Parkway that runs along Tuacahn Wash.

Sewer Lift Stations

There is one sewer lift station in the Ivins City sewer collection system. The facility is located at the intersection of Earl Dr. and 400 W. Currently, this lift station collects a very small amount of flow from a few connections. However, it is anticipated that the lift station will see more use in the near future as development occurs in this area. Table 2-2 provides a summary of the lift station characteristics.

Table 2-2
Sewer Lift Station Summary

Name	Address	Design Capacity (gpm)	Wet Well Volume (cf)	Power Per Pump (HP)	No. Pumps
Earl Dr. Lift Station	400 W Earl Dr.	250	900	5	2

CHAPTER 3
FUTURE GROWTH AND WASTEWATER FLPW PROJECTIONS

INTRODUCTION

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

METHODOLOGY

There are several methods that can be used to estimate future wastewater production. The methodology used in this study is as follows:

1. Define the service area.
2. Estimate daily sewer flows per Equivalent Residential Unit (ERU) using historical culinary water usage data and metered wastewater flows. This includes estimation of infiltration and inflow.
3. Project the growth of the number of sewer service connections for the study area through buildout based on the historical growth trends and current growth projections developed by Ivins City.
4. Convert projections of ERU growth to future wastewater production based on historical wastewater production trends.
5. Consider the effect of State Water Conservation Goals on future demands.

Each step of this process is summarized in the sections that follow.

SERVICE AREA

The current Ivins City sewer collection system service area was previously shown in Figure 2-1 of Chapter 2. The service area encompasses the majority of homes within the main section of the city, but only extends to a small number of commercial connections on the west side of Kayenta Wash. It is anticipated that all new development in Ivins will be connected to the sewer collection system (including new development in Kayenta), and it is the intention of the city to eventually provide sewer collection services to all residents within the city's municipal boundary.

EXISTING SEWER SERVICE AREA POPULATION

As previously discussed, a large portion of Kayenta is currently on septic systems and does not contribute flow to the sewer collection system. For the purposes of hydraulic modeling, only connections that are contributing flow to the sewer collection system are of importance.

Ivins maintains an up-to-date GIS database which tracks the development status of existing lots within the city. This data was used in conjunction with GIS shapefiles of the existing sewer system to identify the number of existing connections to the city's sewer collection system as shown in Figure

3-1. Table 3-1 contains a summary of the number and type of existing connections to the wastewater collection system.

Table 3-1
Ivins City Existing Sewer Service Connections

Connection Type	Number of Connections
Single Family Residence	3,842
Multi-Family Housing	125
Commercial/Industrial/Institutional	80
TOTAL	**4,047**

The most recent U.S. Census from 2020 established the average number of persons per household in Ivins to be 2.51. Based on the number of single family and multi-family units shown in Table 3-1, the current estimated residential sewer service area population in Ivins is approximately 9,958 people.

EXISTING DAILY WASTEWATER FLOWS

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

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

Domestic Wastewater Flow

Domestic wastewater is categorized as the flow that intentionally enters the collection system after being used in a home, business, etc. 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 by reviewing metered culinary water use during winter months. During winter months, there is typically little to no water being used outdoors for irrigation, so the majority of water used during these months is used indoors for showers, toilets, dishwashers, washing machines, and other appliances, all of which contribute to sewer flows. Billing data for the Ivins City culinary water system from 2019-2023 was evaluated to determine an estimate of the average indoor water usage per connection. From previous planning experience, the quantity of indoor water use which ends up in the sewer collection system is typically between 90% - 95% and is categorized as "non-consumptive" use. The remaining portion of indoor water use is assumed to be "consumptive" and does not immediately flow into the sewer system. Table 3-2 provides a summary of the meter data from Ivins and presents an estimate of the average daily wastewater flow from an average residential connection.

LEGEND

- Existing Sewer Service Users
- Existing Sewer Service Users
- Existing Sewer Lines
- Current Sewer Service Area
- Approximate Kayenta Boundary
- City Boundary

Kayenta Parkway
Kwavasa Drive
Old Highway 91
200 North
Center Street
Main St.
400 East
400 West
400 South
800 South
Snow Canyon Drive
Snow Canyon Parkway

NORTH:

SCALE: 0 1,250 2,500 Feet

IVINS CITY EXISTING SEWER SYSTEM USERS

IVINS CITY
SEWER MASTER PLAN

FIGURE NO.
3-1

S:\Ivins\235-22-01 Sewer, Culinary, and Secondary Master Plan, IFFP, IFA, and Rate Study\4.0 GIS\4.3 Figures\Figure 3-1 - Existing Sewer Service Area.mxd aanderson 6/21/2024

Table 3-2
Summary of Metered Winter Culinary Water Usage from 2019-2023

Year	January			February			December		
	# of Residential Connections Sampled[1]	Total Metered Demand (1,000 gal)	Average Demand per Connection	# of Residential Connections Sampled[1]	Total Metered Demand (1,000 gal)	Average Demand per Connection	# of Residential Connections Sampled[1]	Total Metered Demand (1,000 gal)	Total Metered Demand
2019	2,904	16,251	181	2,928	13,769	152	3,097	15,967	166
2020	3,082	16,051	168	3,148	16,650	171	3,346	20,197	195
2021	3,373	21,250	203	3,370	17,098	164	3,593	24,820	223
2022	3,327	16,214	157	3,424	19,765	206	3,448	18,123	170
2023	3,382	15,864	151	3,444	17,590	182	3,643	26,750	237
		Average January	**172**		**Average February**	**175**		**Average December**	**198**
								Average from Each Month Combined	182
								Non-Consumptive Water Use (90% of Indoor Use)	**164**

[1]Sample set included meters with a usage value greater than zero for the respective month.

It should be emphasized that the data provided in Table 3-2 is the metered winter water usage for *residential* service connections. The purpose of this distinction is to determine an estimated flow for one Equivalent Residential Unit, or ERU. Using the ERU as a unit of measurement in planning allows for the standardization of different types of connections, i.e. converting commercial or institutional connections into an equivalent residential unit. This method simplifies the planning process and provides a means of converting a non-residential population into an equivalent residential population. For planning purposes, existing and future wastewater production will be presented in terms of ERUs.

As shown in Table 3-2, the estimated average daily non-consumptive water use per residential connection is estimated to be **164 gallons per day**, which equates to a domestic wastewater flow of approximately 65.3 gallons per capita per day.

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 the collection system as a result of open pipe joints, cracks in pipes, pipes poorly connected at manholes, leaky lateral connections, pipe damage from roots, etc. Infiltration is generally a function of the groundwater level, which typically fluctuates depending on climate and season. While infiltration rates will change seasonally, they generally remain constant during a single 24-hour

period. Temporary increases in the amount of water that enters the system after a storm because of an increase in ground water is considered inflow, which is discussed in a later 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 this master plan, data from the St. George City flow meter located near Snow Canyon High School was used to help estimate infiltration rates in the system. This meter measures the majority of flow leaving Ivins City as well as a portion of flow from Santa Clara City. A data sample from 2022 provided by the City of St. George was used for these estimates (see Figure 3-2). Since infiltration rates do not follow the same diurnal pattern as domestic flows, the average flow over the course of the day (950,500 gpd) will be used to estimate infiltration.

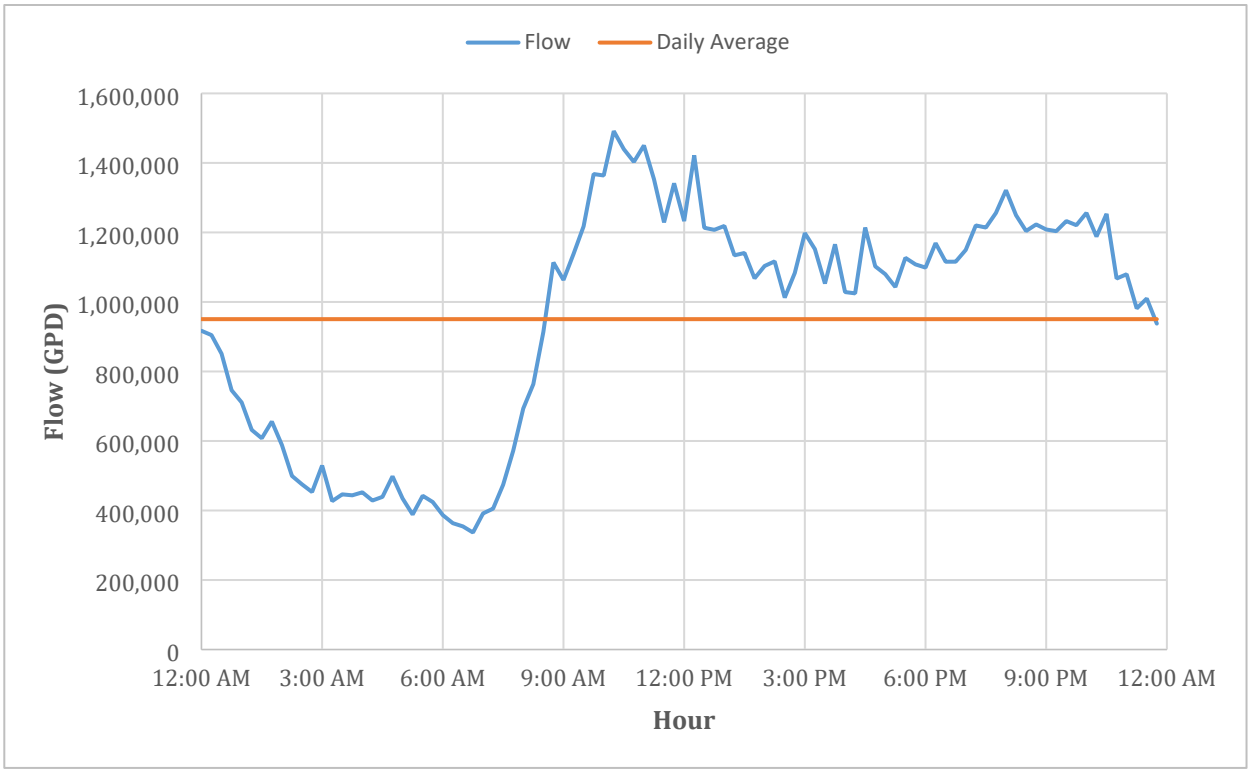


Figure 3-2. Metered Sewer Flow at Snow Canyon H.S., August 14, 2022

The portion of flow contributed by Santa Clara City was estimated using Santa Clara's 2022 billing data. It is estimated that 939 ERUs from Santa Clara currently contribute to flows through the Snow Canyon H.S. meter. Table 3-3 provides a breakdown of the estimated domestic sewer flows passing through the Snow Canyon H.S. meter and a corresponding estimate of the amount of infiltration entering the system.

