Prepared for:

PAYSON
EXPERIENCE THE MANY LAYERS

Sanitary Sewer Master Plan

July 2020

Prepared by:

FREGONESE ASSOCIATES

BOWEN COLLINS & ASSOCIATES

SANITARY SEWER MASTER PLAN

July 2020

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EXECUTIVE SUMMARY

INTRODUCTION

Payson City has retained Bowen Collins & Associates (BC&A) to prepare a master plan for the City's wastewater collection system. The purpose of this sewer master plan report is to identify recommended improvements that will resolve existing and projected future deficiencies in the wastewater collection system throughout the City's service area. This executive summary provides a brief summary of the evaluation process and the recommended system improvements.

GROWTH PROJECTIONS

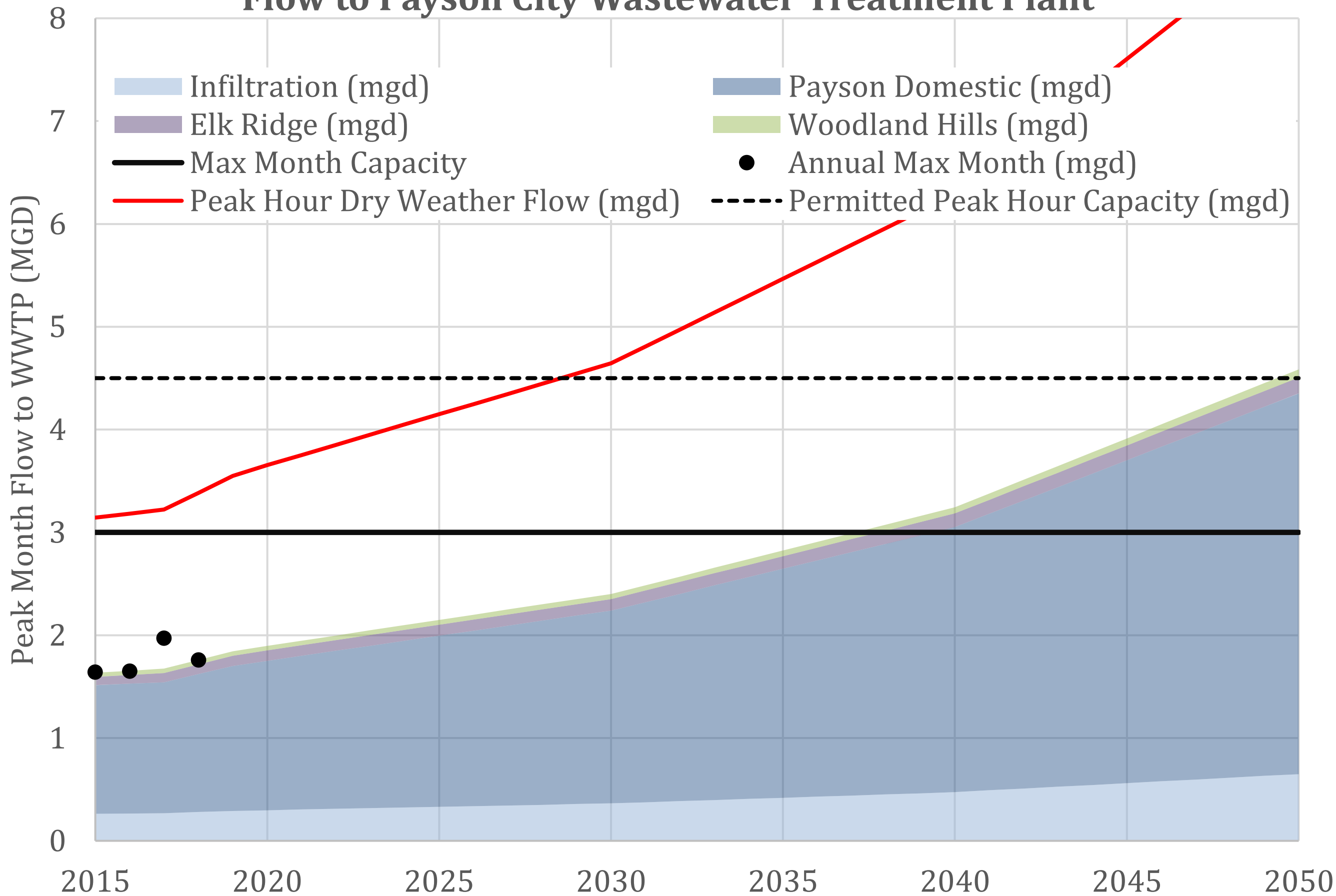
Existing wastewater in the City's collection system was evaluated based on treatment plant data and flow monitoring conducted as part of this study. Projections of future growth in wastewater were developed based on existing production rates (gallons per day per equivalent residential unit) and anticipated growth as provided by the Payson City and other contributing agencies. Table ES-1 and Figure ES-1 show projected growth of wastewater in the future.

Table ES-1
Projected Flows to Payson Treatment Plant* (MGD)

Year	Max Month Infiltration (mgd)	Payson Domestic Wastewater Max Month Production (mgd)	Elk Ridge Domestic Wastewater Max Month Production (mgd)	Woodland Hills Domestic Wastewater Max Month Production (mgd)	Max Month Total Wastewater (mgd)	Peak Hour Flow (mgd)
2019	0.29	1.41	0.10	0.04	1.84	3.55
2030	0.36	1.88	0.11	0.05	2.40	4.64
2040	0.47	2.58	0.13	0.06	3.24	6.29
2050	0.65	3.70	0.15	0.08	4.59	8.92
Buildout	1.04	6.03	0.35	0.17	7.59	14.80

*Estimated max month flow includes both infiltration and domestic production. Note that max month flow does not include the estimated 1 mgd contribution that was estimated for the Payson Fruit Grower's which lasted for one day in June 2017.

Figure ES-1
Flow to Payson City Wastewater Treatment Plant



SYSTEM EVALUATION

Based on existing wastewater flow and projected growth in wastewater flow, the existing and future flows were simulated in a hydraulic model of the City's collection system. For existing flows, model results indicate that there are a few existing deficiencies in the system. For future flows, some significant deficiencies are predicted in the model. While the majority of the system has ample capacity for future growth, several trunk lines serving high growth areas will need to be replaced to meet future demands. Major conclusions based on future model results include:

- Existing Deficiencies – Existing deficiencies east of I-15 and on 300 West and 600 West become just a little bit more severe under future conditions.

- West Outfall – The City's westernmost outfall is woefully under capacity to meet projected growth in the areas South and West of the City's current corporate boundaries. Deficiencies in this trunkline start near the southern boundary of the City and extend all the way to the newly constructed 36-inch pipeline that extends to the City's wastewater treatment plant.

Outside of the West Outfall, the City's existing sewer system performs admirably well under both existing and future loading conditions. Within the heart of the City, it does not appear that many improvements will be needed from a capacity standpoint. Unfortunately, this does not mean that the City will not need to make major investment in its sewer system:

- Building capacity for growth along the West Outfall will require at least one new major outfall.
- Most of the areas of potential future growth are located in areas that cannot be served by gravity using pipelines in the existing system. This means the City will need to build several new lift stations to serve future growth. To avoid an unnecessary number of lift stations that require regular maintenance, it is recommended that the City build gravity mains to collect areas and convey them to recommended regional lift station locations.
- Outside of capacity needs, the City has an aging system that will eventually need additional investment in rehabilitation and replacement of existing pipelines.

SYSTEM IMPROVEMENTS

To resolve potential deficiencies identified as part of the system evaluation, several projects have been proposed to address both future hydraulic deficiencies and the need to service developing areas. Figure ES-2 and Table ES-2 show the projects and associated costs for these projects.

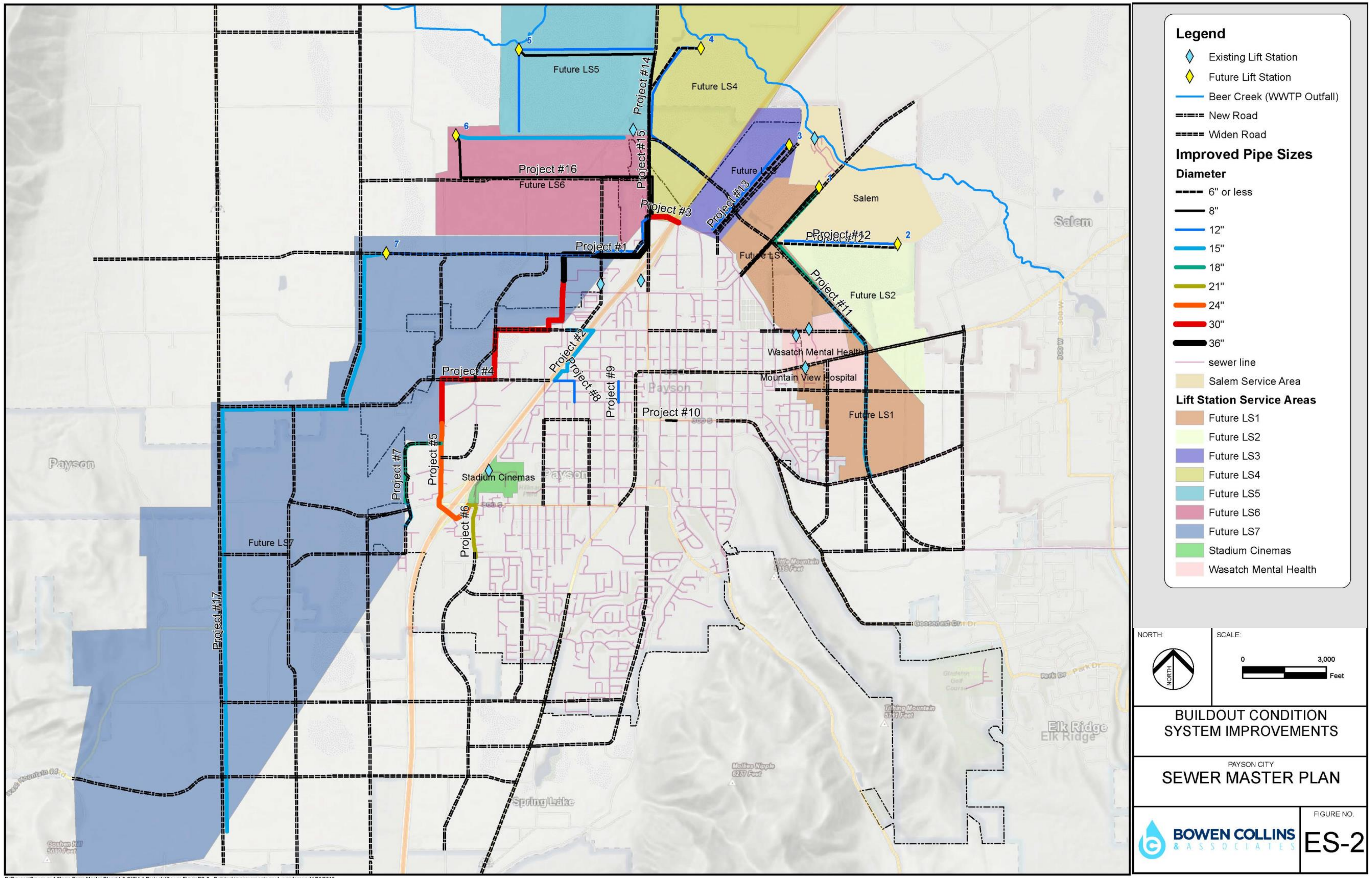


Figure ES-2. Buildout Condition System Improvements

Table ES-2
Proposed Collection System Improvements

Project Number	Year Needed	Project Description	Average Pipe Diameter[2] (inch)	Length (ft)	Total Construction Cost Estimate	Engineering / Admin (15 Percent)	Total Project Cost Estimate
1	2019	2019 Sewer Trunkline Replacement[1]	36	5,161	$2,233,000	$285,000	$2,518,000
2	2020	I-15 East, 400 N to Utah Ave	15	3,336	$1,154,000	$173,000	$1,327,000
3	2040	East Outfall to WWTP	30	1,099	$631,000	$95,000	$726,000
4	2040	American Way, 400 S to 800 N	30	9,394	$5,360,000	$804,000	$6,164,000
5	2040	American Way, 800 S to 400 S	24	4,419	$2,020,000	$303,000	$2,323,000
6	2040	Turf Farm Road, 1150 S to 800 S	21	2,150	$903,000	$135,000	$1,038,000
7	2040	1700 W, 1130 S to 400 S	18	4,238	$1,585,000	$238,000	$1,823,000
8	2040	600 W, 200 S to Utah Ave	10	2,960	$866,000	$130,000	$996,000
9	2040	250 W, 200 S to Utah Ave	10	756	$221,000	$33,000	$254,000
10	2040	300 S, 300 E to 200 E	8	372	$103,000	$15,000	$118,000
11	2021	Lift Station 1[3]			$2,000,000	$300,000	$2,300,000
11.1	2021	Lift Station 1 Gravity	15	12,250	$3,210,000	$482,000	$3,692,000
11.2	2021	Lift Station 1 Pressure Force Main	8	4,240	$1,174,000	$176,000	$1,350,000
12	2040	Lift Station 2			$800,000	$120,000	$920,000
12.1	2040	Lift Station 2 Gravity	12	4,046	$876,000	$131,000	$1,007,000
12.2	2040	Lift Station 2 Pressure Force Main	6	6,273	$1,211,000	$182,000	$1,393,000
13	2040	Lift Station 3[3]			$1,000,000	$150,000	$1,150,000
13.1	2040	Lift Station 3 Gravity	10	4,158	$852,000	$128,000	$980,000
13.2	2040	Lift Station 3 Pressure Force Main	6	4,155	$802,000	$120,000	$922,000
14	2025	Lift Station 4[3]			$2,300,000	$345,000	$2,645,000
14.1	2025	Lift Station 4 Gravity	12	6,356	$1,962,000	$294,000	$2,256,000

Project Number	Year Needed	Project Description	Average Pipe Diameter[2] (inch)	Length (ft)	Total Construction Cost Estimate	Engineering / Admin (15 Percent)	Total Project Cost Estimate
14.2	2025	Lift Station 4 Pressure Force Main	6	7,186	$1,989,000	$298,000	$2,287,000
15	2040	Lift Station 5[3]			$1,500,000	$225,000	$1,725,000
15.1	2040	Lift Station 5 Gravity	12	7,722	$1,673,000	$251,000	$1,924,000
15.2	2040	Lift Station 5 Pressure Force Main	8	10,786	$2,082,000	$312,000	$2,394,000
16	2040	Lift Station 6			$1,600,000	$240,000	$1,840,000
16.1	2040	Lift Station 6 Gravity	15	6,028	$1,504,000	$226,000	$1,730,000
16.2	2040	Lift Station 6 Pressure Force Main	8	9,767	$1,886,000	$283,000	$2,169,000
17	2040	Lift Station 7			$2,500,000	$375,000	$2,875,000
17.1	2040	Lift Station 7 Gravity	15	25,954	$6,474,000	$971,000	$7,445,000
17.2	2040	Lift Station 7 Pressure Force Main	10	10,477	$2,146,000	$322,000	$2,468,000
		Total			**$54,617,000**	**$8,142,000**	**$62,759,000**

SYSTEM MAINTENANCE

The City currently performs cleaning and inspections of sewer mains within the City when personnel are available, but does not have a comprehensive plan for conducting asset management within the City. The City has begun preparing an asset management plan for City sewer assets. Once complete, the City should quickly begin implementing recommendations from the asset management plan. A few components that will be included as part of the asset management plan include:

- Assembling a comprehensive sewer cleaning plan
- Conducting regular video inspection of City collection lines.
- Purchasing and maintaining equipment needed to perform inspections.
- Adequately funding personnel needed to perform operation and maintenance activities and asset management work, especially relative to new sewer lift stations.

Estimated costs for these general recommendations will be outlined in the future asset management plan.

CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis contained in this report, the following actions are recommended:

- **Follow the Overall Development Plan –** Much of the City sewer collection system has capacity for the needs of future growth. However, a few areas of the City will require significant improvements to be able to meet the needs of future growth. In addition, there are many areas of the City that cannot gravity flow to the City's treatment plant. To avoid excessive operation and maintenance costs, the City should limit the number of future lift stations to key areas and construct gravity mains as identified to convey flow to regional lift stations in key locations. Development should not be allowed in any of the regional lift station service areas until the master planned improvements are completed.
- **Adopt the Proposed Master Plan Improvements –** The collection system projects in Table ES-2 represents the best available assessment of City capital needs in the upcoming years. It is recommended that this plan be adopted for budgeting, staffing, rate development, and impact fee calculation purposes.
- **Complete a Rate Study –** It is recommended that the City complete a detailed rate study to explore options for funding the recommended capital improvement projects as well as recommended levels of funding for O&M and system rehabilitation.
- **Develop a Plan for Project Completion –** It is recommended that the City identify a plan to manage and execute the needed projects, either through the acquisition of additional staff or securing assistance from a consultant.
- **Update this Sewer Master Plan Regularly –** Because growth and development patterns may change from those used to assemble this report, it is recommended that the City's Sewer Master Plan be updated on a regular basis. This should be at least once every 5 years and more often if necessitated by a major change in the City (e.g. major new regulatory requirements, annexation of a new area, etc.)

