

MEMORANDUM

DATE: July 29, 2022

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FROM: Kayson Shurtz, P. E.
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SUBJECT: Springville City West Side Annexation
Sanitary Sewer System Review

PROJECT NO.: 344.224.200



INTRODUCTION

A 320-acre industrial development is proposed near the intersection of 4000 South (Highway 77), between 800 West and 1300 West (Spanish Fork City addressing). Springville City (City) requested a feasibility analysis to identify needed water resources, level of service, and needed infrastructure for this area. The City also requested that the scope of the study include approximately 700 additional acres that are outside of the municipal limit but within the Springville City Annexation Declaration Policy Boundary, as shown in Figure 1. These additional developments are 1) north of 4000 South between approximately 700 West and 800 West (160-acre parcel, Spanish Fork City addressing) and 2) north of 4000 South between approximately 1300 West and 2000 West (560-acre parcel, Spanish Fork City addressing). These developments are bordered on the north by Utah Lake's Provo Bay. Additionally, an approximately 477-acre area within City boundaries that was not included in the 2060 Master Plan has been included in this study. Previously, it was expected to be built out past 2060. It is now included because of its proximity to the study area ("West-Side Buildout Area"). Any additional areas of the City that are expected to develop after 2060 are not included in this analysis.

As requested, HAL has performed a review of the effects that the proposed developments will have on the City's sanitary sewer collection system. This includes a hydraulic modeling analysis of the proposed sanitary sewer infrastructure for the development. The analysis assumes that the development types within City's annexation policy limits but outside of current City limits are industrial use with an equivalent residential unit (ERU) density of 3 ERUs/Acre, and that the West-side buildout area within city boundaries will develop as a medium to low density residential development with an ERU density of 9 ERUs/Acre. These projections were provided to HAL

through communication with the City and through the Springville City Wastewater Collection System Master Plan dated 2020 (Master Plan).

This memo includes a discussion of the effects of the proposed developments on the existing system, different alternatives for sewer conveyance, and a discussion of the effects of adding this development to the future scenarios of the Master Plan.

