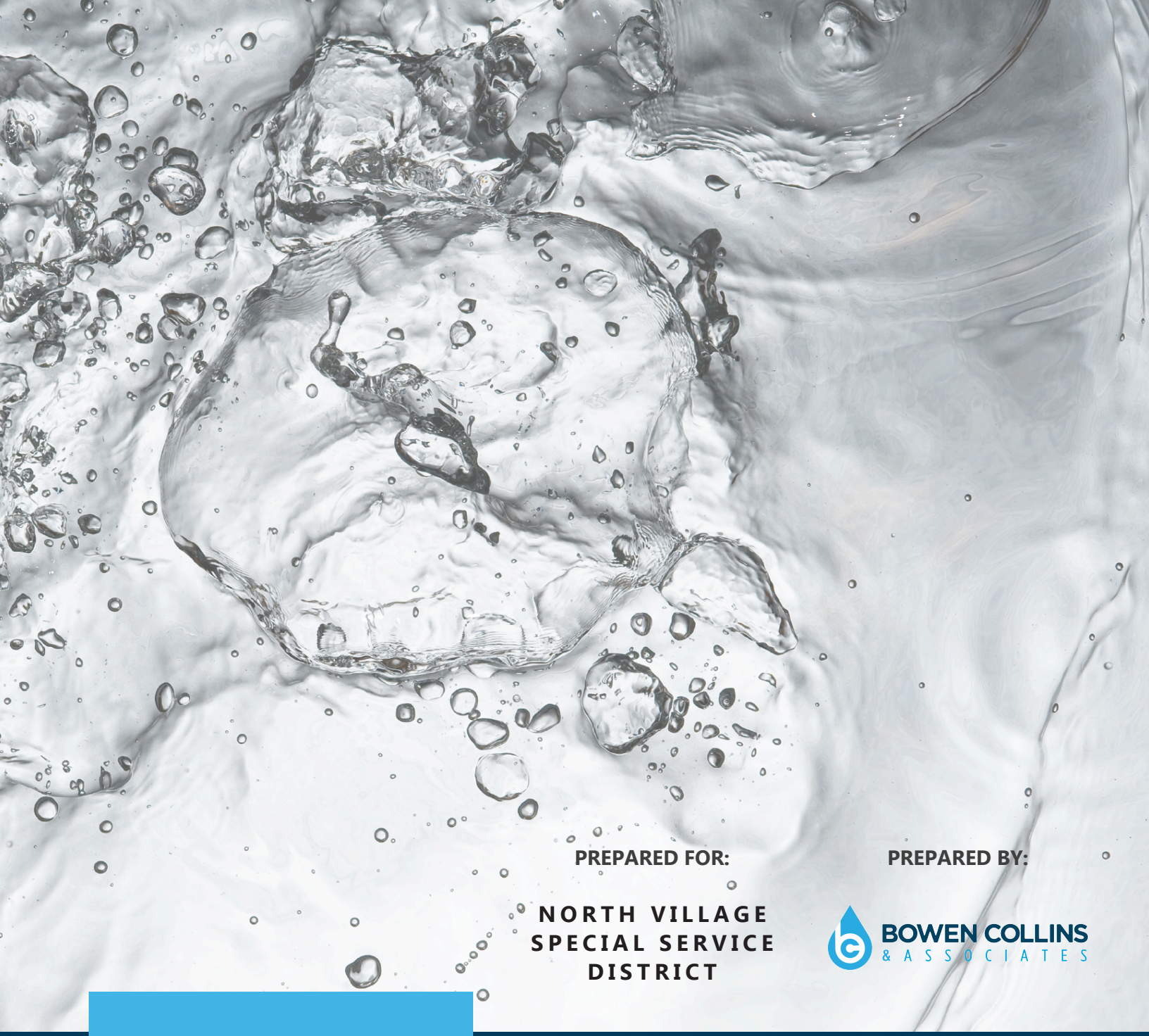

PREPARED FOR:

NORTH VILLAGE SPECIAL SERVICE DISTRICT

PREPARED BY:

BOWEN COLLINS & ASSOCIATES

NORTH VILLAGE SPECIAL SERVICE DISTRICT

SEWER SYSTEM MASTER PLAN

AUGUST 2025

2025 NORTH VILLAGE SPECIAL SERVICE DISTRICT SEWER SYSTEM MASTER PLAN

August 2025

Prepared for:

North Village SSD

Prepared by:

BOWEN COLLINS & ASSOCIATES

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EXECUTIVE SUMMARY

INTRODUCTION

The purpose of this Sewer Master Plan is to provide an implementation plan for recommended improvements to resolve existing and projected deficiencies in the North village Special Service District's (NVSSD / The District) sewer collection system.

PROJECTED FLOWS

To model the District's sewer collection system, it is necessary to project how sewer flows will increase and/or decrease in the future. A sanitary sewer inflow hydrograph consists of two major components: base sanitary flow and infiltration. These two types of flows were calculated using data from the district and applied to growth projections to predict existing and future sewer loading on the NVSSD sewer system.

SEWER COLLECTION SYSTEM EVALUATION

With the development of projected wastewater flows, it is possible to evaluate hydraulic performance of the existing sewer system as well as to identify potential deficiencies using a calibrated sewer model. An existing, 10-year, and buildout condition model was prepared for the District. BC&A analyzed each model to identify proposed projects for the system.

SYSTEM IMPROVEMENTS

Based on the growth projections, flow projections, and sewer model prepared during this analysis, a list of recommended system level projects was produced and is shown in Table ES-1 and Figure ES-1. Additionally, a list of miscellaneous projects was produced and is shown in Table ES-2.

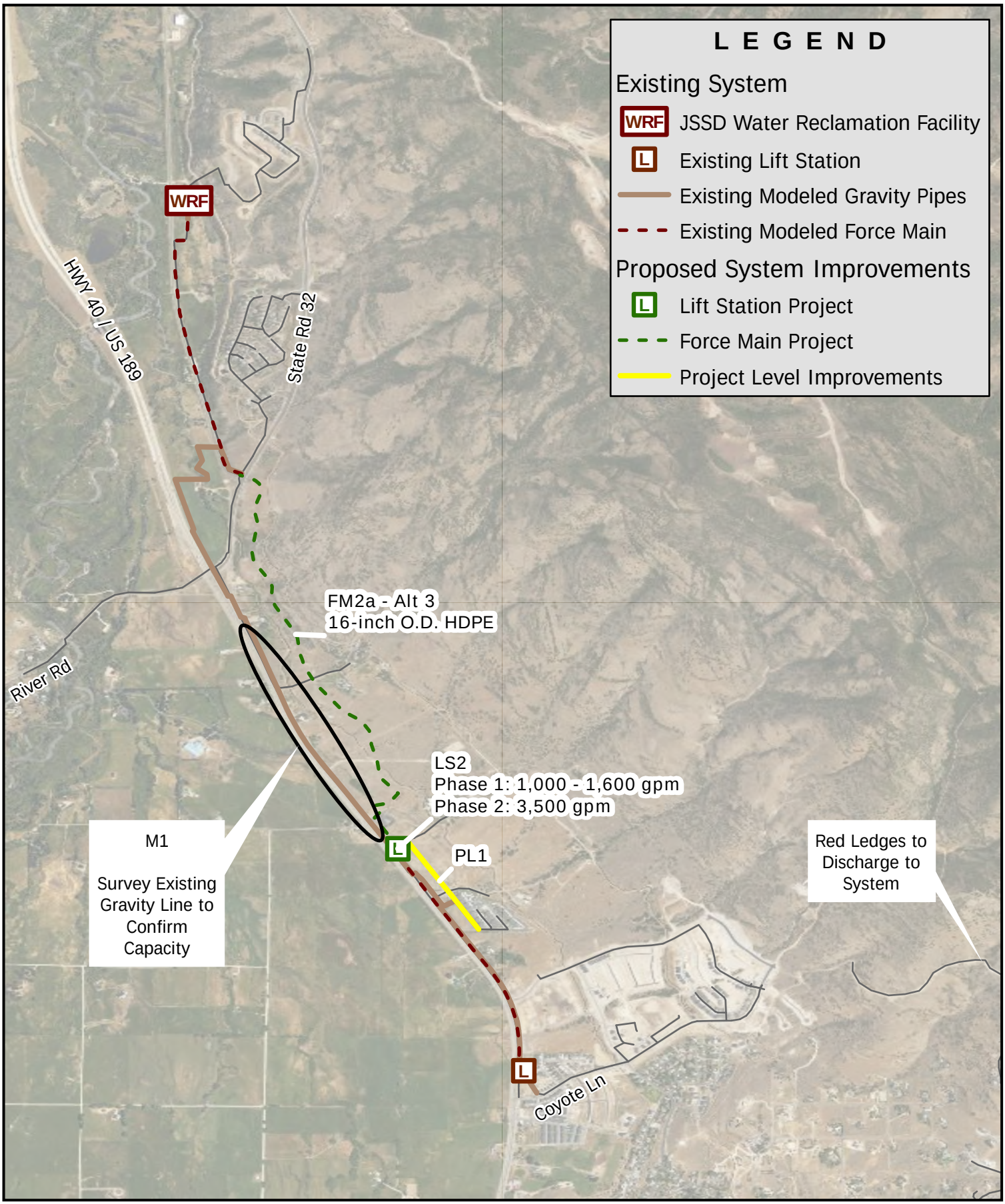
Table ES-1
Recommended System Level NVSSD System Improvements

Project ID	Estimated Construction Year	Project Description	Estimated Total Project Cost in 2025 Dollars
FM2a - Alt 3**	2033	HDPE Force Main from UVU Lift Station to north of HWY 32	$1,679,000
LS2**	2026	Install new UVU lift station	$4,363,000
T1 - Phase 1***	2026	Buy capacity at JWRF	$2,166,000
10-Year Window Total		**-**	**$8,208,000**
T1 - Phase 2***	Ongoing	Buy capacity at JWRF	$15,321,000
Post 10-Year Window Total		**-**	**$15,321,000**

**The cost shown reflects the approximate cost for the entire UVU lift station. Red Ledges is obligated to build a lift station and force main that has capacity for their own ERUs (approximated at $3,194,700 for the lift station and $1,207,400 for the force main) and NVSSD will cover the cost required to increase that capacity to account for NVSSD flows (approximated at $1,168,300 for the new lift station and $471,600 for the force main).
***The costs shown reflect the total equivalent 2025 dollars required to purchase treatment capacity at the JSSD WRF based on the proposed purchasing schedule found within this report. Actual costs will likely change based on a variety of factors discussed in the text.

Table ES-2
Recommended Miscellaneous NVSSD System Improvements

Project ID	Estimated Construction Year	Project Description
M1	2030	Maintenance project to survey the existing gravity system along Highway 40 - this is expected to cost the District under $5,000 (2025 dollars)
PL1	2026	Project level gravity sewer line from Red Ledges to the UVU Lift Station - cost to be sorted out by developers



BOWEN COLLINS & ASSOCIATES

Recommended NVSSD System Improvements

North Village Special Service District

NVSSD Sewer Master Plan

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO. ES-1

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CHAPTER 1
INTRODUCTION AND BACKGROUND

INTRODUCTION

In 2023, North village Special Service District (NVSSD / the District) contracted the services of Bowen, Collins & Associates, Inc. (BC&A) to complete an update to its Sewer System Master Plan which was originally completed by BC&A in 2015. The purpose of this study is to provide NVSSD with an updated plan to maintain a viable and efficient sewer system capable of meeting the expected future demands of its service areas and able to satisfy customer expectations.

NVSSD is situated in Wasatch County and serves an area just north of central Heber City. It was established in 1993 by Wasatch County in response to a request by a group of developers to provide culinary water and sewer services to unincorporated parts of Wasatch County. Currently, it still services some unincorporated parts of Wasatch County, but mostly services areas within the Heber City boundary.

SCOPE OF SERVICES

Since the last master plan was completed, the growth within NVSSD has increased and many improvements have been made to the NVSSD Sewer system. BC&A was retained to complete a Sewer Master Plan which includes the following sub tasks:

Task 1: Collect and review information from previous master plans and analyses. This includes analyzing the existing and future customer base by updating growth projections and estimating sewer demand in addition to collecting and reviewing information on the existing sewer system.