Chapter 1 - Introduction

INTRODUCTION

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

PREVIOUS STUDIES

This study is the first thorough study of the City's wastewater collection infrastructure for many years. As a result, this study is a completely fresh look at the system and no previous studies on the City's wastewater collection system have been referenced here.

SCOPE OF SERVICES

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

Task 1: Collected information as needed to develop the sewer master plan based on the City's general plan and existing facilities.

Task 2: Updated population projections and estimated growth in sewer flow to evaluate future growth needs. This included future growth for each of the contributing cities that flow through the City to the Payson wastewater treatment plant.

Task 3: Developed a hydraulic computer model of the Payson City collection system to evaluate existing and projected future system deficiencies. This included calibrating the model using data from the City's existing GIS database, water meter data from the City, and flow monitoring within the collection system.

Task 4: Identified existing operating deficiencies.

Task 5: Identified projected future operating deficiencies.

Task 6: Evaluated alternative improvements for resolving deficiencies identified in Tasks 4 and 5. This included evaluating alternatives looking at potential diversion locations and interceptor opportunities.

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

Task 8: Documented results of the previous tasks in this master plan report.

ACKNOWLEDGMENTS

The BC&A team wishes to thank the following individuals from the Payson City for their cooperation and assistance in working with us in preparing this report:

Travis Jockumsen	City Engineer
Nestor Gallo	Development Engineer
Jeff Hiatt	Sewer Superintendent

PROJECT STAFF

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

Keith Larson	Project Manager
Andrew McKinnon	Project Engineer, Sewer Modeling
Wyatt Andersen	Project Engineer, Sewer Modeling
Mike Hilbert	Clerical

Chapter 2 - Existing System Features

INTRODUCTION

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

SERVICE AREA

Figure 2-1 identifies the approximate boundary of the Payson collection system service area. For the purpose of this study, the City sewer system service area can be divided into three subareas. The majority of the sewer system service area can be referred to as the "Payson City Service Area" subarea and includes all of the area within the corporate boundaries of the City along with areas of expected annexation in the future. The City will provide both collection system and wastewater treatment of wastewater in this area. The other two subareas consist of the Elk Ridge / Woodland Hills service area and the Salem service area. Both Elk Ridge and Woodland Hills have agreements with Payson City in which Payson agrees to receive and treat their wastewater (See Appendix A). Collection pipelines within Elk Ridge and Woodland Hills are owned and operated by their respective cities. Payson City owns and operate the major trunkline collecting flows at the northern edge of each of these cities. The Salem service area includes an area at the northeast end of the City that can gravity flow to the Salem wastewater treatment plant. Payson City will provide collection system services for the Salem area, but treatment will be provided by the new Salem City wastewater treatment facility.

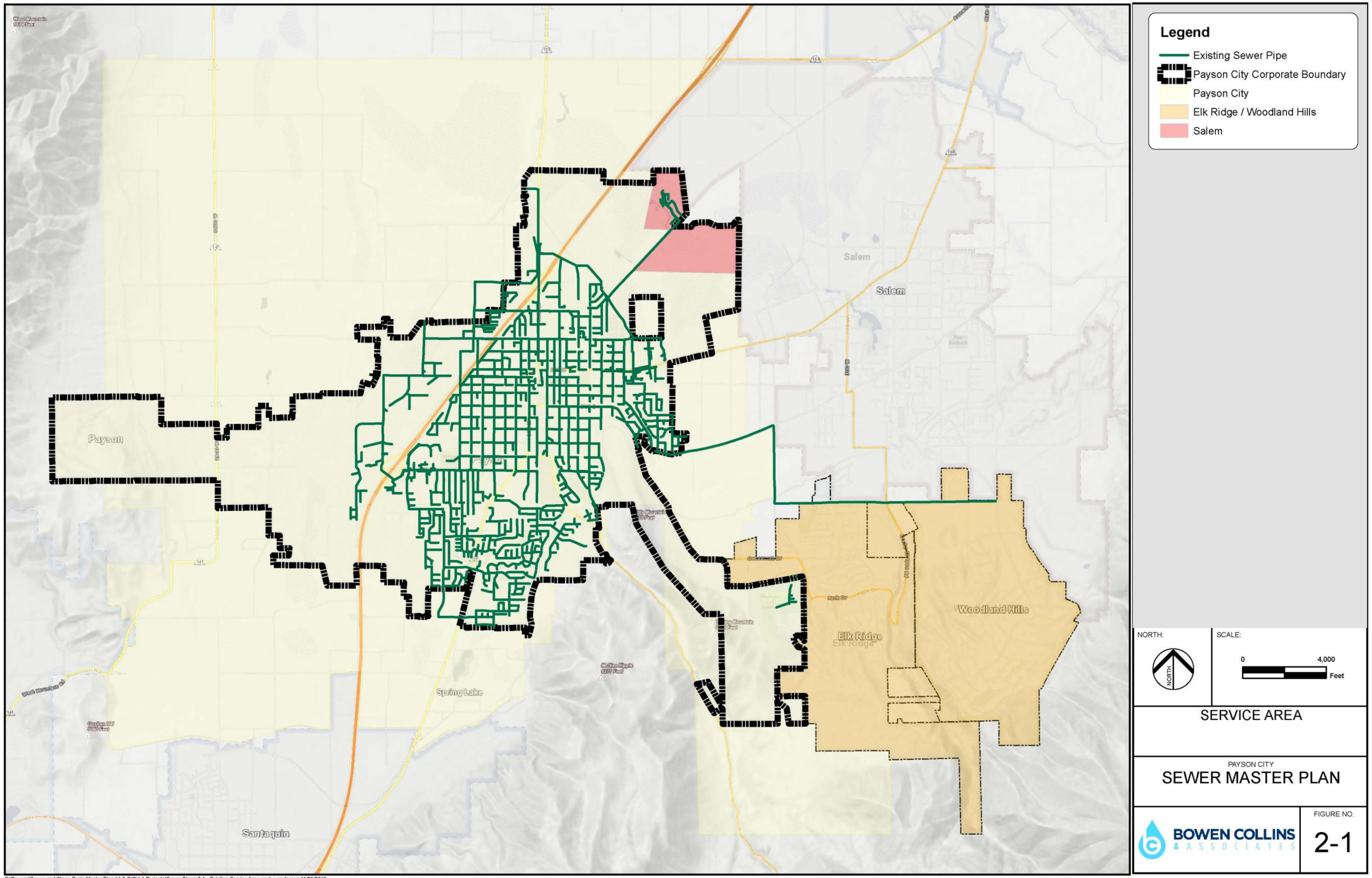


Figure 2-1. Service Area

TOPOGRAPHY

The Payson City sewer system service area is approximately 21.1 square miles (not including Elk Ridge and Woodland Hills) and is bordered by the following: Benjamin and Spanish Fork City to the north, Salem and Elk Ridge to the east, Santaquin City to the south, and West Mountain to the west. The topography of the City generally slopes from south to north with the City's treatment plant located towards the northern edge of the City. Most of the current City collection system flows by gravity to the treatment plant with a few exceptional areas requiring lift stations (One City owned lift station, and several private lift stations). As the City service area expands in the future, areas to the northeast and northwest will require pumping to reach the treatment plant.

COLLECTION SYSTEM

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

Sewer Collection Pipes

Sewer collection pipes in the City system are shown in Figure 2-2. There are a little more than 90 miles of sewer mains and over 1,600 manholes in the Payson City sewer system that are cataloged in the City's GIS database. Table 2-1 contains a summary of the sewer pipes for the Payson City sewer collection system. As can be seen in the table, 43 percent of the pipe in the system is 8 inches in diameter, with another 26 percent of the system being 6 inches in diameter or smaller[1]. The large majority of the 11 percent of pipe with unknown diameter is also likely small diameter pipe. This means that about 80 percent of the City's pipe is 8 inches or smaller. This represents the vast network of small collection mains in neighborhoods throughout the City.

[1] Note that current standards do not allow pipelines that serve multiple connections to be smaller than 8 inches in diameter. See Appendix B for details regarding sewer design and construction standards.

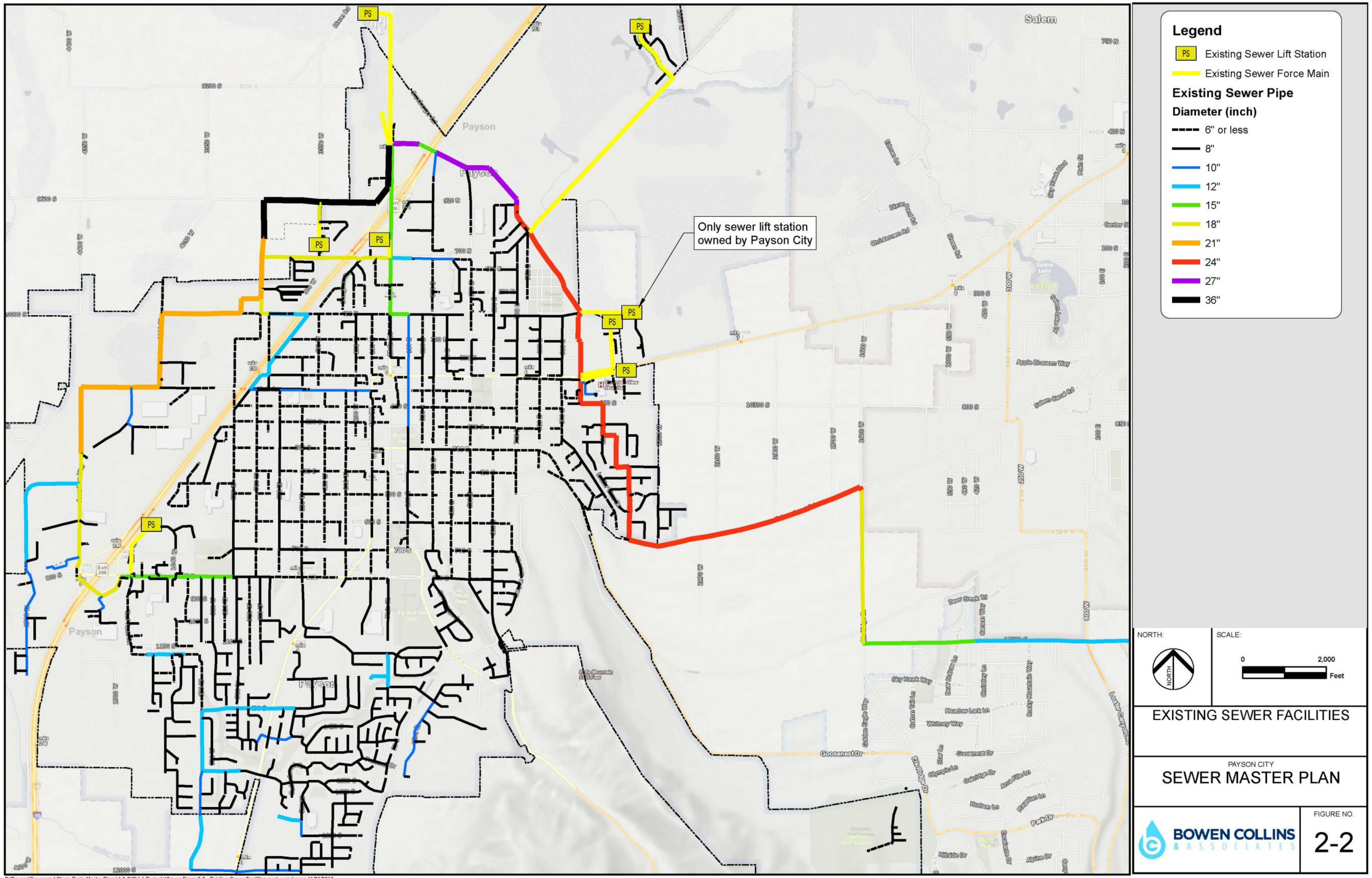


Figure 2-2. Existing Sewer Facilities

Table 2-1
Sewer Collection System Sizes and Lengths

Diameter (in)	Length (ft)	Length (mi)	Percentage (%)
Unknown	53,570	10.1	11.0%
< 6	10,614	2.0	2.2%
6	116,112	22.0	23.8%
8	209,533	39.7	42.9%
10	18,224	3.5	3.7%
12	23,507	4.5	4.8%
15	10,340	2.0	2.1%
16	3,443	0.7	0.7%
18	9,495	1.8	1.9%
21	9,402	1.8	1.9%
24	15,586	3.0	3.2%
27	3,321	0.6	0.7%
36	5,153	1.0	1.1%
Total	**488,300**	**92.5**	**100%**

Table 2-2 shows a breakdown of pipe materials and pipe diameters. PVC currently comprises over half of the system and is the preferred material of construction for most new sewer mains. As the City continues to rehabilitate and replace older existing lines, it is anticipated that the percentage of PVC will gradually increase.

Table 2-2
Sewer Main Material Percentages

Diameter (inch)	Concrete	PVC	Sum (%)
Unknown	6.8%	4.2%	11.0%
< 6	0.9%	1.3%	2.2%
6	20.6%	3.2%	23.8%
8	12.6%	30.3%	42.9%
10	1.3%	2.4%	3.7%
12	0.8%	4.0%	4.8%
15	0.1%	2.0%	2.1%
16	0.0%	0.7%	0.7%
18	1.0%	0.9%	1.9%
21	0.0%	1.9%	1.9%
24	0.0%	3.2%	3.2%
27	0.0%	0.7%	0.7%
36	1.1%	0.0%	1.1%
Total	**45.2%**	**54.8%**	**100%**

Lift Stations

Lift station in the City system are shown in Figure 2-2 and summarized in Tables 2-3 and 2-4. The City only owns one lift station, the Wasatch Mental Health Lift Station. Characteristics and the estimated capacity of this lift station are summarized in the table. There are also a number of privately-owned lift stations in the City. In theory, these lift stations should be maintained by their owners, but the City often assists in maintenance of these facilities due to the inexperience of private landowners in operating sewer facilities.

Table 2-3
Payson City Owned Lift Station Characteristics

Name	Location	Pump Location Type	Wet Well Volume (gallons)	Power (HP)	Design Capacity (gpm)	Size (inch)	Motor Type
Wasatch Mental Health	1250 E 410 N	Dry Pit	900	15	600*	6	VFD

*Capacity estimated based on published pump curves for model type and estimated lift.

Table 2-4
Privately Owned Lift Stations

Name	Location
Veterans Home	1550 N Main St
Arrowhead Park	1600 N 1300 E
Rite-Aid	819 N Main St
400 W	400 W 752 N
Rosewood Estates	1140 E 360 N
Mountain View Hospital	1204 E HWY 198
Stadium Cinemas	1200 W 640 S

*No design information was available for the private lift stations within the City.

PAYSON WASTEWATER TREATMENT FACILITY

The Payson Wastewater Treatment Plant (WWTP) is located at 1062 North Main Street and was first constructed in the early 1960s. The existing maximum month average daily capacity of the treatment plant is 3.0 MGD with a rated peak hydraulic capacity of 4.5 MGD. The treatment plant discharges to Beer Creek which contributes to the Benjamin Slough before reaching Utah Lake. Some of the effluent from the treatment plant is also used as makeup water in the Payson Power Plant. Major features of the treatment plant include the following components:

- Headworks includes: two 30” step screens, 8-foot diameter vortex grit removal, with air lift pump to grit washer
- 70-foot diameter Primary Clarifier
- 102-foot diameter Primary Trickling Filter (57,200 ft^3 Rock Media Volume)
- Primary Pump Station Capacity of 0.5 – 7.0 MGD with one standby pump
- Two 45-foot diameter Intermediate Clarifiers

- Secondary Pump Station Capacity of 0.5 – 6.5 MGD with one standby pump
- Aerotor Tank with Eight STM Aerotors in a 92.5’ x 49.5’ x 16’ Basin
- Two Final Clarifiers (45-foot diameter & 60-foot diameter)
- Two Shallow bed, Traveling Bridge Rapid Sand Filters
- Chlorine Contact Basin with 60-minute detention time
- Three anaerobic digesters (40-foot diameter each)
- Nine drying beds

Chapter 3 - Future Growth and Flow Projections

INTRODUCTION

Before attempting to hydraulically model and evaluate the City's sewer collection facilities, it is important to describe the components of wastewater flows. This includes an estimate of both the quantity and distribution of existing and future flows. The purpose of this chapter is to summarize the results, assumptions, and process of calculating both existing and future wastewater flows.

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

DOMESTIC WASTEWATER

Domestic flow consists of the direct wastewater contributions of residential and nonresidential customers[1]. Domestic flows for the City will be projected based on an "equivalent residential connection" (ERC) defined by indoor residential meter data. The approximate value for indoor water consumption was calculated to be 5,850 gallons per month (195 gallons per day) per ERC during the peak month of consumption. For domestic wastewater production, a consumptive use of 10 percent was estimated for Payson based on treatment plant data, indoor water use, and flow monitoring conducted as part of this study. As a result, the estimated domestic production from each ERC is 5,250 gallons per month (175 gallons per day or approximately 49 gallons per person).

[1] Commercial, industrial, institutional, etc.