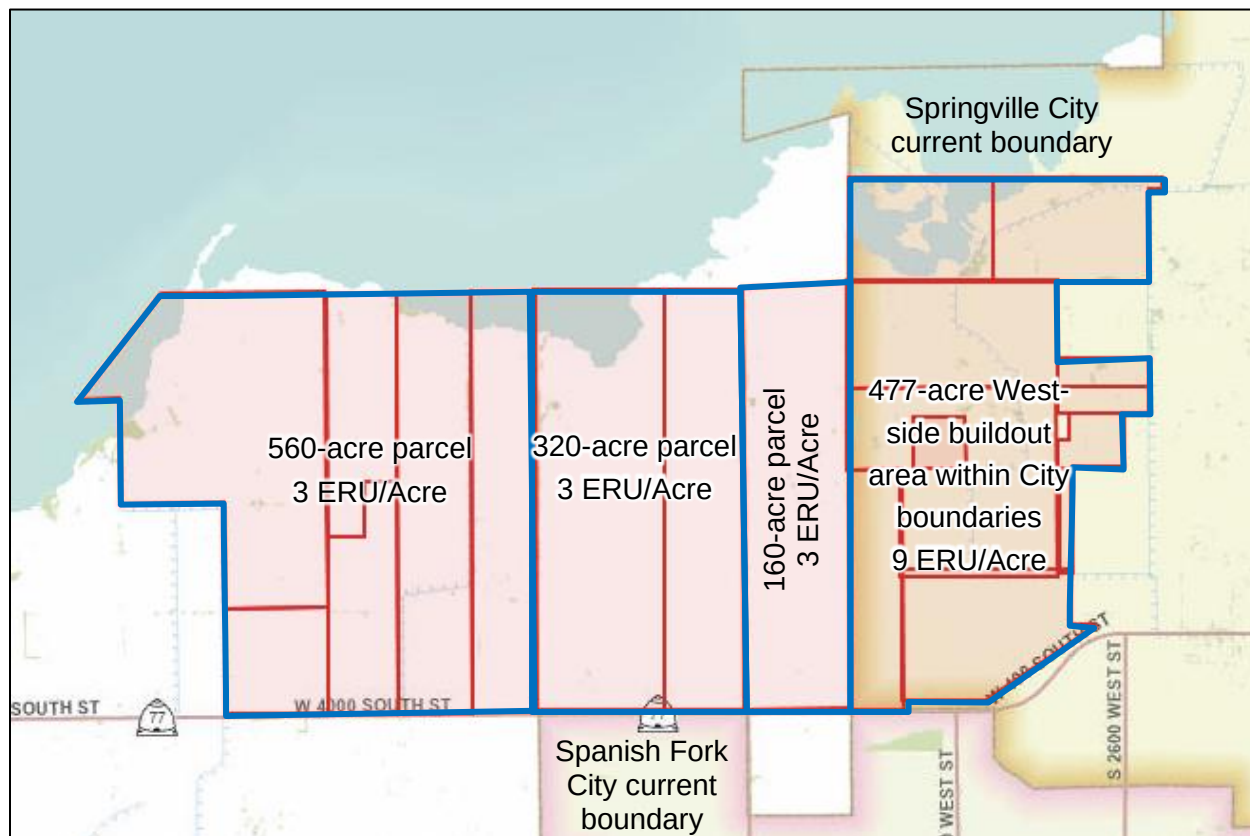


FIGURE 1: ANNEXATION STUDY BOUNDARY AND ERU DENSITY

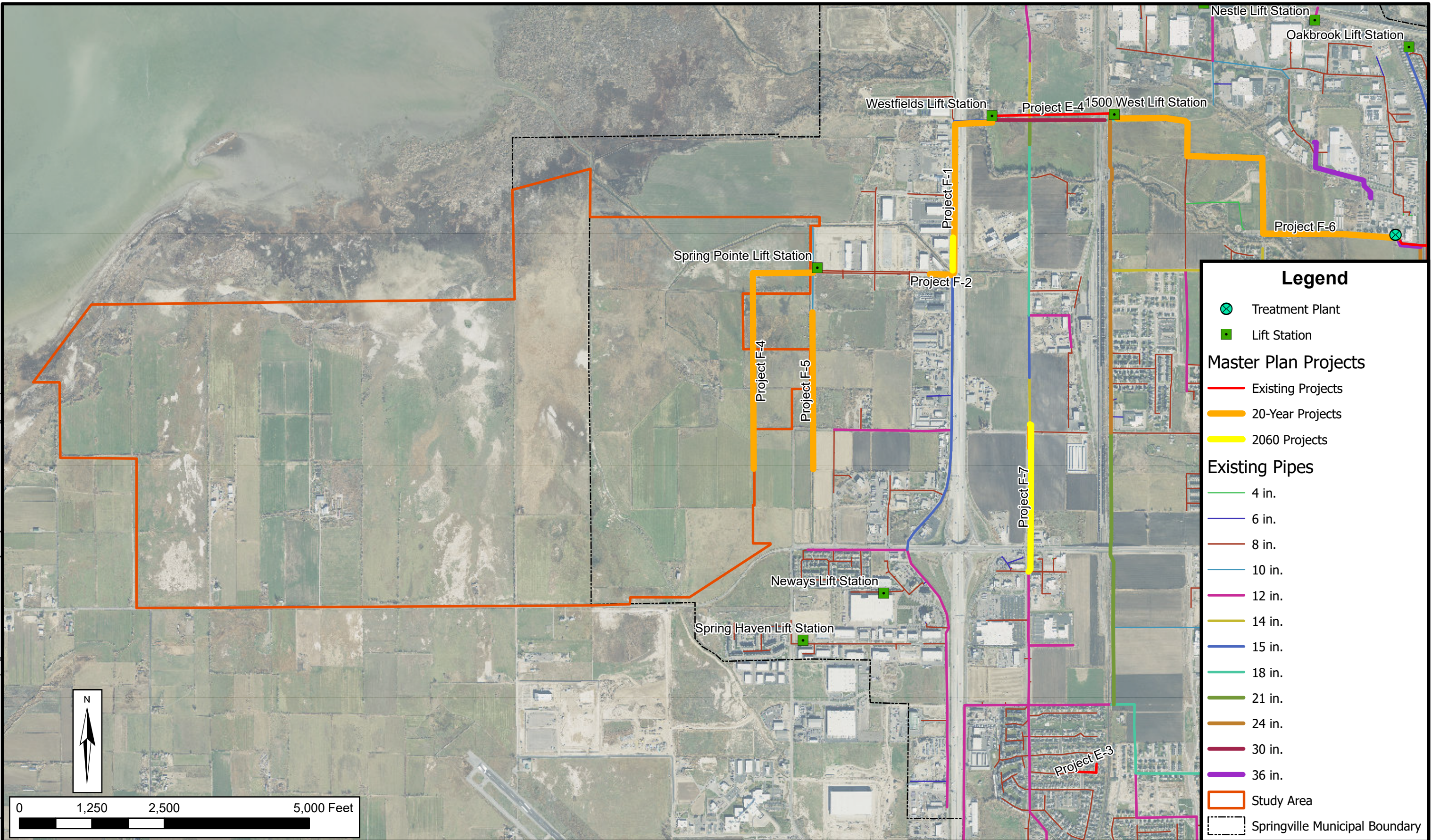
SEWER CONVEYANCE SYSTEM

The proposed developments border the current western boundary of Springville City. The development area proposes 3.6 million square feet of industrial warehouse on 320 acres; and the remaining 720 acres is assumed to be industrial development of similar density. Development in the westside of the City is growing, and HAL, in conjunction with the City, has spent a considerable amount of time studying the existing sewer system and developing plans to convey the expected loadings in the area.

