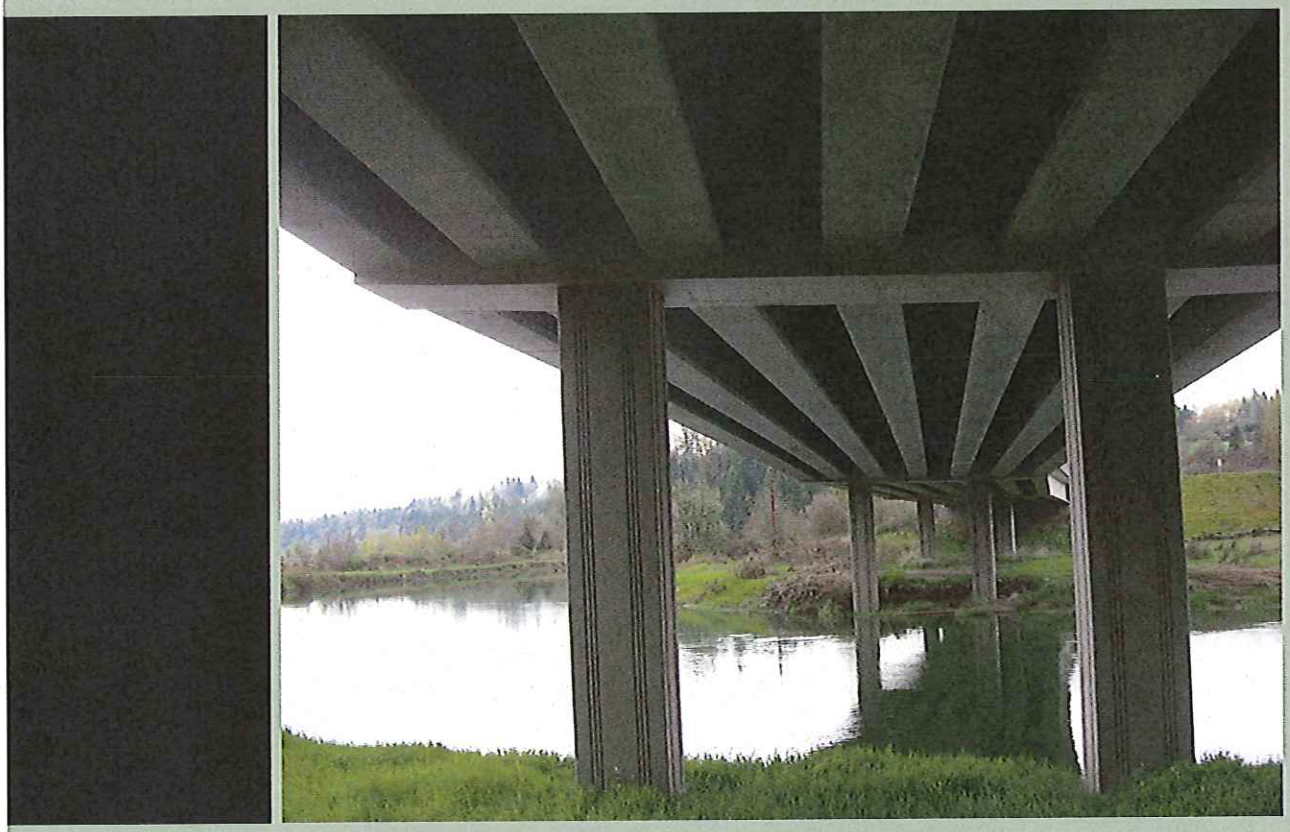
La Center Junction Sewer Study

Prepared for:
City of La Center, WA



otak

May 2011

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Acknowledgements

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Executive Summary

The Urban Growth Area (UGA) for the City of La Center has been expanded west to the intersection of La Center Road and Interstate 5 (I-5), and the City is developing a plan to provide sanitary sewer service to the junction. Options for providing conveyance were first studied in 2009, using the City's planned zoning for that area. In the fall of 2010, the Bureau of Indian Affairs approved the incorporation of land west of I-5 along both sides of La Center Road for a reservation for the Cowlitz Tribe, who plans to build a casino on this property. The City has requested that Otak further study sanitary sewer options for the junction, sizing facilities using new flow rates reflecting a casino at the junction.

The City's plan shows a conveyance system in La Center Road, crossing the La Center Bridge over the East Fork of the Lewis River, and then connecting to existing sewer pipes in La Center Road on the north side of the bridge. The plan called for a pump station on the west side of Eagle Crest Hill, at McCormick Creek, and a siphon to cross the La Center Bridge (the bridge slopes down from north to south). The City has asked that these plans be reviewed with this study.

This report addresses revisions to pipe sizing to accommodate casino flows, which are significantly higher than flows originally anticipated. It also discusses and reviews the following:

- Options for crossing Eagle Crest Hill, including pumping over or tunneling through the hill; and
- Options for crossing the East Fork of the Lewis River at the La Center Bridge.

The study area is currently in unincorporated Clark County, and no sewer service (conveyance or treatment) exists for this area. Homes and businesses currently use septic tanks and drain fields to dispose of wastewater.

With the construction of a new bridge over the East Fork of the Lewis River in 2000, provisions were made to install an 8-inch pipeline on the bridge. Holes were cored through the abutments and piers, and pipes were installed in the roadway north and south of the bridge. Similar provisions were made for the installation of a 6-inch natural gas pipe on the east side of the bridge, but this pipe was never installed.

Flow projections for the area tributary to this collection system were provided in five year increments (from 2016 to 2031) by the City. These projections are included in Appendix A.

Six options were developed for conveying wastewater from the La Center Junction to the City's wastewater treatment plant (WWTP). These options are:

Executive Summary
Continued

- **Option 1:** Installation of a lift station at McCormick Creek, and a lift station south of the La Center Bridge.
- **Option 2:** Installation of a lift station at McCormick Creek with 6-inch and 8-inch siphons on the La Center Bridge, and a 12-inch siphon under the East Fork of the Lewis River.
- **Option 3:** Installation of a lift station at McCormick Creek, and a siphon using 6-inch, 8-inch, and 12-inch pipes under the river at the La Center Bridge.
- **Option 4:** Horizontal directional drilling through Eagle Crest Hill, and a lift station south of the La Center Bridge.
- **Option 5:** Horizontal directional drilling through Eagle Crest Hill, and 6-inch and 8-inch siphons on the La Center Bridge and a 12-inch siphon under the East Fork of the Lewis River.
- **Option 6:** Horizontal directional drilling through Eagle Crest Hill, and a siphon using 6-inch, 8-inch, and 12-inch pipes under the river at the La Center Bridge.

Each option was reviewed for constructability, environmental permitting, maintenance and operations, and cost. Option 2 has the lowest capital construction cost, is the easiest to permit, and is also likely the easiest to maintain.

Phasing of projects within each option was also reviewed. Phases were developed with the following parameters in mind:

- Where a single gravity pipe or force main is recommended, the pipe is sized for the peak hour ultimate build-out flow.
- Where multiple pipes are recommended, phased plans are developed so pipes not immediately needed can be installed when needed.
- Infrastructure for the pump station will be built for the ultimate peak hour flow rate. Pumps and electrical equipment that are normally replaced after 15 to 20 years have been phased.

Criteria from Ecology's *Criteria for Sewage Works Design* (Ecology, 2008) were used for sizing all facilities.

Table ES-1 lists the phased projects for each option, the estimated cost for each option, the flow rate that triggers the project, and the estimated year that flow is reached, based upon flow projections provided by the City.

Table ES-1: Option Phases and Cost Estimates

Option	Phase	Phase Description	Flow Trigger (gpm)	Approx. Year Triggered	Total Estimated Project Cost
1	Phase 1	Installation of gravity pipes, pump stations and force mains.	NA		$7,277,751
	Phase 2	Installation of 6-inch FM and replacement of pumps at LCRLS and LCBLS.	1402	2031	$664,346
	Total Project Cost				**$7,942,097**
2	Phase 1	Installation of gravity mains, LCRLS and force main pipes and 6- and 8-inch siphons.	NA		$5,892,588
	Phase 2	Installation of 12-inch siphon under river	861	2019	$929,633
	Phase 3	Replacement of pumps at LCRLS.	1278	2031	$150,452
	Total Project Cost				**$6,972,673**
3	Phase 1	Installation of gravity mains, LCRLS and force main pipes and 6-, 8- and 12-inch siphons.	NA		$7,111,506
	Phase 2	Replacement of pumps at LCRLS.	1278	2031	$150,452
	Total Project Cost				**$7,261,958**
4	Phase 1	Installation of gravity mains, HDD pipe and LCBPS and force main.	NA		$9,679,344
	Phase 2	Installation of 6-inch FM and replacement of pumps at LCBLS.	1402	2031	$525,296
	Total Project Cost				**$10,204,640**
5	Phase 1	Installation of gravity mains, HDD pipe and 6 and 8-inch siphons.	NA		$8,089,994
	Phase 2	Installation of 12-inch siphon under river.	861	2019	$929,633
	Total Project Cost				**$9,019,627**
6	Phase 1	Installation of gravity mains, HDD pipe and 6-, 8- and 12-inch siphons.	NA		$9,303,992
	Total Project Cost				**$9,303,992**

1.0 Introduction/Background

In September 2007, Clark County Board of Commissioners approved an extension of La Center's Urban Growth Area (UGA) to the I-5 La Center Junction. A study and predesign report completed by the La Center Public Works Department in October 2009 recommends a plan to provide wastewater collection service to the La Center Junction, including a collection system along La Center Road, a sewage lift station at McCormick Creek and a siphon under the La Center Bridge.

The system proposed in the City's 2009 study was sized for anticipated zoning and land use for the UGA expansion at that time. Since then, the development of a casino has been approved for the west side of the La Center Junction. This report discusses revisions and expansions to the City's study to address casino flows, which are significantly higher than flows anticipated in the 2009 study. It also discusses and reviews the following:

- Sizing of a wastewater conveyance system for the La Center Junction, and for areas between the junction and downtown La Center;
- Options for crossing Eagle Crest Hill, including pumping over or tunneling through the hill;
- Options for crossing the East Fork of the Lewis River at the La Center Bridge;
- A phasing plan for system improvements with flow triggers for the implementation of phases, and
- Cost estimates for each system phase.

The study area is shown in Figure 1.