Table 3-3
Estimated Tabulation of Snow Canyon H.S. Metered Sewer Flows

User Type	Approximate Number of Connections Contributing to Metered Flow	Number of ERUs Contributing to Metered Flow	Estimated Domestic Flow per ERU (gpd)	Total Domestic Flow
Ivins Single Family	3,612	3,612	164	592,368
Ivins Multi-Family Housing	118	368	164	60,352
Ivins Non-Residential	50	357	164	58,548
Santa Clara	939	939	207[1]	194,373
Total Estimated Domestic Flow	4,719	5,276	-	905,641
			Total Metered Flow from St. George Data (gpd)	950,501
			Estimated Infiltration (gpd), [Total Flow – Domestic]	44,860
			Estimated Infiltration per ERU (gpd)	**9**

[1]Value estimated using water meter billing data provided by Santa Clara City.

As shown in Table 3-3, the estimated infiltration rate per ERU is 9 gpd. The American Society of Civil Engineers (ASCE) has developed a recommended infiltration allowance for new sewer systems of 400 gallons per inch diameter of pipe per mile of pipe. From previous planning experience, this typically equates to approximately 15% of total sewer flow per ERU for average development densities. Ivins City personnel have reported that high groundwater is not a known issue in their system, so it is reasonable to expect that infiltration rates would be lower than the average sewer collection system. Combining domestic wastewater flow with infiltration, the total estimated dry weather sewer flow per ERU is **173 gpd.**

Inflow

The third and final component of wastewater flow that should 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.

Figure 3-3 shows the measured sewer flows through the Snow Canyon H.S. meter for the month of September, 2014. There was an intense storm event which occurred on September 9 which resulted in 3.11 inches of rain over an 8 hour period. A similar storm occurred later that same month.

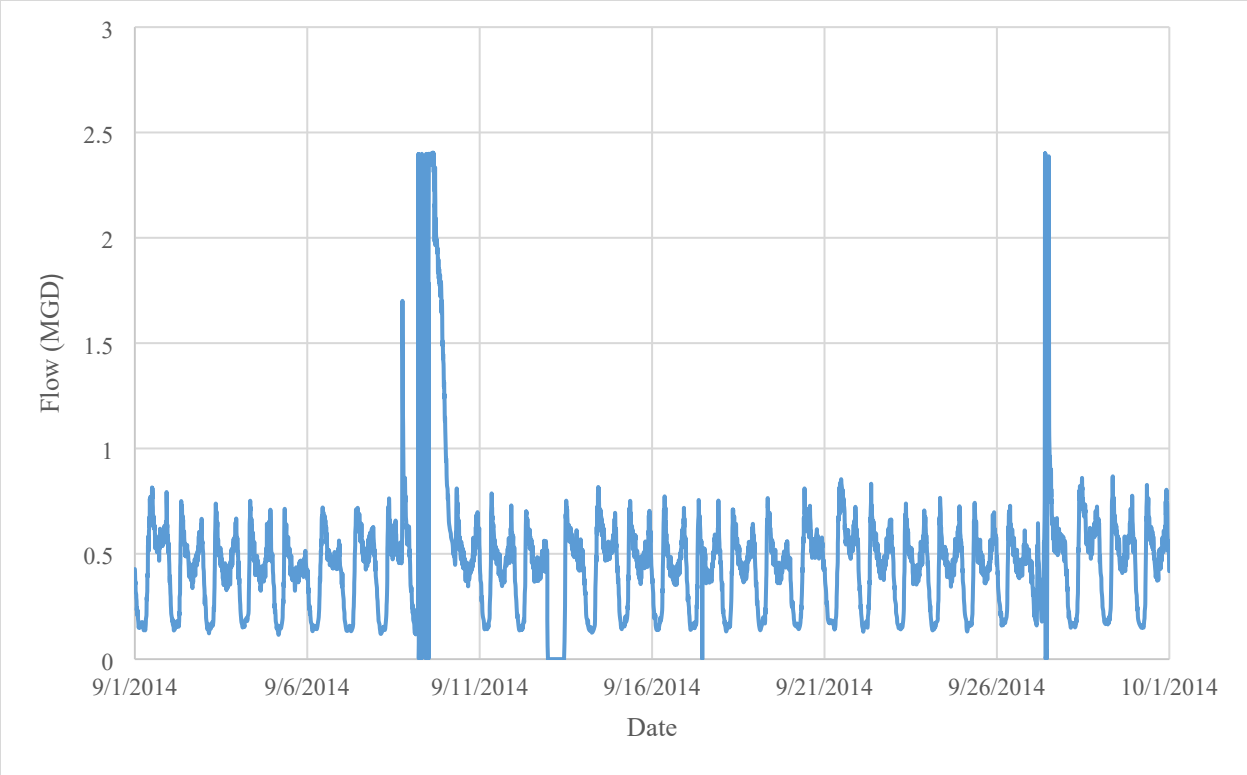


Figure 3-3. Inflow Events from September, 2014 at Snow Canyon H.S. Meter

As shown in Figure 3-3, these rainfall events created an immense spike in flow through the meter. The peak flows measured well over 3 times the typical dry weather peak daily flow. It should be noted that a section of the sewer trunk line just upstream of the meter runs through Tuacahn Wash. This reach of pipe was known to be susceptible to inflow and was particularly vulnerable if the dam near the bottom of the wash began to pond. The city recently carried out improvements to this section of the sewer line to reduce the risk of inflow during storm events. However, the system is still susceptible to inflow events during heavy storms.

It is very difficult to accurately estimate the magnitude and distribution of inflow events for individual pipes without a significant amount of flow monitoring and rain gauge data. As a result, inflow has not been included directly in projected flows, but it will be accounted for in the evaluation of collection system capacity by reserving a specified portion of pipe capacity for inflow events. The collection system evaluation criteria are discussed in detail in Chapter 4.

PROJECTING SERVICE AREA GROWTH

Having developed estimates for wastewater production rates for the existing system, it is now possible to project the increase in sewer flow as a function of projected growth in the city. Growth projections are outlined in the following sections.

Historical Growth Trends

Ivins City has witnessed noteworthy growth over the last 30 years. What was once a small, rural community in the 1980's has quickly grown into a significant suburban development. Table 3-4 shown below provides a summary of historical growth as provided by the U.S. Census Bureau.

Table 3-4
Historical Growth Data[1]

Year	State of Utah	% Growth	Washington County	% Growth	Ivins City	% Growth
1950	688,862		9,836		95	
1960	890,627	29.3%	10,271	4.4%	77	-18.9%
1970	1,059,273	18.9%	13,669	33.1%	137	77.9%
1980	1,461,037	37.9%	26,065	90.7%	600	338.0%
1990	1,722,850	17.9%	48,560	86.3%	1,630	171.7%
2000	2,246,553	30.4%	90,354	86.1%	4,450	173.0%
2010	2,763,885	23.0%	138,115	52.9%	6,753	51.8%
2020	3,271,616	18.4%	180,279	30.5%	8,958	32.7%

[1]Data from U.S. Census Bureau

As shown in Table 3-4, aggressive growth began in Ivins starting in the 1980's and has continued to the present day. It is important to note that the average household size has seen a significant reduction in recent years. The 2000 Census reported an average household size for Ivins City of 3.1 persons per household, while the 2010 Census and 2020 Census report an average household size of 2.78 and 2.51 persons per household, respectively. This is likely a function of a larger number of retirees moving to Ivins. Ivins City is also home to a number of vacation/second homes that are only occupied for a portion of the year. However, for planning purposes, all existing and future sewer system connections will be assumed as active.

Existing Development and Land Use

Figure 3-4 displays the general land use map adopted by Ivins City. Table 3-5 provides a summary of the different land use types within the city.

L E G E N D

Landuse

- CHURCH
- COMM COMMUNITY
- COMM NEIGH
- COMM PROFESSIONAL
- COMM RESORT
- COMM W LIGHT MFG
- HDR
- LDR
- MDR
- OS
- PARK
- RESORT REC
- RMU
- SCHOOL
- City Boundary

NORTH:

NORTH

SCALE:

0 1,250 2,500

Feet

IVINS CITY LAND USE

IVINS CITY

SEWER MASTER PLAN

FIGURE NO.

3-4

S:\Ivins\235-22-01 Sewer, Culinary, and Secondary Master Plan, IFFP, IFA, and Rate Study\4.0 GIS\4.3 Figures\Figure 3-4 - Ivins City Land Use.mxd aanderson 10/2/2023