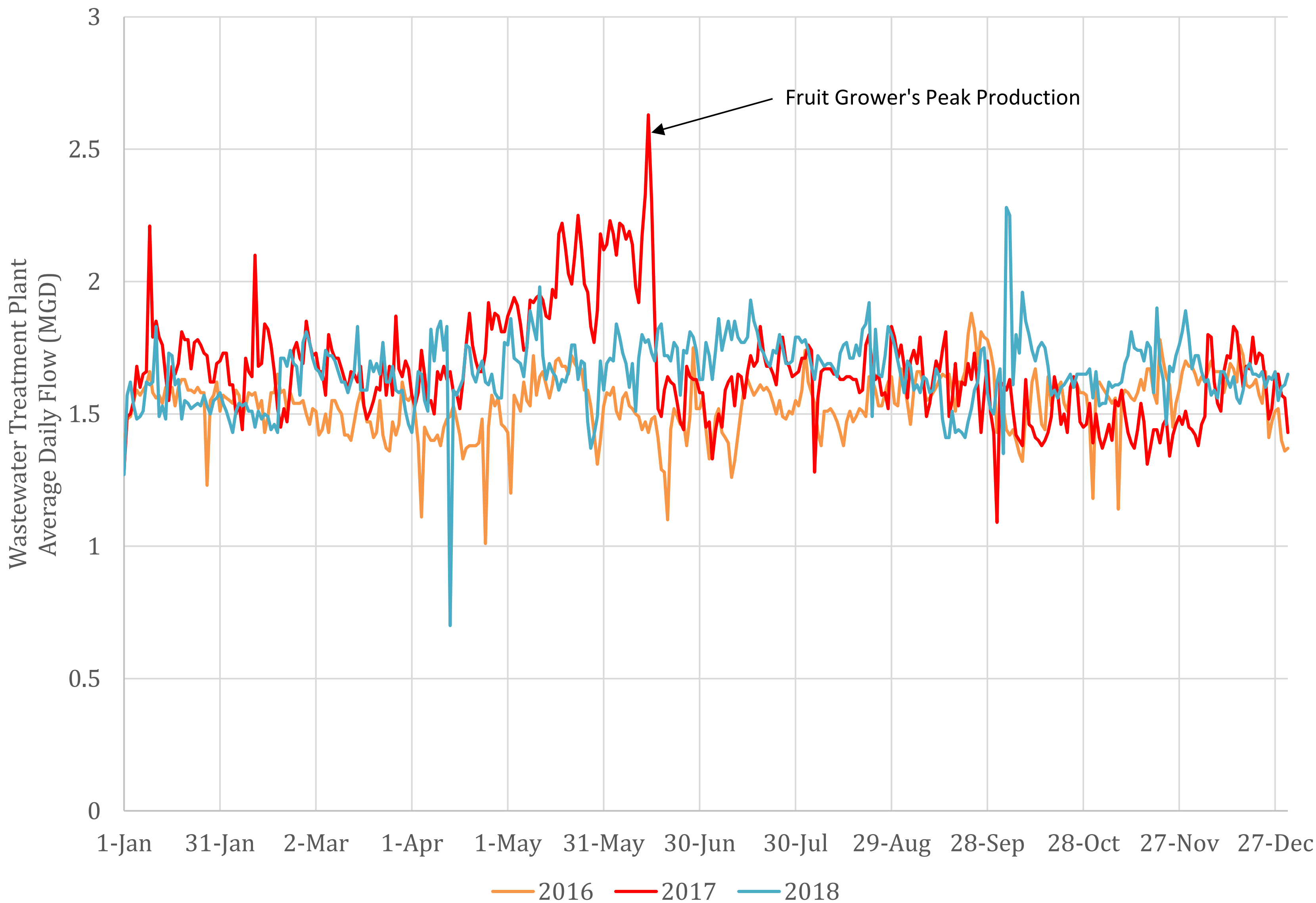
Payson Fruit Grower's Domestic Production

Figure 3-1 shows the average effluent flow rate from the City's wastewater treatment plant from 2016 to 2018. As can be seen in the figure, an unusually high increase in flow was observed in June of 2017. Average daily effluent at the City's wastewater treatment plant increased significantly during this two to three week period, peaking to 2.63 MGD on June 14, 2017. The relatively large increase does not appear to be connected to a large rainfall event.

Based on feedback from City personnel, it was estimated that the temporary increase in flow was likely the result of peak production at one of the food processing facilities in Payson owned by Payson Fruit Growers. Peak production in 2017 from the Fruit Growers was estimated to be approximately 1 million gallons per day (MGD), but may fluctuate from year to year based on crops and operation requirements.

This represents a significant additional hydraulic load that must be factored into collection system modeling. Although treatment is not the focus of this study, it may also represent a significant additional biological load if the additional flow includes large quantities of food waste. However, if the peak production rate is related to cleaning operations, the level of solids or biological loading into the wastewater treatment system may not be that significant. City personnel should consider additional sampling of the Fruit Growers' wastewater during peak production to determine if any additional pre-treatment needs should be considered.

Figure 3-1
2016-2018 WWTP Average Effluent Flow



INFILTRATION

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, roots, etc. Infiltration is generally a function of groundwater levels. Groundwater levels in the service area fluctuate depending on climate and season. Infiltration rates will correspondingly change seasonally but will generally be 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 (see next section).

Factors that can affect infiltration include pipe age, material, and 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 over time.

Infiltration in the collection system was estimated by comparing indoor meter data to flow data collected at the City's treatment plant. Based on overall measurements at the City's treatment plant, infiltration for the Payson treatment plant service area appears to be relatively low. Total infiltration was estimated to be roughly 15 percent of total flow to the treatment plant for the peak month in 2017 (0.27 MGD). This is a relatively low infiltration rate compared to sewer systems in other parts of the State of Utah.

Even though the City's current infiltration rate is relatively low, it does not mean that the City can ignore infiltration. While the low current rate suggests that aggressive infiltration elimination efforts are not needed at this time, the City will need to be vigilant in identifying and repairing sources of infiltration as part of its routine pipeline inspection activities. As the system continues to age, infiltration is expected to increase unless the City continues to invest in repairs. For planning purposes, it has been assumed that the City's repair efforts will be able to maintain existing infiltration at approximately the same level as historic.

For future facilities, projections of infiltration have been approximated by assuming a specific amount of infiltration per growth in population or ERCs. Based on the expected density of the future collection network and recommended industry infiltration allowances for newly constructed sewer facilities, future infiltration per ERC can be estimated as approximately 26 gallons per day per ERC or (7 gallons per person).

INFLOW

Similar to infiltration, inflow is also the intrusion of unwanted water into the sewer system. In the case of inflow, however, this water comes from rainfall and snowmelt instead of groundwater. Inflow may enter the sewer system through roof and foundation drains, yard and area drains, manhole covers, and illicit storm drain connections. In the case of the assorted roof and yard drains, discharge into the sanitary system is against City ordinances. However, illegal storm drain connections often exist and can significantly affect the performance of the sewer system.

Inflow into a collection system can be highly variable and depends on the placement and construction of sewer collection systems as well as the type of storm events that occur. In addition, a long record of rainfall and flow monitoring data is needed to accurately predict how storm events may impact the City's collection system or treatment plant. Thus, this master plan does not attempt to specifically quantify inflow. Instead, inflow in the sewer master plan is accounted for by reserving a portion of pipe capacity for inflow when assessing system performance. In other words, a pipe will be identified as having inadequate capacity at flows somewhat less than the full flow capacity of the pipe. Payson City's design criteria includes a 50 percent capacity buffer for pipes 12-inch and smaller and 25 percent capacity buffer for pipes greater than 12-inch. This buffer provides capacity for inflow and/or other unusual flow events including holidays when sewer production may peak higher than normal.

GROWTH PROJECTIONS

Once an understanding of existing wastewater is developed, it is possible to project the growth in wastewater into the future. Growth projections for Payson City are based on internal projections developed by the City during their general plan update process. Growth projections for the contributing areas of Elk Ridge, and Woodland Hills are based on population growth projections developed by the Mountainlands Association of Governments (MAG) through 2050.

The results of these growth projections are shown in Figures 3-2 through 3-4. Figure 3-2 shows the final development densities associated with the City's new general plan. Figures 3-3 and 3-4 show the areas of projected 10-year and 20-year growth, respectively. Table 3-1 lists the average density of equivalent residential connections identified in the general plan base on landuse type.

Table 3-1
Average Density and Average Wastewater Production by Landuse

Development Type	Average Density (ERCs / acre)	Max Density (ERCs / acre)	Average Daily Domestic Wastewater (gpd/acre)	Average Daily Infiltration (gpd/acre)	Total Wastewater (gpd/acre)
Commercial	2.0	2.0	350.0	52.5	402.5
High Density Residential	8.1	8.8	1,413.9	212.1	1,625.9
Industrial	2.0	2.0	350.0	52.5	402.5
Low Density Residential	2.4	2.8	420.3	63.1	483.4
Medium Density Residential	4.8	5.3	831.6	124.7	956.3
Mixed Use Center	5.4	12.4	940.3	141.0	1,081.4
Mixed Use Neighborhood	7.0	12.3	1,225.8	183.9	1,409.6
Office Flex	2.0	2.0	350.0	52.5	402.5
Rural Residential	0.4	0.5	68.3	10.3	78.6
Transit Oriented Development	10.5	11.6	1,840.2	276.0	2,116.2
Vacant	0.0	0.0	0.0	0.0	0.0
Agricultural, Parks, Open Space, Public	0.0	0.0	0.0	0.0	0.0

*City landuse ordinances allow for a range of densities. For clarity, the table includes both the average and maximum densities observed for each landuse type with the growth projections. The flow estimates shown here based on 175 gpd/ERC for domestic and the average densities for the given landuse type. However, within the actual projections, flow estimates have been based on the density estimated for each specific area based on the City's General Plan and estimates of economic feasibility.