Sewer conveyance in the western portions of the City and nearby faced two limiting factors. First, the ground level is relatively flat, which limits the ability to effectively utilize gravity sewer. Second, the water treatment plant is located on the eastern side of the city at a higher elevation than the westside. This means that wastewater must be pumped to the treatment plant. Due to these challenges, the City utilizes several lift stations (sewage pump stations) to convey the wastewater in the area.

As part of the Master Plan, several improvement projects were identified to convey projected flows for the area. Figure 2 shows the existing sewer infrastructure and Master Plan projects near the study area. The projected loading for the study area is expected to impact a majority of the infrastructure shown in the figure.

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SPRINGVILLE ANNEXATION STUDY

MASTER PLANNED SEWER CONVEYANCE SYSTEM

FIGURE
2

Estimated Hydraulic Loading

An ERU is the average wastewater flow from residential units. ERUs are used to express different flows with the same unit. For example, a development with 5 times the average residential flow would be assigned 5 ERUs. The Master Plan established the hydraulic loading for future developments as follows:

$$\text{Hydraulic Loading (flow) / ERU} = 250 \text{ gallons/day}$$

The hydraulic loading for the study area was calculated using the rates and assumptions from the Master Plan. Table 1 shows the hydraulic loading for the study area. Loadings are expressed in Million Gallons per Day (MGD). The development percent column in Table 1 accounts for planned development sizes, or the amount of land that is developable. This only affects the areas assumed to be industrial based on consultation with the City.

TABLE 1: HYDRAULIC LOADINGS

Development	Development Percent	ERU Density (ERU/Acre)	ERU Total	Average Hydraulic Loading (MGD)	Loading Pattern
160 Acre Parcel	75%	3	360	0.09	Industrial
320 Acre Parcel	75%	~3	708	0.18	Industrial
560 Acre Parcel	75%	3	1,260	0.31	Industrial
Sub-Total Proposed Annexation	N/A	3	2,328	0.58	Industrial
West-Side Buildout Area	100%	9	4,292	1.07	Residential
Grand Total	N/A	N/A	6,620	1.65	N/A

* Based on the area of the warehouse development (1.5 gal/month per square foot)

Typical Hydraulic Loading Patterns

The Master Plan identified three loading patterns for the City, residential, industrial, and mixed. These time patterns show peaking factors over the course of a day based on flow monitoring data. The residential and mixed time series have large peaks in the morning and milder peaks in the evening, while the industrial time series has peaks in the late morning and early afternoon. Figure 3 is a chart of the three loading patterns from the Master Plan.