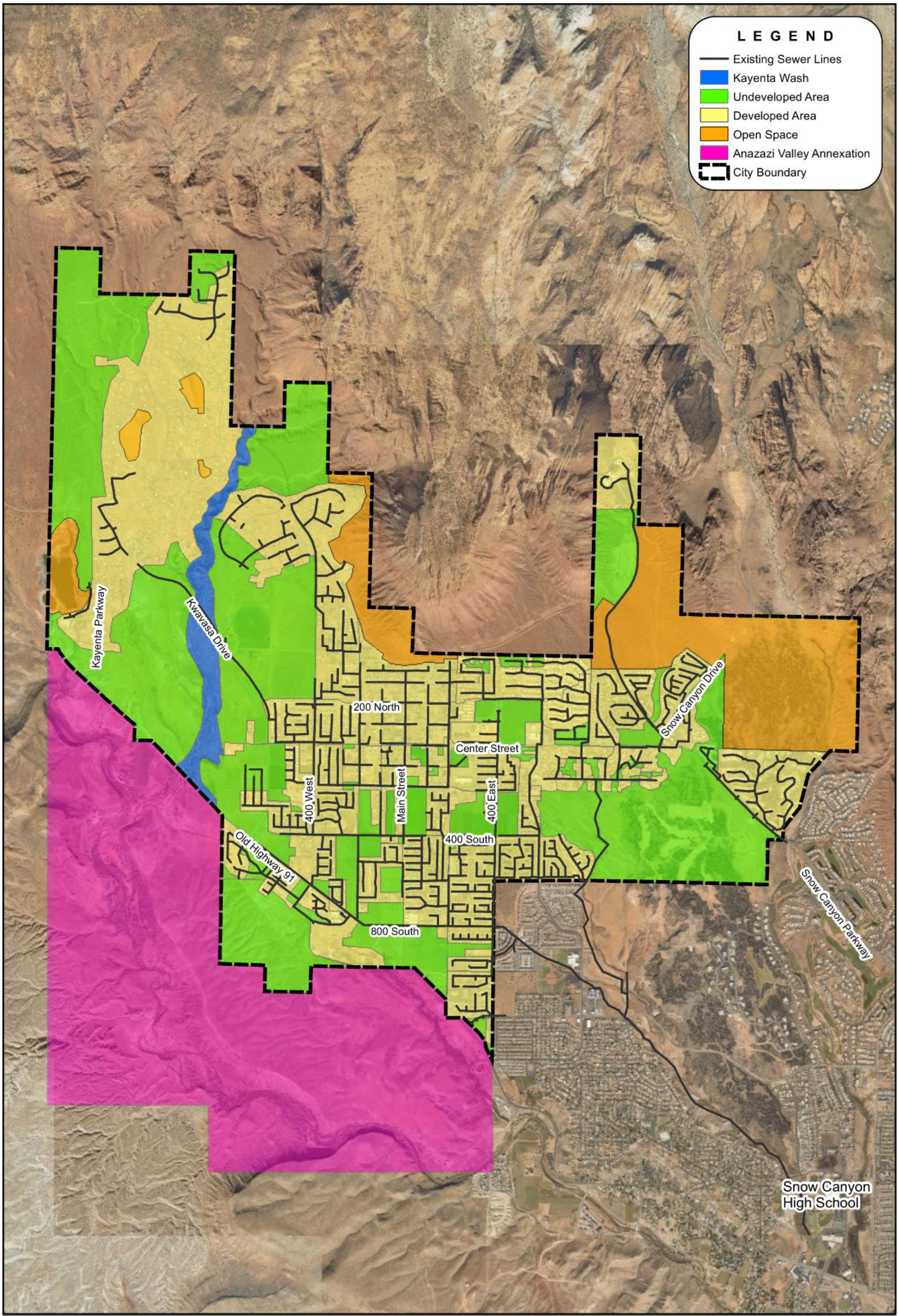
Table 3-5
Summary of Land Use Types

Land Type	Total Acres	Percentage of Total Area
Low Density Residential	2,969	49.49%
Medium Density Residential	1,085	18.09%
High Density Residential	444	7.40%
Commercial - Community	33	0.55%
Commercial - Neighborhood	16	0.27%
Commercial – Professional & Research	16	0.26%
Commercial - Resort	188	3.14%
Commercial – Light Manufacturing	36	0.60%
Other Non-Residential Area	7	0.12%
Open Space	791	13.19%
Parks	50	0.84%
Resort Rec	23	0.38%
Residential Mixed Use	330	5.50%
Schools	10	0.17%
TOTAL ACREAGE	**5,999**	

As shown on Figure 3-4 and Table 3-5, Ivins is a mostly residential city with a limited commercial or industrial influence, and a large portion of the city has been designated as permanent open space. With the aid of recent aerial imagery and GIS planning data provided by the City, Figure 3-5 displays the following information:

- Developed areas within the city
- Undeveloped areas within the city
- Areas to remain undeveloped (open space)
- Potential areas of annexation for additional development

Based on Figure 3-5, approximately 2,800 acres of land in Ivins is currently developed, which represents more than half of the developable land in the city (excluding the potential Anazazi Valley annexation).



IVINS	IVINS CITY SEWER MASTER PLAN	EXISTING DEVELOPED & UNDEVELOPED AREAS	NORTH: NORTH	SCALE: 0 1,250 2,500 Feet	FIGURE NO. 3-5

S:\Ivins\235-22-01 Sewer, Culinary, and Secondary Master Plan, IFFP, IFA, and Rate Study\4.0 GIS\4.3 Figures\Figure 3-5 - Existing Development Areas.mxd aanderson 10/2/2023

Projected Future Development

The current sewer service area does not include all of the existing homes in Ivins; this is reflected in the projections. However, it is assumed that all new growth in the city will be connected to the sewer collection system. Projected service area growth is shown in Table 3-6 below. The projections are for end of year, starting at the end of 2023.

Table 3-6
Projected Sewer Service Area Growth

Year	Total Ivins Housing Units	Number of Housing Units in Sewer Service Area[1]	Number of Non-Residential ERUs	Total Sewer Service ERUs
2023	4,616	4,235	399	4,634
2024	4,776	4,395	543	4,938
2025	4,936	4,555	687	5,242
2026	5,096	4,715	831	5,546
2027	5,256	4,875	975	5,850
2028	5,416	5,035	1,119	6,154
2029	5,576	5,195	1,263	6,458
2030	5,736	5,355	1,407	6,762
2031	5,896	5,515	1,551	7,066
2032	6,056	5,675	1,695	7,370
2033	6,216	5,835	1,839	7,674
2035	6,528	6,192	1,938	8,130
2040	7,309	7,085	2,185	9,270
2045	8,090	7,978	2,433	10,411
2050	8,871	8,871	2,680	11,551

[1]Housing Units in Sewer Service Area are those homes which are currently connected to the sewer collection system. According to Ivins City GIS, there are about 381 homes that are assumed to be on septic tanks. It is assumed that all future connections will be connected to the sewer collection system. At buildout (2050) it has been assumed that these 381 homes will be connected to the sewer collection system.

PROJECTING FUTURE GROWTH IN WASTEWATER FLOW

As shown in Table 3-6, the city is estimated to reach buildout by the year 2050 with a total of 8,871 residential ERUs and 2,680 non-residential ERUs. Based on these projected growth rates, Table 3-7 shows the estimated total daily wastewater production for Ivins City through buildout.

Table 3-7
Projected Daily Wastewater Flows

Year	Residential ERUs	Non-Residential ERUs	Total ERUs	Estimated Average Daily Domestic Wastewater Flow (gal/day)	Estimated Daily Groundwater Infiltration (gal/day)	Total Daily Wastewater Flow (gal/day)
2023	4,235	399	4,634	759,976	41,706	801,682
2024	4,395	543	4,938	809,832	44,442	854,274
2025	4,555	687	5,242	859,688	47,178	906,866
2026	4,715	831	5,546	909,544	49,914	959,458
2027	4,875	975	5,850	959,400	52,650	1,012,050
2028	5,035	1119	6,154	1,009,256	55,386	1,064,642
2029	5,195	1263	6,458	1,059,112	58,122	1,117,234
2030	5,355	1407	6,762	1,108,968	60,858	1,169,826
2031	5,515	1551	7,066	1,158,824	63,594	1,222,418
2032	5,675	1695	7,370	1,208,680	66,330	1,275,010
2033	5,835	1839	7,674	1,258,536	69,066	1,327,602
2035	6,192	1938	8,130	1,333,339	73,171	1,406,510
2040	7,085	2185	9,270	1,520,348	83,434	1,603,781
2045	7,978	2433	10,411	1,707,356	93,696	1,801,052
2050	8,871	2680	11,551	1,894,364	103,959	1,998,323

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 expected to be 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 Ivins 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, invert elevations at manholes, pump settings in lift stations, and any diversions within the system. This information has been collected from GIS system inventory data and direct field observation provided by Ivins City personnel. The following sections describe how geometric data was assembled for use in the hydraulic model.

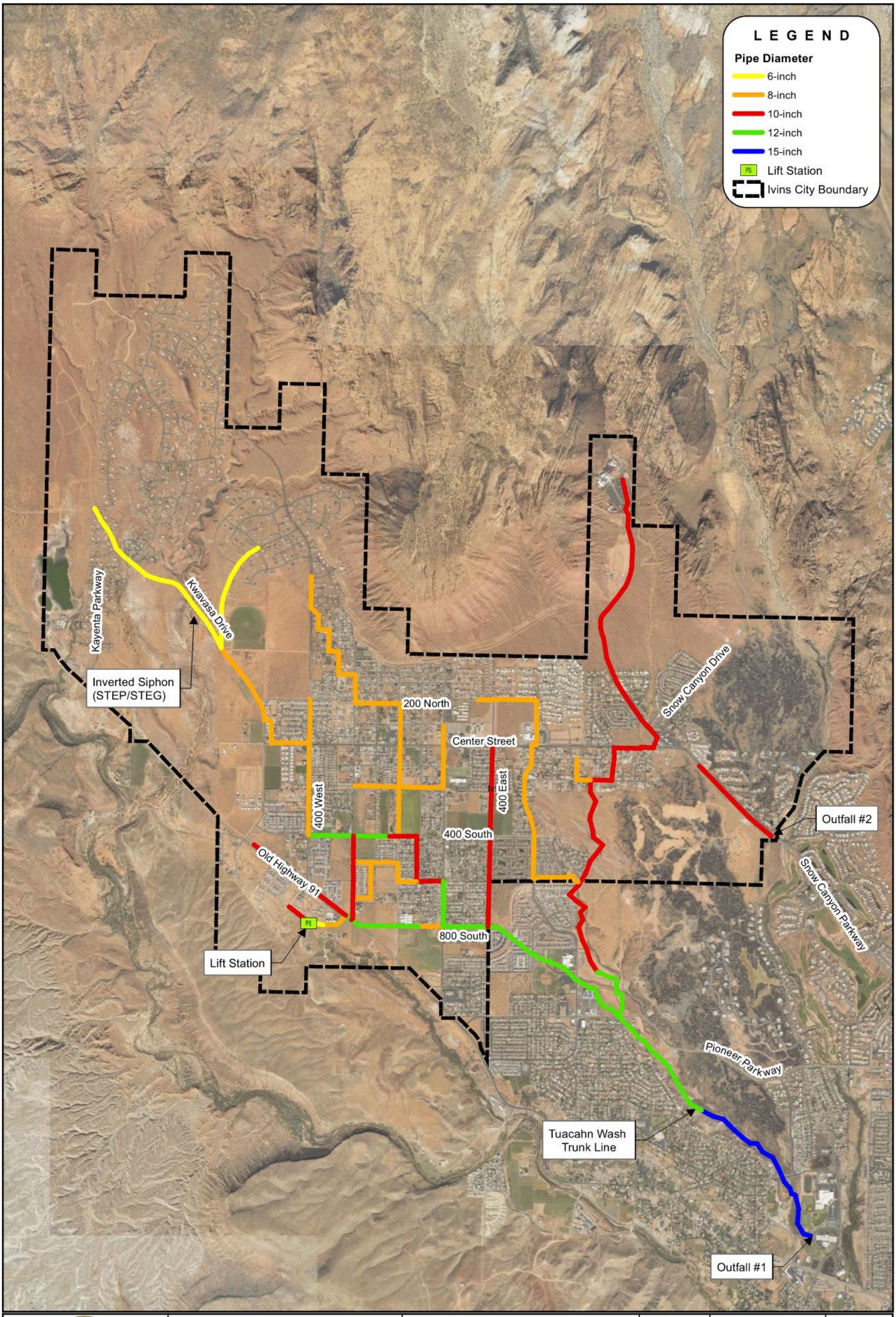
Pipeline and Manhole Locations

Ivins 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 there was uncertainty pertaining to the location or connectivity of a certain pipe or manhole, city staff confirmed conditions in the field and conveyed that information to BC&A to include in the model.