1.0 Introduction/Background

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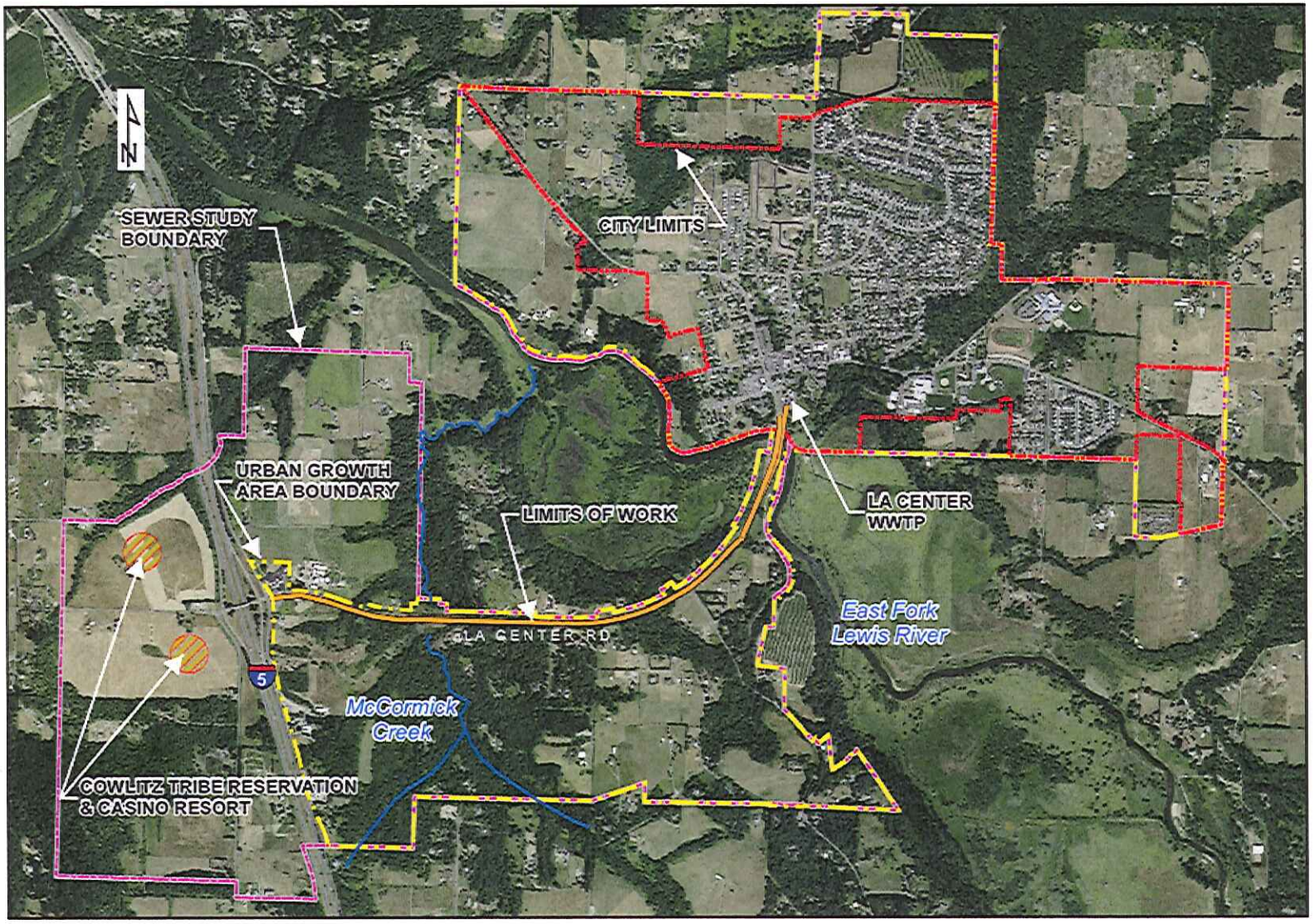

Figure 1: Limits of Study Area

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2.0 Existing Infrastructure

The La Center Junction and areas between the junction and downtown La Center are not currently served by a wastewater collection system. These areas are in unincorporated Clark County and the homes and commercial establishments have septic tanks and drain fields.

With construction of the La Center Bridge in 2000, 8-inch sanitary sewer force mains were installed on the north and south sides of the bridge. The existing force main north of the bridge includes approximately 130 feet of 8-inch HDPE (High Density Polyethylene) that is connected on its north end to an existing sanitary sewer manhole located within Pacific Highway. Sewage from this manhole flows by gravity to the City's Wastewater Treatment Plant (WWTP).

The existing force main south of the bridge includes approximately 370 feet of 8-inch HDPE that ends under the northbound lane of La Center Road. Construction drawings show a blowoff assembly and valve at this location, but these items are either buried or were not installed.

The bridge has block-outs within the abutments and piers to allow for installation of the 8-inch force main on the bridge. The bridge also has block-outs for a 6-inch pipe that was intended to be used for a natural gas pipeline. However, this line was never installed and these block-outs are available for use.

Figure 2: Image of 8-Inch Block-Out under the Bridge

3.0 Proposed Sewer Demands

Anticipated sewer flows are necessary to size the sewer collection system components. Future sewer demands were provided by the City and are included in Appendix A. The collection system has been broken down into segments for sizing facilities and developing projects. Each segment is shown in Figure 3 and is described as follows:

- Segment A – La Center Road from NW 26th Avenue to McCormick Creek.
- Segment B – La Center Road from McCormick Creek to NW Timmen Road. If a lift station is constructed at McCormick Creek, Segment B includes a force main to the top of Eagle Crest Hill, and a gravity main to Timmen Road.
- Segment C – La Center Road from Timmen Road to the La Center Bridge. Future sewer connection from east would connect at La Center Bottoms.
- Segment D – La Center Road at the La Center Bridge.

The flow projections provided by the City have been tallied to size the systems in each of the above segments. These projected flows are shown in Table 1.

Table 1: Projected Sewer Flows Contributing to Project Segments

	Segment A	Segment B	Segments C & D
2016 Sewer Demands (GPM)			
Minimum 24-Hour	70	70	71
Average Daily	183	183	188
Maximum Month	290	290	297
Peak Hour	614	614	629
2021 Sewer Demands (GPM)			
Average Daily	278	306	324
Maximum Month	436	477	505
Peak Hour	893	976	1,031
2031 Sewer Demands (GPM)			
Average Daily	337	412	454
Maximum Month Daily	523	637	699
Peak Hour	1,051	1,278	1,402
Ultimate Build-Out Sewer Demands (GPM)			
Average Daily	536	668	727
Maximum Month Daily	805	1,003	1,090
Peak Hour	1,707	2,103	2,279

3.0 Proposed Sewer Demands

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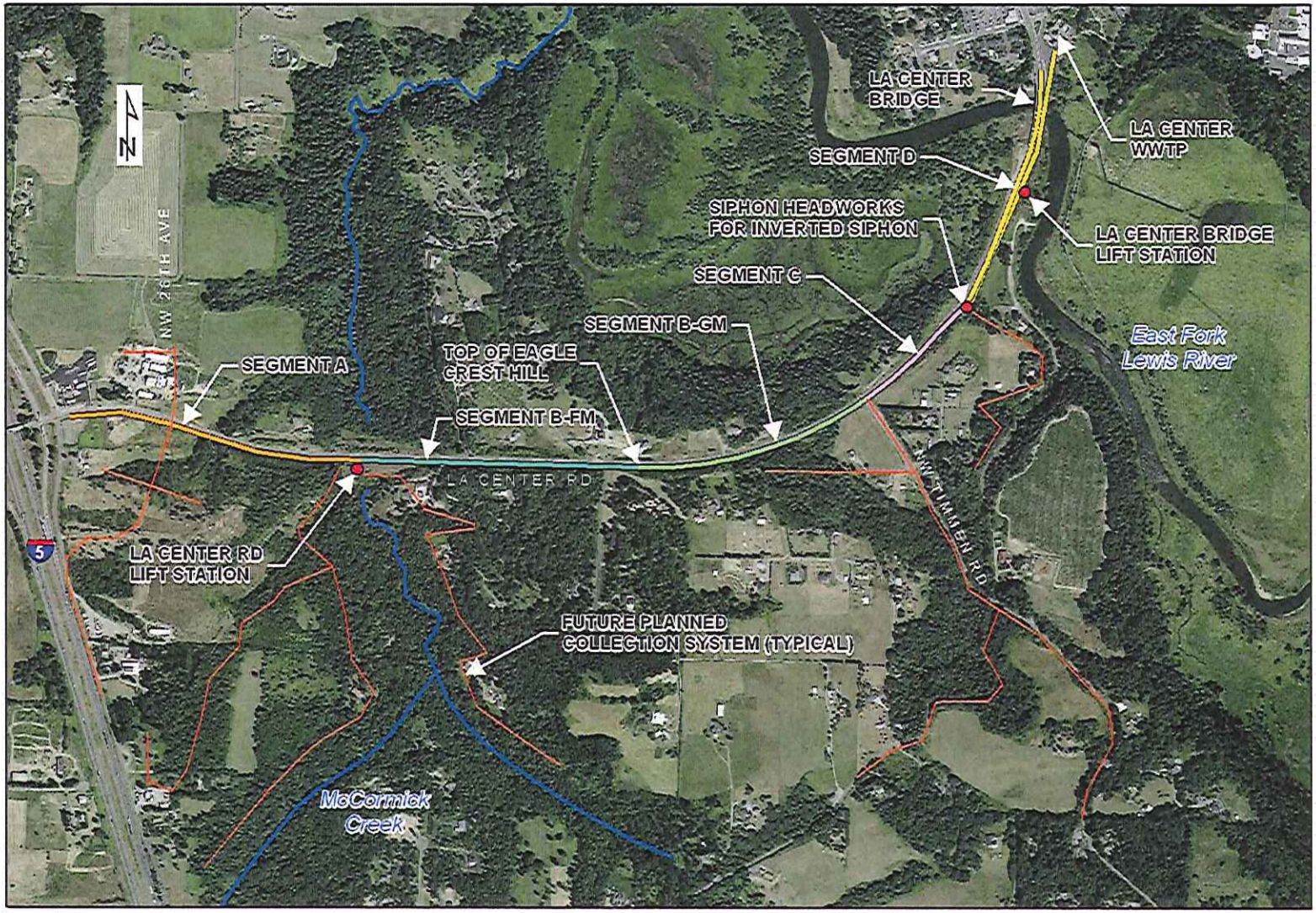

Figure 3: Segment Locations

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4.0 Collection System Alternatives

Alternatives have been reviewed for conveying sewage from the La Center Junction to the WWTP. The two locations where different methods of conveyance have been analyzed are the Eagle Crest Hill area and the La Center Bottoms area. Each is described below. Following a discussion of each alternative, costs are presented, and a recommendation is discussed.

4.1 Eagle Crest Hill Area

The elevation along La Center Road begins around 260 feet at the I-5 La Center Junction and drops rapidly to elevation 156 feet at McCormick Creek, approximately 2,800 feet to the east. From McCormick Creek the elevation rises again to approximately 270 feet at the top of Eagle Crest Hill, approximately 2,000 feet further east, before falling again towards the East Fork of the Lewis River and downtown La Center.

Two options were reviewed for conveying flows over Eagle Crest Hill. One option is the installation of a lift station located at the bottom of the hill near McCormick Creek, and the second option considers the installation of a gravity main tunneled through Eagle Crest Hill. Each option is discussed further below.

Lift Station

The City identified a site for a lift station on the west side of McCormick Creek and the south side of La Center Road. This is a sloping area within the La Center Road right-of-way that, with grading, provides ample room for a lift station, with available access from La Center Road.

For costing and evaluation purposes, it was assumed this station would be a three-pump, submersible lift station with a circular wet well. To meet Washington State Department of Ecology (Ecology) requirements, the station would be sized for the peak-hour flow using two pumps, with the third pump provided for redundancy. The wet well and other infrastructure would be sized for the ultimate peak hour flow, while the pumps would be sized to convey the 20-year peak hour flow rate. A 12-inch force main would convey the flows to the top of Eagle Crest Hill, where a 12-inch gravity system would convey the flows down the opposite side of the hill.

Note that a single 12-inch force main results in low velocities during the early years of operation. If scouring velocities (typically 3 to 3.5 fps) do not routinely occur in the pipe, it can result in sediment deposition that can clog pipes. This can be remedied by frequent pipe cleaning (pigging of the lines), or two smaller diameter pipes can be installed. The first pipe would be used for lower flows and would provide for higher velocities with those lower flows, and the second pipe would be used as flows increase. However, this can add upwards of $100,000 to the installation costs. This should be studied further during preliminary design if a lift station option is selected.

4.0 Collection System Alternatives
Continued

Gravity Installation

To avoid the need for a lift station to convey sewage over Eagle Crest Hill, a gravity main could be constructed through the hill. As the depth of installation is too great for open cut methods, the use of trenchless technology would be necessary. After consultation and review with trenchless technology experts, it was concluded that Horizontal Directional Drilling (HDD) is the most suitable method. HDD involves drilling a pilot hole with a drill that can be steered and tracked from the surface, and pulling the conveyance pipe back through the pilot hole. The pilot hole is enlarged as needed by pulling back increasingly larger reamers, or reaming heads, until the hole reaches the proper size for pulling back the conveyance pipe.

HDD is suited for the long lengths and curvature that would be required for this installation. However, if the slope of the gravity sewer is too flat, the tolerances of an HDD installation are such that it may not result in an installation at the required slope. The minimum recommended slope is two percent, and the use of a slope flatter than two percent could result in flat spots or a reverse grade in the alignment.