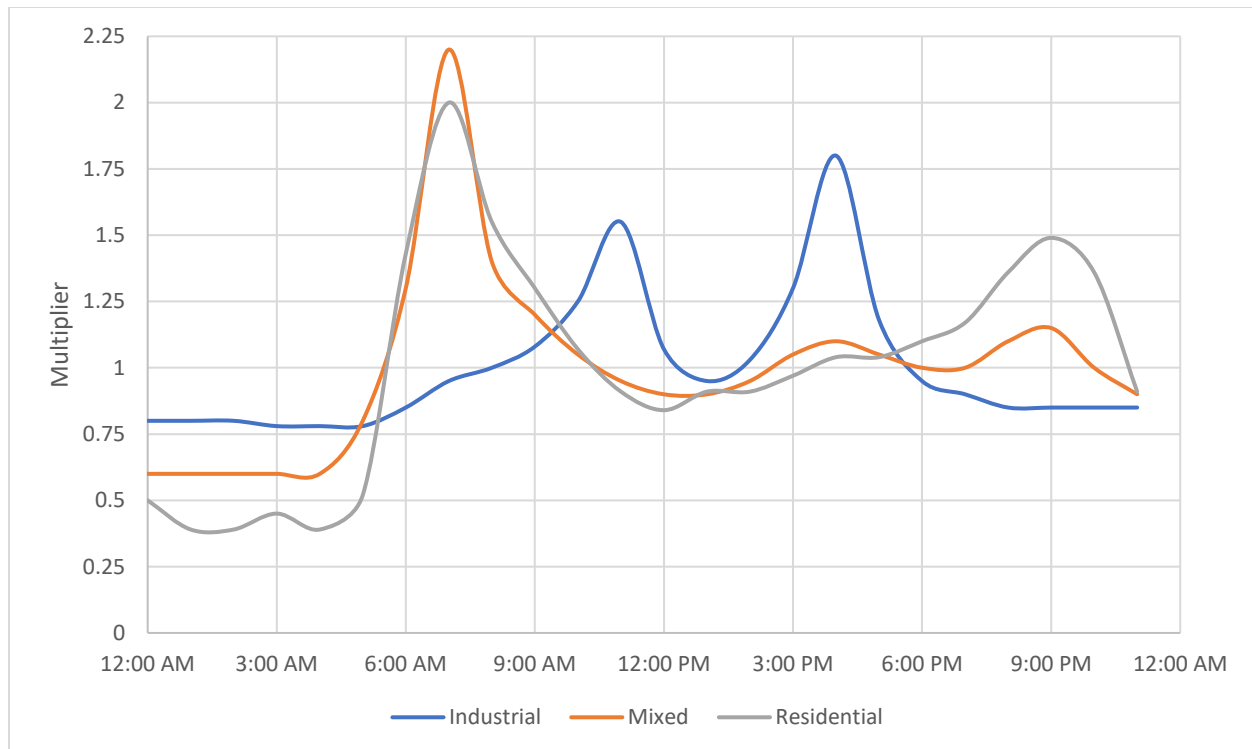


FIGURE 3: LOADING PATTERNS

ANALYSIS

Hydraulic model is a useful tool in evaluating additional sewer loadings and their impact on the system. Additionally, potential solution alternatives can be evaluated. The modeling software used in this study was Autodesk Storm and Sanitary Analysis. This software has been used in previous modeling efforts for the City, including the Master Plan. Three alternative ways to convey the sewer loading were modeled. These alternatives are the Spring Pointe alternative, the Center Street alternative, and the Force Main alternative.

These models use the 2060 forecasting from the Master Plan, and include all of the improvement projects recommended for the system. Any recommendations included in this study are made assuming all of the improvement projects from the Master Plan are implemented into the system. Recommendations are based on modeled pipe fill ratios.

Criteria

According to city standards, a pipe is insufficient when the ratio of the maximum depth in the pipe and the pipe diameter (d/D) reaches 0.75. At this point, it is recommended that the pipe be replaced with a larger pipe or that a parallel sewer is constructed.

Spring Pointe Alternative

The Spring Pointe Alternative assumes that all flows from the study area are routed to the Spring Pointe Lift Station. In this scenario, the flow from the annexation area is conveyed into a yet to be constructed future lift station. This lift station is designated as the Annex Lift station and is located at a point near the 320 Acre development in the Annexation. The Annex Lift Station, and inflow from the West-Side Buildout Area are conveyed to a 15 to 21-inch gravity sewer west of the Spring

Pointe Lift Station. Figure 4 shows the infrastructure needed for this alternative

It should be noted that the location of the Annex Lift Station was also modeled on the current Springville city boundary. This location is shown in the other two alternatives. The modeled results from both locations were minimal in all scenarios.

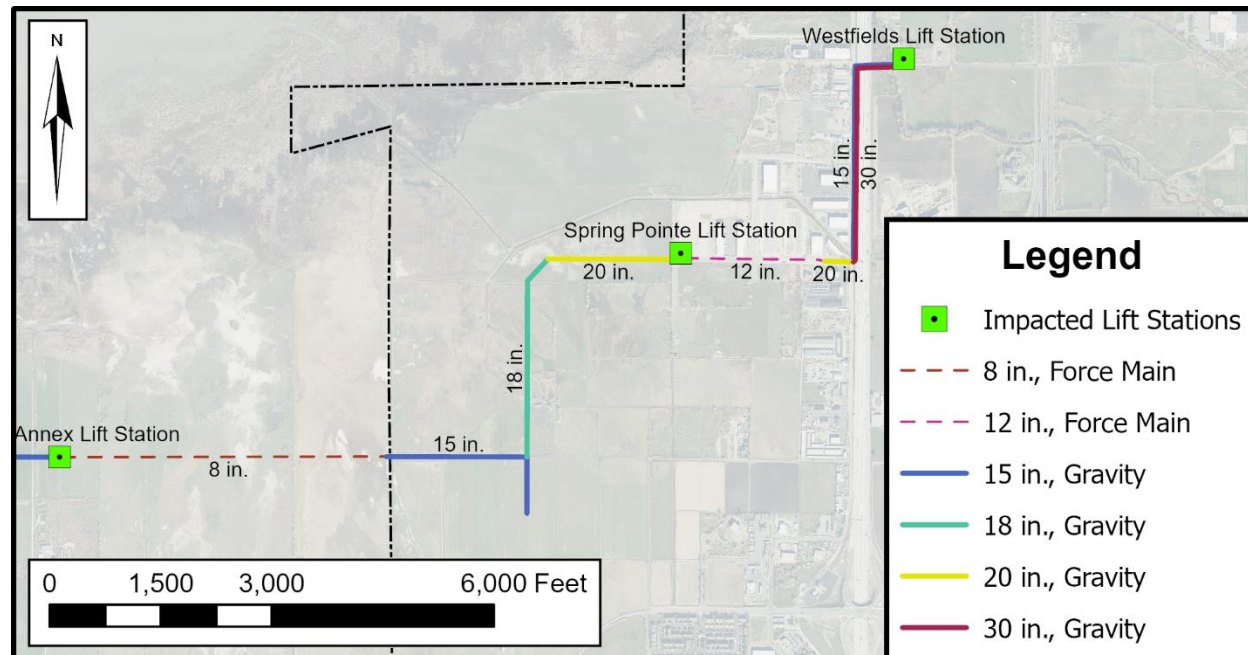


FIGURE 4: SPRING POINTE ALTERNATIVE

Currently, the Spring Pointe Lift Station is too small to receive the projected flows from this scenario. The model predicts the peak flow rate into the Spring Pointe Lift Station are near 2,600 gpm. The Master Plan includes a project to increase the pumping capacity to 900 gpm, though it should be noted that this project was created when the pumping capacity of the lift station was only 360 gpm. While this alternative is heavily reliant on lift stations, this alternative requires fewer pipe upgrades than the other alternatives and generally follows the upgrades in the Master Plan more closely.