Model Pipelines

It was not deemed necessary to model all of the sewer pipes in the Ivins City sewer system. As smaller pipes are added to the model, the more refined the analysis becomes, which requires additional time, effort, and expense. The set of sewer collection pipes to be modeled was selected by Ivins City personnel and represents the main interceptor trunk lines for the city. For smaller collector pipes, State minimum slope and sizing requirements result in capacities that exceed the potential wastewater production for typical residential densities in Ivins City. As a result, modeling pipes that are serving small areas will not add any meaningful results to the analysis.

It should be noted that some additional pipes were added to the modeling set for future flow scenarios in order to evaluate the local response of some of the smaller collection pipes which will likely receive additional sewer flows from growth. Figure 4-1 displays the set of pipes which were included in the existing system hydraulic model (keeping in mind that a few additional pipes were added in future model scenarios). Note that there are several junctions located consecutively in the sewer line along Kwavasa Drive as it crosses Kayenta Wash. While model nodes typically represent manholes, these nodes do not; this section of the sewer line is an inverted siphon and these additional junctions were added to model this unique segment of pipe.



IVINS CITY
SEWER MASTER PLAN

HYDRAULIC SEWER MODEL PIPELINES

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 4-1

S:\ivins\235-22-01 Sewer, Culinary, and Secondary Master Plan, IFFP, IFA, and Rate Study\4.0 GIS\4.3 Figures\Figure 4-1 - Modeled Pipes.mxd aanderson 6/25/2024

Pipe Flow Coefficients

Pipe flow coefficients used throughout the hydraulic model were assigned to have a Manning's coefficient of 0.012. While the majority of the Ivins City system is comprised of PVC which has a lower published Manning's coefficient, a conservative value of 0.012 was chosen for modeling. In reality, most collection pipes can develop thin layers of bacteria and solids (a slime layer) that result in a relatively uniform flow coefficient despite varying materials. 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.

Sediment and Debris

Because of the transportable nature of grease and debris in a sewer collection system, it is not possible to identify the exact location and quantity of grease or debris accumulation for any specific point in time. Similarly, the build-up and erosion rates of sediment in sanitary sewer systems are not always well understood. As a result, the detailed modeling of sediment or grease was not included in the hydraulic model. Instead, the design and evaluation criteria for the Ivins City collection system is based on "clean" pipes.

It should be noted that the hydraulic modeling software used to simulate the operation of the Ivins City wastewater collection system does have the ability to set sediment depth in pipes. Therefore, if the city does collect detailed sediment data for a given section of pipe, the sediment may be added to the model and its effects evaluated. However, it should be emphasized that any sediment levels defined today may change with future flow conditions.

Lift Stations

Ivins City has one lift station in its collection system. Model parameters for the lift station were input based on drawings and the pump curve on record. This information is located in Appendix A.

FLOW DATA

Once all required geometric data was collected and a virtual model of the system was developed, flow data was input to model system hydraulics. Three types of flow information were required for hydraulic modeling: total magnitude of flow, timing of flow, and distribution of flow across the city service area. Each of these flow characteristics is discussed in the following sections.

Total Flow

Flow projections for the Ivins City service area are presented in detail in Chapter 3. Total flow for modeling scenarios from Ivins is summarized in Table 4-1. The flow values in Table 4-1 are for end of year.

Table 4-1
Hydraulic Modeling Scenario Total Daily Flow Volumes from Ivins (gal/day)

Scenario	2023	2033	2050
Domestic Flow/Infiltration	801,682	1,3237,602	1,998,323

*Does not include additional flow which was added in the hydraulic model to the 2 trunk lines which pass through Santa Clara to account for flow contributed by Santa Clara City (for existing and future conditions). See Chapter 3 for estimated flows contributed from Santa Clara City.

Timing of Flow

It should be noted that the volumes shown in Table 4-1 represent total flow over a 24-hour period. Since sanitary sewer flows vary throughout the day with fluctuations in indoor water use, of much greater importance for the purposes of modeling collection system capacity is the calculation of peak flows that occur over the course of a day. Each component of wastewater (domestic, infiltration, inflow) has a unique pattern over the course of a day, as outlined in the following sections.

Domestic Wastewater. The pattern of fluctuating domestic water use is often referred to as a diurnal pattern. Diurnal flow patterns vary depending on the type of user. For example, residential connections will typically produce peak flows between 8:00 am – 10:00 am as people get ready for work and eat breakfast, with another peak occurring in the evening as people make dinner and prepare for bed. Commercial connections may exhibit completely different diurnal wastewater patterns that are unique to their specific water use.

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 sewer 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 possess a lower peaking factor.

To estimate the wastewater peaking factor for the Ivins City collection system, flow data from the Snow Canyon H.S. meter from January 2021 – March 2023 has been evaluated. Flow through the meter is recorded every 15 minutes, providing a good indication of the pattern of flow as it leaves the Ivins system and enters the St. George collection system. The peak daily flow recorded in 2022 occurred in the month of August. Comparing average daily flows and peak daily flows for the month of August, 2022, the average ratio of peak flow to average daily flow was 1.64 (i.e. peak daily flow was 1.64 times higher than the daily average). Applying a conservative buffer to this value of 10%, a peaking factor of 1.8 is recommended for modeling purposes.

It is important to note that the Snow Canyon H.S. meter is at the bottom of the collection system, hence the peak flows measured at the meter have been attenuated. This means that a larger peaking factor should be applied to the upstream collection network in order to yield a 1.8 peaking factor at the meter. The hydraulic model was used to iterate this value which ended up being **1.9**. Figure 4-2 displays the diurnal flow pattern used in the hydraulic model for existing and future conditions. The diurnal flow pattern is based on the data recorded at the Snow Canyon H.S. meter.

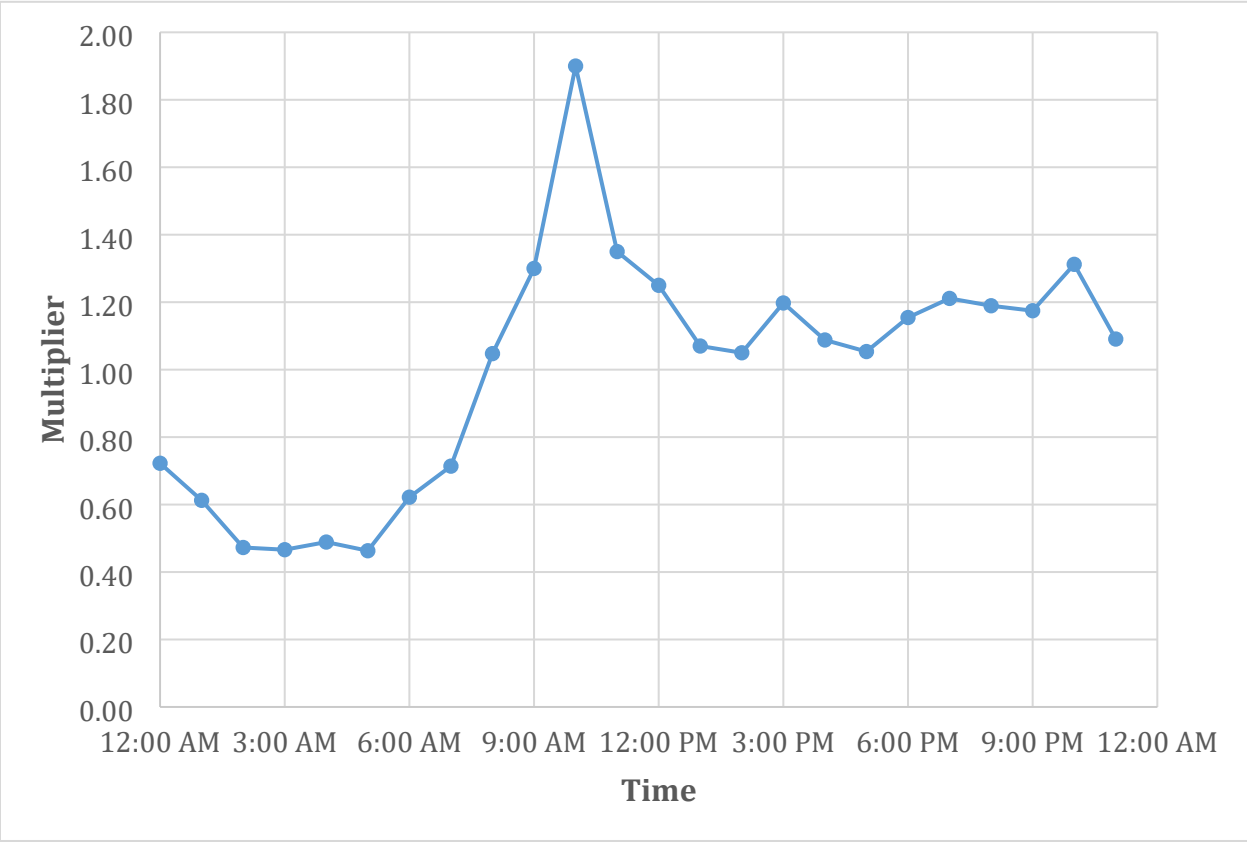


Figure 4-2. Estimated Diurnal Wastewater Flow Pattern for Modeling

Infiltration. As discussed in Chapter 3, infiltration may vary on a seasonal basis but does not generally vary on a daily basis. It has been assumed that infiltration remains constant throughout the day in the collection system model (multiplier value of 1.0 at each time step interval).

Inflow. For this study, inflow has not been modeled directly because of the wide variability in storm events and inflow response possible throughout the system. For planning purposes, 25% of full pipe capacity has been reserved for inflow events, meaning that in order for a pipe to be of adequate size it must convey dry weather flow (domestic & infiltration) using no more than 75% of its full pipe capacity.

Based on the diurnal pattern discussed above, peak flows at the system outfalls are summarized in Table 4-2. The values in Table 4-2 are for the end of the years listed.

Table 4-2
Hydraulic Modeling Peak Outfall Flows[1] (MGD)

Scenario	2023	2033	2050
Dry Weather Flow	1.83	3.15	4.09

[1]Includes additional flow which was added in the hydraulic model to account for flow contributed by Santa Clara City (for existing and future conditions) .

