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Town of Edson

Final Preliminary Design Report

Edson West Sanitary Trunk Main

March 2014





ISL Engineering and Land Services Ltd. is an award-winning full-service consulting firm dedicated to working with all levels of government and the private sector to deliver planning and design solutions for transportation, water, land, and environmental projects.















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1.1 Authorization

In August 2013, ISL Engineering and Land Services Ltd. (ISL) was commissioned by the Town of Edson (the Town) to develop a preliminary engineering design for the West End Sanitary Sewer Trunk Main concept presented in the Municipal Servicing Plan update (AECOM, 2011), hereafter referred to as the MSP.

The purpose of this ISL study is to provide a feasible and cost effective preliminary design of the West Sanitary Trunk Main to service the existing and future development areas.

The project was authorized by the Town of Edson by direction of Mr. Dawit Solomon, M.Sc., P. Eng., Director of Engineering of the Town.

1.2 Scope of Work

The objective of this project is to develop and review alignment alternatives for the proposed West Sanitary Sewer Trunk Main, to determine the most cost effective alignment/servicing option, and prepare a preliminary design for the most cost effective servicing option. Work tasks include:

- Develop 4 preliminary design alignment options and for each:
 - · Complete a geotechnical and environmental assessment
 - Identify Historical Resource requirements
 - Identify any permit and approvals requirements
- Evaluate and recommend the preferred alignment based on feasibility, approvals/permits and cost
 effectiveness
- Prepare draft preliminary engineering drawings and cost estimate for the preferred option
- Prepare a draft report summarizing the preliminary engineering phase of the project
- Refine the preliminary engineering drawings and cost estimate for the preferred option
- Prepare a final report summarizing the preliminary engineering phase of the project



2.0 Background

Previous Studies

2.1.1 West Edson Area Structure Plan

The Edson West Area Structure Plan (ASP), prepared by Lovatt Planning Consultants Ltd. (Lovatt), is currently before council for final approval. The ASP provides a framework for servicing of the west most portion of the Town of Edson and Yellowhead County along Highway 16. The ASP indicates future land use is primarily light industrial and commercial development with a small section of residential land east of Rodeo Road north of Highway 16.

2.1.2 Municipal Servicing Plan Update

In 2011 AECOM completed an update to the Municipal Servicing Plan (MSP). The study identified that large areas of the existing sewer system within the Town experience sanitary backup during heavy rainfall events, resulting in basement backup. The MSP evaluated upgrade alternatives to address these flood risks.

XP-SWMM modeling software was used to evaluate the dry and wet weather flows for the existing and proposed sanitary system. The existing and future sanitary system analysis was used to evaluate the 5 and 25 year, 4 hour and 24 hour rainfall events. The modeling results were used to evaluate system performance by examining pipe capacity utilization and surcharge levels.

The following highlights the conclusions and recommendations from the study:

- The model was used to assist in identifying flood risk areas and evaluate upgrade alternatives.
- The proposed system improvements were divided into three phases; Phase 1 includes the construction of the West Edson Sanitary Trunk Main to address surcharging within 1.0m of the ground level for the 5 year 4 hour event.
- Phase 1 upgrades included upgrades on 1 Avenue, 42 Street, 49 Avenue, 51 Street, 52 Street, 53 Street and 70 Street.
- Alternative 1 includes upgrades to the existing West Sanitary Trunk
- Alternatives 2 and 3 involve the construction of a new trunk sewer to the existing sewer at 54 Street
- Alternative 2 includes a 375mm pipe for existing developments; Alternative 3 includes a 750mm pipe for 2025 development limit west of the Town to Rodeo Road.

A copy of the XPSWMM model for the MSP was made available and a brief review was completed to confirm the working condition of the model. An in depth audit of the model was not completed as this is outside the scope of the current study.

Model Calibration

The model was calibrated using rainfall and flow monitoring data and wet weather flows were estimated within 3% and 19% of monitored flows for the June 2008 and August 2008 rainfall events.

Model Service Area and Flows

The hydraulic model incorporated the existing Town sewer drainage and future 2015 and 2025 development areas within both the Town and County. Separate inputs were included for Areas 11 through 13 and Areas 18 through 23 representing future development within the Town and Yellowhead County, respectively. The following information was extracted from the model.











Existing Development Scenario (approximate peak flows values)

- Model was based on the 5 year 4 hour event
- The sanitary flow from the proposed 70 Street diversion 0.12 m³/s
- The proposed pipe design for the new bypass trunk, to provide relief for the existing system at 70 Street and service future development areas 11, 12 and 13, includes a 375mm diameter pipe at 0.22% grade

2025 Development Scenario (approximate peak flows values)

- 2025 development flows from County land Areas 21, 22 and 23 is 0.12 m³/s
- 2025 development flows from County land Areas 18, 19 and 20 is 0.09 m³/s
- 2025 development flows from Town land Area 11 is 0.01 m³/s
- 2025 development flows from Town land Area 12 is 0.03 m³/s
- 2025 development flows from Town land Area 13 is 0.04 m³/s

Model Remarks

- The degree of calibration of the model is considered reasonable for evaluating system flows.
- The modelled flow from the development upstream of the proposed 70 Street connection appears high
 compared to anticipated flow from rational design calculations. It was noted storm sumps may be
 connected to the system, however there is no way to confirm the additional inflow without further flow
 monitoring.
- A detailed audit of the model and confirmation of servicing areas is required to confirm the flows from 70 Street and the interaction of peak flows from each of the contributing areas as currently there is a significant risk that the flows may be over or under predicting.
- The Town has commented that they are uncertain of the accuracy of the flows calculated in the MSP and that the future flows may be greater than identified in the previous study.

2.2 Alberta Transportation Plans – Highway 16 By-Pass

Alberta Transportation has future plans to construct a bypass from the east side of the Town that reconnects to the existing highway between 75 Street and Rodeo Road. The schedule for construction of the by-pass is uncertain at this time. The proposed bypass restricts opportunity to install the proposed sewer pipe along the south side of the Highway 16 corridor. It is however anticipated that the proposed sewer will not interfere or impact the construction of the future by-pass as long as the sewer is not installed within the lands allocated for the bypass interchange. No alignments within these lands were considered in this study.



2.3 **Design Flows**

The MSP identified two servicing alternatives with regard to design flows. These are:

Alternative 1: Provide servicing for only the proposed Town growth (Areas 11, 12 and 13) and relief at 70 Street.

Alternative 2: Provide servicing for scenario 1, plus accommodate the potential for flows from the future County growth (Areas 18 – 23)

Preliminary design flows were developed based on the design flows outlined in the MSP and associated XPSWMM model as well as additional calculations and analysis.

The review of the XPSWMM model identified the following concerns:

- The Town indicated that the flows identified in the MSP potentially underestimate the actual future flows
- The flow from the existing development draining to the 70 Street connection appears high relative to the service area
- Even though the 70 Street connection is almost immediately adjacent to part of the new development area, the model shows the peak flows occurring at separate times.

Without addressing the above concerns there is a risk of incorrect sizing of future infrastructure. Oversizing of piping and pumping systems may result in increased capital and maintenance costs. Under-sizing the system may result in reduction of the level of service.

Future Development Flows

A high level spreadsheet calculation of the sanitary flows from the future development areas, including both County and Town lands was undertaken for comparison with the model flows. The calculation is included in Appendix A. The following tables summarize the difference between spreadsheet calculations and the MSP model flows, for both alternatives.

Table 2.1: Alternative 1 – Design Flow Comparison

From To		Design Flows Q (L/s)			
M.H.	м.н.	Spreadsheet	Spreadsheet (Q/86%)	Model	
Area 11	75 Street	11.6	13.5	11.3	
Area 12	75 Street	43.5	50.6	28.9	
Area 13	75 Street	60.7	70.6	40.4	
75 Street	70 Street	109.8	127.7	80.4	

Notes:

Spreadsheet Calculations are based on the following:

- Residential Sewage Generation Rate = 375 L/s/person
- Commercial/Industrial Sewage Generation Rate = 13600L/ha/day
- Residential I/I Rate = 0.28 L/s/ha
- Commercial/Industrial I/I Rate = 0.05 L/s/ha
- Residential Peaking Factor = 2.6 P^{-0.1}
- Commercial/Industrial Peaking Factor = 3.0





Table 2.2: Alternative 2 – Design Flow Comparison

From	То	D	esign Flows Q (L/s)	(L/s)		
M.H.	М.Н.	Spreadsheet	Spreadsheet (Q/86%)	Model		
Area 21	Area 22	8.8	10.3	8.0		
Area 22	Area 23	130.6	151.9	88.9		
Area 23	Area 12	181.0	210.5	122.4		
Area 20	Area 19	59.4	69.1	39.7		
Area 19	Area 18	96.0	111.7	64.0		
Area 18	Area 12	141.2	164.1	94.0		
Area 12	75 Street	365.7	425.2	245.2		
Area 11	75 Street	11.6	13.5	11.3		
Area 13	75 Street	60.7	70.6	40.4		
75 Street	70 Street	437.3	508.4	295.9		

Tables 2.1 and 2.2 indicate a large discrepancy between the spreadsheet flows and the MSP model flows, with the spreadsheet calculations indicating significantly larger sanitary flows for the future servicing areas than those identified in the MSP. Additional background information of the future development areas is required prior to making recommendation of which design flows are to be used.

Existing 70 Street Development

The model results show a flow of approximately 141 L/s from the development area of about 53.4 ha (45.2 ha residential; 8.2 ha commercial). This flow results in the downstream system to surcharge. As such it is proposed to divert a portion of this flow to the new sewer trunk at 70 Street. This would result in approximately 115 L/s being diverted to the new trunk.

For comparison a high level calculation of the expected sanitary flow from the existing 70 Street development was also carried out using the following parameters:

Average Residential Sewage Flow = 375 L/person/day
Residential Density = 40 persons/ha
Residential Inflow/Infiltration = 0.28 L/s/ha

Residential Peaking Factor = 2.6P^{-0.1} (P=population/1000)

Average Commercial Sewage Flow = 13,600 L/ha/day Commercial Inflow/Infiltration = 0.05 L/s/ha

Commercial Peaking Factor = 3.0

The calculated peak wet weather flow from the existing development is about 36.1 L/s, compared to the model flow of 141 L/s. The difference between the flows may be attributed to downspout connections from residences to the sanitary sewer. Without additional background information a design flow from this development cannot be confirmed at this time. It is recommended that additional analysis be completed during detail design. For the purpose of the current study it was agreed with the Town that the model flows will be used.



Corresponding Peak Flows

As previously identified the timing of the peak flow from the future development area and existing development, from the proposed 70 Street connection, are slightly offset from each other. The separation is close and without supporting information it is risky to completely rule out the potential for overlap.

Table 2.3: Peak Flow Comparison

	Alternative 1		Alternative 2	
	MSP Flow	Modified Flow	MSP Flow	Modified Flow
Rodeo Road to 75 Street	28.9 L/s	28.9 L/s	245 L/s	245 L/s
75 Street to 70 Street	80.4 L/s	80.4 L/s	296 L/s	296 L/s
70 Street Connection	115 L/s	115 L/s	115 L/s	115 L/s
70 Street to 54 Street	84.6 L/s	195 L/s*	299 L/s	411 L/s*

^{*}Flow assumes coinciding peak flows from 75 Street to 70 Street and 70 Street Connection

For the purpose of this study it is recommended to proceed with the modified flows for design flow alternatives. The preliminary design of pipe diameters and grades will be adjusted to meet elevation constraints while maintaining the modified flow requirements. As mentioned previously, the design flows will need to be confirmed during detailed design prior to finalizing the sizing of pipes and other infrastructure.







3.1 Alignment Alternatives

Four alignment alternatives were considered for the West End Sanitary Sewer Trunk Main. These are described below and shown in Figures 3.1 to 3.4. The upstream point is on Rodeo Road on the West boundary of the Town. The proposed sewer trunk connects to the existing sewer trunk on 54 Street south of Highway 16.

3.1.1 Alignment 1 (Figure 3.1)

Horizontal Alignment

The alignment extends from Rodeo Road to 75 Street within the Highway 16 corridor along the north side of the westbound lanes. East of 74 Street the alignment crosses to the south side of the east bound lanes, immediately west of where the highway divides. From here, the alignment follows Highway 16 east bound lanes to 63 Street where it turns south crossing CN rail tracks. Immediately south of the tracks the alignment turns northeast and follows a cut line along the south boundary of the CN right-of-way. The alignment approaches Bench Creek prior to reaching 54 Street. At this section of Bench Creek the cross section of the creek has been widened, and possibly deepened, previously by CN to manage stormwater runoff. The proposed alignment continues below the widened creek section before connecting into the downstream sewer system on 54 Street.

Vertical Alignment

The vertical alignment alternatives for this route include gravity and pumped solutions that are impacted by the depth of the downstream connection at 54 Street and the existing surface topography.

The ground elevations at Rodeo Road and 75 Street are around 935m and 918m respectively, resulting in and overall grade is about 1.1%. However, the first 600m stretch is at a grade of 2.3% and the remaining stretch has a grade of 0.2%. This ground profile is desirable for gravity systems as it allows for gravity sewer flow with minimal installation depths. Conventional open cut construction methods could be used for this section.

East of 75 Street the ground profile continues to fall for a short distance to low point at an elevation of 917m. From here the ground rises steeply to a high point at an elevation of 925m, located immediately west of 70 Street. Gravity sewer depths along this section would be greater than 10m deep, likely requiring installation by trenchless methods.

East of 71 Street the ground profile drops quickly, from an elevation of 925m to 911m over a distance of approximately 300m before flattening out with some undulations, as the alignment approaches 63 Street. From here the ground profile continues to undulate, ranging in elevation from about 909m to 912m, up to Bench Creek immediately west of 54 Street. With the exception of the section immediately east of the high point the proposed gravity trunk would be installed at relatively shallow depths.

The proposed sewer crossing of the wet area immediately west of 54 Street shows very shallow depths, about 2.4m to obvert. The ground profile shown shows the water surface and not the bottom of the ponding area. Taking into account the depth of water at this location (assumed at approximately 1.5m) there is likely very little cover, potentially less than 1.0 to 1.5m. This would be very difficult and costly to construct as well as having a significantly impact on habitat. Even if construction could be completed, the pipe would most likely be significantly impacted by high rates of groundwater infiltration.

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To mitigate some of the construction and environmental risk associated with crossing the creek, an option to construct an inverted siphon across the creek was considered. This would allow the crossing to be constructed by directional drilling which would significantly lessen the environmental impact. However, due to the elevation of the tie-in sewer, it would not be possible to gain sufficient head across the siphon for it to work efficiently. This would result in significant operation and maintenance issues and is not recommended. As an alternative to an inverted siphon, an option to install a pump station at this location was also considered and rejected due to costs. This is discussed later in this report.

A pumped solution was considered as an alternative to a gravity sewer from 75 Street to the tie-in. This could offer a cost effective solution as the forcemain can be installed at nominal depth, thereby reducing excavation costs. Pumping through a forcemain also reduces the pipe size and potential for infiltration. The pump alternative includes construction of a gravity sewer from Rodeo Road to a pump station near the low point east of 75 Street. A new sewer pipe would also be required to convey flows from the 70 Street diversion towards the pump station site. The pump station would convey flows through a relatively shallow forcemain pipe from the pump station site to the downstream trunk at 54 Street; the forcemain would be installed at minimum depth, about 3.0m to obvert. Crossing the wet area the forcemain pipe could be installed at greater depths to reduce the potential of ground disturbance of pond bottom. Finally, the forcemain would tie in directly to the downstream trunk at 54 Street.

The forcemain would be sized to ensure flows do not exceed a maximum flow velocity of 3.0m/s and minimum flow of 0.9m/s to avoid potential sedimentation in the forcemain. At this preliminary phase it has been determined that the forcemain could be designed such to avoid potential vacuum pressures that can be experienced when pumping across a negative static head.

70 Street Connection

The proposed 70 Street connection for the gravity sewer option would consist of extending a pipe approximately 200m from manhole N594 south to the proposed sanitary trunk near Highway 16. The proposed pipe would be installed at minimum depths primarily by open cut construction. The 70 Street sewer extension would require a trenchless crossing of Highway 16 prior to the connection to the new trunk main.

The pump station option would require the diversion of the 70 Street flows west towards a proposed pump station near 75 Street. The length of new pipe is significantly greater than for the gravity sewer, approximately 890m. The pipe would be installed within the existing service road immediately south of the westbound lanes up to where the undivided highway begins. From here, the pipe would be installed on the north side of the highway corridor to the proposed pump station location near 75 Street.

Utilities

A review of existing utilities was completed to identify any potential conflicts. The general orientation of existing utility lines has been identified on the plans. At this time as-built information, including depth of installation, is not available. The proposed sewer is below typical installation depths of shallow utilities therefore the risk for conflict with shallow utilities is low. In the event of a conflict occurring with existing pipelines, the sewer design will be modified to accommodate existing utilities where possible. If such a design is impeded by existing utilities, relocations of existing pipelines may need to be considered.

In summary, the following pipeline crossings and shared easements have been identified for sewer Alignment 1:

- A TELUS line found in the north ditch along Hwy 16 between Range Road 180 and 75 Street shares the same general alignment as Alignment 1.
- A 1050psi ATCO High Pressure Gas pipeline and Yellowhead Gas crossing located north of Hwy 16 on the east side of Rodeo Road north of Hwy 16
- A Yellowhead Gas crossing found near the SE corner of ¼ Sec 18-53-17-W5 along Hwy 16.









- A 30psi ATCO Gas distribution line running along the eastbound lanes of Hwy 16 in the north ditch right where Hwy 16 splits off east of 74 Street. This looks to feed McPhee Construction Ltd and others on the south side of Hwy 16.
- A Yellowhead Gas line shares the same alignment as sewer Alignment 1 from 63 Street south of the CN tracks as it heads east to 54 Street following the cut line along the south boundary of the CN Rail right-ofway.

3.1.2 Alignment 2 (Figure 3.2)

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Horizontal Alignment

Alignment 2 starts at Rodeo Road and follows a proposed road right-of-way, within future development Areas 11 and 12, to 75 Street. There is no existing development along this stretch with no know encumbrances to construction. At 75 Street the alignment crosses Highway 16 then continues east along the service road for about 400m then head south to the end of the service road then east through the south section of private property before continuing and north east along the CN rail right-of-way and the tree farm to 63 Street. At 63 Street the alignment turns south crossing CN rail towards the government road allowance, along the south end of SE and SW ¼ sections 16-53-17-5, and continues towards 54 Street where the alignment heads north towards the tie in location.

Vertical Alignment

The vertical alignment alternatives for this route include gravity and pumped solutions that are impacted by the depth of the downstream connection at 54 Street and the existing surface topography.

There is a significant amount of grade available from Rodeo Road to 75 Street with an overall grade is about 1.0%. However, the first 600m stretch is at a grade of 2.3%. The ground profile of the remaining stretch has a grade of 0.2%. This ground profile is desirable for gravity systems as it allows for gravity sewer flow with minimal installation depths. The pipe would be installed at grades of up to 1.5% before flattening out to 0.5% coming down from Rodeo Road. Approaching the low point the pipe slope decreases to 0.1 % to keep limit cover.

East of 75 Street the ground profile continues to fall for a short distance to low point a couple hundred meters east of 75 Street at an elevation of 917m. As the alignment heads south and east around the private property the ground profile has a steep rise to a high point, with an elevation of 925m. The combination of sewer depth and limited construction R/W makes large excavations for open cut construction difficult. It is anticipated that this section will include some sections to be constructed by trenchless methods, particularly where depth to invert of up to 14m. At these depths excavations become very wide and require large working areas for conventional open cut methods. Cost of open cut construction at these depths become comparable to trenchless construction.

After the high point the ground gradually falls as the alignment heads south along the service road. As the alignment traverses the private property and along the CN right-of-way the topography has a gentle falling slope to 63 Street. At 63 Street the terrain levels off across the CN tracks and east along the government road allowance to 54 Street. From here, the alignment heads north on 54 Street and the ground elevation drops across Bench Creek, then rises towards the 54 Street connection. At the Bench Creek crossing, the ground cover is less than 1.5m. This is raises significant construction and operational risks and issues which are discussed in later sections of this report.

The pump and forcemain option would be similar to Alignment 1 with the pump station located at the low point east of 75 Street and a forcemain to 54 Street. The flow diversion from 70 Street requires a new pipe constructed from 70 Street east towards the proposed lift station near 75 Street. The advantage of the pump and forcemain option is that it mitigates the deep sewer construction over the high point and also allow the sewer to be installed by means that mitigate construction risk associated with the Bench Creek crossing.

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70 Street Connection

The proposed 70 Street connection for the gravity sewer option would consist of extending a pipe approximately 400m from manhole N594 south to the proposed sanitary trunk near Highway 16. The proposed pipe would be installed at minimum depths primarily by open cut construction. The 70 Street sewer extension would require a trenchless crossing of Highway 16. The sewer pipe would extend another 200m to the connection to the new trunk main.

The pump station option would require the diversion of the 70 Street flows west towards a proposed pump station near 75 Street. The length of new pipe is significantly greater than for the gravity sewer, approximately 890m. The pipe would be installed within the existing service road immediately south of the westbound lanes up to where the undivided highway begins. From here, the pipe would be installed on the south side of the highway corridor to the proposed pump station location near 75 Street.

Utilities

In summary, the following pipeline crossings and shared easements have been identified for sewer Alignment 2:

- A 1050psi ATCO High Pressure Gas pipeline and Yellowhead Gas crossing located north of Hwy 16 on the east side of Rodeo Road north of Hwy 16
- A Yellowhead Gas crossing found near the east boundary of S.W. ¼ Sec 18-53-17-W5 north of Hwy 16.
- A 30psi ATCO Gas distribution line crossing right where Hwy 16 splits off into eastbound and westbound lanes east of 74 Street. The sewer alignment shares the same alignment as the ATCO gas lines as it feeds properties located in NW 1/4 8-53-17-5.
- There is a 38PE Yellowhead Gas line that shares the same alignment along the northbound side of the CN right-of-way south of Hwy 16 eastbound lanes west of 63 Street.
- There are existing Yellowhead Gas, Conserve Oil, and TELUS lines running along the easement between SW 1/4 Sec 16-53-17-5 and NW 1/4 Sec 9-53-17-5 east of 63 Street and west of 54 Street common to proposed sewer Alignment 2.

3.1.3 Alignment 3 (Figure 3.3)

Horizontal Alignment

The alignment extends from Rodeo Road to 75 Street within the Highway 16 corridor along the north side of the west bound lanes. At 75 Street the alignment crosses Highway 16 and heads east along the service road and through the private property immediately south of the highway corridor. About 300m east of 70 Street the alignment meets up with the CN rail right-of way and turns north east to parallel the rail to 63 Street. At this point the alignment separates from the rail right-of way and continues along the south side of the east bound lanes of the highway to 57 Street where it shifts to 1 Avenue before reaching 54 Street. Here, the alignment heads south towards the tie in point, located about 300m south of 1 Avenue.

Vertical Alignment

The vertical alignment from Rodeo Road to 63 Street is similar to Alignment 1. East of 63 Street the ground begins to rises to a peak near 58 Street before falling again to 54 Street. In this section the gravity pipe is up to 11-12m deep. At the creek crossing the depth of pipe is about 2.5m to invert. The depth noted is to water surface not bottom of pond. Further investigation is required to determine the depth of the creek to confirm actual ground cover. However, as there is an existing crossing here that ties into the connection manhole, it is anticipated that a gravity crossing can be made at this point.

A pumping option includes the installation of a forcemain at minimum depths of about 3.0m. At the creek crossing the forcemain could be installed at a greater depth to ensure adequate cover beneath the creek.











70 Street Connection

The proposed 70 Street connection for the gravity sewer option would consist of extending a pipe approximately 200m from manhole N594 south to the proposed sanitary trunk near Highway 16. The proposed pipe would be installed at minimum depths primarily by open cut construction. The 70 Street sewer extension would require a trenchless crossing of Highway 16 prior to the connection to the new trunk main.

The pump station option would require the diversion of the 70 Street flows west towards a proposed pump station near 75 Street. The length of new pipe is significantly greater than for the gravity sewer, approximately 890m. The pipe would be installed within the existing service road immediately south of the westbound lanes up to where the undivided highway begins. From here, the pipe would be installed on the south side of the highway corridor to the proposed pump station location near 75 Street.

Utilities

In summary, the following pipeline crossings and shared easements have been identified for sewer Alignment 3:

- A 1050psi ATCO High Pressure Gas pipeline and Yellowhead Gas crossing located north of Hwy 16 on the east side of Rodeo Road north of Hwy 16
- A Yellowhead Gas crossing found near the SE corner of 1/4 Sec 18-53-17-W5 north of Hwy 16.
- A 30psi ATCO Gas distribution line crossing right where Hwy 16 splits off into eastbound and westbound lanes east of 74 Street. The sewer alignment shares the same alignment as the ATCO gas lines as it feeds properties located in NW ¼ 8-53-17-5.
- A Yellowhead Gas line crossing at 63 Street as sewer Alignment 3 follows the Hwy 16 eastbound lanes.
- ATCO Gas crossings at 59, 58, and 57 St along Hwy 16 eastbound lanes as Alignment 3 turns south onto 57 Street.
- There are FORTIS and Yellowhead Gas lines running along 1Ave from 57 Street to 55 Street shared by Alignment 3.

3.1.4 Alignment 4 (Figure 3.4)

Horizontal Alignment

The alignment extends from Rodeo Road to 74 Street within the Highway 16 corridor along the north side of the west bound lanes. East of 74 Street the alignment crosses to the south side of the east bound lanes, immediately west of where the highway divides. From here, the alignment follows the roadway up to 63 Street where is turns south, crossing CN Rail towards the government road allowance. The remaining section from 63 Street to the tie in point on 54 Street is the same as described in Alignment 2.

Vertical Alignment

Alignment 4 is a hybrid of Alignments 1 and 2. East of 63 Street the alignment and profile is similar to that of Alignment 1. East of 63 Street the alignment and profile are similar to that of Alignment 2. As with the other alignments both pumping and gravity options were investigated for this alignment.

There is a significant amount of grade available from Rodeo Road to 75 Street with an overall grade is about 1.0%. However, the first 600m stretch is at a grade of 2.3%. The ground profile of the remaining stretch has a grade of 0.2%. This ground profile is desirable for gravity systems as it allows for gravity sewer flow with minimal installation depths. The pipe would be installed at grades of up to 1.5% before flattening out to 0.5% coming down from Rodeo Road. Approaching the low point the pipe slope decreases to 0.1 % to keep limit cover.

East of 75 Street the ground continues to fall for a short distance to low point east of 75 Street. Here the elevation is approximately 917m. As the alignment heads south and east around the private property the

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ground profile has a steep rise to a high point, with an elevation of 925m. The combination of sewer depth and limited construction ROW makes large excavations for open cut construction difficult. It is anticipated that this section will include some sections to be constructed by trenchless methods, particularly where depth to invert of up to 14m. At these depths excavations become very wide excavation and require very wide working areas for conventional open cut methods. Cost of open cut construction at these depths become comparable to trenchless construction.

East of 71 Street the ground profile drops quickly, from an elevation of 925m to 911m over a distance of 300m then is relatively level, with some undulations, as the alignment approaches 63 Street. At 63 Street the terrain levels off across the CN tracks and east along the government road allowance to 54 Street. As the alignment heads north on 54 Street the ground elevation drops across Bench Creek then rises towards the 54 Street connection. At the Bench Creek crossing the ground cover is less than 1.5m. This is raises significant construction and operational risks and issues which are discussed in later sections of this report.

Similar to the previous alternative, pumping mitigates the deep sewer construction over the high point and also allow the sewer to be installed by means that mitigate construction risk associated with the Bench Creek crossing.

70 Street Connection

The proposed 70 Street connection for the gravity sewer option would consist of extending a pipe approximately 200m from manhole N594 south to the proposed sanitary trunk near Highway 16. The proposed pipe would be installed at minimum depths primarily by open cut construction. The 70 Street sewer extension would require a trenchless crossing of Highway 16 prior to the connection to the new trunk

The pump station option would require the diversion of the 70 Street flows west towards a proposed pump station near 75 Street. The length of new pipe is significantly greater than for the gravity sewer, approximately 890m. The pipe would be installed within the existing service road immediately south of the westbound lanes up to where the undivided highway begins. From here, the pipe would be installed on the north side of the highway corridor to the proposed pump station location near 75 Street.

In summary, the following pipeline crossings and shared easements have been identified for sewer Alianment 4:

- A TELUS line found in the north ditch along Hwy 16 between Range Road 180 and 75 Street shares the same general alignment as Alignment 1.
- A 1050psi ATCO High Pressure Gas pipeline and Yellowhead Gas crossing located north of Hwy 16 on the east side of Rodeo Road north of Hwy 16
- A Yellowhead Gas crossing found near the SE corner of ¼ Sec 18-53-17-W5 north of Hwy 16.
- A 30psi ATCO Gas distribution line crossing right where Hwy 16 splits off into eastbound and westbound lanes east of 74 Street. The sewer alignment shares the same alignment as the ATCO gas lines as it feeds properties located in NW 1/4 8-53-17-5.
- There are existing Yellowhead Gas, Conserve Oil, and TELUS lines running along the easement between SW 1/4 Sec 16-53-17-5 and NW 1/4 Sec 9-53-17-5 east of 63 Street and west of 54 Street common to proposed sewer Alignment 4.







A pump station and forcemain option was identified for each of the four alignment options. This allows for mitigation of risk and expected high costs associated with deep sewer construction as well as providing means to mitigate construction risk associated with the Bench Creek crossing.

The proposed pump station would be located in the vicinity of the low point near 75 Street. The forcemain would extend from 75 Street to the downstream tie in point at 54 Street. Preliminary pump sizing was completed for the two design flow scenarios, as described below.

Alternative 1:

3.2

- 1. Design flow = 200 L/s; static head = -12.00 m; pump head = 20.27 m (based on Alt 4 alignment)
- 2. FM size = 400 PVC SDR 26
- 3. Min flow in FM = 200 L/s to prevent vacuum condition
- 4. Initial pump selection = 2 x 52.2 kW (70 hp) (Duty + Standby)

Alternative 2:

- 1. Design flow = 500 L/s; static head = -12.00 m; pump head = 12.89 m (based on Alt 4 alignment)
- 2. FM size = 600 PVC SDR 26
- 3. Min flow in FM = 500 L/s to prevent vacuum condition
- 4. Initial pump selection = 2 x 89.5kW (120 hp) (Duty + Standby)

3.3 Other Servicing Options

Multiple Pump Stations

Options to utilize multiple pump stations were considered. However, due to the following issues, the use of multiple pump stations would be neither feasible nor cost effective and therefore, no further consideration was given to their use:

- Increased capital cost for constructing multiple pump stations
- Increased operation and maintenance processes resulting in increased annual operation and maintenance costs
- Operational logistics, programming and reliability of multiple pump stations in series adds unnecessary complexity

Inverted Siphon

The inverted siphon concept includes constructing a conventional gravity system to the east side of Bench Creek. The creek crossing includes construction of an inverted siphon by directionally drilling either a single or multiple pipes below the creek towards the tie in manhole near 54 Street. This type of system is designed to run full and under pressure. The pressure pipe allows for installation beneath the creek at greater depths, compared to a gravity system, which provides adequate cover from the creek bottom while still tying into the downstream sewer system. The operation of the siphon is highly dependent on the available head to drive flows through the siphon, which in this situation about 3m minimum is required.

The analysis for this alternative evaluated a single- and multiple-pipe siphon systems. The single pipe siphon includes only one pipe to convey dry weather and wet weather flows. Due to the large difference between the dry weather flow and wet weather flow rates it is not possible to select a pipe size that would meet minimum flow velocities, to avoid sedimentation, during dry weather flow and meet the limitation in head available for wet weather flows. Sedimentation in the pipe would result in decreased hydraulic capacity and potential odour issues. Therefore a single pipe siphon system is not feasible.

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A multiple siphon pipe scenario was considered. This option would include a sealed gravity sewer system with an inverted siphon crossing at Bench Creek. The gravity sewer would be sized as per typical sewer systems. An inlet structure, located on the west bank of the creek, would divide flows between the various siphon barrels. A multiple barrel system would convey dry weather flow through a primary barrel with additional barrels used to convey additional wet weather flow. The analysis indicated that a 3 or 4 barrel siphon, pipe sizes ranging from 300mm to 800mm outside diameter, is technically feasible however wet weather flow barrels would need to be pumped out post event.

Risks identified during the analysis include:

- · Requirement for pumping out the wet weather siphon barrels following wet weather events
- Requirement for interim pumping of the dry weather flow barrels until the service area is fully developed.
- · Potential for sedimentation and blockages in the siphon barrels that would reduce the capacity of the siphon system.
- · Potential for septic conditions to develop resulting in odour and corrosion issues in sewerage system.
- Potential for air entrapment that would reduce the capacity of the siphon system.
- · Risks associated with the installation of multiple pipes in close proximity by horizontal directional drilling.

Considering the design, operational and construction risks identified above the inverted siphon design was considered unfeasible and henceforth is not carried forward.

Methods of Construction

New trunk construction has been typically done by open cut trenching; however trenchless methods are becoming more prevalent. Traditional open-cut pipe installation consists of excavating a trench, installation of the pipe and bedding and backfilling the excavated material. The level of effort required is dependent on the required depth of the pipe and the subsequent use of the surface above the pipe. Where alignments predominantly cross farm land, the topsoil will be stripped within the pipeline and working rights-of-ways and protected from degradation as per the requirement of the Provincial Soils Conservation Act.

Within existing developed areas it is necessary to restore the pavement surface to at least its original condition. To minimize the surface restoration requirements, or if there are other utilities in close proximity, it is common to use vertical trenching with workers protected by "trench boxes".

The most common trenchless construction techniques for new trunks are Horizontal Directional Drilling (HDD), Case Bore Augering and Pipe Jacking. HDD is conducted in three steps: the initial augering, a series of back reamings with progressively larger sizes, and the pipe insertion. HDD is normally used with HDPE pipe, with the HDPE pipe fused together prior to installation. HDD is only applicable to forcemain construction. HDD Installation of gravity sewer pipe does not meet specified grade tolerances.

Case Bore Augering is a technique in which a casing pipe (usually steel) is simultaneously inserted while forming a bore from a drive pit to a reception pit, by means of a rotating cutting head. Spoil is removed back to the drive shaft by helical wound auger flights rotating in the steel casing. When the casing pipe is completely installed a carrier pipe is inserted into the casing pipe that acts as external protection to the carrier pipe. The auger machine is installed in pits excavated in to a specified length and width for placing the boring machine on line and grade. Case Bore Augering is proposed for locations where casing is required such as roadway or railway crossings.

Pipe Jacking consists of extracting the existing pipe into a receiving pit while inserting a new carrier pipe from a sending pit. The spacing of the two pits is dependent on the size of the line to be replaced, the materials of the existing and new pipe and existing bedding and backfill. This method is limited to concrete pipe or HDPE lined concrete pipe, and thus would only be suitable for the gravity trunk sections.











Trenchless construction would be required at major roadway crossings, railway crossing(s), and water bodies (e.g. pond immediately west of 54 Street). Trenchless construction would, in all likelihood, be required at local roadway crossings, pipeline crossings and creek crossings. Portions of the gravity trunk may have to be installed using trenchless construction based on the depth of excavation.

Construction methods for water crossings will depend, in part, on the applicable environmental legislation that is expected to govern these watercourse crossings. For the purposes of this report, construction across these watercourses is assumed to be completed by trenchless methods. Open cut construction would require extensive environmental approvals and it is uncertain if the approvals would be granted. The proposed method of construction, for each alignment, is shown on the drawings. Cost estimates are based on these proposed methods of construction.

3.5 Servicing of Future Development Areas

3.5.1 West Development Areas

A review of the proposed trunk design with regards to on servicing of the future development areas within the Town and County lands was completed. The purpose of this review was to confirm servicing opportunities for these lands and the most cost effective servicing strategy with regards to this servicing and the trunk design.

Areas 11 and 12, north of Highway 16, between 75 Street and Rodeo Road, would be serviced directly by the new sewer trunk by means of local sanitary sewers connecting to the trunk main at manhole locations.

A contour plan of the future developments Area 22 and Area 23, north of Highway 16, shows a significant rise in the ground profile towards the western limit of the proposed development areas. As such, it is anticipated that installation of the sanitary trunk at minimum depths up to Rodeo Road will allow for gravity servicing of these future development areas towards the proposed trunk main connection at the Rodeo Road on the west boundary of Area 12

Area 13 is a low lying area south of Highway 16 between 70 Street and Rodeo Road. The MSP indicates that Area 13 is to be serviced by a lift station to the new sanitary trunk main. If the pump station servicing option, outlined above, is chosen for the new trunk main design the pump station could be designed such that Area 13 could be gravity fed to the new station eliminating the need for a small lift station for Area 13. Contours show that the low lands of Area 13 are at an elevation of about 914m. Assuming minimum depth and slopes on future sanitary services it is estimated that to service this area by gravity the wet well of the proposed pump station would have to be lowered 2-3m. The order of magnitude cost to lower the proposed wet well would be \$150,000. Based on the size of Area 13, it is estimated that a pump station to service this area would cost in the order of magnitude of \$1.2M.

Per the MSP, the proposed servicing for the future development areas west of Rodeo Road and south of Highway 16 (Areas 18, 19 and 20) includes a gravity sewer running west to east through each of the development areas and connecting to the sanitary trunk main at Rodeo Road. However, while the existing topography indicates that the overall ground profile rises up to an elevation of about 970m at the west most point in Area 20, Area 18 includes lands at elevations as low as 928m. This elevation is lower than the proposed invert at the upstream end of the proposed sanitary trunk, approximately 930m.

Assuming the low lands of Area 18 require servicing there are two options to achieve this. The first is to maintain the trunk elevations identified in the options presented in this report and pump Area 18 and the second is to deepen the trunk sufficiently so as to enable a gravity discharge from Area 18.





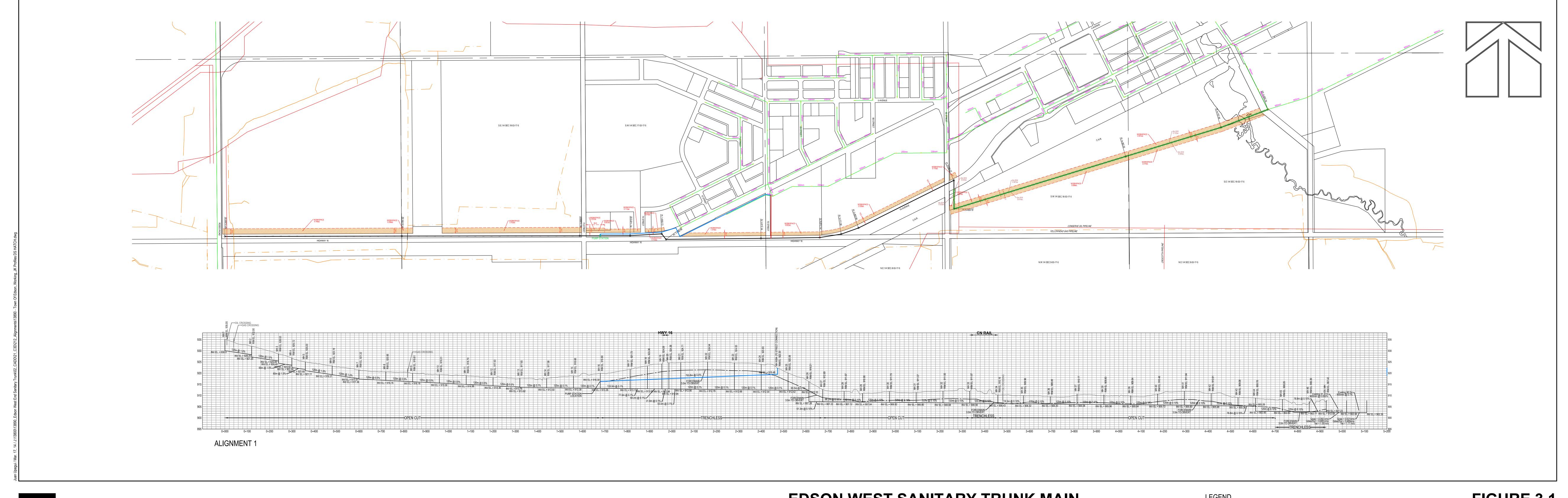


Based on the size of Area 18, it is estimated that a pump station to service this area would cost in the order of magnitude of \$1.5M. Deepening the trunk is feasible because the ground rises considerably from 75 Street to rodeo Road. Preliminary estimates show that in order to service Area 18 by gravity, some 150m of pipe would need to be lowered by around 5m. The order of magnitude cost of this is around \$750,000, which is considerably less than the pumping alternative.

3.5.2 South Development Areas

The lands south of CN right-of-way, from 63 Street to 54 Street, are planned for future commercial/industrial development. It would be preferred to service these future developments to the new sanitary trunk. An accessible connection for these future lands should encourage development by lessening offsite servicing costs. The earlier these lands are developed the sooner the Town can realize a growth in their tax base.