The Westfields Lift station will also need to be upsized in this alternative. The model predicts peak flow rates into the lift station are approximately 4,100 gpm. The Master Plan includes a project to upsize the lift station and the associated force main to increase pumping capacity to 2,500 gpm. Including the expected loading from this alternative nearly doubles the necessary pumping capacity for this lift station.

Center Street Alternative

The Center Street Alternative uses similar routing as the Spring Pointe Alternative. The main difference is the Annex Lift Station connects to the gravity sewer on Center Street, rather than the planned gravity line west of the Spring Pointe Lift Station. While a large portion of flow is still routed through the Spring Pointe Lift Station, this alternative is less reliant on lift stations than the Spring Pointe Alternative. Figure 5 shows the infrastructure needed for the Center Street Alternative.

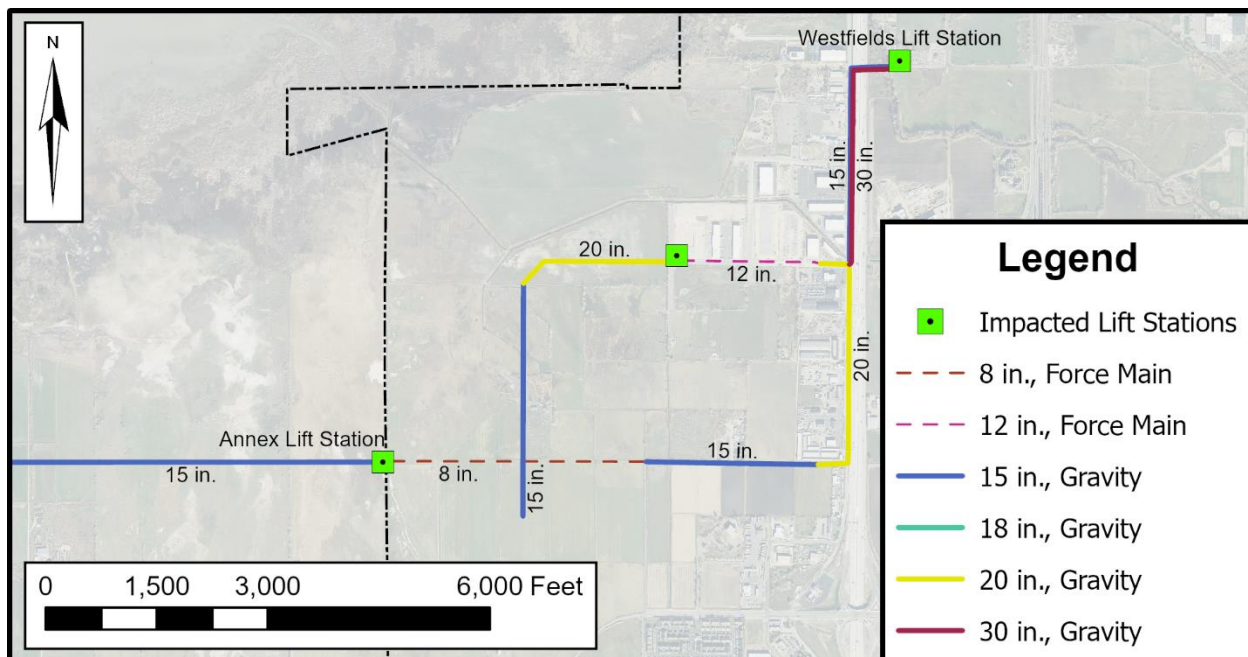


FIGURE 5: CENTER STREET ALTERNATIVE

In this alternative, the Annex Lift Station is shown on the current City boundary. Choosing this location over the previous location had minimal impacts on the model results. Moving the lift station west would increase the necessary length of the force main, but would reduce the necessary depth for the wet well. The alternative locations are discussed further in the memo.

Similar to the Spring Pointe alternative, both the Spring Pointe and Westfields Lift Stations would need to be upgraded in this alternative. However, in this alternative the inflow to the Spring Pointe Lift Station has a smaller peak flow rate of 2,300 gpm. While the reduction in inflow is not as great as expected, the reduced flow rate would require fewer/smaller lift station upgrades. Routing the flow from the annexation to avoid the Spring Pointe Lift Station require additional upgrades to the pipelines along Center Street and the Frontage Road, so the potential cost savings for the Spring Pointe Lift Station are outweighed by the additional pipeline requirements. The Westfields Lift Station sees similar peak flow rates to the Spring Pointe Alternative with peak flow rates at approximately 4,100 gpm.