With a slope of two percent, the pipeline would be very deep between Timmen Road and the La Center Bridge, and a pipeline crossing on the La Center Bridge would not be possible. However, if a lift station was used for conveying sewage across the La Center Bridge, a slope of two percent could be used. A slope of 1.5 percent allows connection to a pipeline crossing on the La Center Bridge. For the purpose of evaluation and costing in this study, a slope of 1.5 percent has been assumed.

Figure 4: Eagle Crest Hill Area

4.0 Collection System Alternatives
Continued

4.1.1 Comparison of Options for Crossing Eagle Crest Hill

Constructability

A lift station of the size and type proposed at McCormick Creek is routinely used in the wastewater industry, and the construction is relatively straightforward. As there is a guardrail along La Center Road where the lift station is planned, access to the site would be from the east, and an access road approximately 800 feet long would be needed. As the site is sloping, extensive grading and possibly retaining walls will be required to make the site suitable for construction.

A geotechnical study and complete review with trenchless technology experts will be necessary to fully determine whether an HDD installation through Eagle Crest Hill is feasible. It is a long drill (approximately 5,000 feet) and with a fairly large diameter pipe (14-inches).

The installation of the gravity sewer through the Eagle Crest Hill would require a specialty contractor with significant experience in similar installations. Although HDD operations of this scale are more commonplace than in the past, it is still an inherently risky and expensive method of pipeline installation. In addition, this pipeline would likely need to be installed at less than the minimum recommended slope, making flat spots or areas of very low slope a likely possibility.

Environmental Permitting

As long as the lift station is placed far enough away from McCormick Creek (as is currently planned), and there are no wetlands on the selected site, there should not be any significant environmental permitting requirements for either of these options.

Cost

As Table 2 shows, capital construction costs for the HDD installation are more than double the cost of the pump station and pipeline. However, long term costs for the maintenance and operation of the pump station will likely be higher than the HDD. A life cycle cost analysis would be necessary, using data from similar pump stations, to determine the time required before the capital and M&O costs of the pump station exceed the capital and M&O costs of the gravity sewer. More information on cost estimates can be found in Section 4.6.

Table 2: Eagle Crest Hill Component Costs

Component Description	Cost
La Center Road Lift Station/Force Main	$1,622,360
Horizontal Directional Drill	$3,345,200

Maintenance and Operations

With the HDD there would be a 5,000 foot long expanse of gravity sewer pipe where no access is available for cleaning or maintenance. This pipe will be up to 150 feet below existing ground in places. Routine maintenance such as cleaning would be very challenging with this pipe, and because the installation would be at a flat slope, there is potential for sediment deposition and build-up.

Pump stations require significant and continuous investments in operations and maintenance, including the need for the equipment replacement. Most pump stations require inspections on a weekly or more frequent basis, but as these are common in the industry, the maintenance and operations needs for a pump station are well known.

4.2 La Center Bridge

The roadway elevation on the south side of the La Center Bridge is lower than the north side, making a gravity system that follows the surface grade impossible. An option to construct a pipe bridge, either integral with the La Center Bridge, separate, or a combination of integral and separate, was considered in this study. To achieve adequate cover over the sewer pipe on the south side of the bridge and adequate slope for scouring velocities, the pipe would need to be suspended approximately four feet below the bottom of the girders on the north end of the bridge. Currently, an access road to a boat ramp is located beneath the north end of the bridge and adequate clearance for boats and trailers may not be available if the pipe was suspended this far below the bridge.

An option to construct a separate pipe bridge that would avoid the boat ramp was evaluated. This bridge would need to be constructed east of the La Center Bridge to avoid the boat ramp access road and connect to the treatment plant. The bridge would also need to be tall enough to avoid flood and debris flows in the East Fork of the Lewis River. In discussions with the City, these factors, along with aesthetic concerns, made this option not worthy of further consideration.

With a gravity crossing of the river not feasible, conveyance of sewage would need to occur through a pressurized system. The two options considered were a lift station and an inverted siphon. These options are discussed further.

Lift Station

A lift station could be placed on the east side of La Center Road to pump flows through the existing 8-inch pipe. This pipe could carry the expected full build-out flow of 2,279 gpm with acceptable TDH and horsepower. However, the velocity is significantly above Ecology's recommended maximum of eight feet per second (fps). There are existing knockouts on the east side of the bridge that could accommodate a 6-inch pipe. Using both force mains to carry the flows reduces the velocities closer to the recommended rates specified by Ecology.

4.0 Collection System Alternatives
Continued

For costing and evaluation purposes, it was assumed this station would be a three-pump, submersible constant speed pump station with a circular wet well. To meet Washington State Department of Ecology (Ecology) requirements, the station would be sized for the peak-hour flow using two pumps, with the third pump provided for redundancy. The wet well and other infrastructure would be sized for the ultimate peak hour flow, while the pumps would be sized to convey the 20-year peak hour flow rate.

The 6-inch force main could be installed with the pump station or it could be installed in the future, when peak hour flows reach 1,486 gpm (beyond year 2031, see Table 1).

As with the station at McCormick Creek, a pump station of this size is common in the wastewater industry, and both the design and operation is fairly straightforward. The main consideration with installation of a pump station is the continued expense, in energy costs, in maintenance and in replacement of parts.

Siphons

Several options have been considered for constructing an inverted siphon to cross the river. Those that involve increasing the size of the existing bridge knockouts and those requiring new knockouts were not considered with this study due to the complexity and uncertainty of the options. A structural analysis of the bridge would be necessary to evaluate these options. The options evaluated with this study include installing two pipes under the bridge and one pipe under the river or installing three pipes under the river.

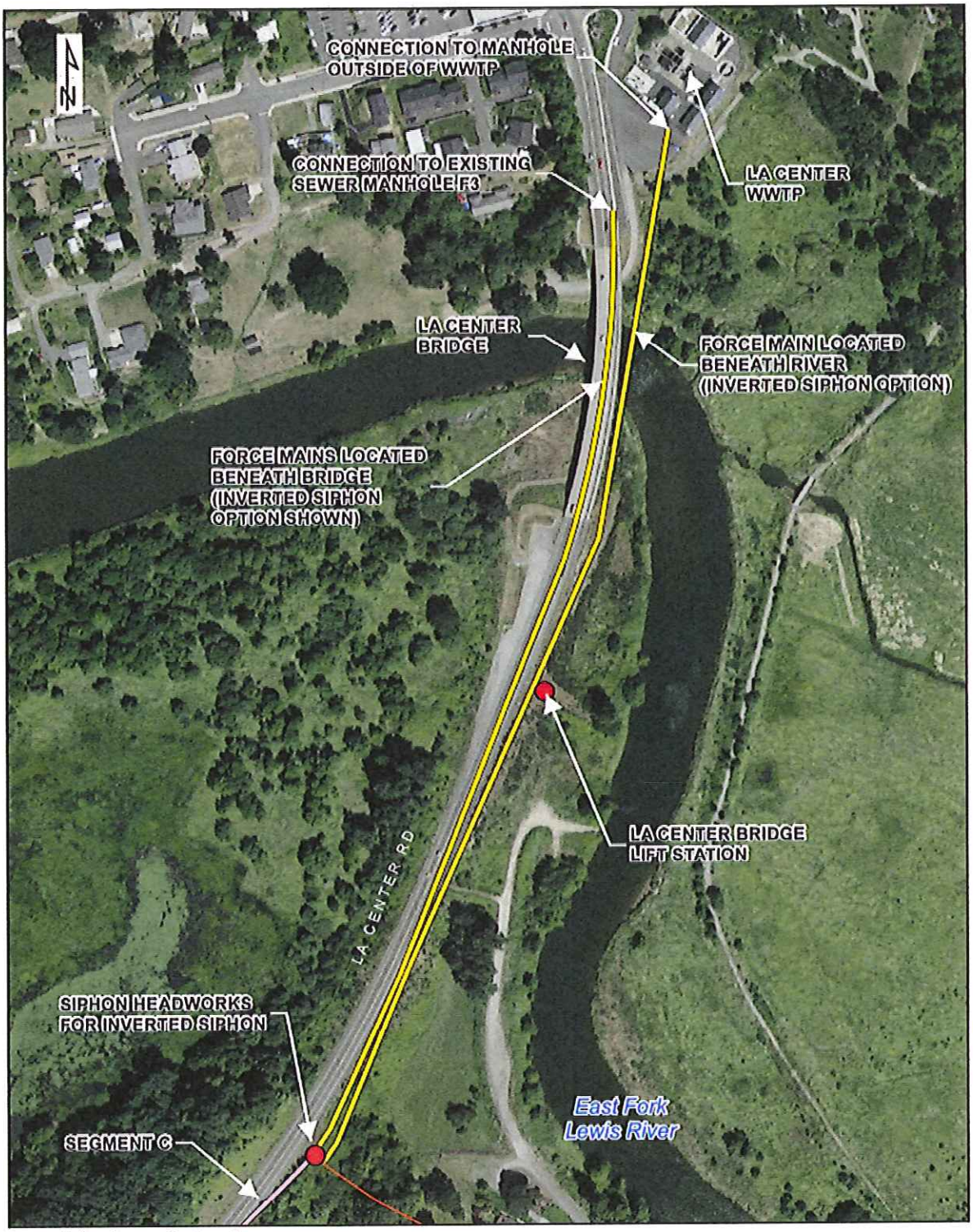

Figure 5: La Center Bridge Area

4.0 Collection System Alternatives
Continued

Ecology guidelines require a minimum pipe size of 6-inch and a minimum of two pipes for inverted siphons. Ecology also recommends maintaining velocities of 3 fps for average flows, which for a 6-inch pipe equates to a flow rate of 264 gpm. The 2016 average daily flows rate of 188 gpm would warrant a pipe smaller than 6-inches. However, due to potential maintenance issues with smaller pipe and Ecology guidelines, the minimum pipe size selected for the siphons is 6-inches.

The minimum hydraulic slope capable of producing 3 fps in a 6-inch pipe is approximately 1.5 percent. Depending on the location of the downstream end of the inverted siphon system, the inverted siphon headworks needs to be located approximately 900 to 1,200 feet south of the south end of the La Center Bridge to obtain sufficient head to produce a hydraulic slope of 1.5 percent. The nearest suitable location based on existing topography for construction of the headworks is approximately 1,300 feet south of the bridge.

To handle the full range of flows expected, the siphon system would consist of three pipes at 6-inch, 8-inch, and 12-inch diameters. A siphon headworks structure consisting of a vault with weirs would be constructed approximately 1,300 feet south of the bridge. The weirs are designed to keep low flows in the 6-inch pipe and distribute flows into the 8-inch and 12-inch pipes consecutively as the flow rates increase. The three pipes would be installed by traditional open cut methods from the siphon headworks to the south end of the bridge. The method for crossing the river and installation on the north side of the river differ depending on the options presented below.

Siphon Option 1

The first option considered is to attach the 6- and 8-inch pipes to the underside of the bridge using the existing knockouts and install the 12-inch pipe beneath the river. Although a full review of the bridge has not been conducted, a visual review of the bridge girders shows no apparent location on the bridge to place a 12-inch pipe.

Approximately 1,340 feet of 6-inch pipe would be installed by open-cut methods south of the bridge, connecting the siphon headworks to the bridge. Another 130 feet would be installed north of the bridge to connect to an existing gravity system. For this study it has been assumed that the 6-inch pipe can connect into the existing manhole located north of the bridge.

Approximately 970 feet of 8-inch pipe would be installed using open cut-methods south of the bridge, connecting the siphon headworks to 370 feet of existing 8-inch pipe. North of the bridge an existing 8-inch pipe connects the bridge to the existing gravity system.

Approximately 1,300 feet of 12-inch pipe would also be installed using open-cut methods south of the bridge. The remaining 800 feet would be drilled beneath the river directly to an

existing manhole located on the southwest corner of the wastewater treatment plant.

The 8-inch and 6-inch pipes are needed immediately to pass the peak hour flow. The installation of the 12-inch pipe under the river could be delayed until the peak hour flow reach 861 gpm (estimated in year 2019, see Table 1).