Task 2: Update and calibrate a hydraulic computer model of NVSSD's existing and future sewer distribution system and use it to analyze existing and future operating deficiencies

Task 3: Create a project implementation schedule by using the model to identify alternative system improvements while considering project costs.

Task 4: Developed a water system capital facilities plan using the completed analysis and stakeholder input.

Task 5: Hold up to three progress meetings with the District and thereby vet and coordinate the master plan projects and recommendations with District staff.

Task 6: Prepare information provided in the prepared capital facilities plan to be used in a future sewer impact fee facilities plan and sewer impact fee analysis.

ACKNOWLEDGEMENTS

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

Max Covey	General Manager
Dave Fuller	Assistant General Manager
Chance Morris	Water Distribution Manager
Drew Robinson	JSSD Sewer Treatment Manager

PROJECT STAFF

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

Keith Larson	Principal-In-Charge
Justin Dietrich	Project Manager
Emily Fica	Project Engineer

REPORT ASSUMPTIONS

As a long-term planning document, this report is based on a number of assumptions relative to future growth patterns, service area expansion (or lack thereof), and source availability. Of special significance to the District are a number of assumptions relative to conservation and development densities. If any variables are significantly different than what has been assumed, the results of this report will need to be adjusted accordingly. Because of these uncertainties, this report and the associated recommendations should be updated every four to six years or sooner if significant changes occur such as annexation or changes in development patterns.

CHAPTER 2
DEMAND PROJECTIONS

INTRODUCTION

To plan for the future, it is necessary to project future increases in sewer demand. The NVSSD service area has experienced a high rate of growth in the last few years. This high rate of growth is expected to continue because there is still considerable space for more development and because current applications and plans for new development are extensive. Expected growth consists of filling in the active service area with new development, as well as development and growth outside of the currently active service area. The purpose of this chapter is to summarize the work that was performed to estimate the sewer service needed to meet both existing and future customer demands.

DEMAND PROJECTION METHODOLOGY

There are several methods that can be used to estimate future sewer needs. This study develops demand projections based on the general plan that has been adopted by Wasatch County as well as real planning documents from upcoming developments. The methodology used in this study is as follows:

1. Define the service area.
2. Project the growth of the number of equivalent sewer connections for the study area through build-out based on County's General Plan and on currently available land development plans.
3. Convert projections of connection growth to a system sewer demand based on historic per connection demand.

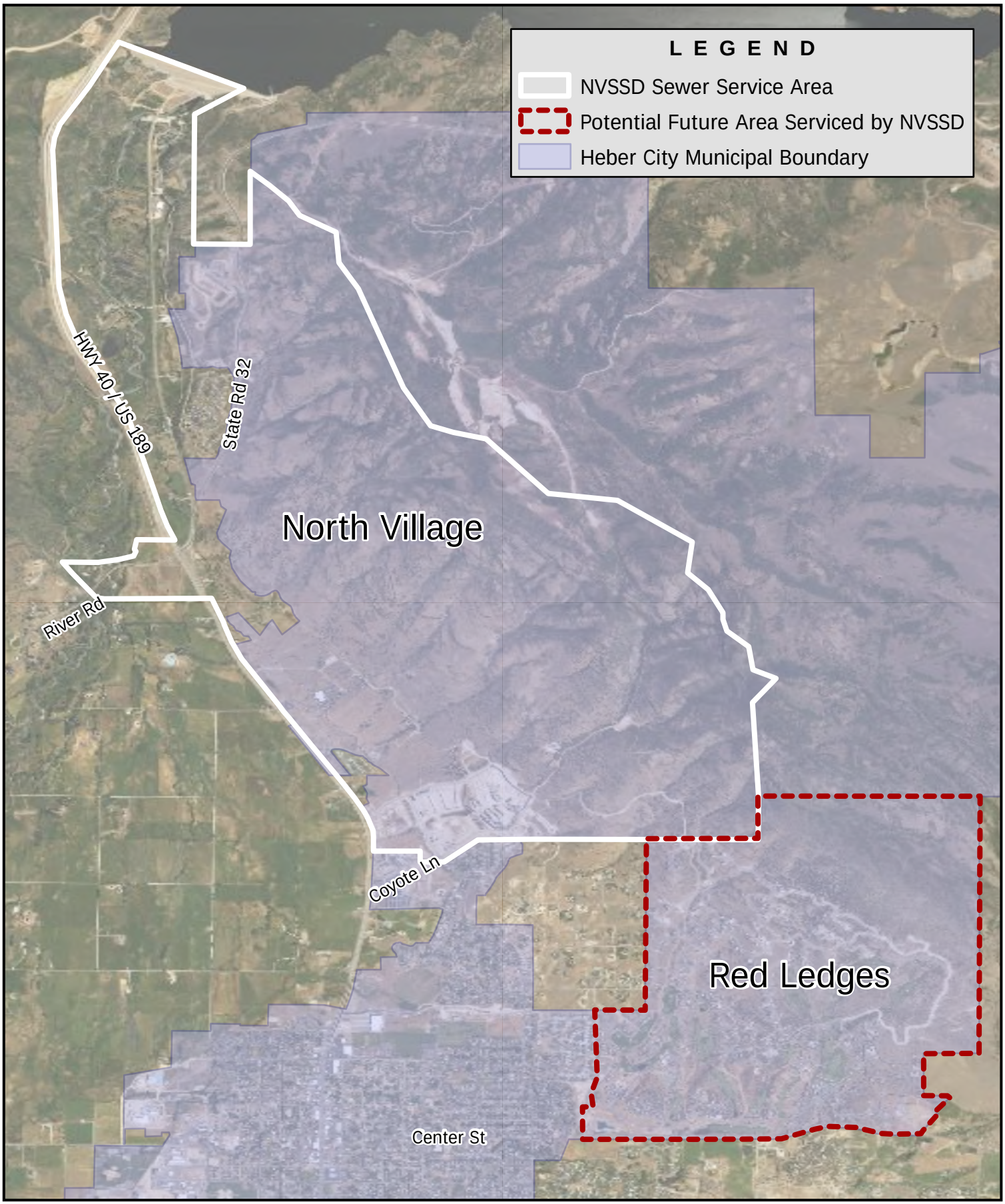
Each step of this process is summarized in the sections that follow.

SERVICE AREAS

The NVSSD sewer system boundary is shown in Figure 2-1. The sewer system boundary contains areas which are currently being served or are planned to be served by NVSSD. The majority of the sewer system serves area within the Heber City municipal boundary, with some of the area being unincorporated land within Wasatch County north of Heber City.

The areas which are currently served, or planned for service in this Master Plan, consist of the following two service areas: the North village area and the Red Ledges area. Some of the key characteristics of each area are described briefly as follows:

- *North Village.* The North Village sewer system serves mostly area within the Heber City municipal boundary as well as some area in unincorporated land within Wasatch County and north of Heber City. Within the sewer service area is a small section of unincorporated county west of Highway 40 that used to be served by NVSSD, but that currently flows to Heber Valley Special Service District (HVSSD) to be treated. Otherwise, the entire area is conveyed to the NVSSD system and then eventually it reaches the Jordanelle Special Service District (JSSD) Water Reclamation Facility (WRF).
- *Red Ledges.* Outside of the current NVSSD system boundary is a development area known as Red Ledges. Red Ledges is a development which began construction over a decade ago and continues to add units each year. Since the development began construction, its effluent has been temporarily allowed to flow through Twin Creeks Special Service District (TCSSD) to be treated at the HVSSD treatment facilities. However, no permanent capacity has been secured at HVSSD treatment facilities, in the Heber City conveyance facilities, or in the TCSSD conveyance system for Red Ledges flow. Therefore, Red Ledges' agreements commit the development to sending their flows through the NVSSD conveyance system and to the JSSD WRF and constructing the necessary improvements required to do so. Necessary improvements for this flow transfer are identified in Chapter 5 below.



BOWEN COLLINS & ASSOCIATES

NVSSD System Boundaries

North Village Special Service District

NVSSD Sewer Master Plan

NORTH:

SCALE: 0 2,000 4,000 Feet

FIGURE NO. 2-1

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SEWER CONNECTION UNITS

Development in NVSSD is quantified using an Equivalent Sewer Connection Unit (SCU). SCUs are a way to provide a common unit of measurement for both residential and non-residential development. SCUs in NVSSD are based on average wastewater production for a typical residential unit within the District.

EXISTING DEVELOPMENT

In June of 2023, the NVSSD active sewer service area had 390 SCUs. Table 2-2 shows the breakdown of these connections per area. These counts were taken from 2023 billing data provided by the District. Therefore, the basis of existing system conditions in this master plan is June 2023.

Table 2-2
Existing connections

Service Area	Equivalent Sewer Connections
North Village	390
Total	**390**

GROWTH PROJECTIONS

The principal goal of this study is to incorporate future needs in the analysis of the system. Therefore, in addition to analyzing existing development, future development has been projected and analyzed in this study.

Buildout

Projected connections for the NVSSD sewer system were prepared for a buildout scenario based on zoning as defined in the 2010 Wasatch County General Plan[1] (WCGP) and other data provided by the District, land developers, and others. District personnel gave input on areas that either were not addressed in the WCGP or that have been updated since the publication. Preference was also given to the most recent information analyzed; often this was land development plans provided by property owner/land developers. Notably, some of the buildout projections were based on planning documents from the Jordanelle Ridge development, which covers a large portion of the NVSSD area.

As stated above, the Red Ledges area is not currently served by NVSSD but will be within the next few years. Therefore, growth from Red Ledges is included in the growth projections in this chapter for convenience.

[1] The 2010 version is the latest version of the County plan currently in publication. We are not aware of any more recent County land use planning.

Table 2-2 shows a summary of the different service areas with the total number of projected build-out connections in each. The total number of sewer connections at build-out is projected to be 5,586.

This Master Plan indicated that at full buildout, NVSSD is projected to serve as many as 6,711 connections after accounting for Red Ledges, which is slightly larger than the total SCUs planned for in previous master planning documents. The minor adjustment is due to a number of factors, including that the buildout area has been refined, some developments have provided more accurate planning densities, and growth projection studies have been updated.

Table 2-3
Build-Out Connections

Service Area	SCUs
North Village	5,586
Red Ledges*	1,125**
Total	**6,711**

*SCUs from Red Ledges are not within the NVSSD political boundary, but are planned to be served by the NVSSD system
**Red Ledges is entitled to develop up to 1,210 SCUs. However, current planning indicates only 1,125 SCUs will actually be developed, and was therefore used for the planning within this study.

System Growth

The projected growth in the number of connections in the NVSSD service area was based on observed historic growth rates, specifics of the service areas, and buildout generally being reached around the year 2080. Growth in system connections is illustrated in Figure 2-2 and Table 2-4.