DISTRIBUTION OF FLOW

With flow magnitude and timing estimated, the final step in developing flow data for the model is distributing it spatially across the city. The following sections describe this process.

Domestic Wastewater

Existing domestic sewer flows included in the hydraulic model were distributed throughout the system by delineating small collection areas based on contours and existing sewer collection pipes. Using the GIS data provided by the city, each current sewer service connection was routed to its corresponding manhole in the model. Homes that are not currently within proximity of the collection system were assumed to be on septic systems and were not included in the existing conditions model. The average domestic flow per ERU of 164 gpd was assigned to each connection within the basin and the summation of flow was directed to the appropriate model node (manhole). A similar approach was used for the distribution of flow in future model scenarios. For the 10-year growth model, "hotspots", or areas with high potential for growth in the near future, were identified by Ivins City personnel. 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 at buildout, filling in any remaining region within the service area that is yet to be developed.

Non-residential flow was distributed throughout the model based on the addresses contained in the culinary water billing data provided by Ivins City. As discussed in Chapter 3, billed flows for non-residential connections were converted to ERUs and assigned to the corresponding model manhole based on location.

Infiltration

Existing infiltration was assigned to model manholes proportionally to the number of contributing ERUs (infiltration was estimated to be 9 gpd per ERU, see Chapter 3).

MODEL CALIBRATION

As discussed previously, peaking factors within the model were calibrated to match the metered flows at the Snow Canyon H.S. In addition, Ivins City staff carried out field observations on a number of manholes and reported the approximate depth of flow during the late morning when peak flows are occurring (between 10:30 – 11:00 am). These reported depths were checked against the model results and were found to be reasonably close.

It should be understood that the hydraulic model developed for this study relies on the available geometric and flow monitoring data provided by Ivins City. As additional pipelines are surveyed or new flow measurement data is collected, the hydraulic model should be updated and recalibrated to reflect actual conditions.

CHAPTER 5
SYSTEM EVALUATION

INTRODUCTION

Using the calibrated hydraulic sewer model, the Ivins City sewer collection system has been evaluated under existing and projected future conditions. The purpose of this chapter is to document the results of the hydraulic computer model and identify potential system deficiencies under existing and future operating conditions.

EVALUATION CRITERIA

In defining what constitutes a hydraulic deficiency, it is important to consider the assumptions made in estimating sewer flows in the model. As described in Chapters 3 and 4, the sewer flow included in the model is composed of two parts: domestic sewer flow and infiltration. These inputs are based on available historical data. Because these estimates are based on average values and a limited data set, actual flows will fluctuate and may be less or greater than the model estimates. 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 eliminate in the sewer collection system is inadequate pipe capacity. For this master plan, a pipe deficiency is defined as any point where the dry weather peak hour flow in a 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 potential sediment deposited in pipes.

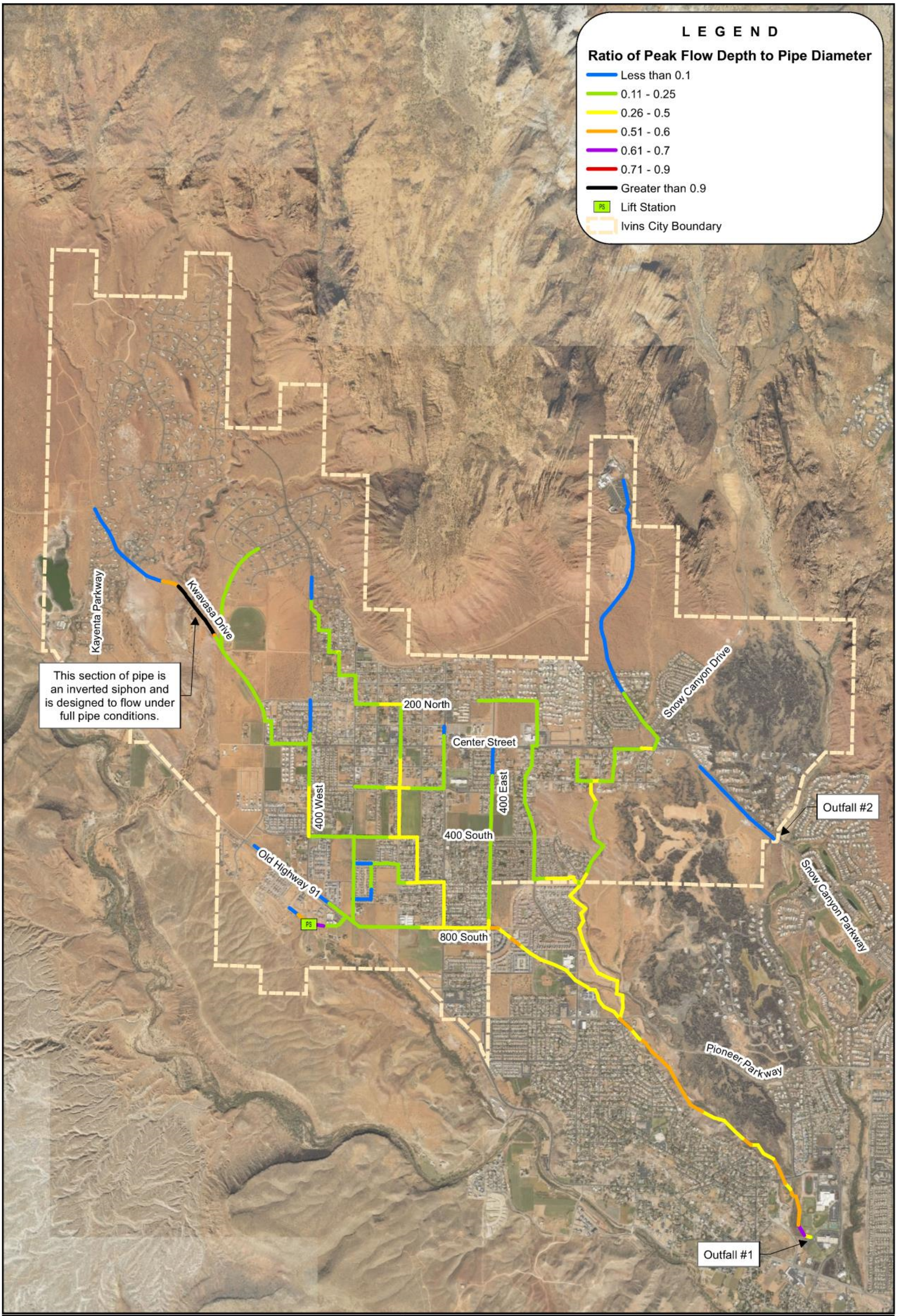
- **Lift Station Capacity –** A lift station capacity deficiency is defined as anytime dry weather peak hour flows exceed 85 percent of the lift station's primary pumping capacity. Note that all lift stations are required to have at least one backup pump in case of mechanical failure or significant inflow from wet weather events.

EXISTING SYSTEM ANALYSIS

Figure 5-1 displays the hydraulic capacity of the sewer system under existing peak hour flow conditions. Pipes in the figure are color coded to show the ratio of maximum simulated flow depth in the pipe to the pipe's diameter. As shown in Figure 5-1, there are no simulated deficiencies in the existing Ivins sewer collection system. The Earl. Drive Lift Station is also operating within its design limits, as shown in Table 5-1. Note that detailed model outputs for each model simulation can be found in Appendix C.

Table 5-1
Lift Station Model Results – Existing Conditions

Name	Design Capacity (gpm)	Wet Well Volume (cf)	Power Per Pump (HP)	No. Pumps	Peak Estimated Flow into Lift Station (gpm)	% Capacity Used
Earl Dr. Lift Station	250	900	5	2	36	15%



IVINS CITY
SEWER
MASTER PLAN

EXISTING CONDITIONS
HYDRAULIC MODEL RESULTS

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO.
5-1

S:\Ivins\235-22-01 Sewer, Culinary, and Secondary Master Plan, IFFP, IFA, and Rate Study\4.0 GIS\4.3 Figures\Figure 5-1 - Existing System Conditions (11 x 17).mxd aanderson 6/25/2024

10-YEAR GROWTH SYSTEM ANALYSIS

The next model scenario of interest is the condition of the system after 10 years of projected future growth. This scenario is useful in the development of a Capital Facilities Plan and Impact Fee Facilities Plan (IFFP). The 10-year growth model was developed through coordination with Ivins City personnel. Areas that are quickly growing ("hotspots") and areas that are anticipated to see infill growth within the next 10 years were identified, and future wastewater production was allocated to these areas in the model.

The results of the 10-year model simulation are shown in Figure 5-2. As shown in the figure, a significant portion of the Lower Tuacahn Wash trunk line (the portion of the line between Pioneer Parkway and Snow Canyon H.S.) is shown as deficient within the 10 year window. This trunk line is crucial for the operation of the system as it conveys almost all of the wastewater flow from the city. The remaining pipes in the system are anticipated to operate below their capacity limits. It should be noted, however, that the upper portion of the Lava Flow Wash trunk line (the line which runs from 800 South & 400 East in Ivins through Santa Clara to Pioneer Parkway) is beginning to approach peak flow capacity in the estimated 10-year growth window. This considered, it is recommended that the city begin to monitor peak flows through this reach of pipe within the next 5-7 years. No lift station deficiencies were identified in the 10 year model (see Table 5-2).