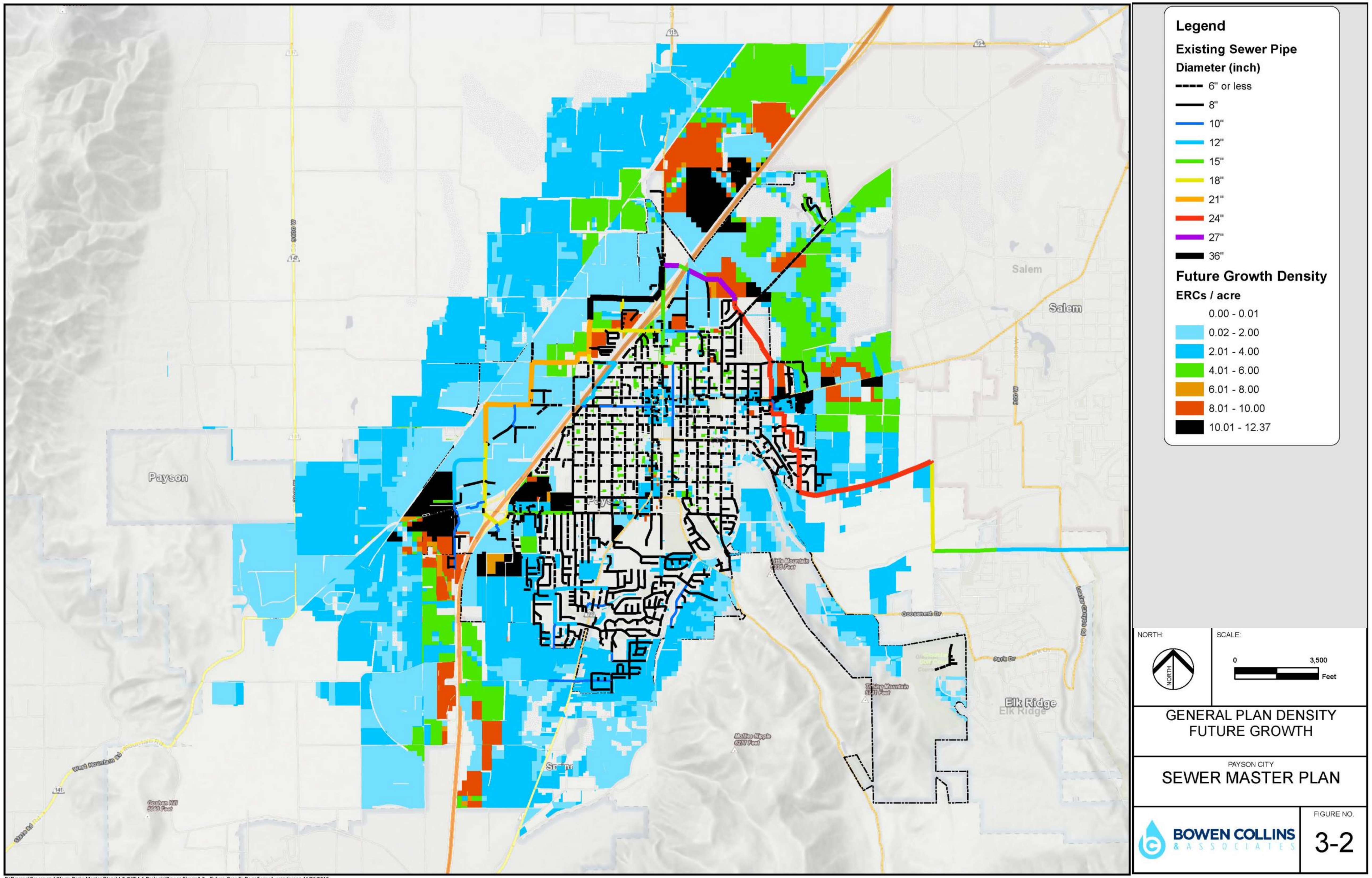


Figure 3-2. General Plan Density Future Growth

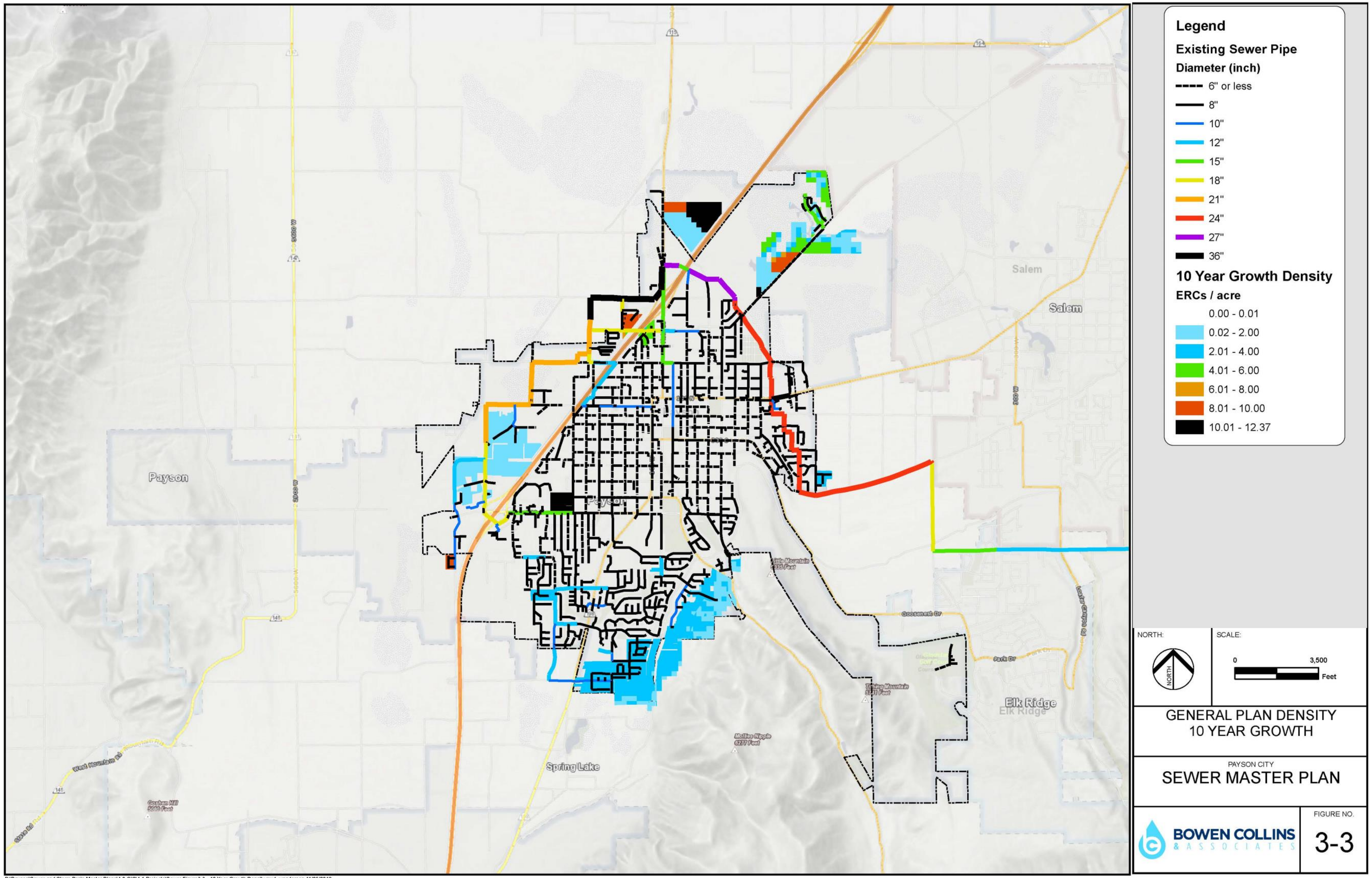


Figure 3-3. General Plan Density 10 Year Growth

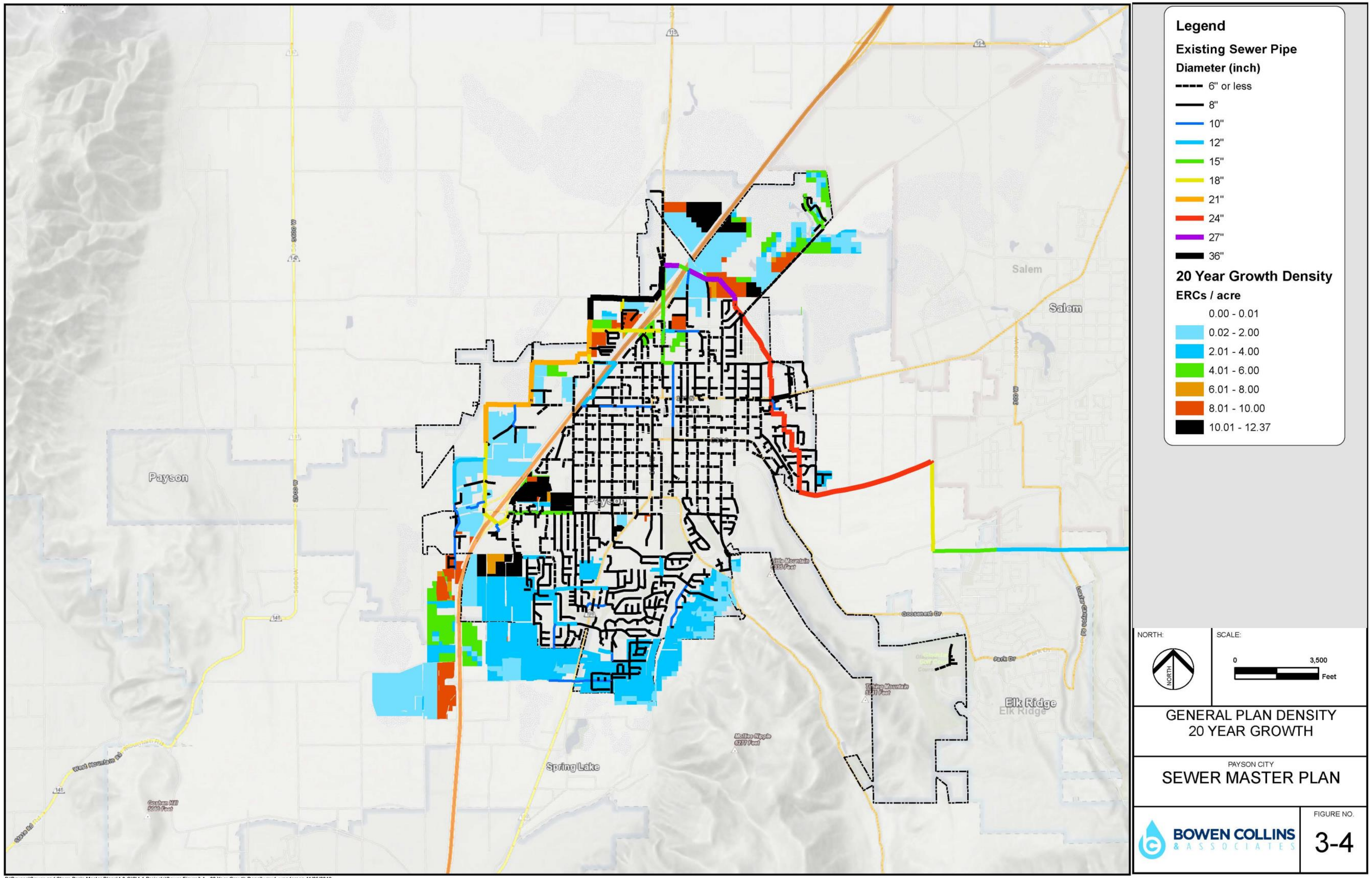


Figure 3-4. General Plan Density 20 Year Growth

Table 3-2 summarizes projected growth in terms of equivalent residential connections (ERCs)[2] anticipated for each city through buildout based on the Payson City general plan (or MAG projections in the case of Elk Ridge and Woodland Hills). Buildout growth estimates for Elk Ridge and Woodland Hills are based on estimates provided by each City.

Table 3-2
Projected Growth in ERCs for Service Area

Year	Payson[1]	Elk Ridge[2]	Woodland Hills[2]	Total
2019	8,057	559	249	8,865
2030	10,717	639	286	11,642
2040	14,724	764	338	15,826
2050	21,153	885	453	22,491
Buildout	34,444	2,005	994	37,443

1 Buildout ERCs for Payson are based on Payson City's new general plan
2 Buildout ERCs for Elk Ridge & Woodland Hills are based on building planning information provided by each City.

Based on these growth projections, Table 3-3 and Figure 3-5 summarize projected max monthly flows and peak hour flows associated with future growth in the treatment plant service area. The existing treatment plant's rated maximum month average daily capacity is 3.0 mgd as indicated in Figure 3-5. The permitted peak hour capacity is limited to 4.5 mgd. Based on permitted capacity, future growth will require expanding the permitted capacity of the plant around the year 2028.

2 An equivalent residential connection (ERC) is representation of potential wastewater flow based on the average flow associated with a typical single family residential connection. Thus, if a commercial customer produces four times the wastewater flow of a single family residential connection, that commercial customer would represent 4.0 ERCs.

ERCs should not be confused with simple "connections". A sewer provider will almost always have significantly more ERCs than connections as a result of large commercial and industrial customers, as well as multi-family customers, than have several ERCs associated with each connection.

ERCs should not be directly compared between different utilities because the definition of ERC is specific to each utility. For example, a large park with no restroom facilities might represent a large number of water ERCs (associated with its irrigation needs), but zero sewer ERCs. Thus, ERCs must be calculated separately for different utilities and should be expected to be different from one another.

Table 3-3
Projected Flows to Payson Treatment Plant* (mgd)

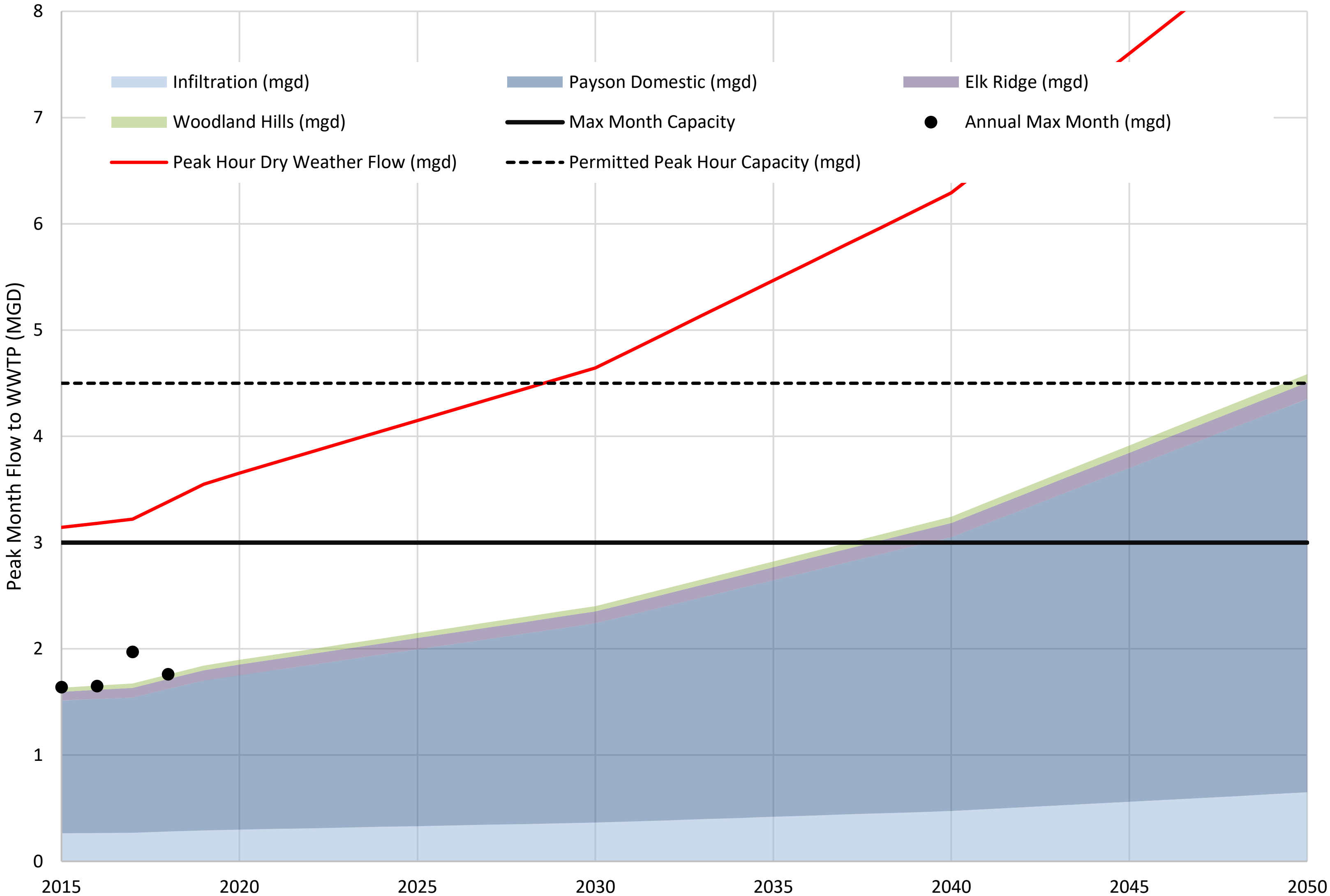
Year	Max Month Infiltration (mgd)	Payson Domestic Wastewater Max Month Production (mgd)	Elk Ridge Domestic Wastewater Max Month Production (mgd)	Woodland Hills Domestic Wastewater Max Month Production (mgd)	Max Month Total Wastewater (mgd)	Peak Hour Flow (mgd)
2019	0.29	1.41	0.10	0.04	1.84	3.55
2030	0.36	1.88	0.11	0.05	2.40	4.64
2040	0.47	2.58	0.13	0.06	3.24	6.29
2050	0.65	3.70	0.15	0.08	4.59	8.92
Buildout	1.04	6.03	0.35	0.17	7.59	14.80

*Estimated max month flow includes both infiltration and domestic production. Note that max month flow does not include the estimated 1 mgd contribution that was estimated for the Payson Fruit Grower's which lasted for one day in June 2017. Average domestic wastewater for Payson Fruit Grower's was estimated as 0.09 mgd.

Two items should be noted regarding these projections:

1. As can be seen in the figure, the projections are mostly in line with actual observed peaks in most years. It should be remembered that, while the projections are to be used as planning values and therefore must necessarily represent the peak expected flow in any given year, the actual peak flow will not be observed in every year. As discussed previously, infiltration can vary significantly from year to year depending on climate conditions. Only in peak infiltration years will the maximum projected flow be observed. In other dryer years, the flow will be less.
2. Given what was just explained in the first item, it seems contradictory that the data point for peak flow in 2017 is above the projected planning flows. However, the peak flow in 2017 appears to have been a one-time event associated with higher than normal peak flow coming from the Utah Fruit Growers. Because no other similar event has been observed in the historic record, and because the City continues to work with the Fruit Growers to moderate flows and avoid another similar event in the future, this extreme peak flow event was not incorporated into the planning projections.

Figure 3-5
Flow to Payson City Wastewater Treatment Plant



Chapter 4 - Hydraulic Modeling

INTRODUCTION

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

GEOMETRIC MODEL DATA

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

Pipeline and Manhole Locations

The City has spent considerable time assembling a GIS inventory of its existing sewer facilities. The database includes information on the location and size of manholes and pipelines in the City collection system. Based on direction from City personnel, pipeline and manhole data was taken directly from the GIS database for use in the model.

Manhole rim and invert information was not available prior to this project for the majority of sewer facilities in the City. As part of this project, the City surveyor conducted a survey of rim and inverts for the sewer mains to be included in the model. That information was used to update the City's GIS database.

Schedule limitations did not allow for all of the City's pipelines to be surveyed. However, all major outfalls and many smaller collection lines were surveyed and included in the model. As additional collection pipelines are surveyed in the future they can be added to the GIS database and model. However, including them in this analysis is not necessary as the areas they serve are small enough that no capacity concerns exist.

Pipe Flow Coefficients

Pipe flow coefficients used throughout the hydraulic model were assigned a Manning's flow coefficient of 0.013. This is approximately equal to the flow coefficient of concrete and clay pipe. While there are other materials in the system with lower published flow coefficients (e.g. PVC), 0.013 was used throughout the system as a conservative approach for estimating pipe capacity. In addition, most collection pipes can develop thin layers of bacteria and solids (a slime layer) that result in a relatively uniform flow coefficient despite varying materials. This is consistent with State of Utah sewer design requirements as outlined in R317-3-2.3.D.2.

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

FLOW DATA

Once all required geometric data was collected and a physical model of the system was developed, flow data was obtained to model the system hydraulics. Three types of flow information were required for hydraulic modeling: domestic wastewater magnitude and distribution, domestic wastewater flow timing, and infiltration magnitude and distribution. Each of these flow characteristics is discussed below.

Domestic Wastewater Magnitude & Distribution

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

For hydraulic modeling purposes, existing domestic flows were distributed based on winter water use records in combination with flow monitoring data. The distribution of future domestic wastewater was based on planned land use in undeveloped areas as defined in the City's new general plan.

Domestic Wastewater Timing

Domestic flow from both residential and non-residential customers varies throughout the day. Peak flows are usually generated during the morning hours as residents prepare for the day (including showers for one portion of the population). There is a another peak in the early evening as residents return from work and clean up from the day (including showers for another portion of the population). Domestic sewer flows are generally lower throughout the remainder of the day and are just a trickle during the early morning hours when most residents are asleep.

The City has some commercial or non-residential users (e.g. Utah Fruit Growers), but no distinct patterns were observed in flow monitoring data for non-residential areas. Peak flows for the Fruit Grower's connection have been assumed to be constant. In reality, peak flows for the Fruit Grower's connection may reflect a more commercial type pattern that would peak in the middle of the day as opposed to morning or evening.

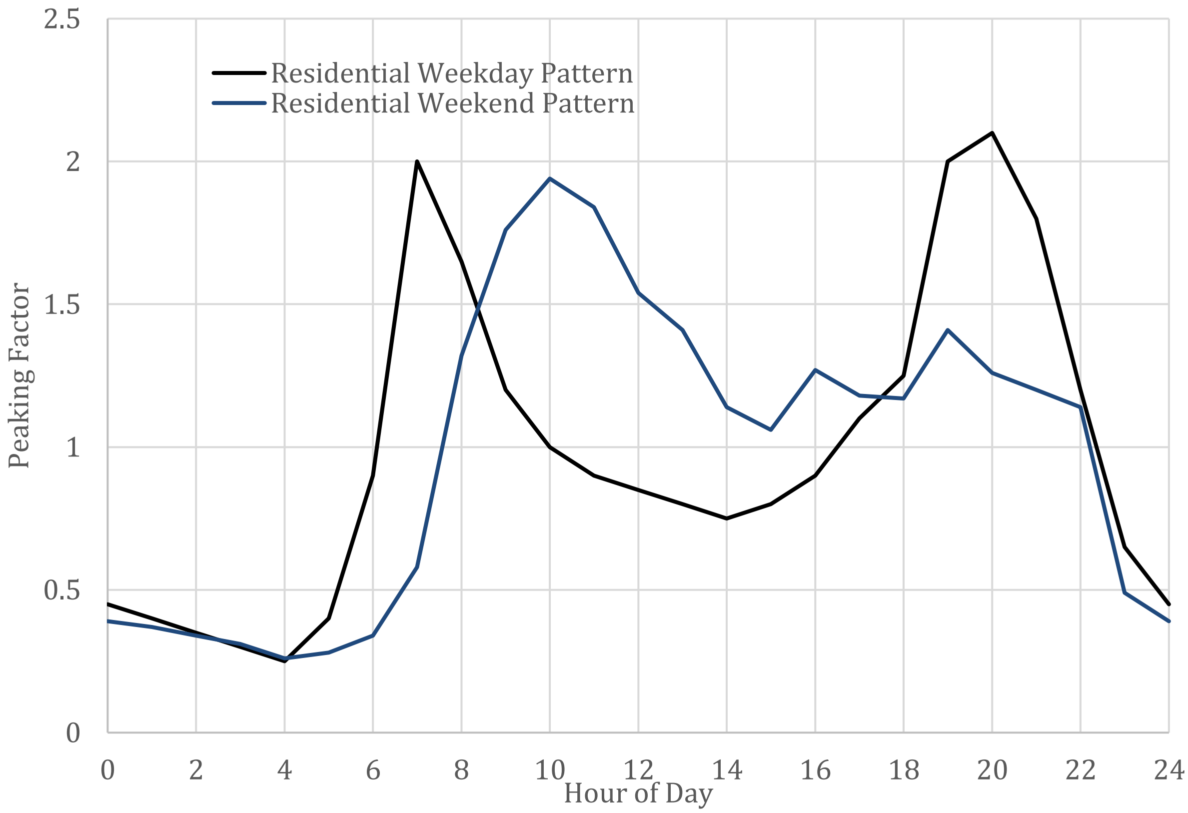
The pattern of fluctuating domestic water use is often referred to as a diurnal pattern. The diurnal pattern for any given customer will vary depending on the type of user. The City has conducted flow monitoring to identify flows and diurnal patterns observed in the collection system. A typical residential diurnal demand pattern was identified for the City for both weekday and weekend conditions as shown in Table 4-1 and Figure 4-1. These are the diurnal patterns applied to the model to match simulated flows in the hydraulic model with the observed flows from flow monitoring.