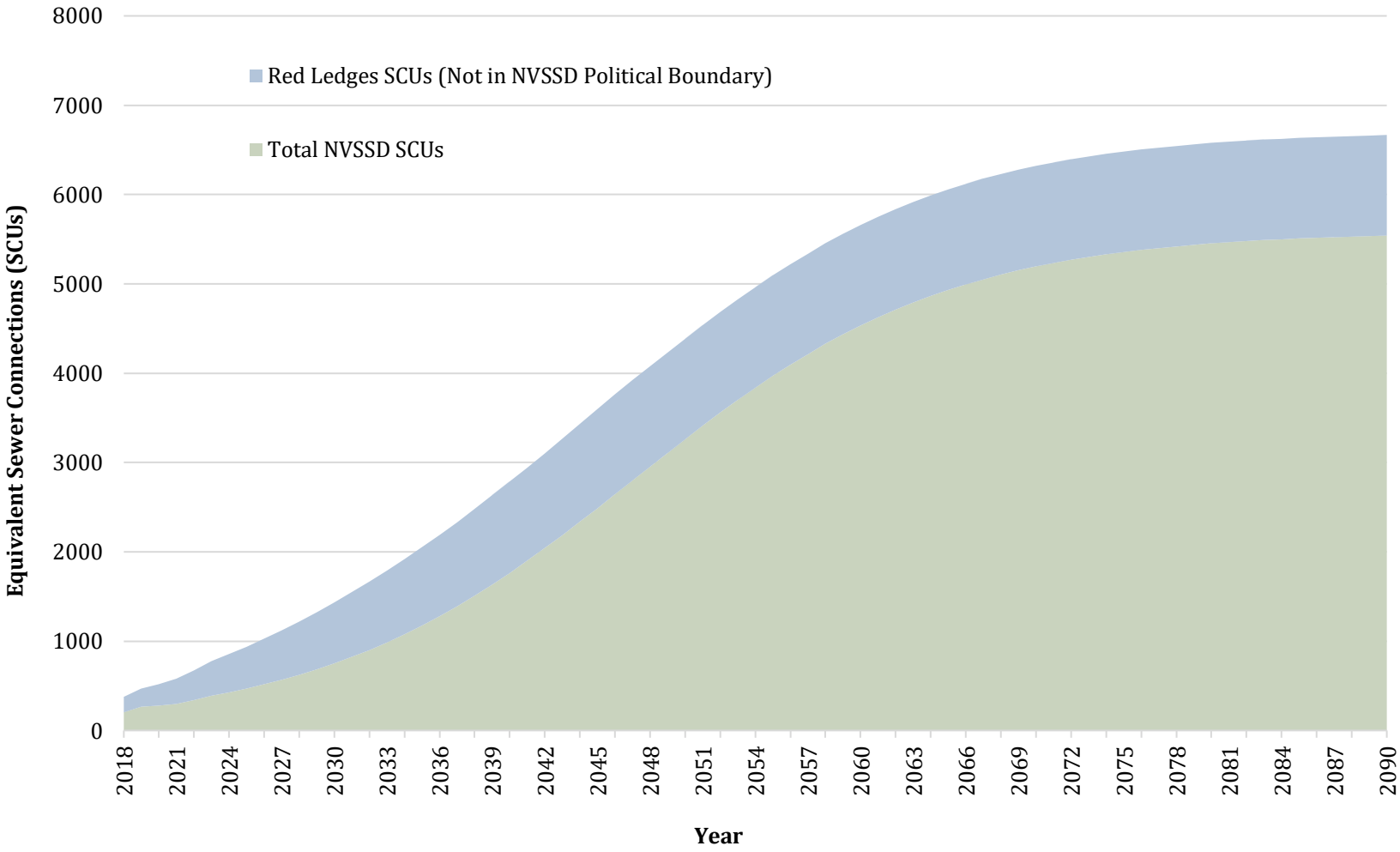


Figure 2-2. Projected Sewer Service Area Growth

Table 2-4
Projected Sewer Service Area Growth

Year	NVSSD Projected SCUs	NVSSD Annual Average Projected Growth Rate	Red Ledges Projected SCUs*	Red Ledges Annual Average Projected Growth Rate
2023	390	N/A	389	N/A
2024	428	9.8%	428	10.0%
2025	470	9.8%	468	9.3%
2026	517	9.8%	510	9.0%
2027	567	9.8%	553	8.4%
2028	623	9.8%	597	8.0%
2029	684	9.8%	640	7.2%
2030	750	9.7%	683	6.7%
2031	823	9.6%	725	6.1%
2032	901	9.5%	767	5.8%
2033	985	9.4%	806	5.1%
2040	1,763	9.9%	1,022	3.3%
2050	3,261	8.5%	1,125	1.0%
2060	4,533	3.9%	1,125	0.0%
2070	5,194	1.5%	1,125	0.0%
Buildout	5,586	0.4%	1,125	0.0%

*SCUs from Red Ledges are not within the NVSSD political boundary, but are planned to be served by the NVSSD system in the future

SEWER DEMAND PROJECTIONS

The future demand of NVSSD customers has been estimated to project sewer service requirements. Three different sewer collection system sources were considered as part of this study and are described below. These flows were then applied to system growth to produce projected demands from 2023 through 2090.

Note that Red Ledges is scheduled to divert its sewer flows through the NVSSD sewer system to the JSSD WRF in 2026. Sewer projections below reflect Red Ledges accordingly.

Sewer flows consist of three components: Base Sanitary Flow, Infiltration, and Inflow.

Base Sanitary Flow

Base sanitary flow consists of the sewer contributions of residential, commercial, and industrial customers. Two main challenges are encountered when estimating base sanitary flow. First, base sanitary flow is not a constant value but varies throughout the day. Second, separating the volume of base sanitary flow from infiltration and inflow is difficult.

Typically, inflow can be separated by observing how flows change during wet weather conditions. However, separating infiltration from base sanitary flow is much more difficult as it requires significant collection system metering (which the District doesn't have).

Although NVSSD does not have its own flow monitoring, there is flow monitoring at the JSSD Water Reclamation Facility (WRF). It is not monitored specifically for NVSSD, but rather the entire JSSD WRF service area. Using this monitoring, dry weather flows can be used to find the peak day combined infiltration and base sanitary flow for an average customer serviced by the JSSD WRF. Then, a rule of thumb can be used to estimate how much of that flow is infiltration. This analysis was recently completed as part of the recent JSSD Sewer Master Plan. This is anticipated to be the most accurate accounting of flow per connection for users served by the WRF (since it includes the NVSSD sewer service area). Those calculations indicated that the daily flow per connection is 216.5 gallons per SCU per day.

Base sanitary flow varies throughout the day so a ratio of hourly flow to average daily flow is prepared and applied to the model. It is important to account for hourly flow because the conveyance system needs to be large enough to convey flows at any time of day, even when those flows are higher than the total average over the day. The ratio itself tends to be dependent on the total connections flowing to the system at a given point. Based on the total units at various locations of the District, a peaking factor of 2.95 was chosen to be applied to the majority of the system. Where almost all the units converge at the UVU list station (and downstream of that point), a smaller peaking factor is more reflective of the system, so a peaking factor of 2.5 was chosen. Total flow projections in this chapter represent the smaller 2.5 peaking factor.

Infiltration

Over time, sewer collection pipes can deteriorate and allow for the entrance of groundwater. Pipe joints, cracked pipes, improper connections, and cracked manholes are particularly susceptible to such occurrences. Depending on the age and condition of the system, infiltration may contribute significant flow to the system. Based on this system, an appropriate allowance for infiltration is 45 gpd per SCU as shown in Table 2-4. This appears to be a reasonable number when comparing minimum observed flows to the WRF with peak day flows.

Although infiltration varies with time when examined over a period of several months or years, very little variation in time will occur during a single day. Therefore, when infiltration is added to the hydraulic model as a component of the total estimated dry weather sewer flow, it is added simply as a constant flow with no daily peaking factor.

Inflow

During rainfall events, water may enter the sewer collection through gaps in surface manholes, damaged pipes, damaged manholes, or illegal drain connections into the system. Because the quantity of this inflow is highly unpredictable, it is not included when calculating sewer production projections. Instead, additional capacity is separately reserved in sewer conveyance facilities sewer lines to plan for inflow events to temporarily increase flows.

Table 2-4
Estimated Daily Sewer Flows

Average Base Sanitary Flow per Sewer Capacity Unit (gpd/SCU):	216.5
Estimated Daily Infiltration per Sewer Capacity Unit (gpd/SCU):	45
Total Estimated Daily Sewer Flow per Sewer Capacity Unit (gpd/SCU):	261.5
Peak Hour Peaking Factor*:	2.5
Estimated Peak Hour Sewer Flow per Sewer Capacity Unit (gpd/SCU):	586

*The daily peaking factor is 2.5 for the downstream end of the system (UVU lift station and everything downstream). Other upstream areas are modeled using a 2.95 peaking factor. Project level facilities should be designed using a peaking factor appropriate for the facility.

Total Sewer Projections

The projected SCUs shown in Table 2-3 can be multiplied by the flow rates calculated above to identify flow rate projections from now through buildout. Table 2-5 identifies the summary of projected sewer demands.

Table 2-5
Summary of Projected Sewer Demands

Year	SCUs Served by NVSSD*	NVSSD Estimated Peak Day Total Sewer Production (MGD)	NVSSD Estimated Peak Hour Sewer Production (MGD)
2023	390	0.10	0.23
2024	428	0.11	0.25
2025	470	0.12	0.28
2026	1,027	0.27	0.60
2027	1,121	0.29	0.66
2028	1,220	0.32	0.72
2029	1,324	0.35	0.78
2030	1,434	0.37	0.84
2031	1,548	0.40	0.91
2032	1,667	0.44	0.98
2033	1,791	0.47	1.05
2040	2,784	0.73	1.63
2050	4,386	1.15	2.57
2060	5,658	1.48	3.32
2070	6,319	1.65	3.70
Buildout	6,711	1.76	3.93

*Red Ledges is scheduled to divert sewer flows from the TCSSD sewer system to the NVSSD sewer system by 2026; hence the increase in total production.

Figure 3-3 Summary of Projected Demands

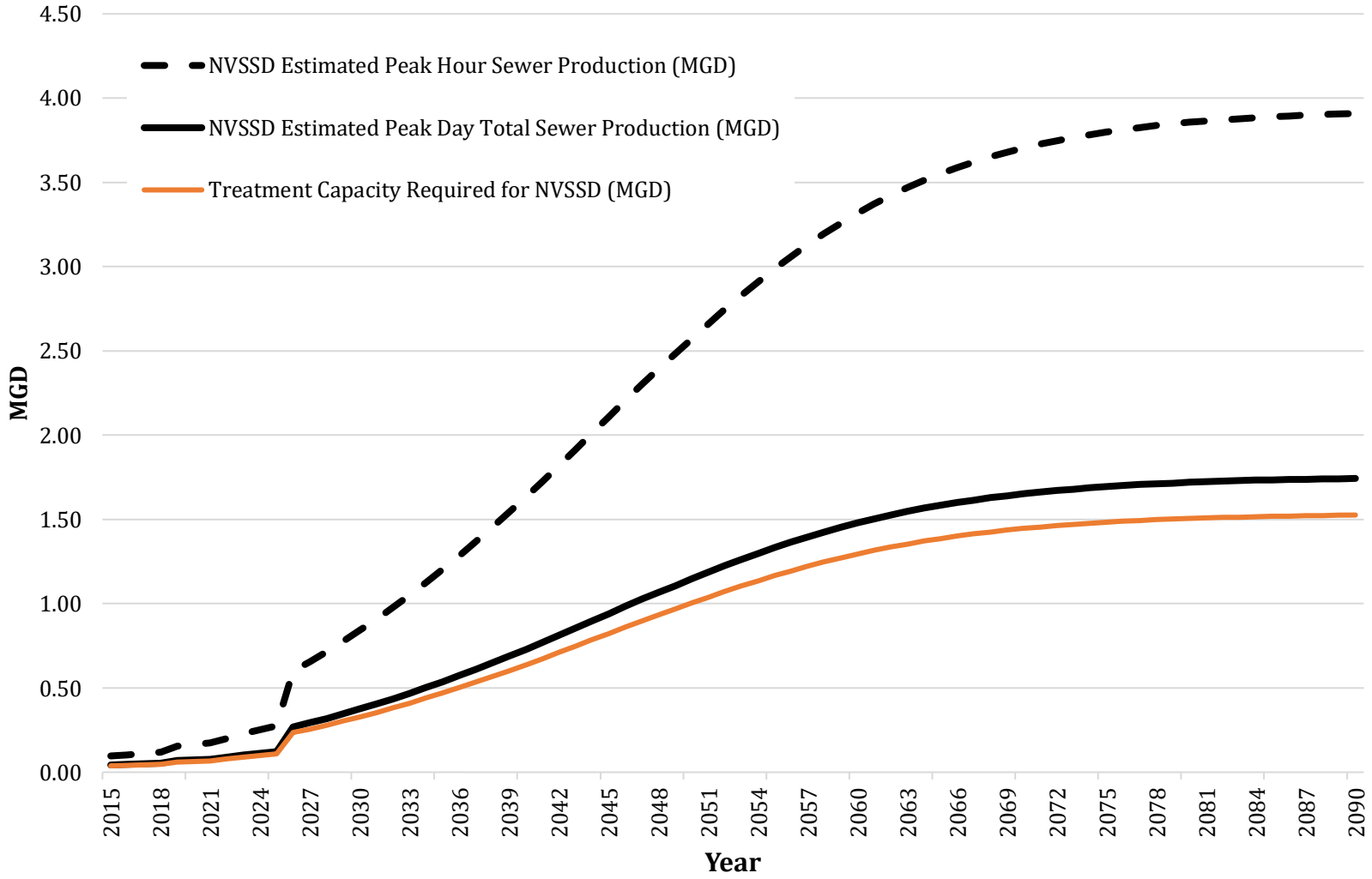


Figure 2-3. Summary of Projected Demands

CONSERVATION

The State of Utah has water conservation goals on a per-capita basis. Because conservation is generally achieved through the reduction of outdoor water use, no reduction in sewer flows due to conservation was assumed for the planning window of this study. With that in mind, it is recommended that the District continue to track water use and adjust its projections in future studies to account for any changes in water use.