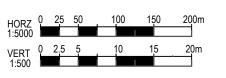
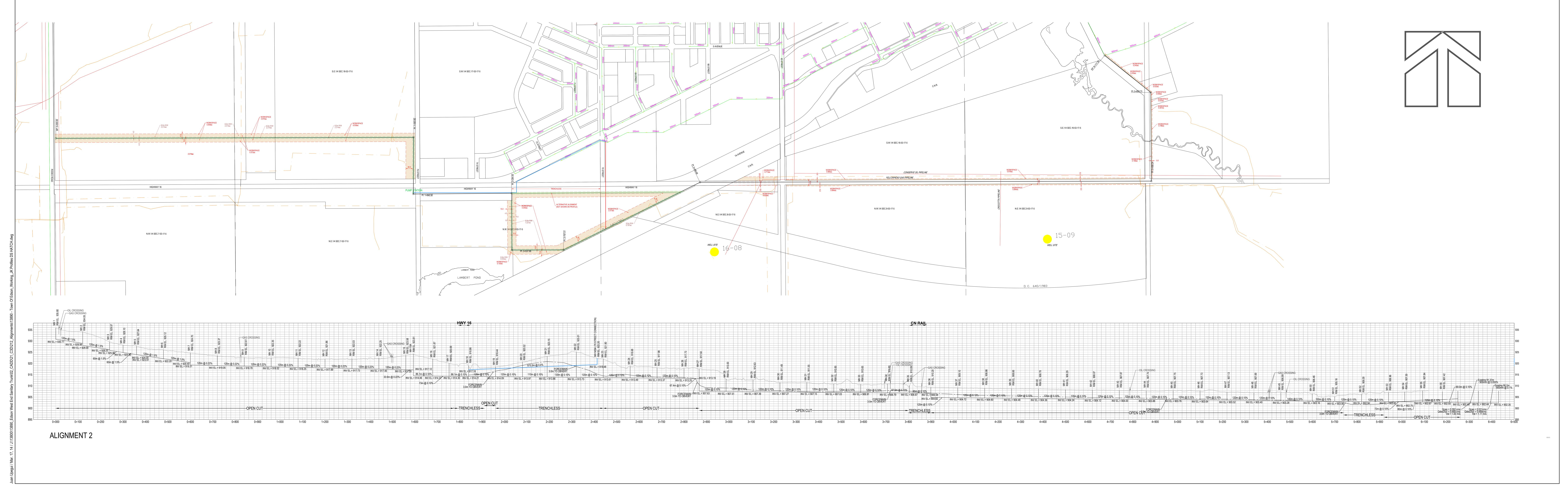
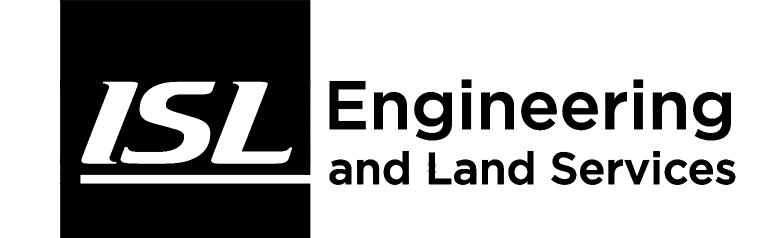
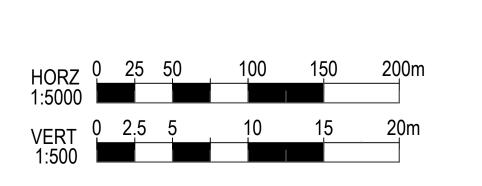


FIGURE 3.1









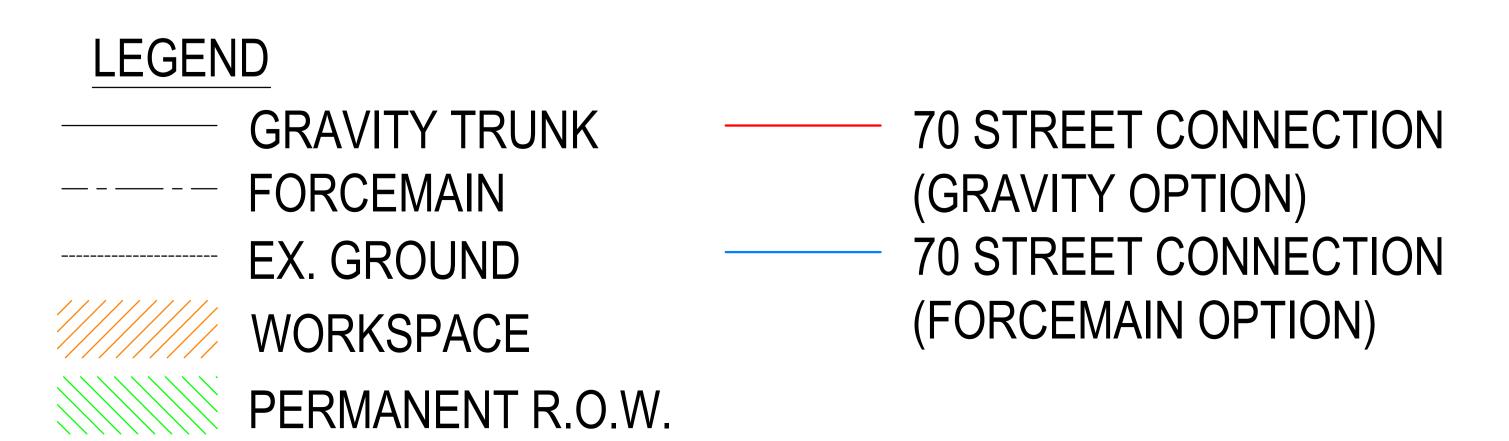
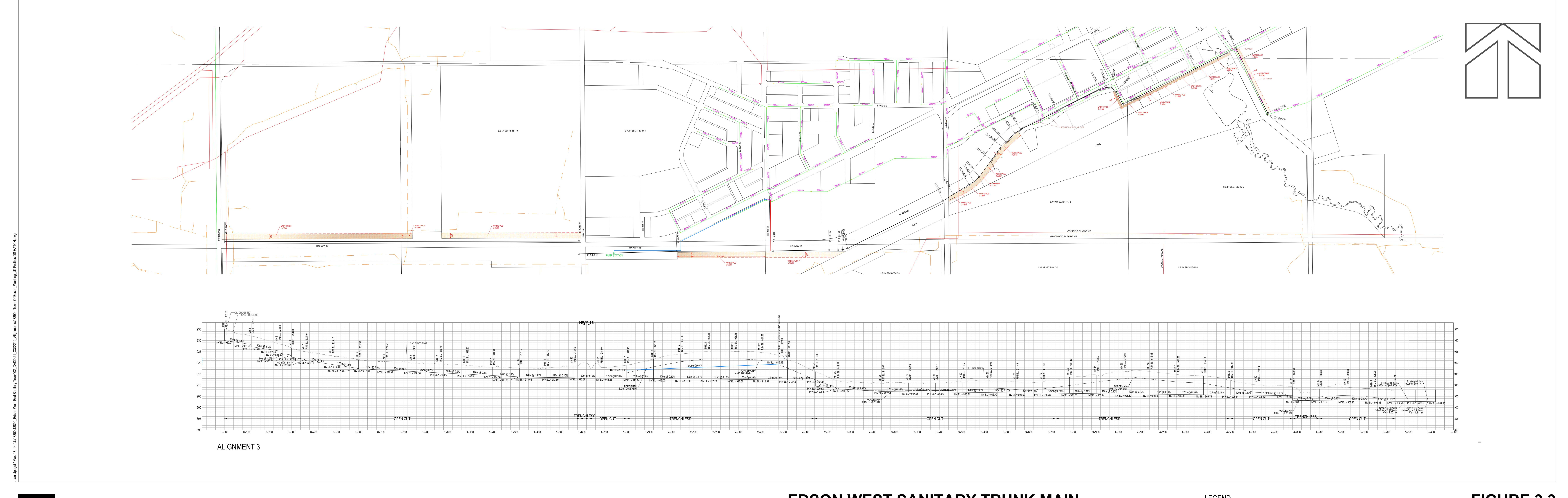
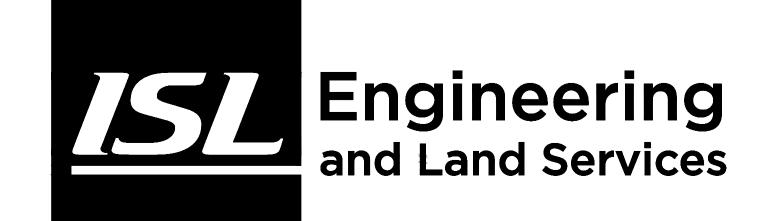
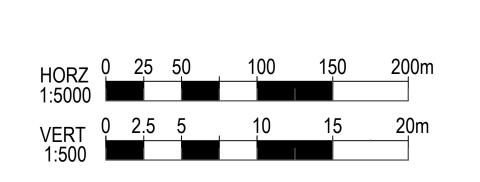


FIGURE 3.2









ALIGNMENT 3

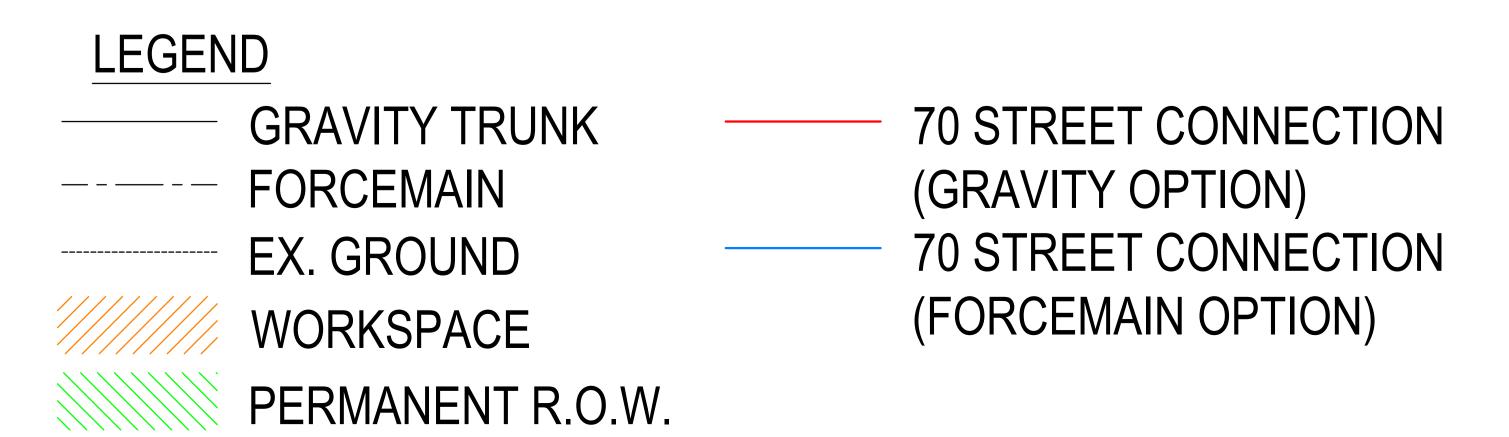
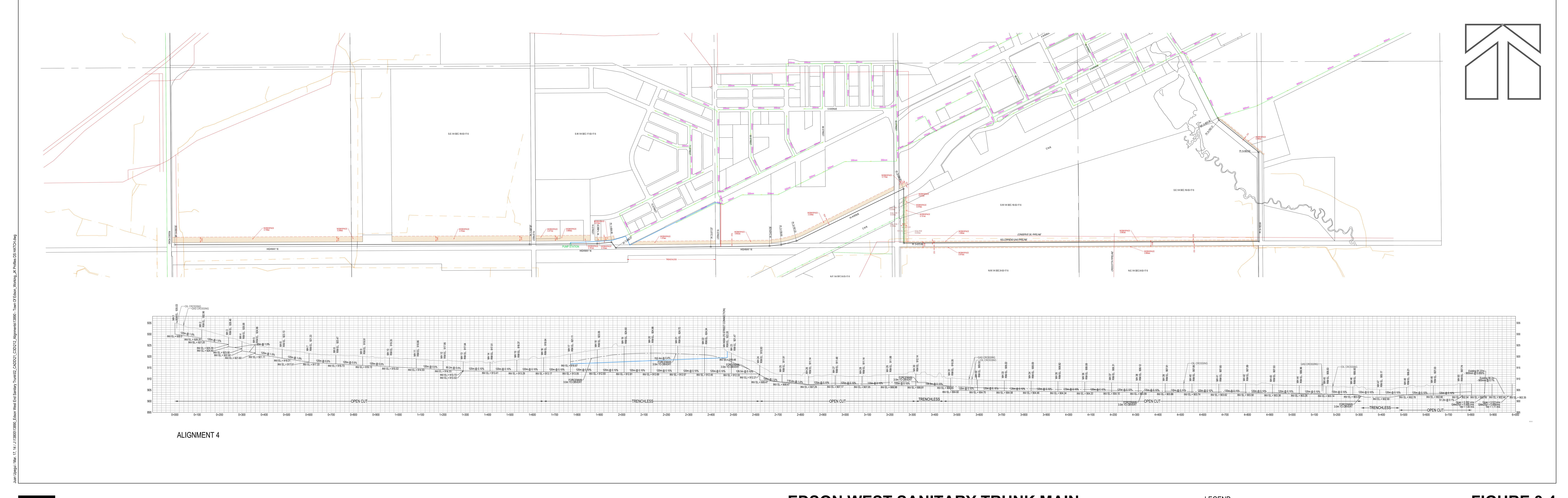
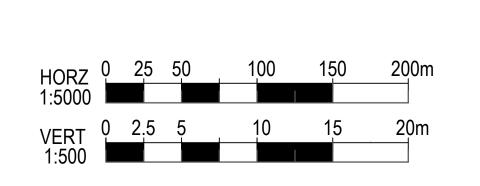


FIGURE 3.3

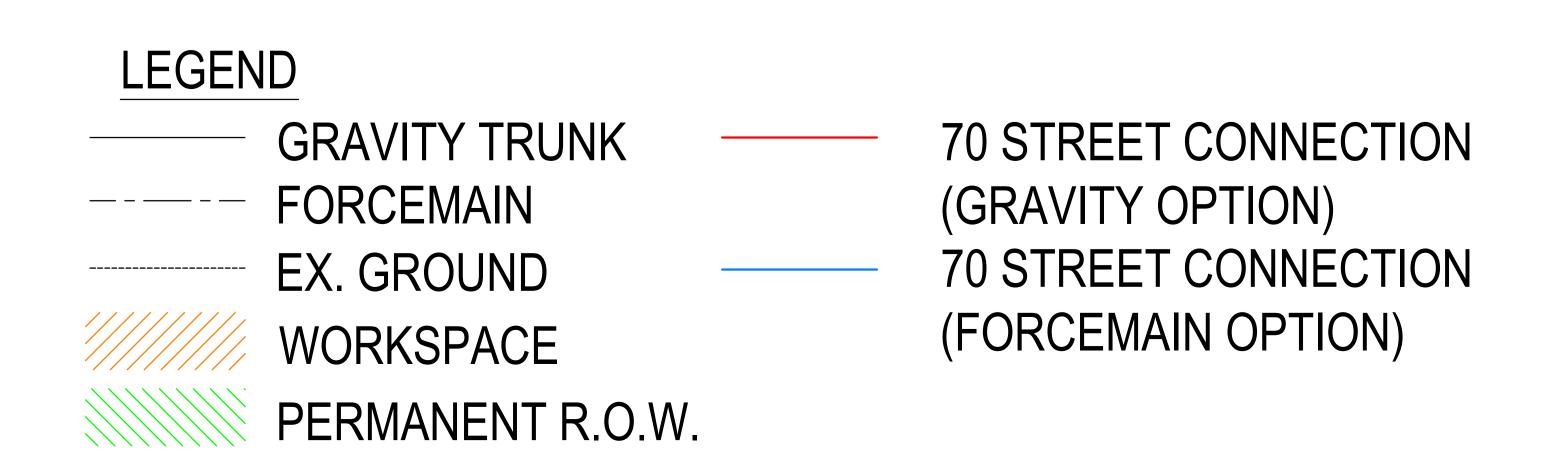








ALIGNMENT 4











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A geotechnical assessment was carried out by P. Machibroda Engineering Ltd. (PMEL). The general soil profile for the Edson area consists of silt, sand and clay followed by glacial till then sandstone. Groundwater levels for the Edson area is 2 to 3 meters below existing surface. The full geotechnical desktop study, by PMEL, includes additional detail, included in Appendix B.

Open cut and trenchless construction methods are both feasible in this type of soil. That being said, the presence of large rocks and boulders do pose a risk, particularly for trenchless construction. The presence of groundwater may result in the need for dewatering during construction, particularly on deep open cut sections. Provisions to address groundwater would also reduce productivity for trenchless construction. This may result in delays in schedule and increase in construction cost.





5.0 Historical Resources Assessment

Historical Resources Review 5.1

Turtle Island Cultural Resource Management Inc. completed and submitted a Statement of Justification (SoJ) for Historical Resources Act requirements. The SoJ did recommend a Historical Resource Impact Assessment for the area surrounding the creek crossing. This may be required as the proposed sewer trunk crosses the same watercourse (downstream) of previously recorded cultural resource sites. In addition, the SoJ also identified the potential for First Nations consultation due to the proximity to known culturally relevant sites. This application (#004539939) was submitted on November 27, 2013. Additional information in included in Appendix C.

Paleontological Review 5.2

Steppe Consulting Inc. completed and submitted a Paleontology Statement of Justification for Historical Resources Act requirements. The Statement of Justification suggests that no further paleontological investigation is required. However, awareness of the possible presence, while considered rare, should be passed on to equipment operators, construction supervisors and environmental monitors. Additional information in included in Appendix C.

5.3 **Alberta Culture Review**

Alberta Culture reviewed the Historic Resource application submission sent on November 27, 2013. To satisfy the clearance requirements a Historical Resource Impact Assessment (HRIA) needs to be completed at the Bench Creek crossing location. This requirement is applicable to all alignment alternatives. This requires that a certified archeologist apply for an archeological assessment permit and dig test pits in the vicinity of the pipeline to confirm the presence of historical artifacts. Should any artifacts be found, a report documenting mitigation measures is to be prepared. If nothing is found, a report stating such is to be prepared. This process may be completed at any time prior to construction. The findings of the report do not expire. Documentation of the response from Alberta Culture are included in Appendix C.







6.1 Environment

This section provides an overview of environmental issues and approvals applicable to the future trunk. Applicable environmental legislation/regulatory documentation is included in Appendix D. Appendix D also presents a frame work, including anticipated approval timelines, for each approving agency.

6.1.1 Federal Legislation

Fisheries Act

Any project that has the potential for harmful alteration, disruption or destruction (HADD) of fish habitat would require authorization from the Department of Fisheries and Oceans (DFO) pursuant to the fisheries Act. Should any development encroach on the bed and shore of the water body, or cross the watercourse, a fish habitat assessment and authorization pursuant to the Fisheries Act would be required.

A review of Fisheries and Wildlife Management Information System (FWMIS) database was preformed (November 2013) and the database records show that the following fish species are present in the Bench Creek, Brook stickleback, White sucker, and Lake chub.

The Project involves crossing of Bench Creek and because there is record of fish species in the water body, the work will require notification and submission of an application for approval to DFO. Also, the project involves works listed under DFO's Operational Statements. Mitigation guidelines listed in the Operational Statements should be followed.

Navigable Waters

The navigable Waters Protection Act (NWPA) is administered in Alberta by Transport Canada. Bench Creek is not considered a navigable water therefore approval under Navigable Waters Protection Act is not required.

Migratory Birds Convention Act and Species at Risk Act

Environment Canada administers the Migratory Birds Convention Act (MBCA) and the Species at Risk Act (SARA). Those Act provide guidelines for enforcement only; neither the MBCA nor the SARA requires permitting or approvals specific to the project. Although no approvals are required, violation of those Acts may result in penalties.

A timing restriction for vegetation clearing is recommended in accordance with the Act. Nesting and fledging seasons for birds included under both federal and provincial legislations are from March 1 to August 15. This timing restriction incorporates early nesters including owl species and late nesters including some passerines.

6.1.2 Provincial Legislation

Water Act

The Province of Alberta owns all water resources in the province. Alberta's Water Act, administered by Alberta Environment and Sustainable Resources Development (AESRD), is the primary piece of legislation governing the use and management of Alberta's water resources, including water held in permanent and temporary wetlands. Approval under the Water Act would be required to drain and fill any of the wetlands. Compensation for wetland loss would be required under the Wetland Policy. Any crossings of the water body – Bench Creek, must follow the "Code of Practice for Watercourse Crossings."

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Pipeline or telecommunication lines crossing the water body are subject to the "Code of Practice for Pipelines and Telecommunications Lines Crossing a Water Body".

For the current project, Alberta Environment needs to be consulted regarding this work and required application submitted.

Alberta Environmental Protection and Enhancement Act

Management facilities including lagoons and sanitary sewer projects are regulated by Alberta's Environmental Protection and Enhancement Act (EPEA). Construction of these facilities requires approval under EPEA.

Public Lands Act

The bed and shore of water bodies that are permanent and naturally occurring are owned by the province under the Public Lands Act, administered by AESRD. Where applicable, the province may claim wetlands and/or the water body in the study area. Consultation with AESRD will be required to determine ownership of the wetlands and the water body.

Wildlife Act

The Alberta Wildlife Act prohibits disturbance to a nest or den of a prescribed wildlife species. Although permitting is not required under the Act, violations of the Act may result in fines. To avoid contravention of the Act, any clearing of trees or wetlands should occur outside the breeding season (April 15 to July 31).

Additional environmental investigations will need to be completed in the detailed design phase to address the following:

- Wetland assessment and compensation
- Impacts to existing tree stands
- · Assess impact to wildlife corridors
- Erosion control measures

6.1.3 Implementation

Construction Operations

Environmental protection measures will be required throughout construction. These are the responsibility of the Contractor and will require to be addressed in an Environmental Construction Operations (ECO) plan, as outlined by Alberta Transportation's Environmental Construction Operations (ECO) Plan Framework.

Erosion Control

Erosion protection is recommended. Temporary erosion prevention practices, will need to be identified in the contractor's ECO Plan and should be applied throughout all work areas on exposed or erodible surfaces.

Environmental Specifications and Recommendations

Review of aerial photos indicates a possible wetland and undisturbed vegetation impacting Alignment 1. Proceeding with this options will require a wetland assessment, potentially leading to compensation is impacted. Further investigation of vegetation in the area will also be required.

Planning should take into consideration: wetlands (both wooded and herbaceous), large tree stands, some of which form a major wildlife corridor through the area, productive agricultural soils, existing development.







6.2 CN Rail

This section provides an overview of CN Rail requirements for sanitary works that are constructed parallel or crossing their right-of-way. A copy of the Water and Sewer Pipeline Guidelines from CN Rail is included in Appendix E. The following design guidelines were identified during the review of the CN guidelines:

Specifications required on Plan

- · Contents of pipe must be noted.
- Crossing angle to be greater than 45 degrees
- Warning markers required on each side of railway right-of-way
- · Direction of flow
 - Not required for gravity sewer pipe
- Emergency shut-off valve locations on each side of track.
 - · Not required for gravity sewer pipe
- · Method of installation
- 13.7m minimum clearance to any bridges, buildings, switches, etc.

Pipe specifications

- Design Loading Cooper E80 (TC E-10)
- Type of pipe, wall thickness, and pressures (operating & max. test) of carrier and casing pipe
- Must be steel cased unless it is a non-pressure (under 700 kPa) gravity feed pipe (sewer) and then the following applies:
 - Concrete pipe as per AREMA and CSA, minimum Class 5.
 - Coated corrugated metal pipe as per AREMA and CSA.
 - Aluminum pipe is not acceptable
- Casing
 - Carrier pipe less than 168.3mm O.D. Casing pipe must be at least 50mm O.D. larger.
 - Carrier pipe more than 168.3mm O.D. Casing pipe must be at least 75mm O.D. larger.
 - Carrier pipe shall be held clear of the casing pipe by properly designed supports, insulators, or centering devices. – CSA Standard 4.12.3.3 (c)
 - Casing must extend the full width of the Railway's core right-of-way and a minimum of 15m on each side from outside track to accommodate for any future construction.
- Wall Thickness
 - Minimum 4.8mm unless not protective cost or it is not cathodically protected add 1.6mm
 - Protective coat or cathodically protected not required for concrete pipe.
- · Minimum Depth of Burial
 - Below Track
 - Mainline, Cased 1.68m
 - Below Right-of-Way
 - Cased/Uncased 0.91m
- Nearest point at which digging can take place
 - Started 3.05m (10 feet) from the gauge side of the nearest rail, calculate a slope to the bottom of the
 proposed pipe at 1.5:1. If a 1.5:1 slope cannot be maintained or more restrictive conditions occur,
 approved shoring will be required.

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The following fees associated with gaining approval from CN were identified:

Engineering Application Fee

 Basic Engineering Application Fee \$750.00

 Rush Application \$2500.00 additional Additional Review Fee \$200.00 per review

Agreement / Easement Fee

• 3m wide x 30m long \$1,850.00

Costs may increase due to location and length requested

Flagging Protection and Signals Protection during Installation

 Flagging Protection \$825.00 (dependant on location

 Signals Protection \$375.00

Additional costs for flagging and signals will be invoiced after completion of project if:

- Time on sire was more than one day for either flagging or signals protection.
- A large number of hours were at overtime rates, i.e. weekend installations.
- 24 hour notice of project cancellation is not received. One additional day of flagging will be invoiced

Survey and Registration

It is the proponent's responsibility and expense to survey and register an easement document

Approval Timeline

Review of utility applications typically takes 6-8 weeks. This timeline is not guaranteed as it can be extended due to the nature of the application, volume, time of year, etc.

6.3 **Alberta Transportation**

An alignment along Highway 16 would be subject to approval from Alberta Transportation (AT). AT prefer not to permit service/utility infrastructure within its road right-of-ways when feasible alternatives exist.

A copy Alberta Transportation procedures for placement of underground water and sewer pipelines in the vicinity of transportation facilities is included in Appendix F. The following design guidelines pertinent to this project are identified below:

Parallel Pipeline

No pipeline right-of way or easement shall be placed less than 30 metres parallel to a highway unless prior approval is obtained from the appropriate Operations Manager.

Crossing Under Pavement - Method of Construction

The open cut method for pipeline installation at any highway is not permitted.

The crossing of highway and pavement surfaces shall be constructed by boring or jacking methods in such a manner that the road grade is not disturbed.

The proposed method of installation shall be shown on the plan of the crossing attached to the application.

Minimum Depth of Cover on the Highway or Road Right-of-Way

The minimum depth of cover over the pipeline where it crosses the right-of-way of a highway or a road shall be 2.5 metres for water and 1.4 metres for sewer lines under the lowest point in the cross-section.









Intersection Angle of Pipeline Crossing of Thoroughfare

The desirable angle of crossing is between 70 and 90 degrees; however other angles may also be accepted in special circumstances.

Slope of Pipeline Crossing

The pipeline shall be placed from one end to the other with a maximum gradient of 1 in 120.

Horizontal and Vertical Pipeline Bends

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No horizontal and/or vertical pipe bends are permitted throughout the right-of-way and within 30 metres of the right-of-way boundaries of a provincial highway, unless approval is obtained from the appropriate Operations Manager.

Cased Crossing

Where casing is required, it shall be continuous and inserted by boring or driving or other approved method.

Diameter of Casing

The diameter of the casing shall be at least 5 centimeters greater (2") than the diameter of the carrier pipe. An exception to this is steel casing of polyethylene pipe, where the next size diameter of pipe may be used.

Minimum Length of Casing

The casing shall extend across full width of the highway right-of-way.

Sealed Casing

The casing shall be satisfactorily sealed to the carrier pipe at both ends.

Casing Not to Carry Other Utilities

No cables of any kind shall be placed within the casing of any pipeline.

Bored or Augered Crossing

Casing shall be fitted into a bored or augured hole of such diameter as to provide a snug fit for the casing.

Boring in Non-Cohesive Soils

Closed boring method shall be used in non-cohesive soil conditions.

Open Excavation, Material and Equipment Storage

No open excavation shall be constructed, nor shall any material or equipment be deposited or stored any closer than 6 metres of a bridge or earth retaining structure (without special consent of the appropriate Regional Bridge Engineer), and 4 metres from the shoulder break of a highway, or a toe of side slope, whichever distance is greater.

Backfilling of Open Trenches

The backfilling of all trenches in the highway right-of-way or within 6 metres of bridge pier or earth retaining structure shall be undertaken immediately after the installation has been placed and passed any necessary inspection. Backfill materials shall be thoroughly compacted with mechanical compactors and the owner of the pipeline will be held responsible for any settling in backfill for a period of three years after the completion of the work.

Waste Material

All waste material shall be removed and all disturbed areas shall be leveled and trimmed in approved manner and re-seeded where necessary to restore the right-of-way to at least as good as original or better conditions.

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Work in the Median

No work shall be undertaken in the median of a divided highway unless approved by the appropriate Operations Manager.

Water Lines - Construction Materials

A heavy wall continuous steel or heavy wall continuous P.E. pipe shall be used for uncased water lines located beneath the road.

Should a cased plastic pipe be used it must be installed in an outer continuous casing and adequately supported at the point where it leaves the casing in order to prevent sheering.

Manholes

Manholes located within the highway right-of-way shall be placed flush with the adjacent ground.

Manholes in the Roadway Side Slopes

No manholes shall be placed in the side slopes unless special approval is obtained from the appropriate Operations Manager.

Manholes in the Median

No manholes shall be located within the centre median of multi-lane highways unless a special permit is obtained from the appropriate Operations Manager.

Construction Safety

All reasonable precautions shall be undertaken during construction to protect and safeguard public safety and property owners. This includes barricading, signing and flag persons as required, to protect and safeguard the lives and property of the travelling public and adjacent property owners. At no time shall the highway or public roadway be closed to traffic. Where normal traffic patterns are to be interrupted due to ditching or other operations, prior approval must be first obtained. Suitable signs shall be erected and if required, a flag person(s) shall be used to direct traffic through the disruption area as approved by the appropriate Operations Manager.

No work is to be conducted during darkness or when there is reduced visibility.

Construction Signing

Contractors are to meet the requirements of the latest edition of the Traffic Accommodation in Work Zones 2008 (1st Edition) manual published by Alberta Transportation. The manual is available on the internet at www.transportation.alberta.ca/3815.htm.

If the signing requirements are not met, the appropriate Operations Manager or his representatives have the right to halt all construction until proper signing is erected. The signs are to be removed immediately following construction completion.

Approval Timeline

Applications for crossing of highways under the jurisdiction of Alberta Transportation by sewer and/or water pipelines shall be submitted to the appropriate Regional Office.

The applicant shall allow minimum 30 working days for the application processing.







7.0 Land Assessment / Acquisition

An assessment of the land value for private lands required for both permanent easements and temporary workspaces was completed along all alignment alternatives. The complete Land Assessment report is included in Appendix G. Land values were included in the cost estimation for each alignment.

Easement and work space requirements were based on the following:

- 8m right-of-way for section line where the sewer is not within public roads or existing right-of-ways.
- workspace width of 30m for areas of open cut installation
- workspace width of 15m for areas of trenchless installation

Easement and workspace requirements are illustrated on each alignment figure. The following table summarizes the total right-of-way and total workspace requirements and associated cost for land acquisition for each alignment.

Table 7.1: Land Requirements

Alignment	Estimate No. of Parcels Impacted	Estimated Total R/W	Estimated Total Work Space	Estimated Total Cost
1	22	2.957 ac	26.650 ac	\$210,059
2	20	5.828 ac	25.623 ac	\$242,152
3	18	0	17.560 ac	\$116,322
4	26	0.398 ac	18.934 ac	\$154,435



8.0 Option Evaluation and Recommendation

8.1 **Capital Cost Estimates**

Capital cost estimates were developed for the proposed system as described in the previous sections of the report. The capital costs are based on the following components and design parameters:

- Gravity sewer trunk for Alternative 1 flows, Alignments 1 through 4
- Gravity sewer trunk for Alternative 2 flows, Alignments 1 through 4
- Gravity sewer trunk, pump station and forcemain for Alternative 1 flows, Alignments 1 through 4
- · Gravity sewer trunk, pump station and forcemain for Alternative 1 flows, Alignments 1 through 4

Cost estimates are provided for each design option in Appendix H. Details for the cost estimates for the pump stations are also included in Appendix H. Table 8.1 is a summary the capital costs for the above design options.

Table 8.1: Capital Cost Summary

Alienment	Alterna	ative 1	Alterna	ative 2
Alignment	Gravity	PS & FM	Gravity	PS & FM
1	\$13,052,483	\$8,259,446	\$16,277,090	\$11,474,592
2	\$13,522,312	\$10,874,253	\$15,630,231	\$14,299,330
3	\$16,190,799	\$8,911,215	\$19,946,446	\$12,185,968
4	\$13,407,490	\$9,559,544	\$16,836,322	\$13,042,816

The above costs do include:

- · Capital construction costs
- · Land acquisition
- Contingency
- Engineering and construction administration

The above costs do not include:

- Annual operation and maintenance costs
- Risk contingency

Total Overall Project costs are included later in this section.

8.2 **Evaluation**

8.2.1 Life Cycle Costs

Life cycle costs were developed for each alignment, flow alternative and servicing option (gravity sewer or pump station and forcemain to assess the cost effectiveness of each option by taking account of operational expenditure in addition to the capital costs over a 30 year service period (2015 to 2045). This analysis included generating an illustration of the following indicators: Total Annual Costs, Total Annual Cash Flow, and Net Present Value (2014\$). For the purpose of this illustration an interest rate of 6% was used in conjunction with a stable inflation rate of 3% to estimate the overall net present worth of each options. Annual operating costs and maintenance and upgrading costs summarized below.







Annual Operating Costs

The annual energy consumption for the pump station were estimated based on the projected average dry weather flow, the total dynamic head and the overall pump / motor efficiency of 75% and 95%, respectively.

Other operating costs for the pump station include:

- Town labour costs and miscellaneous supplies of \$25,000
- Pump operating efficiency of 75%
- Pump motor efficiency of 95%
- Annual energy cost of \$0.15/kWH
- Pipe (gravity or forcemain) operation and maintenance of \$1.00/m.

Maintenance and Upgrading Costs

The following maintenance and upgrading costs are projected for the pump station:

 Pump Replacement every 15 years as well as miscellaneous station upgrades. Based on 2 pumps (Duty & Stand-by) at \$80,000 each plus \$500,000 for installation and miscellaneous upgrades, the total costs would be in the order of \$660,000 (2014\$).

Estimated present worth of operation and maintenance activities for each option is shown in Table 8.2. Further details for each option is included in Appendix H.

Table 8.2: Estimated Operation and Maintenance

Alignment	Alterna	ative 1	Alterna	ative 2
Alignment	Gravity	PS & FM	Gravity	PS & FM
1	\$98,561	\$1,342,939	\$98,561	\$1,386,853
2	\$125,444	\$1,369,803	\$125,444	\$1,413,716
3	\$104,697	\$1,349,075	\$104,697	\$1,392,989
4	\$116,450	\$1,360,828	\$116,450	\$1,404,742

8.2.2 Risk Assessment

This section considers the potential risks associated with each of the four alignments, for both gravity and pumped options, as described in Section 3.0. The purpose of this is to provide an evaluation tool to facilitate in the selection of the preferred/recommended alignment.

In order to assess the severity of the risks, each risk item has been assigned a score related to the magnitude/impact (Table 8.3) of the risk and a score related to the likelihood of occurrence (Table 8.4). A risk severity score is then determined by multiplying the magnitude by the probability. The options with the high overall scores are considered less favorable than those with lower scores. The following steps were taken to measure the overall impact of each risk item:

- 1. Identify the risk / concern
- 2. Identify the consequence of the risk
- 3. Determine the magnitude of the consequence if the risk factor is encountered (i.e. Dollar value) using Table 8.3.
- 4. Determine the likelihood of the risk occurring (i.e. Probability) using Table 8.4
- 5. Determine the risk severity score, Table 8.5, by multiplying the magnitude by the likelihood.
- Calculate the risk contingency to be accounted for in the overall cost by multiplying the cost impact by the probability.

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The amount of risk contingency was calculated for each option by multiplying the cost of impact by probability.

Table 8.3: Magnitude of Risk Factor

Ratings	Magnitude		Cost Impact
Dovostating	People	Fatality	
Devastating (1000)	Environment	Permanent Environmental Damage, Effects Widespread	\$15,000,000
(1000)	Financial & Schedule	Costs > Total Project Cost	
Serious	People	Disabling injury, Long Term Health Impact	
(300)	Environment	Severe Environmental Damage,	\$6,000,000
(300)	Financial & Schedule	Extensive Costs and/or Delay in Schedule	
Lliab	People	Lost Time Injury	
High (100)	Environment	Moderate Environmental Damage, Effects Widespread	\$1,500,000
(100)	Financial & Schedule	Considerable Effect on Cost and/or Schedule	
Moderate	People	Medical Aid Injury	
(50)	Environment	Moderate Environmental Damage, Localized	\$600,000
(30)	Financial & Schedule	Moderate Effect on Cost and/or Schedule	
Low	People	First Aid Injury	
(10)	Environment	Minor Environmental Effect, localized	\$150,000
(10)	Financial & Schedule	Small Effect on Cost and/or Brief Interruption	
Very Lew	People	Minor Injury	
Very Low (1)	Environment	Negligible Environmental Effect	\$15,000
(1)	Financial & Schedule	Trivial Effect on Cost and Schedule	

Table 8.4: Probability of Risk Factor Occurring During Project Lifespan

Probability	Description	Ratings
>80%	Highly Probable	200
50% to 80%	Probable	100
20% to 50%	Somewhat Likely	50
2.0% to 20%	Improbable	25
0.01% to 2.0%	Remote	10
<0.01%	Extremely Remote	1





Table 8.5: Risk Severity

Risk Severity	Description	Explanation
<=100	Minor	Risk is Negligible
101 -> 1250	Acceptable	Some risk control may be justified
1251 ->5000	Significant	Some risk control is required
5001 ->10000	Substantial	Must implement extensive risk controls before continuing
10001 ->25000	Critical	Risk must be eliminated before continuing
> 25001	Intolerable	Cannot accept risk. All activities must stop until risk is avoided

The risk assessment evaluated each risk item based on magnitude/impact and probability for each alignment and servicing option. The detailed risk assessments are included in Appendix I. A summary of the total risk severity and risk contingency is shown in Table 8.6, below.

Table 8.6: Risk Severity and Risk Contingency

Alignment	Gra	avity Option	PS	& FM Option
Alignment	Risk Severity	Risk Contingency	Risk Severity	Risk Contingency
1	49251	\$6,960,150	10251	\$933,150
2	26001	\$4,440,750	501	\$126,750
3	34000	\$5,265,000	8200	\$993,000
4	32251	\$5,010,150	5301	\$621,150

Review of the risk assessment included the following findings:

- Pump station and forcemain options carry significantly less risk than gravity sewer options.
- The amount of ground cover at the Bench Creek crossing is inadequate for gravity sewer options. There is significant risk of environmental damage resulting potential high costs due to related construction issues and fines should environmental damage occur.
- Installation of a forcemain pipe allows for a much deeper crossing of the creek as the system operates as a pressure system and does not need to be installed at a specified positive grade.
- There is a significant risk associated to deep trenchless installations for the gravity sewer options. The potential for encountering obstacles could result in significant costs to rescue construction equipment and project delays.
- The forcemain is a pressure system that can be installed at minimum depths and open cut methods. Any obstacles encountered could be dealt with much more easily.
- Work adjacent to Highway 16 needs to consider protection of existing infrastructure, including an existing watermain and roadway. Extra consideration would need to be accounted for protection of existing infrastructure and persons.
- Accommodations for traffic and businesses needs to be considered for alignment routed through developed areas.

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One risk that was not addressed in the above evaluation is the risk of not receiving approval from Alberta Transportation for the installation of the pipe within the Highway 16 corridor. This risk is applicable to Alignment 1, 3 and 4. If approval is not received from Alberta Transportation Alignment 2 would be the default option as it is located outside of the highway right of way.

8.2.3 Present Worth Evaluation

In order to evaluate the most cost effective option, a present worth evaluation was completed accounting for capital costs, operating and maintenance cost as well as construction contingency and risk contingency. A detailed spreadsheet is presented in Appendix H and the results are summarized in Table 8.7.

At this stage of the project the alignment and risk are reasonably well established. Because of this, the construction contingency (not including risk contingency), for planning and estimating errors and omissions, minor price fluctuations due to the rural location, and design developments and changes within the scope, has been reduce from 35% as per the MSP to 20%.

Table 8.7: Present Worth of the Total Overall Project Cost

Alignment	Altern	ative 1	Alternative 2			
	Gravity	PS & FM	Gravity	PS & FM		
1	\$20,111,193	\$10,535,535	\$23,335,801	\$13,794,595		
2	\$18,088,506	\$12,370,806	\$20,196,426	\$15,839,797		
3	\$21,560,496	\$11,253,290	\$45,027,153	\$14,571,956		
4	\$18,534,090	\$11,541,522	\$21,962,922	\$15,068,708		

The above costs include the following:

- · Costs are based on 2014 dollars
- A contingency of 20% was applied for trunk sewer, forcemain pipe and manhole installations
- Pump station costs include a 35% contingency. The larger contingency for the pump station is required due to uncertainties regarding the pump station location and corresponding restrictions that may be placed on underground construction methods.
- Land acquisition costs, as per Section 7.0
- Engineering and construction administration, 10%.
- Allowance for permits and approvals, 2%

Table 8.7 shows using a pump station and forcemain to be the most cost effective option for all alignment options. Alignment 1 has the lowest cost at \$13,794,595 (Alternative 2 flows). Alignment 2 is the most expensive at \$15,839,797 (Alternative 2 flows) however the difference is less than the contingency used in the estimates.

Although Alignment 1 has the lowest cost, it also has the highest amount of risk, particularly associated with regulatory approvals (AT and Environmental) and the requirement for R/W through private lands. In particular the crossing of Bench Creek is considered highly sensitive. It also does not address the servicing of the future industrial/commercial land to the south of town between 63 Street and 54 Street.

Alignment 2, is the most expensive option (marginally). However, it has the lowest risk because the majority of the alignment is within future development lands and existing road allowance. It also provides accessible servicing for the future industrial/commercial lands between 63 Street and 54 Street.









Alignments 3 and 4 rely heavily on utilizing Alberta Transportation R/W for large sections of the alignments. Initial discussions with AT have indicated this is not preferred, particularly if feasible alternatives exist. Alignment 3 also runs through a significant part of the town. Construction of this could cause considerable disruption and would also carry significant risk. Alignment 3, also limits servicing opportunities for the future development area south of the town.

8.3 Recommended Option

Engineering

and Land Services

Although Alignment 2 has marginally higher costs than the alternatives, it has significantly less risk and as well, provides service for the future development area to the south of the town. Alignment 2 is therefore the recommended alignment alternative.

Due to the considerably high costs and risk associated with gravity servicing, it is recommended that the outfall is constructed using a pump station and forcemain to discharge the flow from the vicinity of 75 Street and Highway 16.

The preliminary design of this option is shown in Figure 3.2. As the recommended option includes a forcemain an alternate alignment for the part parallel to Highway 16 and across a private lot and the tree farm east of 74 Street was identified. This may require trenchless installation and is preferred because it significantly reduces the total area of R/W required across this particular lot. For detailed preliminary design drawings refer to Figures 8.1 to 8.18.

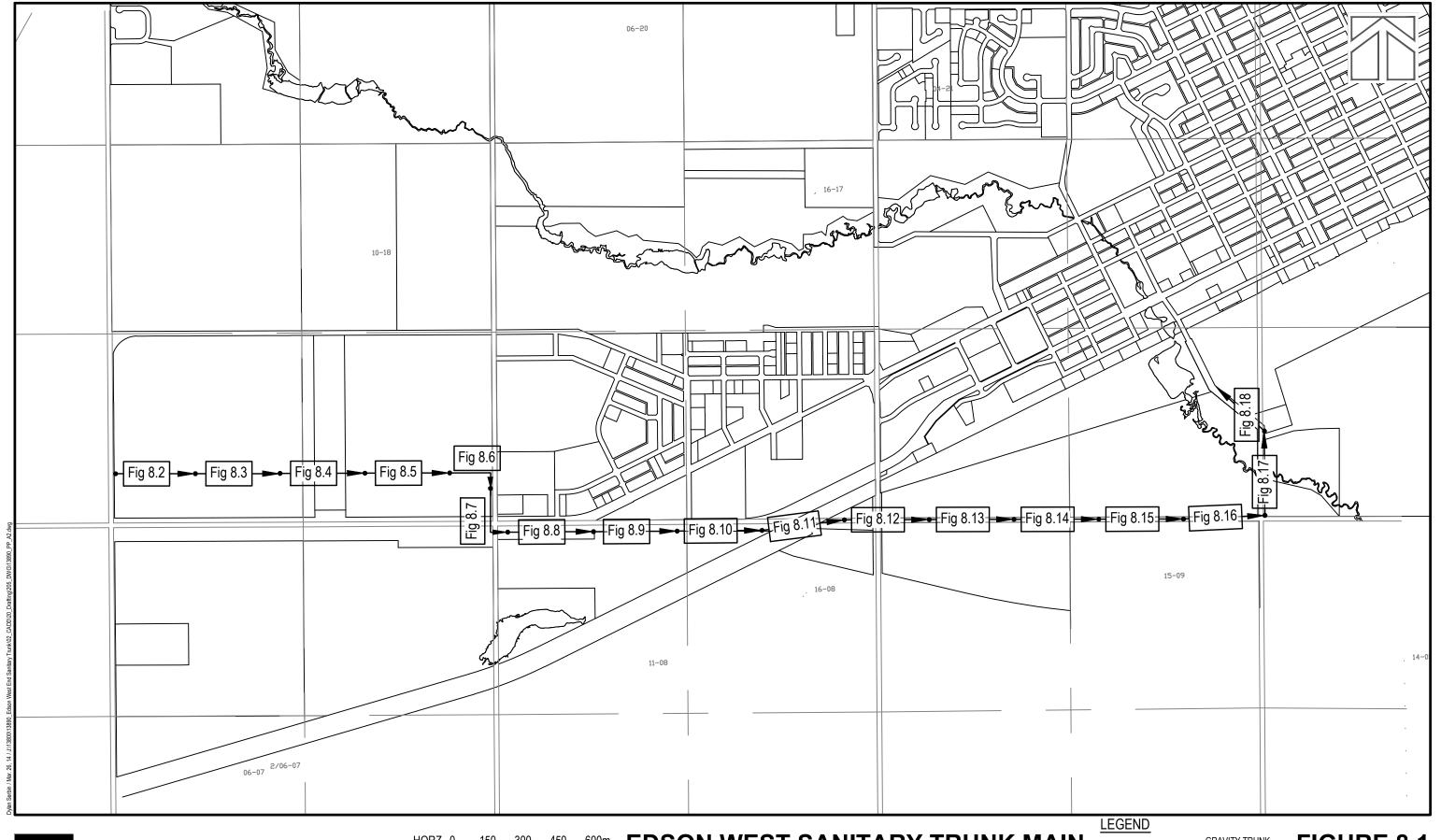
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EDSON WEST SANITARY TRUNK MAIN

PREFERRED PRELIMINARY ALIGNMENT **ALIGNMENT 2**

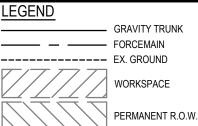
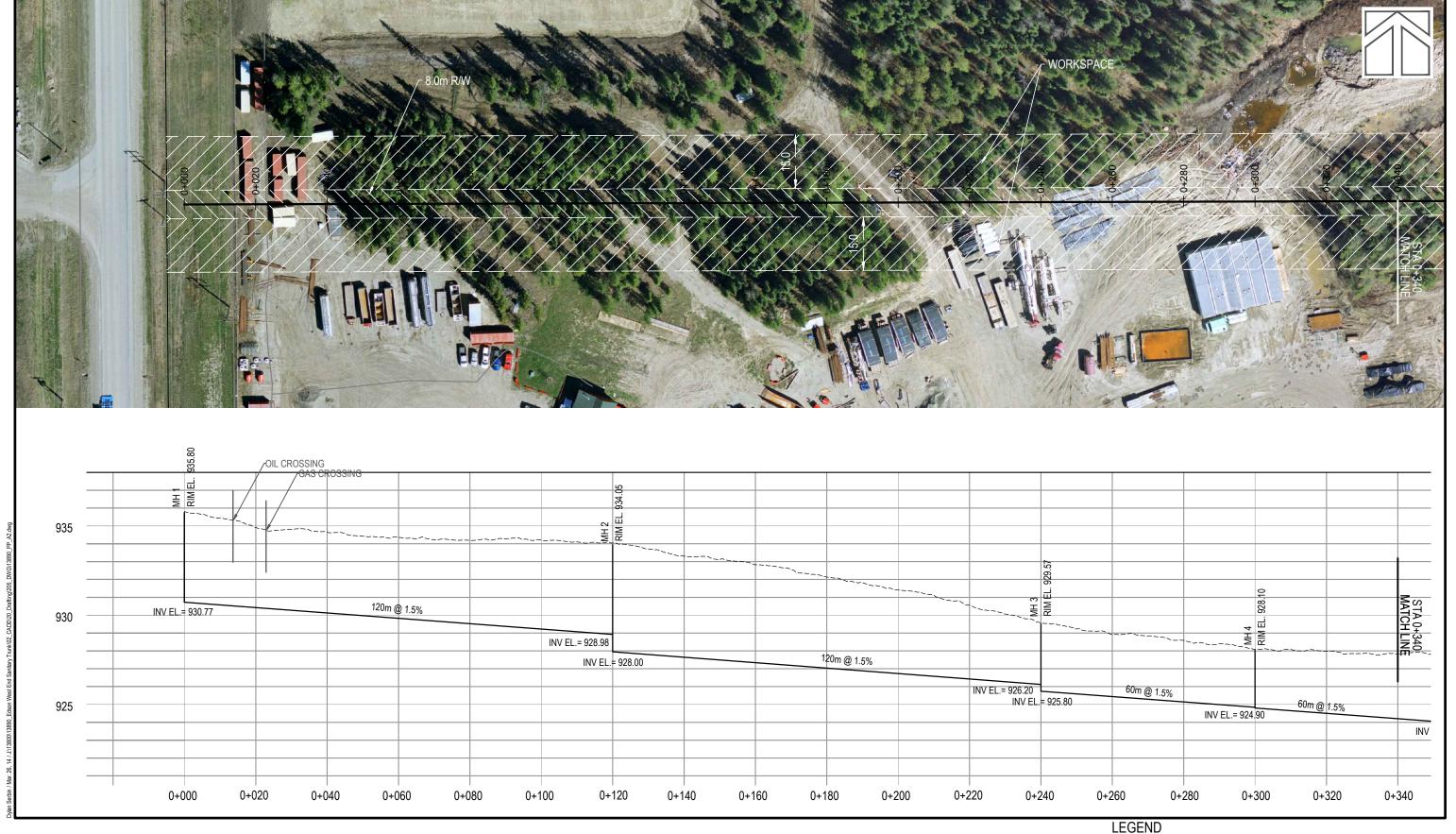
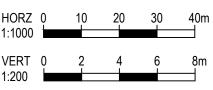


FIGURE 8.1









PREFERRED PRELIMINARY ALIGNMENT ALIGNMENT 2

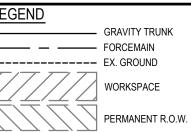
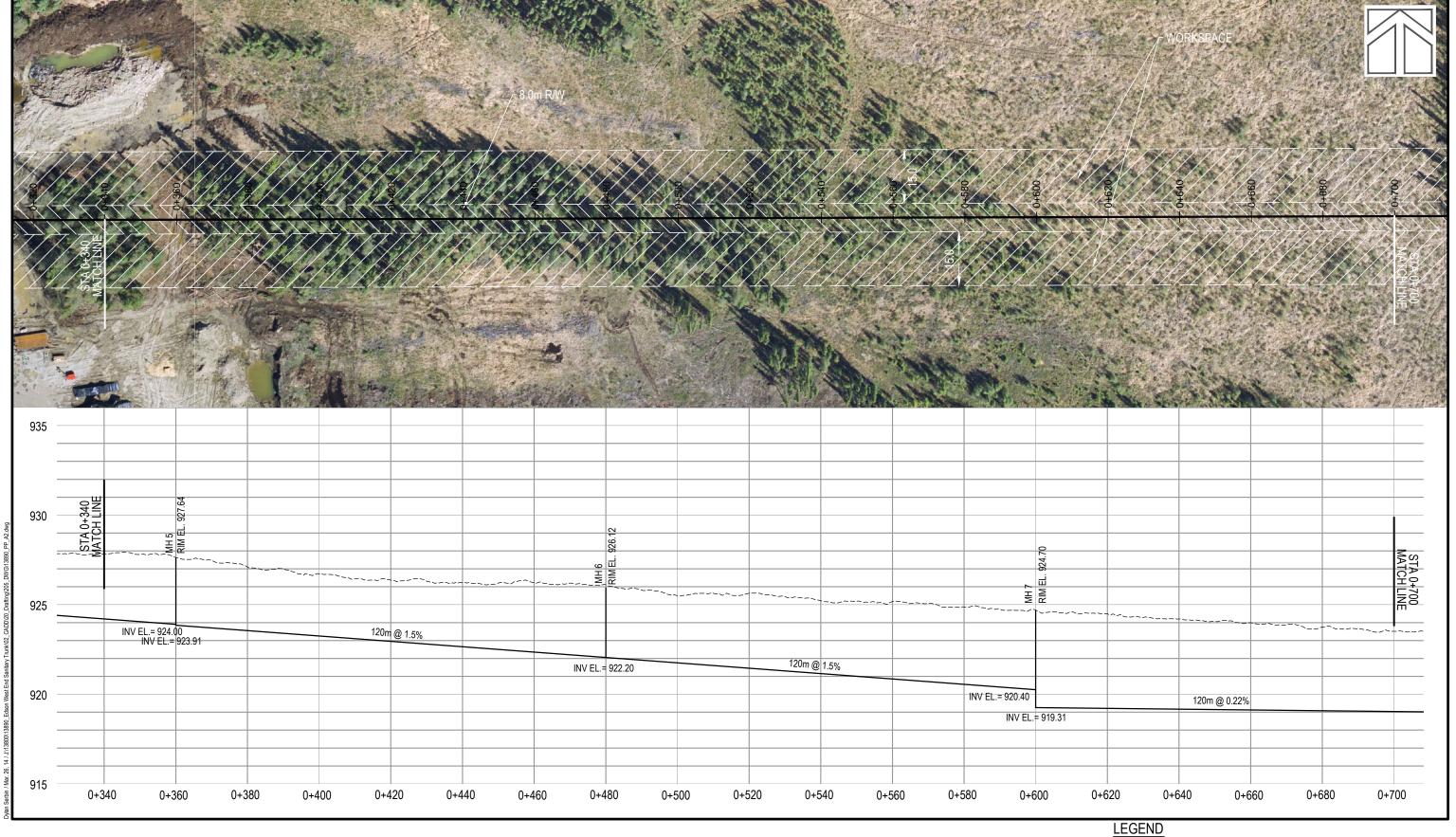
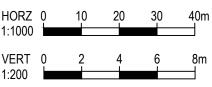