Force Main Alternative

The Force Main Alternative bypasses all of the existing infrastructure on the west side of the City. In this alternative, a force main runs from the Western City Boundary to Wood Springs Drive, where the Transportation Master Plan includes plans to install a new road. From this intersection, a new gravity sewer connects to the water treatment plant inlet. This alternative would install the longest force main in the system, with a length of nearly 13,500-feet. Depending on how the sewer lines are constructed, it may be possible to shorten this force main and extend the gravity line in either direction. Figure 6 shows the required infrastructure for this alternative.

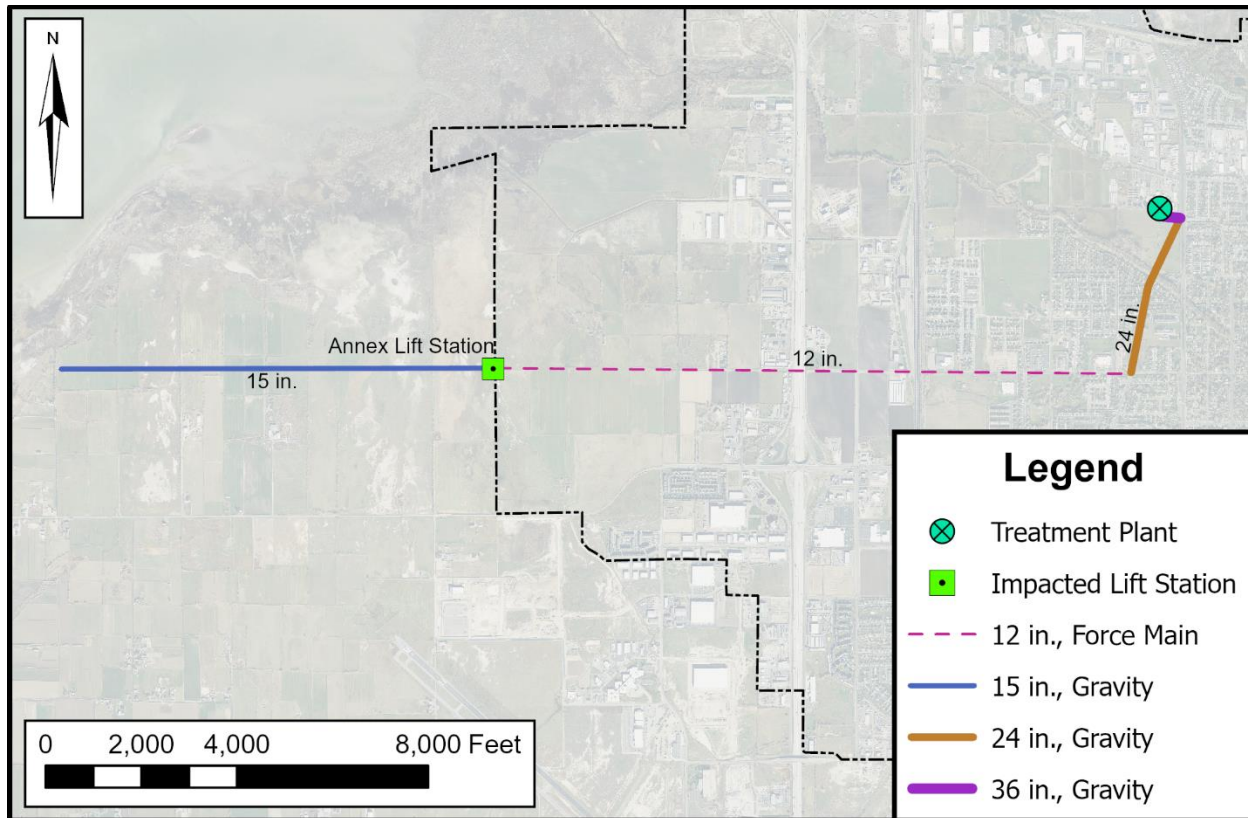


FIGURE 6: FORCE MAIN ALTERNATIVE

While this alternative would install the longest force main in the system, it has the added benefit of minimal upgrades to the existing system. All of the proposed infrastructure would be newly constructed, and the Spring Pointe and Westfields Lift Stations would be unaffected from the projected loading. Some combination of this alternative and previous alternatives is also possible, but was not evaluated in this study.