CHAPTER 3
EXISTING SYSTEM

INTRODUCTION

As part of this capital facilities 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 NVSSD's existing sewer system and is intended to be used as a quick reference for NVSSD personnel. This information also informs the hydraulic model discussed previously in this report.

SEWER COLLECTION PIPES

The NVSSD sewer system is composed of collection lines ranging from 8-inches to 18-inches in diameter, as shown in Figure 3-1. Table 3-1 provides a summary of the length and size of all NVSSD sewer pipes. Pipe material is mostly PVC with a few sections being HDPE. One notable area is the section of force main between State Road 32 and the JSSD Water Reclamation Facility (WRF); this section of pipe was previously used as a gravity line that ran southeast along Old Highway 40. It is now pressurized and runs northwest. Another notable area is the section of gravity pipe on River Road west of Highway 40. This pipe was previously used to convey flows from NVSSD across Highway 40 and to the Heber City system to be treated. After the JSSD WRF was completed and NVSSD flows transitioned to the WRF, that pipe was plugged. It remains in the ground and is not anticipated to be used but can be unplugged and utilized in an emergency scenario.

Table 3-1
NVSSD Sewer Collection Pipe Inventory

Diameter	Total Length (ft)	Percentage of Network
8-inch	52,181	65%
10-inch	1,455	2%
12-inch	7,144	9%
15-inch	18,847	23%
18-inch	744	1%
Total	**80,373**	**100%**

LIFT STATIONS

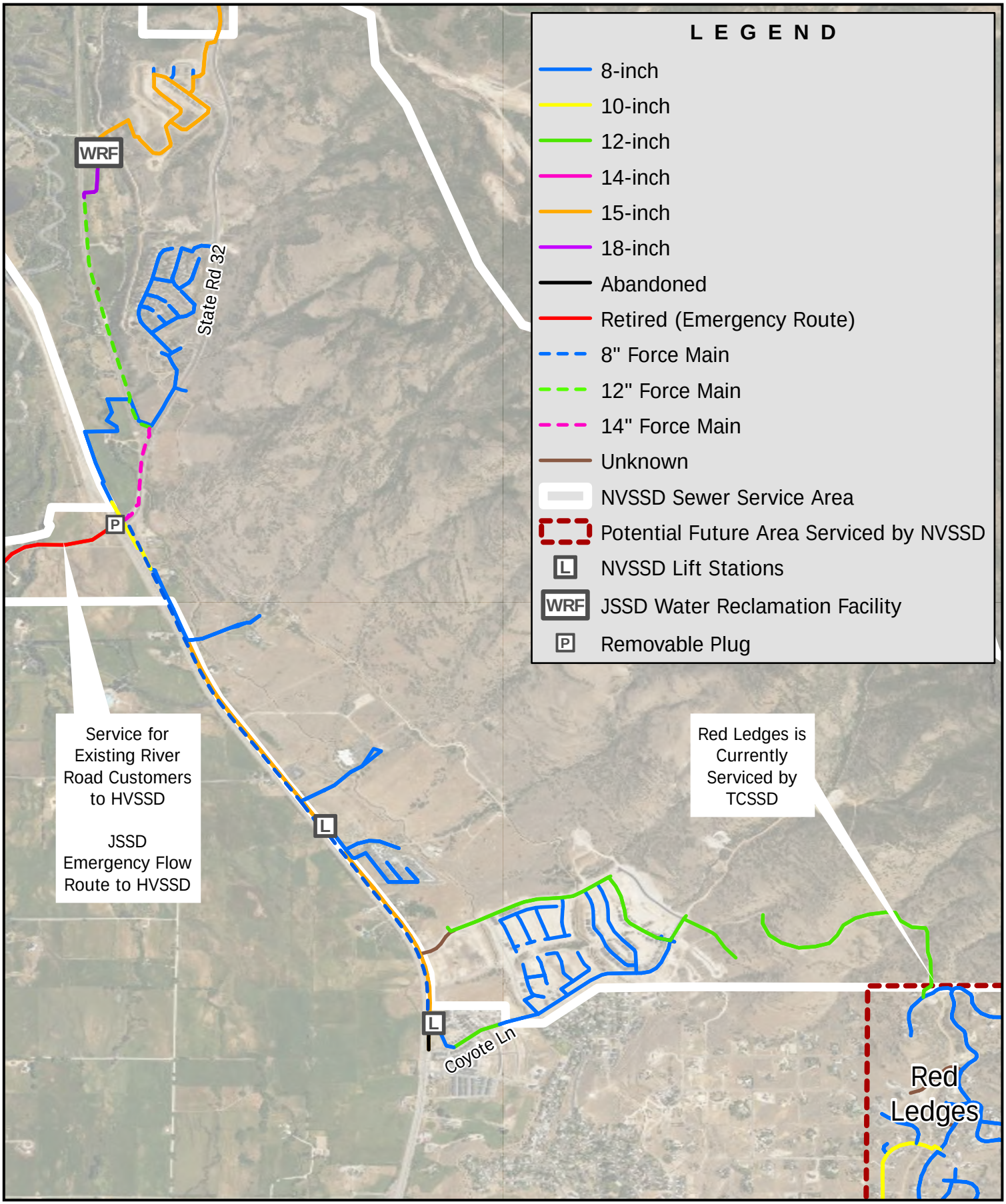
NVSSD currently has 2 sewer lift stations in service. Both lift stations are shown in Figure 3-1 and summarized in Table 3-2 below. A project to increase the capacity of the UVU lift station is expected to be completed in the next couple of years, but the current capacity is shown below.

Table 3-2
NVSSD Lift Station Inventory

Lift Station	Capacity (gpm)
University Lift Station	353
Coyote Lane Lift Station	425

WASTEWATER TREATMENT

JSSD owns and operates a bio-reactor treatment plant known as the Jordanelle Water Reclamation Facility (WRF) as shown on Figure 3-1. The plant was designed for an average day flow capacity of 1 MGD and has plans to add capacity in the future. This plant is where all NVSSD sewers are currently conveyed and treated and where future sewers are planned to be conveyed to and treated.



BOWEN COLLINS & ASSOCIATES

NVSSD Existing Sewer System

North Village Special Service District

NVSSD Sewer Master Plan

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 3-1

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CHAPTER 4
HYDRAULIC MODELING

INTRODUCTION

The purpose of this chapter is to provide NVSSD with the evaluation criteria used to create and analyze a hydraulic model of their sewer system. A hydraulic model is a mathematical representation of the system which considers the pipes, manholes, and wastewater flows found in the sewer collection system. Hydraulic computer models are useful because they allow the user to simulate operations of large, complex sewer systems and consider how future changes in flow will affect those systems.

GEOMETRIC MODEL DEVELOPMENT

There are two major types of data required to create a hydraulic model of a sewer system: geometric data and flow data. Geometric data consists of all information in the model needed to represent the physical characteristics of the system. For NVSSD, this includes locations and sizes of pipes and manholes as well as physical characteristics such as pipe roughness. This information is generally collected from system inventory data, direct field measurement, or design drawings. The following sections describe how geometric data was assembled for use in the hydraulic model.

Pipelines and Manholes

It is not economically feasible to model all the sewer pipes and manholes in most sewer systems. As smaller pipes are added to the model, the more refined the analysis becomes, However, this requires more additional time, effort, and expense. Hence, it is important to consider the required accuracy and available budget when selecting the sewer lines to model.

For this study, modeling major trunk lines was considered adequate for assessing potential hydraulic deficiencies in the system. The sewer CFP which was completed in 2015 had a lack of data pertaining to manhole locations and invert elevations. Therefore, pipe slopes in the model were estimated using surface topography and assumed manhole depth. Since that time, some additional data has been gathered and many of those pipes have been updated to reflect the actual existing pipe slopes. As-built data or survey data for all pipes installed after 2015 was gathered and is reflected in the model.

Pipe Flow Coefficients

Pipes in the hydraulic model were assigned a Manning's roughness coefficient of 0.013. This is approximately equal to the flow coefficient of concrete and clay pipe. While other materials exist within the system with lower published flow coefficients, 0.013 was used throughout the system as a conservative approach for estimating pipe capacity. In reality, collection pipes can develop thin layers of bacteria and solids that result in a relatively uniform flow coefficient close to 0.013 regardless of what material the pipe is actually made of.

FLOW MODEL DEVELOPMENT

Once all required geometric data was collected and a physical model of the system was developed, flow data was added in order to run a hydraulic simulation. Three types of flow information were required for hydraulic modeling: total magnitude of flow, timing of flow, and distribution of flow across the NVSSD service area. The following sections review those flow characteristics.

Total Flow

Flow projections for the NVSSD service area were presented in Chapter 3. Total flow for modeling scenarios is summarized in Table 4-1. Note that Red Ledges is scheduled to divert sewer flows to the NVSSD sewer system in 2026; hence they are not included in the existing flow projections.

Table 4-1
NVSSD Hydraulic Modeling Flow Volumes

Scenario	Base Sanitary Flow (MGD)	Infiltration (MGD)	Total Daily Flow (MGD)
Existing NVSSD	0.08	0.02	0.10
Existing Red Ledges	0.00	0.00	0.00
Existing Total	**0.08**	**0.02**	**0.10**
2033 NVSSD	0.21	0.04	0.26
2033 Red Ledges	0.17	0.04	0.21
2033 Total	**0.39**	**0.08**	**0.47**
Buildout NVSSD	1.21	0.25	1.46
Buildout Red Ledges	0.24	0.05	0.29
Buildout Total	**1.45**	**0.30**	**1.76**

As discussed in Chapter 3, inflow was not incorporated into the model. Instead, the evaluation criteria was formulated to provide adequate excess pipe capacity to accommodate inflow.

Timing of Flow

The values shown in Table 4-1 represent the total flows in the collection system over a 24-hour period. Since sanitary sewer flows vary throughout the day with varying indoor water demands, it is important to model the anticipated peak flow within a day. Therefore, a typical flow pattern based on studies for other similar municipalities with hourly multipliers was chosen. As discussed previously, two different peaking factors were used in the modeling for this analysis. A peaking factor of 2.5 was used at the UVU lift station and everything downstream. A peaking factor of 2.95 was used for all other parts of the system. Both diurnal patterns for these peaking factors are shown in Tables 4-2 and 4-3, respectively. As previously noted, any future design within the system shall use a peaking factor reflective of their actual connectivity which is not necessarily what was used for the modeling in this analysis.