Table 4-1
Payson Service Area Diurnal Patterns

Hour	Residential Weekday Pattern	Residential Weekend Pattern
0	0.45	0.39
1	0.4	0.37
2	0.35	0.34
3	0.3	0.31
4	0.25	0.26
5	0.4	0.28
6	0.9	0.34
7	2.0	0.58
8	1.65	1.32
9	1.2	1.76
10	1	**1.94**
11	0.9	1.84
12	0.85	1.54
13	0.8	1.41
14	0.75	1.14
15	0.8	1.06
16	0.9	1.27
17	1.1	1.18
18	1.25	1.17
19	2	1.41
20	**2.1**	1.26
21	1.8	1.2
22	1.2	1.14
23	0.65	0.49
24	0.45	0.39

The most conservative pattern identified as part of flow monitoring was calculated and applied to the hydraulic modeling of domestic wastewater flows. As can be seen in the table, the highest value for weekday pattern is higher than the highest value for the weekend pattern (i.e. weekdays have a higher peaking factor). However, in some cases, the average volume of wastewater production on weekends can be higher than weekdays which may result in an overall higher absolute peak on weekends (even though the peaking factor is lower). Thus, whether the weekday or weekend will produce the highest peak flow will vary depending on the location in the City and particular flows in a given week. For the purposes of modeling the City, the weekday pattern was applied to the average day, maximum month loading data available from billing data[1]. Any minor fluctuations in peak flows that may result from higher weekend or special event volumes will be accommodated through the City's capacity buffer.

Figure 4-1
Diurnal Patterns for Payson City



[1] The diurnal patterns noted here are the best representation available of citywide flows and are appropriate for system modeling. However, these patterns should not be used for the evaluation of individual pipes. Pipes serving smaller areas should be evaluated using peak factors as defined in the City's sanitary sewer design standards (see Appendix B).

Infiltration Magnitude & Distribution

As discussed in Chapter 3, infiltration may vary on a seasonal basis but does not generally vary on a daily basis. Thus, it has been assumed that infiltration remains constant throughout the day in the collection system model. Existing infiltration was distributed as calibrated using available flow monitoring data within the City. Growth of infiltration within the District was added to the future hydraulic model simulations at a rate of approximately 26 gpd per new connection.

Inflow

For this study, inflow has not been modeled directly because of the wide variability in storm events and inflow response possible in the District. For design purposes, the City has included a capacity allowance in its design criteria to account for inflow into its collection system.

Total Peak Flows

Based on the diurnal patterns used above, peak flows simulated in the model (including both domestic flow and infiltration) are summarized in Table 4-2. It will be noted that peak flows as reported in the table are lower than might be expected by simply adding up the various flow component multiplied by their respective maximum peaking factors. This is because the table represents peak flows as measured at the WWTP and accounts for the modeled attenuation of flow that occurs in the system. Attenuation of flow occurs as a result of several factors such as: travel time through the system resulting in offset peaks from different areas, small amounts of storage in pipelines and manholes detaining a portion of peak flows, etc.

Table 4-2
Hydraulic Modeling Scenario Peak Hour Flows (mgd)

Scenario	2019*	2029*	Buildout*
Dry Weather Flow	4.3	5.1	14.7

*Peak hour flow to the WWTP comes from extended period simulation which accounts for attenuation in the system. These values also assume a surge of 1 mgd from the Payson Fruit Growers.

CALIBRATION

For the last several months, the City has been collecting flow data at various locations throughout the City. Locations where flow data has been collected are shown in Figure 4-2. The process of model calibration involves adjusting or modifying certain model parameters in order to better match the actual conditions of the sewer system as observed in the flow monitoring data.

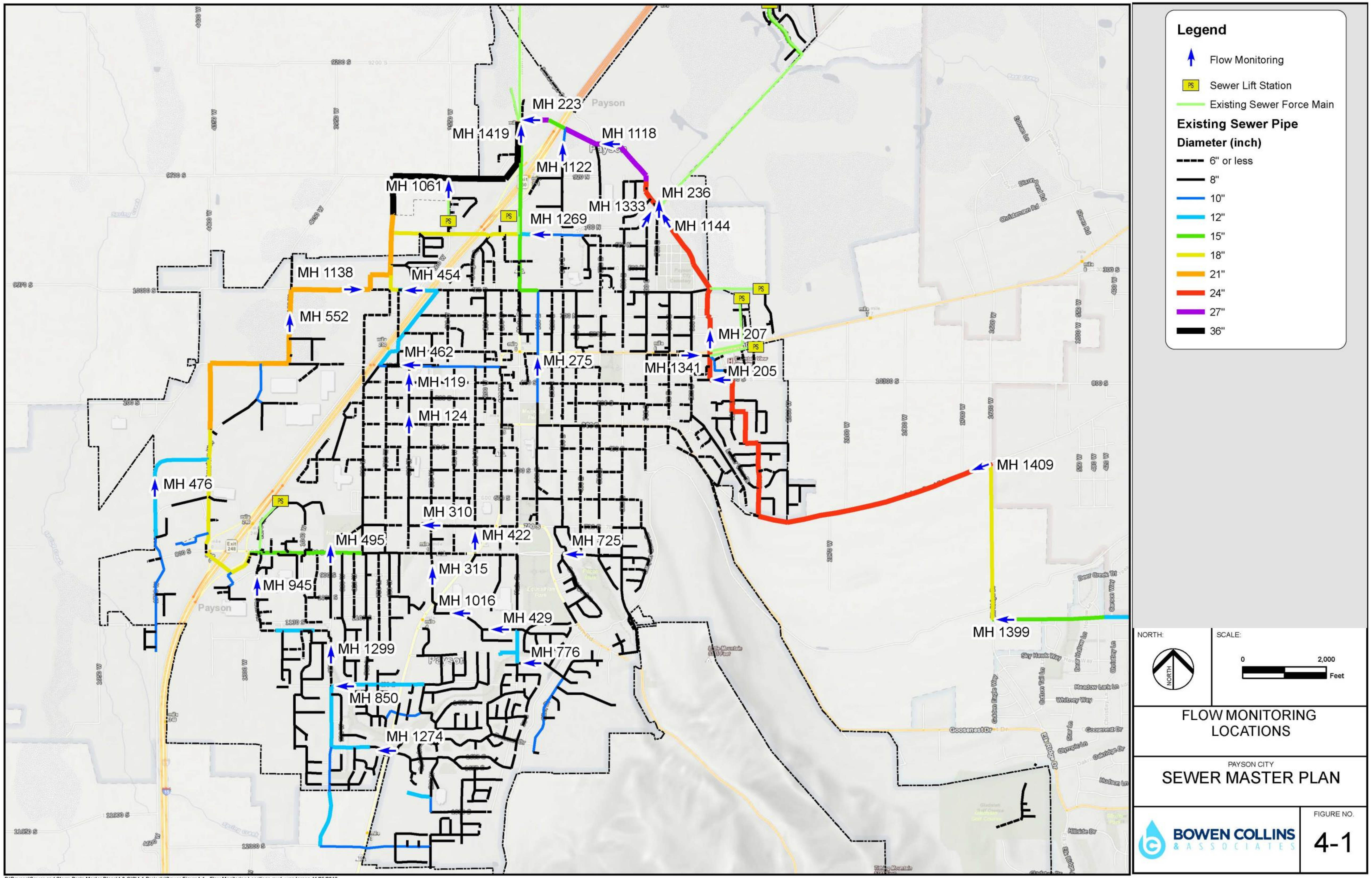


Figure 4-2. Flow Monitoring Locations

A comparison of model simulation results based on initial projections using indoor water use records indicated that the model was generally reproducing system performance at reasonable level of accuracy. However, a few additional model adjustments were made where possible in order to better match the flow monitoring data. The primary model adjustment was in the distribution of existing infiltration. Final results for several sample flow monitoring location are shown in Figures 4-3 through 4-5.

Figure 4-3
Observed vs Simulated Flow at MH1399 (Elk Ridge / Woodland Hills Trunk Line)

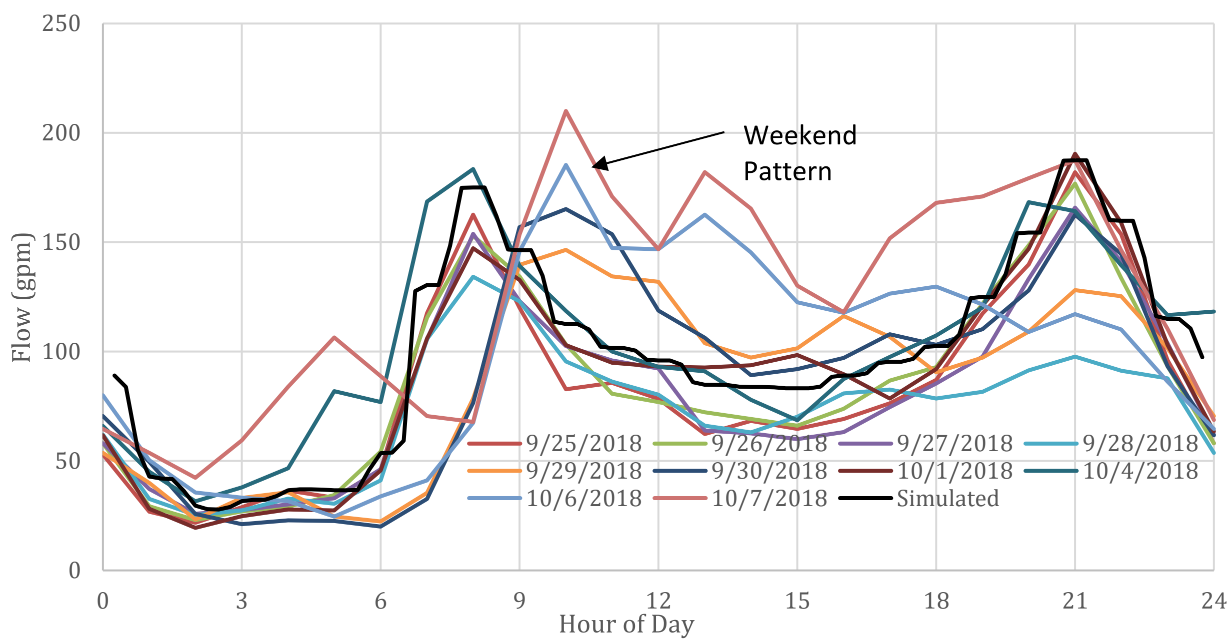


Figure 4-4
Simulated vs Observed Flow at MH1299 (930 W & 1280 S)

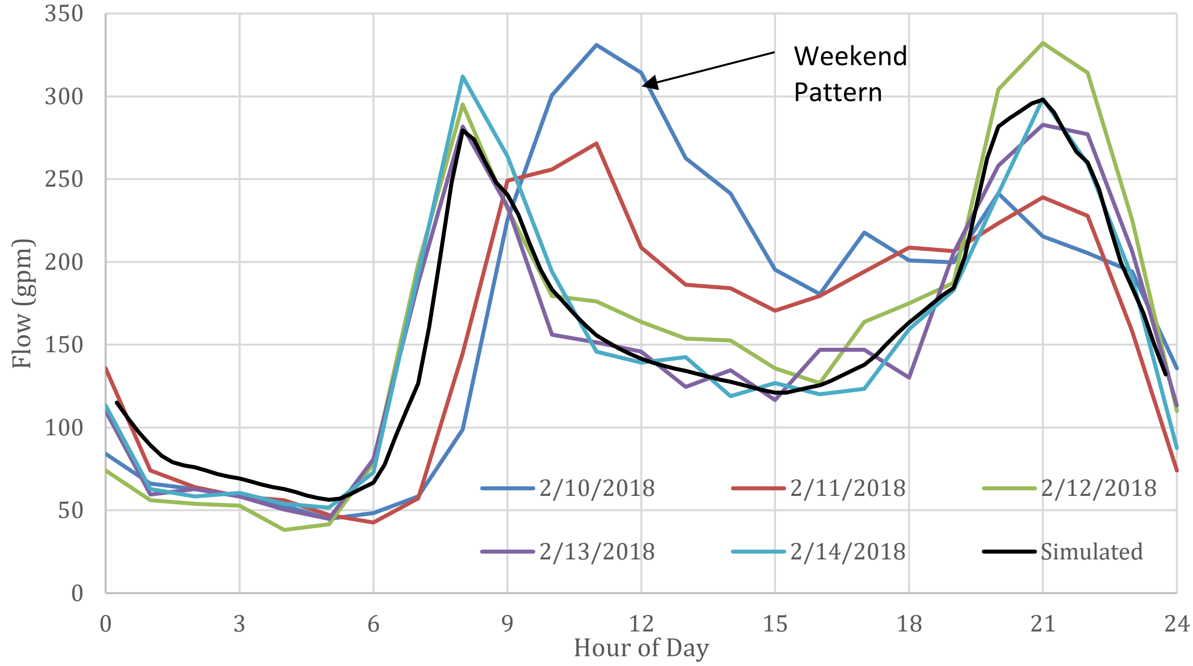
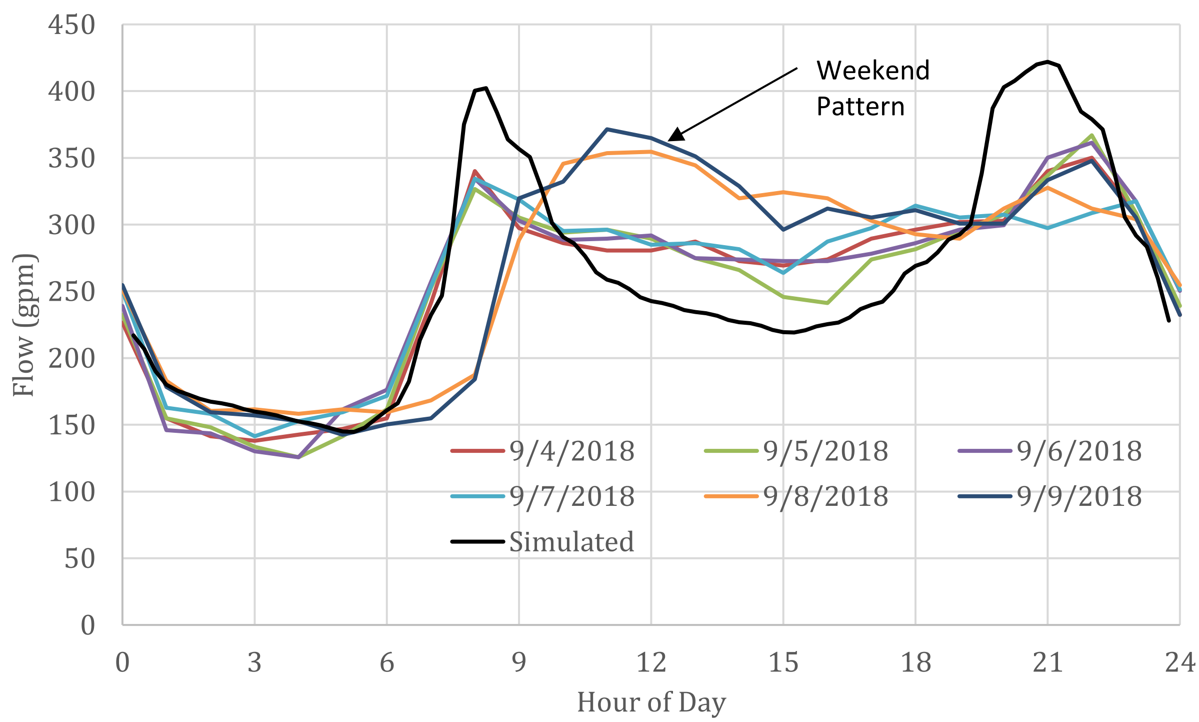


Figure 4-5
Simulated vs. Observed Flow at MH223 (1000 N & Main)



Chapter 5 - System Evaluation

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

EVALUATION CRITERIA

In defining what constitutes a hydraulic deficiency, it is important to consider the assumptions made in estimating sewer flows in the model. As described in Chapters 3 and 4, the sewer flow included in the model is composed of two parts: domestic sewer flow and infiltration. These inputs are based on available historic data. Based on the nature of this data, the hydraulic criteria used for evaluating hydraulic performance must take the following issues into account:

- **Dry Weather vs. Wet Weather Flows** – As noted above, the sewer flows modeled in the system include only domestic flows and infiltration. For reasons enumerated previously, inflow is not included. This means that model results are essentially for dry weather conditions. In wet weather, inflow will be added to the system and must be accounted for. The criteria established for identifying deficiencies should leave some unused capacity available for inflow during wet weather events.
- **Flow Variability** – Because these estimates are based on average values and a limited data set, actual flows will fluctuate and may be greater or lower than the model estimates. For example, infiltration during extremely wet years could be more than estimated in the model (e.g. 1983 was a statewide historically wet year that led to much higher than average infiltration and flooding in many areas). The criteria established for identifying deficiencies should be sufficiently conservative to account for occasional flows higher than those estimated in the model.