Siphon Option 2

The second option would be to install all three pipes beneath the river using HDD. Current technology allows all three pipes to be pulled back through the pilot hole with one pull. These pipes would be drilled directly to a connection point at the WWTP.

Approximately 1,300 feet of each pipe would be installed from the siphon headwork structure to a location near the south end of the bridge. The remaining 800 foot section to the wastewater treatment plant would be installed under the river. The three pipes would discharge into an outlet chamber consisting of a manhole or vault constructed near the wastewater treatment plant. The outlet chamber would connect to the gravity sewer system using a short segment of 12-inch pipe.

4.2.1 Comparison of Options at the La Center Bridge

Constructability

The pump station proposed for the La Center Bridge is also routinely used in the wastewater industry, and the design, and construction is straightforward. The site selected for the pump station is near La Center Road, and access would be relatively easy. The site is flat, so grading would be minimal.

Siphons on the bridge planned with Siphon Option 1 would be easy to install, as these were planned for when the bridge was constructed. Installing the 12-inch pipe under the river would be more challenging, and a specialty contractor would be required, but an installation of this size and length is frequently performed.

Available technology allows the installation of three pipes at one time using HDD methods, as is proposed with Siphon Option 2. This would require a specialty contractor with experience in this type of installation, but the sizes and length of installation reduces the risk and makes this operation within the capabilities of today's technology.

Environmental Permitting

All three options for crossing the East Fork of the Lewis River will require Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife (WDFW) for work performed within the limits of ordinary high water (OHW). Because the disturbance within OHW is minimal, all permits should be straightforward to obtain. A brief discussion of permitting in relation to the three options is discussed below:

1. **Pump Station/Force Main.** With this option all pipes are installed on the bridge. Obtaining an HPA permit for this option will be straightforward to obtain.
2. **Siphons on the Bridge and Under the River.** Obtaining an HPA for installing the pipes on the bridge will be easy to obtain, but installing the 12-inch pipe under the river is normally more challenging to permit. Permitting agencies are less comfortable with HDD installations. They are concerned over drilling mud reaching the surface of the stream, or drilling equipment getting stuck under the river. Therefore, the HDD installation will likely take longer to permit. If installation of the 12-inch pipe is delayed until needed, the permitting for this option will likely be faster for the initial construction.
3. **Three Siphon Pipes under the River.** Because this option does not use a bridge crossing and places all three pipes under the river, this option will be tougher to permit. Pipeline crossings under rivers are permittable, but permitting agencies generally require more information and it can take more time to obtain the required permit.

Cost

As Table 3 shows, the cost of installing the 6-inch and 8-inch siphons on the bridge, with a third 12-inch siphon under the river is the least expensive option, followed by installing all three siphons under the river. Note that the costs in Table 3 assume that installation of all project components occur in one phase. See Section 4.6 for more information on cost estimates.

Table 3: La Center Bridge Component Costs

Component Description	Cost
La Center Bridge Lift Station/Force Main	$1,066,524
Siphon on bridge and under river	$763,265
Siphon under river	$845,300

Maintenance and Operations

Siphons require high velocities to scour out sediment deposits and keep the pipe clean. Multiple, smaller diameter pipes are routinely used with siphons to keep velocities high, and to maintain one pipe while the other pipe(s) remain in service. During the early years of operation, flows will be low and frequent cleaning will be necessary to prevent sediment buildup. As flows increase, cleaning frequency can be decreased.

Pump stations require significant and continuous investments in operations and maintenance, including the need for the equipment replacement. Most pump stations require inspections on a weekly or more frequent basis, but as these are common in the industry, the maintenance and operations needs for a pump station are well known.

4.3 Collection System Options

The following section summarizes six options analyzed for each segment of the sewer collection system. A graphic of the six alternatives is shown in Figure 6.

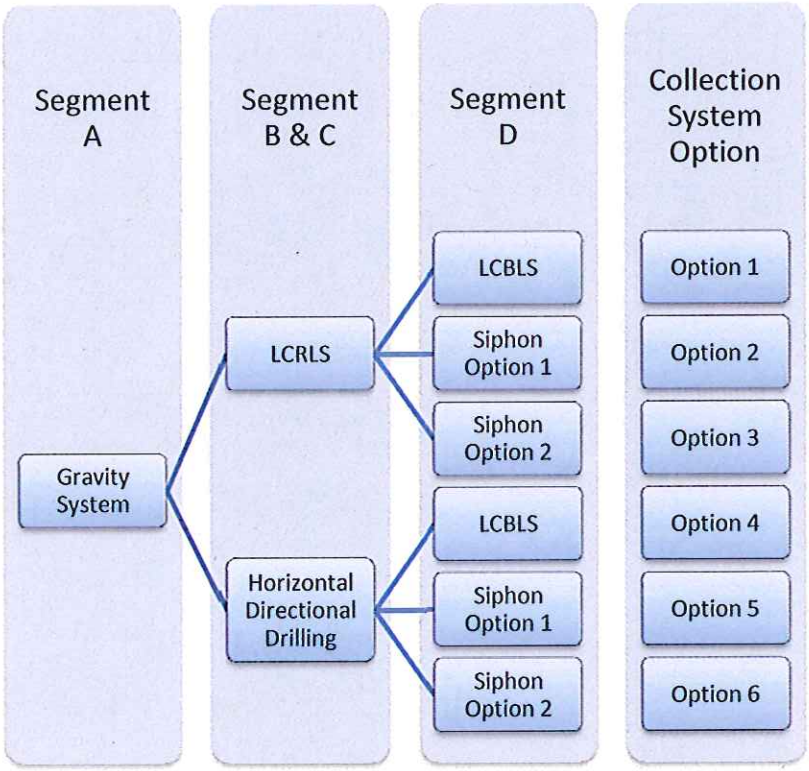

Figure 6: Summary of Collection System Options

Option 1

This project consists of a lift station at McCormick Creek, and a lift station south of the La Center Bridge. It includes the following components:

Segment A

- 2,293 feet of 10-inch gravity sewer from NW 26th Avenue to the bottom of the hill west of McCormick Creek.

Segment B

- A lift station at McCormick Creek.
- 2,065 feet of 12-inch force main.
- 2,000 feet of 12-inch gravity sewer.

4.0 Collection System Alternatives
Continued

Segment C
- 1,200 feet of 12-inch gravity sewer.

Segment D
- 800 feet of 12-inch and 200 feet of 15-inch gravity sewer from NW Timmen Road to the proposed lift station location approximately 370 feet from the south end of the La Center Bridge.
- A lift station approximately 370 feet south of the La Center Bridge on the east side of La Center Road.
- 477 feet of 8-inch pipe on the bridge, connected to the 8-inch pipes north and south of the bridge.
- 370 feet of 6-inch force main pipe installed south of the bridge, 477 feet of 6-inch diameter force main installed on the bridge, and 130 feet of 6-inch pipe installed north of the bridge to connect to the existing manhole in La Center Road. These pipes are needed when peak hour flows at the lift station reach 1,486 gpm, which is projected to occur after year 2031.

Option 2
This option consists of a lift station at McCormick Creek and 6-inch and 8-inch siphons on the La Center Bridge and a 12-inch siphon under the river. It includes the following components:

Segment A
- 2,293 feet of 10-inch gravity sewer from NW 26th Avenue to the bottom of the hill west of McCormick Creek.

Segment B
- A lift station at McCormick Creek.
- 2,065 feet of 12-inch force main.
- 2,000 feet of 12-inch gravity sewer.

Segment C
- 1,200 feet of 12-inch gravity sewer from NW Timmen Road to the siphon headworks located 1,300 feet south of the La Center Bridge.

Segment D
- A siphon headworks vault 1,350 feet south of the La Center Bridge on the east side of La Center Road.
- 1,340 feet of 6-inch pipe installed from the siphon headworks to the south end of the La Center Bridge.

- 970 feet of 8-inch pipe from the siphon headworks to the existing 8-inch pipe in La Center Road south of the bridge.
- 477 feet of 8-inch pipe installed on the bridge.
- 477 feet of 6-inch pipe installed on the bridge.
- 130 feet of 6-inch pipe installed north of the bridge to connect to the existing manhole in La Center Road.
- 1,300 feet of 12-inch pipe installed from the siphon headworks to the south end of the La Center Bridge, 800 feet of 12-inch pipe installed beneath the river and underground on the north side of the river to a 48-inch manhole located outside of the WWTP, and a short section of 12-inch pipe to connect to an existing manhole outside the WWTP. These pipes will be needed when flows at the bridge reach 861 gpm, which, using the flow projections provided by the City, is estimated to occur in year 2019.

Option 3

This project consists of a lift station at McCormick Creek, and a siphon for 6-inch, 8-inch, and 12-inch pipes under the river at the La Center Bridge. It includes the following components:

Segment A

- 2,293 feet of 10-inch gravity sewer from NW 26th Avenue to the bottom of the hill west of McCormick Creek.

Segment B

- A Pump Station at McCormick Creek.
- 2,065 feet of 12-inch force main.
- 2,000 feet of 12-inch gravity sewer.

Segment C

- 1,200 feet of 12-inch gravity sewer.

Segment D

- A siphon headworks vault 1,350 feet south of the La Center Bridge on the east side of La Center Road.
- 1,300 feet of 6-inch, 8-inch, and 12-inch pipe installed from the siphon headworks to the south end of the La Center Bridge.
- 800 feet of inverted siphon installed beneath the river. The inverted siphon would consist of three pipes of sizes 6-inch, 8-inch, and 12-inch. The three pipes would be installed at the same time.

4.0 Collection System Alternatives
Continued

- A 96-inch manhole (or similar structure) outside of the wastewater treatment plant to receive the siphon pipes. This manhole would connect to the existing gravity system manhole using a short segment of pipe.

Option 4

This project consists of horizontal directional drilling through Eagle Crest Hill, and a lift station south of the La Center Bridge. It includes the following components:

Segment A

- 2,293 feet of 10-inch gravity sewer from NW 26th Avenue to the bottom of the hill west of McCormick Creek.

Segment B

- 5,028 feet of 14-inch gravity sewer beneath Eagle Crest from McCormick Creek to La Center bottoms installed by horizontal directional drilling. Pipe would continue through Segment C.
- A separate gravity system will be required to convey flow from NW Eagle Crest Road and NW 13th Avenue. This is not included in the costs for this project.

Segment C

- The 14-inch gravity pipe from Segment B would be approximately 60 feet below grade at NW Timmen Road. A separate gravity system would be required to convey flow from NW Timmen Road to the La Center Bridge. The gravity system may be an extension of that serving NW Eagle Crest Road and NW 13th Avenue. This is not included in the costs for this project.

Segment D

- 800 feet of 12-inch and 200 feet of 15-inch gravity sewer from NW Timmen Road to the proposed lift station location approximately 370 feet from the south end of the La Center Bridge.
- A lift station approximately 370 feet south of the La Center Bridge on the east side of La Center Road.
- 477 feet of 8-inch pipe on the bridge, connected to the 8-inch pipes north and south of the bridge.
- 370 feet of 6-inch force main pipe installed south of the bridge, 477 feet of 6-inch diameter force main installed on the bridge, and 130 feet of 6-inch pipe installed north of the bridge to connect to the existing manhole in La Center Road. These pipes are needed when peak hour flows at the lift station reach 1,486 gpm, which is projected to occur after year 2031.

Option 5

This project consists of horizontal directional drilling through Eagle Crest Hill, and 6-inch and 8-inch siphons on the La Center Bridge and a 12-inch siphon under the river. It includes the following components:

Segment A

- 2,293 feet of 10-inch gravity sewer from NW 26th Avenue to the bottom of the hill west of McCormick Creek.

Segment B

- 5,028 feet of 14-inch gravity sewer beneath Eagle Crest from McCormick Creek to the La Center Bridge installed by horizontal directional drilling. The HDD installation would continue through the extents of Segment C (See Figure 3).
- A separate gravity system will be required to convey flow from NW Eagle Crest Road and NW 13th Avenue to a point where it could connect to the La Center Road system. This is not included in the costs for this project.