Table 4-2
NVSSD Hydraulic Modeling Diurnal Pattern – 2.5

Hour	Multiplying Factor
12:00 AM	0.80
1:00 AM	0.60
2:00 AM	0.40
3:00 AM	0.30
4:00 AM	0.20
5:00 AM	0.25
6:00 AM	0.30
7:00 AM	0.45
8:00 AM	0.64
9:00 AM	1.10
10:00 AM	1.70
11:00 AM	2.50
12:00 PM	2.00
1:00 PM	1.60
2:00 PM	1.40
3:00 PM	1.25
4:00 PM	1.10
5:00 PM	1.05
6:00 PM	1.15
7:00 PM	1.33
8:00 PM	1.09
9:00 PM	0.97
10:00 PM	0.90
11:00 PM	0.92
12:00 AM	0.80

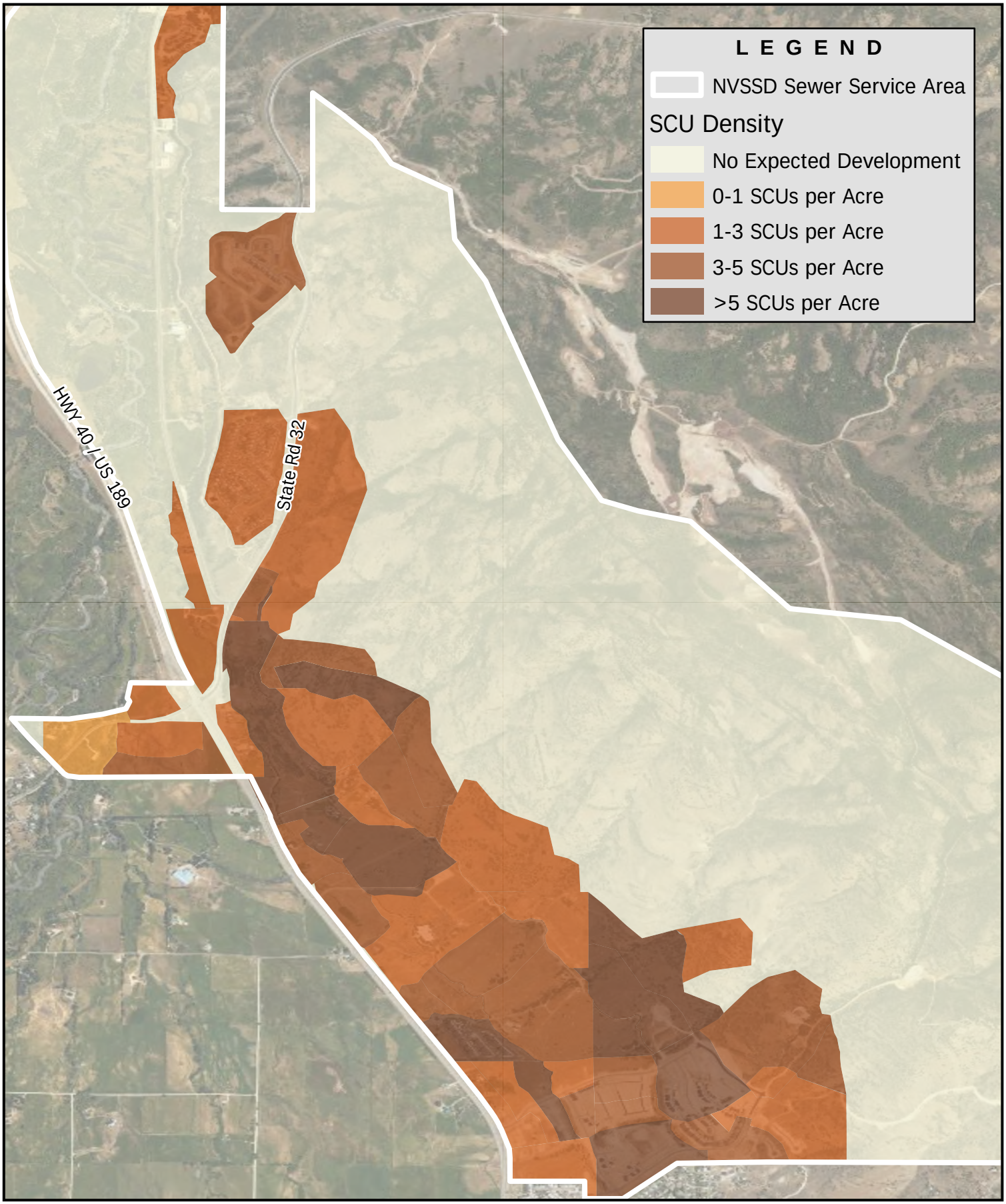
Table 4-3
NVSSD Hydraulic Modeling Diurnal Pattern – 2.95

Hour	Multiplying Factor
12:00 AM	0.74
1:00 AM	0.48
2:00 AM	0.22
3:00 AM	0.09
4:00 AM	0.05
5:00 AM	0.03
6:00 AM	0.09
7:00 AM	0.29
8:00 AM	0.53
9:00 AM	1.13
10:00 AM	1.91
11:00 AM	2.95
12:00 PM	2.30
1:00 PM	1.78
2:00 PM	1.52
3:00 PM	1.33
4:00 PM	1.13
5:00 PM	1.07
6:00 PM	1.20
7:00 PM	1.34
8:00 PM	1.12
9:00 PM	0.96
10:00 PM	0.87
11:00 PM	0.90
12:00 AM	0.74

Distribution of Flow

With total flow magnitude and timing estimated, the final step in developing flow inputs for the model is determining the spatial distribution across NVSSD. First, the District was broken into small sections that identify planned existing, 10-year, and buildout SCU density. The sewer density in each section was approximated using aerial photography of existing conditions as well as land use and zoning planning from the District. The resulting buildout SCU density is shown geographically in Figure 4-1.

Next, flow distribution was estimated by breaking the entire NVSSD service area into separate sewer sub basins as shown in Figure 4-2. Once basins within the district were delineated, surface topography was used to assign flow from that particular basin to a particular junction in the model. In most instances, flows from a basin were input at the upstream-most point of a pipe to maintain a conservative evaluation.



BOWEN COLLINS & ASSOCIATES

NVSSD Planned Buildout Densities

North Village Special Service District

NVSSD Sewer Master Plan

NORTH:

NORTH

SCALE:

0 1,250 2,500

Feet

FIGURE NO.

4-1

P:\Twin Creeks SSD\256-17-01.27 TCSSD Sewer Master Plan\4.0 GIS\4.4 APRX\TCSSD-NVSSD Sewer Master Plan\TCSSD-NVSSD Sewer Master Plan.aprx efica 6/5/2025

BOWEN COLLINS & ASSOCIATES

NVSSD Sewer Sub Basins

North Village Special Service District

NVSSD Sewer Master Plan

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 4-2

P:\Twin Creeks SSD\256-17-01.27 TCSSD Sewer Master Plan\4.0 GIS\4.4 APRX\TCSSD-NVSSD Sewer Master Plan\TCSSD-NVSSD Sewer Master Plan.aprx efica 7/8/2025

CHAPTER 5
COLLECTION SYSTEM EVALUATION

INTRODUCTION

The purpose of this chapter is to present the hydraulic modeling results for the NVSSD sewer collection systems for the existing, 10-year, and buildout conditions. Based on these results, any deficiencies in the existing or future sewer system were determined.

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 the above chapters, the sewer flow in the model is composed of two parts: base sanitary flow and infiltration. Because flow estimates are based on a limited data set, actual flows will fluctuate and may be greater than the model estimates. For example, infiltration during extremely wet years could be more than estimated in the model. The criteria established for identifying deficiencies should be sufficiently conservative to account for occasional flows higher than those estimated in the model.

Sewer Main Level of Service

It is important to eliminate deficiencies in NVSSD's sewer system, including inadequate pipe capacity. For gravity pipes in this master plan, a pipe capacity deficiency has been defined as any point where the modeled peak flow in the pipe is greater than 75 percent of the pipe's full flow capacity (which occurs at a depth of approximately 65 percent of the maximum depth). The remaining 25 percent of pipe capacity is reserved for inflow and/or unaccounted-for fluctuations in domestic flow and infiltration

Force Main Level of Service

For force main pipes in this master plan, a pipe capacity deficiency has been identified as any point where the velocity is greater than 7 feet per second or where there were pressures greater than the system could handle. By eliminating excessive pipeline velocities, this standard optimizes pump efficiency, limits potential for hydraulic surge issues, and maximizes the lift of the force main.

Lift Station Level of Service

For Based on industry standards and good design practice, peak daily flow to a lift station should not exceed 75 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 lift stations. The minimum design level of service for lift stations in NVSSD is correspondingly 25 percent higher than estimated peak flows at buildout.

The minimum wet well volume for lift stations should be large enough to prevent excessive cycling of lift station pumps. Based on manufacturers' 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.

MODEL RESULTS AND ANALYSIS

The following section describes and discusses the results of the existing, 10-year, and buildout model results.

Existing System Model Results

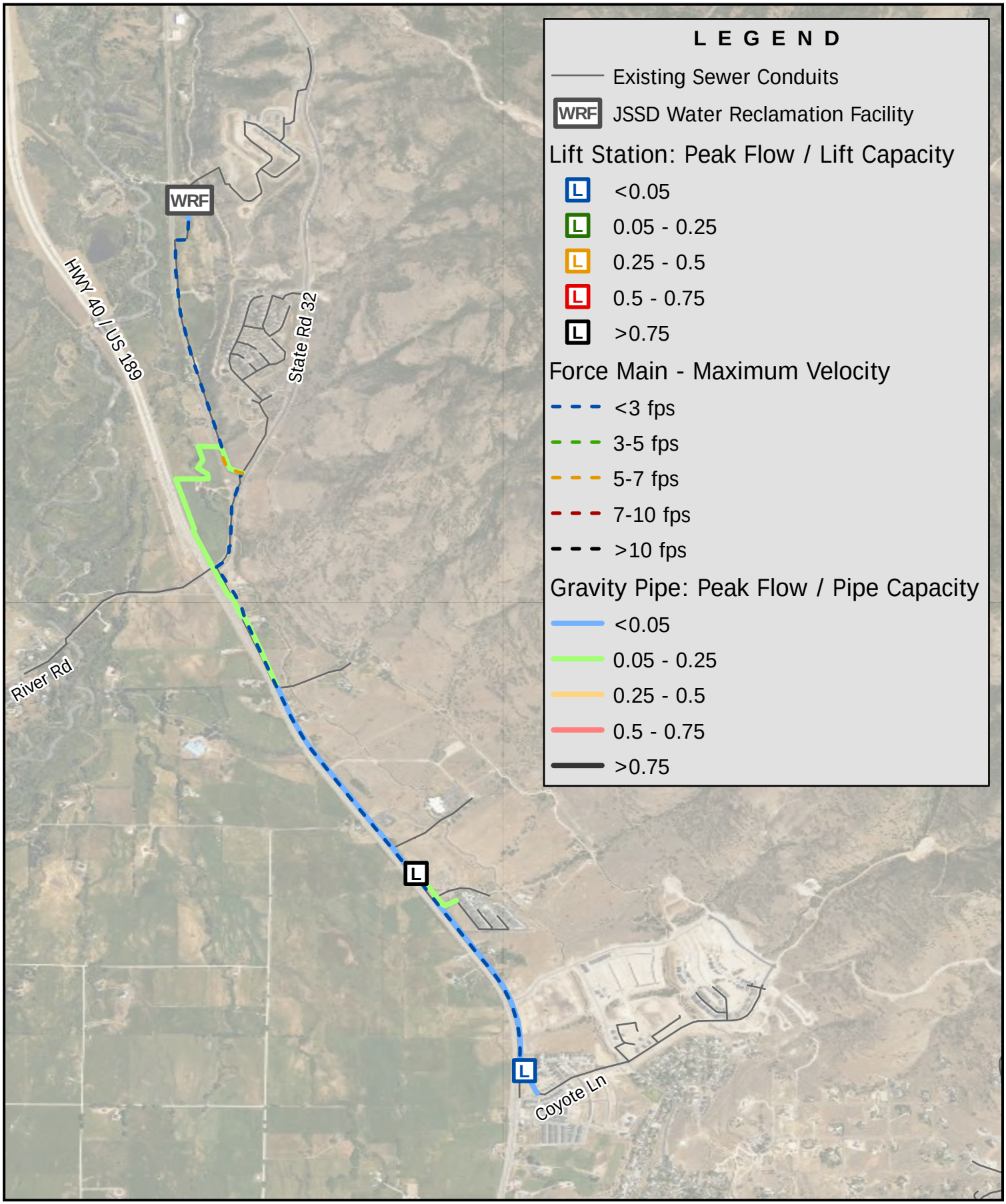
Figure 5-1 displays the results of the 24-hour hydraulic model simulation for the existing NVSSD sewer collection system. The figure displays the percentage used of full flow capacity. According to the level of service stated above, there are no existing gravity pipe capacity, force main capacity, or lift station capacity deficiencies.