FIGURE 8.2









PREFERRED PRELIMINARY ALIGNMENT ALIGNMENT 2

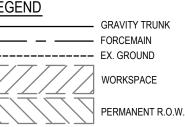
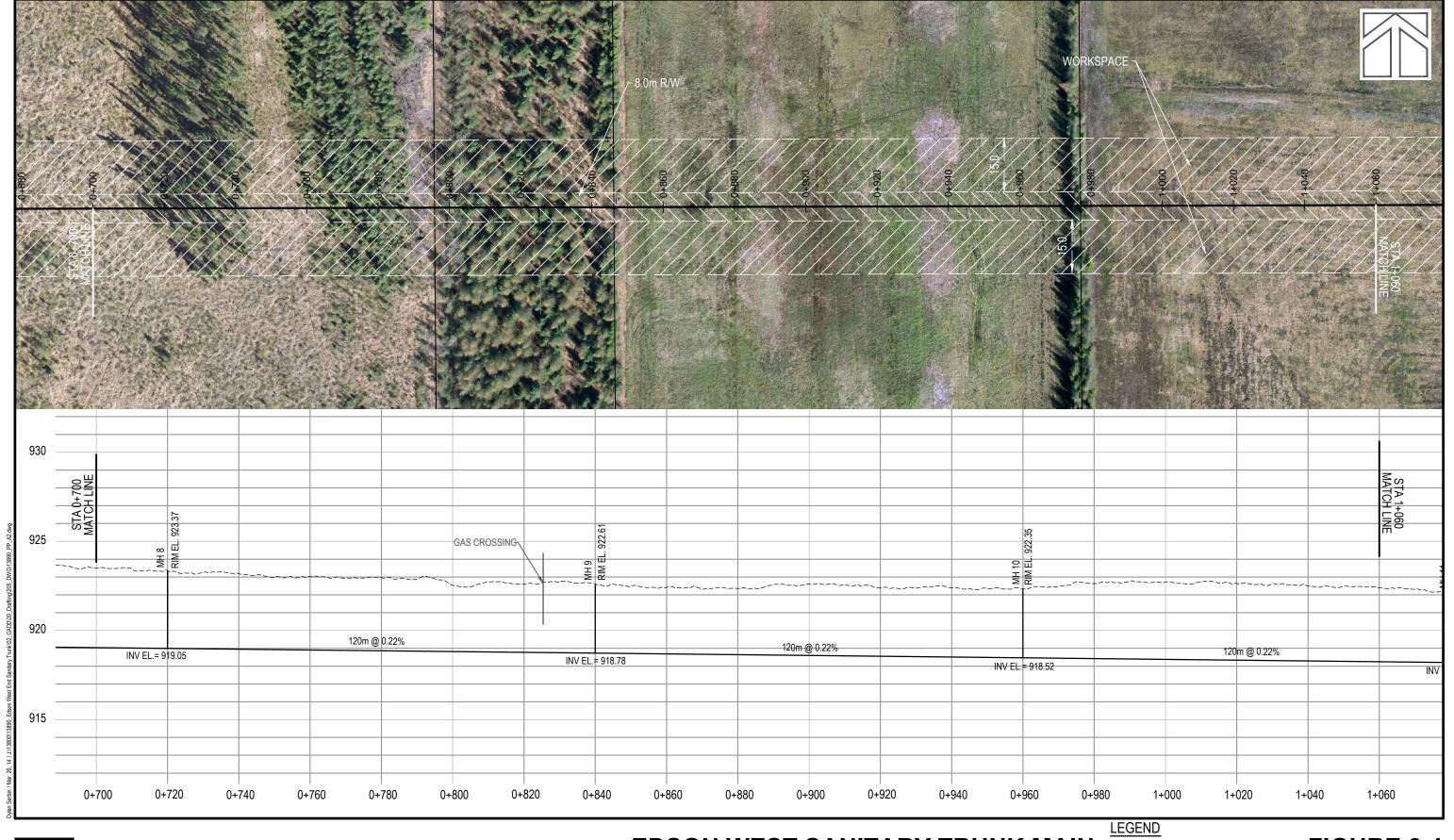
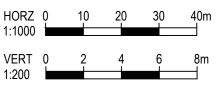


FIGURE 8.3









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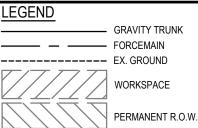
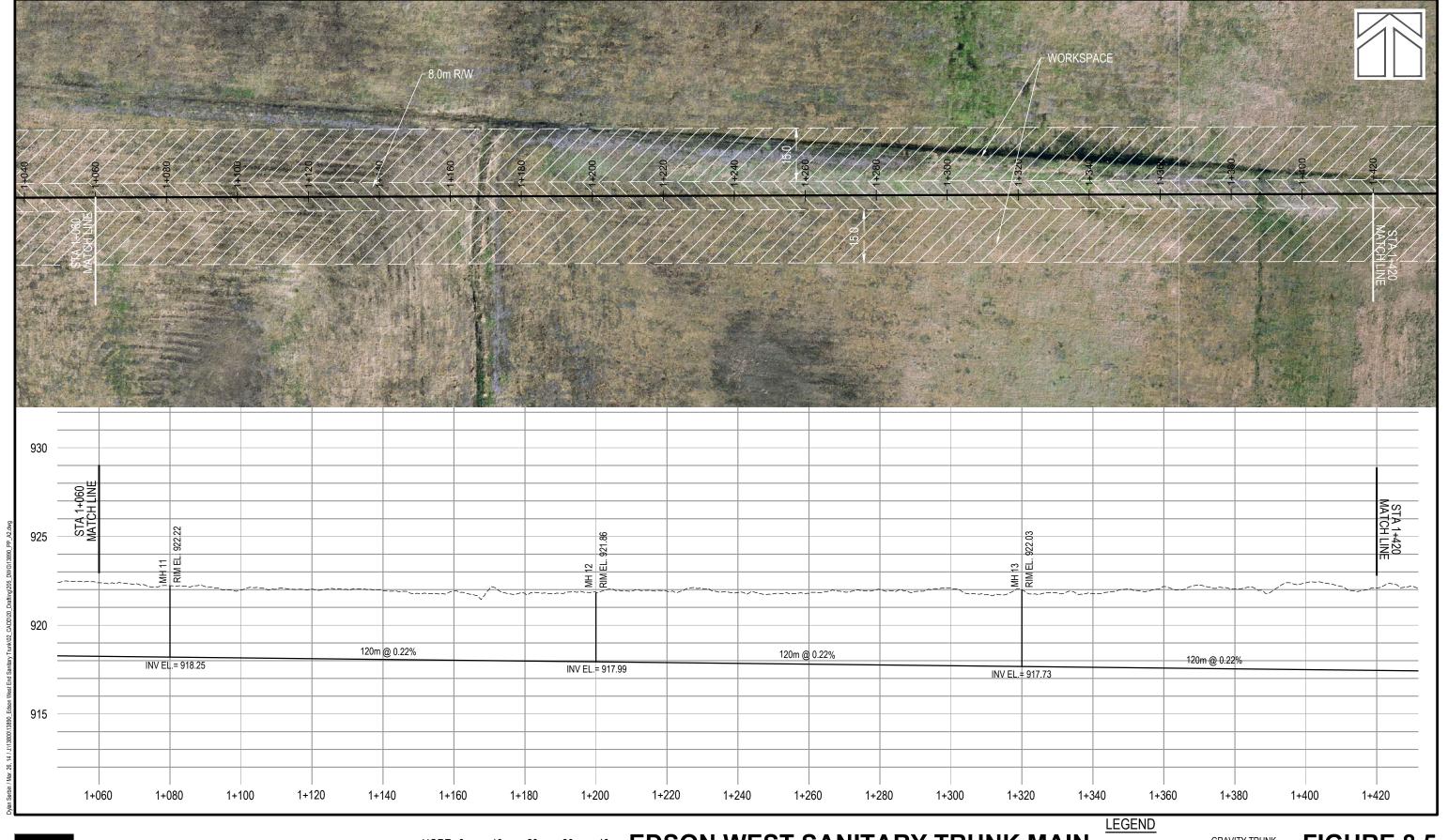


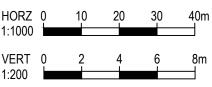
FIGURE 8.4

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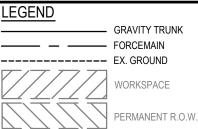
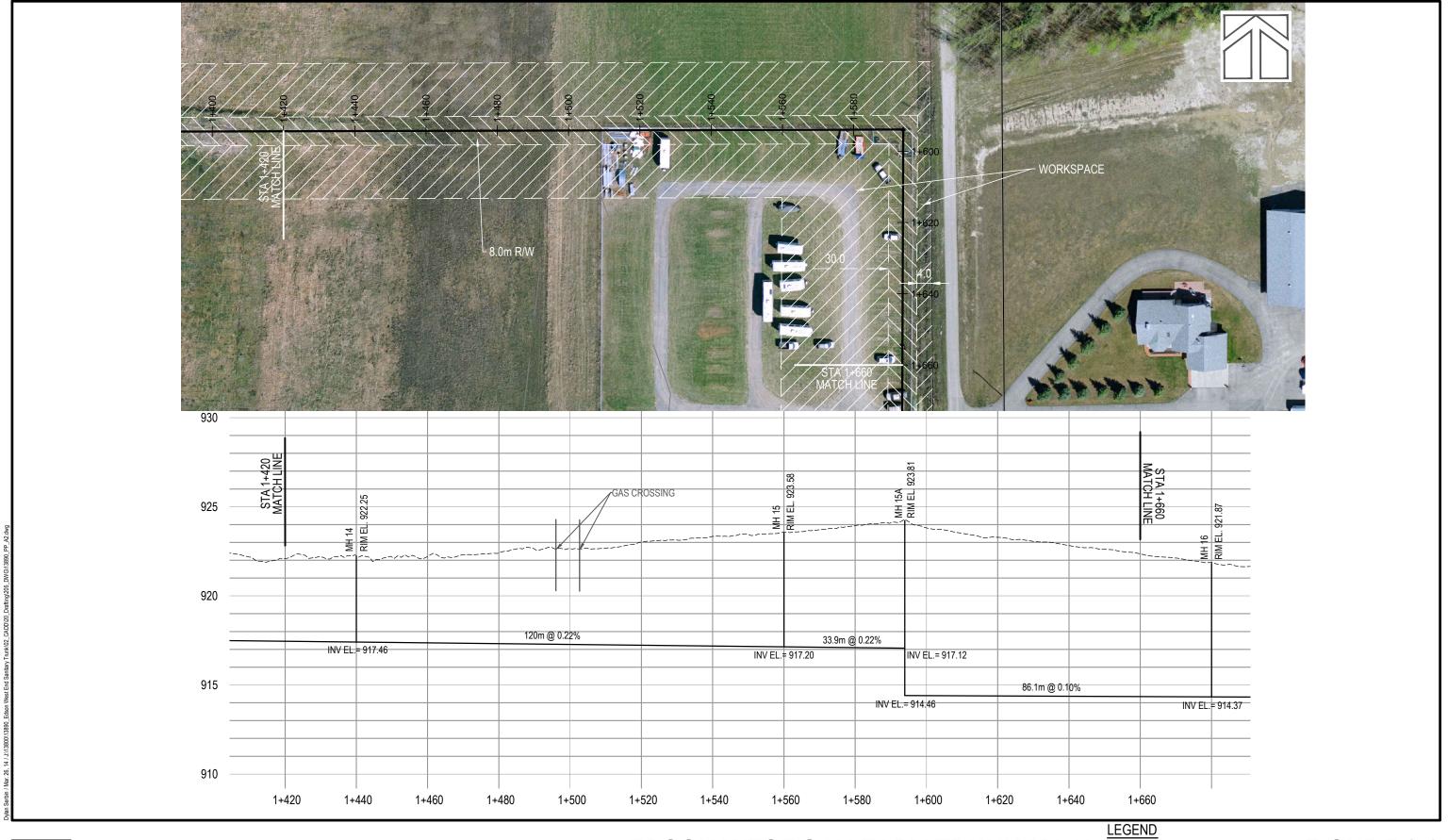


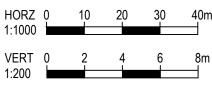
FIGURE 8.5

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PREFERRED PRELIMINARY ALIGNMENT **ALIGNMENT 2**

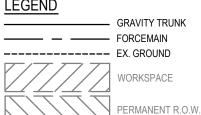
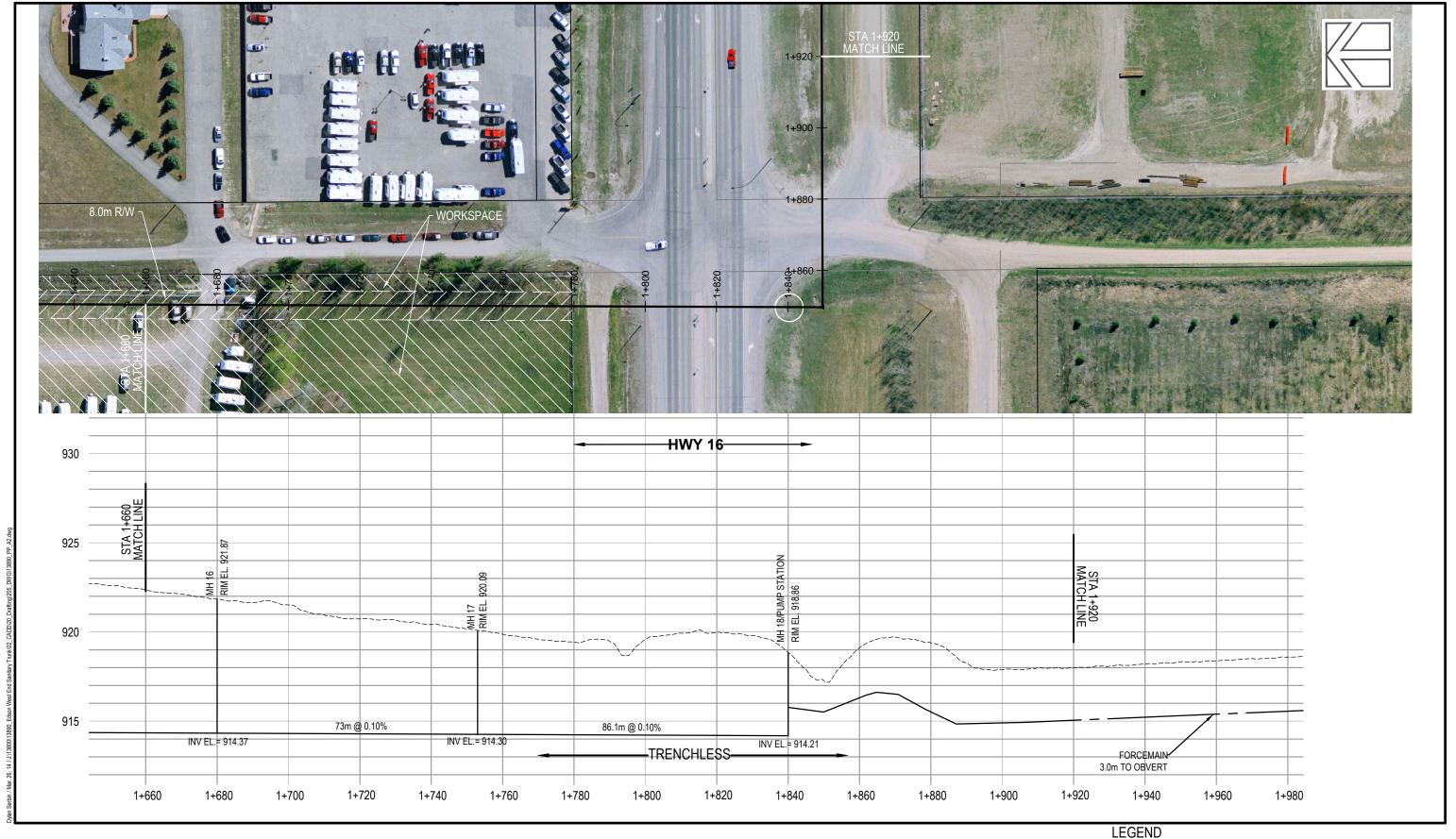
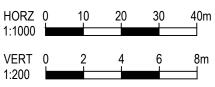


FIGURE 8.6









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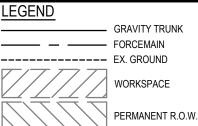
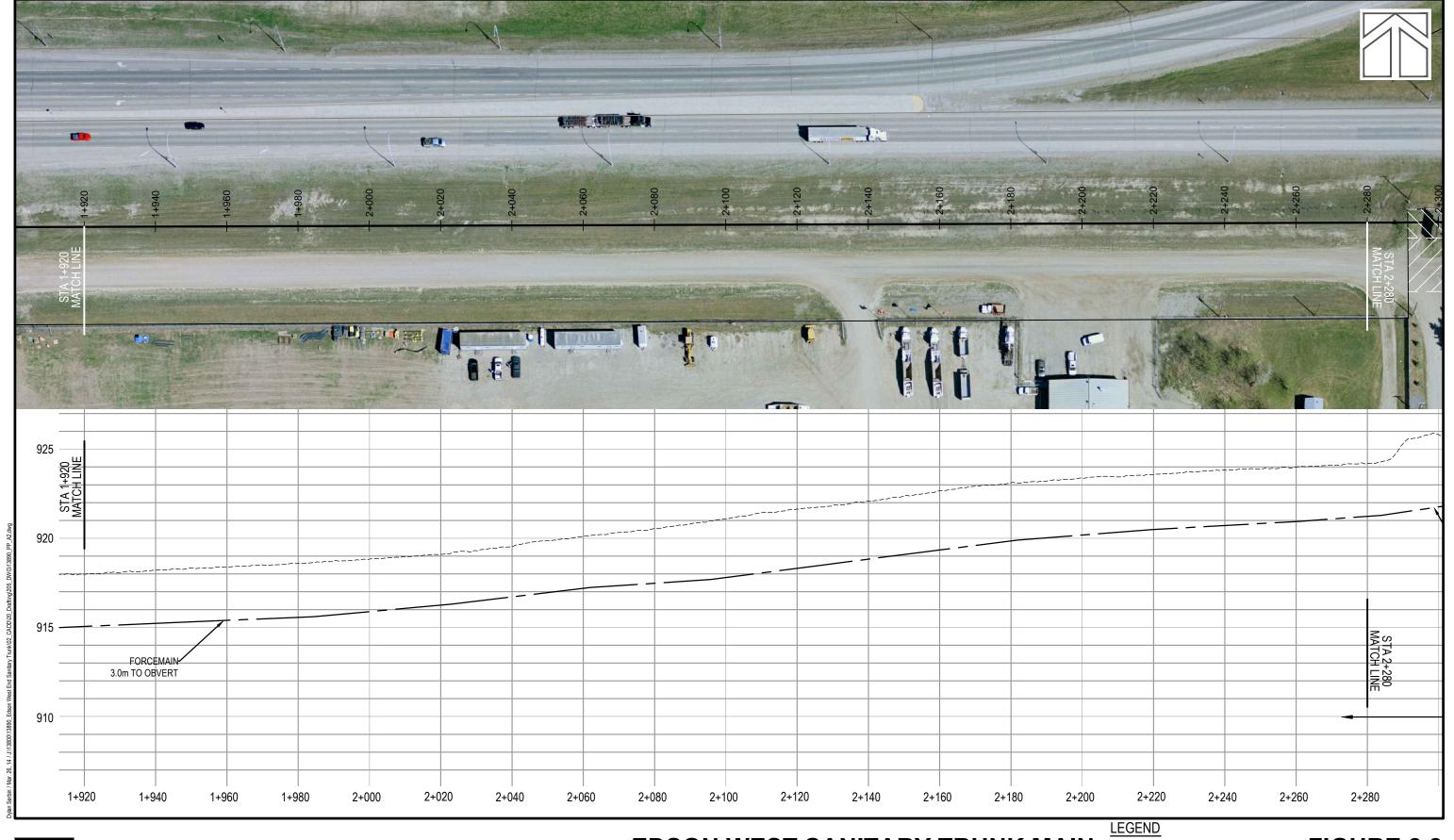


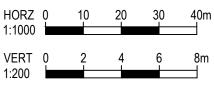
FIGURE 8.7

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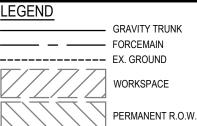


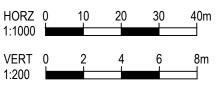
FIGURE 8.8

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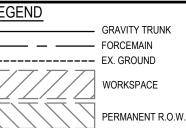
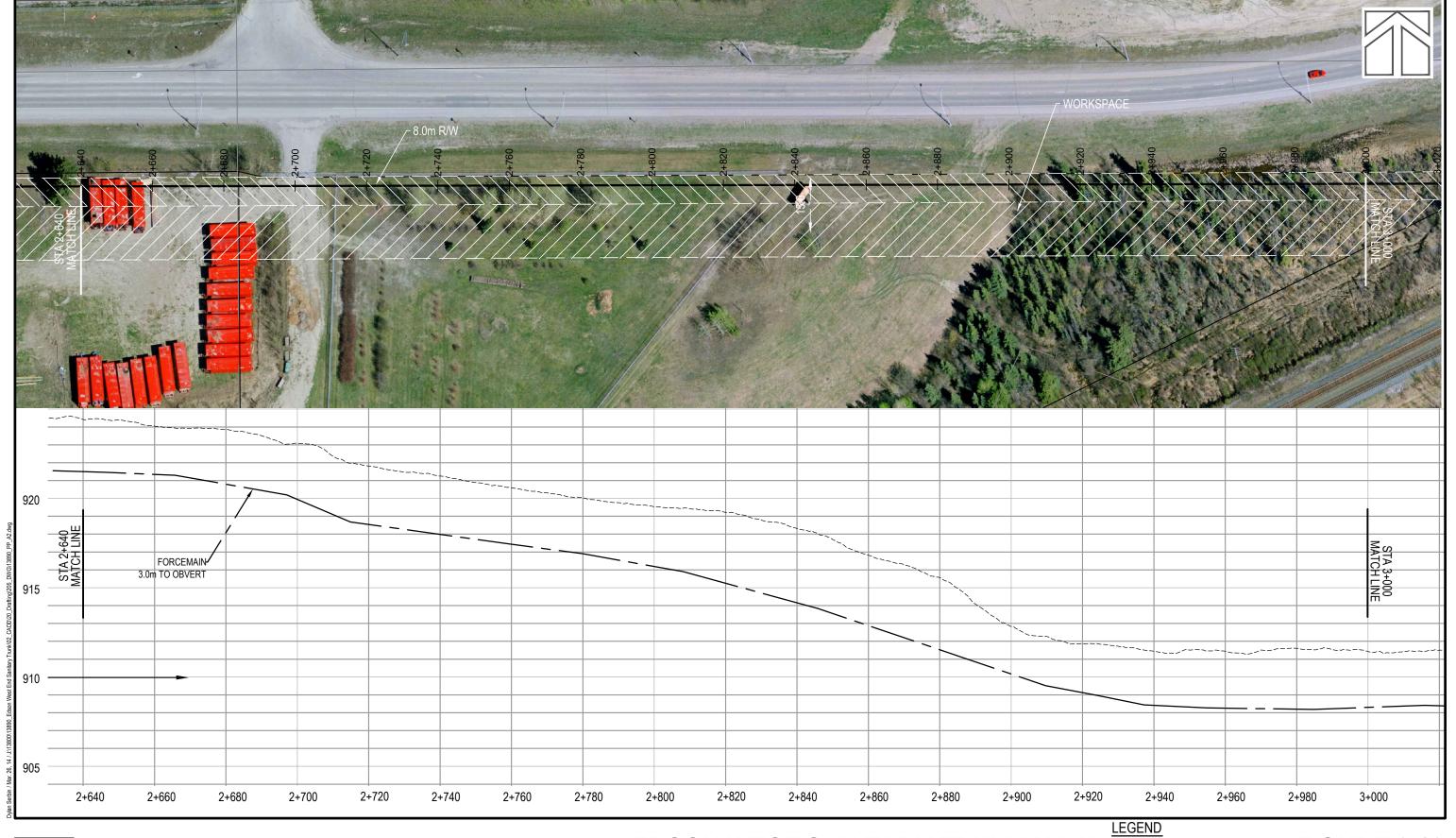
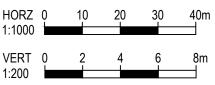


FIGURE 8.9









PREFERRED PRELIMINARY ALIGNMENT ALIGNMENT 2

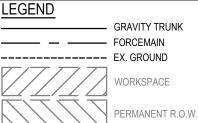
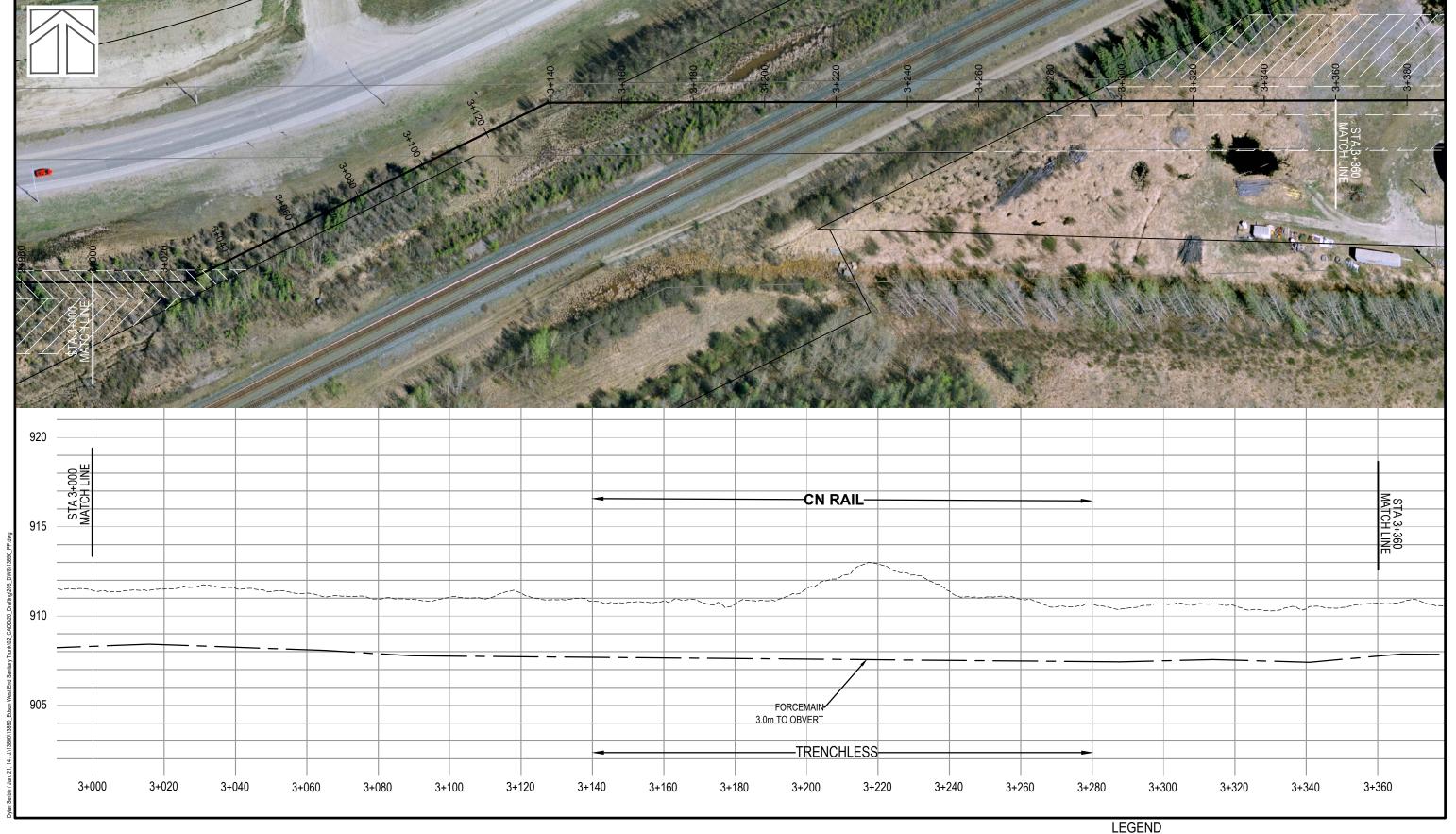
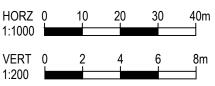


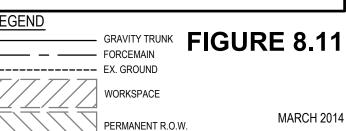
FIGURE 8.10

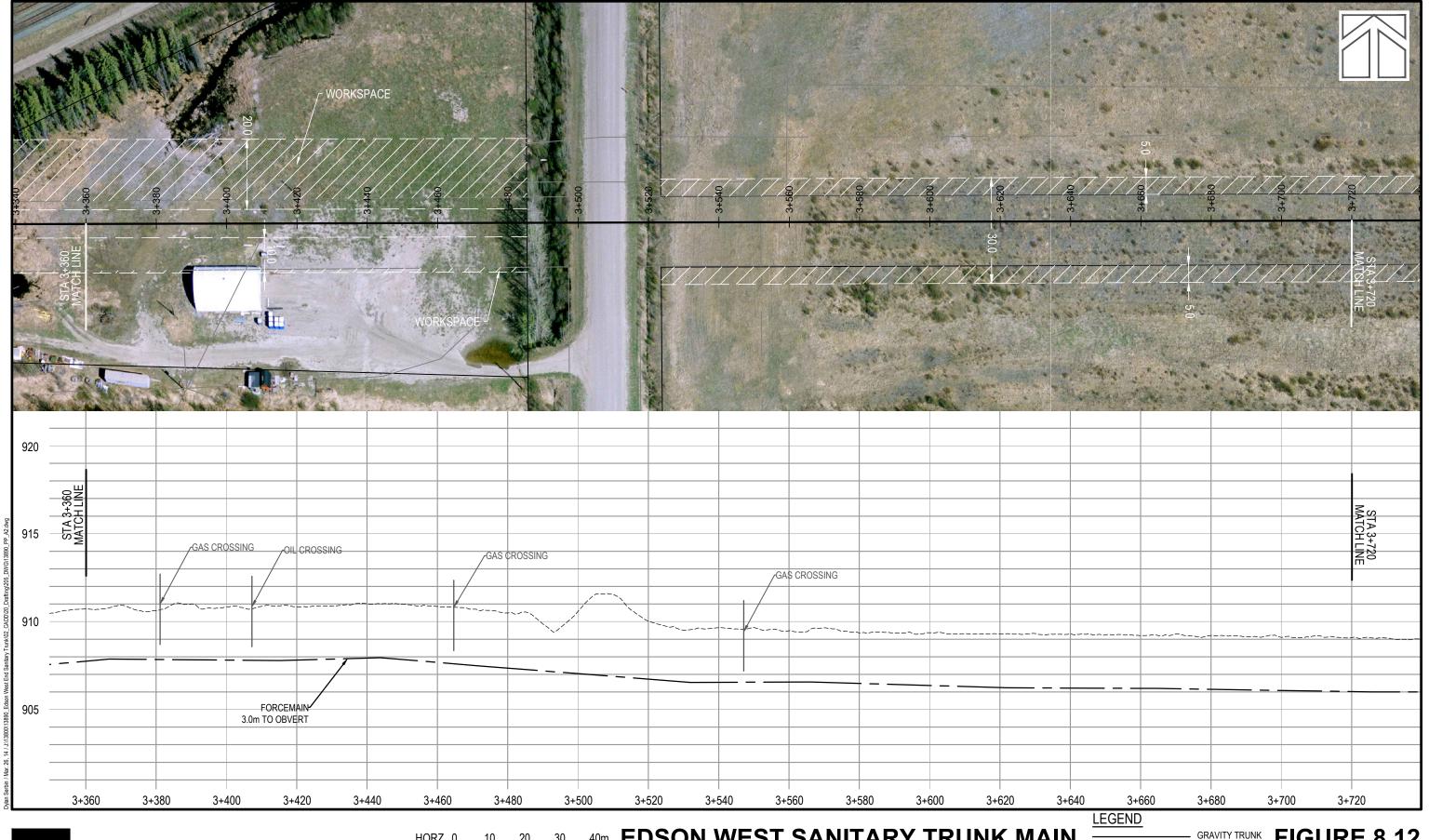






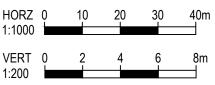












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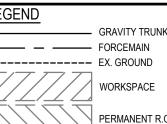
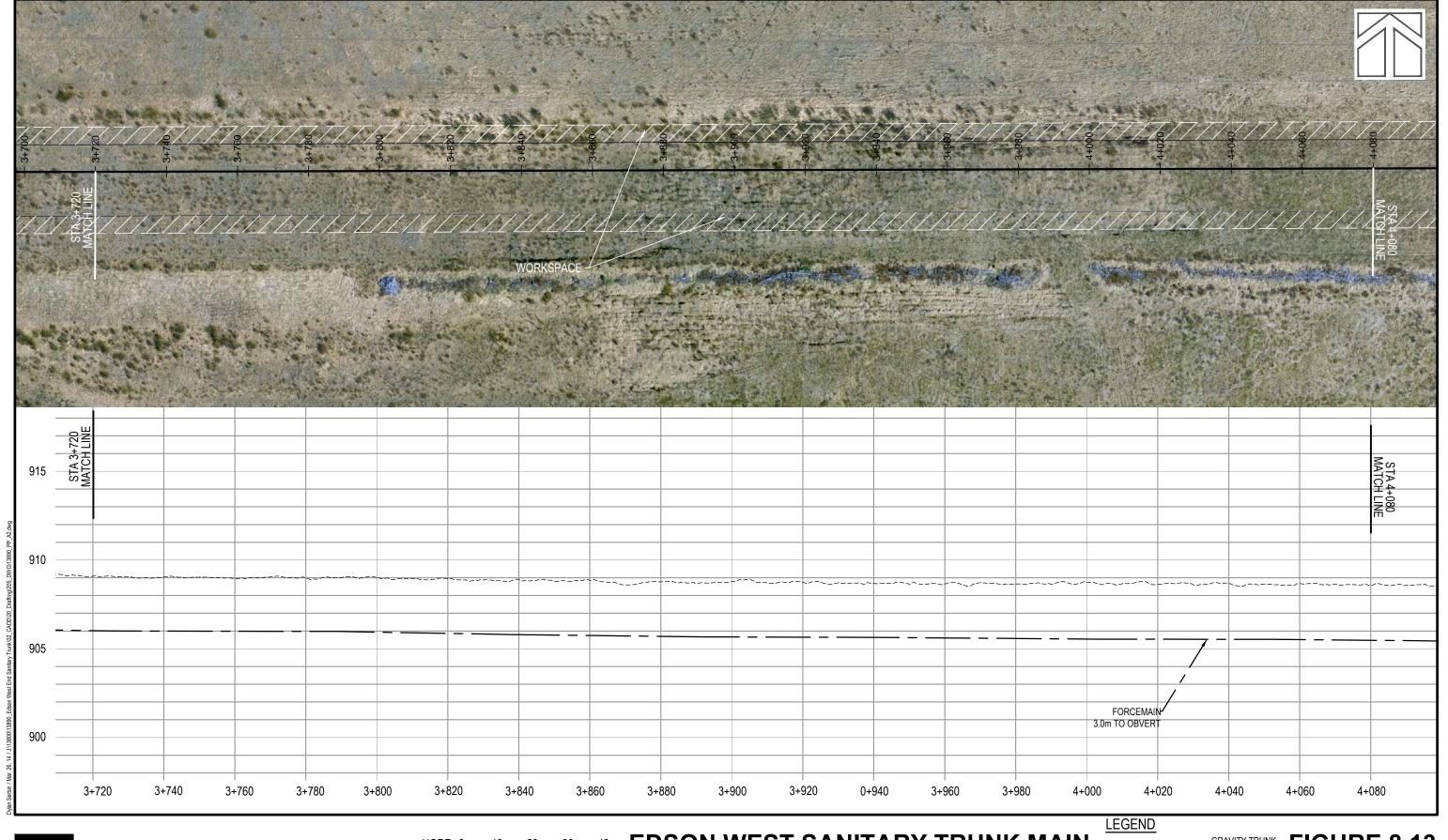


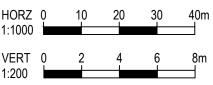
FIGURE 8.12

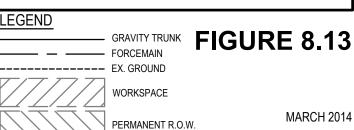
PERMANENT R.O.W.

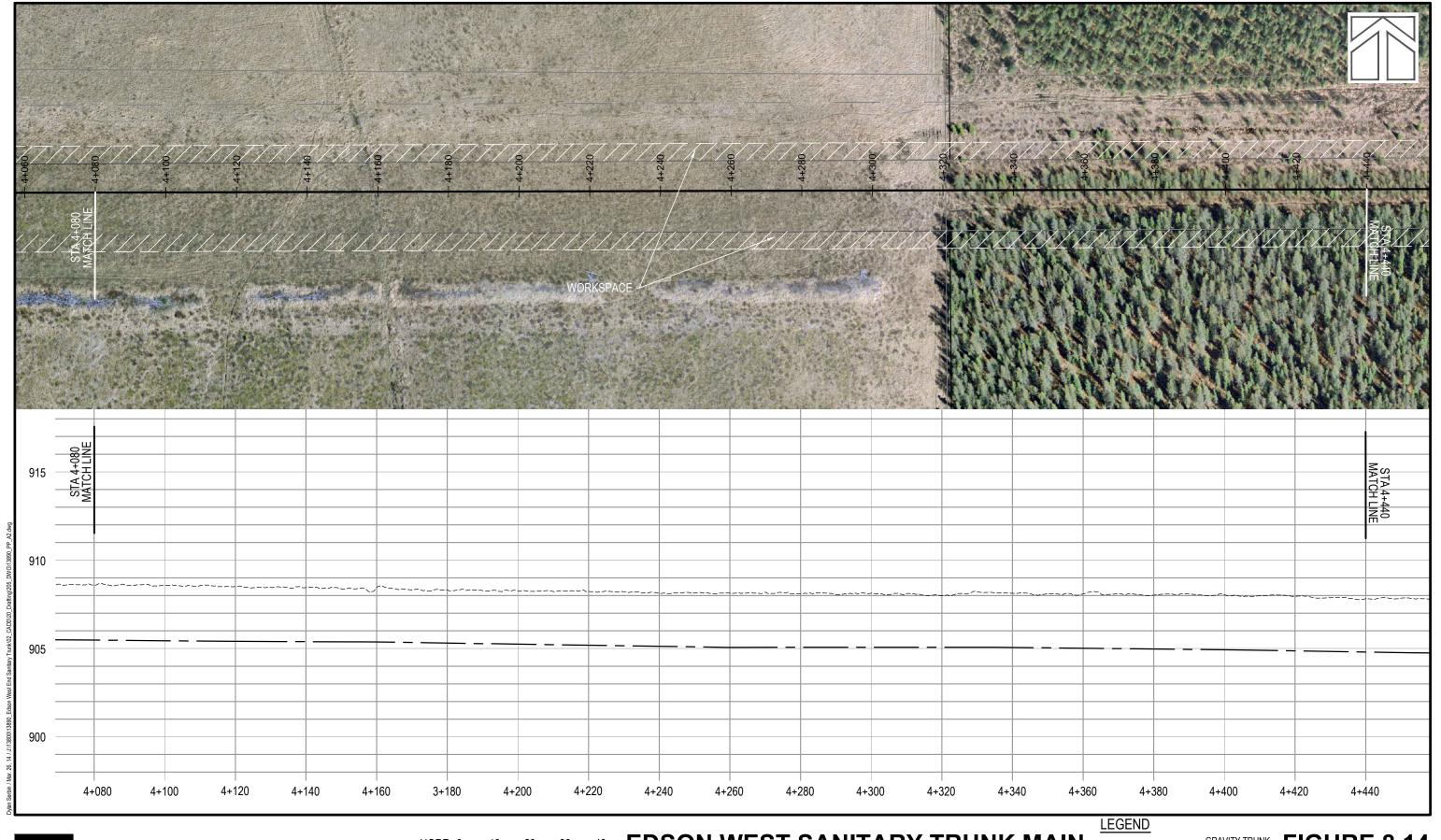






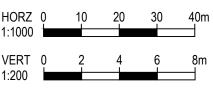


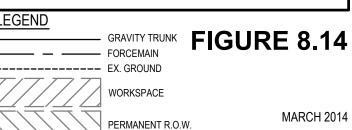


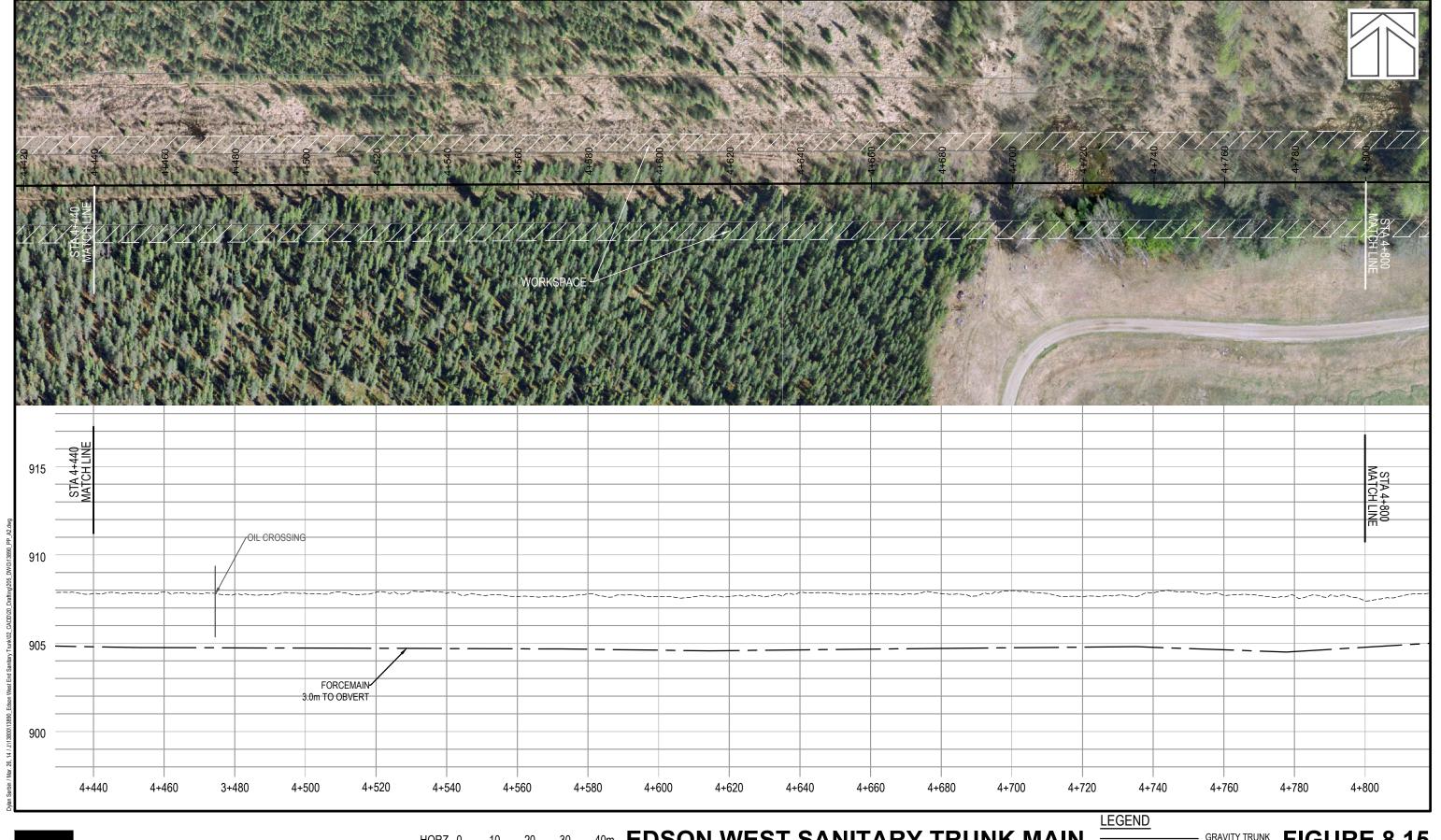






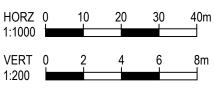




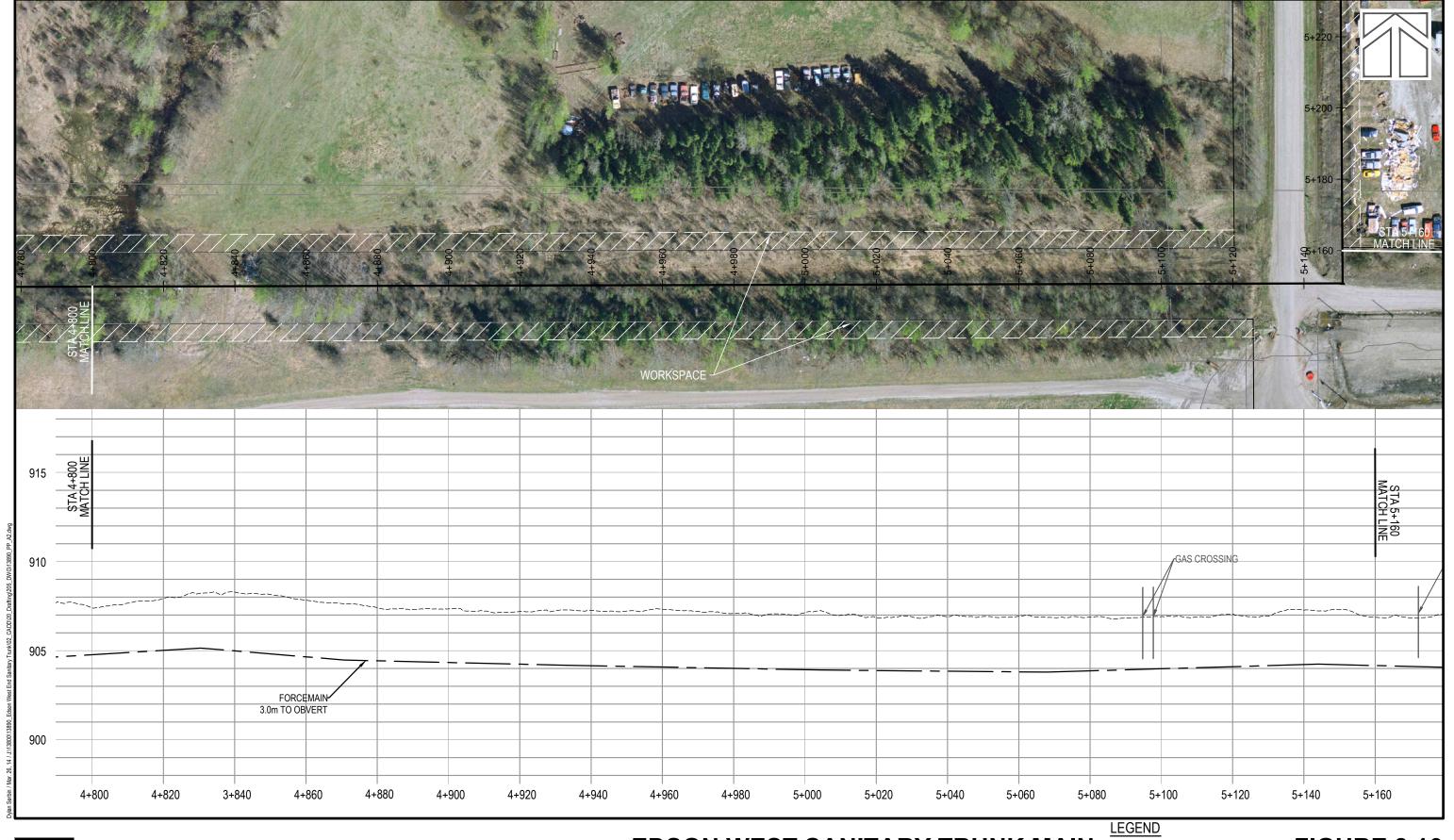






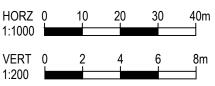


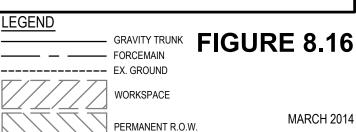


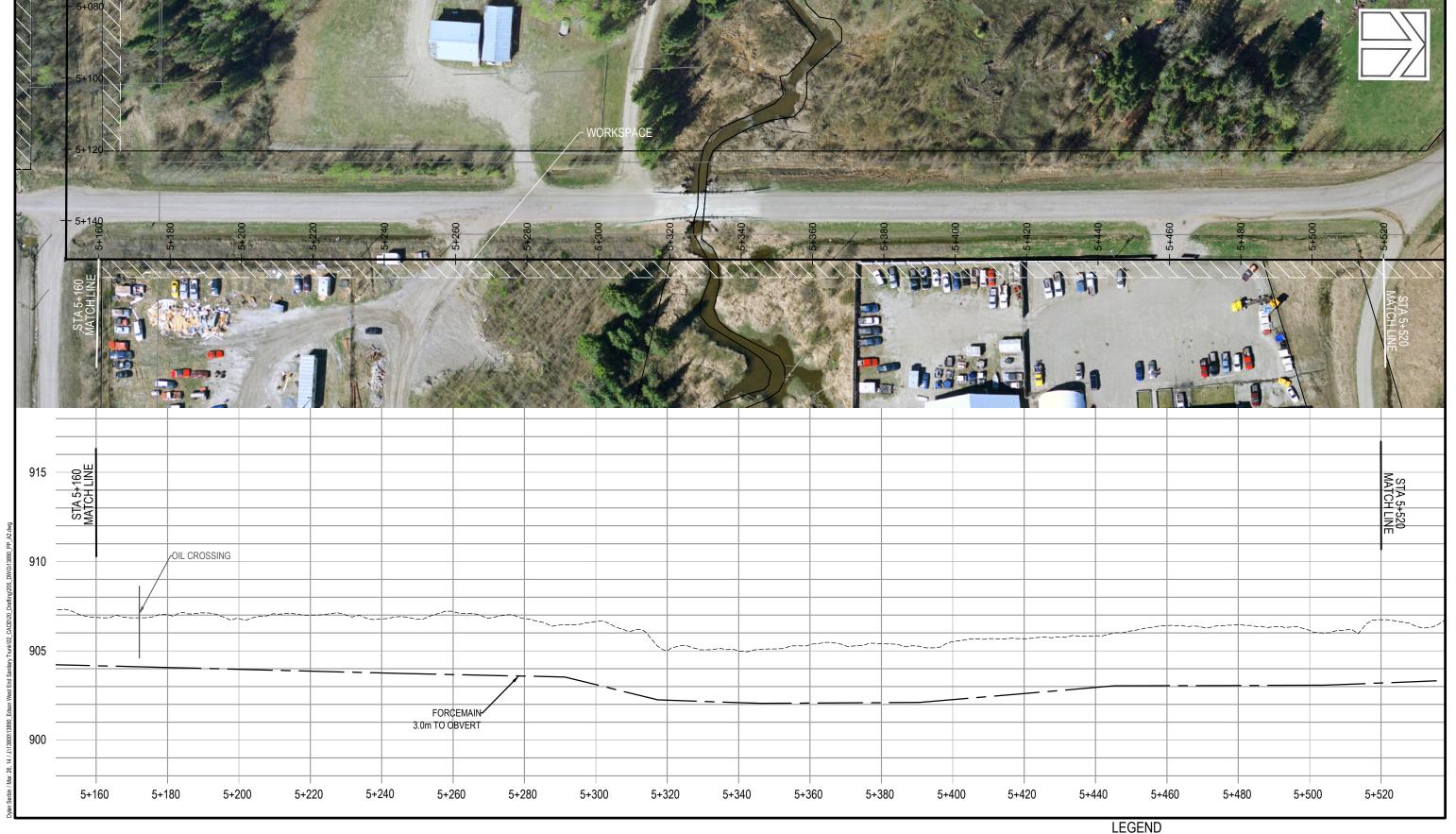






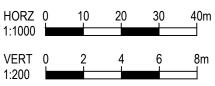












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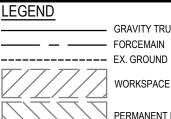


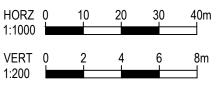
FIGURE 8.17

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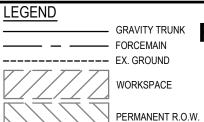




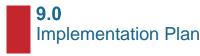




PREFERRED PRELIMINARY ALIGNMENT ALIGNMENT 2







9.1 Introduction

This section presents an overview of the next steps required to implement the sanitary sewer system. It is understood that the Town would like to commence with the detailed design and construction of the recommended system as soon as possible.