Segment C

- The 14-inch gravity pipe from Segment B would be approximately 60 feet below grade at NW Timmen Road. A separate gravity system would be required to convey flow from NW Timmen Road to the siphon headworks. The gravity system may be an extension of that serving NW Eagle Crest Road and NW 13th Avenue. This is not included in the costs for this project.

Segment D

- A siphon headworks vault 1,350 feet south of the La Center Bridge on the east side of La Center Road.
- 1,340 feet of 6-inch pipe installed from the siphon headworks to the south end of the La Center Bridge.
- 970 feet of 8-inch pipe from the siphon headworks to the existing 8-inch pipe in La Center Road south of the bridge.
- 477 feet of 8-inch pipe installed on the bridge.
- 477 feet of 6-inch pipe installed on the bridge.
- 130 feet of 6-inch pipe installed north of the bridge to connect to the existing manhole in La Center Road.
- 1,300 feet of 12-inch pipe installed from the siphon headworks to the south end of the La Center Bridge, 800 feet of 12-inch pipe installed beneath the river and underground on the north side of the river to a 48-inch manhole located outside of the WWTP, and a short section of 12-inch pipe to connect to an existing manhole outside the WWTP.

These pipes will be needed when flows at the bridge reach 861 gpm, which, using the flow projections provided by the City, is estimated to occur in year 2019.

Option 6

This project consists of horizontal directional drilling through Eagle Crest Hill, and a siphon for 6-inch, 8-inch, and 12-inch pipes under the river at the La Center Bridge. It includes the following components:

Segment A

- 2,293 feet of 10-inch gravity sewer from NW 26th Avenue to the bottom of the hill west of McCormick Creek.

Segment B

- 5,028 feet of 14-inch gravity sewer beneath Eagle Crest from McCormick Creek to La Center bottoms installed by horizontal directional drilling. Pipe would continue through Segment C.
- Separate gravity system will be required to convey flow from NW Eagle Crest Road and NW 13th Avenue. This is not included in the costs for this project.

Segment C

- The 14-inch gravity pipe from Segment B would be approximately 60 feet below grade at NW Timmen Road. A separate gravity system would be required to convey flow from NW Timmen Road to the siphon headworks. The gravity system may be an extension of that serving NW Eagle Crest Road and NW 13th Avenue. This is not included in the costs for this project.

Segment D

- A siphon headworks vault 1,350 feet south of the La Center Bridge on the east side of La Center Road.
- 1,300 feet of 6-inch, 8-inch, and 12-inch pipe installed from the siphon headworks to the south end of the La Center Bridge.
- 800 feet of inverted siphon installed beneath the river. The inverted siphon would consist of three pipes of sizes 6-inch, 8-inch, and 12-inch. The three pipes would be installed at the same time.
- A 96-inch manhole (or similar structure) outside of the wastewater treatment plant to receive the siphon pipes. This manhole would connect to the existing gravity system manhole using a short segment of pipe.

4.4 System Sizing

Ecology's standards were used to size system components. Where single gravity pipes or force mains are recommended, these are sized for the peak-hour ultimate build-out flow rate.

Where multiple pipes are required, the capacity of all pipes is sized for the peak-hour ultimate build-out flow rate, but the pipes are installed when needed to meet flow projection estimates. The following criteria were used to size system elements:

1. **Gravity Mains**
- 8-inch minimum diameter.
- Sized for Peak Hour Flow (PHF).
- Manning's roughness of 0.013.
- Minimum velocity of 2.0 fps when flowing full.
- Preferred maximum velocity of 15 fps.

2. **Lift Stations**
- Minimum firm capacity is PHF.
- Wetwell volume in gallons = tQ/4 for constant speed pumps where t is minimum time between starts in minutes and Q is pump capacity in gpm.

3. **Force Mains**
- 4-inch minimum diameter.
- Minimum velocity of 2 fps.
- Optimum velocity between 3.5 and 5 fps.
- Maximum velocity of 8 fps.

4. **Inverted Siphon**
- Minimum velocity of 3 fps.
- Minimum diameter of 6-inches.

4.5 Project Phasing

The gravity pipes installed in Segments A, B, C, and D, along with the HDD pipe in Segment B, would all be sized for ultimate build-out with the Phase 1 installation. Where multiple force mains are proposed (i.e., at the La Center Bridge), there are opportunities to defer installation of some of the pipelines. Opportunities for phasing pipe installations at the La Center Bridge were identified for Options 1, 2, 4, and 5.

The infrastructure for each pump station (wet well, buildings, site grading, etc.) will be constructed for ultimate build-out with Phase 1, but the pumps are expected to be replaced after 15 to 20 years. Options 1 through 4 include a phase for replacing pumps at each lift station in 2031.

4.0 Collection System Alternatives
Continued

No phasing opportunities were identified for Option 6. Phasing descriptions, along with flow triggers, and the approximate year the flow trigger will be reached, are listed in Table 4.

Table 4: Phase Descriptions

Option		Phase Description	Flow Trigger (gpm)	Approx. Year Triggered
1	Phase 2	Installation of 6-inch FM and new pumps at both pump stations	1280 at LCRLS/1402 at LCBLS	2031
2	Phase 2	12-inch siphon under the river	861	2019
	Phase 3	Replacement of pumps at LCRLS	1278	2031
3	Phase 2	Replacement of pumps at LCRLS	1278	2031
4	Phase 2	Installation of 6-inch force main and pumps at LCBLS	1402	2031
5	Phase 2	12-inch siphon under the river	861	2019

4.6 Cost Estimates
Estimates of project costs have been prepared to allow for budgeting of projects. The cost estimates prepared for this study are order of magnitude estimates and have an expected accuracy between +30 percent and -25 percent of the estimated cost.

To develop cost estimates for each option, vendors were contacted for material costs, and bid items were reviewed for comparable items. Assumptions from the City's 2009 sewer study were used in this analysis and are shown in Table 5.

Table 5: Sewer Project Cost Markups

Markup Item	Percentage Markup
Contractor Mobilization	8.0
Temporary Erosion and Sediment Control	1.0
Landscape Restoration	1.0
Contractor Overhead and Profit	15
Engineering, Legal, and Administration	27

Table 5: Sewer Project Cost Markups	
Markup Item	Percentage Markup
Taxes	8.2
Contingency	30

The markup for "Engineering, Legal, and Administration" covers design, survey, construction management, and project administration. A contingency of 30 percent of the total project cost has been added to all estimates to account for the level of accuracy expected for these estimates as described above.

The total estimated project costs for each option are listed in Table 6 and include the factors listed in Table 3, all in 2011 dollars. Prices have not been escalated to cover costs increase due to inflation for future construction. Detailed estimates are included in Appendix B.

Table 6: Option Cost Estimates			
Option	Phase	Phase Description	Total Estimated Project Cost
1	Phase 1	Installation of gravity pipes, pump stations and force mains.	$7,277,751
	Phase 2	Installation of 6-inch force main and new pumps at both pump stations.	$646,346
		Total	**$7,942,097**
2	Phase 1	Installation of gravity mains, LCRLS and force main pipes and 6 and 8-inch siphons.	$5,892,588
	Phase 2	Installation of 12-inch siphon under river.	$929,633
	Phase 3	Replacement of pumps at LCRLS.	$150,452
		Total	**$6,972,673**
3	Phase 1	Installation of gravity mains, LCRLS and force main pipes and 6-, 8- and 12-inch siphons.	$7,111,506
	Phase 2	Replacement of pumps at LCRLS.	$150,452
		Total	**$7,261,958**
4	Phase 1	Installation of gravity mains, HDD pipe and LCBPS and force main.	$9,679,344
	Phase 2	Installation of 6-inch force main and pumps at LCBLS.	$525,296
		Total	**$10,204,640**

Table 6: Option Cost Estimates			
Option	Phase	Phase Description	Total Estimated Project Cost
5	Phase 1	Installation of gravity mains, HDD pipe and 6- and 8-inch siphons.	$8,089,994
	Phase 2	Installation of 12-inch siphon under river.	$929,633
		Total	**$9,019,627**
6	Phase 1	Installation of gravity mains, HDD pipe and 6-, 8- and 12-inch siphons.	**$9,303,992**

Table 6 shows the costs and phasing for each option. The three options using HDD are significantly more expensive to construct than installing a pump station at McCormick Creek. This is because the costs for HDD installation for a pipeline of this size have been estimated from recent bids at $650 per linear foot.

The three options that use a pump station at McCormick Creek are the least expensive and relatively close in cost, with Option 2, the option that places the 6-inch and 8-inch pipes on the bridge the least expensive of all options.

4.7 Timeline

Ecology will likely require the preparation and approval of an Engineering Report ahead of the construction of this project. This report should be prepared and submitted as soon as possible as it will likely be the major schedule driver.

If federal and/or state permits (from the Army Corps of Engineers or WDFW) are required, these can also affect schedule, although the permits required for this project are likely to take three to six months to obtain, which should fit within the time it will take to design the components of this project.

Table 7 provides estimates of the time required for various project components.

Table 7: Project Components and Estimated Timelines	
Project Component	Time Frame
Preliminary Engineering/Engineering Report	6-8 months
Review of Engineering Report by Ecology	Up to 1 year
Environmental Permitting	3-6 months
Preparation of Construction Documents	6-9 months

5.0 Conclusion

With the expansion of La Center's Urban Growth Area (UGA) to the I-5 La Center Junction, and the planned casino at the junction, La Center is planning for sewer service to the junction, and the properties along La Center Road between the junction and downtown. This study evaluated options for conveying flows to the City's WWTP, sized system components, and estimates of the costs for the options. The six options reviewed are:

- **Option 1:** Installation of a lift station at McCormick Creek, and a lift station south of the La Center Bridge.
- **Option 2:** Installation of a lift station at McCormick Creek and 6-inch and 8-inch siphons on the La Center Bridge and a 12-inch siphon under the East Fork of the Lewis River.
- **Option 3:** Installation of a lift station at McCormick Creek, and a siphon for 6-inch, 8-inch, and 12-inch pipes under the river at the La Center Bridge.
- **Option 4:** Horizontal directional drilling through Eagle Crest Hill, and a lift station south of the La Center Bridge.
- **Option 5:** Horizontal directional drilling through Eagle Crest Hill, and 6-inch and 8-inch siphons on the La Center Bridge and a 12-inch siphon under the East Fork of the Lewis River.
- **Option 6:** Horizontal directional drilling through Eagle Crest Hill, and a siphon for 6-inch, 8-inch, and 12-inch pipes under the river at the La Center Bridge.

Each option was reviewed for constructability, environmental permitting, maintenance and operations, and cost. Option 2 has the lowest capital construction cost, is the easiest to permit, and is also likely the easiest to maintain.

Phasing of projects within each option was also reviewed. Phases were developed with the following parameters in mind:

- Where a single gravity pipe or force main is recommended, the pipe is sized for the peak hour ultimate build-out flows.
- Where multiple pipes are recommended, phased plans are developed so pipes not immediately needed can be installed when needed.
- Infrastructure for the pump station will be built for the ultimate peak hour flow rate. Pumps and electrical equipment that are normally replaced after 15 to 20 years have been phased.

Criteria from Ecology's *Criteria for Sewage Works Design* (Ecology, 2008) were used for sizing all facilities.