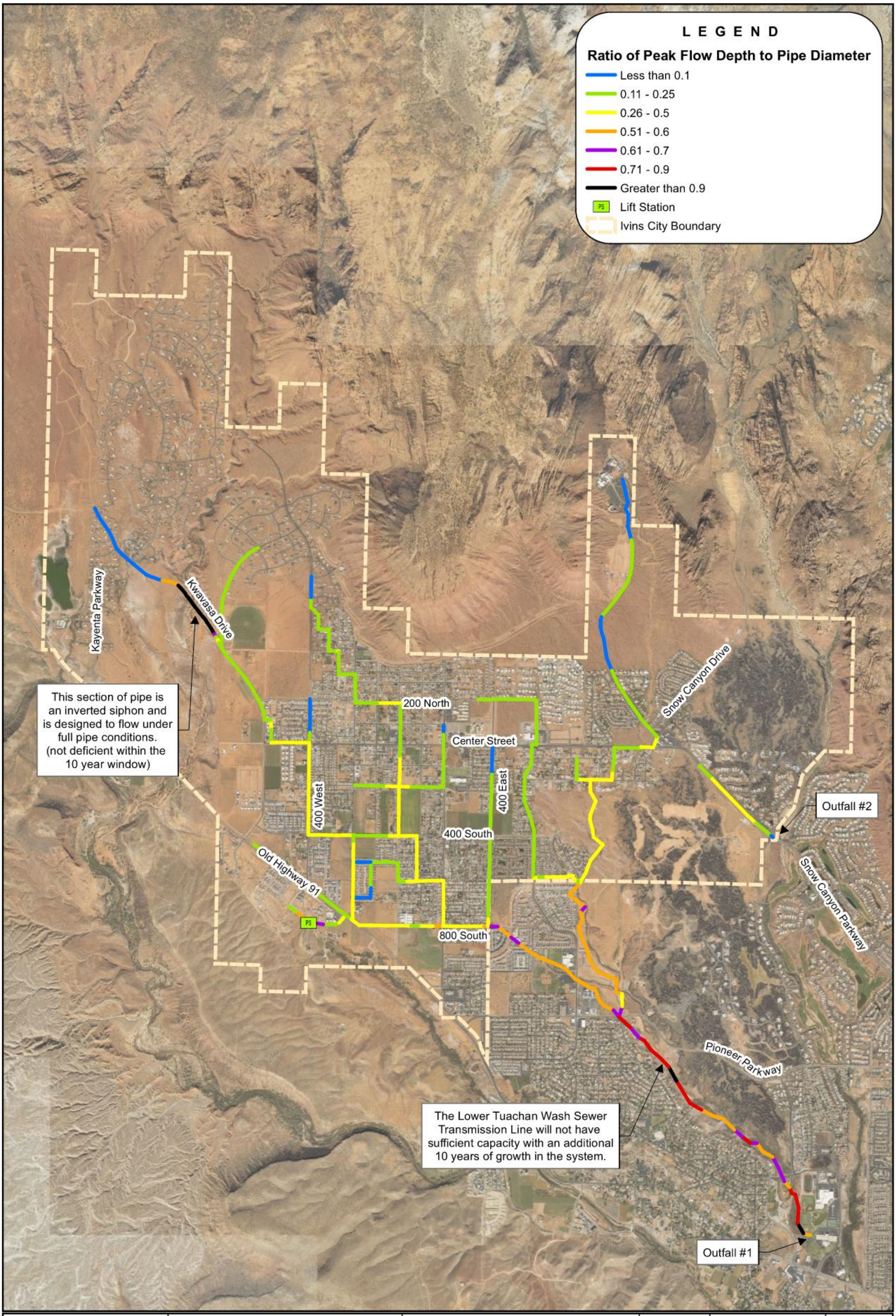
Table 5-2
Lift Station Model Results – 10 Year Growth Conditions

Name	Design Capacity (gpm)	Wet Well Volume (cf)	Power Per Pump (HP)	No. Pumps	Peak Estimated Flow into Lift Station (gpm)	% Capacity Used
Earl Dr. Lift Station	250	900	5	2	97	39%

BUILDOUT SYSTEM ANALYSIS

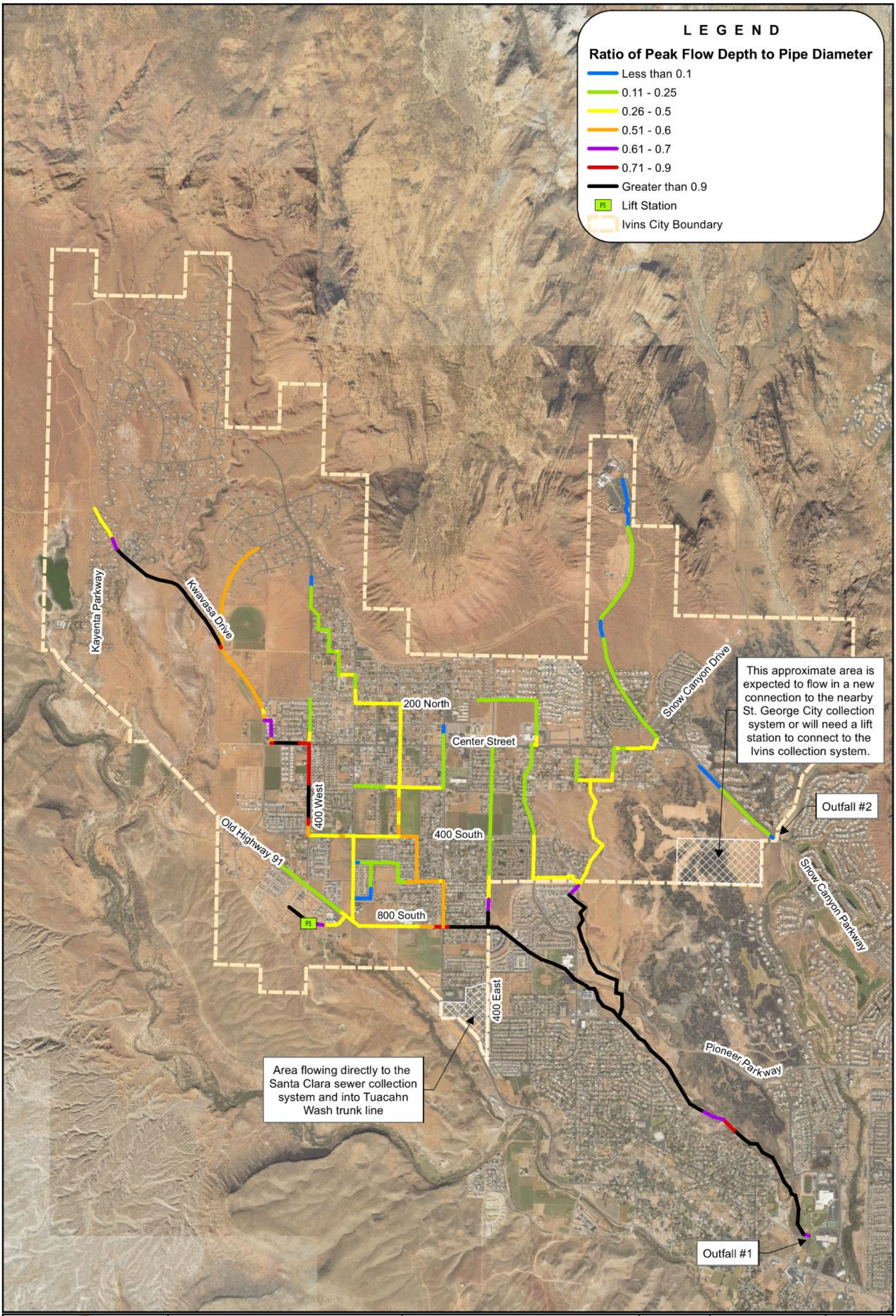
Figure 5-3 shows system performance as calculated by the hydraulic model for sewer flows at projected full buildout conditions without any improvements to existing components of the system. The following assumptions were made in the development of the buildout model:

- Population densities are based on planning information provided by Ivins City.
- As discussed in Chapter 2, it has been assumed that all homes in Kayenta will be connected to sewer service at buildout. The results shown in Figure 5-3 assume that all existing homes in Kayenta and all new development south of the intersection of Kayenta Parkway and Kwavasa Drive will end up flowing down Highway 91 to 800 South (via new system and project level improvements). All existing homes and new development to the north of this intersection has been assigned to the existing 6 inch STEP/STEG line that flows under Kayenta Wash.
- 500 ERUs from the Anasazi Valley annexation have been added to the model at buildout.
- It was assumed that the area of Ivins that currently flows directly into the Santa Clara system will continue to do so at buildout. It has also been assumed that approximately 50 acres of currently undeveloped land on the southeast side of Ivins near Entrada Golf Course will require a new connection to the St. George system. Unless a lift station is installed, this area will not flow by gravity to existing Ivins City collection pipes.



OUR HOME BENEATH THE BIG RED MOUNTAIN IVINS UTAH	IVINS CITY SEWER MASTER PLAN	10 YEAR GROWTH HYDRAULIC MODEL RESULTS	NORTH: NORTH	SCALE: 0 1,250 2,500 Feet	FIGURE NO. 5-2

S:\Ivins\235-22-01 Sewer, Culinary, and Secondary Master Plan, IFFP, IFA, and Rate Study\4.0 GIS\4.3 Figures\Figure 5-2 - 10 YEAR model results (11x17).mxd aanderson 6/25/2024



IVINS CITY

SEWER MASTER PLAN

BUILDOUT POPULATION HYDRAULIC MODEL RESULTS

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 5-3

S:\Ivins\235-22-01 Sewer, Culinary, and Secondary Master Plan, IFFP, IFA, and Rate Study\4.0 GIS\4.3 Figures\Figure 5-3 - Buildout model results (11x17).mxd aanderson 6/25/2024

As shown in Figure 5-3, there are a number of areas in the collection system that would not have adequate conveyance capacity to accommodate system flows under a buildout scenario. This is typical for most municipal sewer collection systems. The Earl Dr. Lift Station is anticipated to have adequate pumping capacity through buildout (see Table 5-3). The city should continue to monitor connections to the lift station and assess actual flows in the future.

Table 5-3
Lift Station Model Results – Buildout Conditions

Name	Design Capacity (gpm)	Wet Well Volume (cf)	Power Per Pump (HP)	No. Pumps	Peak Estimated Flow into Lift Station (gpm)	% Capacity Used
Earl Dr. Lift Station	250	900	5	2	166	66%

STEP/STEG SYSTEM

While the Ivins City collection system is primarily composed of conventional gravity sewer network, a portion of the system servicing Kayenta uses a Septic Tank Effluent Gravity/Septic Tank Effluent Pumped (STEP/STEG) system. The concept behind the STEP/STEG system is illustrated in Figure 5-4. Rather than collecting all wastewater from users, STEP/STEG systems utilize a septic tank to collect and remove most solids from the wastewater before it reaches the collection system. In theory, without solids present in the collection system, they can flow under pressure and utilize smaller diameter collection lines that do not necessarily need to follow a certain grade (i.e. do not need to flow by gravity). Depending on the location of the home with respect to the collection main, the water will either leave the septic tank via gravity or via a pump.



Figure 5-4. STEP/STEG Sewer Collection System, Courtesy of Orenco Systems

Although there are certain potential benefits to a STEP/STEG system, there are a number of factors that should be considered, including:

1. STEP/STEG systems can introduce additional mechanical and electrical components not needed in a conventional sewer collection system. They also require an individual septic tanks at every connection. These components need to be watched and maintained to ensure proper operation of the system.

2. Unlike conventional sewer, it is difficult to observe conditions within a STEP/STEG collection system. Issues within the collection system, such as clogs or leaks, may be very difficult to detect.

3. STEP/STEG systems likely have a lower capital cost to construct, but long-term costs are ultimately put back on the homeowner.