9.2 Regulatory Approvals / Considerations

A review of applicable federal and provincial regulations and discussions with regulators identified the following regulatory issues. These will have to be considered during the detailed design and construction phases of this project.

Federal Government

Department of Fisheries and Oceans

 The Project involves crossing of Bench Creek and because there is record of fish species in the water body, the work will require notification and submission of an application for approval to DFO. Also, the project involves works listed under DFO's Operational Statements. Mitigation guidelines listed in the Operational Statements should be followed.

Migratory Birds Convention Act

 Although no approvals are required, a timing restriction for vegetation clearing is recommended in accordance with the Act. Nesting and fledging seasons for birds included under both federal and provincial legislations are from March 1 to August 15.

Provincial Government

Water Act

- Crossing of Bench Creek must follow the "Code of Practice for Watercourse Crossings.
- Alberta Environment needs to be consulted regarding this work

Environmental Protection and Enhancement Act (EPEA)

• Construction of the sewer trunk will require approval under EPEA.

Public Lands Act

Crossing of Bench Creek may require a License of Occupation from AESRD under the Public Lands Act;
 need to contact AESRD during detailed design

Wildlife Act

- Any clearing of trees or wetlands should occur outside the breeding season (April 15 to July 31)
- No permitting or approvals is required under this act.

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Right-of-Way Acquisition 9.3

The recommended alignment requires both permanent right-of-way and temporary working easements on up to 20 parcels of land. Upon approval to proceed with detailed design of the recommended design, land acquisition activities should commence. Land acquisition would include the following tasks:

- Upon approval, engage landowners affected by the alignment to perform an initial consultation and acquire written consent to conduct required surveys on the property
- Upon confirmation of the R/W requirements and receipt of individual ownership plans prepared per parcel of land impacted, prepare valuations and offers for each affected parcel
- Prepare Utility Right-of-Way agreements
- Engage affected landowners and negotiate the agreements with the intent to acquire voluntary approval, execute and register against Title accordingly
- Prepare and update project tracking reports outlining any conditions of construction and compensation requirements per parcel

9.4 **Crossing Agreements**

The proposed sewer pipe crosses a CN rail line, Highway 16 and several oil / gas pipeline R/W's. Crossing agreements will need to be obtained for each. The pipeline companies will need to be contacted early in the detailed design phase of the project to identify any site specific conditions that would apply to this project. The following crossings have been identified for the recommended Alignment 2:

- AT approval for the Highway 16 crossing and any sections within 30 m of the highway right-of-way.
- CN Rail track crossing at 63 Street.
- 1050psi ATCO High Pressure Gas pipeline and Yellowhead Gas crossing located north of Hwy 16 on the east side of Rodeo Road north of Hwy 16.
- Yellowhead Gas crossing found near the SE corner of ¼ Sec 18-53-17-W5 along Hwy 16.
- 30psi ATCO Gas distribution line running along the eastbound lanes of Hwy 16 in the north ditch right where Hwy 16 splits off east of 74 Street. This looks to feed McPhee Construction Ltd and others on the south side of Hwy 16.
- Yellowhead Gas, Conserve Oil and Telus lines run along the government road allowance from 63 street to 54 street parallel to Alignment 2.

9.5 **Geotechnical Investigation**

On acceptance of the recommended Alignment 2, a thorough geotechnical investigation will be carried out. The geotechnical investigation will include a comprehensive borehole investigation to evaluate soil and groundwater conditions. This will aid development of the detailed design, including refining the identification of appropriate methods of construction.











10.0

Conclusions and Recommendations

10.1 Conclusions

1. Previous Studies

The ASP states that the extension of the sanitary trunk is not economically feasible to service future development areas within the County. This statement is not support by the Town.

Alberta Transportation has future plans to construct a bypass from the east side of the Town that reconnects to the existing highway between 75 Street and Rodeo Road. The schedule for construction of the by-pass is uncertain at this time. However, the fact that it is planned, restricts any opportunity to install the proposed sewer pipe along the south side of the Highway 16 corridor. It is however anticipated that the proposed sewer will not interfere or impact the construction of the future by-pass as long as the sewer is not installed within the lands allocated for the bypass interchange.

2. Design Flows

The calculated peak wet weather flow from the existing development upstream of 70 Street appears high relative to the service area. Without additional background information a design flow from this development cannot be confirmed at this time. It is recommended that additional analysis be completed during detailed design.

During the review of the model flows it was identified that the timing of the peak flow from the future development area and existing development, from the proposed 70 Street connection, are slightly offset from each other. The separation is too close and without supporting information it is risky to completely rule out the potential for overlap. Design flows will need to be confirmed during detailed design prior to finalizing the sizing of pipes and other infrastructure.

Design flows have been prepare for two Alternatives. Alternative 1 only includes flows from existing and future developments within the Town limits. Alternative 2 includes flows from existing and future development form both the Town and County.

3. Utilities

A number of existing utilities are crossed for each alignment, including Telus, ATCO Gas, ATCO Pipelines, and Yellowhead Gas. Crossing agreements will be required at each crossing, however it is anticipated that obtaining these agreements will be straight forward.

4. Historical Resources

A Statement for Justification for Historical Resources and Paleontology was submitted to Alberta Culture for review. The Historical Resources review identified previous sites of significance along Bench Creek upstream of the proposed construction work. The document suggests that Alberta Culture may set a requirement for First Nations consultation for work in this area.

The Statement for Justification for Paleontology did not identify any concerns with the construction of the sanitary trunk line and suggested that no additional paleontology investigation is required.

5. R/W Assessment

A right-of-way assessment was completed for each alignment. The assessment included a valuation for acquiring a permanent easement and temporary workspace, as required.

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Edson West Sanitary Trunk Main Town of Edson - Preliminary Design Report





6. Desktop Geotechnical

The general soil profile for the Edson area consists of silt, sand and clay followed by glacial till then sandstone. Groundwater levels for the Edson area is 2 to 3 meters below existing surface. The high water level will impact the productivity and cost of construction, particularly any deep trenchless installation

7. Gravity Sewer

The topography significantly impacts the ability to service by gravity. Although there is significant elevation difference from Rodeo Road, 935m, and 54 Street, 907m, the grade drop is not constant along the project length. From west to east, there is a significant drop in elevation from Rodeo Road to east of 75 Street, 935m to 919m. Continuing east of 75 street the ground profile reaches an elevations near 925m, near 72 Street, before falling to 911m with shallow grades towards 54 Street. A gravity sewer would be installed at steep grades up to 75 Street. From here it would be installed at shallow grades and large depths, up to 12m towards 70 Street. This would require trenchless installation methods that are expensive and risky. Although much of the section downstream of 70 Street would be relatively shallow, the downstream tie in constraint at 54 Street presents a significant amount of risk with imposing limited cover at the Bench Creek Crossing. This presents significant risk during both construction and operation.

8. Pump Station and Forcemain

A pump station design option would include a pump station located at 75 Street that would convey sewage through a forcemain to 54 Street. The forcemain can be installed at minimum depths along the majority of the alignment. At the creek crossing the forcemain can be installed at greater depths to ensure adequate cover. The installation across Bench Creek can be completed using horizontal directional drilling to further reduce impact to the creek and surrounding area. This option has less cost and risk than a gravity sewer option.

9. CN Rail Crossings

The design of CN Rail crossings and sections where pipe is placed parallel to the rail immediately adjacent to CN right-of-way, the sewer pipeline will have to meet the requirements outlined by CN for water and sewer pipeline crossings. This will need to be completed during the detail design phase.

10. Alberta Transportation Approval

The risk of not receiving approval from Alberta Transportation for the installation of the pipe within the Highway 16 corridor is applicable to Alignment 1, 3 and 4. If approval is not received from Alberta Transportation Alignment 2 would be the default option as it is located outside of the highway right of way.

11. Preferred Alignment/Design

The preferred overall design concept includes a gravity sewer to a pump station near 75 Street and a forcemain to 54 Street. The preferred alignment is Alignment 2. The preferred design concept has the following advantages:

- . By utilizing a pump station and forcemain the risk associated with the Bench Creek Crossing is significantly reduced as compared to a gravity system as the pipe may be installed at greater depth since it does not require installation at a specified grade.
- Installation of the forcemain also allows for installation at shallower depths than a gravity system. This allows for open cut installation which is less expensive and carries less construction risk.
- Alignment 2 carries the least amount of risk.
- Alignment 2 is the most expensive option however the difference compared to the least expensive option is marginal.
- Alignment 2 provides accessible servicing for future industrial/commercial developments between 63 Street and 54 Street.





10.2 Recommendations

- 1. Ultimate design flow rates, including from future Town and County developments and flow diversion from 70 Street, should be confirmed to ensure proper sizing of piping and other infrastructure.
- **2.** Alignment 2 with a pump station and forcemain is the recommended design option to convey flows to the existing trunk at 54 Street.
- 3. Implement the implementation plan including:
- A geotechnical investigation to identify soil conditions should commence at the outset of detailed design.
- Prepare and submit applications to environmental agencies
- Land acquisition activities should commence at the outset of detailed design.
- Submit and AT permit application for work within R/W
- Submit AT and CN crossing applications early

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Appendix A
Flow Calculations

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Table A-1
TOWN OF EDSON
WEST SANITARY TRUNK MAIN
FUTURE FLOWS - TOWN LIMITS ONLY
JAMES KERCHER

Development	Population	Res. Area	Comm./Ind. Area
Area 11	500	20	0.00
Area 12	0	0	83.30
Area 13	0	0	116.30

FROM	ТО	RES.	AREA		SUM	COMM	. AREA	AVERAGE	PEAK	AVERAGE	PEAK	1/1.	DESIGN	DESIGN
M.H.	M.H.	ADDED	TOTAL	POPULATION	POPULATION	ADDED	TOTAL	FLOW	FACTOR	FLOW	FACTOR	1/1. (L/s)	Q	86% Q
171.1 1.	IVI.I I.	На	На		TOTOLATION	На	На	(RES.) (L/s)	(RES)	(COM.) (L/s)	(COM)	(L/3)	L/s	L/s
AREA11	75 STREET	20.00	20.00	500	500	0.00	0.00	2.17	2.79	0.00	3.00	5.60	11.6	13.5
AREA12	75 STREET	0.00	0.00	0	0	83.30	83.30	0.00	0.00	13.11	3.00	4.17	43.5	50.6
AREA13	75 STREET	0.00	0.00	0	0	116.30	116.30	0.00	0.00	18.31	3.00	5.82	60.7	70.6
75 STREET	70 STREET	0.00	20.00	0	500	0.00	199.60	0.00	2.79	31.42	3.00	15.58	109.8	127.7

13600 L/Ha/day

0.28 L/s/ha

0.05 L/s/ha

PROPOSED DESIGN PARAMETERS (based on the 2009 Sanitary Sewer Master Plan & Town standards): AVERAGE RESIDENTIAL SEWAGE FLOW = 375 L/person/day

AVERAGE RESIDENTIAL SEWAGE FLOW =
COMMERCIAL, INDUSTRIAL, AND INSTITUTIONAL SEWAGE FLOW =
RESIDENTIAL INFLOW / INFILTRATION =
COMM., IND., INST. INFLOW / INFILTRATION =
PEAKING FACTOR (RES.) = 2.6P -0.1 OR 1.5 (THE LARGER OF THE TWO)
PEAKING FACTOR (COM./IND.) = 3.0
REQUIRED FLOW = 86% OF DESIGN FLOW
Manning's n = 0.013
MIN v= 0.6 m/s

Table A-2
TOWN OF EDSON
WEST SANITARY TRUNK MAIN
FUTURE FLOWS - TOWN LIMITS AND COUNTY
JAMES KERCHER

Development	Population	Res. Area	Comm./Ind. Area
Area 11	500	20	0.00
Area 12	0	0	83.30
Area 13	0	0	116.30
Area 18	0	0	86.40
Area 19	0	0	70.10
Area 20	0	0	113.80
Area 21	460	11.5	0.00
Area 22	0	0	233.20
Area 23	0	0	96.50
	960	31.5	799.6

FROM	ТО	RES.	AREA	ADDED	SUM	COMM	I. AREA	AVERAGE	PEAK	AVERAGE	PEAK	1/1.	DESIGN	DESIGN
M.H.	M.H.	ADDED	TOTAL		POPULATION	ADDED	TOTAL	FLOW	FACTOR	FLOW	FACTOR	(L/s)	Q	Q / 86%
IVI.I I.	IVI.I I.	На	На	FORULATION	FOFULATION	На	На	(RES.) (L/s)	(RES)	(COM.) (L/s)	(COM)	(L/5)	L/s	L/s
AREA 21	AREA 22	11.50	11.50	460	460	0.00	0.00	2.00	2.81	0.00	3.00	3.22	8.8	10.3
AREA 22	AREA 23	0.00	11.50	0	460	233.20	233.20	2.00	2.81	36.71	3.00	14.88	130.6	151.9
AREA 23	AREA 12	0.00	11.50	0	460	96.50	329.70	2.00	2.81	51.90	3.00	19.71	181.0	210.5
AREA 20	AREA 19	0.00	0.00	0	0	113.80	113.80	0.00	0.00	17.91	3.00	5.69	59.4	69.1
AREA 19	AREA 18	0.00	0.00	0	0	70.10	183.90	0.00	0.00	28.95	3.00	9.20	96.0	111.7
AREA 18	AREA 12	0.00	0.00	0	0	86.40	270.30	0.00	0.00	42.55	3.00	13.52	141.2	164.1
AREA 12	75 STREET	0.00	11.50	0	460	83.30	683.30	2.00	2.81	107.56	3.00	37.39	365.7	425.2
AREA 11	75 STREET	20.00	20.00	500	500	0.00	0.00	2.17	2.79	0.00	3.00	5.60	11.6	13.5
AREA 13	75 STREET	0.00	0.00	0	0	116.30	116.30	0.00	0.00	18.31	3.00	5.82	60.7	70.6
75 STREET	70 STREET	0.00	31.50	0	960	0.00	799.60	4.17	2.61	125.86	3.00	48.80	437.3	508.4

13600 L/Ha/day

0.28 L/s/ha

0.05 L/s/ha

PROPOSED DESIGN PARAMETERS (based on the 2009 Sanitary Sewer Master Plan & Town standards): AVERAGE RESIDENTIAL SEWAGE FLOW = 375 L/person/day

AVERAGE RESIDENTIAL SEWAGE FLOW =
COMMERCIAL, INDUSTRIAL, AND INSTITUTIONAL SEWAGE FLOW =
RESIDENTIAL INFLOW / INFILTRATION =
COMM., IND., INST. INFLOW / INFILTRATION =
PEAKING FACTOR (RES.) = 2.6P -0.1 OR 1.5 (THE LARGER OF THE TWO)
PEAKING FACTOR (COM./IND.) = 3.0
REQUIRED FLOW = 86% OF DESIGN FLOW
Manning's n = 0.013

MIN v= 0.6 m/s



Engineering and Land Services





Appendix B



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P. MACHIBRODA ENGINEERING LTD.

CONSULTING GEOTECHNICAL GEOENVIRONMENTAL ENGINEERS AND GEOSCIENTISTS

EDMONTON

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- Concrete Testing
- · Asphalt Testing



Member of the Association of Consulting Engineering Companies/Canada October 11, 2013

ISL Engineering and Land Services Ltd. 7909 - 51 Avenue Edmonton, Alberta T6E 5L9

T: 780.438.9000 F: 780.438.3700

Email: <u>JKercher@islengineering.com</u>

ATTENTION:MR. JAMES KERCHER, P.ENG, PROJECT ENGINEER

Dear Sir:

RE: GEOTECHNICAL INVESTIGATION - DESKTOP STUDY WEST END SANITARY SEWER TRUNK MAIN PROJECT TOWN OF EDSON, ALBERTA PMEL REPORT NO. A13-2258

P. Machibroda Engineering Ltd. (PMEL) conducted a desktop geotechnical investigation for the above-mentioned project. Authorization to conduct this investigation was provided on September 10, 2013. The Terms of Reference for this investigation were presented in P. Machibroda Engineering Ltd. (PMEL) Proposal No. 0712-2478, dated July 15, 2013.

Soil Stratigraphy

The general soil profile for the Edson area consisted of variable deposits of silt, sand and clay followed by glacial till then sandstone. Groundwater level for the Edson area is 2 to 3 meters below existing surface.

PMEL has conducted geotechnical investigations for different residential and commercial projects in Edson area and soil profiles are as follows.

Site-1 (near 31 Street and 1 Avenue)

The general soil profile consisted of a thin layer of topsoil (0 to 300 mm) overlying variable deposits of silt, sand and clay (0.3 to 3.3 metres) followed by glacial till, which extended to at least 9 metres below existing ground surface, the maximum depth penetrated by our test holes at this site. Variable inter/intra deposits of sand and clay shale (2.5 to 9 metres) were encountered throughout the subject site. Groundwater seepage and sloughing conditions were encountered during test drilling.

Site-2 (near 55 Street and 2 Avenue)

The general subgrade soil conditions consisted of a surficial layer of clay fill followed by medium to highly plastic clay (1.6 to 7.0 metres), overlying an extensive deposit of silt and sand (7.0 to 9.0 metres), which extended to at least 12.0 metres below existing ground surface, the maximum depth penetrated by our test holes at this site. An extensive peat layer was encountered from 0.5 to 2.6 metres in one Test Hole. Groundwater seepage and sloughing conditions were encountered during test drilling.

Site-3 (near 59 Street and 4 Avenue)

The general subgrade soil conditions consisted of medium and highly plastic silt and clay (0.5 to 3.5 metres) deposits followed by glacial till (3.5 to 16.0 metres). The glacial till was underlain by sandstone which extended to a depth of at least 18.0 metres below existing grade, the maximum depth explored with our test holes at this site. The test holes remained open during and immediately after drilling.

The subgrade soils are frost susceptible and the average depth of frost penetration for the Edson area is 2 metres.

Physiography and Regional Geology

Review of published information (ERCB, 2011) revealed the following:

 The subject property overlies bedrock of the Upper Paskapoo Formation; grey to greenish grey, thick-bedded, calcareous, cherty sandstone; grey and green siltstone and mudstone; minor conglomerate; thin limestone, coal and tuff beds; nonmarine.

Aerial Photo Record System (APRS)

Historical aerial photographs of 1951, 1969, 1977, 1986, 1995 and 2007 were obtained for the site and examined to identify site specific land-use which may have resulted in environmental concerns on and/or adjacent to the site. A summary of observations made has been presented below.

- The subject site is mostly undeveloped forested area with some areas of clear-cutting located towards the west. A railroad and Highway No. 16 is visible in the project area. The topography is mainly flat with slight slope.
- Substantial clear cutting and cultivation has occurred towards the south. Development within the Town of Edson has occurred.
- 1977 Construction of the Edson Airport is visible to the north side of the project location.

Page 3

1986 Further development has occurred to the north of the subject site.

Construction of the Edson Airport is completed. Highway No. 16 is

realigned to the east.

1995 Relatively consistent with 1986 observations.

2007 Relatively consistent with 1995 observations.

Closure

We trust that this is the information you require at this time. Please contact our office if you should require additional information.

/15/2013

P. MACHIBRODA ENGINEERING LTD.

PERMIT TO PRACTICE
Engineering

John Sowinski, E.I.T.

Date

Ø

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AHM Zafrul Alam, P.Eng

PERMIT NUMBER: P-5862

The Association of Professional Engineers, and Geoscientists of Alberta

Zobayur Rahman, P.Eng.

Paul Machib

, P.Eng., FCSCE

ZA:ZR:PM:zz:clb



Engineering and Land Services





Appendix C

Historical Resources Review

islengineering.com March 2014 | APPENDIX

Town of Edson West End Sanitary Sewer Trunk Main

Statement of Justification (SoJ) for Historical Resource Act Requirements

Prepared For: Town of Edson Contact:

Town of EdsonDawit SolomonP.O. Box 6300780-723-4402605 – 50th Streetdawits@edson.ca

T7E 1T7

Edson, Alberta.

Prepared By: Turtle Island Contact

Turtle Island Cultural Resource Management Inc. Gareth Spicer 5 Creston Crescent N.W. Calgary, Alberta. 403-620-9032

T2M 4J9 gareth@turtleislandcrm.com

Project Description:

The project involves the installation of a sewer main trunk on the south side of the Town of Edson, Alberta. The primary impact will be to lands owned by the Town of Edson; although some private and crown land will also be impacted depending on the chosen alignment. The project encompasses an area of approximately 2.4 ha in the foothills of the Rocky Mountains immediately south of the Town of Edson. There are four possible alignments each of which follow existing roads, highways, and utility right of ways for the majority of their length. The project proceeds through the town and includes areas of previous disturbance such as: a rail line, the Yellowhead Highway, roads, utility right of ways, and an existent landfill. The work will include a combination of open trench and trenchless excavation methods. Areas of open cut trench will represent significant surface disturbance.

The highest potential for impact to cultural resources is at the crossing of Bench Creek. At this crossing the proposed sewer line will be approximately 2.5 metres under the level of the creek channel, up to 14 metres below the general land surface. There are previously recorded sites associated with Bench Creek including four sites approximately 4.5 km upstream. Although these known sites are located outside the development footprint their presence on the same water course as the development has resulted in a recommendation for a Historic Resources Impact Assessment (HRIA) to focus on the creek crossing and affected land in the immediate vicinity.

Other matters relating to Historic Resource Act (HRA) clearance are palaeontology and sites of cultural interest. The depth of the proposed work may trigger palaeontological requirements that could include deep testing and/or palaeontological monitoring. A Statement of Justification (SoJ) for *Historical Resource Act* requirements for palaeontology has been prepared and submitted in relation to this project and are currently under review by the Royal Tyrrell Museum. In Addition, all four of the proposed alignments pass into an area that contain sites of recorded aboriginal cultural importance, this is noted as 4c designates from the *Listing of Historical Resources* (Sept. 2013), these locations are depicted on the included graphic. This indicates that there are culturally relevant sites that have been

recorded by a First Nations community. The actual location of these sites, their nature and communities potentially affected are not made available by Alberta Culture. If one or more of these sites may be impacted by the proposed development Alberta Culture may require consultation with the appropriate First Nations communities.

Historic Resource Act requirements are currently pending review by the Historic Resource Management Branch at Alberta Culture. This application (#004539939) was submitted on November 27, 2013 and is currently in screening. Historic Resource Act clearance and any pending requirements associated with that clearance are expected to be issued by Alberta Culture in the first half of January 2014.

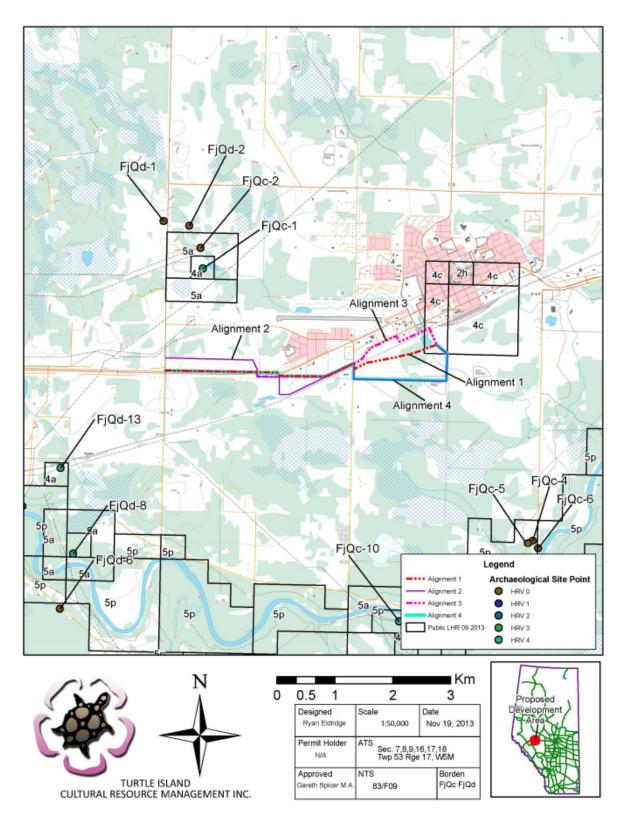
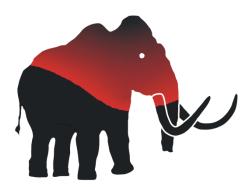


Figure 1: Project area showing culture resource Sites and HRV notations.

SoJ - Palaeontological Statement of Justification

Town of Edson - West End Sanitary Sewer Trunk Main

November 28th, 2013



Paul **E. McN**eil, Ph.**D.**Steppe Consulting Inc.
264 Edgebrook Park NW, Calgary, AB T3A 5T7
Phone: (403) 286-8608, Cell (403) 615-6325
Email: pemcneil@gmail.com

Statement of Justification for *Historical Resources Act*Requirements for projects other than small-scale oil and gas

This document contains sensitive information about Historic Resources that are protected under the provisions of the *Alberta Historical Resources Act*. This information is to be used to assist in planning the proposed project only. It is not to be disseminated, and no copies of this document are to be made without written permission of the Historic Resources Management Branch, Alberta Culture and Community Spirit.

Project Name or Project Identifier

Town of Edson – Edson West Sanitary Trunk Main

Disposition Type & Number: n/a

Name: Paul McNeil

Corporate name of consulting company: Steppe Consulting Inc. Address: 264 Edgebrook Park NW, Calgary, AB, T3A 5T7

Phone number: 403 615 6325

E-mail address: pemcneil@gmail.com

Name of proponent contact: Dawit Solomon

Company: Town of Edson

Address: Box 6300 605-50 Street, Edson, AB, T7E 1T7

Phone number: 780 723 4402 Fax number: 780 723 3508

E-mail address: dawits@edson.ca

Land	ds	A ffe	cte	d
	-			

Legal Description	Land Ownership Type	HR∨
(1-4)-18-53-17 W5	Tenure is a mixture of Crown	-
(13-16)-7-53-17 W5	and Freehold, including CN	-
(13-16)-8-53-17 W5	Rail's ROW.	-
(1,2)-17-53-17 W5		-
(1-10)-16-53-17 W5		4C

Activity type and Anticipated Ground Disturbance

This project will consist of the construction of a new trunk sewer on the southwest edge of Edson from Rodeo Road (Range Road 180) to an existing sewer trunk on 54 Street. Four alternative routes have been proposed for the sewer route (Figure 1). The pipeline will generally be installed approximately 3m below ground level, however a hill in the center of the planned alternatives could result in depths up to 14m below surface in order to maintain the correct grade on the sewer for gravity drainage. Open trenching is planned for the shallower installation, for deeper installation, trenchless methods have been recommended to reduce disturbance as the size of the required excavations would negate the extra cost.

Project size

The project area is approximately 2.4 hectares.

Existing Disturbance

The proposed sewer trunk is located on land that has previously been developed for agricultural, transportation, and industrial purposes. Alternatives follow the route of Highway 16 and CN railway tracks just south of the town of Edson.

Landscape and Environmental Information

The proposed sewer trunk route is located on agricultural, industrial land just south of Edson. Ephemeral drainages and sloughs are located throughout the project area, with Bench Creek, at its eastern end, being the only permanent watercourse. Bench Creek is low and swampy with little incision at all potential crossings, so exposure of surficial or bedrock geology is unlikely.

Geology

The regional surficial geology is primarily of glacio lacustrine clay silt and sand overlying the Edson Tills (Figure 2). The Edson tills are continental in origin with clasts being dominantly igneous and high grade metamorphics in a silt and clay matrix (Gabert and Roed, 1968; Roed, 1970). In the Project area, the Edson Till overlies a buried river channel filled with an earlier Cordilleran till. Because of the buried channel, the Quaternary deposits in the project area are a minimum of 30m thick (Gabert and Roed, 1968). The bedrock geology is comprised of the Paleocene Paskapoo Formation. The Paskapoo is fluvial in origin and consists of thickly bedded buff sandstone with greenish siltstone and mudstone (Hamilton *et al.*, 1999; Hamblin, 2004). Given the thickness of the unconformably overlying Quaternary sediments, the Paskapoo Formation should not be impacted during construction.

Palaeontology

No palaeontological HRV values have been assigned for any of the LSDs that Project will affect. 5P values are assigned to LSDs which contain the McLeod River Valley south of Edson, because of potential exposure of the Paskapoo Formation. A search of the online HeRMIS database indicates that there are currently not only no fossils in collections from the Project township (53-17W5), but there are also no fossils from any of the surrounding townships as well.

No Quaternary fossils are known from the project area and the glacial deposits present are low in palaeontological potential. However while Quaternary fossils are rare, and their occurrence difficult to predict, they can, and are, unearthed in construction projects across the province. The Paleocene Paskapoo Formation is a source of a variety of mammal fossils (e.g. Fox, 1994; Scott, 2006), plants (e.g. Hoffman and Stockey, 1999), freshwater and terrestrial molluscs, reptiles (e.g. turtle, crocodile), freshwater fish, and insects (e.g. Hoffman and Stockey, 1999).

Archaeological Resources						
Since this SOJ is focused on palaeontology, no archaeological information is						
included he	re.		_			
Bo rd en#	HRV	Relationship to activity	Anticipated Impacts			
	(distance and direction from					
project)						
I llust r ative	Materi	als				
Project Plan	ıs.					

Evaluation

The Quaternary geology consists of glacio-lacustrine deposits overlying continental and Cordilleran tills, all of which have low palaeontological potential. The Quaternary deposits are greater than 30m thick in the project area indicating that the potentially fossiliferous Paleocene Paskapoo Formation will not be impacted.

Recommen**d**ations

No further palaeontological I investigation or monitoring is recommended for the proposed Edson West Sanitary Trunk Main.

Quaternary fossils, while extremely rare in the surficial deposits that the project impacts, can occur. Therefore awareness of their possible presence should be passed on to equipment operators, construction supervisors and environmental monitors. If encountered, they should be set aside and a palaeontologist contacted.

(Recommendations regarding paleontological resources must be made by a professional palaeontologist.)

paracontologist.)	
Recommendations made by:	Date:
Paul McNeil, Ph.D., Steppe Consulting Inc.,	November 28, 2013

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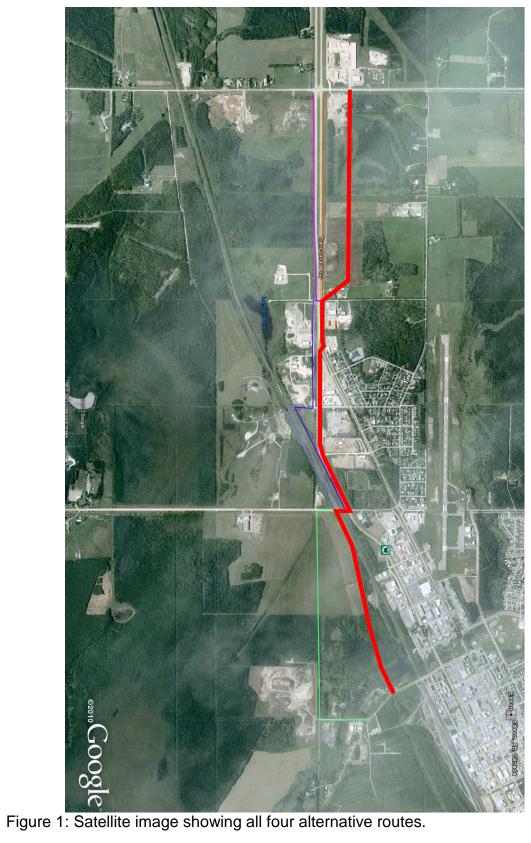
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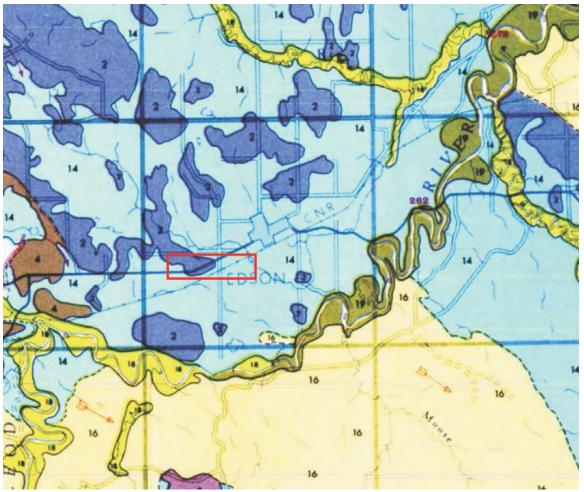


Figure 2: Surficial geology. All four project alternatives will fall within the red rectangle. Acronyms: 2 – Edson Till; 14 - glacio-lacustrine sand, silt and clay. Modified from Roed (1970).



Heritage Division

Old St. Stephen's College 8820 – 112 Street Edmonton, Alberta T6G 2P8

Canada

Telephone: 780-431-2300

www.alberta.ca

Via e-mail: dawits@edson.ca

February 18, 2014

Project File: 4710-14-0001 OPaC Application: 004539939

Mr. Dawit Solomon Town of Edson P.O. Box 6300, 605 – 50th Street Edson, Alberta T7E 1T7

Dear Mr. Solomon:

SUBJECT: HISTORICAL RESOURCES ACT (HRA) APPROVAL

TOWN OF EDSON

WEST END SANITARY SEWER TRUNK MAIN

SEWAGE LINE

The attached Schedule "B" outlines Alberta Culture's requirements for the proposed footprint of Town of Edson: West End Sanitary Sewer Trunk Main, as illustrated on the attached plan. These requirements involve the conduct of a Historic Resources Impact Assessment (HRIA) for any portion of the Project that passes through the SE-16-53-17-W5M. The Town of Edson is granted conditional *Historical Resources Act* clearance to proceed with development of the remainder of the project on the understanding that the required HRIA will be undertaken.

Should you require additional information or have any questions concerning these requirements, please contact Barry Newton (Land Use Planner) at 780-431-2330 (toll-free 310-0000) or barry.newton@gov.ab.ca.

I would like to thank representatives of the Town of Edson for their cooperation in our endeavour to conserve the Province's historic resources.

Sincerely,

David Link, PhD

Assistant Deputy Minister

Attachments



OPaC: 004539939

HISTORICAL RESOURCES ACT APPROVAL

TOWN OF EDSON TOWN OF EDSON: WEST END SANITARY SEWER TRUNK MAIN SEWAGE LINE

HRA REQUIREMENTS PROJECT FILE: 4710-14-0001

(Schedule "B")

For the purposes of this Schedule the Town of Edson shall be referred to as the "Proponent" and Town of Edson: West End Sanitary Sewer Trunk Main shall be referred to as the "Project."

A Historic Resources Impact Assessment is required for portions of the Project as outlined below. Part I of this Approval provides the Proponent with *Historical Resources Act* clearance for components of the Project while Part II outlines the conditions attached to this Approval.

I. HISTORICAL RESOURCES ACT APPROVAL

Historical Resources Act conditional clearance is granted to the Proponent for the Project as illustrated on the attached plan with the exception of any of the alignments which pass through the SE-16-53-17-W5M.

II. CONDITIONS ATTACHED TO APPROVAL

The Proponent is granted conditional *Historical Resources Act* clearance to proceed with the Project on the understanding that a Historical Resources Impact Assessment (HRIA) for archaeological resources will be conducted within SE-16-53-17-W5M, as outlined below.

1.0 ARCHAEOLOGICAL RESOURCES

The potential for selected components of the Project to affect archaeological resources is high.

1.1 Historic Resources Impact Assessment

Pursuant to Section 37(2) of the *Historical Resources Act* (*HRA*, or Act) a Historic Resources Impact Assessment (HRIA) for archaeological resources and any work resulting from this assessment is to be conducted on behalf of the Proponent by an archaeologist qualified to hold an Archaeological Research Permit within the Province of Alberta. In order to conduct the HRIA, the archaeological consultant must submit "An Application for an Archaeological Research Permit - Mitigative Research Project" to the Historic Resources Management Branch, Heritage Division,

February 18, 2014

SCHEDULE B 4710-14-0001

Alberta Culture. Please allow ten working days for the permit to be processed. An approved permit must be issued prior to the initiation of any archaeological field investigations.

1.1.1 Alberta Regulation 254/2002

Archaeological investigations conducted under permit in Alberta are subject to the conditions stated within Alberta Regulation 254/2002, *Archaeological and Palaeontological Research Permit Regulation*, conditions set forth in the approved permit, and any other conditions that the Minister imposes under Section 30 of the Act.

1.1.2 Contacting the Archaeological Survey

For further information regarding the acquisition of a Permit to Excavate Archaeological Resources and/or archaeological consultants obligations under Alberta Regulation 254/2002, please contact Martina Purdon, Head, Archaeological Information & Regulatory Approvals at 780-431-2331 (toll-free 310-0000), or e-mail martina.purdon@gov.ab.ca

1.1.3 Coverage

A pre-construction HRIA is required for any chosen route of the Project that crosses SE-16-53-17-W5M. The HRIA is to include all areas of high archaeological potential.

1.1.4 Timing

The HRIA is to be carried out prior to the initiation of any land surface disturbance activities under snow-free, unfrozen ground conditions. Should the Project require field studies under winter conditions, directions in the Archaeological Survey, *Survey Notes and Instructions: Information Bulletin Regarding Winter HRIA Work* must be followed.

1.1.5 Deep Testing

A deep testing program is required in areas of significant sedimentation.

1.1.6 Relationship to known sites in Project area

Historic structures may be located within or adjacent to lands affected by the Project. During the conduct of the HRIA the Proponent's archaeological consultant is to confirm the relationship between the Project and historic structures. If historic structures are encountered within or adjacent to the Project the directions included in the *Requirements for recording and reporting historic structures within the context of archaeological HRIAs* (Revised February 2013) apply.

1.1.7 Location of HRIA studies

Within the final report and any interim report(s) the location of pedestrian surveys, deep testing program(s) and the location and number of shovel tests must be discussed and clearly illustrated.

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SCHEDULE B 4710-14-0001

1.2 Reporting the results of archaeological resources HRIA

1.2.1 Submission of "Archaeological Site Inventory Data" forms

The Proponent's archaeological consultant is required to submit "Archaeological Site Inventory Data" forms for each prehistoric and historic archaeological site recorded or re-examined during the conduct of the HRIA. While the discovery of a site must be reported within 30 days following the date of discovery, site data forms are to be submitted within 30 days of the date on which the permit period ends, or at the same time or prior to the submission of any interim report or the final report, whichever comes first.

1.2.2 Submission of HRIA final report

The final report must be submitted within 180 days after the expiration of the permit, or at least six weeks prior to the anticipated conduct of land surface disturbance activities, whichever comes first. Copies of the final report and any interim reports are to be submitted to the Historic Resources Management Branch, Heritage Division, Alberta Culture, Old St. Stephen's College, 8820 – 112 Street, Edmonton, Alberta, T6G 2P8.

1.2.3 Submission of interim report(s)

Should the Proponent find it necessary to obtain *Historical Resources Act* clearance for portions or all of the lands affected by the Project prior to the submission of the final report, Alberta Culture will consider accepting the submission of an interim report, or reports.

2.0 STANDARD CONDITIONS UNDER THE HISTORICAL RESOURCES ACT

The Proponent must comply with standard conditions under the *Historical Resources Act*, which are applicable to all land surface disturbance activities in the Province. Standard conditions require applicants to report the discovery of historic resources and comply with the historic resources section of *Alberta's First Nations Consultation Guidelines on Land Management and Resource Development* (Alberta Culture's Consultation Guidelines). These requirements are stated in Attachment 1- *Standard Requirements under the Historical Resources Act, Reporting the Discovery of Historic Resources*.

3.0 FURTHER SALVAGE, PRESERVATIVE OR PROTECTIVE MEASURES

Based upon the results of the HRIA(s) reporting the discovery of archaeological resources, palaeontological resources, historic period sites and/or Aboriginal Traditional Use Site(s), the Proponent may be ordered to undertake further salvage, preservative or protective measures or take any other actions that the Minister responsible for the *Historical Resources Act* considers necessary.

February 18, 2014 3

SCHEDULE B 4710-14-0001

4.0 REQUESTS FOR HISTORICAL RESOURCES ACT CLEARANCE

Based upon the results of the HRIA studies, Alberta Culture may consider granting *Historical Resources Act* clearance to all or portions of the Project area. In the final report, and any interim report(s) the Proponent's consultant(s) must clearly identify and illustrate those portions of the Project area for which *Historical Resources Act* clearance is requested.

5.0 PRE-EMINENCE OF CONDITIONS OF HRA REQUIREMENTS

Should the contents of conditions included within this Schedule be at variance with any instructions associated with the *Listing of Historic Resources* and/or the permit application, the conditions of the Schedule take precedence. Following instructions as outlined in this Schedule should result in the granting of *Historical Resources Act* clearance and/or the issuance of requirements regarding further historic resources studies in a timely manner.

6.0 COMPLIANCE IS MANDATORY

These conditions shall be considered directions of the Minister of Alberta Culture under the *Act*. The Proponent and agents acting on behalf of the Proponent are required to become knowledgeable of the conditions. Failure to abide by the conditions will result in *Historical Resources Act* approval not being granted, or delayed.