10-Year Model Results

Figure 5-2 displays the results of the 24-hour hydraulic model simulation for the 10-Year NVSSD sewer collection system. The figure displays the percentage used of full flow capacity. According to the level of service stated above. There are no gravity pipe capacity deficiencies within a 10-year window. However, there is one force main pipe as well as one lift station which shows as a deficiency. There are no foreseen projects related to the expansion of the service area in the 10-year window.

Buildout Model Results

Figure 5-3 displays the results of the 24-hour hydraulic model simulation for the Buildout NVSSD sewer collection system. The figure displays the percentage used of full flow capacity. According to the level of service stated above. There are no gravity pipe capacity deficiencies in the buildout window. As expected, the same force main pipe and lift station identified in the 10-year window still show as being deficient at buildout. There are no foreseen projects related to the expansion of the service area in the buildout window.



BOWEN COLLINS & ASSOCIATES

NVSSD Existing Sewer System Model Results

North Village Special Service District

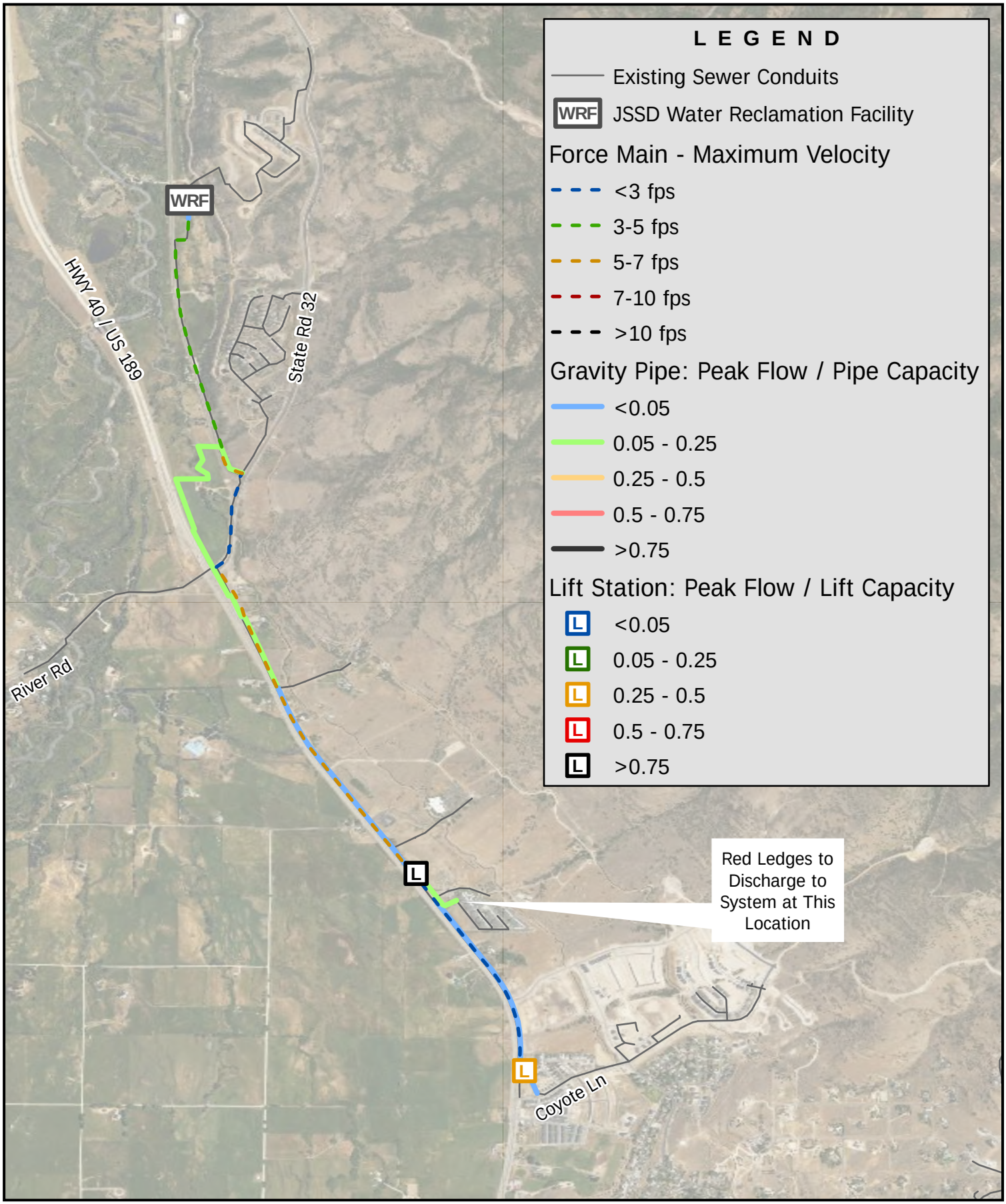
NVSSD Sewer Master Plan

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 5-1

P:\Twin Creeks SSD\256-17-01.27 TCSSD Sewer Master Plan\4.0 GIS\4.4 APRX\TCSSD-NVSSD Sewer Master Plan\TCSSD-NVSSD Sewer Master Plan.aprx efica 6/5/2025



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NVSSD 10-Year Sewer System Model Results

North Village Special Service District

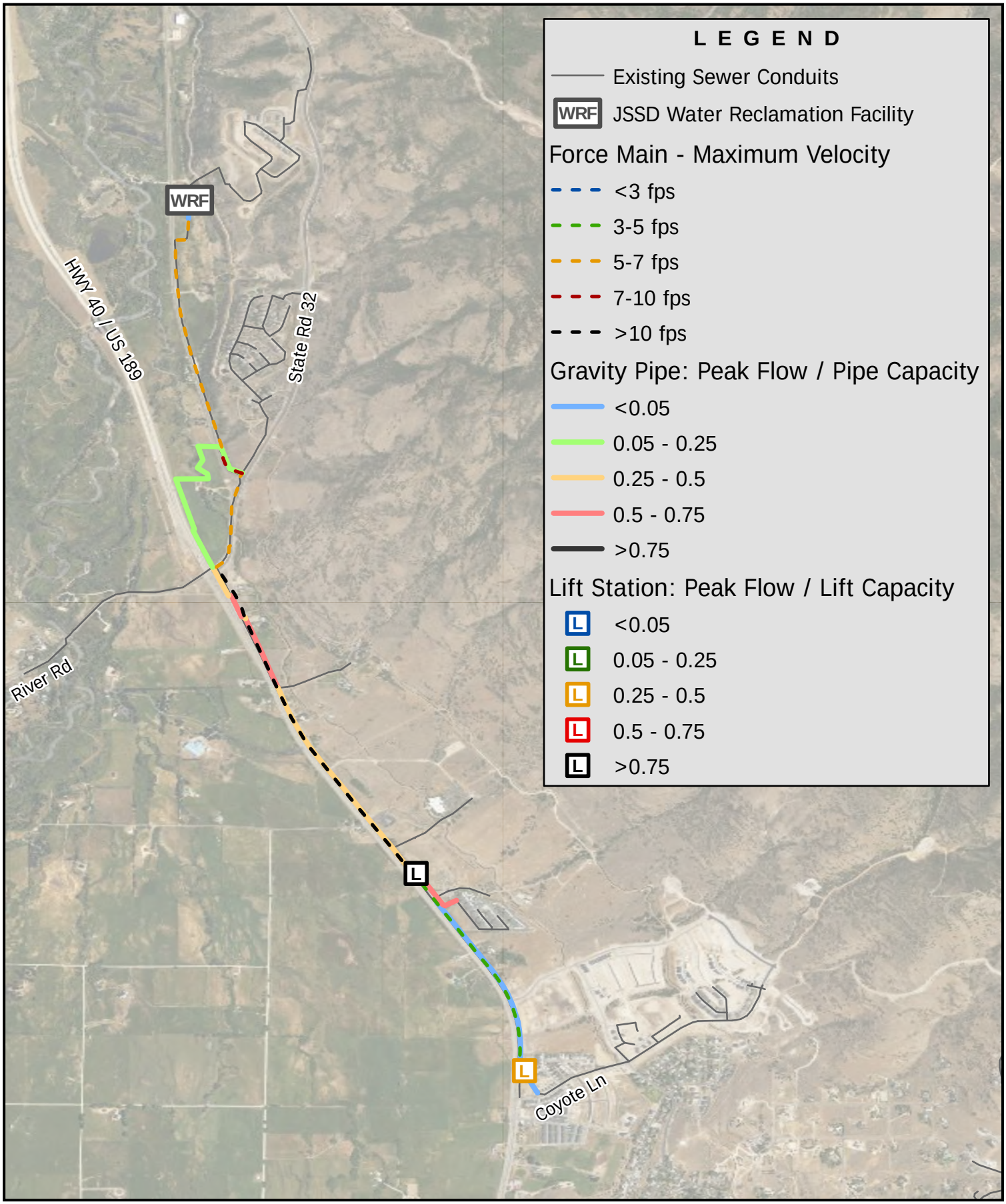
NVSSD Sewer Master Plan

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 5-2

P:\Twin Creeks SSD\256-17-01.27 TCSSD Sewer Master Plan\4.0 GIS\4.4 APRX\TCSSD-NVSSD Sewer Master Plan\TCSSD-NVSSD Sewer Master Plan.aprx efica 6/5/2025



BOWEN COLLINS & ASSOCIATES

NVSSD Buildout Sewer System Model Results

North Village Special Service District

NVSSD Sewer Master Plan

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 5-3

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RECOMMENDED SEWER IMPROVEMENTS

The following section discusses consideration taken regarding system planning and identifies system recommendations and proposed capital improvement projects for NVSSD.

Red Ledges

As discussed in the chapters above, Red Ledges is obligated to build the necessary infrastructure to convey their flows to the JSSD WRF through NVSSD sewer system in 2026, thence leaving the TCSSD system. The required infrastructure is as follows:

- UVU Lift Station
- Gravity Sewer Line from Red Ledges to the UVU Lift Station
- Upsize Existing 8-inch Force Main from the UVU lift station to SR 32

Regarding timing and modeled flows within this analysis, flows from Red Ledges are included in the 10-year model and the buildout model, but are not included in the existing model. All three of the above-stated projects will need to be completed prior to Red Ledges connecting and sending effluent through NVSSD.

Force Main from UVU Lift Station to JSSD WRF (Water Reclamation Facility)

The UVU lift station currently pumps flow to the existing JSSD WRF through a series of force main pipes. The first section of this pipe is an 8-inch force main which takes flow from the UVU lift station to State Road 32 where it crosses under the road inside of a 16-inch steel casing. The second section of this pipe is a 14-inch HDPE force main which takes flow from the 8-inch pipe to Old Highway 40. The final section of this pipe is a 12-inch PVC force main which takes flows from the corner of Old Highway 40 and State Road 32 to the JSSD WRF.

The buildout model completed as part of this analysis indicates that the majority of the sections of 12-inch PVC and 14-inch HDPE have a maximum velocity of less than 7 feet per second. There is a small section which has a velocity of about 10 feet per second. Although this is higher than NVSSD would typically design for, it is within an acceptable range given how short of a segment it is. Therefore, these two sections of force main have capacity to serve the system through buildout.

The 8-inch force main does not have capacity to serve the system through buildout and will need to be upsized. This project was previously identified in master planning as FM2a. The existing 8-inch force main is over one mile long, so bypass pumping the entire line in order to upsize it in its current alignment is undesirable if it can be avoided. Additionally, the new pipe (and any bypass line) will need to cross State Road 32. Three different alternative alignments were considered for the upsize projects and are compared in Table 5-1 below.