Annex Lift Station Alternatives

In all alternatives modeled, the annexation area requires a lift station to convey sewer hydraulic loadings. The terrain is generally flat and at a lower elevation than the rest of the sewer system in the City. It may be possible to run a gravity line across the entire annexation area at minimum slopes, but this will result in a deeper wet well at the lift station and will likely result in septic flows. Groundwater infiltration rates into the sewer will likely be high unless the system is constructed with special attention to seal the system. Depending on the desired depth of the wet well and the desired length and slope of the force main, the lift station could be placed west of the city boundary, on the city boundary, or east of the city boundary. Figure 4 shows an option to place the lift station about 4,500 feet west of the city boundary, and Figures 5 and 6 show the lift station on the city boundary. Modeling the lift station in different locations had little to no effect on the results of the alternatives. However, minimizing the length of low slope gravity sewers may reduce maintenance concerns, inflow and infiltration, and hydrogen sulfide protection.

It should be noted that pumping from one lift station to another creates reliance of the lift stations on each other within the chain to function properly. If one lift station fails, or is taken out of service, it will impact all the lift stations which pump to it. Additionally, introducing more mechanical equipment also introduces a greater probability that a failure could occur.

Waste Water Treatment Plant

In addition to the several improvement projects for the sewer conveyance system, the Master Plan also states that the capacity of the wastewater treatment plant has a design capacity of approximately 9.3 MGD and a permitted capacity of 6.6 MGD. Unless upgrades have been made since the completion of the Master Plan, the peak inflow to the treatment plant is expected to reach its design capacity by 2038. By 2060, the Master Plan predicted the peak inflow to the treatment plant to reach 11.0 MGD. The additional loading from this study puts the peak inflow to the wastewater treatment plant at around 14.0 MGD. If this area is to be serviced by the existing treatment plant, major upgrades will be necessary.

A nearby City has recently built a new wastewater treatment plant that meets the more stringent effluent standards required by the state. The total construction cost of the plant was approximately \$14 M with a capacity of treating 3 MGD of wastewater. This could give the City a ballpark estimate of treatment costs for additional upgrades they will eventually need. A rough estimate could be \$5 M for per 1 MG of treated wastewater.

COST ESTIMATES

Typical representative unit costs were used to development the project construction cost estimates. Sources of typical unit costs included HAL's bid tabulation records for similar recent projects in Utah, and the RS Means Heavy Construction Cost Index. All of the cost estimates include an additional 35% for Engineering and Contingency.

ACCURACY OF COST ESTIMATES

When considering cost estimates, there are several levels or degrees of accuracy, depending on the purpose of the estimate and the percentage of detailed design that has been completed. The following levels of accuracy are typical:

<u>Type of Estimate</u>	<u>Accuracy</u>
Master Plan	-50% to +100%
Preliminary Design	-30% to +50%
Final Design or Bid	-10% to +10%

For example, at the master plan level (or conceptual or feasibility design level), if a project is estimated to cost \$1,000,000, then the accuracy or reliability of the cost estimate would typically be expected to range between approximately \$500,000 and \$2,000,000. While this may not seem very accurate, the purpose of master planning is to develop general sizing, location, cost and scheduling information on a number of individual projects that may be designed and constructed over a period of many years. Master planning also typically includes the selection of common design criteria to help ensure uniformity and compatibility among future individual projects. Details such as the exact capacity of individual projects, the level of redundancy, the location of facilities, the alignment and depth of pipelines, the extent of utility conflicts, the cost of land and easements, the construction methodology, the types of equipment and material to be used, the time of construction, interest and inflation rates, permitting requirements, etc., are typically developed during the more detailed levels of design.

Cost Estimates for the three alternatives presented can be found in Tables 2-5. Table 5 shows the cost estimates for each alternative.

TABLE 2: SPRING POINTE ALTERNATIVE COST ESTIMATE

Component	Current Size/Master Plan Project	Upgrade Needed	Cost Estimate
Annex Lift Station	N/A	Install lift station capable of handling peak flows of 705 gpm and 400 gpm average flows	\$1,350,000
Annex Force Main	N/A	Install 4,390 feet of 8" force main (Depends on the construction of Lift Station)	\$860,000
Annex Gravity Line Inlet	N/A	Install 5,350 feet of 15" gravity line	\$2,896,000
Annex Lift Station Gravity Line Outlet	N/A	Install 1,900 feet of 15" gravity line. (Depends on the construction of Lift Station)	\$1,030,000
Western Gravity Line (Project F-4)	4,500 feet of 10" gravity line	Reroute pipeline to follow future road plans. Install 765 feet of 15" gravity line, 2,375 feet of 18" gravity line, and 2,122 feet of 21" gravity line	\$3,080,000
Frontage Road Parallel Pipe (Project F-1)	3,300 feet of 15" parallel gravity line	Upsize parallel gravity line to 30"	\$3,060,000
Spring Pointe Gravity Line (Project F-2)	Replace existing 10" line with a 400 foot 15" line	Upsize gravity line to 21" gravity line (Depends on the construction of the lift station)	\$250,000
Spring Pointe Lift Station (Project F-6)	Construct an additional lift station to increase pump capacity to 900 gpm	Upsize lift station to be capable of handling 2,650 gpm peak flows and 1,600 gpm average flows	\$2,700,000
Westfields Lift Station (Project F-11)	Construct an additional lift station to increase pump capacity to 2,500 gpm	Upsize lift station to be capable of handling 4,400 gpm peak flows and 3,000 gpm average flows. Requires an additional 9,000 ft of 14-inch force main from Westfields to treatment plant	\$6,500,000
Sub-Totals			\$21,726,000