February 18, 2014 4



Application for Historical Resources Act Clearance

Activity Administration

Date Received: January 16, 2014 HRM File: 4710-14-0001

Purpose of Application: All New Lands Additional Lands No New Lands

Project Category: Waste Management and Water Treatment (4710)

Project Type: Sewage Line Approximate Project Area (ha) 2.4 ha

Project Identifier: Town of Edson: West End Sanitary Sewer Trunk Main

Additional Identifier(s):

Key Contact: Ryan Eldridge

Address: 6131 Lacombe Way Sw

Postal Code: T3E 5T4

E-mail: ryan@turtleislandcrm.com Affiliation: Turtle Island CRM

City / Province: Calgary, AB Phone: (403) 589-9347

Fax: () -

Your File Number:

Is the Proponent the same as the Key Contact? Yes No If no, complete the following:

Proponent: Town of Edson

Address: P.O. Box 6300 605 - 50 st

Postal Code: T7E 1T7

E-mail: dawits@edson.ca

Contact Name: **Dawit Solomon** City / Province: Edson, AB Phone: (780) 723-4402

Fax: (780) 723-3508

Proposed Development Area						Land Ov	vnership	
MER	RGE	TWP	SEC	LSD List	FRH	SA	CU	СТ
5	17	53	9	13-16	_	_	. ,	_
5	17	53	16	1-9	_	_	. ,	_
5	17	53	8	13-16	_	_	. ,	-
5	18	53	13	1	_	_		-
5	17	53	18	1-4	_	_	;	_
5	17	53	17	1-4	_	_	,	_
5	17	53	7	13-16	_	_	. ,	_

HRM File: 4710-14-0001 Page 1 of 2

Historical Resources impact Assessn	nent:						
For archaeological resources:							
Has a HRIA been conducted?	_	Yes	;	No	Permit Number (if applicable):		
For palaeontological resource:							
Has a HRIA been conducted?	_	Yes	•	No			
Historical Resources Act clearance is granted for the activities described on this application and its attached plan(s)/sketch(es)							

Historical Resources Act clearance is granted for the activities described on this application and its attached plan(s)/sketch(es) subject to the conditions specified in the attached document(s).

February 18, 2014

David Link

Date

HRM File: 4710-14-0001 Page 2 of 2



ATTACHMENT 1

STANDARD REQUIREMENTS UNDER THE *HISTORICAL RESOURCES ACT* REPORTING THE DISCOVERY OF HISTORIC RESOURCES

Pursuant to Section 31 of the *Historical Resources Act*, Proponents are required to report the discovery of historic resources. These requirements are applicable to all activities in the Province. This bulletin provides Proponents and their agents with instructions for contacting the Heritage Division of Alberta Culture.

1.0 ARCHAEOLOGICAL RESOURCES

1.1 Reporting the discovery of archaeological resources

During the conduct of developments, Proponents and/or their agents may become aware of and/or encounter archaeological resources. The discovery of archaeological resources is to be reported to Martina Purdon, Head, Archaeological Information and Regulatory Approvals at 780-431-2331 (toll-free 310-0000), or e-mail martina.purdon@gov.ab.ca.

2.0 PALAEONTOLOGICAL RESOURCES

2.1 Reporting the discovery of palaeontological resources

During the conduct of developments, Proponents and/or their agents may encounter palaeontological resources. The discovery of palaeontological resources is to be reported to Dan Spivak, Head, Resource Management, Royal Tyrrell Museum of Palaeontology at 403-820-6210 (toll-free 310-0000), or e-mail dan.spivak@gov.ab.ca.

3.0 HISTORIC PERIOD SITES

3.1 Reporting the discovery of historic period sites

During the conduct of developments, Proponents and/or their agents may become aware of and/or encounter historic period sites. The discovery of historic period sites is to be reported to Martina Purdon, Head, Archaeological Information and Regulatory Approvals at 780-431-2331 (toll-free 310-0000), or e-mail martina.purdon@gov.ab.ca. Please note that some historic period sites may also be considered Aboriginal Traditional Use Sites.

...continued



ATTACHMENT 1 REPORTING THE DISCOVERY OF HISTORIC RESOURCES

4.0 ABORIGINAL TRADITIONAL USE SITES

4.1 Reporting the discovery of Aboriginal traditional use sites

During the conduct of consultation processes and/or activities associated with developments, Proponents and/or their agents may become aware of and/or encounter Aboriginal Traditional Use Sites which Alberta Culture may consider as historic resources under the *Historical Resources Act*. A listing of Aboriginal Traditional Use Sites considered as historic resources under the *Historical Resources Act* is provided in Attachment 2. The discovery of any Aboriginal Traditional Use Site that is of a type described in Attachment 2 is to be reported to Valerie Knaga, Director, Aboriginal Heritage Section at 780-431-2371 (toll-free 310-0000), or e-mail valerie.k.knaga@gov.ab.ca.

4.2 Aboriginal traditional use sites and Alberta Culture's Consultation Guidelines

Under the circumstance described in Condition 4.1 Reporting the discovery of Aboriginal traditional use sites, Proponents must comply with Part V Tourism, Parks, Recreation and Culture Guidelines for First Nations Consultation on Resource Development and Land Management (Alberta Culture's Consultation Guidelines) of Alberta's First Nations Consultation Guidelines on Land Management and Resource Development.

5.0 FURTHER SALVAGE, PRESERVATIVE OR PROTECTIVE MEASURES

Based upon the results of reporting of the discovery of archaeological resources, palaeontological resources, historic period sites and/or Aboriginal Traditional Use Site(s), Proponents may be ordered to undertake further salvage, preservative or protective measures or take any other actions that the Minister responsible for the *Historical Resources Act* considers necessary.

This bulletin may be cited as:

Standard Requirements under the Historical Resources Act, Reporting the discovery of historic resources. Land Use Planning, Archaeological Survey, Historic Resources Management Branch, Heritage Division, Alberta Culture, Edmonton, Alberta.

Dated: July 2013



ATTACHMENT 2

ABORIGINAL TRADITIONAL USE SITES

Aboriginal Traditional Use Sites considered by Alberta Culture as historic resources under the *Historical Resources Act* include but may not be limited to the following:

Historic cabin remains;

Historic cabin (unoccupied);

Cultural or historical community camp site;

Ceremonial site/Spiritual site;

Gravesite(s);

Historic settlement/Homestead:

Historic site;

Oral history site;

Ceremonial plant or mineral gathering site;

Trail; and,

Wickiup/Sweat lodge site.

This listing updates the list on pages 5 and 6 of *Tourism, Parks, Recreation and Culture Guidelines for First Nations Consultation on Resource Development and Land Management* (referred to as the Alberta Culture's Consultation Guidelines), Part V of Alberta's *First Nations Consultation Guidelines on Land Management and Resource Development*, dated November, 2007.





Appendix D

Environmental Review

islengineering.com March 2014 | APPENDIX



#1, 6325 - 12 Street SE Calgary, AB T2H 2K1 T: 403.254.0544 F: 403.254.9186

Date December, 2013 Project #: 13890

Reference: - Environmental overview - Edson West Sanitary Trunk Alignment

1. Introduction

The purpose of the Edson West Sanitary Trunk Alignment Environmental Overview is to provide the planning team with natural site and ecological connections information to guide the preparation of the alignment design plans.

Environmental Overview includes environmental opportunities and constraints in the area and future permitting pathways.

2. Project Description

Town of Edson is proposing alignments options for new trunk sewer from Rodeo Road to the existing sewer trunk on 54 Street.

3. Environmental Legislation/Permits/Authorizations

These environmental legislations should be considered during planning of the project.

Federal Legislation

Fisheries Act

Any project that has the potential for harmful alteration, disruption or destruction (HADD) of fish habitat would require authorization from the Department of Fisheries and Oceans (DFO) pursuant to the Fisheries Act. Should any development encroach on the bed and shore of the water body, or cross the watercourse, a fish habitat assessment and authorization pursuant to the Fisheries Act would be required.

Review of Fisheries and Wildlife Management Information System (FWMIS) database was preform (November 2013), the database records are showing that fish species are present in the Bench Creek including: Brook stickleback, White sucker, Lake chub.

The Project involves crossing of Bench Creek and there is record of fish species in the water body, DFO should be contacted regarding this proposed work and application for approval should be submitted to DFO. Also, the project involves works listed under DFO's Operational Statements. Mitigation guidelines listed in the Operational Statements should be followed. Notification is to be submitted to DFO.







Navigable Waters

The navigable Waters Protection Act (NWPA) is administered in Alberta by Transport Canada. The Bench Creek is not considered a navigable water therefore approval under Navigable Waters Protection Act is likely not required (Please see attached: navigable waters map of Alberta).

Migratory Birds Convention Act And Species at Risk Act

Environment Canada administers the Migratory Birds Convention Act (MBCA) and the Species at Risk Act (SARA). Those Act provide guidelines for enforcement only; neither the MBCA nor the SARA requires permitting or approvals specific to the project. Although no approvals are required, violation of those Acts may result in penalties.

A timing restriction for vegetation clearing is recommended in accordance with the Act. Nesting and fledging seasons for birds included under both federal and provincial legislations are from March 1 to August 15. This timing restriction incorporates early nesters including owl species and late nesters including some passerines.

Provincial Legislation

Water Act

The Province of Alberta owns all water resources in the province. Alberta's Water Act, administered by Alberta Environment and Sustainable Resources Development (AESRD), is the primary piece of legislation governing the use and management of Alberta's water resources, including water held in permanent and temporary wetlands. Approval under the Water Act would be required to drain and fill any of the wetlands. Compensation for wetland loss would be required under the Wetland Policy. Any crossings of the water body - Bench Creek, must follow the "Code of Practice for Watercourse Crossings", any outfalls into the water body must follow the "Code of Practice for Outfall Structures on Water Bodies". Pipeline or telecommunication lines crossing the water body are subject to the "Code of Practice for Pipelines and Telecommunications Lines Crossing a Water Body". For the current project, Alberta Environment needs to be consulted regarding this work and required application submitted.

Alberta Environmental Protection and Enhancement Act

Management facilities including lagoons and sanitary sewer projects are regulated by Alberta's Environmental Protection and Enhancement Act (EPEA). Construction of these facilities requires approval under EPEA.

Public Lands Act

The bed and shore of water bodies that are permanent and naturally occurring are owned by the province under the Public Lands Act, administered by AESRD. The province may claim wetlands and/or the water body in the study area. Consultation with AESRD will be required to determine ownership of the wetlands and the water body.

Widlife Act

The Alberta Wildlife Act prohibits disturbance to a nest or den of a prescribed wildlife species. Although permitting is not required under the Act, violations of the Act may result in fines. To avoid contravention of the Act, any clearing or trees or wetlands should occur outside the breeding season (April 15 to July 31).





4. Construction operations

Environmental protection measures will be utilized throughout construction and are the responsibility of the Contractor. As outlined by Alberta Transportation's Environmental Construction Operations (ECO) Plan Framework, environmental issues that will be addressed in the Contractor's ECO Plan include, but not limited to the following:

- Handling and disposal of reject material;
- Procedures to prevent/mitigate oil/fuel spills:
- Fuelling and servicing equipment;
- Rinsing of truck boxes;
- Dust control;
- Machinery emissions;
- Managing the application of oil products

5. Erosion Control

Erosion protection is recommended. Temporary erosion prevention practices, as identified in the contractor's ECO Plan should be applied throughout all work areas on exposed or erodible surfaces, and are the responsibility of the Contractor during construction.

6. Environmental Specifications and Recommendations

It is difficult to assess which alignment is most favorable from environmental point of view. From aerial photos looks like Alignment 2 is crossing wetlands and undisturbed vegetation, in this option further investigation is required and wetland assessment and compensation would apply.

Further investigation of vegetation in the area is required.

Planning should take into consideration: wetlands (both wooded and herbaceous), large tree stands, some of which form a major wildlife corridor through the area, productive agricultural soils, existing development.

ISL Engineering and Land Services Ltd.

Marta Sudyk, B.Sc., CPESC **Environmental Specialist**

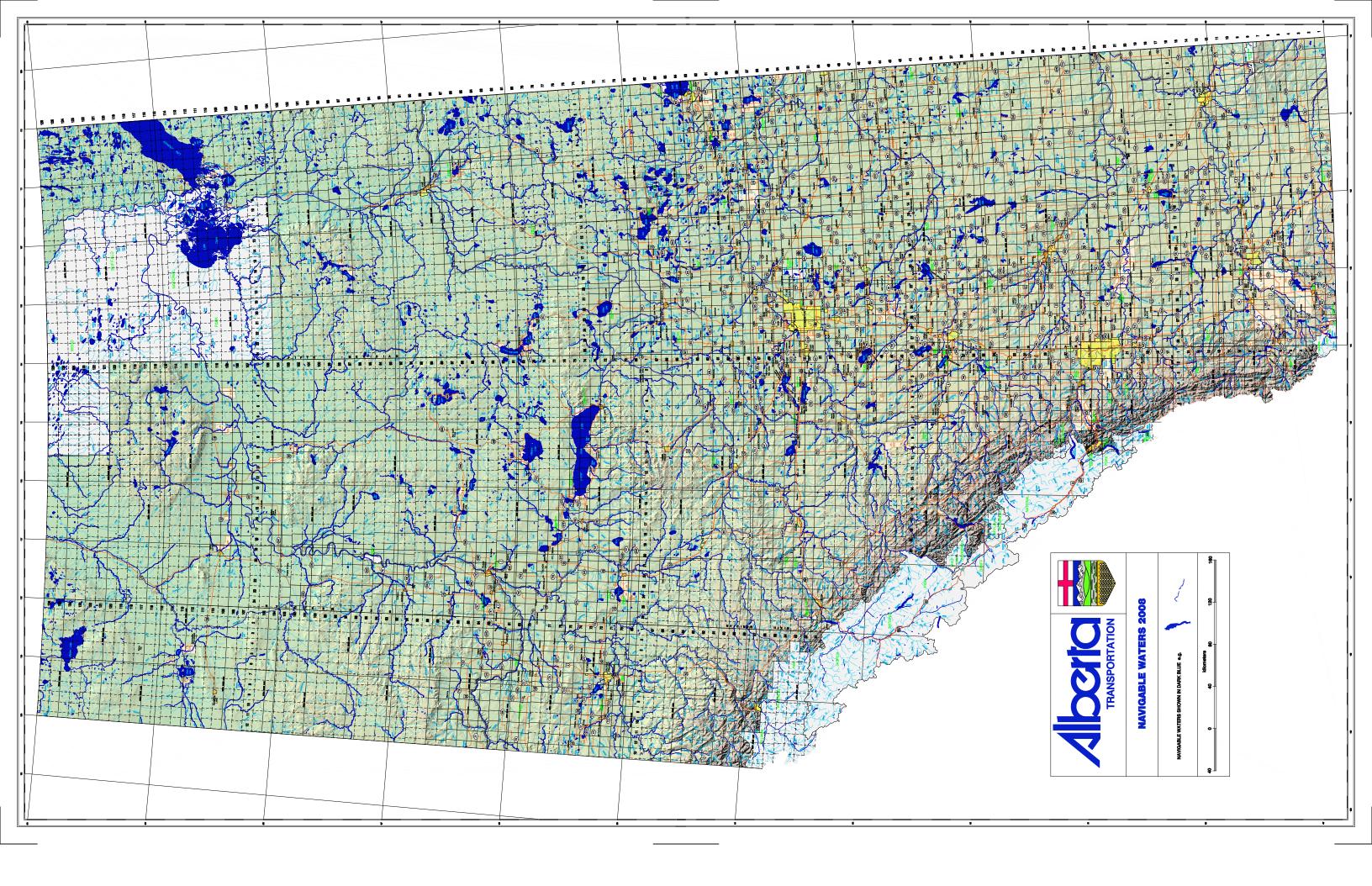


Table D-1 - Environmental Regulatory Planning Framework



Federal

	Fisheries Act - administered by Fisheries and Oceans Canada (DFO)						
1	Does the Project involve construction in	YES>	Fish assessment report (usually needed)	2-5 months			
	or adjacent to a fish-bearing creek/river?		Submit Application (template available) DFO	+			
			provides Authorization OR Letter of Advice	2-5 months			
		$NO \longrightarrow$	Fisheries Act does not apply				
10	Doos the Project involve works listed	VEC >	Follow mitigation guidalines listed in the OC if	Dravida natica 14 warking			
1a	Does the Project involve works listed under a DFO Operational Statement?	-	Follow mitigation guidelines listed in the OS, if not possible must apply for Authorization	Provide notice 14 working days prior to construction (OS notification form)			

Navigable Waters Protection Act (NWPA) - administered by Transport Canada (TC)					
2	Does the Project involve works in or on	YES	Submit NWPA Application	1-2 months	
	the banks of a navigable creek/river?			+	
	_		TC review and approval	10+ months	
		$NO \longrightarrow$	DO NOT SUBMIT***		

Canad	Canadian Environmental Assessment Act (CEAA) - admin by Federal Responsible Authority (agency that granted approval or funding					
3	Does the Project require federal	YES				
	approval OR receive federal funding OR		Screening Environmental Assessment is			
	is located on federal lands?		required (info from DFO/NWPA application	0-6 months		
			may be sufficient). Full EIA may be required	(more if full EIA required)		
			Responsible Authority reviews project based	0-3 months		
			on Screening Criteria, prepares report and			
			gives clearance			
		$NO \longrightarrow$	CEAA does not apply			

	Migratory Birds Convention Act (MCBA) - administered by Canadian Wildlife Service (CWS)					
4	Will there be any tree removals or	YES		N/A		
	disturbance to shore areas/wetlands		Restrict tree removals and shore/wetland			
	required?		modifications to outside bird nesting season			
		$NO \longrightarrow$	MCBA does not apply			

Provincial

	Water Act (WA)- administered by Alberta Environment					
5	Does the Project involve construction in	YES>	Fish assessment report (usually needed)	Application 1-2 months		
	or affecting a naturally occurring		Submit Application (template available) DFO	Public Notice 2 weeks		
	creek/river or other waterbody?		provides Authorization OR Letter of Advice	Approval 2-4 months		
				(total 4-6 months)		
		$NO \longrightarrow$	Water Act does not apply			
5a	Does the Project involve works listed	YES>	Follow guidelines in the appropriate COP, if	Provide notice 14 days		
	under a Code of Practice (COP)?		not possible must apply for Approval	prior to construction		
				(COP notification form)		
5b	Is there a Restricted Activity Period	YES>	Schedule any instream work to occur outside	Scheduling to comply to		
	(RAP) on the stream? (see COP Maps)		of RAP	RAP		

Public Lands Act - administered by Alberta Sustainable Resource Development (ASRD)					
6	Does the Project involve construction on	UNSUR	Determination from SRD Lands required.	1-3+ months	
	public lands, including bed/banks of	E?>	For wetlands, Class IV and V may be claimed.		
	creek/river or bed/shore of naturally occurring wetlands/lakes?		For lakes, need the legal bank of water body.		

YE	S->	Submit application for Approval	2-6+ months
		Review and approvals by ASRD	
		(may be approval, Temporary Field	
		Authorization, Disposition)	
N	\rightarrow	Water Act does not apply	

Historical Resources Act (HRA)- administered by Alberta Culture & Community Spirit					
7	Will the Project affect an undisturbed	YES>	Submit project overview	1 month	
	areas (e.g. native grasslands, forests,		If notified, complete Historical Resources		
	river valleys) or Heritage Sites?		Overview (by archeological sub)	If req + 2-4 months	
			If notified, complete Historical Resources		
			Impact Assessment (sub)	If req + 4+months	
		$NO \longrightarrow$	HRA does not apply		

Measures to Avoid Causing Harm to Fish and Fish Habitat

If you are conducting a project near water, it is your responsibility to ensure you avoid causing <u>serious harm to fish</u> in compliance with the *Fisheries Act*. The following advice will help you avoid causing harm and comply with the *Act*.

PLEASE NOTE: This advice applies to all project types and replaces all "Operational Statements" previously produced by DFO for different project types in all regions.

Measures

Project Planning

Timing

- Time work in water to respect <u>timing windows</u> to protect fish, including their eggs, juveniles, spawning adults and/or the organisms upon which they feed.
- Minimize duration of in-water work.
- Conduct instream work during periods of low flow, or at low tide, to further reduce the risk to fish and their habitat or to allow work in water to be isolated from flows.
- Schedule work to avoid wet, windy and rainy periods that may increase erosion and sedimentation.

Site Selection

- Design and plan activities and works in waterbody such that loss or disturbance to aquatic habitat is minimized and sensitive spawning habitats are avoided.
- Design and construct approaches to the waterbody such that they are perpendicular to the watercourse to minimize loss or disturbance to riparian vegetation.
- Avoid building structures on meander bends, braided streams, alluvial fans, active floodplains or any other area that is inherently unstable and may result in erosion and scouring of the stream bed or the built structures.
- Undertake all instream activities in isolation of open or flowing water to maintain the natural flow of water downstream and avoid introducing sediment into the watercourse.

Contaminant and Spill Management

- Plan activities near water such that materials such as paint, primers, blasting abrasives, rust solvents, degreasers, grout, or other chemicals do not enter the watercourse.
- Develop a response plan that is to be implemented immediately in the event of a sediment release or spill of a deleterious substance and keep an emergency spill kit on site.
- Ensure that building material used in a watercourse has been handled and treated in a manner to prevent the release or leaching of substances into the water that may be deleterious to fish.

Erosion and Sediment Control

- Develop and implement an Erosion and Sediment Control Plan for the site that minimizes risk of sedimentation
 of the waterbody during all phases of the project. Erosion and sediment control measures should be maintained
 until all disturbed ground has been permanently stabilized, suspended sediment has resettled to the bed of the
 waterbody or settling basin and runoff water is clear. The plan should, where applicable, include:
 - Installation of effective erosion and sediment control measures before starting work to prevent sediment from entering the water body.
 - Measures for managing water flowing onto the site, as well as water being pumped/diverted from the site such that sediment is filtered out prior to the water entering a waterbody. For example, pumping/diversion of water to a vegetated area, construction of a settling basin or other filtration system.

- Site isolation measures (e.g., silt boom or silt curtain) for containing suspended sediment where inwater work is required (e.g., dredging, underwater cable installation).
- O Measures for containing and stabilizing waste material (e.g., dredging spoils, construction waste and materials, commercial logging waste, uprooted or cut aquatic plants, accumulated debris) above the high water mark of nearby waterbodies to prevent re-entry.
- Regular inspection and maintenance of erosion and sediment control measures and structures during the course of construction.
- o Repairs to erosion and sediment control measures and structures if damage occurs.
- o Removal of non-biodegradable erosion and sediment control materials once site is stabilized.

Shoreline Re-vegetation and Stabilization

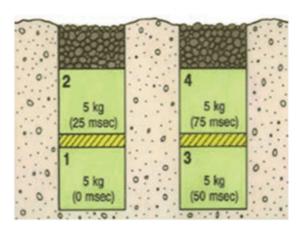
- Clearing of riparian vegetation should be kept to a minimum: use existing trails, roads or cut lines wherever possible to avoid disturbance to the riparian vegetation and prevent soil compaction. When practicable, prune or top the vegetation instead of grubbing/uprooting.
- Minimize the removal of natural woody debris, rocks, sand or other materials from the banks, the shoreline or the bed of the waterbody below the ordinary high water mark. If material is removed from the waterbody, set it aside and return it to the original location once construction activities are completed.
- Immediately stabilize shoreline or banks disturbed by any activity associated with the project to prevent erosion and/or sedimentation, preferably through re-vegetation with native species suitable for the site.
- Restore bed and banks of the waterbody to their original contour and gradient; if the original gradient cannot be
 restored due to instability, a stable gradient that does not obstruct fish passage should be restored.
- If replacement rock reinforcement/armouring is required to stabilize eroding or exposed areas, then ensure that appropriately-sized, clean rock is used; and that rock is installed at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment.
- Remove all construction materials from site upon project completion.

Fish Protection

- Ensure that all in-water activities, or associated in-water structures, do not interfere with fish passage, constrict
 the channel width, or reduce flows.
- Retain a qualified environmental professional to ensure applicable permits for relocating fish are obtained and to capture any fish trapped within an isolated/enclosed area at the work site and safely relocate them to an appropriate location in the same waters. Fish may need to be relocated again, should flooding occur on the site.
- Screen any water intakes or outlet pipes to prevent entrainment or impingement of fish. Entrainment occurs when
 a fish is drawn into a water intake and cannot escape. Impingement occurs when an entrapped fish is held in
 contact with the intake screen and is unable to free itself.
 - o In freshwater, follow these measures for design and installation of intake end of pipe fish screens to protect fish where water is extracted from fish-bearing waters:
 - Screens should be located in areas and depths of water with low concentrations of fish throughout the year.
 - Screens should be located away from natural or artificial structures that may attract fish that are migrating, spawning, or in rearing habitat.
 - The screen face should be oriented in the same direction as the flow.
 - Ensure openings in the guides and seals are less than the opening criteria to make "fish tight".
 - Screens should be located a minimum of 300 mm (12 in.) above the bottom of the watercourse to prevent entrainment of sediment and aquatic organisms associated with the bottom area.
 - Structural support should be provided to the screen panels to prevent sagging and collapse of the screen.
 - Large cylindrical and box-type screens should have a manifold installed in them to ensure
 even water velocity distribution across the screen surface. The ends of the structure should be
 made out of solid materials and the end of the manifold capped.
 - Heavier cages or trash racks can be fabricated out of bar or grating to protect the finer fish screen, especially where there is debris loading (woody material, leaves, algae mats, etc.). A 150 mm (6 in.) spacing between bars is typical.
 - Provision should be made for the removal, inspection, and cleaning of screens.

- Ensure regular maintenance and repair of cleaning apparatus, seals, and screens is carried out to prevent debris-fouling and impingement of fish.
- Pumps should be shut down when fish screens are removed for inspection and cleaning.
- Avoid using explosives in or near water. Use of explosives in or near water produces shock waves that can
 damage a fish swim bladder and rupture internal organs. Blasting vibrations may also kill or damage fish eggs or
 larvae.
 - o If explosives are required as part of a project (e.g., removal of structures such as piers, pilings, footings; removal of obstructions such as beaver dams; or preparation of a river or lake bottom for installation of a structure such as a dam or water intake), the potential for impacts to fish and fish habitat should be minimized by implementing the following measures:
 - Time in-water work requiring the use of explosives to prevent disruption of vulnerable fish life stages, including eggs and larvae, by adhering to appropriate fisheries timing windows.
 - Isolate the work site to exclude fish from within the blast area by using bubble/air curtains (i.e., a column of bubbled water extending from the substrate to the water surface as generated by forcing large volumes of air through a perforated pipe/hose), cofferdams or aquadams.
 - Remove any fish trapped within the isolated area and release unharmed beyond the blast area prior to initiating blasting
 - Minimize blast charge weights used and subdivide each charge into a series of smaller charges in blast holes (i.e., decking) with a minimum 25 millisecond (1/1000 seconds) delay between charge detonations (see Figure 1).
 - Back-fill blast holes (stemmed) with sand or gravel to grade or to streambed/water interface to confine the blast.
 - Place blasting mats over top of holes to minimize scattering of blast debris around the area.
 - Do not use ammonium nitrate based explosives in or near water due to the production of toxic by-products.
 - Remove all blasting debris and other associated equipment/products from the blast area.

Figure 1: Sample Blasting Arrangement



Per Fig. 1: 20 kg total weight of charge; 25 msecs delay between charges and blast holes; and decking of charges within holes.

Operation of Machinery

Ensure that machinery arrives on site in a clean condition and is maintained free of fluid leaks, invasive species
and noxious weeds.

- Whenever possible, operate machinery on land above the high water mark, on ice, or from a floating barge in a manner that minimizes disturbance to the banks and bed of the waterbody.
- Limit machinery fording of the watercourse to a one-time event (i.e., over and back), and only if no alternative crossing method is available. If repeated crossings of the watercourse are required, construct a temporary crossing structure.
- Use temporary crossing structures or other practices to cross streams or waterbodies with steep and highly erodible (e.g., dominated by organic materials and silts) banks and beds. For fording equipment without a temporary crossing structure, use stream bank and bed protection methods (e.g., swamp mats, pads) if minor rutting is likely to occur during fording.
- Wash, refuel and service machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water.

Date modified:

2013-11-25





Appendix E

CN Rail Guidelines

islengineering.com March 2014 | APPENDIX



A GUIDE TO THE PIPE AND WIRE PROCESS

- WATER/SEWER PIPELINE -

General Guidelines

1. Applications

Applications must have five (5) copies of an acceptable plan attached. Plans must provide sufficient information to determine that installation will meet Railway Standards, General Order requirements and CSA Standards. They must be to scale or have all dimensions shown. They must clearly and accurately show Railway property lines. Refer to Appendix "C-1" for detail list of areas where Railway requirements exceed General Order or CSA Standards as well as a list of common omissions.

2. <u>Agreement/Easement</u>

- 2.1 When plans are approved by the Railway for installation, the Company will be sent appropriate documents with:
 - i. Agreement/Easement for signing.
 - ii. Costs.
 - iii. Special conditions will be identified.
 - iv. Company responsibilities will be listed.
- 2.2. Acceptance by the Company will be by signing appropriate documents, and returning it with a cheque in the amount requested. If the Company is not incorporated, the signature should be witnessed.
- 2.3 When the Company's acceptance is received, the Railway will reply with a Letter of Acknowledgment with contact names and phone numbers of local CN personnel to make arrangements.

3. **Installation**

- 3.1 Installation can be done with Ten (10) working days' notice to the contacts listed on Letter of Acknowledgment. This notice will allow the Railway to arrange for flagging protection and signals location as required. See Appendix "B-1".
- 3.2 After installation, if there are no additional flagging charges, and payment was prepaid, the account will be closed. If additional charges are applicable, an invoice will be produced.

4. Contact Names, Addresses and Phone Numbers

Mail/Email should be directed to:

NORTHERN ONTARIO, MANITOBA, AND SASKATCHEWAN

CN Design and Construction Prairie Division Operations Building B, 2nd Floor 10229 – 127th Avenue Edmonton, AB T5E 0B9

ATTENTION: Utilities Coordinator

Telephone: (780) 643-7668 Fax: (780) 472-3047 Email: <u>praengsvc@cn.ca</u>

ALBERTA AND BRITISH COLUMBIA

CN Design and Construction Pacific Division Operations Building B, 2nd Floor 10229 – 127th Avenue Edmonton, AB T5E 0B9

ATTENTION: Utilities Coordinator

Telephone: (780) 472-3041
Fax: (780) 472-3047
Email: wcengsvc@cn.ca

BC RAIL TERRITORY

CN Design and Construction Pacific Division Operations Building B, 2nd Floor 10229 – 127th Avenue Edmonton, AB T5E 0B9

ATTENTION: Utilities Coordinator

Telephone: (780) 643-7668
Fax: (780) 472-3047
Email: wcengsvc@cn.ca

Appendix "B-1"

FLAGGING PROTECTION & SIGNALS & COMMUNICATIONS PROTECTION

What is flagging protection and signals protection?

Flagging protection consists of protecting men and equipment from passing trains and protecting passing trains from possible damage that could occur to the track infrastructure as a result of construction. Signals protection is locating underground and/or above ground signal wires, underground Railway power lines, Railway fibre optics cable and the protection of these facilities while the work is in progress.

When is it required?

Flagging is required for men and equipment on the Railway right-of-way unless so specified. Signals protection is required if the Signals & Communication Department ("S&C") has identified the work area as being one of possible conflict.

What are the costs?

The Railway recovers from the Company it's costs for actual time spent getting to, from, and on the site by Railway field forces. Flagging protection is provided by a flagging foreman, and the signals protection is provided by a S&C Maintainer.

Time required to contact the Railway's Traffic Controller and set up "flagging protection" could vary daily, depending on conditions. Flags or other positive protection must be in place before the contractor starts work and removed only after the contractor's day is over, or protection has expired.

Work blocks for the next twenty-four (24) hours have to be communicated to the Railway's Traffic Controller by **1400** hours. The Company, or its agent, is responsible to advise the Railway flag person on site prior to that time, of their schedule for the following day.

Depending on the flagging protection provided, it may not be possible to provide extensions or reductions to the length of time set up to provide protection for the Company or its agent on that day.

CONSTRUCTION, OPERATION AND MAINTENANCE OF CROSSINGS

- 1. The Company shall give the Railway at least ten (10) days' prior notice of its intention to do any construction or maintenance work. The determination of this notice period shall not include Saturdays, Sundays and statutory holidays. Should an emergency situation arise, the Company shall contact the Railway to make special arrangements. The Railway agrees to act reasonably in these situations.
- 2. Construction and maintenance by the Company of any crossing shall be subject to the supervision of the Railway's appointed representatives.
- 3. Should any work be required to support or repair the tracks or facilities of the Railway or to protect train movements due to the construction, operation, maintenance or removal of crossings, such work shall be performed by the Railway and the Company shall reimburse the Railway for all reasonable costs associated with such work upon receipt of the Railway's account.
- 4. The Company shall maintain all Crossings under this Agreement in good order and condition in accordance with the applicable rules, requirements and specifications issued from time to time by the Canadian Standards Association and approved by Transport Canada. If at any time during the term of this Agreement, the Company neglects to do any restoration and Maintenance work required to keep any Crossing free from hazard, the Railway, after giving reasonable prior written notice to the Company specifying the nature of the work required, may itself carry out such work. The Company shall reimburse the Railway for all reasonable costs associated with this work upon receipt of the Railway's account.
- 5. The construction, operation and Maintenance of Crossings shall be carried out in a manner so as to minimize interference with Railway Property, facilities and operations. When any such work has been completed, Railway Property shall be restored by the Company to its former condition so far as practicable. The Company shall, at its expense, expeditiously and effectively, remedy any interference that does occur, or, should no appropriate remedy be found, remove such crossing and restore the Railway Property to good order and condition. Should the Company fail to correct such interference, the Railway reserves the right to do so at the Company's expense and the Company will reimburse the Railway upon receipt of the Railway's account therefore.
- 6. The Railway may impose other construction conditions at time of application.

FEE SCHEDULE

(plus applicable taxes)

1. <u>Basic Engineering Application Fee</u> \$ 750.00

Rush application add \$ 2,500.00

- response back within two weeks (workload permitting)

2. Agreement/Easement Fee starting at: \$ 1,850.00

\$1,850.00 applies to a 3m wide x 30m long

or

\$10,000.00 applies to a 3m wide x 30m long for major yards

NOTE: Cost may increase due to location and length requested

3. <u>Flagging Protection and Signals Protection During Installation</u>

Minimum costs: Flagging protection \$ 825.00 (dependent on location)

Signals protection \$ 375.00

Additional costs for flagging and signals will be invoiced after completion of project if:

- time on site was more than one day for either flagging or signals protection
- a large number of hours were at overtime rates ,i.e. weekend installations.
- 24 hour notice of project cancellation is not received. One additional day of flagging will be invoiced.

4. <u>Additional Review Fee</u> \$ 200.00 per review

5. Additional Costs

The Railway reserves the right to charge for additional costs incurred by the Railway as a result of specific applications. Without limiting the generality, this includes items such as open-cut installations, inductive coordination, charges for train delays and slow orders, consulting and inspection costs.

6. Fee Review

All fees and charges that may be imposed under this Agreement are subject to annual review and adjustment by the Railway.

7. <u>Survey and Registration</u>

It is the Company's responsibility and expense to survey and register an easement document.

Appendix "C-1"

WATER/SEWER PIPELINE CROSSINGS

Applicants must submit five (5) copies of an acceptable plan. Plans must meet TC E-10 and CN Standards.

Cost for reviewing the first plan received shall be included in the basic engineering application fee. The applicant may be charged an additional fee for each review after the initial application due to inadequate or missing information.

Plans Must Have:

- > Plan Number & Date
 - o Revised plans must have a revision number & date of revision.
- > Full company name & contact information of the owner of the pipeline.
 - o can be on the application letter
- Land Description (legal description & or CN Subdivision & Mileage)
- > Site Plan & Profile
 - o width of CN right-of-way / number of tracks / angle of crossing
 - o If encased . . . a cross section or a note advising on spacers, etc.
- > Drawing must be to scale or have all dimensions/measurement noted.
- > NOTE stating: "Installation and maintenance to be in accordance with TC E10."
- > "Signed" stamp of a Professional Engineer.

SPECS Required on Plan:

- Contents of pipe must be noted.
- Crossing angle to be greater than 45 degrees.
- Warning Markers required on each side of the railway right-of-way
- Direction of flow.
 - Not required for a gravity sewer pipe.
- Emergency Shut-off Valve locations noted on each side of track.
 - Not required for a gravity sewer pipe.
- Method of Installation.
- > 13.7m minimum clearance to any bridges, buildings, switches, etc.

PIPE SPECS

- Design Loading Cooper E80 (TC E-10)
- > Type of Pipe, Wall Thickness, and Pressures (operating & max. test) of carrier & casing pipe.
- Must be STEEL CASED unless it is a non-pressure (under 700 kpa) gravity feed pipe (sewer) and then the following applies:
 - o concrete pipe as per AREMA & CSA, minimum Class 5.
 - o Coated corrugated metal pipe as per AREMA & CSA.
 - ALUMINUM PIPE is not acceptable!

cont'd

cont'd Appendix "C-1" (pipe specs)

> Casing

- o Carrier pipe less than 168.3 mm O.D. . . . casing pipe must be at least 50 mm O.D. larger.
- o Carrier pipe more than 168.3 mm O.D. . . . casing pipe must be at least 75 mm O.D. larger.
- Carrier pipe shall be held clear of the casing pipe by properly designed supports, insulators, or centering devices. - CSA Standard 4.12.3.3 (c)
- Casing must extend the full width of the Railway's core right-of-way and a minimum of 15 m on each side from outside track to accommodate for any future construction. Based on our standard 100' right-of-way.

NOTE: TC E-10 & Z662 states a 7 m minimum from center outside track.

 Casing pipe to be left open on the ends (not sealed) when the ends of the casing are at or above ground surface and above high-water level (AREMA 5.1.6.4).

> Wall Thickness

- minimum 4.8mm . . . unless no protective coat or it is not cathodically protected . . . ADD 1.6 mm. (*TC E-10 & AREMA*) . . ie . . . YJ-1 = yellow jacket coding
- o see Table 4.10 *CSA Z662* for all sizes (Table 4.9 *CSA Z662-99*)
- o protective coat or cathodically protected not required for concrete pipe

Cased/Uncased

> Minimum Depth of Burial

BELOW TRACK

Mainline	Cased	1.68 m ((168 cm)	(5.5 ft)
Other Tracks	Cased/Uncased	1.37 m ((137 cm)	(4.5 ft)
BELOW RIGHT-OF-W	'AY			

.91 m (91 cm)

(3.0 ft)

Geo-technical Report:

If installation is known or suspected to be a problem due to soil conditions at location or if this is a large bore pipeline (cased or uncased), a written recommendation from a Geo-technical Engineer, who has reviewed soil testing and water table results, will be required. The written recommendation is to note the following:

- > That the method of installation is appropriate to the soil conditions.
- > There will be no adverse affect to CN operations and property.
- > The contingency plan if problems arise during construction at the site.

Nearest Point at which digging can take place.

Starting 10 (ten) feet from the gauge side of the nearest rail, calculate a slope to the bottom of the proposed pipe at 1.5:1. If a 1.5:1 slope cannot be maintained or more restrictive conditions occur, approved shoring will be required.





Standards Respecting Pipeline Crossings Under Railways

TC E-10, June 21, 2000

Table of Contents

- a. Scope
- b. General Applications and Exclusions
- c. General Conditions
- d. Requirements for Pipelines Crossing under Railways General
- e. Requirements for Oil and Gas Pipelines under Railways
- f. Requirements for Steam, Water, Sewer and Other Non-Flammable Substance Pipelines under Railways

Appendix A:

Plans and Design Requirements for Pipelines Crossing under Railways

1. Scope

- 1. These standards may be known as the "Pipeline Crossing Standards".
- 1.2 These standards are intended to ensure that pipeline crossings under Railways are installed, renewed and maintained in a safe manner. These standards apply to Railway Companies subject to the jurisdiction of the Minister of Transport pursuant to the *Railway Safety Act*.

2. General Applications and Exclusions

- 2.1 Pipeline Installation Procedures shall be in strict conformance with all Federal, Provincial and local safety regulations.
- 2.2 These standards do not include overhead cable crossings, overhead pipeline crossings, and underground cable crossings.
- 2.3 These standards do not apply to any pipe installed under a railway right-of-way prior to the date of approval of these standards, unless the pipeline crossing is to be reconstructed.

3. General Conditions

- 3.1 No person shall commence the installation of any pipe under a railway without:
 - a. submitting to the railway company detailed plans of the proposed installation in accordance with the requirements outlined in Appendix 'A'; and
 - b. obtaining a written approval from the railway company that owns, operates or has control of the railway.
- 3.2 No person shall commence the repair, maintenance or removal of any pipe under a railway without obtaining a written approval from the railway company that owns, operates or has control of the railway.
- 3.3 Every owner of a pipe installed under a railway, shall at all times maintain the pipe in good working order and condition, so that:
 - a. the safety of railway operations is not threatened in any manner;
 - b. the safety of the public, including the lives, well-being and health of people is safeguarded; and
 - c. the environment is protected.

4. Requirements for Pipelines Crossing under Railways - General

For oil and gas pipelines crossing under railways, the requirements of C.S.A. Standard Z662-99, and subsequent revisions, will apply as modified and amended in Section 5 herein.

For steam, water, sewer or other non-flammable substance pipelines crossing under railways, the requirements of Section 6 shall apply.

The term "Engineer" used herein means the Chief Engineer of the railway company or his authorized representative.

General: Railway design loading applicable to all pipelines crossing under railways shall be Cooper's E80 track loading, with diesel impact as specified in C.S.A. Standard Z662-99. The use of optional limits states design processes under C.S.A. Standard Z662-99 will not apply to the design of oil and gas pipelines crossing under railways.

5. Requirements for Oil and Gas Pipelines under Railways

5.1 Amend C.S.A. Standard Z662-99 Clause 4.7 Cover and Clearance Requirements as follows:

Table 4.8 "Minimum Cover and Clearance Requirements": In the case of oil and gas, and hazardous* gas pipelines crossing under railways, Table 4.8 shall be amended as follows:

Table 4.8: Minimum Cover and Clearance Requirements

(1) Minimum cover for buried pipelines, cm (measured to top of carrier or casing pipe, as applicable)

Minimum Cover and Clearance Requirements

	William Cover	1		
Location	Type of Pipeline	Class		Rock excavation requiring blasting
		Location	Excavatio	or removal by comparable means
			n	
Cr	ossings of railway right	s-of-way: b	below base	of rail**
	All	tracks:		
Cased	Flammable or	All	168 (5.5ft)	168 (5.5ft)
	hazardous* gas or			
	liquid			
Uncased	Flammable or	All	305	305 (10.0ft)
	hazardous* gas or		(10.0ft)	·
	liquid			
Crossings of rai	lway rights-of-way: be	low bottom	of ditches	or ground surface***
Cased	Flammable or	All	91 (3.0ft)	91 (3.0ft)
	hazardous* gas or			
	liquid			
Uncased	Flammable or	All	183 (6.0ft)	183 (6.0ft)
	hazardous* gas or			, ,
	liquid			
Railway righ	ts-of-way for cased or	uncased bu	ried longitu	dinal pipelines***
Between 762cm and 1524 cm	Flammable or	All	183 (6.0ft)	183 (6.0ft)
from centreline of nearest track	hazardous* gas or			
	liquid			
Greater than 1524cm from the	Flammable or	All	152 (5.0ft)	152 (5.0ft)
centre-line of nearest track	hazardous* gas or			. ,
	liquid			
	1 4			

- * Non-flammable gas or liquid products which, from their nature or pressure, might cause damage or endanger the lives, well-being and health of people, or the environment, if escaping on or in the vicinity of railway property.
- ** Within 7 metres of centre of outside rail, measured at right angles to the centre-line of the track.
- *** On portions of the right-of-way where carrier or casing pipe is not directly eneath any track.

5.2 Amend C.S.A. Standard Z662-99 Clause 4.7.1 as follows;

Add to end of Clause 4.7.1:

• For oil and gas pipelines crossing under railways, minimum cover requirements shall be in accordance with Table 4.8 of the referenced standard C.S.A. Z662-99, as amended herein. For any proposed pipeline crossing physically unable to meet the minimum cover requirements specified in Table 4.8 as amended herein, the applicant will propose alternative methods and shall obtain approval of the Engineer to use such methods.

5.3 Amend C.S.A. Standard Z662-99 as follows;

Add as a new Clause 4.8.5 called "Pipe installation near railway bridges and buildings" the following:

• Pipelines carrying flammable or hazardous gas or liquids under railways shall not be placed within a culvert, under railway bridges nor closer than 13.7m to any portion of any railway bridge, building or other important structure on a railway right-of-way, except in special cases and then by special design as approved by the Engineer.

Add to Clause 10.2.2:

• Emergency response procedures shall be developed by the applicant to handle a situation in which a pipeline leak or railroad derailment or incident may jeopardize the integrity of the pipeline. Local conditions shall be considered when developing these procedures.

Add to Clause 10.2.8.4:

• Oil and gas pipeline crossings shall be prominently identified where pipelines enter and exit railway right-of-way, approximately on the limits thereof, by signs in a language or languages appropriate to the region in which the sign is located. Such signs shall meet the requirements of C.S.A. Standard Z662-99, as amended herein. Additional signage will be required by the Engineer where the above signs are not readily visible from the track.

Add as a new Clause 4.4.11 called "Emergency Shutoff Valves" the following:

• For oil and gas pipelines, accessible emergency shutoff valves shall be located each side of the railway within effective distances as mutually agreed to by the Engineer and the pipeline company. These valves shall be marked with signs for identification. Where pipelines are provided with automatic control stations and/or valves that are remotely operated, no emergency shutoff valves are required at the crossing.

Add as a new Clause 4.7.4 called "Longitudinal installations" the following:

- Longitudinal oil and gas pipelines on the railway right-of-way shall be located as far as possible from any track. They shall not be within 7.62m of the centre-line of any track, and shall be marked by a sign approved by the Engineer every 152.4m and at every road crossing, streambed, other utility crossing, and at locations of major change in direction of the line. In exceptional situations, where it is not physically possible to locate the pipeline beyond 7.62m of the centre-line of a track, the carrier pipe shall be encased or of special design and must be approved by the Engineer.
- 5.4 **Amend** C.S.A. Standard Z662-99 Table 4.9 "Least Nominal Wall Thickness for Steel Casing Pipe in Cased Crossings and Carrier Pipe in Uncased Crossings" as follows;

All least nominal wall thicknesses for steel casing pipe in cased crossings and steel carrier pipe in uncased crossings shall be as shown in Table 4.9, except that the least nominal wall thickness shall not be less than 4.8 mm in any case.

Add new Notes under Table 4.9, as follows:

Notes:

- a. When steel casing pipe or carrier pipe is installed under a railway without benefit of a protective coating or is not cathodically protected, the least nominal wall thickness shown in Table 4.9 shall be increased by a minimum of 1.6mm.
- b. Steel casing or carrier pipe installed under a railway shall have a specified minimum yield strength of 241 Mpa or greater.
- 5.5 Amend C.S.A. Standard Z662-99 Clause 4.8.3 "Crossings of Roads and Railways" as follows;

Add new item to Clause 4.8.3.3 Cased Crossings:

(h) Casing pipe and joints under railways shall be of leakproof construction capable of withstanding railway loadings specified herein, and shall be of steel unless otherwise indicated herein, or as approved by the Engineer.