With these issues in mind, the following criteria have been established to identify capacity deficiencies in the system:

Pipelines

The evaluation criteria for pipelines varies by pipe size:

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

As can be seen, all pipelines include a portion of the pipeline that is reserved for inflow and/or unaccounted for fluctuations in domestic flow and infiltration. The design criteria requires the portion of capacity allocated for this purpose be greater for smaller sized pipes because of the greater potential for peaking variability in smaller pipes. The buffer capacity also minimizes surcharging of laterals during wet weather events or other extreme fluctuations in flow.

There are occasionally situations in which a relatively short section of pipe is installed at flat slope comparative to the pipes around it. In this case, a strict review of the flat section of pipe's capacity against existing or projected flows may identify it as hydraulically deficient. However, it may not actually cause any problems in the field because the overall slope of the larger reach of pipeline has adequate capacity and the flat section of pipeline is not long enough to appreciably restrict the flow. In this situation, the flat section of pipeline will only be considered deficient if the maximum depth of flow at its upstream end exceeds 50 percent of the pipeline diameter for pipes 12-inch and smaller and 65 percent[1] of pipeline depth for pipes 15-inch and larger.

Lift Stations

For all lift stations owned and operated by the City, the following minimum standards apply:

- **Lift Station Capacity –** Based on industry standards and good design practice, it is recommended that peak daily flow into a lift station not exceed 85 percent of the lift station's hydraulic pumping capacity. Allowing for a modest amount of capacity above projected flows accounts for unknowns associated with flow projections and mechanical wear at each lift station.

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[1] Approximate depth of flow in a pipeline with flow at 75% of full flow capacity.

- **Wet Well Capacity –** The minimum wet well volume for lift stations should be large enough to prevent excessive cycling of lift station pumps. Based on manufacture recommendations for pump operation, the maximum number of cycles per hour should be six or less. Exceeding this value will significantly shorten the lifespan of the lift station pumps.

Force Mains

For all force mains owned and operated by the City, the following minimum standards apply:

- **Average Velocity –** Per State of Utah standards, a velocity of not less than 2 feet per second shall be maintained at the average design flow, to avoid septic sewage and resulting odors.
- **Maximum Velocity –** Peak velocity through the force main should not exceed 7 feet per second.

Other Design Standards

The purpose of this chapter is to evaluate capacity needs in the collection system. As a result, the evaluation standards described above focus on capacity needs only. For complete design and construction of sewer system improvements, the City has a more comprehensive set of design standards. Appendix B contains the City's current design standards with a series of red line suggested modifications from BC&A. Implementing these modifications will keep the design standards consistent with the rest of this master plan.

EXISTING SYSTEM ANALYSIS

Pipelines

Figure 5-1 displays the hydraulic performance of the sewer system under existing peak hour flow conditions[2]. Pipes in the figures are color coded to show the ratio of peak flow rate in the pipe to the pipe's full capacity[3]. Based on peak flow and pipe capacities, there are a few areas of the City that do not meet the City's design criteria:

- East of I-15 Between Utah Avenue and 100 North – This flat section of pipe appears to be severely under capacity. However, because it is a relatively short section, its potential for surcharging and impact on the system is still relatively small.

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[2] Includes 1 MGD constant flow from the Payson Fruit Growers

[3] Results include the new 36-inch West outfall improvements currently under construction

- 300 West and 600 West Between 200 South and Utah Avenue – These two 8-inch segments of pipe are currently between 50 percent and 75 percent of capacity. This does not technically meet the City’s design standards because of the smaller diameter of these pipes. However, because there is still a comparatively large amount of available remaining capacity, addressing these deficiencies can be a lower priority.

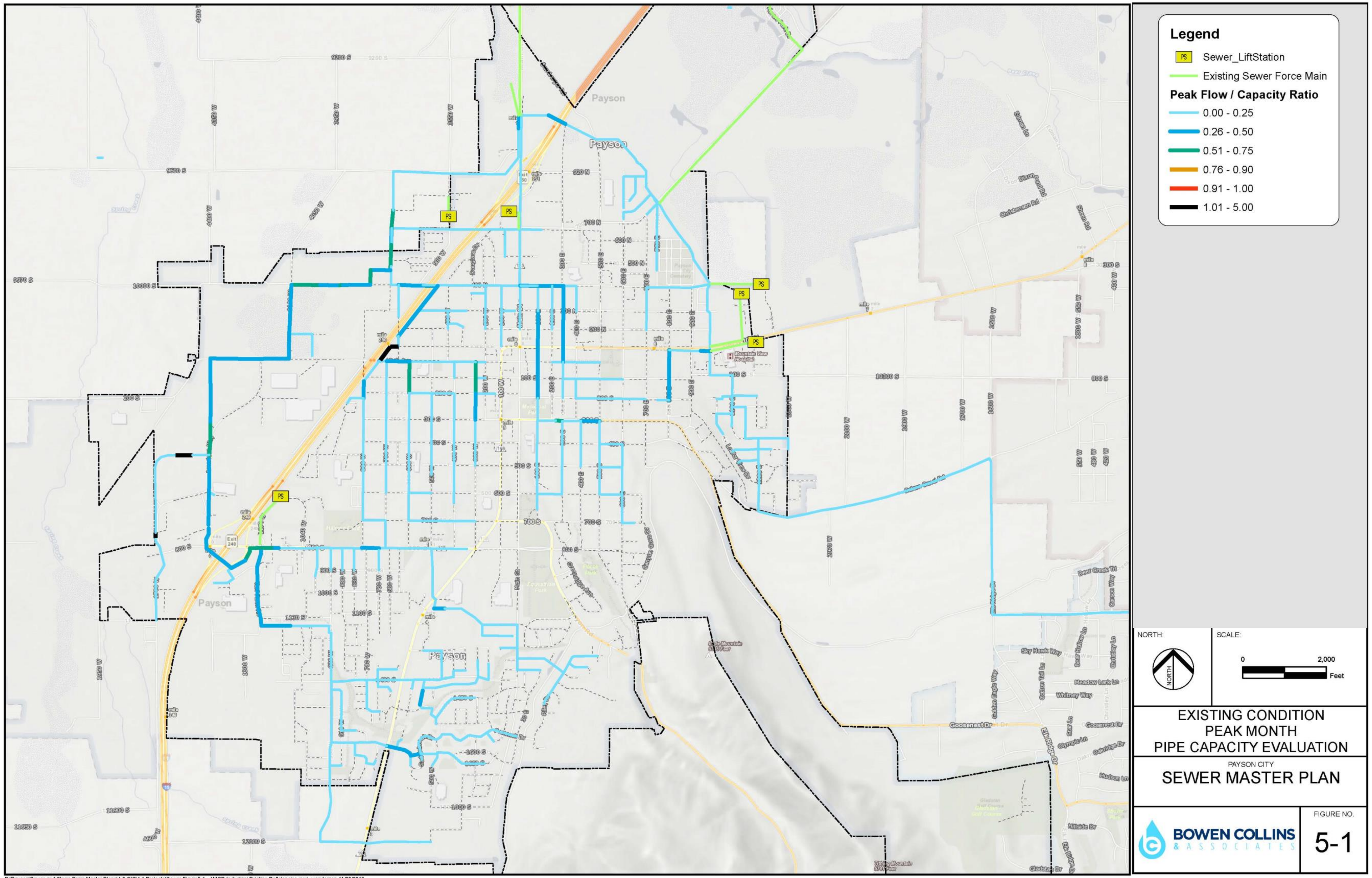

Figure 5-1. Existing Condition Peak Month Pipe Capacity Evaluation

Lift Stations

As discussed previously, the City only owns and operates one lift station, Wasatch Mental Health. Table 5-1 lists the design capacity of the City's lift station and the estimated existing peak flow to the lift station.

Table 5-1
Lift Station Design Capacity – Existing Conditions

Name	Design Capacity (gpm)	Existing Peak Flow Estimate* (gpm)
Wasatch Mental Health	600	50

*Peak flow estimated using billing data and State of Utah Small Area Peaking Factor

As can be seen in the table, there is no current concern with lift station capacity in the existing sewer system.

City personnel have also expressed concerns about some of the private lift stations in the City. While all private lift stations are supposed to be operated and maintained by the private property owner, City personnel often assist with maintenance or replacement of private lift station components. Where possible, the City would like to eliminate private lift stations to improve maintenance and limit potential sanitary sewer overflow conditions. Table 5-2 lists the estimated existing peak flow at each lift station and the potential to gravity service the lift station or combine with a future lift station service area. The City's preference is to operate and maintain as few lift stations as possible.

Table 5-2
Lift Station Peak Flows & Potential for Elimination

Name	Existing Peak Flow Estimate* (gpm)	Potential to Gravity Service or Combine with Future Lift Station
Wasatch Mental Health	50	High
Veterans Home	58	High
Arrowhead Park	0	Low
Rite-Aid	8	Low
400 W	0	Low
Rosewood Estates	51	High
Mountain View Hospital	54	High
Stadium Cinemas	16	Medium

*Peak flow estimated using billing data and State of Utah Small Area Peaking Factor. Lift stations with no flow are relatively new stations for which flow records do not yet exist.

FUTURE SYSTEM ANALYSIS

Pipelines

Figures 5-2 and 5-3 show the hydraulic performance as calculated by the hydraulic model for sewer flows as projected through full buildout conditions. These results are based on the existing system assuming no improvements are made. These results assume that sewer flows associated with future development will flow to the nearest manhole in the existing system. While the majority of the system under buildout conditions has ample capacity, some significant deficiencies have been observed in the model results:

- Existing Deficiencies – Existing deficiencies east of I-15 and on 300 West and 600 West become just a little bit more severe under future conditions.
- West Outfall – The City's westernmost outfall is woefully under capacity to meet projected growth in the areas South and West of the City's current corporate boundaries. Deficiencies in this trunkline start near the southern boundary of the City and extend all the way to the newly constructed 36-inch pipeline that extends to the City's wastewater treatment plant. Figures 5-2 and 5-3 help identify how soon some of the deficiencies will occur.

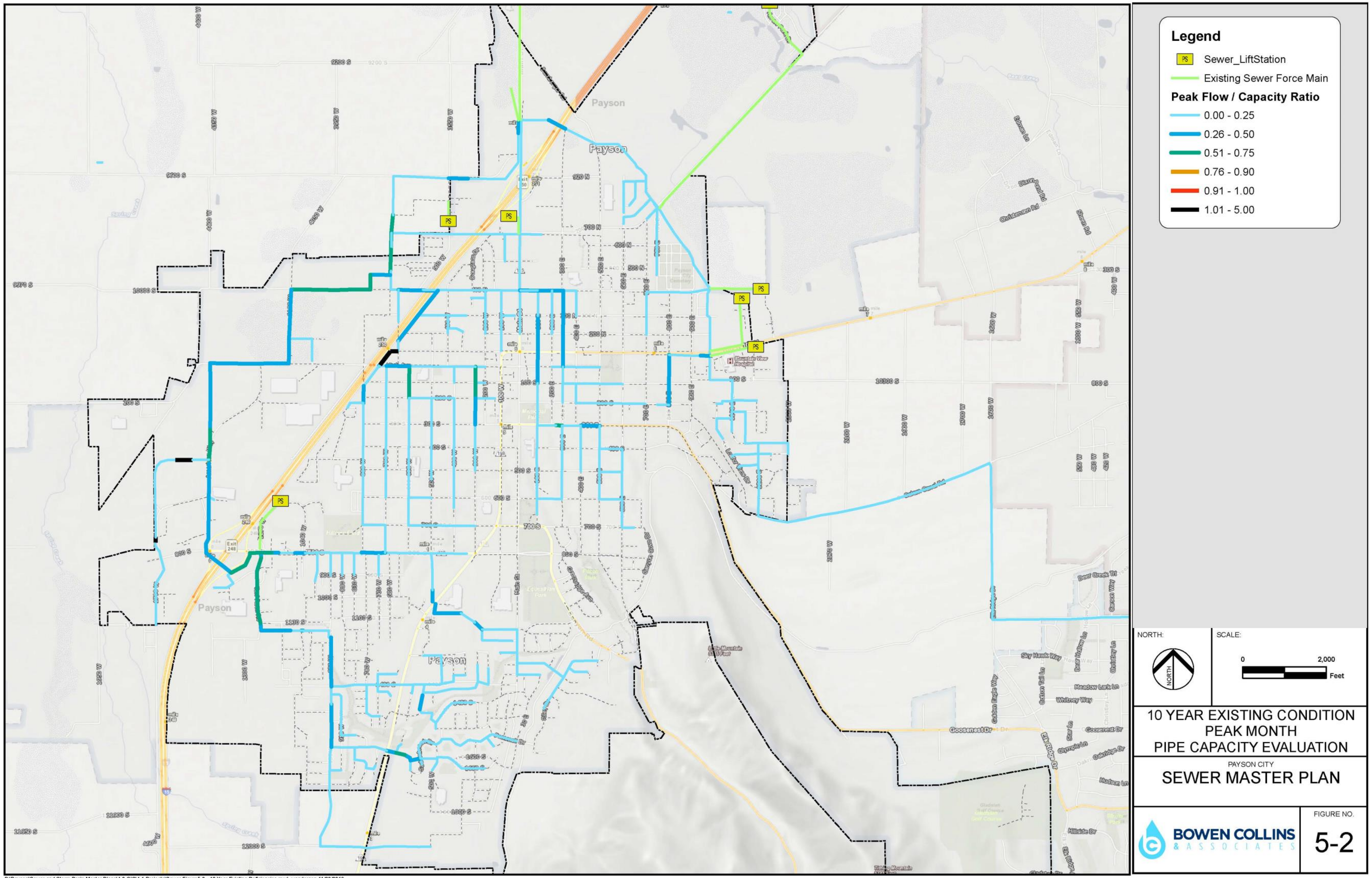

Figure 5-2. 10 Year Existing Condition Peak Month Pipe Capacity Evaluation

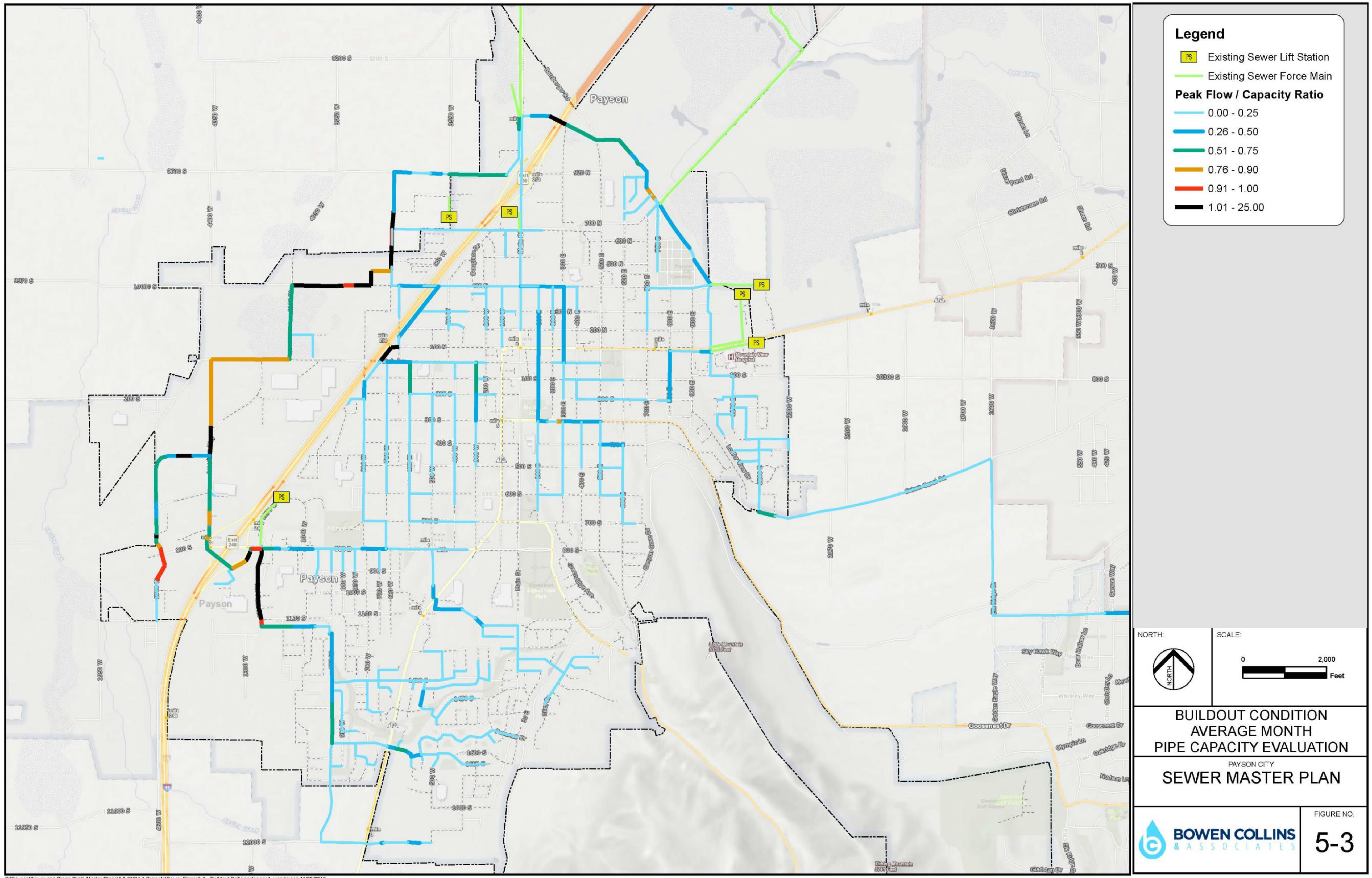

Figure 5-3. Buildout Condition Average Month Pipe Capacity Evaluation

Lift Stations

Table 5-3 lists the design capacity of the City's Wasatch Mental Health Lift Station and the estimated peak flow at buildout to the lift station.