Appendices

Appendix A — Flow Estimates

Table A-1: Build-Out Sewer Demands for La Center UGA South of La Center Bridge with Casino Flow			
Area	Average Daily Demand (gpd)	Maximum Month Daily Demand (gpd)	Peak Hour Flow (gpm)
Cowlitz Development	470,000	705,000	1,142
SW Junction	51,500	77,250	89
NE Junction	157,200	235,800	286
SE Junction	93,800	140,700	190
Eagle Crest Area	9,100	13,650	19
S. of Eagle Crest Area	180,800	271,200	377
Timmen & Spencer Rd	51,400	77,100	107
Timmen Landing Area	32,900	49,350	69
Total Flows	**1,046,700**	**1,570,050**	**2,279**

Table A-2: 2031 Sewer Demands for La Center UGA South of La Center Bridge with Casino Flow			
Area	Average Daily Demand (gpd)	Maximum Month Daily Demand (gpd)	Peak Hour Flow (gpm)
Cowlitz Development	260,000	416,000	632
SW Junction	40,500	60,750	70
NE Junction	118,600	177,900	216
SE Junction	65,600	98,400	133
Eagle Crest Area	9,100	13,650	19
S. of Eagle Crest Area	100,000	150,000	208
Timmen & Spencer Rd	30,000	45,000	63
Timmen Landing Area	29,700	44,550	62
Total Flows	**653,500**	**1,006,250**	**1,402**

Appendix A — Flow Estimates
Continued

Table A-3: 2021 Sewer Demands for La Center UGA South of La Center Bridge with Casino Flow			
Area	Average Daily Demand (gpd)	Maximum Month Daily Demand (gpd)	Peak Hour Flow (gpm)
Cowlitz Development	260,000	416,000	632
SW Junction	27,000	40,500	47
NE Junction	79,100	118,650	144
SE Junction	34,700	52,050	70
Eagle Crest Area	0	0	0
S. of Eagle Crest Area	40,000	60,000	83
Timmen & Spencer Rd	10,000	15,000	21
Timmen Landing Area	16,200	24,300	34
Total Flows	**467,000**	**726,500**	**1,031**

Table A-4: 2016 Sewer Demands for La Center UGA South of La Center Bridge with Casino Flow			
Area	Average Daily Demand (gpd)	Maximum Month Daily Demand (gpd)	Peak Hour Flow (gpm)
Cowlitz Development	220,000	352,000	535
SW Junction	0	0	0
NE Junction	39,500	59,250	72
SE Junction	3,900	5,850	8
Eagle Crest Area	0	0	0
S. of Eagle Crest Area	0	0	0
Timmen & Spencer Rd	0	0	0
Timmen Landing Area	7,200	10,800	15
Total Flows	**270,600**	**427,900**	**629**

Appendix B — Cost Estimates

La Center Junction Sewer Study
Project 1 Phase 1

ITEM	QUANTITY	UNIT	BID ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	1	LS	MOBILIZATION	$301,779	$301,779
2	1	L.S.	SPCC PLAN	$1,000	$1,000
3	1	L.S.	TYPE B PROGRESS SCHEDULE	$10,000	$10,000
4	1	LS	TRAFFIC CONTROL	$402,668	$402,668
5	1	LS	CLEARING AND GRUBBING	$5,000	$5,000
6	1	LS	REMOVAL OF STRUCTURE AND OBSTRUCTION	$5,000	$5,000
7	7800	CY	ROADWAY EXCAVATION INCL. HAUL	$10	$78,000
8	11560	SY	PLANING BITUMINOUS PAVEMENT	$6	$69,360
9	1780	TON	CRUSHED SURFACING BASE COURSE	$35	$62,300
10	1030	TON	CRUSHED SURFACING TOP COURSE	$35	$36,050
11	2200	TON	HMA CL. 1/2 INCH PG 64-22	$90	$198,000
12	17116	LF	SAWCUT	$2	$34,232
13	8558	LF	TRENCH SAFETY SYSTEM	$2	$17,116
14	9485	LF	TESTING SEWER PIPE	$3	$28,455
15	2293	LF	SEG A, SEWER GRAVITY MAIN, 10 INCH DIA.	$74	$169,682
16	1	EA	LA CENTER ROAD LIFT STATION (LCRLS)	$1,170,000	$1,170,000
17	2065	LF	LCRLS FORCE MAIN, 12 INCH DIA.	$64	$132,160
18	2000	LF	SEG B SEWER GRAVITY MAIN, 12 INCH DIA.	$76	$152,000
19	1200	LF	SEG C SEWER GRAVITY MAIN, 12 INCH DIA.	$76	$91,200
20	800	LF	SEG D SEWER GRAVITY MAIN, 12 INCH DIA.	$76	$60,800
21	200	LF	SEG D SEWER GRAVITY MAIN, 15 INCH DIA.	$81	$16,200
22	1	EA	LA CENTER BRIDGE LIFT STATION	$840,000	$840,000
23	477	LF	SEWER FORCE MAIN, ON BRIDGE, 8 INCH DIA.	$150	$71,550
24	2	EA	AIR-VACUUM RELEASE VALVE	$5,000	$10,000
25	15	EA	MANHOLES, 48 INCH DIA.	$2,500	$37,500
26	1	LS	TEMPORARY EROSION CONTROL	$36,983	$36,983
27	1	LS	LANDSCAPING RESTORATION	$36,983	$36,983
Phase 1 Construction Subtotal					**$4,074,017**
Sales Tax at 8.2%					$334,069
Phase 1 Construction Total					**$4,408,087**
Engineering, Legal, and Administration				27%	$1,190,183
Contingency				30%	$1,679,481
Total Estimated Phase 1 Project Cost					**$7,277,751**

La Center Junction Sewer Study
Project 1 Phase 2

ITEM	QUANTITY	UNIT	BID ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	1	LS	MOBILIZATION	$16,016	$16,016
2	1	L.S.	SPCC PLAN	$1,000	$1,000
3	1	L.S.	TYPE B PROGRESS SCHEDULE	$10,000	$10,000
4	1	LS	TRAFFIC CONTROL	$77,160	$77,160
5	400	CY	ROADWAY EXCAVATION INCL. HAUL	$10	$4,000
6	600	SY	PLANING BITUMINOUS PAVEMENT	$6	$3,600
7	190	TON	CRUSHED SURFACING BASE COURSE	$35	$6,650
8	100	TON	CRUSHED SURFACING TOP COURSE	$35	$3,500
9	120	TON	HMA CL. 1/2 INCH PG 64-22	$90	$10,800
10	900	LF	SAWCUT	$2	$1,800
11	908	LF	TRENCH SAFETY SYSTEM	$2	$1,816
12	450	LF	TESTING SEWER PIPE	$3	$1,350
13	450	LF	LCBLS FORCE MAIN, 6 INCH DIA.	$41	$18,349
14	450	LF	SEWER FORCE MAIN, ON BRIDGE, 6 INCH DIA.	$125	$56,250
15	1	LS	TEMPORARY EROSION CONTROL	$1,963	$1,963
16	1	LS	LANDSCAPING RESTORATION	$1,963	$1,963
Phase 2 Construction Subtotal					**$216,217**
Sales Tax at 8.2%					$17,730
Phase 2 Construction Total					**$233,947**
Engineering, Legal, and Administration				27%	$63,166
Contingency				30%	$89,134
1	2	LS	REPLACEMENT PUMPS/UPGRADE ELECT	$139,050	$278,100
Total Estimated Phase 2 Project Cost					**$664,346**

La Center Junction Sewer Study
Project 2 Phase 1

ITEM	QUANTITY	UNIT	BID ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	1	LS	MOBILIZATION	$244,342	$244,342
2	1	L.S.	SPCC PLAN	$1,000	$1,000
3	1	L.S.	TYPE B PROGRESS SCHEDULE	$10,000	$10,000
4	1	LS	TRAFFIC CONTROL	$363,585	$363,585
5	1	LS	CLEARING AND GRUBBING	$5,000	$5,000
6	1	LS	REMOVAL OF STRUCTURE AND OBSTRUCTION	$5,000	$5,000
7	9200	CY	ROADWAY EXCAVATION INCL. HAUL	$10	$92,000
8	12000	SY	PLANING BITUMINOUS PAVEMENT	$6	$72,000
9	2000	TON	CRUSHED SURFACING BASE COURSE	$35	$70,000
10	1110	TON	CRUSHED SURFACING TOP COURSE	$35	$38,850
11	2420	TON	HMA CL. 1/2 INCH PG 64-22	$90	$217,800
12	17876	LF	SAWCUT	$2	$35,752
13	8938	LF	TRENCH SAFETY SYSTEM	$2	$17,876
14	11272	LF	TESTING SEWER PIPE	$3	$33,816
15	2293	LF	SEG A, SEWER GRAVITY MAIN, 10 INCH DIA.	$74	$169,682
16	1	EA	LA CENTER ROAD LIFT STATION (LCRLS)	$1,170,000	$1,170,000
17	2065	LF	LCRLS FORCE MAIN, 12 INCH DIA.	$64	$132,160
18	2000	LF	SEG B SEWER GRAVITY MAIN, 12 INCH DIA.	$76	$152,000
19	1200	LF	SEG C SEWER GRAVITY MAIN, 12 INCH DIA.	$76	$91,200
20	1380	LF	SEWER, FORCE MAIN, OPEN TRENCH, 6 INCH DIA.	$43	$59,340
21	930	LF	SEWER, FORCE MAIN, OPEN TRENCH, 8 INCH DIA.	$45	$41,850
22	477	LF	SEWER FORCE MAIN, ON BRIDGE, 6 INCH DIA.	$125	$59,625
23	477	LF	SEWER FORCE MAIN, ON BRIDGE, 8 INCH DIA.	$150	$71,550
24	1	LS	SIPHON HEADWORKS VAULT, 12' L x 7' W x 10' D	$16,800	$16,800
25	2	EA	AIR-VACUUM RELEASE VALVE	$5,000	$10,000
26	23	EA	MANHOLES, 48 INCH DIA.	$2,500	$57,500
27	1	LS	TEMPORARY EROSION CONTROL	$29,944	$29,944
28	1	LS	LANDSCAPING RESTORATION	$29,944	$29,944
Phase 1 Construction Subtotal					**$3,298,616**
Sales Tax at 8.2%					$270,486
Phase 1 Construction Total					**$3,569,102**
Engineering, Legal, and Administration				27%	$963,658
Contingency				30%	$1,359,828
Total Estimated Phase 1 Project Cost					**$5,892,588**

La Center Junction Sewer Study
Project 2 Phase 2

ITEM	QUANTITY	UNIT	BID ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	1	LS	MOBILIZATION	$53,420	$53,420
2	1	L.S.	SPCC PLAN	$1,000	$1,000
3	1	L.S.	TYPE B PROGRESS SCHEDULE	$10,000	$10,000
4	1	LS	TRAFFIC CONTROL	$34,984	$34,984
5	1000	CY	ROADWAY EXCAVATION INCL. HAUL	$10	$10,000
6	1840	SY	PLANING BITUMINOUS PAVEMENT	$6	$11,040
7	360	TON	CRUSHED SURFACING BASE COURSE	$35	$12,600
8	180	TON	CRUSHED SURFACING TOP COURSE	$35	$6,300
9	480	TON	HMA CL. 1/2 INCH PG 64-22	$90	$43,200
10	2608	LF	SAWCUT	$2	$5,216
11	1300	LF	TRENCH SAFETY SYSTEM	$2	$2,600
12	2100	LF	TESTING SEWER PIPE	$3	$6,300
13	1300	LF	SEWER, FORCE MAIN, OPEN TRENCH, 12 INCH DIA.	$57	$74,100
14	800	LF	SEWER FORCE MAIN, UNDER RIVER, 12 INCH DIA.	$550	$440,000
15	1	LS	TEMPORARY EROSION CONTROL	$5,204	$5,204
16	1	LS	LANDSCAPING RESTORATION	$5,204	$5,204
Phase 2 Construction Subtotal					**$520,400**
Sales Tax at 8.2%					$42,673
Phase 2 Construction Total					**$563,073**
Engineering, Legal, and Administration				27%	$152,030
Contingency				30%	$214,531
Total Estimated Phase 2 Project Cost					**$929,633**

La Center Junction Sewer Study
Project 2 Phase 3

ITEM	QUANTITY	UNIT	BID ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	1	LS	REPLACEMENT PUMPS/UPGRADE ELECT	$139,050	$139,050
Phase 2 Construction Subtotal					**$139,050**
Sales Tax at 8.2%					$11,402
Phase 2 Construction Total					**$150,452**