5.6 **Replace** C.S.A Standard Z662-99 Clause 12.4.6 with the following:

Polyethylene carrier pipe may be used in pipeline systems for the transportation of gaseous hydrocarbons under railways if:

- a. The design pressure does not exceed 700 kPa.
- b. The carrier pipe is made from polyethylene materials permitted by C.S.A. Standard CAN/CSA-B137.4-92 (R1998), and subsequent revisions.
- c. The outside diameter of the carrier pipe is not greater than 168.3mm.
- d. The polyethylene carrier pipe within the entire limits of the railway right-of-way, is encased in a steel casing pipe meeting the requirements of C.S.A Standard Z662-99, as amended herein.

5.7 **Replace** C.S.A. Standard Z662-99 Clause 15.4.5 with the following:

Aluminum pipe is not acceptable for use in pipeline crossings under railways.

6. Requirements for Steam, Water, Sewer and Other Non-Flammable Substance Pipelines under Railways

6.1 Carrier and Casing Pipe Requirements

Pipelines carrying steam, water (other than oilfield steam and water), sewer, and other non-flammable or non-hazardous substances under railways shall be encased in a larger pipe or conduit called the casing pipe. Casing pipe may be omitted under the following conditions:

- a. under secondary or industrial tracks as approved by the Engineer, provided maximum operating pressure in the carrier pipe does not exceed 700 kPa.;
- b. for non-pressure sewer crossings where the strength of the pipe and its joints are capable of withstanding railway loading, as approved by the Engineer.

Carrier pipe, casing pipe, and joints shall conform to the applicable requirements of AREMA Ch. 1 Section 5.3 with respective materials in conformance with C.S.A. Standards, and be:

- a. of acceptable material and construction as approved by the Engineer, and
- b. of sufficient strength to withstand the internal pressure and external loading, and
- c. properly connected at the joints and leakproof.

Joints for carrier line pipe shall be leakproof mechanical or welded type.

For steel carrier or casing pipe the least nominal wall thickness shall be in accordance with C.S.A. Standard Z662-99 as amended in Section 5 of this Pipeline Crossing Standard.

For pressures under 700 kPa in the carrier pipe, the casing pipe, if required, may be reinforced concrete pipe conforming to specifications in AREMA Manual for Railway Engineering Chapter 8 "Concrete Structures and Foundations", Part 10 "Reinforced Concrete Culvert Pipe", or coated corrugated metal pipe conforming to AREMA Manual Chapter 1, Part 4, all as approved by the Engineer. Respective materials shall conform to applicable C.S.A. standards.

6.2 Minimum Cover and Clearance Requirements

a) Minimum cover for buried pipelines, cm (measured to top of carrier or casing pipe, as applicable)

Minimum cover and clearance requirements for burried pipelines

T	William Cover and Clearance			1 1	
Location	Type of Pipeline	Class	Normal	Rock Excavation requiring	
		Locatio	Excavation	blasting or removal by	
		n		comparable means	
	Crossings of railway rights-	of-way: l	oelow base of ra	il**	
	Main t	racks:			
Cased	Water, sewer, steam or non-	All	168 (5.5 ft) or	168 (5.5 ft) or below frost line	
	flammable or non-hazardous*		below frost line		
	substance				
	Crossings of railway rights-	of-way: l	pelow base of ra	il**	
	Second or Indu	ıstrial Tı	racks:		
Cased	Water, sewer, steam or non-	All	137 (4.5 ft) or	137 (4.5 ft) or below frost line	
	flammable or non-hazardous*		below frost line		
	substance				
Uncased	Water, sewer, steam or non-	All	137 (4.5 ft) or	137 (4.5 ft) or below frost line	
	flammable or non-hazardous*		below frost line		
	substance				
Crossings	of railway rights-of-way below	bottom	of ditches or gro	ound surface***	
Cased	Water, sewer, steam or non-	All	91 (3.0 ft) or	91 (3.0 ft) or below frost line	
	flammable or non-hazardous*		below frost line	, , ,	
	substance				
Uncased	Water, sewer, steam or non-	All	91 (3.0 ft) or	91 (3.0 ft) or below frost line	
	flammable or non-hazardous*		below frost line		
	substance				
Railway rights-of-way for cased or uncased buried longitudinal pipelines***					
Up to 1524 cm from	Water, sewer, steam or non-	All	122 (4.0 ft) or	122 (4.0 ft) or below frost line	
centre-line of nearest	flammable or non-hazardous*		below frost line	, , ,	
track	substance				
Greater than 1524 cm	Water, sewer, steam or non-	All	91 (3.0 ft) or	91 (3.0 ft) or below frost line	
from centre-line of	flammable or non-hazardous*		below frost line		
nearest track	substance				

^{*} Non-flammable gas or liquid products which, from their nature or pressure, might cause damage or endanger the lives, well-being and health of people, or the environment, if escaping on or in the vicinity of railway property.

^{**} Within 7 metres of centre of outside rail, measured at right angles to the centre-line of the track.

^{***} On portions of the right-of-way where carrier or casing pipe is not directly beneath any track.

6.3 General Installation Requirements

For water and sewer crossings under railways, the highest point of carrier pipe shall be below the frost line. In regions of permafrost or where other obstacles make it impossible to place the pipe below the frost line, the applicant will propose alternate methods to protect the pipe in sub-freezing temperatures and shall obtain approval of the Engineer to use such methods.

Pipelines carrying steam, water (including oilfield steam and water), sewer and other non-flammable or non-hazardous substances under railways, shall not be placed within culverts nor under railway bridges where there is likelihood of restricting the area required for the purposes for which the culverts or bridges were built, or of endangering the foundations. Any such pipelines laid longitudinally on railway rights-of-way shall be located as far as practicable from any tracks or other important structures. If located within 7.62 metres of the centre-line of any track, or where there is significant risk of damage from leakage to any bridge, building or other important structure, the carrier pipe shall be encased or of special design as approved by the Engineer.

Every open drain crossing tracks in a railway yard shall be safely covered for at least 3.0m from the centre-line of track, except in times of flood when uncovered open drains may be provided as may be necessary. In this case warning signs shall be erected.

C.S.A. Standards current at time of constructing the pipeline, shall govern the inspection and testing of the facility within the railway rights-of-way. The proof testing of the strength of carrier pipe shall be in accordance with C.S.A requirements.

Appendix A: Plans and Design Requirements for Pipelines Crossing under Railways

For all pipeline crossings under railways (including oil and gas, steam, water, sewer, storm drain, etc.), plans for proposed installation shall be submitted to and meet the approval of the Engineer before construction is begun.

Plans shall be drawn to scale showing the relation of the proposed pipeline to railway tracks, angle of crossing, location of nearest shut-off valves, railway mileage, right-of-way lines and general layout of tracks and railway structures and facilities. Plans should also show a cross-section (or sections) from field survey, showing pipe in relation to actual profile of ground and tracks, with location of any joints in the carrier or casing pipe within the railway right-of-way, and necessary geotechnical boreholes (soil type) and ground water levels. Pipelines shall be installed under tracks by boring and/or jacking, if practicable. If open-cutting or tunneling is approved, the proposed limits of excavation, details of sheeting and method of supporting tracks or driving tunnel shall be shown, with supporting engineering calculations.

In addition to the above, plans should contain the following data:

- Railway Mileage & Subdivision
- Municipal Descriptions of Adjoining Properties
- Name of Pipeline Owner

Data	Carrier Pipe	Casing Pipe
Contents to be handled		
Outside Diameter		
Pipe Material		
Specification and grade		
Wall thickness		
Maximum Operating Pressure		
Maximum Surge & Test Pressure		
Maximum Operating Temperature		
Minimum Operating Temperature		
Type of joint		
Coating		
Method of installation		

Vents:

- Number
- Size
- Height above ground

Seals:

- Both ends
- Type

Other Information:

- Bury: Base of rail to top of casing (m)
- Bury: (Not beneath tracks) (m)
- Bury: (Roadway ditches) (m)
- Extent of casing measured perpendicular to centre-line of track (m)
- Type, size and spacing of insulators or supports (m)
- Distance C.L. track to face of jacking/receiving pits (m)
- Bury: Base of rail to bottom jacking/receiving pits (m)
- Cathodic Protection: yes/no
- Geotechnical Boreholes: yes/no
- Soil Type:
- Base of Rail to ground water (m)

Plans shall be sealed and signed by a professional engineer, competent in this field, registered in the province or territory in which the pipeline crossing is located.

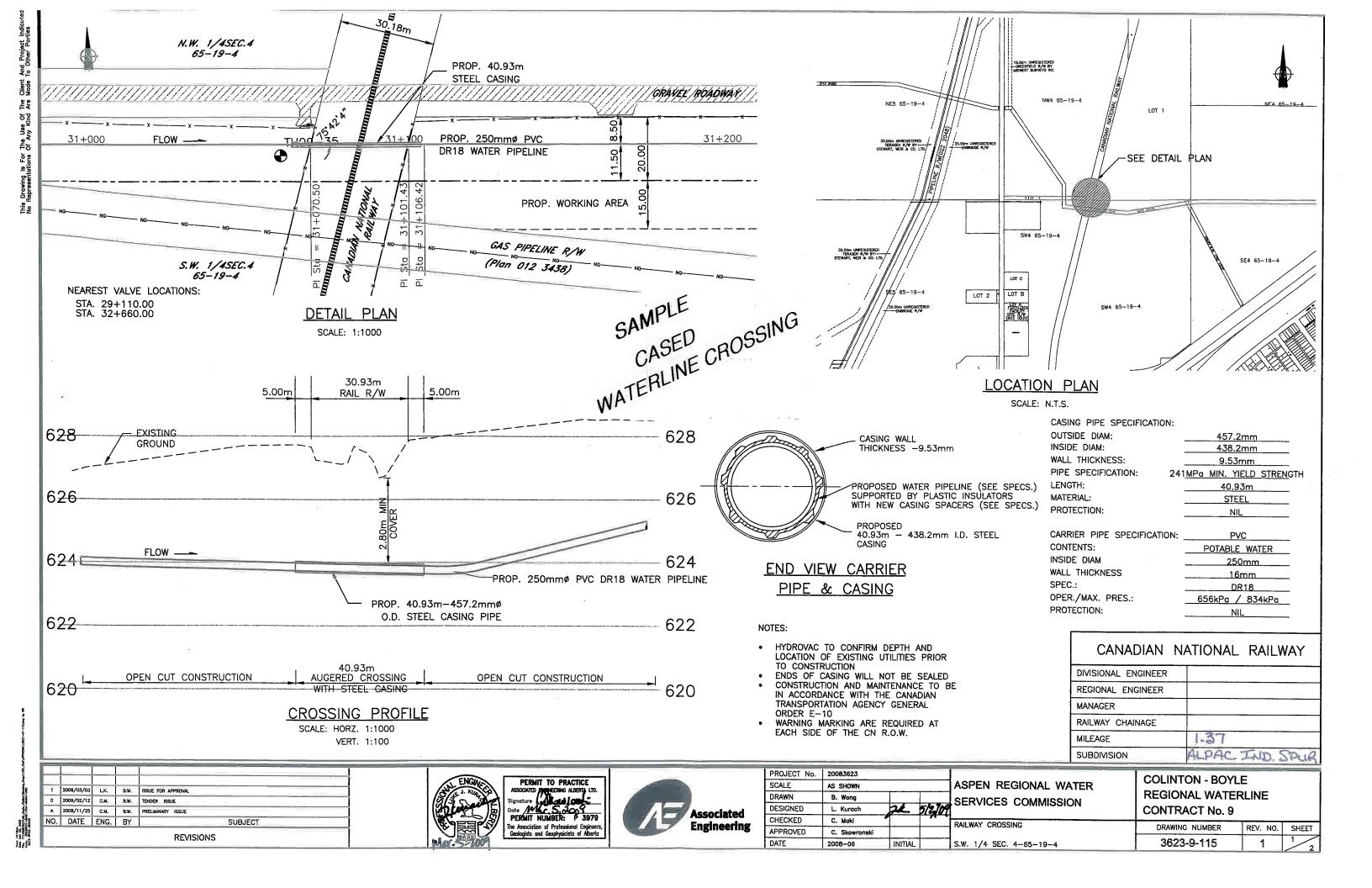
The execution of work on railway rights-of-way, including the supporting of tracks, shall be subject to the inspection and direction of the Engineer.

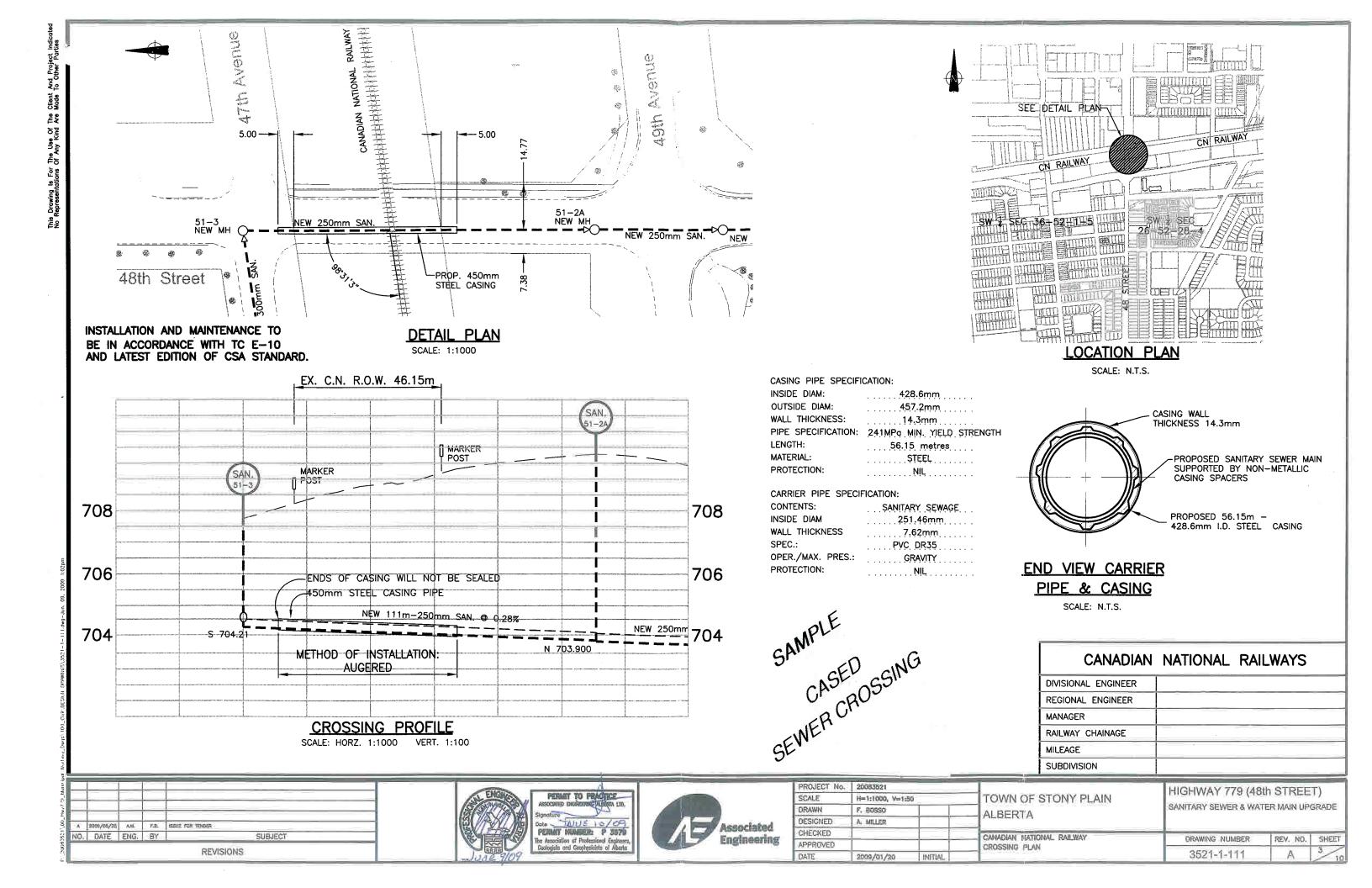
Where laws or orders of public authority prescribe a higher degree of protection than specified herein, then the higher degree of protection so prescribed shall be deemed a part of this Standard.

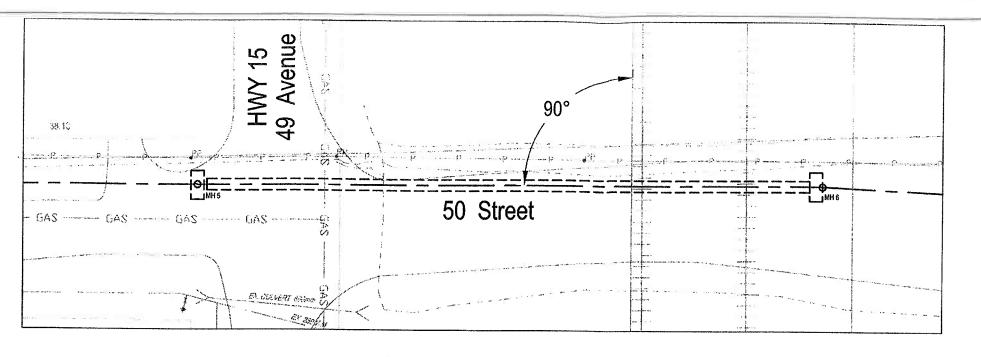
Date Modified: 2009-08-27

http://www.tc.gc.ca/eng/railsafety/standards-tce10-236.htm#4

http://www.csa.ca/cm/home







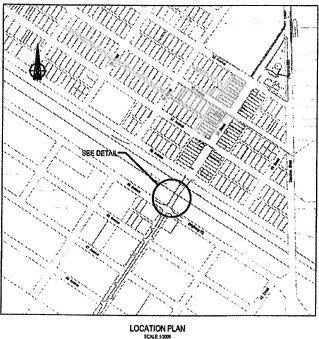
Edge Of Aspnall C.N. Railway R/W 689 Highway 15 R/W Top of Rail Top of Rail 688 C.N. Railway Property 5.6 687 687 686 686 MH6 685 STORM SEWER PROFILE 685 EX Gas - 60mm Gas Line 684 684 2.1 683 683 PROPOSED 1500mm CONC. (C-76) @ 0.20% GRADE JACKING PIPE 682 682 SOUTH INV = 681.363 INV = 681.580 NORTH

Storm Sewer Specifications

- OD 1500mm
- Material -Reinforced Concrete C-76, Jacking Pipe, CLASS V
- Joints Steel Belt Bands
- Trenchless Installation From MH5 to MH6
- 85m @ 0.20% grade.
- Gravity Storm Sewer Line (non-pressure)
- OWNER TOWN OF MUNDARE
- **NB INSTALLATION AND MAINTENANCE TO BE IN** ACCORDANCE WITH TC E10.

Location & Legal Description

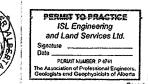
- Mile 70.88
- Vegreville Subdivision
- -E1/2 Section 19, Twp 53, Rge 16, W4M



TOWN OF MUNDARE

SAMPLE UNCASED UNCASED SEWER CROSSING

6				- TION
5				ENG/WA
4				(1 000 F 1 00
3				13.9. 3Mm E
2				THE COMPLETE TO THE
1			l	1/3/2443/3
lo.	DESCRIPTION	BY	DATE	
	REVISIONS			(BURB)





C.N. RAILWAY CROSSING

Date: March 10, 2009

CROSSING CNR PLAN 4217 S

12679 XS 02 Sheel No.



Appendix F
Alberta Transportation Guidelines



islengineering.com March 2014 | APPENDIX



APPLICATION PROCEDURES FOR PLACEMENT OF UNDERGROUND WATER AND SEWER PIPELINES IN THE VICINITY OF TRANSPORTATION FACILITIES UNDER THE JURISDICTION OF ALBERTA TRANSPORTATION

- 1.0 Application Procedures
- 2.0 General Construction Guidelines

1.0 APPLICATION PROCEDURES

Applications for crossing of highways under the jurisdiction of Alberta Transportation by sewer and/or water pipelines shall be submitted to the appropriate Regional Office.

The applicant shall allow minimum 30 working days for the application processing.

Application for water and/or sewer crossing public roads other than highways within the boundaries of any Municipal District or County shall be submitted to the appropriate Municipality.

1.01 APPLICATION REQUIREMENTS

The application should clearly state the purpose of the application, the type of the facility, method of construction, and provide the legal land description, number of the highway involved, and particulars of the contact person responsible for the application. In case of sewer lines it should also state whether the line is for sanitary sewage or storm drainage.

Incomplete applications without proper documentation will be returned without review.

A copy of the permit issued shall be provided to the contractor and made available for verification at the construction site at all times.

No construction may be undertaken without a valid permit.

Only work covered by original permit can be performed at the site. Any additional work, variation or change from the proposal covered by the original permit requires additional approval(s).

Each of the drawings submitted with the application shall have a number for reference purposes.

The application should contain a key plan showing proposed crossing location(s) and two (2) copies of the crossing plan for each proposed crossing. Attached to these procedures are sample crossing plans.

Each crossing plan shall include:

 Key plan at a suggested scale of 1:10,000 indicating legal land description for the proposed crossing including appropriate section number, township, range;

- 2) Detail plan of the crossing at a minimum scale of 1:1000 showing: a dimensional tie along the centre-line of the highway or road to the known point, the proposed angle of the crossing and the pipeline alignment to a minimum distance of 50 metres on each side of the highway right-of-way;
- 3) Proposed surveyed cross-section of the crossing at a minimum horizontal scale of 1:200 and vertical 1:100.

The cross-section has to show:

- a) Width of the existing highway right-of-way,
- b) Width of proposed highway right-of-way (if known),
- c) Type of road surface, e.g. paved, graveled or dirt,
- d) Slope pipe below highway (maximum 1:120), and
- e) Minimum depth of cover (i) 1.4 metres for sewer, and (ii) 2.5 metres for water line throughout the highway right-of-way and within 30 metres each side of its right-of-way boundaries;
- 4) Profile along the centre-line of the highway or road for minimum distance of 400 metres in each direction from the crossing at a minimum horizontal scale of 1:5000 and vertical 1:200; and
- 5) Pipe specifications of pipeline at the crossing site, including:
 - I. Carrier pipe specifications:
 - a) Outside diameter.
 - b) Wall thickness,
 - c) Maximum operating pressure,
 - d) Minimum yield strength of pipe, and
 - e) Fittings, if any.
 - II. Casing pipe specifications (cased crossings only):
 - a) Outside diameter,
 - b) Wall thickness, and
 - c) Minimum yield strength and information if a casing pipe is new or used.

2.0 GENERAL CONSTRUCTION GUIDELINES

2.01 CONSTRUCTION COMMENCEMENT AND COMPLETION

The applicant shall contact the appropriate Operations Manager or Development and Planning Technologist at least two working days prior to commencement of construction to review the project.

The applicant shall contact the appropriate Operations Manager or Development and Planning Technologist at least two working days prior to construction completion to allow for site inspection if required.

2.02 PARALLEL PIPELINE

No pipeline right-of way or easement shall be placed less than 30 metres parallel to a highway unless prior approval is obtained from the appropriate Operations Manager.

2.03 CROSSING UNDER PAVEMENT - METHOD OF CROSSING

The open cut method for pipeline installation at any highway is not permitted.

The crossing of highway and pavement surfaces shall be constructed by boring or jacking methods in such a manner that the road grade is not disturbed.

The proposed method of installation shall be shown on the plan of the crossing attached to the application.

2.04 MINIMUM DEPTH OF COVER ON THE HIGHWAY OR ROAD RIGHT-OF-WAY

The minimum depth of cover over the pipeline where it crosses the right-of-way of a highway or a road shall be 2.5 metres for water and 1.4 metres for sewer lines under the lowest point in the cross-section.

2.05 INTERSECTION ANGLE OF PIPELINE CROSSING OF THOROUGHFARE

The desirable angle of crossing is between 70 and 90 degrees; however other angles may also be accepted in special circumstances.

2.06 SLOPE OF PIPELINE CROSSING

The pipeline shall be placed from one end to the other with a maximum gradient of 1 in 120.

2.07 HORIZONTAL AND VERTICAL PIPELINE BENDS

No horizontal and/or vertical pipe bends are permitted throughout the right-of-way and within 30 metres of the right-of-way boundaries of a provincial highway, unless approval is obtained from the appropriate Operations Manager.

2.08 CASED CROSSING

Where casing is required, it shall be continuous and inserted by boring or driving or other approved method.

2.09 DIAMETER OF CASING

The diameter of the casing shall be at least 5 centimetres greater (2") than the diameter of the carrier pipe. An exception to this is steel casing of polyethylene pipe, where the next size diameter of pipe may be used.

2.10 MINIMUM LENGTH OF CASING

The casing shall extend across full width of the highway right-of-way.

2.11 SEALED CASING

The casing shall be satisfactorily sealed to the carrier pipe at both ends.

2.12 CASING NOT TO CARRY OTHER UTILITIES

No cables of any kind shall be placed within the casing of any pipeline.

2.13 VENTING OF CASING PIPE

Vents shall not be placed within the limits of the highway right-of-way.

2.14 BORED OR AUGURED CROSSING

Casing shall be fitted into a bored or augured hole of such diameter as to provide a snug fit for the casing.

2.15 BORE SIZE

The bore size for heavy wall pipe shall be no more than one pipe size larger than the installed pipe. If the bore is larger than one pipe size, a pipe of the bore size shall be installed to form a cased crossing.

2.16 BORING IN NON-COHESIVE SOILS

Closed boring method shall be used in non-cohesive soil conditions.

2.17 DRAINAGE STRUCTURE

A pipeline shall not run through a culvert or drainage structure.

2.18 PIPELINE ATTACHMENTS TO BRIDGE STRUCTURES

No pipeline shall be attached to bridge structure without the written consent of the appropriate Regional Bridge Engineer.

2.19 OPEN EXCAVATION, MATERIAL AND EQUIPMENT STORAGE

No open excavation shall be constructed, nor shall any material or equipment be deposited or stored any closer than 6 metres of a bridge or earth retaining structure (without special consent of the appropriate Regional Bridge Engineer), and 4 metres from the shoulder break of a highway, or a toe of sideslope, whichever distance is greater.

2.20 BACKFILLING OF OPEN TRENCHES

The backfilling of all trenches in the highway right-of-way or within 6 metres of bridge pier or earth retaining structure shall be undertaken immediately after the installation has been placed and passed any necessary inspection. Backfill materials shall be thoroughly compacted with mechanical compactors and the owner of the pipeline will be held responsible for any settling in backfill for a period of three years after the completion of the work.

2.21 WASTE MATERIAL

All waste material shall be removed and all disturbed areas shall be leveled and trimmed in approved manner and re-seeded where necessary to restore the right-of-way to at least as good as original or better conditions.

2.22 WORK IN THE MEDIAN

No work shall be undertaken in the median of a divided highway unless approved by the appropriate Operations Manager.

2.23 WATER LINES -- CONSTRUCTION MATERIALS

A heavy wall continuous steel or heavy wall continuous P.E. pipe shall be used for uncased water lines located beneath the road.

Should a cased plastic pipe be used it must be installed in an outer continuous casing and adequately supported at the point where it leaves the casing in order to prevent sheering.

2.24 MANHOLES

Manholes located within the highway right-of-way shall be placed flush with the adjacent ground.

2.25 MANHOLES IN THE ROADWAY SIDESLOPES

No manholes shall be placed in the sideslopes unless special approval is obtained from the appropriate Operations Manager.

2.26 MANHOLES IN THE MEDIAN

No manholes shall be located within the centre median of multi-lane highways unless a special permit is obtained from the appropriate Operations Manager.

2.27 CONSTRUCTION SAFETY

All reasonable precautions shall be undertaken during construction to protect and safeguard public safety and property owners. This includes barricading, signing and flagpersons as required, to protect and safeguard the lives and property of the travelling public and adjacent property owners. At no time shall the highway or public roadway be closed to traffic. Where normal traffic patterns are to be interrupted due to ditching or other operations, prior approval must be first obtained. Suitable signs shall be erected and if required, a flagperson(s) shall be used to direct traffic through the disruption area as approved by the appropriate Operations Manager.

No work is to be conducted during darkness or when there is reduced visibility.

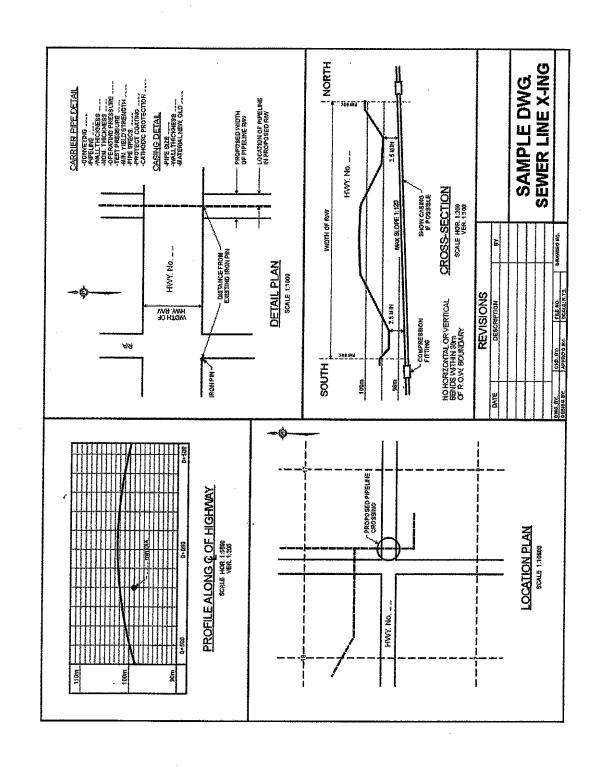
2.28 CONSTRUCTION SIGNING

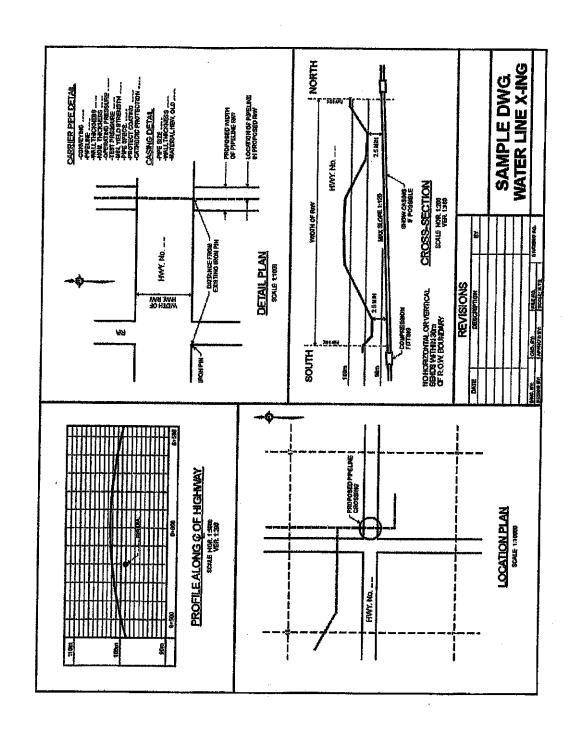
Contractors are to meet the requirements of the latest edition of the *Traffic Accommodation in Work Zones 2008 (1st Edition)* manual published by Alberta Transportation. The manual is available on the internet at www.transportation.alberta.ca/3815.htm.

If the signing requirements are not met, the appropriate Operations Manager or his representatives have the right to halt all construction until proper signing is erected. The signs are to be removed immediately following construction completion.

2.29 MODEL AGREEMENTS

There is no model agreement available at this time.











Appendix G
Land Assessment Report



islengineering.com March 2014 | APPENDIX



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

Edson West End Sanitary Trunk Main (Preliminary Alignment Options: 1 to 4; Review & Valuation)



605 - 50th Street, P.O. Box 6300 Edson, Alberta T7E 1T7



#100, 7909 - 51 Avenue NW, Edmonton, AB T6E 5L9

Prepared for: James Kercher

T: 780.438.9000 / F: 780.438.3700 / E-mail: <u>JKercher@islengineering.com</u>



100, 11634 – 142 St, Edmonton, AB T5M 1V4

Prepared by: Scott Land & Lease Ltd.

100, 11634 - 142 St, Edmonton, AB T5M 1V4 / T 780-428-2212 / Fax 780-425-5263 / E-mail

edmonton@scottland.ca



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

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Preliminary Alignment Options: 1 to 4; Review & Valuation March 20, 2014

Estimated Compensation Analysis

• Estimated Compensation Analysis

See the following inserted page.

• Limiting Conditions

The values provided are intended to aid in the functional evaluation of this specific study. These values are not provided for use in the acquisition of right-of-way or temporary workspace associated with this or any other project. This report and the values provided within are not to be considered an appraisal.

Parcel Sizes	1							Zoning	Zoning Details
80 to 160+	40 to 80	20 to 40	10 to 20	5 to 10	2.5 to 5	1 to 2.5	under 1		DC: Direct Control
104.1	61.73	24.01	14.55	9.63	4.82	2.19	0.68		UR: Urban
119.305	46.06	26.56	15.56	9.63	3	2.07	0.68		GSI - C: Glenwood Service Industr.
214.944	47.83	26.46	16.53	8.77	3.19	1.99	0.68		M - 1A: Light Industrial (Serviced)
104.1	46.06	26.46	14.11	5.56	4.74	2.03	0.9		CS: Community Services
119.305	61.04	40.04	10.16	9.63	2.89	1.31	0.82		C - 2: Service Commercial
160	40.04		14.55	8.77	4.82	2.07	0.99		M - 2: Heavy Industrial
114.39	61.73		15.56	9.63	3	2.08	0.68		M - 1B: Light Industrial (Unserviced)
214.944	46.06				3.19	1.31	0.68		M - 2: Heavy Industrial
104.1	61.04				2.89	1.1	0.68		E - R: Enviro Reserve
119.305		_				1.1	0.9		
214.944						1.1		='	
104.1	1					1.22			
119.305	1					1.11			
214.944						1.98			
160	1					2.19			
214.944						2.07			
	_					1.99			
						2.03			
						1.31			

	Valuation per Acre							
Market Value	\$6 ,000 . 00	\$10,000.00	\$1 5,000.00	\$25,000.00	\$40,000.00	\$200,000.00	\$270,000.00	\$ 3 50,000 . 00
Temp Workspace	H alf M ∨	H alf M ∨	Half MV	Flat rate \$5,000.00	Flat rate \$5,000.00	Flat rate \$5,000.00	Flat rate	Flat rate \$5,000.00
							\$5,000.00	
		N/A; Cemetery			N/A; ER			
	N/A; Railway		_					
		-				N/A; Railway		
				Extrapolated,	Extrapolated,			•
				limited current sales	limited current sales			
				or listings in this	or listings in this			
				category	category			



Preliminary Alignment Options: 1 to 4; Review & Valuation

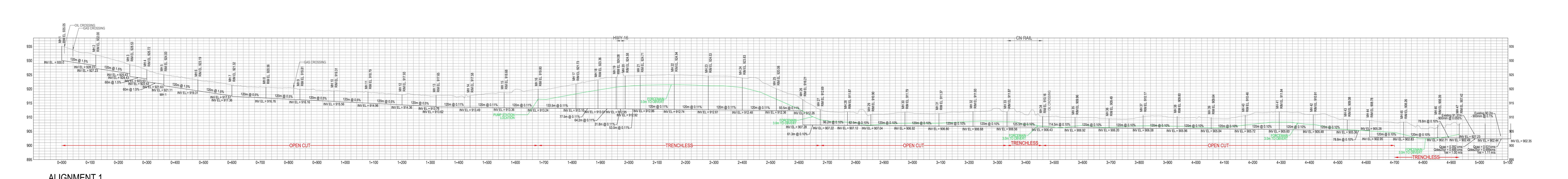
March 20, 2014

Preliminary Alignment Option 1; Review & Valuation

(Reference Drawing; 13890 - AL 1 161213.pdf)

See the following inserted drawing.





ALIGNMENT 1

EDSON WEST SANITARY TRUNK MAIN

FORCEMAIN

EXISTING GROUND

DECEMBER, 2013

HORZ 0 25 50 75 100 150 200m 1:2500 VERT 0 1 2 3 4 6 8m 1:10



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

...Preliminary Alignment Option 1; Review & Valuation

• Review & Valuation

Legal Description:	0122165;1;9
LINC#:	0030 789 663
Parcel Size:	104.1 ac
Picture reference #(s):	1
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	4.78 ac
Zoning:	DC
Valuation:	\$16,840.00
Additional Notes:	Chain link fence replacement (not valuated) and damages for truck storage relocation during utilization of TWS (\$2,500.00)



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

Legal Description:	5;17;53;18;SE
LINC#:	0022 037 618
Parcel Size:	9.63 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.298 ac
Zoning:	UR
Valuation:	\$5,000.00
Additional Notes:	Vacant
, additional recon	, acan



Edson West End Sanitary Trunk Main

Logal Description:	5·17·52·10·CE
Legal Description: LINC#:	5;17;53;18;SE 0022 037 592
Parcel Size:	119.305 ac
Picture reference #(s):	2
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	3.703 ac
Zoning:	UR
Valuation:	\$13,109.00
Additional Notes:	Partial 4 strand barbed wire, and partial panel fencing (not valuated), some landscaping and trees potentially impacted (\$2,000.00)



Edson West End Sanitary Trunk Main

Additional Notes:

Preliminary Alignment Options: 1 to 4; Review & Valuation

(\$3,000.00)

Legal Description:	0125979;8;3
LINC#:	0029 127 685
Parcel Size:	2.19 ac
Picture reference #(s):	3
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.237 ac
Zoning:	GSI-C
Valuation:	\$8,000.00
A 1 11/1 1 A 1 /	11 (1) (1) (1) (1) (1) (1)

No fencing, damages for pickup truck storage during utilization of TWS



Edson West End Sanitary Trunk Main

Legal Description:	9920048;8;2
LINC#:	0029 127 677
Parcel Size:	4.82 ac
Picture reference #(s):	4
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.657 ac
Zoning:	GSI-C
Valuation:	\$5,000.00
Additional Notes:	Chain link fence replacement (not valuated)



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

_	
Legal Description:	5756HW;8;P
LINC#:	0016 621 690
Parcel Size:	2.07 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.113 ac
Zanina	00.0
Zoning:	GSI-C
Valuation:	\$5,000.00



Edson West End Sanitary Trunk Main

Additional Notes:

Preliminary Alignment Options: 1 to 4; Review & Valuation

_	
Legal Description:	5756HW;7;1
LINC#:	0014 909 691
Parcel Size:	0.68 ac
Picture reference #(s):	5
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.08 ac
Zoning:	GSI-C
Valuation:	\$5,000.00
A 1 11/1 1 A 1	

Chain link fence replacement (not valuated), otherwise vacant



Edson West End Sanitary Trunk Main

Preliminary Alignment Options: 1 to 4; Review & Valuation

Legal Description:	9620096;7;6
LINC#:	0026 622 472
Parcel Size:	068 ac
Picture reference #(s):	5
Picture(s):	Incide Municipal or Draving aid Deaduration
Estimated ROW area	Inside Municipal or Provincial Roadway
required (ac): Estimated TWS area required (ac):	0.08 ac
Zoning:	GSI-C
Valuation:	\$5,000.00
Additional Notes:	Chain link fence replacement (not valuated), otherwise vacant



Edson West End Sanitary Trunk Main

Legal Description:	9620096;7;5
LINC#:	0026 622 464
Parcel Size:	0.68 ac
Picture reference #(s):	5
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.08 ac
Zoning:	GSI-C
Valuation:	\$5,000.00
Additional Notes:	Chain link fence replacement (not valuated), otherwise vacant



Edson West End Sanitary Trunk Main

Additional Notes:

Preliminary Alignment Options: 1 to 4; Review & Valuation

Logal Description	0620006:7:4
Linc#:	9620096;7;4 0026 622 457
Parcel Size:	0.9 ac
Picture reference #(s):	5
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.08 ac
Zoning:	GSI-C
Valuation:	\$5,000.00

Chain link fence replacement (not valuated), otherwise vacant



Legal Description:	3344TR;11;3
LINC#:	0016 287 682
Parcel Size:	1.99 ac
Picture reference #(s):	6
Picture(s):	Inside Municipal or Provincial Roadway
required (ac):	inside Municipal of Provincial Roadway
Estimated TWS area required (ac):	0.46 ac
Zoning:	M-1A
Valuation:	\$6,000.00
Additional Notes:	Chain link fence replacement (not valuated), damages for truck trailer relocation during utilization of TWS (\$1,000.00)



Edson West End Sanitary Trunk Main

Land Decembra	2244TD:44:2
Legal Description:	3344TR;11;2
LINC#:	0016 287 690
Parcel Size:	3 ac
Picture reference #(s):	6
Picture(s):	

Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.46 ac
Zoning:	M-1A
Valuation:	\$10,000.00
Additional Notes:	Chain link fence replacement (not valuated), damages for office trailer relocation during utilization of TWS (\$5,000.00)



Edson West End Sanitary Trunk Main

Legal Description:	3344TR;11;1
LINC#:	0013 183 934
Parcel Size:	3.19 ac
Picture reference #(s):	6
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.46 ac
Zoning:	M-1A
Valuation:	\$10,000.00
Additional Notes:	Chain link fence replacement (not valuated), damages for stockpiled material relocation during utilization of TWS (\$5,000.00)



Edson West End Sanitary Trunk Main

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_	
Legal Description:	6389LZ;OT
LINC#:	0016 257 230
Parcel Size:	14.55 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.852 ac
Zoning:	M-1A
Valuation:	\$5,000.00
Valuation: Additional Notes:	\$5,000.00 Vacant



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

Legal Description: LINC#: O015 924 111 Parcel Size: 15.56 ac Picture reference #(s): Picture(s): Inside Municipal or Provincial Roadway required (ac): Estimated TWS area required (ac): Zoning: Valuation: Additional Notes: S314Z;B Unit 924 111 Inside Municipal or Provincial Roadway Inside Municipal or Provincia		
LINC#: 0015 924 111 Parcel Size: 15.56 ac Picture reference #(s): 7 Picture(s): Estimated ROW area required (ac): Estimated TWS area required (ac): Zoning: M-1A Valuation: \$5,000.00	Logal Description:	53147·R
Parcel Size: 15.56 ac Picture reference #(s): 7 Picture(s): Estimated ROW area required (ac): Estimated TWS area required (ac): Zoning: M-1A Valuation: \$5,000.00		
Picture reference #(s): Picture(s): Inside Municipal or Provincial Roadway required (ac): Estimated TWS area required TwS area required (ac): Zoning: Valuation: 7 Inside Municipal or Provincial Roadway 1.114 ac 4.114 ac 55,000.00		
Estimated ROW area required (ac): Estimated TWS area required (ac): Zoning: W-1A Valuation: Valuation:		
Estimated ROW area required (ac): Estimated TWS area required (ac): Zoning: Valuation: M-1A Valuation:		7
required (ac): Estimated TWS area required (ac): Zoning: M-1A Valuation: \$5,000.00		Incide Municipal or Prayingial Readway
required (ac): Zoning: M-1A Valuation: \$5,000.00		inside Municipal of Provincial Roadway
Zoning: M-1A Valuation: \$5,000.00		1.114 ac
Zoning: M-1A Valuation: \$5,000.00	required (ac):	
Valuation: \$5,000.00		M-1A
	Valuation:	
Onain initiation replacement (not valuated), etholwide valuati		
	, tallional 1000.	enam min torres replacement (not raidated), etherwise radant



Edson West End Sanitary Trunk Main

Preliminary Alignment Options: 1 to 4; Review & Valuation

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Legal Description:	5314Z;B
LINC#:	0016 732 596
Parcel Size:	61.73 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	1.114 ac
Zoning:	CS
Valuation:	N/A
Additional Notes:	Cemetery, if Town or County owned may not require valuation for TWS, approval required from Director of Cemeteries in Service

Alberta, heavily treed, otherwise vacant



Edson West End Sanitary Trunk Main

Additional Notes:

Preliminary Alignment Options: 1 to 4; Review & Valuation

Legal Description:	8022726;201;2
LINC#:	0012 062 220
Parcel Size:	2.03 ac
Picture reference #(s):	8
Picture(s):	
Estimated ROW area	Inside Municipal or Provincial Roadway
required (ac): Estimated TWS area required (ac):	0.175 ac
Zoning:	C2
Valuation:	\$5.000.00

Some minor landscaping damages, otherwise vacant



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

Legal Description:	4040TR;OT
LINC#:	0018 627 182
Parcel Size:	No title
Picture reference #(s):	9
Picture(s):	
required (ac):	0.033 ac
Estimated TWS area required (ac):	N/A
Zoning:	C-2
Valuation:	N/A
Additional Notes:	Acquisition likely not required, should be nominally approved through railway crossing permit, proximity to water well



March :	20, 201	4
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Legal Description:	9521371;;34
LINC#:	0026 361 162
Parcel Size:	1.31 ac
Picture reference #(s):	9
Picture(s):	0.033 ac
required (ac):	
Estimated TWS area	N/A
required (ac):	
Zoning:	C-2
Valuation:	N/A
Additional Notes:	Acquisition likely not required, should be nominally approved through
	railway crossing permit



March	20	201	1
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LINC#: Parcel Size:	1118CL;OT 0027 779 487 214.944 ac 9
LINC#: Parcel Size: Picture reference #(s):	0027 779 487 214.944 ac
Picture reference #(s):	
	9
Picture(s):	
Estimated ROW area	N/A
required (ac):	
Estimated TWS area required (ac):	N/A
Zoning:	M-2
	N/A
Additional Notes:	Acquisition likely not required, should be nominally approved through railway crossing permit



March :	20, 201	4
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	_
Legal Description:	5;17;53;16;SW
LINC#:	0011 091 650
Parcel Size:	46.06 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	1.721 ac
Estimated TWS area required (ac):	6.181 ac
Zoning:	UR
Valuation:	\$48,115.00
Additional Notes:	Vacant

Legal Description:	5;17;53;16;SE
LINC#:	0021 983 755
Parcel Size:	47.83 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	1.236 ac
Estimated TWS area required (ac):	4.655 ac
Zoning:	UR
Valuation:	\$47,995.00
Additional Notes:	Largely vacant and heavily treed, potential impact with
	improvement on east end (uninspected)



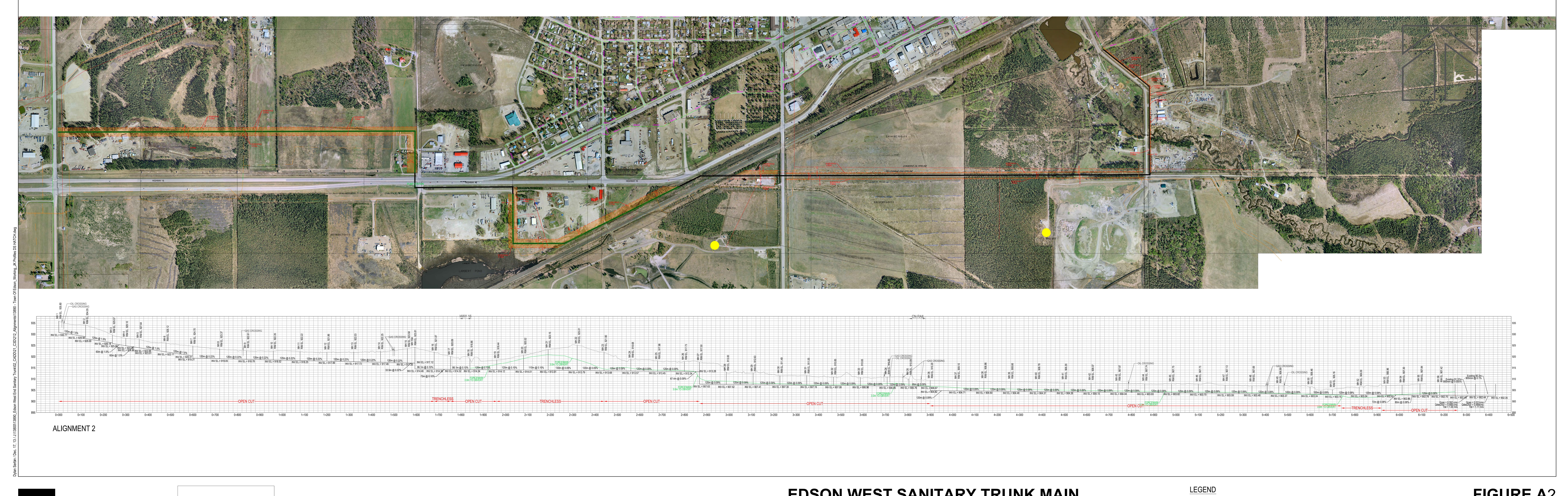
Preliminary Alignment Options: 1 to 4; Review & Valuation

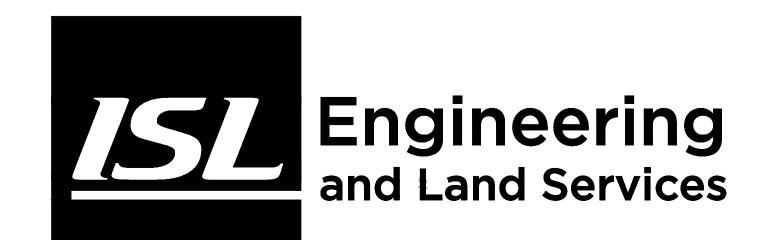
March 20, 2014

Preliminary Alignment Option 2 Review & Valuation

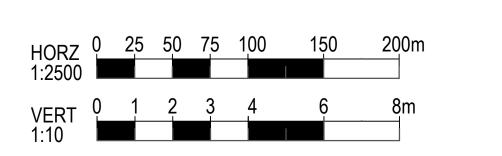
(Reference Drawing; 13890 - AL 2 161213.pdf)

See the following inserted drawing.