Table 5-3
Lift Station Design Capacity

Name	Design Capacity (gpm)	Peak Flow Estimate at Buildout* (gpm)
Wasatch Mental Health	600	450

*Peak flow estimated using projected densities in the general plan and 10-State Standard Peaking Factor

As can be seen in the table, existing capacity appears to be adequate to meet projected future demands.

CONCLUSIONS

Outside of the West Outfall, the City's existing sewer system performs admirably well under both existing and future loading conditions. Within the heart of the City, it does not appear that many improvements will be needed from a capacity standpoint.

Unfortunately, this does not mean that the City will not need to make major investments in its sewer system:

- Building capacity for growth along the West Outfall will require at least one new major outfall.
- Most of the areas of potential future growth are located in areas that cannot be served by gravity using pipelines in the existing system. This means the City will need to build several new lift stations to serve future growth.
- Outside of capacity needs, the City has an aging system that will eventually need additional investment in rehabilitation and replacement of existing pipelines.

Chapter 6 - System Improvements

The hydraulic model results presented in Chapter 5 have identified potential deficiencies in the sewer system under existing and build-out conditions. The purpose of this chapter is to identify system improvements intended to solve these deficiencies as the City approaches build-out.

COLLECTION SYSTEM CAPACITY IMPROVEMENTS

System improvement projects have been identified to resolve hydraulic deficiencies and serve the needs of future growth as identified in Figure 6-1. In reviewing this figure, the following should be noted:

- The identified projects include only the major, system level sewer trunk lines to serve the City. It is assumed that project level pipelines will be constructed by development as growth occurs.
- Project numbers in this chapter have been assigned by location and do not represent project priority. The priority and timing of each project will be discussed later in this chapter. This will include a discussion of remaining available capacity in each pipeline and triggers necessitating projection construction.
- Pipeline diameters provided here are approximations based on existing pipeline slopes (for replacement of existing pipes) or available surface topography (for new pipes). Once detailed design of the sewer mains commences, the designer should verify the appropriate diameter to provide capacity for projected build-out flows.

Detailed descriptions of each recommended project are as follows:

Project 1 – 2019 Sewer Trunkline Replacement Project – This project was under construction as the master plan was being completed. An existing sewer trunkline on the west side of the City's collection system experienced a failure in late 2018. The City prepared a new design to replace and upsize the existing trunkline from approximately 800 North 700 West (existing manhole #555) to Main Street by the wastewater treatment plant (existing manhole #891) The replacement pipe design increases the pipe size to 36-inch pipe and will be completed in late 2019. It should be noted that all results shown in Chapter 5 are based on this pipeline already being in place.

Project 2 – I-15 East, 400 North to Utah Avenue – There are several pipes in the existing sewer collection line east of I-15 between 100 North and Utah Avenue that exceed the City's design criteria under existing conditions. The deficient pipes should be increased in size along with pipes directly downstream to avoid maintenance concerns. The improvement extent includes upsizing existing 8-inch and 12-inch pipe to 15-inch from Utah Avenue (existing manhole #459) to 400 North and crossing under I-15 to 600 West (existing manhole #453).

Project 3 – East Outfall to WWTP – The City will need to upsize the pipes leading to the wastewater treatment plant from the east. There is an existing 15-inch pipe that crosses I-15, which acts as a bottleneck for the collection system on the east side of the City. This includes the I-15 crossing, beginning at existing manhole #13 and ending at the outfall the treatment plant (manhole #891). This project is not needed within the next 10-years based on existing growth projections, but will be needed by buildout. Existing pipes will need to be upsized from 15-inch and 27-inch to 30-inch. The I-15 crossing itself may need to be constructed with multiple barrels depending on crossing design requirements. This project could be constructed in two phases with the first phase being the upsizing of the 15-inch bottleneck.

Project 4 – American Way, 400 South to 800 North – The City will eventually need to upsize the trunkline on the west edge of the City starting at approximately 400 South & American Way (existing manhole #531) and continuing to where the 2019 Sewer Trunkline Replacement Project ended (existing manhole #555). This improvement project will likely need to be built in phases, but will not be required within the next 10-years based on the City's general plan growth distribution projections.

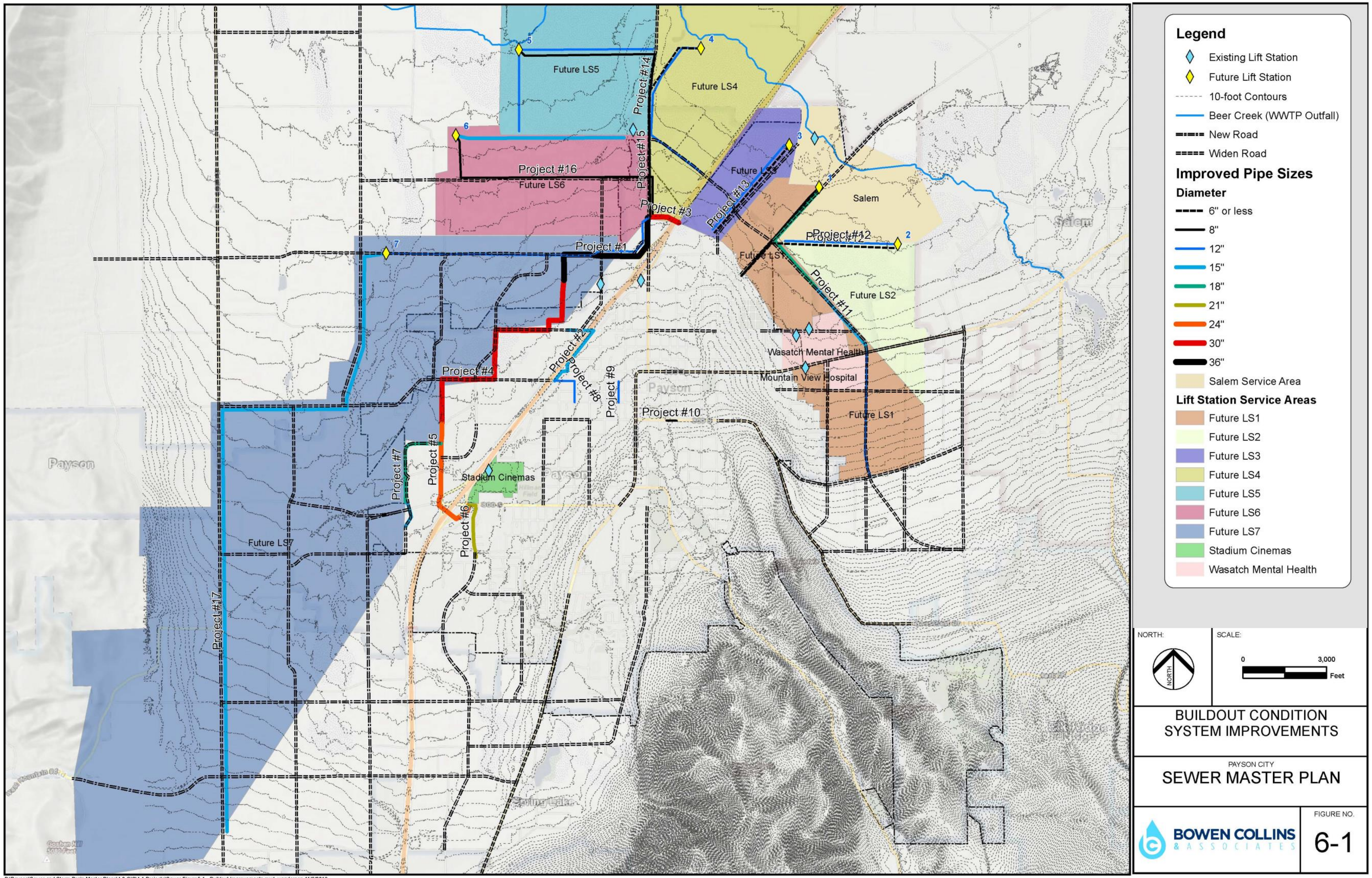

Figure 6-1. Buildout Condition System Improvements

Project 5 – American Way, 800 South to 400 South – The City will eventually need to upsize the trunkline on the west edge of the City starting at approximately 800 South & 1300 West (existing manhole #971) and continuing to 400 South & American Way (existing manhole #531). This improvement project will likely need to be built in phases, but will not be required within the next 10-years based on the City's general plan growth distribution projections.

Project 6 –Turf Farm Road, 1150 South to 800 South – The City will eventually need to upsize the existing sewer pipeline starting from existing manhole #573 on 1150 South & Turf Farm Road and continuing to 800 South & 1300 West (manhole #971). This project will not be required within the next 10-years based on the City's general plan growth distribution projections.

Project 7 –1700 West, 1130 South to 400 South – The City will eventually need to upsize the existing sewer pipeline starting from approximately 1130 South & 1700 West (manhole #470) and continuing to 400 South & American Way (existing manhole #1164).

Project 8 – 600 West, 200 South to Utah Ave – The existing 6-inch pipes from 200 South (manhole #120) to Utah Ave (manhole #1085) along 600 West exceed 50 percent capacity under existing dry weather conditions. Because peak flow depths are less than 65 percent of the pipes' diameter and there is little potential growth upstream of this section of pipe, this improvement project has been considered a lower priority improvement project.

Project 9 – 250 West, 200 South to Utah Ave – The existing 6-inch pipes from 200 South (manhole #86) to Utah Ave (manhole #84) along 600 West exceed 50 percent capacity under existing dry weather conditions. Because peak flow depths are less than 65 percent of the pipes' diameter and there is little potential growth upstream of this section of pipe, this improvement project has been considered a lower priority improvement project.

Project 10 – 300 South, 300 East to 200 East – The City will eventually need to upsize the existing 6-inch sewer pipeline starting from 300 East (manhole #288) to 200 East (manhole #289) on 300 South. Because peak flow depths are less than 65 percent of the pipes' diameter and there is little potential growth upstream of this section of pipe, this improvement project has been considered a lower priority improvement project.

LIFT STATION SERVICE AREAS

Payson currently only has one City-owned lift station (Wasatch Mental Health). As growth continues in areas significantly east or west of existing collection lines within the City, additional lift stations will need to be constructed to facilitate development because topography is either too flat to gravity fall to the City's wastewater treatment plant or the terrain slopes away from existing gravity collection lines. To minimize the number of long-term lift stations and force mains that the City needs to operate and maintain, BC&A and City personnel have identified a few locations to construct regional wastewater lift stations as identified in Figure 6-1. Although the precise lift station service areas boundaries and lift station locations may shift somewhat as part of detailed design of the lift station, the approximate service area characteristics are summarized in Table 6-1.

Table 6-1
Lift Station Service Area Characteristics

Service Area	Timeframe	Approximate Service Area (acres)	Future Number of ERCs Served[2]	Required Capacity[3] (gpm)
[1]Lift Station Area 1	2020	687	4,110	1,540
Lift Station Area 2	Beyond 10 Years	324	1,150	680
Lift Station Area 3	Beyond 10 Years	226	830	550
Lift Station Area 4	2021	961	5,200	1,790
Lift Station Area 5	Beyond 10 Years	643	1,500	810
Lift Station Area 6	Beyond 10 Years	633	1,750	890
Lift Station Area 7	Beyond 10 Years	3,888	6,700	2,100

[1]Lift Station Area 1 includes absorbing the service areas of the following lift stations: Wasatch Mental Health, Rosewood Estates, and Mountain View Hospital.
[2]A 10 percent factor has been added to future ERCs from general plan values to accommodate potential shifting of service area boundaries during design.
[3]Required dry weather capacity calculated based on State of Utah Small Area Peaking Factor. Includes a 15 percent safety factor to account for deterioration of mechanical equipment over time.

In general, the lift station service areas have been numbered sequentially counterclockwise around the City's wastewater treatment plant. Each lift station service area is described below.

- **Lift Station 1 –** The area north of Salem Canal Road and east of the City's existing collection system will need to be lifted to be treated at the City's wastewater treatment plant. The best location to construct a regional lift station for this area would be near Beer Creek and Arrowhead Trail road. A new gravity main will be constructed in the future Nebo Beltway to collect areas to the south and west. To reduce long term maintenance costs, the existing Wasatch Mental Health, Rosewood Estates, and Mountain View Hospital lift stations could be decommissioned and conveyed to this larger regional lift station. It should be noted that the area adjacent to Beer Creek includes wetlands. Dewatering costs to construct a lift station at this location are anticipated to be higher than average. For short-term planning, continuing to use the existing WMH lift station may be the most expedient for developers. However, the long-term recommendation will be to convey all flow to the recommended Lift Station 1 location.

- **Lift Station 2 –** This area is intended to collect areas to the east of the future Nebo Beltway road that cannot gravity flow to Lift Station 1.
- **Lift Station 3 –** Due to the relatively shallow slope of the area near Beer Creek, it is assumed an additional lift station to service the area approaching Beer Creek on the east side of I-15 will be needed. Based on the wetlands in the vicinity of Beer Creek, dewatering costs to construct a lift station at this location are anticipated to be higher than average.
- **Lift Station 4 –** The topography of the area between I-15 and Main Street (3200 West County coordinate) and north of the treatment is a small valley with 3200 West and I-15 being high points. The area north of Beer Creek slopes mostly south and west toward Beer Creek and the area south of Beer Creek slopes north. The lift station is shown near the lowest point of the area that is not in Beer Creek. Based on the wetlands in the vicinity of Beer Creek, dewatering costs to construct a lift station at this location are anticipated to be higher than average.
- **Lift Station 5 –** The northwest area of the City closest to Beer Creek will need a lift station to convey flow back to the City treatment plant. Based on the wetlands in the vicinity of Beer Creek, dewatering costs to construct a lift station at this location are anticipated to be higher than average.
- **Lift Station 6 –** This lift station is located west of the City's wastewater treatment plant. The area at this location cannot gravity flow to Lift Station 5.
- **Lift Station 7 –** This lift station will serve all of the areas to the south and west of the City that cannot be collected by gravity into its existing trunk lines.

In association with each lift station, the City will need to build gravity outfalls to each lift station and a force main back to the main City outfalls to the treatment plant. These are also shown in Figure 6-1. I will be noted that only the most critical outfall for each lift station has been shown in the figure. While it is expected that there will be many other collection lines and outfalls within each lift station, there is not enough planning information at this point to provide any meaningful guidance on the location or size of these facilities. Details for each lift station area should be added as additional planning information becomes available.

Because many of the lift stations will potentially have parallel force mains (Lift Stations 1-2 and well as Lift Stations 4-6), the City might consider constructing some of the force mains simultaneously to avoid duplicate efforts for future projects.

IMPORTANCE OF LIFT STATION SERVICE AREA BOUNDARIES

To summarize the section above, a very large portion of the developable area in Payson City cannot be currently served by gravity sewer lines in the City. In order to meet future development needs, this master plan lays out a limited number of lift stations to serve those areas that will need to be pumped. While this approach provides the best performing system for the lowest long-term cost to the City, it does require some large initial investments to facilitate even small developments below the City's existing gravity system.

Because of the large initial investment required to build the recommended regional lift stations, it is expected that many developers will approach the City with proposals to build smaller lift stations serving just their developments that connect into the closest gravity pipeline. This approach is not recommended. If the City allows developers to significantly deviate from the master planned lift station areas, two major consequences are expected:

- Exponential Increase in Lift Station Maintenance Costs – The City has been fortunate thus far to only own and operate one lift station. For many providers maintaining lift stations is one of the most costly aspects of running their sewer system. Even with the optimization contained in this report, the City is projected to eventually have 7 additional lift stations. Allowing individual developers to build their own lift station could result in this number ballooning to dozens more. In some cases, developers will propose making the lift station private, but very few property owners are well equipped to handle the cost and complexity of operating a lift station in the long run. It has been our experience that most of these “private” lift stations end up being pushed back to the City after citizens tire of a series of failures.

- Loss of Capacity for Upstream Properties – The current master plan is based on the City following the plan for the lift station service areas. If properties are allowed to connect into existing gravity lines at locations other than those planned, the connections will use up needed capacity in the pipelines, potentially necessitating moratoriums on upstream development that could otherwise be accommodated in the pipelines.

For these reasons, it is strongly recommended that the City follow the plan and not allow any development in the lift station service area boundaries until the regional lift stations are constructed. Developers can either wait for the stations to be completed by the City as funds become available or can finance the improvements by developing reimbursements agreements with the City.