Considering these points, it is recommended that the city limit STEP/STEG connections only to areas where it is deemed appropriate. If an area can be served by conventional gravity sewer, that should be the standard requirement. The city should continue to monitor the performance of the existing STEP/STEG system and identify ways to maintain and ensure proper operation of the system. This may include:

- Periodic pressure flushing of the system.

- Dye testing to help confirm system continuity.

- Routine camera inspection (if possible)

CONCEPT OF A DECENTRALIZED WASTEWATER TREATENT FACILITY

In 2021, Ivins City hired BC&A to conduct a Wastewater Feasibility Study (Feasibility Study) to determine if a local wastewater treatment facility in Ivins was financially beneficial and feasible for the city. The recommendations in the Feasibility Study are based on several different factors, including water supply availability, water and sewer rates, and potential uses of reuse water. The conclusion of the analysis was that a local wastewater facility could be financially feasible, but that the breakeven point is likely very far in the future.

The Washington County Water Conservancy District is working to develop a Regional Reuse Plan that will involve the cooperation of all Regional Water Supply Agreement partner cities. This plan involves new treatment facilities, pipelines, and reservoirs aimed at better utilizing reuse water in our community. Considering that there is now a regional reuse water plan, it is not recommended that Ivins pursue the concept of a decentralized system. One of the primary reasons behind this recommendation pertains to the water rights. In order for the city to lay claim on water for a reuse purpose, it needs to be the parent holder of the water right (or have approval from the parent water right holder to use the water). The majority of water used in Ivins comes from WCWCD or the City of St. George, and if that water can be used within the regional reuse system, it is unlikely that WCWCD or St. George would allow Ivins to reclaim and use that water.

Another reason for this recommendation is that WCWCD is planning to construct a surface water treatment facility on the west side of the county that would produce potential water for Ivins, Santa

Clara, and St. George. However, this project is contingent upon certain components of the regional reuse system. Therefore, if Ivins were to pursue its own wastewater treatment facility, it may end up complicating the overall regional plans for future water supply development.

The concept of a decentralized wastewater treatment facility in Ivins (or somewhere on the west side of county) should not be abandoned entirely. The city should continue to evaluate different alternatives into the future. At some point in the coming years, constructing a wastewater treatment facility in Ivins may become a more beneficial option.

CHAPTER 6
RECOMMENDED SEWER SYSTEM IMPROVEMENTS

INTRODUCTION

The hydraulic model results have identified potential deficiencies in the sewer system under future growth conditions. This chapter presents recommended sewer system improvements intended to resolve deficiencies as the city continues to grow toward full buildout. Priority of each project is chosen based on the predicted timing of necessity.

RECOMMENDED SEWER SYSTEM IMPROVEMENTS

A number of system improvements have been identified to resolve hydraulic deficiencies related to projected future sewer flows. As discussed in Chapter 5, there were no deficiencies simulated in the existing system, but deficiencies have been identified within the 10-year growth window as well as at buildout. All recommended improvement projects are discussed below and are shown in Figure 6-1. Note that the improvement projects discussed in this chapter assume that all existing homes in Kayenta will be connected to sewer service by 2050 (buildout).

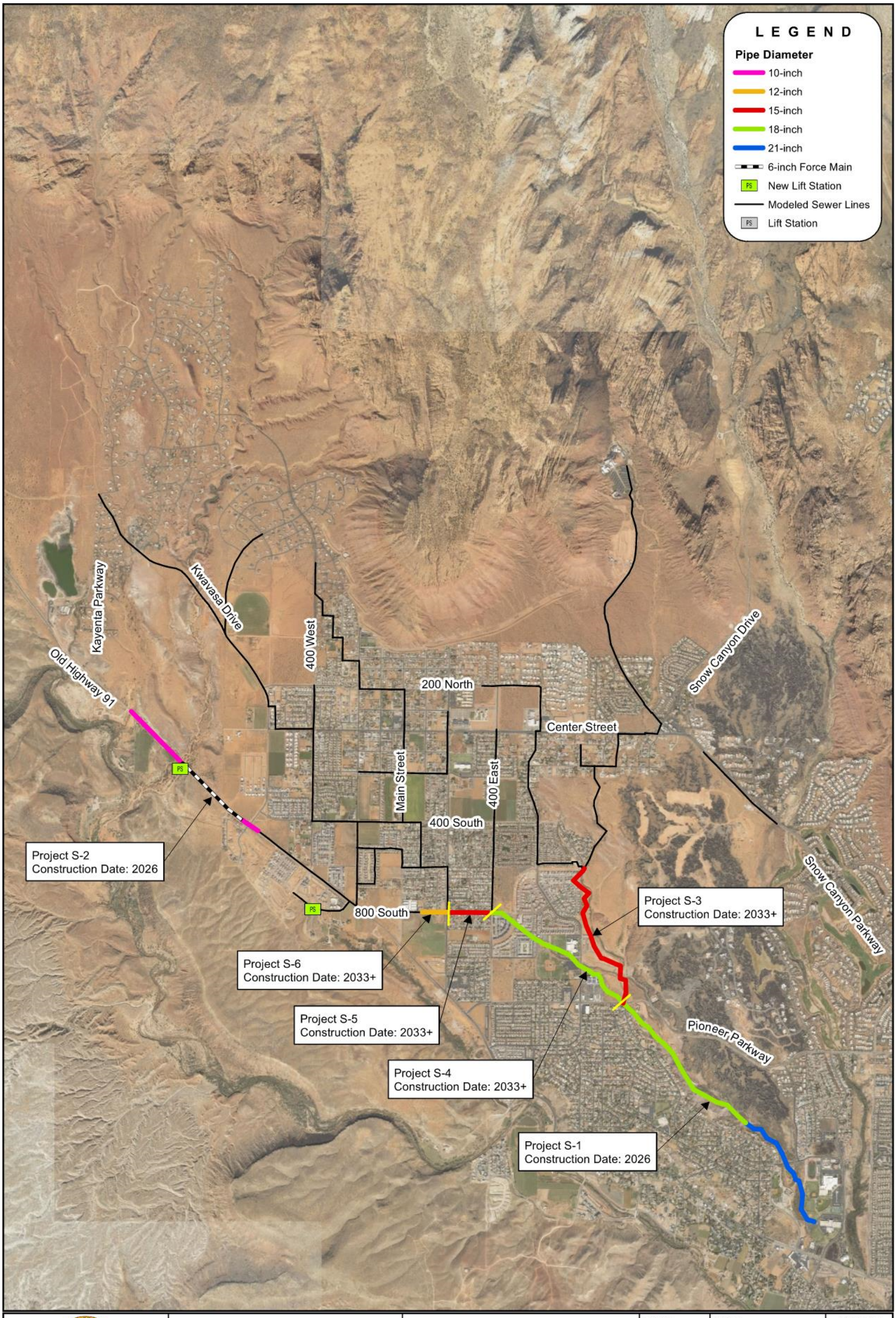
S-1. Lower Tuachan Wash Sewer Line Replacement Project
Construction Date: 2025

Model results have indicated that the Lower Tuacahn Wash sewer trunk line is approaching its peak flow capacity. This line is vital for the operation of the system, and a surcharging event could result in significant financial and/or environmental consequences. This deficiency could be addressed in two ways:

- The existing 9,100 feet of trunk line along the Lower Tuachan Wash between Pioneer Parkway and Snow Canyon H.S. could be replaced with a new 18-inch and 21-inch pipe (5,200 feet of 18-inch pipe and 3,900 feet of 21-inch pipe). The upsized line will provide the necessary capacity to convey wastewater flows through buildout.
- Rather than replacing the existing pipe, a new parallel 15-inch line (9,100 feet) could be installed to accommodate future flows.

As part of this replacement project, the city may decide to investigate the possibility of a new sewer line alignment. The current alignment is problematic in that it runs through an active drainage wash, making the pipe susceptible to excessive inflow and infiltration. The options for realignment are limited, but it may be worth evaluating different alternatives during the design phase that would improve the overall functionality of the pipe, such as locating the pipe further away from the main drainage channel. If no other reasonable options are available for realignment, fusible HDPE could be installed in this reach of pipe in order to limit the risk of I&I entering the pipe at joints.

Due to the limitations in potential parallel pipe alignments, the estimated costs for this project are based on replacing the existing line with a new 18-inch/21-inch pipeline.



IVINS CITY
SEWER MASTER PLAN

RECOMMENDED SYSTEM IMPROVEMENTS THROUGH BUILDOUT

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 6-1

S:\Ivins\235-22-01 Sewer, Culinary, and Secondary Master Plan, IFFP, IFA, and Rate Study\4.0 GIS\4.3 Figures\Figure 6-1 - Recommended Improvement Projects (11 x 17).mxd aanderson 6/25/2024

Since the Lower Tuachan Wash line serves both Ivins City and Santa Clara, the cost of carrying out the recommended improvements should be shared between each city on the basis of proportional flow. Based on the calculations and assumptions from this study as well as the 2022 Santa Clara Impact Fee Facilities Plan prepared by Sunrise Engineering, the estimated percentage of flow attributed to Ivins and Santa Clara in the Lower Tuachan Wash line from Pioneer Parkway to Snow Canyon High School is summarized in Table 6-1.

Table 6-1
Tuacahn Wash Sewer Line Estimated Flow Distribution

Condition	Estimated Average Daily Ivins Flow (cfs)	Estimated Average Daily Santa Clara Flow[1] (cfs)	% Flow from Ivins	% Flow from Santa Clara
Existing	1.203	0.326	79%	21%
10-Year Growth	1.736	0.721	71%	29%
Buildout	2.754	1.067	72%	28%

[1]Santa Clara flow estimates based on ERU counts from Santa Clara IFFP and estimated flow per ERU of 216 gpd (207 gpd domestic flow/9 gpd infiltration). See Chapter 3 for additional information.

As shown in the table, while there is some anticipated fluctuation in the proportional usage of the Tuacahn Wash sewer line over time, at buildout it is expected that 72% of the flow in the line will come from Ivins and 28% will come from Santa Clara. Based on the information in Table 6-1, it its recommended that Ivins plan to pay for 72% of the total project cost to replace the line.

In recent years, Ivins City and Santa Clara City have communicated with City of St. George to discuss the possibility of turning this reach of pipe over the St. George to be managed as a regional sewer line. St. George was willing to consider this option, but would require that the improvements associated with project S-1 be completed prior to taking ownership. It should be reiterated that discussions between Ivins City and St. George City regarding the Lower Tuacahn Wash trunk line are in the preliminary stages and no formal agreements have been completed at this point.