EDSON WEST SANITARY TRUNK MAIN

GRAVITY SEWER

ALIGNMENT 2

----FORCEMAIN

——— EXISTING GROUND



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

...Preliminary Alignment Option 2; Review & Valuation

• Review & Valuation

Legal Description:	0122165;1;9
LINC#:	0030 789 663
Parcel Size:	104.1 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	2.214 ac
Estimated TWS area required (ac):	5.939 ac
Zoning:	DC
Valuation:	\$31,101.00
Additional Notes:	Assume TWS will be adjusted to avoid impacting the
	improvement, no damages valuated.
	Assume TWS will be adjusted to avoid impacting the

Legal Description:	5;17;53;18;SE
LINC#:	0022 037 618
Parcel Size:	9.63 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	0.27 ac
Estimated TWS area required (ac):	0.372 ac
Zoning:	UR
Valuation:	\$15,800.00
Additional Notes:	Vacant



Edson West End Sanitary Trunk Main

4513RS;;A
0015 120 835
24.01 ac
N/A
N/A
0.55 ac
0.970 ac
UR
\$15,525.00
Vacant



Edson West End Sanitary Trunk Main

Legal Description:	5;17;53;18;SE
LINC#:	0022 037 592
Parcel Size:	119.305 ac
Picture reference #(s):	2
Picture(s):	
Estimated ROW area required (ac):	0.825 ac
Estimated TWS area required (ac):	6.038 ac
Zoning:	UR
Valuation:	\$28,064.00
Additional Notes:	Panel fencing (not valuated), damages for RV storage loss, landscaping and trees (\$5,000.00)



Edson West End Sanitary Trunk Main

Legal Description:	5;17;53;8;NW
LINC#:	0019 088 830
Parcel Size:	26.56 ac
Picture reference #(s):	10
Picture(s):	
Estimated ROW area required (ac):	0.614 ac
Estimated TWS area required (ac):	2.27 ac
Zoning:	UR
Valuation:	\$33,235.00
Additional Notes:	Proximity damages to dwelling, power lines also in close proximity and
	damages for shelter belt tree loss (\$7,000.00)



March	20.	2014
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Legal Description:	8520288;1;1
LINC#:	0011 065 993
Parcel Size:	16.53 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	0.034 ac
Estimated TWS area required (ac):	0.150 ac
Zoning:	UR
Valuation:	\$5,850.00
Additional Notes:	Vacant

Legal Description:	5;17;53;8;NW
LINC#:	0027 842 889
Parcel Size:	26.46 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	0.614 ac
Estimated TWS area required (ac):	2.27 ac
Zoning:	UR
Valuation:	\$28,735.00
Additional Notes:	Damages for relocation of stored equipment (\$2,500.00)

_	_
Legal Description:	5;17;53;8;NE
LINC#:	0021 986 583
Parcel Size:	8.77 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	0.767 ac
Estimated TWS area required (ac):	2.273 ac
Zoning:	UR
Valuation:	\$35,680.00
Additional Notes:	Vacant



March 20, 2014	
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_	
Legal Description:	9524985;1;1
LINC#:	0026 588 807
Parcel Size:	4.74 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	N/A
Estimated TWS area required (ac):	0.751 ac
Zoning:	UR
Valuation:	\$5,000.00
Additional Notes:	Vacant

Legal Description:	5;17;53;16;SW
LINC#:	0011 091 650
Parcel Size:	46.06 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.98 ac
Zoning:	UR
Valuation:	\$4,900.00
Additional Notes:	Vacant

Legal Description:	5;17;53;9;NW
LINC#:	0021 720 420
Parcel Size:	61.04 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.984 ac
Zoning:	UR
Valuation:	\$4,920.00
Additional Notes:	Vacant



March	20,	20	14

Legal Description:	5;17;53;16;SE
LINC#:	0021 983 762
Parcel Size:	40.04 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.978 ac
Zoning:	UR
Valuation:	\$4,890.00
Additional Notes:	Vacant

Legal Description:	5;17;53;9;NE
LINC#:	0017 174 582
Parcel Size:	160 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.984 ac
Zoning:	UR
Valuation:	\$2,952.00
Additional Notes:	Vacant

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spected fencing likely impacted (not valuated), damages for eation of vehicles during TWS utilization (\$2,500.00)



March	20,	2014	

Legal Description:	8720609;1;1
LINC#:	0010 607 083
Parcel Size:	2.08 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.098 ac
Zoning:	M-1B
Valuation:	\$5,000.00
Additional Notes:	Vacant

Legal Description:	0124430;3;2ER
LINC#:	0029 013 877
Parcel Size:	5.56 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.196 ac
Zoning:	ER
Valuation:	N/A
Additional Notes:	Environmental Reserve

0124430;3;1
0029 013 869
14.11 ac
N/A
N/A
Inside Municipal or Provincial Roadway
0.207ac
M-2
\$7,500.00
Uninspected fencing likely impacted (not valuated), damages for relocation of vehicles during TWS utilization (\$2,500.00)



Edson West End Sanitary Trunk Main

	_
Legal Description:	5;17;53;15;SW
LINC#:	0029 013 852
Parcel Size:	114.39 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.033 ac
Zoning:	UR
Valuation:	\$500.00 (minimum payment)
Additional Notes:	Vacant

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Legal Description:	1118CL;OT
LINC#:	0027 779 487
Parcel Size:	214.944 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.245
Zoning:	M-2
Valuation:	N/A
Additional Notes:	Acquisition likely not required, should be nominally approved
	through railway encroach permit



Preliminary Alignment Options: 1 to 4; Review & Valuation

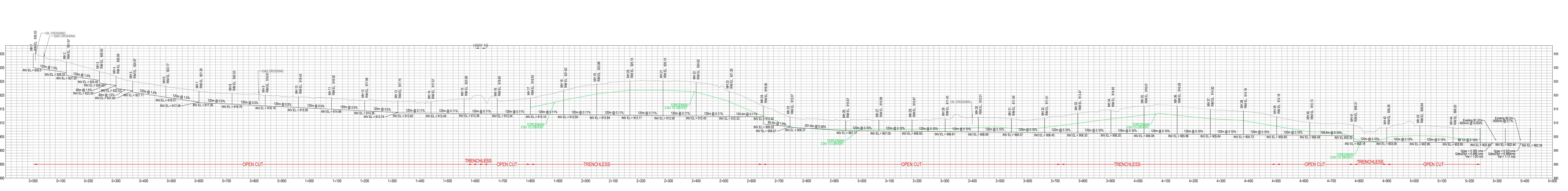
March 20, 2014

Preliminary Alignment Option 3; Review & Valuation

(Reference Drawing; 13890 - AL 3 161213.pdf)

See the following inserted drawing.





ALIGNMENT 3



HORZ 0 25 50 75 100 150 200m 1:2500 VERT 0 1 2 3 4 6 8m 1:10

EDSON WEST SANITARY TRUNK MAIN

FORCEMAIN

EXISTING GROUND

DECEMBER, 2013



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

...Preliminary Alignment Option 3; Review & Valuation

• Review & Valuation

Legal Description:	0122165;1;9
LINC#:	0030 789 663
Parcel Size:	104.1 ac
Picture reference #(s):	1
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area	4.79 ac
required (ac):	
Zoning:	DC
Valuation:	\$16,870.00
Additional Notes:	Chain link fence replacement (not valuated) and damages for truck
	storage relocation during utilization of TWS (\$2,500.00)



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

Legal Description:	5;17;53;18;SE
LINC#:	0022 037 618
Parcel Size:	9.63 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.296 ac
Zoning:	UR
Valuation:	\$5,000.00
Additional Notes:	Vacant
, taditional Potosi	radam



M	larch	20,	2014	

Legal Description:	5;17;53;18;SE
LINC#:	0022 037 592
Parcel Size:	119.305 ac
Picture reference #(s):	2
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area	3.703 ac
required (ac):	
Zoning:	UR
Valuation:	\$13,109.00
Additional Notes:	Partial 4 strand barbed wire, and partial panel fencing (not valuated),
	some landscaping and trees potentially impacted (\$2,000.00)



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Legal Description:	5;17;53;8;NW
LINC#:	0027 842 889
Parcel Size:	26.46 ac
Picture reference #(s):	11
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	2.245 ac
Zoning:	UR
Valuation:	\$21,838.00
Additional Notes:	Damages for shelter belt tree loss, and bin relocation (\$5,000.00)



Legal Description:	5;17;53;8;NE
LINC#:	0021 986 583
Parcel Size:	8.77 ac
Picture reference #(s):	12
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	2.060 ac
Zoning:	UR
Valuation:	\$6,500.00
Additional Notes:	Chain link fence replacement (not valuated), damages for trees and landscaping (\$1,500.00)



Edson West End Sanitary Trunk Main

Legal Description:	4040TR;OT
LINC#:	0018 627 182
Parcel Size:	No Title
Picture reference #(s):	9
Picture(s): Estimated ROW area	Inside Municipal or Provincial Roadway
required (ac):	inside Municipal of Frovincial Roadway
Estimated TWS area required (ac):	0.115 ac
Zoning:	C-2
Valuation:	N/A
Additional Notes:	Acquisition likely not required, should be nominally approved through
	railway crossing permit, proximity to water well



Edson West End Sanitary Trunk Main

Legal Description:	9521371;;34
LINC#:	0026 361 162
Parcel Size:	1.31 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.725 ac
Zoning:	C-2
Valuation:	\$5,000.00
Additional Notes:	Vacant

Legal Description:	9521371;;33
LINC#:	0026 361 155
Parcel Size:	1.1 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.122 ac
Zoning:	C-2
Valuation:	\$5,000.00
Additional Notes:	Vacant

Legal Description:	1322934;200;1C
LINC#:	0035 727 361
Parcel Size:	10.16 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.911 ac
Zoning:	C-2
Valuation:	\$5,000.00
Additional Notes:	Vacant



Edson West End Sanitary Trunk Main

Legal Description:	8022726;200;11
LINC#:	0012 059 366
Parcel Size:	0.82 ac
Picture reference #(s):	13
Picture(s):	ROAD CLOSED
Estimated ROW area	Inside Municipal or Provincial Roadway
required (ac): Estimated TWS area	0.184 ac
required (ac):	0.104 ac
Zoning:	C-2
Valuation:	\$8,000.00
Additional Notes:	Damages for relocation of trailer storage (\$3,000.00)



Edson West End Sanitary Trunk Main

Legal Description:	9521371;;26
LINC#:	0026 361 089
Parcel Size:	1.1 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.222
Zoning:	C-2
Valuation:	\$5,000.00
Additional Notes:	Vacant

Legal Description:	9521371;;25
LINC#:	0026 361 071
Parcel Size:	1.1 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.226 ac
Zoning:	C-2
Valuation:	\$5,000.00
Additional Notes:	Vacant

Legal Description:	9521371;;24
LINC#:	0026 361 063
Parcel Size:	1.1 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.226 ac
Zoning:	C-2
Valuation:	\$5,000.00
Additional Notes:	Proximity to improvement



March	Ζυ,	20	14

Legal Description:	9521371;;23
LINC#:	0026 361 056
Parcel Size:	0.99 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.203 ac
Zoning:	C-2
Valuation:	\$5,000.00
Additional Notes:	Vacant

Legal Description:	9521371;;22
LINC#:	0026 361 048
Parcel Size:	1.22 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.249 ac
Zoning:	C-2
Valuation:	\$5,000.00
Additional Notes:	Vacant

	_
Legal Description:	9521371;;21
LINC#:	0026 361 030
Parcel Size:	1.11 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.226 ac
Zoning:	C-2
Valuation:	\$5,000.00
Additional Notes:	Vacant



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

_	
Legal Description:	9521371;;20
LINC#:	0027 380 435
Parcel Size:	1.98 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.158 ac
Zoning:	M1A
Valuation:	\$5,000.00
Additional Notes:	Vacant

Legal Description:	1118CL;OT
LINC#:	0027 779 487
Parcel Size:	214.944
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.899 ac
Zoning:	M-2
Valuation:	N/A
Additional Notes:	Acquisition likely not required, should be nominally approved
	through railway encroach permit



Preliminary Alignment Options: 1 to 4; Review & Valuation

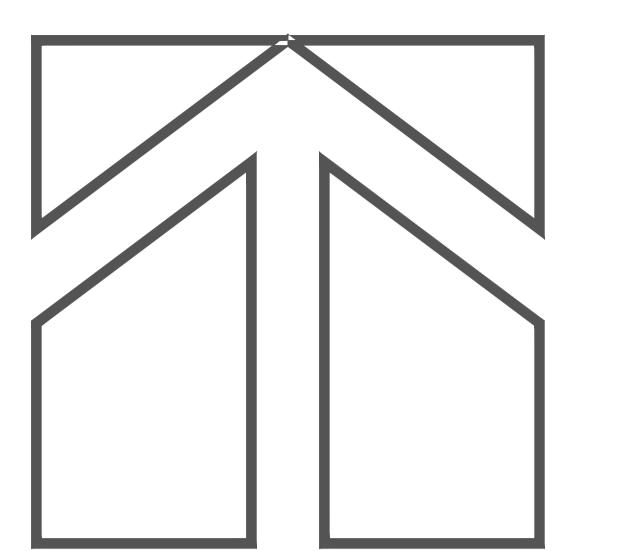
March 20, 2014

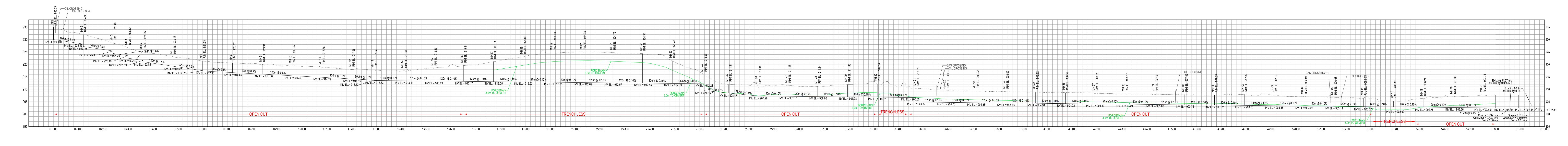
Preliminary Alignment Option 4; Review & Valuation

(Reference Drawing; 13890 - AL 4 161213.pdf)

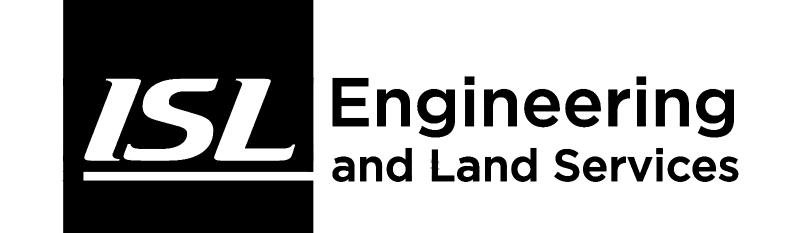
See the following inserted drawing.







ALIGNMENT 4





HORZ 0 25 50 75 100 150 200m 1:2500 VERT 0 1 2 3 4 6 8m 1:10

EDSON WEST SANITARY TRUNK MAIN

FORCEMAIN

ALIGNMENT 4

EXISTING GROUND

DECEMBER, 2013



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

...Preliminary Alignment Option 4; Review & Valuation

• Review & Valuation

Legal Description:	0122165;1;9
LINC#:	0030 789 663
Parcel Size:	104.1 ac
Picture reference #(s):	1
Picture(s):	Incide Municipal or Provincial Readway
required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	4.748 ac
Zoning:	DC
Valuation:	\$16,744.00
Additional Notes:	Chain link fence replacement (not valuated) and damages for truck storage relocation during utilization of TWS (\$2,500.00)



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

_	
Legal Description:	5;17;53;18;SE
LINC#:	0022 037 618
Parcel Size:	9.63 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.298 ac
Zoning:	UR
Zoriirig.	OK .
Valuation:	\$5,000.00



Edson West End Sanitary Trunk Main

Preliminary Alignment Options: 1 to 4; Review & Valuation

Legal Description:	5;17;53;18;SE
LINC#:	0022 037 592
Parcel Size:	119.305 ac
Picture reference #(s):	2
Picture(s):	
Estimated ROW area	Inside Municipal or Provincial Roadway
required (ac):	0.700
Estimated TWS area	3.703 ac
required (ac):	115
Zoning:	UR
Valuation:	\$13,109.00
Additional Notes:	Partial 4 strand barbed wire, and partial panel fencing (not valuated),

some landscaping and trees potentially impacted (\$2,000.00)



Edson West End Sanitary Trunk Main

Legal Description:	0125979;8;3
LINC#:	0029 127 685
Parcel Size:	2.19 ac
Picture reference #(s):	3
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.337 ac
Zoning:	GSI-C
Valuation:	\$8,000.00
Additional Notes:	No fencing, damages for pickup truck storage during utilization of TWS (\$3,000.00)



Edson West End Sanitary Trunk Main

Legal Description:	9920048;8;2
LINC#:	0029 127 677
Parcel Size:	4.82 ac
Picture reference #(s):	4
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.889 ac
Zoning:	GSI-C
Valuation:	\$5,000.00
Additional Notes:	Chain link fence replacement (not valuated)



Edson West End Sanitary Trunk Main

5756HW;8;P
0016 621 690
2.07 ac
N/A
N/A
Inside Municipal or Provincial Roadway
0.181 ac
GSI-C
\$5,000.00
Vacant



Edson West End Sanitary Trunk Main

Preliminary Alignment Options: 1 to 4; Review & Valuation

GSI-C

\$5,000.00

Zoning: Valuation:

Additional Notes:

Legal Description:	5756HW;7;1
LINC#:	0014 909 691
Parcel Size:	0.68 ac
Picture reference #(s):	5
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.08 ac

Chain link fence replacement (not valuated), otherwise vacant



Edson West End Sanitary Trunk Main

Additional Notes:

Preliminary Alignment Options: 1 to 4; Review & Valuation

Legal Description:	9620096;7;6
LINC#:	0026 622 472
Parcel Size:	0.68 ac
Picture reference #(s):	5
Picture(s):	
Estimated ROW area	Inside Municipal or Provincial Roadway
required (ac):	0.00
Estimated TWS area required (ac):	0.08 ac
Zoning:	GSI-C
Valuation:	\$5.000.00

Chain link fence replacement (not valuated), otherwise vacant



Edson West End Sanitary Trunk Main

Preliminary Alignment Options: 1 to 4; Review & Valuation

Legal Description:	9620096;7;5
LINC#:	0026 622 464
Parcel Size:	0.68 ac
Picture reference #(s):	5
Picture(s):	Incide Municipal or Provincial Readway
Estimated ROW area	Inside Municipal or Provincial Roadway
required (ac): Estimated TWS area required (ac):	0.08 ac
Zoning:	GSI-C
Valuation:	\$5,000.00
Additional Notes:	Chain link fence replacement (not valuated), otherwise vacant



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

Legal Description:	9620096;7;4
LINC#:	0026 622 457
Parcel Size:	0.9 ac
Picture reference #(s):	5
Picture(s): Estimated ROW area	Inside Municipal or Provincial Roadway
required (ac):	inside Municipal of Frovincial Roadway
Estimated TWS area required (ac):	0.08 ac
Zoning:	GSI-C
Valuation:	\$5,000.00
Additional Notes:	Chain link fence replacement (not valuated), otherwise vacant



Edson West End Sanitary Trunk Main

Legal Description:	3344TR;11;3
LINC#:	0016 287 682
Parcel Size:	1.99 ac
Picture reference #(s):	6
Picture(s):	
Estimated ROW area	Incide Municipal or Provincial Pondway
required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area	0.46 ac
required (ac):	
Zoning:	M-1A
Valuation:	\$6,000.00
Additional Notes:	Chain link fence replacement (not valuated), damages for truck trailer
	relocation during utilization of TWS (\$1,000.00)



Edson West End Sanitary Trunk Main

Legal Description:	3344TR;11;2
LINC#:	0016 287 690
Parcel Size:	3 ac
Picture reference #(s):	6
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.46 ac
Zoning:	M-1A
Valuation:	\$10,000.00
Additional Notes:	Chain link fence replacement (not valuated), damages for office trailer relocation during utilization of TWS (\$5,000.00)



Edson West End Sanitary Trunk Main

Legal Description:	3344TR;11;1
LINC#:	0013 183 934
Parcel Size:	3.19 ac
Picture reference #(s):	6
Picture(s):	Inside Municipal or Provincial Roadway
required (ac):	Inside Municipal of Provincial Roadway
Estimated TWS area required (ac):	0.46 ac
Zoning:	M-1A
Valuation:	\$10,000.00
Additional Notes:	Chain link fence replacement (not valuated), damages for stockpiled material relocation during utilization of TWS (\$5,000.00)



Edson West End Sanitary Trunk Main

Legal Description:	6389LZ;OT
LINC#:	0016 257 230
Parcel Size:	14.55 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.852 ac
Zoning:	M-1A
Valuation:	\$5,000.00
Additional Notes:	Vacant



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

Legal Description:	5314Z;B
LINC#:	0015 924 111
Parcel Size:	15.56 ac
Picture reference #(s):	7
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	1.114 ac
Zoning:	M-1A
Valuation:	\$5,000.00
Additional Notes:	Chain link fence replacement (not valuated), otherwise vacant



March 20, 2014

Edson West End Sanitary Trunk Main

Preliminary Alignment Options: 1 to 4; Review & Valuation

Legal Description:	5314Z;B
LINC#:	0016 732 596
Parcel Size:	61.73 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	1.114 ac
Zoning:	CS
Valuation:	N/A
Additional Notes:	Cemetery, if Town or County owned may not require valuation for TWS, approval required from Director of Cemeteries in Service
	Alberta, heavily treed, otherwise vacant



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

Legal Description:	8022726;201;2
LINC#:	0012 062 220
Parcel Size:	2.03 ac
Picture reference #(s):	8
Picture(s):	
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.175 ac
Zoning:	C2
Valuation:	\$5,000.00
Additional Notes:	Some minor landscaping damages, otherwise vacant



March 20, 2014

Edson West End Sanitary Trunk Main

Preliminary Alignment Options: 1 to 4; Review & Valuation

Legal Description:	4040TR;OT
LINC#:	0018 627 182
Parcel Size:	No Title
Picture reference #(s):	9
Picture(s): Estimated ROW area	0.034ac
required (ac):	0.034ac
Estimated TWS area	0.012 ac
required (ac):	0.012 40
Zoning:	C-2
Valuation:	N/A
Additional Notes:	Acquisition likely not required, should be nominally approved through

railway crossing permit, proximity to water well



March 20, 2014

Edson West End Sanitary Trunk Main

Preliminary Alignment Options: 1 to 4; Review & Valuation

Legal Description:	9521371;;34
LINC#:	0026 361 162
Parcel Size:	1.31 ac
Picture reference #(s):	9
Picture(s):	
Estimated ROW area required (ac):	0.034 ac
Estimated TWS area required (ac):	0.078
Zoning:	C-2
Valuation:	N/A
Additional Notes:	Acquisition likely not required, should be nominally approved through railway crossing permit



Preliminary Alignment Options: 1 to 4; Review & Valuation

March 20, 2014

Legal Description:	1118CL;OT
LINC#:	0027 779 487
Parcel Size:	214.944 ac
Picture reference #(s):	9
Picture(s):	0.108 ac (crossing tracks)
required (ac):	0.100 ac (crossing tracks)
Estimated TWS area required (ac):	0.151 ac
Zoning:	M-2
Valuation:	N/A
Additional Notes:	Acquisition likely not required, should be nominally approved through railway crossing permit



Preliminary Alignment Options: 1 to 4; Review & Valuation

March	20.	2014
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	_
Legal Description:	5;17;53;16;SW
LINC#:	0011 091 650
Parcel Size:	46.06 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	0.222 ac (Partially in road)
Estimated TWS area required (ac):	1.260 ac
Zoning:	UR
Valuation:	\$8,520.00
Additional Notes:	Vacant

Legal Description:	5;17;53;9;NW
LINC#:	0021 720 420
Parcel Size:	61.04 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.975 ac
Zoning:	UR
Valuation:	\$9,750.00
Additional Notes:	Vacant

Legal Description:	5;17;53;16;SE
LINC#:	0021 983 762
Parcel Size:	40.04 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.963 ac
Zoning:	UR
Valuation:	\$9,360.00
Additional Notes:	Vacant
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Preliminary Alignment Options: 1 to 4; Review & Valuation

March	20	201	۱ /
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Legal Description:	5;17;53;9;NE
LINC#:	0017 174 582
Parcel Size:	160 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.984
Zoning:	UR
Valuation:	\$2,952.00
Additional Notes:	Vacant

Legal Description:	9826359;;1
LINC#:	0027 779 495
Parcel Size:	2.89 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.096 ac
Zoning:	M-2
Valuation:	\$5,000.00
Additional Notes:	Vacant

_	
Legal Description:	1118CL;OT
LINC#:	0027 779 487
Parcel Size:	214.944 ac
Picture reference #(s):	N/A
Picture(s):	N/A
Estimated ROW area required (ac):	Inside Municipal or Provincial Roadway
Estimated TWS area required (ac):	0.288 ac
Zoning:	M-2
Valuation:	\$5,000.00
Additional Notes:	Vacant



Preliminary Alignment Options: 1 to 4; Review & Valuation March 20, 2014

Ove**r**view

• Preliminary Alignment Option 1

Estimated # of Parcels Impacted	Estimated Total ROW	Estimated Total TWS	Estimated Total Cost
22	2.957 ac	25.650 ac	\$210,059.00

• Preliminary Alignment Option 2

Estimated # of Parcels Impacted	Estimated Total ROW	Estimated Total TWS	Estimated Total Cost
20	5.828 ac	25.623 ac	\$242,152.00

Preliminary Alignment Option 3

Estimated # of Parcels Impacted	Estimated Total ROW	Estimated Total TWS	Estimated Total Cost
18	0.000 ac	17.560 ac	\$116,322.00

Preliminary Alignment Option 4

Estimated # of Parcels Impacted	Estimated Total ROW	Estimated Total TWS	Estimated Total Cost
26	0.398 ac	18.934 ac	\$154,435.00





Appendix H
Cost Estimate and Analysis



islengineering.com March 2014 | APPENDIX

Table H-1a Alignment 1 Alternative 1 Flows

Gravity Sev	wer Option												Open Cut				Trenchless			U	/S MH			
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)		Cost	Length (m)	Unit Cost (\$/m)	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)		Cost	Total
MH 1	MH 2	120.0	1.50	935.1	932.0	930.00	928.20	5.0	3.8	4.4	300	120.0	805	\$	96,600			\$ -	5.0	1200	2400	\$	12,120	\$ 108,720
MH 2	MH 3	120.0	1.50	932.0	928.5	927.20	925.40	4.8	3.1	4.0	300	120.0	805	\$	96,600			\$ -	4.8	1200	2400	\$	11,520	\$ 108,120
MH 3	MH 4	60.0	1.50	928.5	926.7	924.40	923.50	4.1	3.2	3.7	300	60.0	750	\$	45,000			\$ -	4.1	1200	2400	\$	9,912	\$ 54,912
MH 4	MH 5	60.0	1.50	926.7	924.0	922.50	921.60	4.2	2.4	3.3	300	60.0	750	\$	45,000			\$ -	4.2	1200	2400	\$	10,128	\$ 55,128
MH 5	MH 6	120.0	1.50	924.0	923.2	921.11	919.31	2.9	3.9	3.4	300	120.0	750	\$	90,000			\$ -	2.9	1200	2400	\$	6,936	\$ 96,936
MH 6	MH 7	120.0	1.50	923.2	921.3	919.31	917.51	3.9	3.8	3.8	300	120.0	750	\$	90,000			\$ -	3.9	1200	2400	\$	9,312	\$ 99,312
MH 7	MH 8	120.0	0.50	921.3	920.6	917.36	916.76	4.0	3.8	3.9	375	120.0	810	\$	97,200			\$ -	4.0	1200	2400	\$	9,504	\$ 106,704
MH 8	MH 9	120.0	0.50	920.6	919.8	916.76	916.16	3.8	3.6	3.7	375	120.0	810	\$	97,200			\$ -	3.8	1200	2400	\$	9,120	\$ 106,320
MH 9	MH 10	120.0	0.50	919.8	919.3	916.16	915.56	3.6	3.8	3.7	375	120.0	810	\$	97,200			\$ -	3.6	1200	2400	\$	8,760	\$ 105,960
MH 10	MH 11	120.0	0.50	919.3	918.8	915.56	914.96	3.8	3.8	3.8	375	120.0	810	\$	97,200			\$ -	3.8	1200	2400	\$	9,000	\$ 106,200
MH 11	MH 12	120.0	0.50	918.8	917.9	914.96	914.36	3.8	3.6	3.7	375	120.0	810	\$	97,200			\$ -	3.8	1200	2400	\$	9,192	\$ 106,392
MH 12	MH 13	120.0	0.50	917.9	917.7	914.36	913.76	3.6	3.9	3.7	375	120.0	810	\$	97,200			\$ -	3.6	1200	2400	\$	8,568	\$ 105,768
MH 13	MH 14	120.0	0.10	917.7	917.6	913.62	913.50	4.0	4.1	4.1	525	120.0	850	\$	102,000			\$ -	4.0	1200	2400	\$	9,672	\$ 111,672
MH 14	MH 15	120.0	0.10	917.6	918.7	913.50	913.38	4.1	5.3	4.7	525	120.0	850	\$	102,000			\$ -	4.1	1200	2400	\$	9,792	\$ 111,792
MH 15	MH 16	120.0	0.10	918.7	919.8	913.38	913.26	5.3	6.5	5.9	525	75.0	910	\$	68,250	45.0	3400	\$ 153,000	5.3	1200	2400	\$	12,720	\$ 233,970
MH 16	MH 17	133.5	0.10	919.8	921.7	913.26	913.13	6.5	8.6	7.6	525			\$	-	133.5	3400	\$ 453,900	6.5	1200	2400	\$	15,696	\$ 469,596
MH 17	MH 18	77.5	0.10	921.7	923.4	913.13	913.05	8.6	10.3	9.5	525			\$	-	77.5	3400	\$ 263,500	8.6	1200	2400	\$	20,648	\$ 284,148
MH 18	MH 19	64.2	0.10	923.4	924.1	913.05	912.98	10.3	11.1	10.7	525			\$	-	64.2	3400	\$ 218,280	10.3	1200	2400	\$	24,746	\$ 243,026
MH 19	MH 20	31.8	0.10	924.1	924.6	912.98	912.95	11.1	11.6	11.4	525			\$	-	31.8	3400	\$ 108,120	11.1	1200	2400	\$	26,628	\$ 134,748
MH 20	MH 21	53.0	0.10	924.6	924.7	912.95	912.90	11.6	11.8	11.7	525			\$	-	53.0	3400	\$ 180,200	11.6	1200	2400	\$	27,905	\$ 208,105
MH 21	MH 22	120.0	0.10	924.7	924.9	912.90	912.78	11.8	12.2	12.0	525			\$	-	120.0	3400	\$ 408,000	11.8	1200	2400	\$	28,344	\$ 436,344
MH 22	MH 23	120.0	0.10	924.9	924.5	912.78	912.66	12.2	11.9	12.0	525			\$	-	120.0	3400	\$ 408,000	12.2	1200	2400	\$	29,184	\$ 437,184
MH 23	MH 24	120.0	0.10	924.5	923.8	912.66	912.54	11.9	11.3	11.6	525			\$	-	120.0	3400	\$ 408,000	11.9	1200	2400	\$	28,488	\$ 436,488
MH 24	MH 25	120.0	0.10	923.8	920.1	912.54	912.42	11.3	7.6	9.5	675			\$	-	120.0	3850	\$ 462,000	11.3	1500	3000	\$	33,870	\$ 495,870
MH 25	MH 26	93.5	0.10	920.1	916.2	912.42	912.33	7.6	3.9	5.8	675			\$	-	93.5	3850	\$ 359,975	7.6	1500	3000	\$	22,920	\$ 382,895
MH 26	MH 27	61.3	0.10	916.2	912.7	907.28	907.22	8.9	5.5	7.2	675			\$	-	61.3	3850	\$ 236,005	8.9	1500	3000	\$	26,790	\$ 262,795
MH 27	MH 28	96.2	0.10	912.7	911.9	907.22	907.12	5.5	4.7	5.1	675	02.5	4005	т .	- 00 542	96.2	3850	\$ 370,370	5.5	1500	3000	\$	16,414	\$ 386,784
MH 28	MH 29	82.5	0.10	911.9	910.9	907.12	907.04	4.7	3.9	4.3	675	82.5	1085	\$	89,513			\$ -	4.7	1500	3000	\$	14,242	\$ 103,755
MH 29	MH 30	120.0	0.10	910.9	911.8	907.04	906.92	3.9	4.9	4.4	675	120.0	1085	\$ ¢	130,200			\$ -	3.9	1500	3000	\$ ¢	11,580	\$ 141,780
MH 30	MH 31 MH 32	120.0 120.0	0.10	911.8	911.4	906.92	906.80	4.9 4.6	4.6	4.7 4.9	675 675	120.0 120.0	1085	\$	130,200 130,200			\$ - \$ -	4.9 4.6	1500	3000 3000	\$	14,610	\$ 144,810
MH 31	MH 33		0.10	911.4	911.9 911.9	906.80 906.68	906.68 906.56	5.2	5.2	5.3	675		1085	\$			+	\$ - \$ -	5.2	1500 1500	3000	¢	13,710 15,750	\$ 143,910 \$ 151,950
MH 32 MH 33	MH 34	120.0 125.5	0.10 0.10	911.9 911.9	911.9	906.56	906.36	5.3	3.7	4.5	675	120.0	1135	\$	136,200	125.5	3850	\$ 483,175	5.3	1500	3000	ċ	15,730	\$ 499,105
MH 34	MH 35	114.5	0.10	911.9	910.2	906.36	906.43	3.7	3.6	3.7	675	114.5	1040	\$	119,080	123.3	3630	\$ 463,175	3.7	1500	3000	ς ς	11,176	\$ 130,257
MH 35	MH 36	120.0	0.10	910.2	910.0	906.43	906.32	3.7	3.8	3.7	675	120.0	1040	\$	124,800		 	\$ - \$ -	3.6	1500	3000	ر د	10,920	\$ 135,720
MH 36	MH 37	120.0	0.10	910.0	910.0	906.32	906.20	3.8	3.9	3.8	675	120.0	1040	ر د	124,800		1	\$ - \$ -	3.8	1500	3000	ς ς	11,280	\$ 136,080
MH 37	MH 38	120.0	0.10	910.0	910.0	906.20	905.96	3.9	4.0	3.9	675	120.0	1040	ς ,	124,800		 	\$ -	3.9	1500	3000	ς .	11,640	\$ 136,440
MH 38	MH 39	120.0	0.10	910.0	910.0	905.96	905.84	4.0	4.0	4.1	675	120.0	1040	ς .	130.200		 	\$ - \$ -	4.0	1500	3000	ς ,	12,000	\$ 142,200
MH 39	MH 40	120.0	0.10	910.0	910.0	905.84	905.72	4.0	4.1	4.1	675	120.0	1085	\$	130,200		 	\$ -	4.0	1500	3000	\$	12,360	\$ 142,560
MH 40	MH 41	120.0	0.10	910.0	910.0	905.72	905.60	4.1	4.4	4.2	675	120.0	1085	\$	130,200		 	\$ -	4.1	1500	3000	Ś		\$ 142,920
MH 41	MH 42	120.0	0.10	910.0	910.0	905.60	905.48	4.4	4.5	4.4	675	120.0	1085	\$	130,200			\$ -	4.4	1500	3000	\$		\$ 143,280
MH 42	MH 43	120.0	0.10	910.0	910.0	905.48	905.36	4.4	4.6	4.5	675	120.0	1085	\$	130,200		 	\$ -	4.5	1500	3000	\$		\$ 143,640
MH 43	MH 44	78.8	0.10	910.0	908.8	905.36	905.28	4.6	3.5	4.0	675	78.8	1085	\$	85,498			\$ -	4.6	1500	3000	Ś		\$ 99,298
MH 44	MH 45	120.0	0.10	908.8	908.3	902.95	902.83	5.8	5.4	5.6	675	90.0	1135	\$	102,150	30.0	3850	\$ 115,500	5.8	1500	3000	Ś		\$ 235,140
MH 45	MH 46	120.0	0.10	908.3	906.4	902.83	902.71	5.4	3.7	4.6	675	50.0	1133	\$	-	120.0	3850	\$ 462,000	5.4	1500	3000	Ś	16,290	\$ 478,290
MH 46	Ex. MH	78.8	0.10	906.4	907.4	902.71	902.63	3.7	4.8	4.2	675			\$	_	78.8	3850	\$ 303,380	3.7	1500	3000	\$	11,040	\$ 314,420
1	-23.14111	4931.1		300.1	557.1	, ,,,,,	302.03	0.,			,,	3440.8		٠,		1490.3		+ - 55,550	J.,				Sub-total	

Contingency (20%) \$ 1,872,289

Sub-total \$ 11,233,733 70 Street Connection \$ 210,210

Land Acquisition \$ 210,059

Total Construction Cost \$ 11,654,002

Engineering and Construction Administration (10%) \$ 1,165,400

Permits and Approvals (2%) \$ 233,080

Total Estimated Project Cost \$ 13,052,483

Table H-1b
Alignment 1
Alternative 1 Flows

Pump Stati	on and For	cemain Opt	tion										Open Cut			Trenchless			U	/S MH			
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)	Cost	Length (m)	Unit Cost (\$/m)	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)	Cost		Total
MH 1	MH 2	120.0	1.50	935.1	932.0	930.00	928.20	5.0	3.8	4.4	300	120.0	805	\$ 96,600			\$ -	5.0	1200	2400	\$ 12,120	\$	108,720
MH 2	MH 3	120.0	1.50	932.0	928.5	927.20	925.40	4.8	3.1	4.0	300	120.0	805	\$ 96,600			\$ -	4.8	1200	2400	\$ 11,520	\$	108,120
MH 3	MH 4	60.0	1.50	928.5	926.7	924.40	923.50	4.1	3.2	3.7	300	60.0	750	\$ 45,000			\$ -	4.1	1200	2400	\$ 9,912	\$	54,912
MH 4	MH 5	60.0	1.50	926.7	924.0	922.50	921.60	4.2	2.4	3.3	300	60.0	750	\$ 45,000			\$ -	4.2	1200	2400	\$ 10,128	\$	55,128
MH 5	MH 6	120.0	1.50	924.0	923.2	921.11	919.31	2.9	3.9	3.4	300	120.0	750	\$ 90,000			\$ -	2.9	1200	2400	\$ 6,936	\$	96,936
MH 6	MH 7	120.0	1.50	923.2	921.3	919.31	917.51	3.9	3.8	3.8	300	120.0	750	\$ 90,000			\$ -	3.9	1200	2400	\$ 9,312	\$	99,312
MH 7	MH 8	120.0	0.50	921.3	920.6	917.36	916.76	4.0	3.8	3.9	375	120.0	810	\$ 97,200			\$ -	4.0	1200	2400	\$ 9,504	\$	106,704
MH 8	MH 9	120.0	0.50	920.6	919.8	916.76	916.16	3.8	3.6	3.7	375	120.0	810	\$ 97,200			\$ -	3.8	1200	2400	\$ 9,120	\$	106,320
MH 9	MH 10	120.0	0.50	919.8	919.3	916.16	915.56	3.6	3.8	3.7	375	120.0	810	\$ 97,200			\$ -	3.6	1200	2400	\$ 8,760	\$	105,960
MH 10	MH 11	120.0	0.50	919.3	918.8	915.56	914.96	3.8	3.8	3.8	375	120.0	810	\$ 97,200			\$ -	3.8	1200	2400	\$ 9,000	\$	106,200
MH 11	MH 12	120.0	0.50	918.8	917.9	914.96	914.36	3.8	3.6	3.7	375	120.0	810	\$ 97,200			\$ -	3.8	1200	2400	\$ 9,192	\$	106,392
MH 12	MH 13	120.0	0.50	917.9	917.7	914.36	913.76	3.6	3.9	3.7	375	120.0	810	\$ 97,200			\$ -	3.6	1200	2400	\$ 8,568	\$	105,768
MH 13	MH 14	120.0	0.10	917.7	917.6	913.62	913.50	4.0	4.1	4.1	525	120.0	975	\$ 117,000			\$ -	4.0	1200	2400	\$ 9,672	\$	126,672
MH 14	MH 15	120.0	0.10	917.6	918.7	913.50	913.38	4.1	5.3	4.7	525	120.0	975	\$ 117,000			\$ 	4.1	1200	2400	\$ 9,792	\$	126,792
MH 15	MH 16	120.0	0.10	918.7	919.8	913.38	913.26	5.3	6.5	5.9	525	75.0	910	\$ 68,250	45.0	3400	\$ 153,000	5.3	1200	2400	\$ 12,720	\$	233,970
MH 16	Ex. MH	3251.1	N/A	919.8	907.4	916.80	904.42	3.0	3.0	3.0	400	3251.1	810	\$ 2,633,391				3.0	1200	2400	\$ 7,200	\$	2,640,591
·		4931 1		-			-				·	4886 1			<u>45 0</u>	•	 		•		Sub-total	Ċ	4 288 497

4931.1 4886.1 45.0 **Sub-total \$ 4,288,497**

 Sub-total
 \$ 4,288,497

 Contingency (20%)
 \$ 857,699

 Sub-total
 \$ 5,146,196

 70 Street Connection
 \$ 955,110

 Pump Station
 \$ 2,018,250

 Land Acquisition
 \$ 210,059

 Total Construction Cost
 \$ 7,374,505

Engineering and Construction Administration (10%) \$ 737,451 Permits and Approvals (2%) \$ 147,490