SUMMARY OF RECOMMENDED IMPROVEMENTS

Table 6-2 summarizes the cost estimates of gravity trunk lines and force mains needed to serve buildout growth. See Figure 6-1 for the locations of the recommended improvements.

Table 6-2
Proposed Collection System Improvements

Project Number	Year Needed	Project Description	Average Pipe Diameter[2] (inch)	Length (ft)	Total Construction Cost Estimate	Engineering / Admin (15 Percent)	Total Project Cost Estimate
1	2019	2019 Sewer Trunkline Replacement[1]	36	5,161	$2,233,000	$285,000	$2,518,000
2	2020	I-15 East, 400 N to Utah Ave	15	3,336	$1,154,000	$173,000	$1,327,000
3	2040	East Outfall to WWTP	30	1,099	$631,000	$95,000	$726,000
4	2040	American Way, 400 S to 800 N	30	9,394	$5,360,000	$804,000	$6,164,000
5	2040	American Way, 800 S to 400 S	24	4,419	$2,020,000	$303,000	$2,323,000
6	2040	Turf Farm Road, 1150 S to 800 S	21	2,150	$903,000	$135,000	$1,038,000
7	2040	1700 W, 1130 S to 400 S	18	4,238	$1,585,000	$238,000	$1,823,000
8	2040	600 W, 200 S to Utah Ave	10	2,960	$866,000	$130,000	$996,000

Project Number	Year Needed	Project Description	Average Pipe Diameter[2] (inch)	Length (ft)	Total Construction Cost Estimate	Engineering / Admin (15 Percent)	Total Project Cost Estimate
9	2040	250 W, 200 S to Utah Ave	10	756	$221,000	$33,000	$254,000
10	2040	300 S, 300 E to 200 E	8	372	$103,000	$15,000	$118,000
11	2021	Lift Station 1[3]			$2,000,000	$300,000	$2,300,000
11.1	2021	Lift Station 1 Gravity	15	12,250	$3,210,000	$482,000	$3,692,000
11.2	2021	Lift Station 1 Pressure Force Main	8	4,240	$1,174,000	$176,000	$1,350,000
12	2040	Lift Station 2			$800,000	$120,000	$920,000
12.1	2040	Lift Station 2 Gravity	12	4,046	$876,000	$131,000	$1,007,000
12.2	2040	Lift Station 2 Pressure Force Main	6	6,273	$1,211,000	$182,000	$1,393,000
13	2040	Lift Station 3[3]			$1,000,000	$150,000	$1,150,000
13.1	2040	Lift Station 3 Gravity	10	4,158	$852,000	$128,000	$980,000
13.2	2040	Lift Station 3 Pressure Force Main	6	4,155	$802,000	$120,000	$922,000
14	2025	Lift Station 4[3]			$2,300,000	$345,000	$2,645,000
14.1	2025	Lift Station 4 Gravity	12	6,356	$1,962,000	$294,000	$2,256,000
14.2	2025	Lift Station 4 Pressure Force Main	6	7,186	$1,989,000	$298,000	$2,287,000
15	2040	Lift Station 5[3]			$1,500,000	$225,000	$1,725,000
15.1	2040	Lift Station 5 Gravity	12	7,722	$1,673,000	$251,000	$1,924,000
15.2	2040	Lift Station 5 Pressure Force Main	8	10,786	$2,082,000	$312,000	$2,394,000
16	2040	Lift Station 6			$1,600,000	$240,000	$1,840,000
16.1	2040	Lift Station 6 Gravity	15	6,028	$1,504,000	$226,000	$1,730,000
16.2	2040	Lift Station 6 Pressure Force Main	8	9,767	$1,886,000	$283,000	$2,169,000
17	2040	Lift Station 7			$2,500,000	$375,000	$2,875,000
17.1	2040	Lift Station 7 Gravity	15	25,954	$6,474,000	$971,000	$7,445,000

Project Number	Year Needed	Project Description	Average Pipe Diameter[2] (inch)	Length (ft)	Total Construction Cost Estimate	Engineering / Admin (15 Percent)	Total Project Cost Estimate
17.2	2040	Lift Station 7 Pressure Force Main	10	10,477	$2,146,000	$322,000	$2,468,000
		Total			**$54,617,000**	**$8,142,000**	**$62,759,000**

[1] Project currently under construction. Construction cost shown is the bid cost for construction.
[2] The project numbers shown include multiple pipe diameters in some cases. Average pipe diameter is intended to represent the majority of pipes.
[3]Cost estimates include higher than average dewatering costs based on needed lift station location.

PROJECT TIMING AND TRIGGER POINTS

Included in Table 6-2 is an estimate of the needed timing of improvements based on current growth and development projections. However, it is obvious that actual growth could be very different than projections (either faster or slower) depending on a whole host of economic issues. To assist city personnel in adjusting project timing in the future, “trigger points” have been calculated for many of the major projects above. Trigger points represent the amount of development that can take place upstream of a project before the capacity of the existing facility is exceeds and the City needs to take action. Trigger points for collection system capacity improvements associated with existing pipes are provided in Table 6-3.

Table 6-3
Collection System Capacity Improvements Trigger Points

Project No.	Existing Peak Flow (gpm)	Trigger Point Flow (gpm)*	Remaining Upstream ERCs to Reach Trigger Point
2	315	135	0
3	533	1470	3,672
4	1500	2400	3,527
5	1460	2475	3,977
6	365	500	1,509
7	55	300	1,548
8	113	200	733
9	87	75	100
10	125	84	4

*****Based on when peak flow reach 65 percent depth in pipe regardless of pipe size.

Shown in the table is the existing peak flow rate that is seen in the existing pipe, the trigger point flow rate where flow will exceed the capacity of the existing pipe, and the number of ERCs that are remaining from existing conditions to reach the trigger point flow rate. The trigger point flow rate is based on 65 percent depth in the pipeline (which equates to 75 percent of the full capacity of the existing pipe).

It is worth noting that Projects No. 9 & 10 are both located in areas of the City that have little potential for additional growth. So, while both pipes have little capacity remaining, both are not expected to hit their trigger point flow for many years. If redevelopment in their service areas occurs sooner, these projects may need to be expedited.

It is also worth noting that none of the future lift station projects (Projects 11 through 17) are included in the trigger point table. This is because these lift stations are all associated with new service areas. The timing of each project will need to coincide with adding any development into the new service areas.

Finally, please note that one additional tool has been included to assist in evaluating available capacity and future project timing. Appendix C includes a map book with detailed model results for all the modeled pipelines in the City. Included in the results are the rated capacity[1], the existing peak flow, and the projected future flow at buildout for each pipeline.

TREATMENT PLANT PROJECTS

In addition to the collection system improvements identified in this master plan, the City is also aware of some required treatment plant projects to maintain existing capacity or improve the level of service at the City's treatment plant. The costs of these projects were not available as part of this study, but are expected to be developed in detail as part of an upcoming treatment plant facility plan. Because the City has remaining capacity for the next 10-years, most project are anticipated to be maintenance related or potentially increases in level of service projects.

ADDITIONAL PLANNING PROJECTS

In addition to the capital projects identified, the City should budget costs to more regularly update planning documents. Based on the large amount of undeveloped area around the City and the fast pace of development, the City should update its planning documents at least every

[1] At 75% or 50% of full flow capacity as appropriate for pipe diameter.

three years to keep up with growth projections and costs. Estimated costs for recommended planning documents are listed in Table 6-4.

Table 6-4
Planning Projects

Project No.	Projected Year of Study	Project Name	Total Cost in 2019 Dollars
PP1	2020	Treatment Plant Facility Plan Study	**$75,000**
PP2	2022	Sewer Master Plan, IFFP, IFA Update	**$50,000**
PP3	2025	Sewer Master Plan, IFFP, IFA Update	**$50,000**
PP4	2028	Sewer Master Plan, IFFP, IFA Update	**$50,000**

POTENTIAL CAPITAL IMPROVEMENT PROJECT FUNDING SOURCES

As part of this master plan, the City asked BC&A to provide information regarding potential capital improvement project funding sources to fund the proposed improvements identified in this report. Funding for wastewater capital improvement projects is generally more limited than funding for many other types of projects. From past experience and research, the following is a summary of potential wastewater capital improvement project funding sources and information that should be noted about each source:

- **EPA's Water Infrastructure Finance and Innovation Act (WIFIA)** – WIFIA is a federally funded loan that can finance up to 49% of a selected project that meets the program's requirements. Eligible wastewater projects for communities of Payson's size (population of 25,000 or less) must have a project cost of greater than $5 million. WIFIA funding could definitely be used for Payson City's proposed wastewater treatment plant projects. Some wastewater collection system projects may also be eligible. NEPA environmental clearances, Davis-Bacon wages, American Iron and Steel requirements, and all other federal cross-cutter provisions will need to be met for any projects using this funding.
- **EPA's Clean Water and Drinking Water State Revolving Fund (SRF)** – SRF is a federally funded program administered at the State level. This program provides financial assistance primarily through below market loans, but also through purchase of debt or refinancing, loan guarantees, and even some grants for "hardship communities". Hardship communities are those where the cost of service is greater than 1.4% of the

median household income. Payson City's current sewer rates are only about half this amount. Thus, the City would not qualify for grant funding but could likely qualify for a low interest loan.

To qualify for funding, a project must result in a water quality benefit. Thus, eligible wastewater projects generally include wastewater treatment plant projects and some wastewater collection system projects. Most of the funding for this program comes from federal sources. As a result, NEPA environmental clearances, Davis-Bacon wages, American Iron and Steel requirements, and all other federal cross-cutter provisions will need to be met for any projects using this funding. However, some small projects can be funded exclusively through State money, in which case some of these provisions may not be required.

- **USDA's Water and Waste Disposal Loan and Grant Program** – This USDA funding provides loans and grants to rural cities, towns, and water districts to fund drinking water, stormwater drainage, and waste disposal systems in rural communities. Unfortunately, funding is limited to communities with 10,000 or fewer residents. Payson City's service area consists of too many residents to be eligible for this funding source.

Chapter 7 - System Maintenance Plan

Previous chapters of this report have identified improvements to resolve existing deficiencies and to accommodate wastewater flow from future growth while providing an acceptable level of service. However, installing a quality system will be of limited value unless it is maintained correctly. The purpose of this chapter is to identify recommended operation and maintenance activities for the City to maintain the system in good working order. This will include recommendations regarding both ongoing maintenance activities as well as recommended system rehabilitation and replacement investment.

SEWER SYSTEM MAINTENANCE ACTIVITIES

Sewer system maintenance activities can generally be divided between pipeline, lift station, and treatment plant activities. Consideration of treatment plant maintenance is beyond the scope of this study, but pipelines and lift station are discussed individually in the following sections.

Recommended Pipe Cleaning Practices

The City currently maintains more than 90 miles of gravity sewer pipelines. Over time, each of these pipeline will see a reduction in capacity as a result of: sediment deposition; accumulation of fats, oils, and greases; tree root infiltration, etc. While City crews do currently clean these pipelines from time to time, establishing some specific goals relative to cleaning could improve the efficacy of the City's cleaning activities. It is recommended that the City's pipeline cleaning program be designed to accomplish the following goals:

- **Improve Data Collection Associated with Cleaning Activities –** Because cleaning is important to avoiding restrictions in pipeline and costly sewer backups, most cities have a goal to clean all their pipelines over a given intervals (usually once a year). However, while cleaning is important and necessary, it can be hard on pipelines. Especially for concrete pipelines experiencing hydrogen sulfide degradation, aggressive cleaning can accelerate wear and shorten the life span of pipelines. Unnecessary cleaning is also a waste of time for City personnel. Thus, a good cleaning program should be designed to clean the pipelines often enough to avoid significant reductions in capacity, but not so often that it unnecessarily damages pipes or wastes City time.

The ideal approach is to establish a clean schedule based on the needs of each pipeline. However, to do this, the City will need to closely track the results of cleaning activities. It is recommended that the City develop a database of cleaning results. This database should record the pipeline inventory number, the date of cleaning, and the amount of sediment or debris encountered during each cleaning event. Once sufficient data is collected, the City will be then able to develop a customized schedule for the cleaning of pipelines. For some pipelines, this may still be once per year (or even more frequently). For others, cleaning may be necessary only once every 10 to 15 years.

- **Establish a Cleaning Baseline –** To initially establish a cleaning database, it is recommended that the City establish a schedule to clean all the pipelines in its system over the next 2 to 3 years. Any pipelines identified as high or medium priority in the City's Asset Management Plan (currently being prepared by BC&A) should be cleaned within no more than 1 year. Lower priority pipelines should then be cleaned. All data should be collected and assembled into a database as described above.
- **Develop and Update a Cleaning Program –** Based on the initial data collected, cleaning intervals should be established for the pipelines in the City. Cleaning results for the next round of cleaning should be recorded and cleaning intervals revised as necessary. Adequate personnel and equipment should be dedicated to staff the identified cleaning program.

Recommended Lift Station Maintenance Practices

The City has not historically had to spend much time maintaining lift stations. There is currently only one City-owned lift station and it is relatively small. In the future, the City will add seven or more major lift stations. Four of these are expected within the next 10 years. Required maintenance of lift stations is exponentially higher than that required for pipelines. In preparation for increased maintenance of lift stations, the following actions are recommended:

- **Standard Operating Procedures –** Develop detailed Standard Operating Procedures (SOPs) that cover maintenance of larger lift stations regular intervals (e.g. daily visits, monthly maintenance activities, annual maintenance activities, etc.).
- **Increase Operations Staff –** Prepared to hire additional staff to meet increased maintenance needs.

SYSTEM REHABILITATION AND REPLACEMENT

In order to assemble accurately project City costs, it is not adequate to consider only capacity related improvements. It is also necessary to budget for the expected rehabilitation and replacement of system components. The City is currently developing an Asset Management Plan for their sewer collection system. The rehabilitation and replacement costs that result from the Asset Management Plan are not included in this master plan, since the Asset Management Plan is not completed. However, this section discusses the importance of accounting for system rehabilitation and replacement in the sewer collection system.

Concrete Pipe Assessment and Rehabilitation

One major category of concern relative to sewer system rehabilitation and replacement is the corrosion of existing concrete pipe. Hydrogen sulfide gas in a sewer system can result in the formation of sulfuric acid (H_2SO_4) on pipe and manhole walls. Sulfuric acid can result in severe corrosion of ferrous metals and concrete. The top of a moist concrete pipe is a common area for the formation of sulfuric acid and corresponding corrosion. This is a significant concern for Payson because most of the City's large diameter collection lines are constructed of concrete pipe. A recent pipe collapse within the City highlighted the need for additional asset management work within the City.

Existing Pipe Inspection Practices

The City does not have a comprehensive video inspection of its entire collection system. Current practices for video inspection include conducting CCTV inspections based on City personnel availability and interest in evaluating specific parts of the collection system. The pipe inspection videos are then uploaded to an online database called Pipeline Observation System Management (POSM) where the videos can be viewed and other attributes of the pipe can be observed (pipe length, pipe diameter, pipe material, date of inspection, pipe identification numbers, and upstream/downstream manhole identification numbers). POSM does not provide the user with an easy way of finding which video corresponds with which pipe in the system. The user has to browse through a long list of videos and carefully look for the pipe identification number to select which video matches the pipe of interest. The POSM software system does not provide a method of commenting or rating pipe deficiencies. As a result, the existing software system has limited ability to document the history of a pipe and allow other users to review pipe condition.

Recommended Pipe Inspection Practices

To prevent future pipe collapses and potential fines from sanitary sewer overflows, it is recommended the City complete a full inspection of all pipes within its collection system. However, it is recommended that the City adopt a uniform method of rating pipe deficiencies and purchase/maintain video inspection software to allow City personnel to rate all pipes that are inspected in the collection system. One program that may be useful for the City to adopt is the NASSCO Pipeline Assessment Certification Program (PACP). A few benefits of the PACP program include the following:

- Nationally recognized system for pipe condition assessment.
- Most video inspection system manufacturers and software systems include options of including PACP coding.
- Uniform training programs are available for City employees.
- PACP coding can be done while video footage is being recorded such that the status or condition of a pipe can be assessed “at a glance” in the City’s GIS database so that extensive review of video footage is not necessary.
- A consistent rating system for City pipes allows the City to evaluate the rate of decline for certain areas of the City. This will potentially allow the City to project or predict when collection system components will need rehabilitation.

There are a number of PACP compatible systems that may be used for assessing the condition of City pipes. The City should adopt one that suits its needs best, purchase any required equipment and software, and train City personnel on its implementation. Once adopted, the City should set a goal to inspect all pipes in its collection system at least once every two years for the next four years. Once two inspections have been completed, the City may consider reducing the frequency of video inspections on some pipelines if it can be determined that pipe conditions are relatively unchanging. The City may need to add employees to be able to implement this recommendation. Video inspections and cleaning will likely require at least one full time employee dedicated to this task. It is worth noting that the costs of a pipe failure and subsequent fines for property damage and fines from sanitary sewer overflows likely significantly exceed the costs for operation personnel.

10-YEAR REHAB PLAN

Once the City has completed one full inspection of the City collection system utilizing a uniform condition assessment program, the City should develop a 10-year plan for system rehabilitation based on the condition assessment and any recommendations from the City's Asset Management Plan.