La Center Junction Sewer Study
Project 3 Phase 1

ITEM	QUANTITY	UNIT	BID ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	1	LS	MOBILIZATION	$294,886	$294,886
2	1	L.S.	SPCC PLAN	$1,000	$1,000
3	1	L.S.	TYPE B PROGRESS SCHEDULE	$10,000	$10,000
4	1	LS	TRAFFIC CONTROL	$363,308	$363,308
5	1	LS	CLEARING AND GRUBBING	$5,000	$5,000
6	1	LS	REMOVAL OF STRUCTURE AND OBSTRUCTION	$5,000	$5,000
7	9300	CY	ROADWAY EXCAVATION INCL. HAUL	$10	$93,000
8	11893	SY	PLANING BITUMINOUS PAVEMENT	$6	$71,360
9	1974	TON	CRUSHED SURFACING BASE COURSE	$35	$69,091
10	1097	TON	CRUSHED SURFACING TOP COURSE	$35	$38,395
11	2384	TON	HMA CL. 1/2 INCH PG 64-22	$90	$214,575
12	17716	LF	SAWCUT	$2	$35,432
13	8858	LF	TRENCH SAFETY SYSTEM	$2	$17,716
14	13858	LF	TESTING SEWER PIPE	$3	$41,574
15	2293	LF	SEG A, SEWER GRAVITY MAIN, 10 INCH DIA.	$74	$169,682
16	1	EA	LA CENTER ROAD LIFT STATION (LCRLS)	$1,170,000	$1,170,000
17	2065	LF	LCRLS FORCE MAIN, 12 INCH DIA.	$64	$132,160
18	2000	LF	SEG B SEWER GRAVITY MAIN, 12 INCH DIA.	$76	$152,000
19	1200	LF	SEG C SEWER GRAVITY MAIN, 12 INCH DIA.	$76	$91,200
20	1300	LF	SEWER, SIPHON PIPE, OPEN TRENCH, 6 INCH DIA.	$43	$55,900
21	1300	LF	SEWER, SIPHON PIPE, OPEN TRENCH, 8 INCH DIA.	$45	$58,500
22	1300	LF	SEWER, SIPHON PIPE, OPEN TRENCH, 12 INCH DIA.	$57	$74,100
23	800	LF	SEWER, SIPHON PIPE, UNDER RIVER 6, 8, & 12 INCH DIA.	$800	$640,000
24	1	LS	SIPHON HEADWORKS VAULT, 12' L x 7' W x 10' D	$16,800	$16,800
25	2	EA	AIR-VACUUM RELEASE VALVE	$5,000	$10,000
26	24	EA	MANHOLES, 48 INCH DIA.	$2,500	$60,000
27	1	EA	MANHOLES, 96 INCH DIA.	$18,000	$18,000
28	1	LS	TEMPORARY EROSION CONTROL	$36,138	$36,138
29	1	LS	LANDSCAPING RESTORATION	$36,138	$36,138
CONSTRUCTION SUBTOTAL					**$3,980,955**
Sales Tax at 8.2%					$326,438
CONSTRUCTION TOTAL					**$4,307,393**
Engineering, Legal, and Administration				27%	$1,162,996
Contingency				30%	$1,641,117
Total Estimated Project Cost					**$7,111,506**

La Center Junction Sewer Study
Project 3 Phase 2

ITEM	QUANTITY	UNIT	BID ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	1	LS	REPLACEMENT PUMPS/UPGRADE ELECT	$139,050	$139,050
Phase 2 Construction Subtotal					**$139,050**
Sales Tax at 8.2%					$11,402
Phase 2 Construction Total					**$150,452**

La Center Junction Sewer Study
Project 4 Phase 1

ITEM	QUANTITY	UNIT	BID ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	1	LS	MOBILIZATION	$401,363	$401,363
2	1	L.S.	SPCC PLAN	$1,000	$1,000
3	1	L.S.	TYPE B PROGRESS SCHEDULE	$10,000	$10,000
4	1	LS	TRAFFIC CONTROL	$234,776	$234,776
5	1	LS	CLEARING AND GRUBBING	$5,000	$5,000
6	1	LS	REMOVAL OF STRUCTURE AND OBSTRUCTION	$5,000	$5,000
7	3000	CY	ROADWAY EXCAVATION INCL. HAUL	$10	$30,000
8	3060	SY	PLANING BITUMINOUS PAVEMENT	$6	$18,360
9	460	TON	CRUSHED SURFACING BASE COURSE	$35	$16,100
10	300	TON	CRUSHED SURFACING TOP COURSE	$35	$10,500
11	850	TON	HMA CL. 1/2 INCH PG 64-22	$90	$76,500
12	6586	LF	SAWCUT	$2	$13,172
13	3293	LF	TRENCH SAFETY SYSTEM	$2	$6,586
14	9248	LF	TESTING SEWER PIPE	$3	$27,744
15	2293	LF	SEG A, SEWER GRAVITY MAIN, 10 INCH DIA.	$74	$169,682
16	5028	LF	SEG B, HORIZONTAL DIRECTIONAL DRILL, 14 INCH DIA.	$650	$3,268,200
17	800	LF	SEG D SEWER GRAVITY MAIN, 12 INCH DIA.	$76	$60,800
18	200	LF	SEG D SEWER GRAVITY MAIN, 15 INCH DIA.	$81	$16,200
19	1	EA	LA CENTER BRIDGE LIFT STATION (LCBLS)	$840,000	$840,000
20	477	LF	SEWER FORCE MAIN, ON BRIDGE, 8 INCH DIA.	$150	$71,550
21	15	EA	MANHOLES, 48 INCH DIA.	$2,500	$37,500
22	1	LS	TEMPORARY EROSION CONTROL	$49,187	$49,187
23	1	LS	LANDSCAPING RESTORATION	$49,187	$49,187
Phase 1 Construction Subtotal					**$5,418,407**
Sales Tax at 8.2%					$444,309
Phase 1 Construction Total					**$5,862,716**
Engineering, Legal, and Administration				27%	$1,582,933
Contingency				30%	$2,233,695
Total Estimated Phase 1 Project Cost					**$9,679,344**

La Center Junction Sewer Study
Project 4 Phase 2

ITEM	QUANTITY	UNIT	BID ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	1	LS	MOBILIZATION	$16,016	$16,016
2	1	L.S.	SPCC PLAN	$1,000	$1,000
3	1	L.S.	TYPE B PROGRESS SCHEDULE	$10,000	$10,000
4	1	LS	TRAFFIC CONTROL	$77,160	$77,160
5	400	CY	ROADWAY EXCAVATION INCL. HAUL	$10	$4,000
6	600	SY	PLANING BITUMINOUS PAVEMENT	$6	$3,600
7	190	TON	CRUSHED SURFACING BASE COURSE	$35	$6,650
8	100	TON	CRUSHED SURFACING TOP COURSE	$35	$3,500
9	120	TON	HMA CL. 1/2 INCH PG 64-22	$90	$10,800
10	900	LF	SAWCUT	$2	$1,800
11	908	LF	TRENCH SAFETY SYSTEM	$2	$1,816
12	450	LF	TESTING SEWER PIPE	$3	$1,350
13	450	LF	LCBLS FORCE MAIN, 6 INCH DIA.	$41	$18,349
14	450	0	SEWER FORCE MAIN, ON BRIDGE, 6 INCH DIA.	$125	$56,250
15	1	LS	TEMPORARY EROSION CONTROL	$1,963	$1,963
16	1	LS	LANDSCAPING RESTORATION	$1,963	$1,963
Phase 2 Construction Subtotal					**$216,217**
Sales Tax at 8.2%					$17,730
Phase 2 Construction Total					**$233,947**
Engineering, Legal, and Administration				27%	$63,166
Contingency				30%	$89,134
	1	LS	REPLACEMENT PUMPS/UPGRADE ELECT	$139,050	$139,050
Total Estimated Phase 2 Project Cost					**$525,296**

La Center Junction Sewer Study
Project 5 Phase 1

ITEM	QUANTITY	UNIT	BID ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	1	LS	MOBILIZATION	$335,459	$335,459
2	1	L.S.	SPCC PLAN	$1,000	$1,000
3	1	L.S.	TYPE B PROGRESS SCHEDULE	$10,000	$10,000
4	1	LS	TRAFFIC CONTROL	$118,533	$118,533
5	1	LS	CLEARING AND GRUBBING	$5,000	$5,000
6	1	LS	REMOVAL OF STRUCTURE AND OBSTRUCTION	$5,000	$5,000
7	4400	CY	ROADWAY EXCAVATION INCL. HAUL	$10	$44,000
8	4900	SY	PLANING BITUMINOUS PAVEMENT	$6	$29,400
9	680	TON	CRUSHED SURFACING BASE COURSE	$35	$23,800
10	380	TON	CRUSHED SURFACING TOP COURSE	$35	$13,300
11	1070	TON	HMA CL. 1/2 INCH PG 64-22	$90	$96,300
12	7346	LF	SAWCUT	$2	$14,692
13	3673	LF	TRENCH SAFETY SYSTEM	$2	$7,346
14	11035	LF	TESTING SEWER PIPE	$3	$33,105
15	2293	LF	SEG A, SEWER GRAVITY MAIN, 10 INCH DIA.	$74	$169,682
16	5028	LF	SEG B, HORIZONTAL DIRECTIONAL DRILL, 14 INCH DIA.	$650	$3,268,200
17	1380	LF	SEWER, FORCE MAIN, OPEN TRENCH, 6 INCH DIA.	$43	$59,340
18	930	LF	SEWER, FORCE MAIN, OPEN TRENCH, 8 INCH DIA.	$45	$41,850
19	477	LF	SEWER FORCE MAIN, ON BRIDGE, 6 INCH DIA.	$125	$59,625
20	477	LF	SEWER FORCE MAIN, ON BRIDGE, 8 INCH DIA.	$150	$71,550
21	1	LS	SIPHON HEADWORKS VAULT, 12' L x 7' W x 10' D	$16,800	$16,800
22	9	EA	MANHOLES, 48 INCH DIA.	$2,500	$22,500
23	1	LS	TEMPORARY EROSION CONTROL	$41,110	$41,110
24	1	LS	LANDSCAPING RESTORATION	$41,110	$41,110
CONSTRUCTION SUBTOTAL					**$4,528,703**
Sales Tax at 8.2%					$371,354
CONSTRUCTION TOTAL					**$4,900,057**
Engineering, Legal, and Administration				27%	$1,323,015
Contingency				30%	$1,866,922
Total Estimated Project Cost					**$8,089,994**

La Center Junction Sewer Study
Project 5 Phase 2

ITEM	QUANTITY	UNIT	BID ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	1	LS	MOBILIZATION	$53,420	$53,420
2	1	L.S.	SPCC PLAN	$1,000	$1,000
3	1	L.S.	TYPE B PROGRESS SCHEDULE	$10,000	$10,000
4	1	LS	TRAFFIC CONTROL	$34,984	$34,984
5	1000	CY	ROADWAY EXCAVATION INCL. HAUL	$10	$10,000
6	1840	SY	PLANING BITUMINOUS PAVEMENT	$6	$11,040
7	360	TON	CRUSHED SURFACING BASE COURSE	$35	$12,600
8	180	TON	CRUSHED SURFACING TOP COURSE	$35	$6,300
9	480	TON	HMA CL. 1/2 INCH PG 64-22	$90	$43,200
10	2608	LF	SAWCUT	$2	$5,216
11	1300	LF	TRENCH SAFETY SYSTEM	$2	$2,600
12	2100	LF	TESTING SEWER PIPE	$3	$6,300
13	1300	LF	SEWER, FORCE MAIN, OPEN TRENCH, 12 INCH DIA.	$57	$74,100
14	800	LF	SEWER FORCE MAIN, UNDER RIVER, 12 INCH DIA.	$550	$440,000
15	1	LS	TEMPORARY EROSION CONTROL	$5,204	$5,204
16	1	LS	LANDSCAPING RESTORATION	$5,204	$5,204
Phase 2 Construction Subtotal					**$520,400**
Sales Tax at 8.2%					$42,673
Phase 2 Construction Total					**$563,073**
Engineering, Legal, and Administration				27%	$152,030
Contingency				30%	$214,531
Total Estimated Phase 2 Project Cost					**$929,633**