The alignments identified in Table 5-1 are also shown in Figure 5-5 below. In addition to cost, there are project considerations that influence the decision on which alternative best suits the District's needs. After considering cost, feasibility, and other project considerations, BC&A recommends that the District pursue Alternative 3. Although this alternative relies on future development to be installed, it has some major benefits, which include:

- Allowing the District to avoid a plethora of utility conflicts along Highway 40
- Allowing the District to avoid reusing or replacing the existing casing under the busy intersection at State Road 32, which may or may not be in the required condition to be reused
- Requiring only one cut across State Road 32 instead of two since bypassing would not be required
- Costing a similar amount as Alternative 2

Please note that the three alternatives shall be re-evaluated prior to design to confirm that the assumptions made in this plan are accurate and that Alternative 3 still best meets the District's needs.

Discharge to JSSD WRF (Water Reclamation Facility)

As discussed in Chapter 3, the entirety of the NVSSD system discharges to the existing JSSD WRF to be treated and plans to continue doing so through buildout. NVSSD began paying JSSD impact fees for capacity in 2016 on a per-connection basis. At this time, NVSSD has purchased a total of 0.337 Million Gallons per Day (MGD) of capacity. Part of that reserved capacity is for Red Ledges, because they have already purchased capacity for their required buildout ERUs. At buildout, NVSSD is expected to require 1.536 MGD of treatment capacity (including Red Ledges). Therefore, NVSSD will need to purchase 1.20 MGD of additional capacity from now through buildout.

Figure 5-4 below shows a potential treatment capacity purchasing schedule for NVSSD. The schedule shows NVSSD purchasing treatment capacity in 5-year blocks starting in 2031. For the first block, this would be approximately $2.2 million dollars. Note that the proposed purchasing schedule is not rigid but is rather meant to be used as a guideline by administrative staff. And while purchasing capacity in blocks is typically preferred from an administrative and planning perspective, JSSD and NVSSD may decide to continue to purchase capacity on a connection-by-connection basis. The important conclusion is that NVSSD must continue to secure sewer treatment capacity to meet the demands of growth.

Note that the connection fee identified as part of this project are not certain, but rather based on preliminary cost estimates of WSSD WRF expansion projects. Costs will almost certainly change depending on actual construction costs of expansion projects.

Recommended Project Level Improvements

This section reviews the list of projects which were identified as part of the analysis performed in this master plan. It is recommended that these projects be completed to benefit specific developments. Figure 5-6 provides a visual reference for the recommended improvements.

- ***M1: Survey Existing Gravity System Along Highway 40.*** During data investigation, it was found that there is a section of gravity pipe which is installed and in service, but that does not have any record drawings or survey associated with it. The section has 4,200 feet of 15-inch pipe and 1,500 feet of 8-inch pipe. After considering ground slope and available data from the upper and lower connection points, it is anticipated that this line will have capacity for the system through buildout. However, this line should be surveyed to confirm that this assumption is correct. To serve buildout demands, the 8-inch segment needs to have capacity for 600 gpm and the 15-inch segment needs to have capacity for 1,200 gpm.
- ***PL1: Gravity Sewer Line From Red Ledges to the UVU lift station.*** As part of connecting to the NVSSD system, Red Ledges needs to install a gravity sewer line to get them to the UVU lift station. Most of this line is already complete. The downstream segment of this line needs to be upsized. The required capacity in the downstream segment of this line (as shown on Figure 5-6) is expected to be 1,700 gpm. It should be noted that the lower segment of this line as shown in Figure 5-6 will need to be utilized by both Red Ledges and adjacent development. The installed gravity pipe must have the capacity to serve both of these developments, as is reflected in the 1,700 gpm capacity. If an upsize is needed to satisfy the requirements of the adjacent development, the gravity line will still be considered a project level improvement and the cost to upsize is to be worked out between Red Ledges and the developer that needs the upsize.

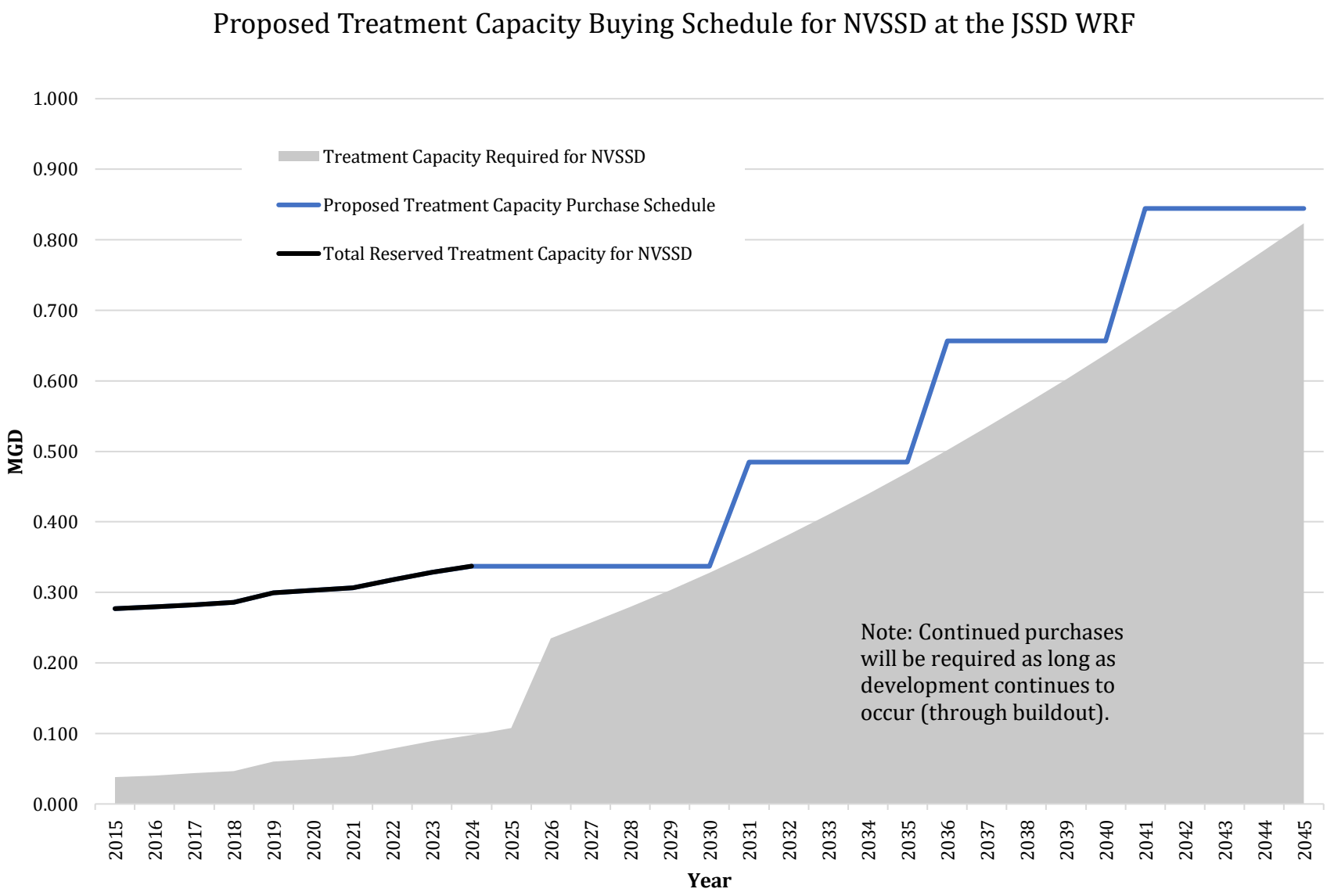


Figure 5-4. Proposed Treatment Capacity Buying Schedule for NVSSD at the JSSD WRF

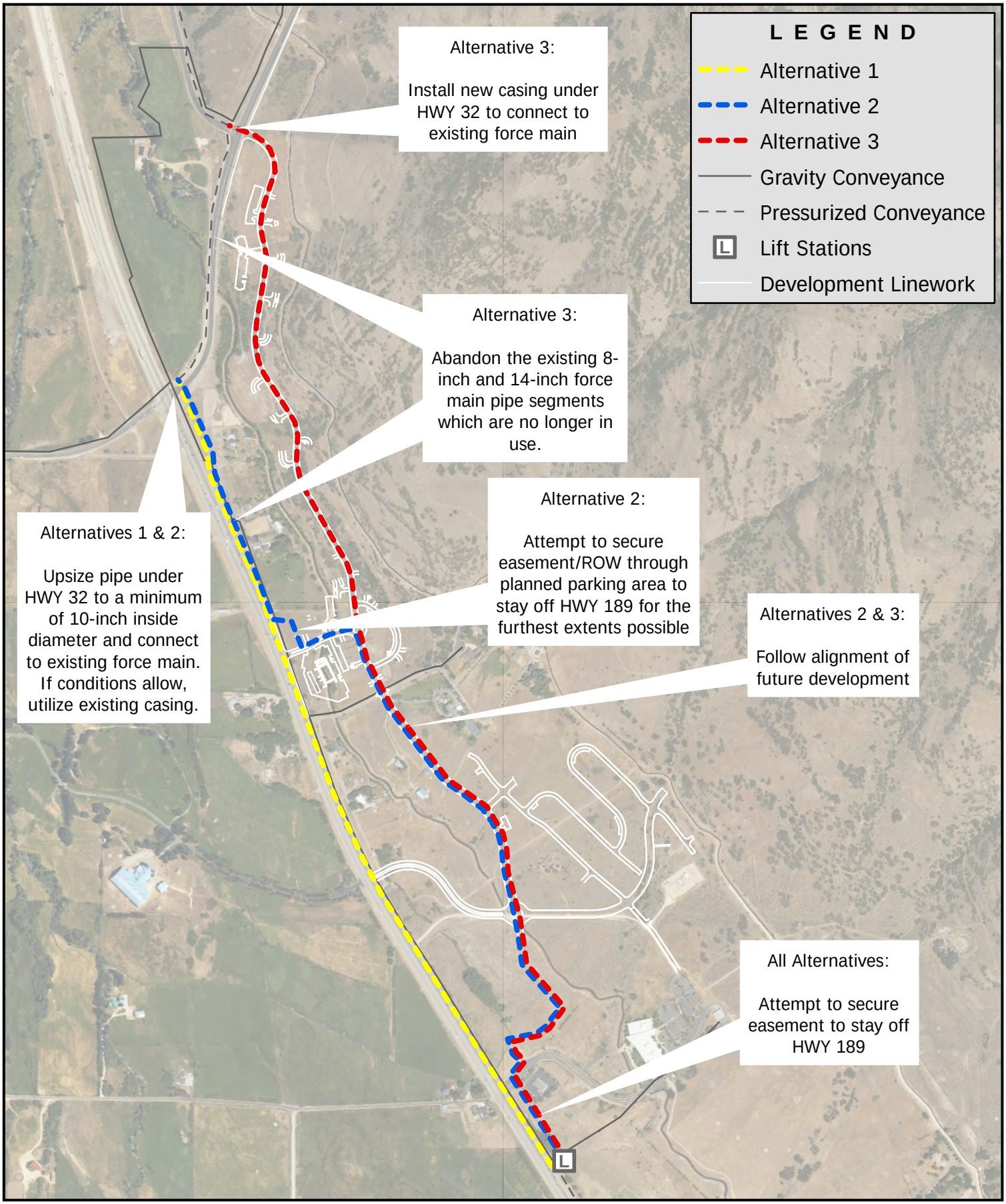
Recommended System Level Improvements

This section reviews the recommended list of capital improvement projects for the NVSSD sewer system. The following list of projects takes the model outputs, expansion requirements, and uncertainties into account. Figure 5-6 provides a visual reference for the recommended system improvements.