TABLE 3: CENTER STREET ALTERNATIVE COST ESTIMATE

Component	Current Size/Master Plan Project	Upgrade Needed	Cost Estimate
Annex Lift Station	N/A	Install lift station capable of handling peak flows of 705 gpm and 400 gpm average flows	\$1,350,000
Annex Force Main	N/A	Install 3,500 feet of 8" force main (Depends on the construction of Lift Station)	\$690,000
Annex Gravity Line Inlet	N/A	Install 9,200 feet of 15" gravity line	\$5,000,000
Western Gravity Line (Project F-4)	4,500 feet of 10" gravity line	Reroute pipeline to follow future road plans. Install 3,140 feet of 15" gravity line & 2,125 feet of 21" gravity line	\$3,000,000
Frontage Road Parallel Pipe (Project F-1)	3,300 feet of 15" parallel gravity line	Upsize parallel gravity line to 30"	\$3,060,000
Center Street Road	1,625 feet of 12" gravity line	Upsize gravity line to 15" and extend line 700 feet west	\$1,260,000
South Frontage Road	3,080 feet of 15" gravity line	Upsize gravity line to 21"	\$1,890,000
Spring Pointe Gravity Line (Project F-2)	Replace existing 10" line with a 400 foot 15" line	Upsize gravity line to 21" gravity line (Depends on the construction of the lift station)	\$250,000
Spring Pointe Lift Station (Project F-6)	Construct an additional lift station to increase pump capacity to 900 gpm	Upsize lift station to be capable of handling 2,300 gpm peak flows and 1,300 gpm average flows	\$2,430,000
Westfields Lift Station (Project F-11)	Construct an additional lift station to increase pump capacity to 2,500 gpm	Upsize lift station to be capable of handling 4,400 gpm peak flows and 3,000 gpm average flows. Requires an additional 9,000 ft of 14-inch force main from Westfields to treatment plant	\$6,500,000
Sub-Totals			\$25,430,000

TABLE 4: FORCE MAIN ALTERNATIVE COST ESTIMATE

Component	Current Size/Master Plan Project	Upgrade Needed	Cost Estimate
Annex Lift Station	N/A	Install lift station capable of handling 2,030 gpm peak flows and 1,200 gpm average flows	\$2,700,000
Annex Force Main	N/A	Install 13,275 feet of 12" force main	\$3,260,000
Annex Gravity Line Inlet	N/A	Install 9,200 feet of 15" gravity line	\$4,980,000
New Gravity Line	N/A	Install 3,410 feet of 24" gravity line	\$2,170,000
Sub-Totals			\$13,110,000

TABLE 5: COST COMPARISON

Alternative	Cost Estimate
Spring Pointe Alternative	\$21,726,000
Center Street Alternative	\$25,430,000
Force Main Alternative	\$13,110,000

CONCLUSION AND RECOMENDATIONS

Due to the relatively flat slopes and location of the potential annexation area, providing sewer service will be difficult. Most of the proposed gravity sewers would need to be laid at or near minimum slopes, which in turn requires larger pipes when compared with areas that have more slope. Additionally, lift stations are required to get the wastewater flows to the wastewater treatment facility. Three alternatives were presented with various configurations. Two of the three include pumping from one lift station to another which creates increased dependency of one lift station on another. This should be considered when making decisions and constructing future lift stations so that adequate redundancy is provided including but not limited to backup generators, redundant pumps, and routine maintenance. The low sewer flows will likely cause the development of septic flows with hydrogen sulfide generation. This may require additional operator training and safety procedures and will require special construction to avoid acidic corrosion of the manholes and pipes.

It would appear that the solution with the lowest initial capital cost would be to require the annexation area to design their wastewater collection system to flow to a common lift station that would pump to a force main that would run parallel with Center Street all the way to a point where gravity lines could be installed to send the flows to the wastewater treatment plant. This option does require a long force main (13,275 ft), but the other options also require a relatively long force main upgrade for Westfields as well (9,200 ft).

As noted in the report the existing wastewater treatment plant capacity is only 9.3 MGD. Projected peak flows from the Master Plan indicated that by 2038 upgrades would be required. It is our understanding that the WWTP headworks are believed to be currently deficient and should be

further evaluated. The Annexation area depending on how quickly it develops could expedite that need. The current Master Plan projects peak flows to the treatment plant at 11 MGD. Including the Annexation, the peak flows increase to approximately 14 MGD. It is likely that significant upgrades at the treatment plant will be required to accommodate future flows as well as potential flows from the Annexation area. As so many changes have occurred since the last master plan was completed it may be in the City's interest to complete an update to their current plan to capture changes in assumptions and locations of developments.