La Center Junction Sewer Study
Project 6

ITEM	QUANTITY	UNIT	BID ITEM DESCRIPTION	UNIT PRICE	TOTAL
1	1	LS	MOBILIZATION	$385,799	$385,799
2	1	L.S.	SPCC PLAN	$1,000	$1,000
3	1	L.S.	TYPE B PROGRESS SCHEDULE	$10,000	$10,000
4	1	LS	TRAFFIC CONTROL	$118,256	$118,256
5	1	LS	CLEARING AND GRUBBING	$5,000	$5,000
6	1	LS	REMOVAL OF STRUCTURE AND OBSTRUCTION	$5,000	$5,000
7	4500	CY	ROADWAY EXCAVATION INCL. HAUL	$10	$45,000
8	4793	SY	PLANING BITUMINOUS PAVEMENT	$6	$28,760
9	654	TON	CRUSHED SURFACING BASE COURSE	$35	$22,891
10	367	TON	CRUSHED SURFACING TOP COURSE	$35	$12,845
11	1034	TON	HMA CL. 1/2 INCH PG 64-22	$90	$93,075
12	7186	LF	SAWCUT	$2	$14,372
13	3593	LF	TRENCH SAFETY SYSTEM	$2	$7,186
14	13621	LF	TESTING SEWER PIPE	$3	$40,863
15	2293	LF	SEG A, SEWER GRAVITY MAIN, 10 INCH DIA.	$74	$169,682
16	5028	LF	SEG B, HORIZONTAL DIRECTIONAL DRILL, 14 INCH DIA.	$650	$3,268,200
17	1300	LF	SEWER, SIPHON PIPE, OPEN TRENCH, 6 INCH DIA.	$43	$55,900
18	1300	LF	SEWER, SIPHON PIPE, OPEN TRENCH, 8 INCH DIA.	$45	$58,500
19	1300	LF	SEWER, SIPHON PIPE, OPEN TRENCH, 12 INCH DIA.	$57	$74,100
20	800	LF	SEWER, SIPHON PIPE, UNDER RIVER 6, 8, & 12 INCH DIA.	$800	$640,000
21	1	LS	SIPHON HEADWORKS VAULT, 12' L x 7' W x 10' D	$16,800	$16,800
22	9	EA	MANHOLES, 48 INCH DIA.	$2,500	$22,500
23	1	EA	MANHOLES, 96 INCH DIA.	$18,000	$18,000
24	1	LS	TEMPORARY EROSION CONTROL	$47,279	$47,279
25	1	LS	LANDSCAPING RESTORATION	$47,279	$47,279
CONSTRUCTION SUBTOTAL					**$5,208,288**
Sales Tax at 8.2%					$427,080
CONSTRUCTION TOTAL					**$5,635,368**
Engineering, Legal, and Administration				27%	$1,521,549
Contingency				30%	$2,147,075
Total Estimated Project Cost					**$9,303,992**

Appendix C — Hydraulic Calculations

Inverted Siphon on Bridge and Under River Design

2 Pipes on Bridge

Length of Siphon Pipe to Manhole F3:	1947	ft
Manning's n	0.015	
Upstream WSE:	73.6	ft
Downstream WSE:	42.72	ft
Inlet loss:	0.4	ft
Available fall (invert to invert):	30.88	ft
Available head for friction:	30.48	ft
Available hydraulic slope:	0.0157	ft/ft

Future Pipe under River

Length of Siphon Pipe to WTP:	2100	ft
Manning's n	0.015	
Upstream WSE:	73.6	ft
Downstream WSE:	29.6	ft
Inlet loss:	0.4	ft
Available fall (invert to invert):	44	ft
Available head for friction:	43.6	ft
Available hydraulic slope:	0.0208	ft/ft

1st Pipe

Pipe 1 Size:	6	inch
Pipe Capacity:	0.608	cfs
	273	gpm
Full flow velocity:	3.1	fps
Min. Flow for 3 fps	264	gpm
Equiv. Hazen-Williams Coefficient:	82	

2nd Pipe

2021 Peak Hourly Flow:	1031	gpm
	2.297	cfs
2021 PHF minus Pipe 1 flow:	758	gpm
	1.689	cfs
Required Pipe Size:	8.8	inch
Selected Pipe Size:	8	inch
Pipe Capacity:	1.310	cfs
	588	gpm
Full flow velocity:	3.8	fps
Min. Flow for 3 fps	470	gpm
Equiv. Hazen-Williams Coefficient:	83	

3rd Pipe

Build-out Peak Hourly Flow:	2551	gpm
	5.684	cfs
Build-out PHF minus Pipe 1 & 2 flow:	1690	gpm
	3.765	cfs
Required Pipe Size:	11.3	inch
Selected Pipe Size:	12	inch
Pipe Capacity:	4.449	cfs
	1997	gpm
Full flow velocity:	5.7	fps
Min. Flow for 3 fps	1058	gpm
Equiv. Hazen-Williams Coefficient:	83	

Inverted Siphon Beneath River

Length of Siphon Pipe:	2100	ft
Manning's n	0.015	
Upstream WSE:	73.6	ft
Downstream WSE:	29.6	ft
Inlet loss:	0.4	ft
Available fall (invert to invert):	44	ft
Available head for friction:	43.6	ft
Available hydraulic slope:	0.0208	ft/ft

1st Pipe

Pipe 1 Size:	6	inch
Pipe Capacity:	0.701	cfs
	314	gpm
Full flow velocity:	3.6	fps
Min. Flow for 3 fps	264	gpm
Equiv. Hazen-Williams Coefficient:	81	

2nd Pipe

2021 Peak Hourly Flow:	1031	gpm
	2.297	cfs
2021 PHF minus Pipe 1 flow:	717	gpm
	1.596	cfs
Required Pipe Size:	8.2	inch
Selected Pipe Size:	8	inch
Pipe Capacity:	1.509	cfs
	677	gpm
Full flow velocity:	4.3	fps
Min. Flow for 3 fps	470	gpm
Equiv. Hazen-Williams Coefficient:	82	

3rd Pipe

Build-out Peak Hourly Flow:	2279	gpm
	5.078	cfs
Build-out PHF minus Pipe 1 & 2 flow:	1287	gpm
	2.868	cfs
Required Pipe Size:	10.2	inch
Selected Pipe Size:	12	inch
Pipe Capacity:	4.449	cfs
	1997	gpm
Full flow velocity:	5.7	fps
Min. Flow for 3 fps	1058	gpm
Equiv. Hazen-Williams Coefficient:	83	

Gravity Sewer Pipes

Segment A

MH	Rim Elev.	IE In (ft)	IE Out (ft)	Pipe length (ft)	Pipe Size D (inch)	Invert Depth (ft)	Pipe Slope (ft/ft)	Peak Flow (gpm)	Peak Flow (cfs)	Manning's n	% Full Pipe (d/D)	Velocity (fps)	Q Full (cfs)	V Full (fps)
A1	264		257.1	400	10	6.9	0.0240	1504	3.351	0.013	80.83%	7.09	3.394	6.22
A2	258.88	247.5	247.3	400	10	11.58	0.0250	1504	3.351	0.013	79.17%	7.24	3.464	6.35
B1	244	237.3	237.1	293	10	6.9	0.0562	1707	3.803	0.013	63.54%	10.40	5.196	9.53
B2	227.32	220.62	220.42	400	10	6.9	0.0614	1707	3.803	0.013	61.68%	10.77	5.429	9.95
B3	202.56	195.86	195.66	400	10	6.9	0.0641	1707	3.803	0.013	60.82%	10.95	5.545	10.17
B4	176.74	170.04	169.84	220	10	6.9	0.0657	1707	3.803	0.013	60.32%	11.06	5.615	10.29
B5	162.09	155.39	155.19	180	10	6.9	0.0455	2103	4.686	0.013	100.00%	8.59	4.673	8.57

Segment
B

Horizontal Directional Drilling Option

MH	Rim Elev.	IE In (ft)	IE Out (ft)	Pipe length (ft)	Pipe Size D (inch)	Invert Depth (ft)	Pipe Slope (ft/ft)	Peak Flow (gpm)	Peak Flow (cfs)	Manning's n	% Full Pipe (d/D)	Velocity (fps)	Q Full (cfs)	V Full (fps)
C1	156	149.3	149.1	5028	14	6.9	0.0150	2103	4.686	0.013	62.34%	6.69	6.585	6.16
E1	82.44	73.61	73.4											

La Center Road Lift Station Option

IE In (ft)	IE Out (ft)	Pipe length (ft)	Pipe Size D (inch)	Peak Flow (gpm)	Peak Flow (cfs)	Velocity (fps)	Friction Head Loss (ft) C=135	Static Head (ft)	Total Head (ft)
116	262.3	2065	12	2103	4.686	5.97	19	146	166

Gravity Main

MH	Rim Elev.	IE In (ft)	IE Out (ft)	Pipe length (ft)	Pipe Size D (inch)	Invert Depth (ft)	Pipe Slope (ft/ft)	Peak Flow (gpm)	Peak Flow (cfs)	Manning's n	% Full Pipe (d/D)	Velocity (fps)	Q Full (cfs)	V Full (fps)
C2	269	262.3	262.1	400	12	6.9	0.0228	2103	4.686	0.013	72.26%	7.71	5.374	6.84
C3	259.7	253	252.8	400	12	6.9	0.0628	2103	4.686	0.013	51.47%	11.50	8.924	11.36
C4	234.4	227.7	227.5	400	12	6.9	0.0688	2103	4.686	0.013	50.09%	11.90	9.341	11.89
C5	206.7	200	199.8	400	12	6.9	0.0698	2103	4.686	0.013	49.88%	11.97	9.409	11.98
C6	178.6	171.9	171.7	400	12	6.9	0.0695	2103	4.686	0.013	49.93%	11.95	9.392	11.96
D1	150.6	143.9	143.7											

Segment C

Horizontal Directional Drilling Option

14-inch pipe continues from Segment B. Separate gravity system required for NW Timmen and Spencer Road.

Gravity Pipe with La Center Road Lift Station Option

MH	Rim Elev.	IE In (ft)	IE Out (ft)	Pipe length (ft)	Pipe Size D (inch)	Invert Depth (ft)	Pipe Slope (ft/ft)	Peak Flow (gpm)	Peak Flow (cfs)	Manning's n	% Full Pipe (d/D)	Velocity (fps)	Q Full (cfs)	V Full (fps)
D1	150.6	143.9	143.7	400	12	6.9	0.0695	2279	5.078	0.013	52.37%	12.19	9.392	11.96
D2	122.6	115.9	115.7	400	12	6.9	0.0693	2279	5.078	0.013	52.44%	12.18	9.375	11.94
D3	94.7	88	87.8	400	12	6.9	0.0355	2279	5.078	0.013	65.01%	9.39	6.712	8.55
E1	82.4	73.6	73.4											

Segment D

La Center Bridge Lift Station Option

MH	Rim Elev.	IE In (ft)	IE Out (ft)	Pipe length (ft)	Pipe Size D (inch)	Invert Depth (ft)	Pipe Slope (ft/ft)	Peak Flow (gpm)	Peak Flow (cfs)	Manning's n	% Full Pipe (d/D)	Velocity (fps)	Q Full (cfs)	V Full (fps)
E1	82.4	73.61	73.4	400	12	9	0.0617	2279	5.078	0.013	54.33%	11.65	8.846	11.26
E2	55.44	48.74	48.54	400	12	6.9	0.0349	2279	5.078	0.013	65.39%	9.33	6.655	8.47
E3	41.28	34.58	34.38	200	15	6.9	0.0082	2279	5.078	0.013	72.00%	5.37	5.849	4.77
LCBLS	38	32.74												

	IE In (ft)	IE Out (ft)	Pipe length (ft)	Pipe Size D (inch)	Peak Flow (gpm)	Peak Flow (cfs)	Velocity (fps)	Friction Head Loss (ft) C=135	Static Head (ft)	Total Head (ft)
Force Main	23	42.72	925	8	1486	3.311	9.48	33	20	52
	23	42.72	925	6	793	1.767	9.00	41	20	61