S-2. Old Highway 91 Sewer Line Extension
Construction Date: 2026

As shown in Chapter 5, under buildout conditions, there are a number of locations in the collection system where the existing collection system capacity is inadequate to convey future flows. One alternative to address such issues is to upsize or install parallel pipes to increase flow capacity. Another solution is to divert water to a different location of the system, bypassing infrastructure that is undersized for future flows. This project aims to collect flows from the area west of Dry Wash and conveying water down Old Highway 91 rather than through the inverted siphon in Kwavasa Drive.

The project consists of constructing a new sewer line, force main, and sewer lift station along Old Highway 91 to convey future flows. The project consists of 4 components:

A. Install 2,300 feet of 10 inch gravity sewer along Old Highway 91 starting at Dry Wash and going to the northwest to a point near 3 Mile Lane.
B. Construct a 375 gpm lift station near Dry Wash on the south side of Old Highway 91. The conceptual location of the pump station would be near the existing booster pump station servicing KWU.

C. Install 2,700 pipe of 6-inch pressure sewer from the lift station to the high point in Old Highway 91 (near the intersection of Kwavasa Drive and Old Highway 91).
D. Install 600 feet of 10-inch gravity sewer to connect to the existing gravity collection system (near the intersection of Kwavasa Drive and Old Highway 91)

S-3. Upper Tuacahn Wash Pipe Replacement Project

An existing 10-inch sewer line crosses the Ivin/Santa Clara boundary near the south end of Cordero Drive and runs through Santa Clara to Pioneer Parkway. The pipe then connects into the main outfall that runs through the Lower Tuacahn Wash. Model results suggest that this section of pipe will require a future upsize to meet capacity needs at buildout. The project involves replacing approximately 5,000 feet of existing 10-inch pipe with a new 15-inch line. Project costs estimates assume a full pipe replacement, but the city may elect to explore parallel pipe options for this project. Based on Ivins flow projections from this master plan and information available in the Santa Clara City IFFP, the estimated allocation of flow for this section of pipe is 54% from Ivins and 46% from Santa Clara.

S-4. 800 South & 400 East to Pioneer Parkway Replacement Project Construction Date: 2033+

The existing 12-inch sewer line that runs from 800 South & 400 East in Ivins through Santa Clara to the intersection of Pioneer Parkway & Red Mountain Drive (Lava Flow trunk line) serves as a major trunk line to convey wastewater from Ivins City to the St. George City sewer collection system. Under projected buildout conditions, this section of sewer line will not have adequate capacity.

Replacing this approximately 5,000 foot reach of pipe with a new 18-inch line will provide adequate flow capacity for estimated buildout flows. Since this pipe serves both Ivins and Santa Clara, the cost to upsize this line should be shared between the two entities. Based on Ivins flow projections from this master plan and information available in the Santa Clara City IFFP, the estimated allocation of flow for this section of pipe is 80% from Ivins and 20% from Santa Clara. Project cost estimates reflect this assumed distribution of flow between each city.

S-5. 800 South from 200 East to 400 East Pipe Replacement Project Construction Date: 2033+

This project consists of replacing about 1,350 feet of the 12-inch pipe in 800 South which runs from 200 East to 400 East with a new 15-inch pipe. The city may explore parallel pipe options as the time to address this deficiency gets closer in the future.

S-6. 800 South from 200 East to 100 East Pipe Replacement Project Construction Date: 2033+

This short section of 8-inch pipe will not have capacity to meet future system flows. It is recommended that the pipe be replaced with a new 12-inch pipe (about 750 feet of total length).

The recommended projects with their associated cost estimates are summarized in Table 6-2.

Table 6-2
Ivins City Recommended Capital Improvement Projects

Project Identifier	Project Year	Description	Unit	Quantity	Pipe Diameter (in.)	Unit Cost	Estimated 2024 Construction Cost	Engineering, Survey, Admin (15% of Construction Cost)	Total Estimated Cost	% Paid by Ivins City	Total 2023 Cost to Ivins City
S-1 A	2026	Lower Tuacahn Wash Sewer Line Replacement Project (Reach A)	LF	5,200	18	$350	$1,820,000	$273,000	$2,093,000	72%	$1,507,000
S-1 B	2026	Lower Tuacahn Wash Sewer Line Replacement Project (Reach B)	LF	3,900	21	$400	$1,560,000	$234,000	$1,794,000	72%	$1,292,000
S-2 A	2026	Old Highway 91 Sewer Line Extension (Reach A)	LF	2,300	10	$350	$805,000	$120,750	$925,750	100%	$926,000
S-2 B	2026	Old Highway 91 Sewer Line Extension (Reach B, Lift station)	LS	1	NA	$750,000	$750,000	$112,500	$862,500	100%	$863,000
S-2 C	2026	Old Highway 91 Sewer Line Extension (Reach C, Pressure Pipe)	LF	2,700	6	$225	$607,500	$91,125	$698,625	100%	$699,000
S-2 D	2026	Old Highway 91 Sewer Line Extension (Reach D)	LF	600	10	$350	$210,000	$31,500	$241,500	100%	$242,000
S-3	2033+	Upper Tuacahn Wash Pipe Replacement Project	LF	5,000	15	$325	$1,625,000	$243,750	$1,868,750	54%	$1,009,000
S-4	2033+	800 South & 400 East to Pioneer Parkway Replacement Project	LF	5,000	18	$375	$1,875,000	$281,250	$2,156,250	80%	$1,725,000
S-5	2033+	800 South from 200 East to 400 East Pipe Replacement Project	LF	1,350	15	$325	$438,750	$65,813	$504,563	100%	$505,000
S-6	2033+	800 South from 200 East to 100 East Pipe Replacement Project	LF	750	12	$300	$225,000	$33,750	$258,750	100%	$259,000
		Total					**$9,916,250**	**$1,487,438**	**$11,403,688**		**$9,027,000**

CHAPTER 7
10 YEAR CAPITAL IMPROVEMENT PLAN

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

DEVELOPING AN ANNUAL BUDGET

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

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

The sewer collection system is composed of over 350,000 feet of gravity and pressurized sewer pipe. Table 7-1 summarizes the estimated replacement value of the city's existing sewer collection system. The total cost to replace the entire Ivins City sewer collection system, in today's dollars, is just over **$100 million dollars**.

Table 7-1
Estimated Sewer Collection System Replacement Value

System Component	Quantity	Unit Installation Price	Estimated Replacement Value
STEP/STEG			
2	647	$120	$77,640
4	10,798	$140	$1,511,720
		Subtotal	**$1,589,360**
Gravity Sewer			
6[1]	7,378	$275	$2,028,950
8	277,671	$275	$76,359,525
10	38,795	$300	$11,638,500
12	18,544	$320	$5,934,080
15	5,157	$375	$1,933,875
		Subtotal	**$97,894,930**
Pressurized Sewer Pipe			
6	480	$200	$96,000
		Subtotal	**$96,000**
Lift Stations			
Earl Drive Lift Station	1	$1,500,000	$1,500,000
		Subtotal	**$1,500,000**
		Grand Total	**$101,080,290**

[1]For gravity sewer, Utah State code requires a minimum sewer diameter of 8-inches. It is assumed that existing 6-inch pipe will eventually 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 (20% to 60% depending on pipe diameter). If the city were able to rehabilitate the entire system rather than replace components, it would drastically reduce the "replacement value" to about $42 million (assuming rehabilitation methods for gravity sewer pipes cost 40% of full replacement costs, while pressure sewer, 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 saving with rehabilitation, while others may require upsizing or correction of grade issues; all of these scenarios would require a replacement.

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

Table 7-2
Recommended Annual Sewer Collection System Budget

System Component	Service Life	Full Replacement	Rehabilitation[1]	50% Replacement 50% Rehabilitation (Recommended System Valuation)[2]	Recommended Annual Budget[3]
STEP/STEG	80 Years	$1,589,000	$1,589,000	$1,589,000	$19,863
Gravity Sewer	80 Years	$97,895,000	$39,158,000	$68,526,500	$856,581
Pressurized Sewer Pipe	80 Years	$96,000	$96,000	$96,000	$1,200
Lift Stations	40 Years	$1,500,000	$1,500,000	$1,500,000	$37,500
TOTAL		**$101,080,000**	**$42,343,000**	**$71,711,500**	**$915,144**

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

As shown in Table 7-2, the recommended annual budget for system renewal and rehabilitation is approximately $900,000. However, because the city's system is relatively new, investing or setting aside this much every year for system renewal is excessive. This considered, it is recommended that the city invest 50% of this value ($450,000) per year for system renewal (or save that amount each year for future system renewal). As the system continues to age, the city will want to re-evaluate how much is being set aside for the replacement of the existing system and adjust plans as needed.

10-YEAR CAPITAL IMPROVEMENT PLAN

Table 7-4 provides an outlay of the recommended projects to be completed within the next 10 years. As discussed in Chapter 6, there is only one recommended capital sewer collection system improvement to be carried out in the next 10 years, but it is a relatively large project. The city should take advantage of this opportunity to focus on other areas of the existing system that may require replacement or rehabilitation due to condition-related issues. The city has retained BC&A to conduct a user rate analysis that will determine how the city will meet its future funding needs, including O&M, system renewal, and capital projects.

Table 7-3
Recommended 10-year Capital Improvement Plan

Project	Description	Estimated 2024 Cost	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total Inflated Cost
S-1 A	Lower Tuacahn Wash Sewer Line Replacement Project (Reach A)	$1,507,000			$1,599,000								$1,599,000
S-1 B	Lower Tuacahn Wash Sewer Line Replacement Project (Reach B)	$1,292,000			$1,371,000								$1,371,000
S-2 A	Old Highway 91 Sewer Line Extension (Reach A)	$926,000			$982,000								$982,000
S-2 B	Old Highway 91 Sewer Line Extension (Reach B, Lift station)	$863,000			$916,000								$916,000
S-2 C	Old Highway 91 Sewer Line Extension (Reach C, Pressure Pipe)	$699,000			$742,000								$742,000
S-2 D	Old Highway 91 Sewer Line Extension (Reach D)	$242,000			$257,000								$257,000
PL	Update Master Plan and Associated Analyses					$80,000				$90,000			$170,000
RR	Ongoing Rehab and Replacement	-	$450,000	$450,000	$450,000	$450,000	$450,000	$450,000	$450,000	$450,000	$450,000	$450,000	$4,500,000
	Total Improvements	**$5,529,000**	**$450,000**	**$450,000**	**$6,317,000**	**$530,000**	**$450,000**	**$450,000**	**$450,000**	**$540,000**	**$450,000**	**$450,000**	**$10,537,000**

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