- ***T1: Buy-In at JSSD WRF.*** As discussed above, NVSSD must continue to purchase treatment capacity from JSSD (potentially in 5-year blocks). The total cost shown for this project includes one of those blocks being purchased within the 10-year window. This first block would be equivalent to 0.172 MGD.
- ***FM2a: Upsize existing 8-inch Force Main.*** Project FM2a was included in previous capital facilities plans but has changed in size and alignment since those plans. This force main needs to convey 3,500 gpm of flow from the UVU lift station to the existing system on the north side of State Road 32. This flow rate already accounts for the required 25% safety factor. The current recommended alignment as discussed in the sections above includes 8,500 feet of 16-inch nominal HDPE sewer line (approximately 14.1 I.D.) parallel to Highway 40 and a new crossing at State Road 32. This project includes the abandonment of the existing 8-inch force main that does not meet velocity or pressure rating requirements at buildout.
- ***LS2: UVU Lift Station Upsize.*** Project LS2 was included in previous capital facilities plans but has changed in size since those plans. The updated recommendation is to upsize the existing lift station to provide 3,500 gpm of capacity at buildout. This flow rate accounts for the required 25% safety factor. Current planning indicates this will be completed in conjunction with Red Ledges connecting to the system in the next couple of years.

Table 5-1 NVSSD FM2a Alternative Alignment Comparison

Project	Description	Prelim Cost Estimate	Pros	Cons
FM2a Alt 1	Utilize existing casing under SR32 and follow alignment of existing 8-inch force main	$2,272,300	• The pipe is shorter than other alternatives. • The alignment does not rely on future developments to be installed and would need to be installed fully by the District.	• The cost is significantly higher than the other two alternatives. • If the existing casing in State Road 32 is not in proper condition to be re-used, either trenchless technology will need to be utilized or a trench will need cut on State Road 32 to install a new upsized force main. This would increase the cost from what is shown here. • This entire alignment runs along Highway 40, which increases the utilities which will need to be avoided or designed around. • This entire alignment runs along Highway 40, which makes long-term maintenance more difficult due to its proximity to the busy road.
FM2a Alt 2	Utilize existing casing under SR32 and move alignment to be perpendicular to Highway 40 and within future developments	$1,690,200	• This is anticipated to be one of the two least expensive alternatives. • The existing force main that runs along State Road 32, which was installed recently, will be utilized. • The existing 16-inch steel casing under State Road 32 will likely be able to be re-used; these cost savings are reflected in the cost shown here. • The section of this alignment in future developments will avoid running along Highway 40, which in turn allows for significantly less utility conflicts. • The section of this alignment along Highway 40 does not rely on developments being installed and would instead need to be fully installed by the District.	• If the existing casing in State Road 32 is not in proper condition to be re-used, either trenchless technology will need to be utilized, or a trench will need cut on State Road 32 to install a new upsized force main. This would increase the cost from what is shown here. • The section of this alignment along Highway 40 will be complicated by existing utilities in the road. • Sections of this alignment along Highway 40 will be more difficult to maintain in the long-term due to its proximity to the busy road. • The section of this alignment in future development areas will depend on those developments being completed in order to be installed. If the District runs out of capacity in the existing 8-inch line prior to those development being constructed, the District will need to fund and construct the force main upfront prior to roads being constructed.
FM2a Alt 3	Install new casing under SR32 near Old Hwy 40 and move alignment to be perpendicular to Highway 40 and within future developments	$1,660,600	• This is anticipated to be one of the two least expensive alternatives. • None of this alignment runs along Highway 40, which in turn decreases (and almost negates) utility conflicts. • The entire alignment runs along local roads, making long-term maintenance more accessible and more safe than it would be if it were along the highway. • The location at which this alternative crosses State Road 32 is set off from the intersection at Highway 40, making it less busy than the intersection.	• This alternative bypasses the existing 14-inch force main, and that force main will likely end up being abandoned. • The entirety of this alignment is in future development areas, making it dependent on those areas being constructed. If the District runs out of capacity in the existing 8-inch line prior to those developments being constructed, the District will need to fund and construct the force main upfront prior to roads being constructed.



BOWEN COLLINS & ASSOCIATES

NVSSD Pressurized System (Project FM2a) Alternatives Analysis

North Village Special Service District

NVSSD Sewer Master Plan

NORTH:

SCALE: 0 450 900 Feet

FIGURE NO. 5-5

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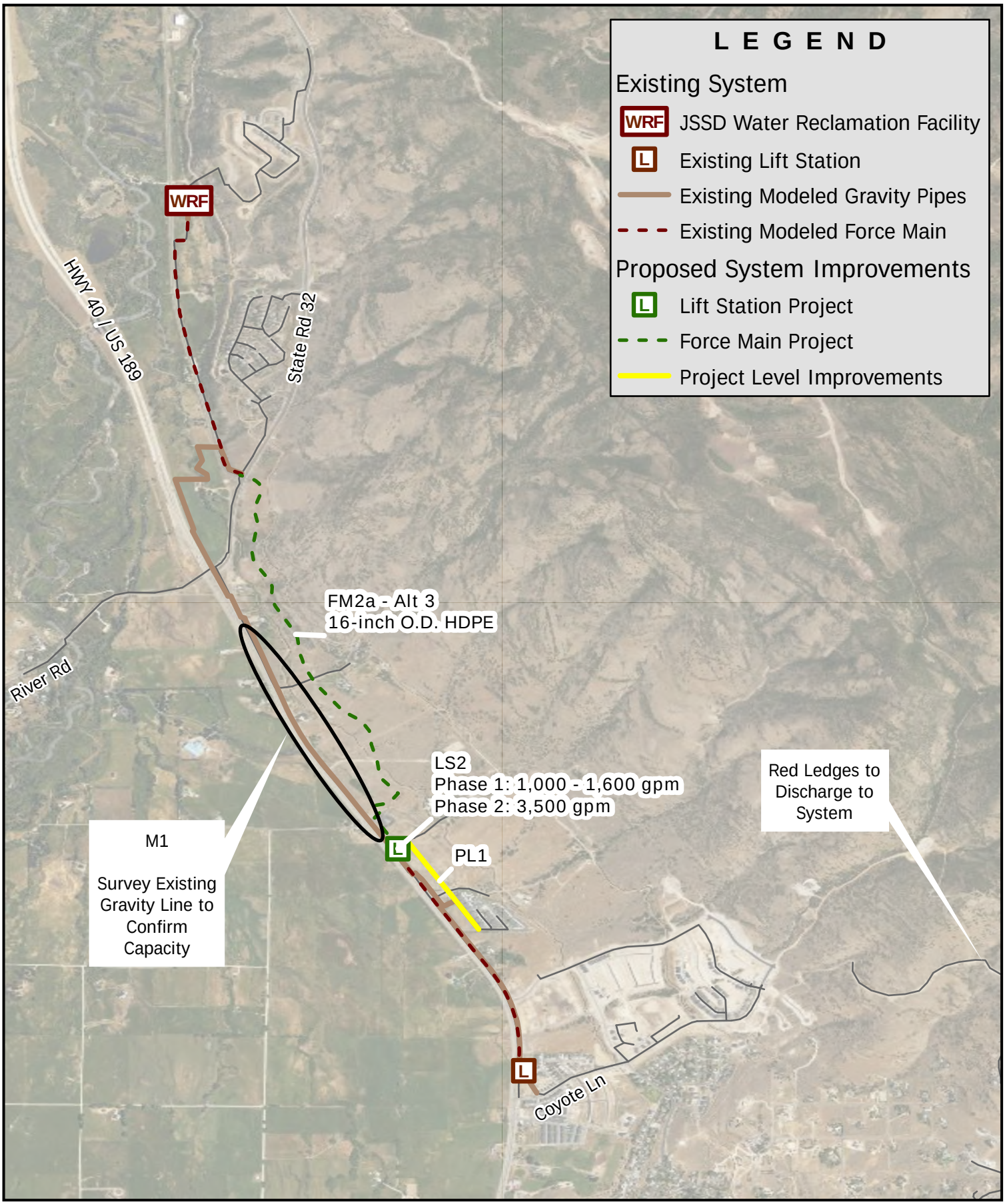

BOWEN COLLINS & ASSOCIATES

Recommended NVSSD System Improvements

North Village Special Service District

NVSSD Sewer Master Plan

NORTH:

SCALE: 0 1,250 2,500 Feet

FIGURE NO. 5-6

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CHAPTER 6
CAPITAL IMPROVEMENTS PLAN

INTRODUCTION

Recommended capital improvements pertaining to the NVSSD sewer collection system are identified and described in Chapter 5. The purpose of this chapter is to summarize each project, present a cost estimate for each project, and develop an implementation plan for the recommended improvements.

CAPITAL IMPROVEMENT PLAN SUMMARY AND BUDGET

The recommended system level capital improvements for the NVSSD sewer collection system discussed previously in chapter 5 are shown in Table 6-1. Included in this table is a summary of each project, expected completion date, and an estimate of project costs. A 15 percent engineering cost has been included for each project. The location of each project is shown in Figure 5-6. Projects have been broken up based on whether they are recommended to be included in the 10-year window or in the buildout window.

IMPLEMENTATION RECOMMENDATIONS

With the analysis underlying this master plan complete, the following list provides implementation recommendations:

- ***Adopt Master Plan with Capital Improvements Plan*.** The capital improvements plans summarized in Table 6-1 and 6-2 represent the best available assessment of District capital needs in the upcoming years. It is recommended that this plan be adopted for budgeting, staffing, fand financial planning purposes.
- ***Prepare to Adequately Fund Projects*.** To facilitate the completion of the proposed projects, the District needs to budget accordingly. The District needs to continually manage budgets, impact fees, and sewer rates to ensure adequate funding. Additionally, the District should keep an eye out for any alternative funding opportunities such as loans and grants.
- ***Update This Master Plan Regularly*.** This sewer master plan is best utilized when viewed as a living document. The conclusions contained herein are based on multiple assumptions that will assuredly change from time to time. As changes occur, the conclusions and recommendations in this report may need to be revised. For this reason, it is recommended that this study be updated every 3-5 years. Doing so will capture changes in growth patterns, costs, and system construction.

Table 6-1
Recommended System Level NVSSD Improvements

Project ID	Estimated Construction Year	Project Description	Approximate Size*	Estimated Construction Cost in 2024 Dollars	Engineering Cost (15%)	Estimated Total Project Cost in 2025 Dollars
FM2a - Alt 3**	2033	HDPE Force Main from UVU Lift Station to north of HWY 32	16-inch O.D./ 8500 LF/ 3,500 gpm	$1,459,200	$218,880	$1,679,000
LS2**	2026	Install new UVU lift station	3,500 gpm	$3,794,000	$569,000	$4,363,000
T1 - Phase 1***	2026	Buy capacity at JWRF	0.172 MGD	NA	NA	$2,166,000
10-Year Window Total		**-**	**-**	**$5,253,200**	**$787,880**	**$8,208,000**
T1 - Phase 2***	Ongoing	Buy capacity at JWRF	1.518 MGD	NA	NA	$15,321,000
Post 10-Year Window Total		**-**	**-**	**$0**	**$0**	**$15,321,000**

*Design flows shown account for a 25% safety factor
**The cost shown reflects the approximate cost for the entire UVU lift station. Red Ledges is obligated to build a lift station and force main that has capacity for their own ERUs (approximated at $3,194,700 for the lift station and $1,207,400 for the force main) and NVSSD will cover the cost required to increase that capacity to account for NVSSD flows (approximated at $1,168,300 for the new lift station and $471,600 for the force main).
***The costs shown reflect the total equivalent 2025 dollars required to purchase treatment capacity at the JSSD WRF based on the proposed purchasing schedule found within this report. Actual costs will likely change based on a variety of factors discussed in the text.

Table 6-2
Recommended Miscellaneous NVSSD System Improvements

Project ID	Estimated Construction Year	Project Description
M1	2030	Maintenance project to survey the existing gravity system along Highway 40 - this is expected to cost the District under $5,000 (2025 dollars)
PL1	2026	Project level gravity sewer line from Red Ledges to the UVU Lift Station - cost to be sorted out by developers

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PROVO, UTAH OFFICE
1712 S EAST BAY BLVD
SUITE 345
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ST. GEORGE, UTAH OFFICE
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