Total Estimated Project Cost \$ 8,259,446

Table H-1c Alignment 1 **Alternative 2 Flows**

From To Length (m) Pipe Slope (%) Pipe Slope (%
MH 2 MH 3 120.0 1.50 932.0 928.5 927.20 925.40 4.8 3.1 4.0 450 120.0 915 \$ 109,800 \$ - 4.8 1200 2400 \$ 11,520 \$ 121,3 MH 3 MH 4 60.0 1.50 928.5 926.7 924.40 923.50 4.1 3.2 3.7 450 60.0 870 \$ 52,200 \$ - 4.1 1200 2400 \$ 9,912 \$ 62,1 MH 5 60.0 1.50 926.7 924.0 922.50 921.60 4.2 2.4 3.3 450 60.0 870 \$ 52,200 \$ - 4.1 1200 2400 \$ 91,012 \$ 62,1 MH 5 MH 6 120.0 1.50 924.0 923.2 921.1 919.31 2.9 3.9 3.4 450 120.0 870 \$ 104,400 \$ \$ - 4.2 1200 2400 \$ 9,312 \$ 113,7 MH 7
MH 3 MH 4 60.0 1.50 928.5 926.7 924.40 923.50 4.1 3.2 3.7 450 60.0 870 \$ 52,200 \$ - 4.1 1200 2400 \$ 9,912 \$ 62,1 MH 4 MH 5 60.0 1.50 926.7 924.0 922.50 921.60 4.2 2.4 3.3 450 60.0 870 \$ 52,200 \$ - 4.2 1200 2400 \$ 10,128 \$ 62,3 MH 5 MH 6 120.0 1.50 924.0 923.2 921.11 919.31 2.9 3.9 3.4 450 120.0 870 \$ 104,400 \$ 5 - 2.9 1200 2400 \$ 6,936 \$ 111,3 MH 7 10.0 1.50 923.2 921.3 919.31 191.51 3.9 3.8 3.8 450 120.0 870 \$ 104,400 \$ \$ - 4.0 120.0 930 \$ 111,600 \$ <t< td=""></t<>
MH 4 MH 5 60.0 1.50 926.7 924.0 922.50 921.60 4.2 2.4 3.3 450 60.0 870 \$ 52,200 \$ - 4.2 1200 2400 \$ 10,128 \$ 62,3 MH 5 MH 6 120.0 1.50 924.0 923.2 921.1 191.31 2.9 3.9 3.4 450 120.0 870 \$ 104,400 \$ - 2.9 1200 2400 \$ 6,936 \$ 111,3 MH 6 MH 7 120.0 1.50 923.2 921.3 191.31 916.76 4.0 3.8 3.8 450 120.0 870 \$ 104,400 \$ - 2.9 1200 2400 \$ 6,936 \$ 111,3 MH 7 MH 8 120.0 0.50 921.3 920.6 917.36 916.76 4.0 3.8 3.9 525 120.0 930 \$ 111,600 \$ - 3.9 120.0 2400 \$ 9,504 \$ 121,1 MH 9 MH 10 120.0
MH 5 MH 6 120.0 1.50 924.0 923.2 921.11 919.31 2.9 3.9 3.4 450 120.0 870 \$ 104,400 \$ - 2.9 1200 2400 \$ 6,936 \$ 111,3 MH 6 MH 7 120.0 1.50 923.2 921.3 919.31 917.51 3.9 3.8 3.8 450 120.0 870 \$ 104,400 \$ - 3.9 1200 2400 \$ 9,312 \$ 113,7 MH 7 MH 8 120.0 0.50 921.3 920.6 917.36 916.76 4.0 3.8 3.9 525 120.0 930 \$ 111,600 \$ - 4.0 1200 2400 \$ 9,504 \$ 121,1 MH 8 MH 9 120.0 0.50 920.6 919.8 916.76 916.16 3.8 3.6 3.7 525 120.0 930 \$ 111,600 \$ - 3.8 120 2400 \$ 9,120 \$ 120,7 <
MH 6 MH 7 120.0 1.50 923.2 921.3 919.31 917.51 3.9 3.8 3.8 450 120.0 870 \$ 104,400 \$ - 3.9 1200 2400 \$ 9,312 \$ 113,7 MH 7 MH 8 120.0 0.50 921.3 920.6 917.36 916.76 4.0 3.8 3.9 525 120.0 930 \$ 111,600 \$ - 4.0 1200 2400 \$ 9,504 \$ 121,1 MH 8 MH 9 120.0 0.50 920.6 919.8 916.16 3.8 3.6 3.7 525 120.0 930 \$ 111,600 \$ - 3.8 1200 2400 \$ 9,504 \$ 121,1 MH 9 MH 10 120.0 0.50 919.8 919.3 916.16 918.56 3.6 3.8 3.7 525 120.0 930 \$ 111,600 \$ - 3.6 1200 2400 \$ 9,702 \$ 120,3 MH 10 MH 11 120.0 0.50<
MH 7 MH 8 12.0 0.50 921.3 920.6 916.76 4.0 3.8 3.9 525 120.0 930 \$ 111,600 \$ - 4.0 1200 2400 \$ 9,504 \$ 121,1 MH 8 MH 9 12.0 0.50 920.6 919.8 916.76 916.16 3.8 3.6 3.7 525 120.0 930 \$ 111,600 \$ - 4.0 1200 2400 \$ 9,504 \$ 120,7 MH 9 MH 10 12.0 0.50 919.8 919.3 916.16 915.56 3.6 3.8 3.7 525 120.0 930 \$ 111,600 \$ - 3.6 1200 2400 \$ 9,504 \$ 120,7 MH 10 12.0 0.50 919.8 919.3 916.16 915.56 3.6 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8
MH 8 MH 9 120.0 0.50 920.6 919.8 916.76 916.16 3.8 3.6 3.7 525 120.0 930 \$ 111,600 \$ - 3.8 1200 2400 \$ 9,120 \$ 120,7 MH 9 MH 10 120.0 0.50 919.8 919.3 916.16 915.56 3.6 3.8 3.7 525 120.0 930 \$ 111,600 \$ - 3.6 1200 2400 \$ 8,760 \$ 120,3 MH 10 MH 11 120.0 0.50 919.3 918.8 915.56 914.96 3.8 3.8 3.8 3.8 525 120.0 930 \$ 111,600 \$ - 3.8 1200 2400 \$ 9,700 \$ 120,6 MH 11 MH 12 120.0 0.50 918.8 917.9 914.96 914.36 3.8 3.6 3.7 525 120.0 930 \$ 111,600 \$ - 3.8 1200 2400 \$ 9,900 \$ 120,7 MH 12 MH
MH 9 MH 10 120.0 0.50 919.8 919.3 916.16 915.56 3.6 3.8 3.7 525 120.0 930 \$ 111,600 \$ - 3.6 1200 2400 \$ 8,760 \$ 120,3 MH 10 MH 11 120.0 0.50 919.3 918.8 915.56 914.96 3.8 3.8 3.8 525 120.0 930 \$ 111,600 \$ - 3.6 1200 2400 \$ 9,000 \$ 120,6 MH 11 MH 12 120.0 0.50 918.8 917.9 914.96 914.36 3.8 3.6 3.7 525 120.0 930 \$ 111,600 \$ - 3.8 1200 2400 \$ 9,000 \$ 120,6 MH 12 MH 13 120.0 0.50 918.8 917.9 914.36 3.8 3.6 3.7 525 120.0 930 \$ 111,600 \$ - 3.8 1200 2400 \$ 9,912 \$ 120,7 MH 12 MH 13 120.0 <th< td=""></th<>
MH 10 MH 11 120.0 0.50 919.3 918.8 915.56 914.96 3.8 3.8 3.8 525 120.0 930 \$ 111,600 \$ - 3.8 1200 2400 \$ 9,000 \$ 120,60 MH 11 MH 12 120.0 0.50 918.8 917.9 914.36 3.8 3.6 3.7 525 120.0 930 \$ 111,600 \$ - 3.8 1200 2400 \$ 9,000 \$ 120,60 MH 12 120.0 0.50 918.8 917.9 914.36 3.8 3.6 3.7 525 120.0 930 \$ 111,600 \$ - 3.8 1200 2400 \$ 9,192 \$ 120,7 MH 12 MH 13 120.0 0.50 917.9 917.7 914.36 913.76 3.6 3.9 3.7 525 120.0 930 \$ 111,600 \$ - 3.6 1200 2400 \$ 8,568 \$ 120,0 MH 13 MH 14 120.0 0.10 917.
MH 11 MH 12 120.0 0.50 918.8 917.9 914.96 914.36 3.8 3.6 3.7 525 120.0 930 \$ 111,600 \$ - 3.8 1200 2400 \$ 9,192 \$ 120,7 MH 12 MH 13 120.0 0.50 917.9 917.7 914.36 913.76 3.6 3.9 3.7 525 120.0 930 \$ 111,600 \$ - 3.6 1200 2400 \$ 9,192 \$ 120,7 MH 13 MH 14 120.0 0.10 917.7 917.6 913.62 913.50 4.0 4.1 4.1 675 120.0 1085 \$ 130,200 \$ - 4.0 1500 3000 \$ 12,040 \$ 142,4 MH 14 MH 15 120.0 0.10 917.6 918.7 913.50 913.38 4.1 5.3 4.7 675 120.0 1085 \$ 130,200 \$ - 4.1 1500 3000 \$ 12,240 \$ 142,4
MH 12 MH 13 120.0 0.50 917.9 917.7 914.36 913.76 3.6 3.9 3.7 525 120.0 930 \$ 111,600 \$ - 3.6 1200 2400 \$ 8,568 \$ 120,1 MH 13 MH 14 120.0 0.10 917.7 917.6 913.62 913.50 4.0 4.1 4.1 675 120.0 1085 \$ 130,200 \$ - 4.0 1500 3000 \$ 12,000 \$ 142,4 MH 14 MH 15 120.0 0.10 917.6 918.7 913.50 913.38 4.1 5.3 4.7 675 120.0 1085 \$ 130,200 \$ - 4.1 1500 3000 \$ 12,240 \$ 142,4
MH 13 MH 14 120.0 0.10 917.7 917.6 913.62 913.50 4.0 4.1 4.1 675 120.0 1085 \$ 130,200 \$ - 4.0 1500 3000 \$ 12,090 \$ 142,20 MH 14 MH 15 120.0 0.10 917.6 918.7 913.50 913.38 4.1 5.3 4.7 675 120.0 1085 \$ 130,200 \$ - 4.1 1500 3000 \$ 12,240 \$ 142,40
MH 14 MH 15 120.0 0.10 917.6 918.7 913.50 913.38 4.1 5.3 4.7 675 120.0 1085 \$ 130,200 \$ \$ - 4.1 1500 3000 \$ 12,240 \$ 142,40
MH 15 MH 16 120.0 0.10 918.7 919.8 913.38 913.26 5.3 6.5 5.9 750 75.0 1400 \$ 105,000 45.0 4350 \$ 195,750 5.3 1500 3000 \$ 15,900 \$ 316,60
MH 16 MH 17 133.5 0.10 919.8 921.7 913.26 913.13 6.5 8.6 7.6 750 \$ - 133.5 4350 \$ 580,725 6.5 1500 3000 \$ 19,620 \$ 600,3
MH 17 MH 18 77.5 0.10 921.7 923.4 913.13 913.05 8.6 10.3 9.5 750 \$ - 77.5 4350 \$ 337,125 8.6 1500 3000 \$ 25,811 \$ 362,9
MH 18 MH 19 64.2 0.10 923.4 924.1 913.05 912.98 10.3 11.1 10.7 750 \$ - 64.2 4350 \$ 279,270 10.3 1500 3000 \$ 30,933 \$ 310,2
MH 19 MH 20 31.8 0.10 924.1 924.6 912.98 912.95 11.1 11.6 11.4 750 \$ - 31.8 4350 \$ 138,330 11.1 1500 3000 \$ 33,286 \$ 171,6
MH 20 MH 21 53.0 0.10 924.6 924.7 912.95 912.90 11.6 11.8 11.7 750 \$ - 53.0 4350 \$ 230,550 11.6 1500 3000 \$ 34,881 \$ 265,4
MH 21 MH 22 120.0 0.10 924.7 924.9 912.90 912.78 11.8 12.2 12.0 750 \$ - 120.0 4350 \$ 522,000 11.8 1500 3000 \$ 35,430 \$ 557,400 \$ 557
MH 22 MH 23 120.0 0.10 924.9 924.5 912.78 912.66 12.2 11.9 12.0 750 \$ - 120.0 4350 \$ 522,000 12.2 1500 3000 \$ 36,480 \$ 558,4
MH 23 MH 24 120.0 0.10 924.5 923.8 912.66 912.54 11.9 11.3 11.6 900 \$ - 120.0 4800 \$ 576,000 11.9 1800 3400 \$ 40,358 \$ 616,3
MH 24 MH 25 120.0 0.10 923.8 920.1 912.54 912.42 11.3 7.6 9.5 900 \$ - 120.0 4800 \$ 576,000 11.3 1800 3400 \$ 38,386 \$ 614,3
MH 25 MH 26 93.5 0.10 920.1 916.2 912.42 912.33 7.6 3.9 5.8 900 \$ - 93.5 4800 \$ 448,800 7.6 1800 3400 \$ 25,976 \$ 474,7
MH 26 MH 27 61.3 0.10 916.2 912.7 907.28 907.22 8.9 5.5 7.2 900 \$ - 61.3 4800 \$ 294,240 8.9 1800 3400 \$ 30,362 \$ 324,640 \$ - 61.3 4800 \$ 294,240 \$ - 61.3 4800 \$ - 61.
MH 27 MH 28 96.2 0.10 912.7 911.9 907.22 907.12 5.5 4.7 5.1 900 \$ - 96.2 4800 \$ 461,760 5.5 1800 3400 \$ 18,602 \$ 480,300 \$ 18,602 \$ 18,
MH 28 MH 29 82.5 0.10 911.9 910.9 907.12 907.04 4.7 3.9 4.3 900 82.5 1415 \$ 116,738 \$ \$ - 4.7 1800 3400 \$ 16,141 \$ 132,8
MH 29 MH 30 120.0 0.10 910.9 911.8 907.04 906.92 3.9 4.9 4.4 900 120.0 1415 \$ 169,800 \$ - 3.9 1800 3400 \$ 13,124 \$ 182,9
MH 30 MH 31 120.0 0.10 911.8 911.4 906.92 906.80 4.9 4.6 4.7 900 120.0 1415 \$ 169,800 \$ 5 - 4.9 1800 3400 \$ 16,558 \$ 186,3
MH 31 MH 32 120.0 0.10 911.4 911.9 906.80 906.68 4.6 5.2 4.9 900 120.0 1415 \$ 169,800 \$ \$ - 4.6 1800 3400 \$ 15,538 \$ 185,3
11111 52 11111 53 1250 5125 51215 51215 5150 515 515 515 515 515 515 515 515
MH 33 MH 34 125.5 0.10 911.9 910.2 906.56 906.43 5.3 3.7 4.5 900 \$ \$ - 125.5 4800 \$ 602,400 5.3 1800 3400 \$ 18,054 \$ 620,400 MH 34 MH 35 114.5 0.10 910.2 910.0 906.43 906.32 3.7 3.6 3.7 900 114.5 1300 \$ 148.850 \$ \$ - 3.7 1800 3400 \$ 12.667 \$ 161.5
11111 51 11111 51 12 13 13 13 13 13 13 13 13 13 13 13 13 13
MH 35 MH 36 120.0 0.10 910.0 910.0 906.32 906.20 3.6 3.8 3.7 900 120.0 1300 \$ 156,000 \$ 5 - 3.6 1800 3400 \$ 12,376 \$ 168,3
MH 41 MH 42 120.0 0.10 910.0 910.0 905.60 905.48 4.4 4.5 4.4 900 120.0 1415 \$ 169,800 \$ - 4.4 1800 3400 \$ 14,824 \$ 184,6 MH 42 MH 43 120.0 0.10 910.0 910.0 905.48 905.36 4.5 4.6 4.5 900 120.0 1415 \$ 169,800 \$ - 4.5 1800 3400 \$ 15,232 \$ 185,00
MH 45 MH 46 120.0 0.10 908.3 906.4 902.83 902.71 5.4 3.7 4.6 900 \$ - 120.0 4800 \$ 576,000 5.4 1800 3400 \$ 18,462 \$ 594,4 MH 46 Ex. MH 78.8 0.10 906.4 907.4 902.71 902.63 3.7 4.8 4.2 900 \$ - 78.8 4800 \$ 378,240 3.7 1800 3400 \$ 12,512 \$ 390,7
4931.1 3440.8 1490.3 50.4 907.4 907.4 902.71 902.03 5.7 4.8 4.2 900 \$ 12,312 \$ 390,7

Contingency (20%) \$ 2,352,141 Sub-total \$ 14,112,847 70 Street Connection \$ 210,210

Land Acquisition \$ 210,059

Total Construction Cost \$ 14,533,116

Engineering and Construction Administration (10%) \$ 1,453,312

Permits and Approvals (2%) \$ 290,662 Total Estimated Project Cost \$ 16,277,090

Table 1d
Alignment 1
Alternative 2 Flows

Pump Stati	on and Ford	emain Opt	ion										Open Cut			Trenchless			U	/S MH			
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)	Cost	Length (m)	Unit Cost (\$/m)	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)	 Cost	Total	
MH 1	MH 2	120.0	1.50	935.1	932.0	930.00	928.20	5.0	3.8	4.4	450	120.0	915	\$ 109,800.00			\$ -	5.0	1200	2400	\$ 12,120	\$ 121	1,920
MH 2	MH 3	120.0	1.50	932.0	928.5	927.20	925.40	4.8	3.1	4.0	450	120.0	915	\$ 109,800.00			\$ -	4.8	1200	2400	\$ 11,520	\$ 121	1,320
MH 3	MH 4	60.0	1.50	928.5	926.7	924.40	923.50	4.1	3.2	3.7	450	60.0	870	\$ 52,200.00			\$ -	4.1	1200	2400	\$ 9,912	\$ 62	2,112
MH 4	MH 5	60.0	1.50	926.7	924.0	922.50	921.60	4.2	2.4	3.3	450	60.0	870	\$ 52,200.00			\$ -	4.2	1200	2400	\$ 10,128	\$ 62	2,328
MH 5	MH 6	120.0	1.50	924.0	923.2	921.11	919.31	2.9	3.9	3.4	450	120.0	870	\$ 104,400.00			\$ -	2.9	1200	2400	\$ 6,936	\$ 111	1,336
MH 6	MH 7	120.0	1.50	923.2	921.3	919.31	917.51	3.9	3.8	3.8	450	120.0	870	\$ 104,400.00			\$ -	3.9	1200	2400	\$ 9,312	\$ 113	3,712
MH 7	MH 8	120.0	0.50	921.3	920.6	917.36	916.76	4.0	3.8	3.9	525	120.0	930	\$ 111,600.00			\$ -	4.0	1200	2400	\$ 9,504	\$ 121	1,104
MH 8	MH 9	120.0	0.50	920.6	919.8	916.76	916.16	3.8	3.6	3.7	525	120.0	930	\$ 111,600.00			\$ -	3.8	1200	2400	\$ 9,120	\$ 120	0,720
MH 9	MH 10	120.0	0.50	919.8	919.3	916.16	915.56	3.6	3.8	3.7	525	120.0	930	\$ 111,600.00			\$ -	3.6	1200	2400	\$ 8,760	\$ 120	0,360
MH 10	MH 11	120.0	0.50	919.3	918.8	915.56	914.96	3.8	3.8	3.8	525	120.0	930	\$ 111,600.00			\$ -	3.8	1200	2400	\$ 9,000	\$ 120	0,600
MH 11	MH 12	120.0	0.50	918.8	917.9	914.96	914.36	3.8	3.6	3.7	525	120.0	930	\$ 111,600.00			\$ -	3.8	1200	2400	\$ 9,192	\$ 120	0,792
MH 12	MH 13	120.0	0.50	917.9	917.7	914.36	913.76	3.6	3.9	3.7	525	120.0	930	\$ 111,600.00			\$ -	3.6	1200	2400	\$ 8,568	\$ 120	0,168
MH 13	MH 14	120.0	0.10	917.7	917.6	913.62	913.50	4.0	4.1	4.1	675	120.0	1085	\$ 130,200.00			\$ -	4.0	1500	3000	\$ 12,090	\$ 142	2,290
MH 14	MH 15	120.0	0.10	917.6	918.7	913.50	913.38	4.1	5.3	4.7	675	120.0	1085	\$ 130,200.00			\$ -	4.1	1500	3000	\$ 12,240	\$ 142	2,440
MH 15	MH 16	120.0	0.10	918.7	919.8	913.38	913.26	5.3	6.5	5.9	750	75.0	1400	\$ 105,000.00	45.0	4350	\$ 195,750.00	5.3	1500	3000	\$ 15,900	\$ 316	6,650
MH 16	Ex. MH	3251.1	N/A	919.8	907.4	916.80	904.42	3.0	3.0	3.0	600	3251.1	970	\$ 3,153,567.00		_	_	3.0	1500	3000	\$ 9,000	\$ 3,162	2,567

4931.1

Sub-total \$ 5,080,419

Contingency (20%) \$ 1,016,084

Sub-total \$ 6,096,503 70 Street Connection \$ 955,110

Pump Station \$ 2,983,500

Land Acquisition \$ 210,059

Total Construction Cost \$ 10,245,172

Engineering and Construction Administration (10%) \$ 1,024,517

Permits and Approvals (2%) \$ 204,903

Total Estimated Project Cost \$ 11,474,592

Table H-2a Alignment 2 Alternative 1 Flows Gravity Sewer Option

Gravity Se	wer Option												Open Cut				Trenchless			U	I/S MH			<u> </u>
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)		Cost	Length (m)	Unit Cost (\$/m)	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)		Cost	Total
MH 1	MH 2	120.0	1.50	935.8	934.1	930.77	928.98	5.0	5.1	5.0	300	120.0	865	\$	103,800			\$ -	5.0	1200	2400	\$	12,072	\$ 115,872
MH 2	MH 3	120.0	1.50	934.1	929.6	928.00	926.20	6.0	3.4	4.7	300	120.0	805	\$	96,600			\$ -	6.0	1200	2400	\$	14,520	\$ 111,120
MH 3	MH 4	60.0	1.50	929.6	928.1	925.80	924.90	3.8	3.2	3.5	300	60.0	750	\$	45,000			\$ -	3.8	1200	2400	\$	9,048	\$ 54,048
MH 4	MH 5	60.0	1.50	928.1	927.6	924.90	924.00	3.2	3.6	3.4	300	60.0	750	\$	45,000			\$ -	3.2	1200	2400	\$	7,680	\$ 52,680
MH 5	MH 6	120.0	1.50	927.6	926.1	924.00	922.20	3.6	3.9	3.8	300	120.0	750	\$	90,000			\$ -	3.6	1200	2400	\$	8,736	\$ 98,736
MH 6	MH 7	120.0	1.50	926.1	924.7	922.20	920.40	3.9	4.3	4.1	300	120.0	805	\$	96,600			\$ -	3.9	1200	2400	\$	9,408	\$ 106,008
MH 7	MH 8	120.0	0.22	924.7	923.4	919.31	919.05	5.4	4.3	4.9	375	120.0	850	\$	102,000			\$ -	5.4	1200	2400	\$	12,936	\$ 114,936
MH 8	MH 9	120.0	0.22	923.4	922.6	919.05	918.78	4.3	3.8	4.1	375	120.0	850	\$	102,000			\$ -	4.3	1200	2400	\$	10,378	\$ 112,378
MH 9	MH 10	120.0	0.22	922.6	922.4	918.78	918.52	3.8	3.8	3.8	375	120.0	810	\$	97,200			\$ -	3.8	1200	2400	\$	9,187	\$ 106,387
MH 10	MH 11	120.0	0.22	922.4	922.2	918.52	918.25	3.8	4.0	3.9	375	120.0	810	\$	97,200			\$ -	3.8	1200	2400	\$	9,197	\$ 106,397
MH 11	MH 12	120.0	0.22	922.2	921.9	918.25	917.99	4.0	3.9	3.9	375	120.0	810	\$	97,200			\$ -	4.0	1200	2400	\$	9,518	\$ 106,718
MH 12	MH 13	120.0	0.22	921.9	922.0	917.99	917.73	3.9	4.3	4.1	375	120.0	850	\$	102,000			\$ -	3.9	1200	2400	\$	9,288	\$ 111,288
MH 13	MH 14	120.0	0.22	922.0	922.3	917.73	917.46	4.3	4.8	4.5	375	120.0	850	\$	102,000			\$ -	4.3	1200	2400	\$	10,330	\$ 112,330
MH 14	MH 15	120.0	0.22	922.3	923.6	917.46	917.20	4.8	6.4	5.6	375	120.0	910	\$	109,200			\$ -	4.8	1200	2400	\$	11,491	\$ 120,691
MH 15	MH 15A	33.9	0.22	923.6	923.8	917.20	917.12	6.4	6.7	6.5	375			\$	-	33.9	2400	\$ 81,360	6.4	1200	2400	\$	15,317	\$ 96,677
MH 15A	MH 16	86.1	0.10	923.8	921.9	914.46	914.37	9.3	7.5	8.4	525			\$	-	86.1	3400	\$ 292,740	9.3	1200	2400	\$	22,440	\$ 315,180
MH 16	MH 17	73.0	0.10	921.9	920.1	914.37	914.30	7.5	5.8	6.6	525			\$	-	73.0	3400	\$ 248,200	7.5	1200	2400	\$	17,991	\$ 266,191
MH 17	MH 18	86.1	0.10	920.1	918.9	914.30	914.21	5.8	4.6	5.2	525	20.0	1045	\$	20,900	66.1	3400	\$ 224,740	5.8	1200	2400	\$	13,894	\$ 259,534
MH 18	MH 19	120.0	0.10	918.9	918.4	914.21	914.09	4.6	4.3	4.5	525	60.0	975	\$	58,500	60.0	3400	\$ 204,000	4.6	1200	2400	\$	11,148	
MH 19	MH 20	120.0	0.10	918.4	920.5	914.09	913.97	4.3	6.5	5.4	525	120.0	1045	\$	125,400			\$ -	4.3	1200	2400	\$	10,428	\$ 135,828
MH 20	MH 21	110.0	0.10	920.5	923.2	913.97	913.86	6.5	9.3	7.9	525			\$	-	110.0	3400	\$ 374,000	6.5	1200	2400	\$	15,708	\$ 389,708
MH 21	MH 22	130.0	0.10	923.2	925.0	913.86	913.73	9.3	11.3	10.3	525			\$	-	130.0	3400	\$ 442,000	9.3	1200	2400	\$	22,284	\$ 464,284
MH 22	MH 23	120.0	0.10	925.0	921.9	913.73	913.61	11.3	8.3	9.8	525			\$	-	120.0	3400	\$ 408,000	11.3	1200	2400	\$	27,060	\$ 435,060
MH 23	MH 24	120.0	0.10	921.9	918.7	913.61	913.49	8.3	5.2	6.7	675	80.0	1135	\$	90,800	40.0	3850	\$ 154,000	8.3	1500	3000	\$	24,856	\$ 269,656
MH 24	MH 25	120.0	0.10	918.7	918.0	913.49	913.37	5.2	4.6	4.9	675	120.0	1085	\$	130,200			\$ -	5.2	1500	3000	\$	15,556	\$ 145,756
MH 25	MH 26	120.0	0.10	918.0	917.7	913.37	913.25	4.6	4.5	4.5	675	120.0	1085	\$	130,200			\$ -	4.6	1500	3000	\$	13,816	
MH 26	MH 27	67.4	0.10	917.7	917.5	913.25	913.19	4.5	4.3	4.4	675	67.4	1085	\$	73,129			\$ -	4.5	1500	3000	\$	13,426	\$ 86,555
MH 27	MH 28	120.0	0.10	917.5	913.0	907.63	907.51	9.9	5.5	7.7	675	120.0	1135	\$	136,200			\$ -	9.9	1500	3000	\$	29,610	
MH 28 MH 29	MH 29 MH 30	120.0 120.0	0.10 0.10	913.0 912.6	912.6 911.5	907.51 907.39	907.39 907.27	5.5 5.2	5.2 4.2	5.4 4.7	675 675	120.0 120.0	1135 1085	\$	136,200 130,200			\$ - \$ -	5.5 5.2	1500 1500	3000 3000	\$	16,470 15,720	\$ 152,670 \$ 145,920
MH 30	MH 31	120.0	0.10	911.5	911.6	907.27	907.15	4.2	4.4	4.7	675	120.0	1085	ç	130,200			\$ -	4.2	1500	3000	ç	12,660	\$ 142,860
MH 31	MH 32	120.0	0.10	911.6	910.9	907.15	907.13	4.4	3.8	4.3	675	120.0	1085	\$	130,200			\$ -	4.4	1500	3000	ç	13,200	\$ 143,400
MH 32	MH 33	120.0	0.10	910.9	910.7	907.03	906.91	3.8	3.7	3.8	675	120.0	1040	\$	124,800			\$ -	3.8	1500	3000	\$	11,460	\$ 136,260
MH 33	MH 34	120.0	0.10	910.7	910.9	906.91	906.79	3.7	4.1	3.9	675	120.0	1040	\$	124,800			\$ -	3.7	1500	3000	Ś	11,220	\$ 136,020
MH 34	MH 35	120.0	0.10	910.9	910.1	906.79	906.67	4.1	3.4	3.7	675	120.0	1040	\$	124,800			\$ -	4.1	1500	3000	Ś	12,180	\$ 136,980
MH 35	MH 36	95.0	0.10	910.1	910.2	906.67	906.58	3.4	3.6	3.5	675			Ś		95.0	3850	\$ 365,750	3.4	1500	3000	Ś	10,260	\$ 376,010
MH 36	MH 37	120.0	0.10	910.2	909.1	904.84	904.72	5.4	4.4	4.9	675	120.0	1085	Ś	130,200			\$ -	5.4	1500	3000	\$	16,080	\$ 146,280
MH 37	MH 38	120.0	0.10	909.1	908.9	904.72	904.60	4.4	4.3	4.3	675	120.0	1085	\$	130,200			\$ -	4.4	1500	3000	\$	13,140	
MH 38	MH 39	120.0	0.10	908.9	908.9	904.60	904.48	4.3	4.4	4.3	675	120.0	1085	\$	130,200			\$ -	4.3	1500	3000	\$	12,780	\$ 142,980
MH 39	MH 40	120.0	0.10	908.9	908.8	904.48	904.36	4.4	4.4	4.4	675	120.0	1085	\$	130,200			\$ -	4.4	1500	3000	\$	13,140	
MH 40	MH 41	120.0	0.10	908.8	908.3	904.36	904.24	4.4	4.0	4.2	675	120.0	1085	\$	130,200			\$ -	4.4	1500	3000	\$	13,260	\$ 143,460
MH 41	MH 42	120.0	0.10	908.3	908.1	904.24	904.12	4.0	4.0	4.0	675	120.0	1085	\$	130,200			\$ -	4.0	1500	3000	\$	12,150	\$ 142,350
MH 42	MH 43	120.0	0.10	908.1	907.9	904.12	904.00	4.0	3.9	3.9	675	120.0	1040	\$	124,800			\$ -	4.0	1500	3000	\$	11,850	\$ 136,650
MH 43	MH 44	120.0	0.10	907.9	907.7	904.00	903.88	3.9	3.9	3.9	675	120.0	1040	\$	124,800			\$ -	3.9	1500	3000	\$	11,610	\$ 136,410
MH 44	MH 45	120.0	0.10	907.7	907.8	903.88	903.76	3.9	4.0	3.9	675	120.0	1040	\$	124,800			\$ -	3.9	1500	3000	\$	11,580	\$ 136,380
MH 45	MH 46	120.0	0.10	907.8	907.7	903.76	903.64	4.0	4.1	4.0	675	120.0	1085	\$	130,200			\$ -	4.0	1500	3000	\$	11,970	
MH 46	MH 47	120.0	0.10	907.7	907.1	903.64	903.52	4.1	3.6	3.9	675	120.0	1040	\$	124,800			\$ -	4.1	1500	3000	\$	12,270	
MH 47	MH 48	120.0	0.10	907.1	907.7	903.52	903.40	3.6	4.3	4.0	675	120.0	1085	\$	130,200			\$ -	3.6	1500	3000	\$	10,830	
MH 48	MH 49	120.0	0.10	907.7	907.0	903.40	903.28	4.3	3.7	4.0	675	120.0	1085	\$	130,200			\$ -	4.3	1500	3000	\$	12,870	
MH 49	MH 50	120.0	0.10	907.0	906.5	903.28	903.16	3.7	3.3	3.5	675	120.0	1040	\$	124,800			\$ -	3.7	1500	3000	\$	11,130	
MH 50	MH 51	100.0	0.10	906.5	905.2	903.16	903.06	3.3	2.1	2.7	675	100.0	1040	\$	104,000	05.5	0.0	\$ -	3.3	1500	3000	\$	9,900	
MH 51	MH 52	120.0	0.10	905.2	906.1	903.06	902.94	2.1	3.2	2.6	675	40.0	1040	\$	41,600	80.0	3850	\$ 308,000	2.1	1500	3000	\$	6,300	
MH 52	MH 53	120.0	0.10	906.1	907.0	902.94	902.82	3.2	4.1	3.6	675	20.0	1040	\$	20,800	100.0	3850	\$ 385,000	3.2	1500	3000	\$	9,450	
MH 53	MH 54	72.0	0.10	907.0	907.3	902.82	902.75	4.1	4.6	4.3	675	72.0	1085	\$	78,120			\$ -	4.1	1500	3000	\$	12,420	
MH 54	MH 55	80.0	0.10	907.3	907.8	902.75	902.67	4.6	5.2	4.9	675	80.0	1085	\$	86,800			\$ -	4.6	1500	3000	\$	13,656	
MH 55	MH 56	120.0	0.10	907.8	907.4	902.67	902.55	5.2	4.9	5.0	675	120.0	1135	\$	136,200			\$ - \$ -	5.2	1500	3000	\$	15,516	
MH 56	Ex. MH	62.0 6275.5	0.10	907.4	907.4	902.55	902.49	4.9	4.9	4.9	675	62.0 5281.4	1085	\$	67,270	994.1	l	\$ -	4.9	1500	3000	Ş	14,616 Sub-total	

6275.5 5281.4 Sub-total \$ 9,527,720 994.1

Contingency (20%) \$ 1,905,544

Sub-total \$ 11,433,264 70 Street Connection \$ 430,170

Land Acquisition \$ 210,059 Total Construction Cost \$ 12,073,493

Engineering and Construction Administration (10%) \$ 1,207,349

Permits and Approvals (2%) \$ 241,470 Total Estimated Project Cost \$ 13,522,312

Table H-2b Alignment 2 Alternative 1 Flows

Pump Stat	ion and For	cemain Opt	tion										Open Cut			Trenchless			ι	J/S MH		
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)	Cost	Length (m)	Unit Cost (\$/m)	Cost	Vt.	MH Size n Required (mm)	Unit Cost (\$/vt. m)	Cost	Total
MH 1	MH 2	120.0	1.50	935.8	934.1	930.77	928.98	5.0	5.1	5.0	300	120.0	865	\$ 103,800			\$ -	5.0	1200	2400	\$ 12,072	\$ 115,872
MH 2	MH 3	120.0	1.50	934.1	929.6	928.00	926.20	6.0	3.4	4.7	300	120.0	805	\$ 96,600			\$ -	6.0	1200	2400	\$ 14,520	\$ 111,120
MH 3	MH 4	60.0	1.50	929.6	928.1	925.80	924.90	3.8	3.2	3.5	300	60.0	750	\$ 45,000			\$ -	3.8	1200	2400	\$ 9,048	\$ 54,048
MH 4	MH 5	60.0	1.50	928.1	927.6	924.90	924.00	3.2	3.6	3.4	300	60.0	750	\$ 45,000			\$ -	3.2	1200	2400	\$ 7,680	\$ 52,680
MH 5	MH 6	120.0	1.50	927.6	926.1	924.00	922.20	3.6	3.9	3.8	300	120.0	750	\$ 90,000			\$ -	3.0	1200	2400	\$ 8,736	\$ 98,736
MH 6	MH 7	120.0	1.50	926.1	924.7	922.20	920.40	3.9	4.3	4.1	300	120.0	805	\$ 96,600			\$ -	3.9	1200	2400	\$ 9,408	\$ 106,008
MH 7	MH 8	120.0	0.22	924.7	923.4	919.31	919.05	5.4	4.3	4.9	375	120.0	850	\$ 102,000			\$ -	5.4	1200	2400	\$ 12,936	\$ 114,936
MH 8	MH 9	120.0	0.22	923.4	922.6	919.05	918.78	4.3	3.8	4.1	375	120.0	850	\$ 102,000			\$ -	4.3	1200	2400	\$ 10,378	\$ 112,378
MH 9	MH 10	120.0	0.22	922.6	922.4	918.78	918.52	3.8	3.8	3.8	375	120.0	810	\$ 97,200			\$ -	3.8	1200	2400	\$ 9,187	\$ 106,387
MH 10	MH 11	120.0	0.22	922.4	922.2	918.52	918.25	3.8	4.0	3.9	375	120.0	810	\$ 97,200			\$ -	3.8	1200	2400	\$ 9,197	\$ 106,397
MH 11	MH 12	120.0	0.22	922.2	921.9	918.25	917.99	4.0	3.9	3.9	375	120.0	810	\$ 97,200			\$ -	4.0	1200	2400	\$ 9,518	\$ 106,718
MH 12	MH 13	120.0	0.22	921.9	922.0	917.99	917.73	3.9	4.3	4.1	375	120.0	850	\$ 102,000			\$ -	3.9	1200	2400	\$ 9,288	\$ 111,288
MH 13	MH 14	120.0	0.22	922.0	922.3	917.73	917.46	4.3	4.8	4.5	375	120.0	850	\$ 102,000			\$ -	4.3		2400	\$ 10,330	\$ 112,330
MH 14	MH 15	120.0	0.22	922.3	923.6	917.46	917.20	4.8	6.4	5.6	375	120.0	910	\$ 109,200			\$ -	4.8		2400	\$ 11,491	\$ 120,691
MH 15	MH 15A	33.9	0.22	923.6	923.8	917.20	917.12	6.4	6.7	6.5	375			\$ -	33.9	2400	\$ 81,3			2400	\$ 15,317	\$ 96,677
MH 15A	MH 16	86.1	0.10	923.8	921.9	914.46	914.37	9.3	7.5	8.4	525			\$ -	86.1	3400	\$ 292,7			2400	\$ 22,440	\$ 315,180
MH 16	MH 17	73.0	0.10	921.9	920.1	914.37	914.30	7.5	5.8	6.6	525			\$ -	73.0	3400	\$ 248,2	_		2400	\$ 17,991	\$ 266,191
MH 17	MH 18	86.1	0.10	920.1	918.9	914.30	914.21	5.8	4.6	5.2	525	20.0	1045	\$ 20,900	66.1	3400	\$ 224,7	_		2400	\$ 13,894	\$ 259,534
MH 18	Ex. MH	4436.4	N/A	918.9	918.4	915.86	915.44	3.0	3.0	3.0	400	4436.4	870	\$ 3,859,668				3.0	1200	2400	\$ 7,200	\$ 3,866,868

6275.5 Sub-total \$ 6,234,038

Contingency (20%) \$ 1,246,808

Sub-total \$ 7,480,846

70 Street Connection \$ 955,110

Pump Station \$ 2,018,250

Land Acquisition \$ 210,059

Total Construction Cost \$ 9,709,155

Engineering and Construction Administration (10%) \$ 970,915

Permits and Approvals (2%) \$ 194,183

Total Estimated Project Cost \$ 10,874,253

Table H-2c
Alignment 2
Alternative 2 Flows
Gravity Sewer Option

Gravity Sev	wer Option												Open Cut				Trenchless			U	/S MH		
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)		Cost	Length (m)	Unit Cost (\$/m)	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)	Cost	Total
MH 1	MH 2	120.0	1.50	935.8	934.1	930.77	928.98	5.0	5.1	5.0	450	120.0	915	\$	109,800			\$ -	5.0	1200	2400	\$ 12,072	\$ 121,872
MH 2	MH 3	120.0	1.50	934.1	929.6	928.00	926.20	6.0	3.4	4.7	450	120.0	915	\$	109,800			\$ -	6.0	1200	2400	\$ 14,520	\$ 124,320
MH 3	MH 4	60.0	1.50	929.6	928.1	925.80	924.90	3.8	3.2	3.5	450	60.0	870	\$	52,200			\$ -	3.8	1200	2400	\$ 9,048	\$ 61,248
MH 4	MH 5	60.0	1.50	928.1	927.6	924.90	924.00	3.2	3.6	3.4	450	60.0	870	\$	52,200			\$ -	3.2	1200	2400	\$ 7,680	\$ 59,880
MH 5	MH 6	120.0	1.50	927.6	926.1	924.00	922.20	3.6	3.9	3.8	450	120.0	870	\$	104,400			\$ -	3.6	1200	2400	\$ 8,736	\$ 113,136
MH 6	MH 7	120.0	1.50	926.1	924.7	922.20	920.40	3.9	4.3	4.1	450	120.0	915	\$	109,800			\$ -	3.9	1200	2400	\$ 9,408	\$ 119,208
MH 7	MH 8	120.0	0.22	924.7	923.4	919.31	919.05	5.4	4.3	4.9	600	120.0	1015	\$	121,800			\$ -	5.4	1200	2400	\$ 12,936	\$ 134,736
MH 8	MH 9	120.0	0.22	923.4	922.6	919.05	918.78	4.3	3.8	4.1	600	120.0	1015	\$	121,800			\$ -	4.3	1200	2400	\$ 10,378	\$ 132,178
MH 9	MH 10	120.0	0.22	922.6	922.4	918.78	918.52	3.8	3.8	3.8	600	120.0	970	\$	116,400			\$ -	3.8	1200	2400	\$ 9,187	\$ 125,587
MH 10	MH 11	120.0	0.22	922.4	922.2	918.52	918.25	3.8	4.0	3.9	600	120.0	970	\$	116,400			\$ -	3.8	1200	2400	\$ 9,197	\$ 125,597
MH 11	MH 12	120.0	0.22	922.2	921.9	918.25	917.99	4.0	3.9	3.9	600	120.0	970	\$	116,400			\$ -	4.0	1200	2400	\$ 9,518	\$ 125,918
MH 12	MH 13	120.0	0.22	921.9	922.0	917.99	917.73	3.9	4.3	4.1	600	120.0	1015	\$	121,800			\$ -	3.9	1200	2400	\$ 9,288	\$ 131,088
MH 13	MH 14	120.0	0.22	922.0	922.3	917.73	917.46	4.3	4.8	4.5	600	120.0	1015	\$	121,800			\$ -	4.3	1200	2400	\$ 10,330	\$ 132,130
MH 14	MH 15	120.0	0.22	922.3	923.6	917.46	917.20	4.8	6.4	5.6	600	120.0	1090	\$	130,800			\$ -	4.8	1200	2400	\$ 11,491	\$ 142,291
MH 15	MH 15A	33.9	0.22	923.6	923.8	917.20	917.12	6.4	6.7	6.5	600			\$	-	33.9	3650	\$ 123,735	6.4	1200	2400	\$ 15,317	\$ 139,052
MH 15A	MH 16	86.1	0.10	923.8	921.9	914.46	914.37	9.3	7.5	8.4	750			\$	-	86.1	4350	\$ 374,535	9.3	1500	3000	\$ 28,050	\$ 402,585
MH 16	MH 17	73.0	0.10	921.9	920.1	914.37	914.30	7.5	5.8	6.6	750			\$	-	73.0	4350	\$ 317,550	7.5	1500	3000	\$ 22,488	\$ 340,038
MH 17	MH 18	86.1	0.10	920.1	918.9	914.30	914.21	5.8	4.6	5.2	750	20.0	1240	\$	24,800	66.1	4350	\$ 287,535	5.8	1500	3000	\$ 17,367	\$ 329,702
MH 18	MH 19	120.0	0.10	918.9	918.4	914.21	914.09	4.6	4.3	4.5	750	60.0	1240	Ś	74,400	60.0	4350	\$ 261,000	4.6	1500	3000	\$ 13,936	\$ 349,336
MH 19	MH 20	120.0	0.10	918.4	920.5	914.09	913.97	4.3	6.5	5.4	750	120.0	1400	Ś	168,000			\$ -	4.3	1500	3000	\$ 13,036	\$ 181,036
MH 20	MH 21	110.0	0.10	920.5	923.2	913.97	913.86	6.5	9.3	7.9	750			\$	-	110.0	4350	\$ 478,500	6.5	1500	3000	\$ 19,636	\$ 498,136
MH 21	MH 22	130.0	0.10	923.2	925.0	913.86	913.73	9.3	11.3	10.3	750			\$	-	130.0	4350	\$ 565,500	9.3	1500	3000	\$ 27,856	\$ 593,356
MH 22	MH 23	120.0	0.10	925.0	921.9	913.73	913.61	11.3	8.3	9.8	750			\$	-	120.0	4350	\$ 522,000	11.3	1500	3000	\$ 33,826	\$ 555,826
MH 23	MH 24	120.0	0.10	921.9	918.7	913.61	913.49	8.3	5.2	6.7	900	60.0	1500	Ś	90,000	60.0	4800	\$ 288,000	8.3	1800	3400	\$ 28,170	\$ 406,170
MH 24	MH 25	120.0	0.10	918.7	918.0	913.49	913.37	5.2	4.6	4.9	900	120.0	1415	Ś	169,800			\$ -	5.2	1800	3400	\$ 17,630	\$ 187,430
MH 25	MH 26	120.0	0.10	918.0	917.7	913.37	913.25	4.6	4.5	4.5	900	120.0	1415	Ś	169,800			\$ -	4.6	1800	3400	\$ 15,658	\$ 185,458
MH 26	MH 27	67.4	0.10	917.7	917.5	913.25	913.19	4.5	4.3	4.4	900	67.4	1415	Ś	95,371			\$ -	4.5	1800	3400	\$ 15,216	\$ 110,587
MH 27	MH 28	120.0	0.10	917.5	913.0	907.63	907.51	9.9	5.5	7.7	900	120.0	1500	Ś	180,000			\$ -	9.9	1800	3400	\$ 33,558	\$ 213,558
MH 28	MH 29	120.0	0.10	913.0	912.6	907.51	907.39	5.5	5.2	5.4	900	120.0	1500	\$	180,000			\$ -	5.5	1800	3400	\$ 18,666	\$ 198,666
MH 29	MH 30	120.0	0.10	912.6	911.5	907.39	907.27	5.2	4.2	4.7	900	120.0	1415	\$	169,800			\$ -	5.2	1800	3400	\$ 17,816	\$ 187,616
MH 30	MH 31	120.0	0.10	911.5	911.6	907.27	907.15	4.2	4.4	4.3	900	120.0	1415	Ś	169,800			\$ -	4.2	1800	3400	\$ 14,348	\$ 184,148
MH 31	MH 32	120.0	0.10	911.6	910.9	907.15	907.03	4.4	3.8	4.1	900	120.0	1415	\$	169,800			\$ -	4.4	1800	3400	\$ 14,960	\$ 184,760
MH 32	MH 33	120.0	0.10	910.9	910.7	907.03	906.91	3.8	3.7	3.8	900	120.0	1300	\$	156,000			\$ -	3.8	1800	3400	\$ 12,988	\$ 168,988
MH 33	MH 34	120.0	0.10	910.7	910.9	906.91	906.79	3.7	4.1	3.9	900	120.0	1300	Ś	156,000			\$ -	3.7	1800	3400	\$ 12,716	\$ 168,716
MH 34	MH 35	120.0	0.10	910.9	910.1	906.79	906.67	4.1	3.4	3.7	900	120.0	1300	Ś	156,000			\$ -	4.1	1800	3400	\$ 13,804	\$ 169,804
MH 35	MH 36	95.0	0.10	910.1	910.2	906.67	906.58	3.4	3.6	3.5	900			\$	-	95.0	4800	\$ 456,000	3.4	1800	3400	\$ 11,628	\$ 467,628
MH 36	MH 37	120.0	0.10	910.2	909.1	904.84	904.72	5.4	4.4	4.9	900	120.0	1415	Ś	169,800			\$ -	5.4	1800	3400	\$ 18,224	\$ 188,024
MH 37	MH 38	120.0	0.10	909.1	908.9	904.72	904.60	4.4	4.3	4.3	900	120.0	1415	\$	169,800			\$ -	4.4	1800	3400	\$ 14,892	\$ 184,692
MH 38	MH 39	120.0	0.10	908.9	908.9	904.60	904.48	4.3	4.4	4.3	900	120.0	1415	\$	169,800			\$ -	4.3	1800	3400	\$ 14,484	\$ 184,284
MH 39	MH 40	120.0	0.10	908.9	908.8	904.48	904.36	4.4	4.4	4.4	900	120.0	1415	\$	169,800			\$ -	4.4	1800	3400	\$ 14,892	\$ 184,692
MH 40	MH 41	120.0	0.10	908.8	908.3	904.36	904.24	4.4	4.0	4.2	900	120.0	1415	\$	169,800			\$ -	4.4	1800	3400	\$ 15,028	\$ 184,828
MH 41	MH 42	120.0	0.10	908.3	908.1	904.24	904.12	4.0	4.0	4.0	900	120.0	1300	\$	156,000			\$ -	4.0	1800	3400	\$ 13,770	\$ 169,770
MH 42	MH 43	120.0	0.10	908.1	907.9	904.12	904.00	4.0	3.9	3.9	900	120.0	1300	\$	156,000			\$ -	4.0	1800	3400	\$ 13,430	\$ 169,430
MH 43	MH 44	120.0	0.10	907.9	907.7	904.00	903.88	3.9	3.9	3.9	900	120.0	1300	\$	156,000			\$ -	3.9	1800	3400	\$ 13,158	\$ 169,158
MH 44	MH 45	120.0	0.10	907.7	907.8	903.88	903.76	3.9	4.0	3.9	900	120.0	1300	\$	156,000		1	\$ -	3.9	1800	3400	\$ 13,124	\$ 169,124
MH 45	MH 46	120.0	0.10	907.8	907.7	903.76	903.64	4.0	4.1	4.0	900	120.0	1300	\$	156,000			\$ -	4.0	1800	3400	\$ 13,566	
MH 46	MH 47	120.0	0.10	907.7	907.1	903.64	903.52	4.1	3.6	3.9	900	120.0	1300	\$	156,000			\$ -	4.1	1800	3400	\$ 13,906	
MH 47	MH 48	120.0	0.10	907.1	907.7	903.52	903.40	3.6	4.3	4.0	900	120.0	1300	\$	156,000			\$ -	3.6	1800	3400	\$ 12,274	
MH 48	MH 49	120.0	0.10	907.7	907.0	903.40	903.28	4.3	3.7	4.0	900	120.0	1300	\$	156,000			\$ -	4.3	1800	3400	\$ 14,586	
MH 49	MH 50	120.0	0.10	907.0	906.5	903.28	903.16	3.7	3.3	3.5	900	120.0	1300	\$	156,000			\$ -	3.7	1800	3400	\$ 12,614	
MH 50	MH 51	100.0	0.10	906.5	905.2	903.16	903.06	3.3	2.1	2.7	900	100.0	1300	\$	130,000		1	\$ -	3.3	1800	3400	\$ 11,220	
MH 51	MH 52	120.0	0.10	905.2	906.1	903.06	902.94	2.1	3.2	2.6	900	40.0	1300	\$	52,000	80.0	1	\$ -	2.1	1800	3400	\$ 7,140	
MH 52	MH 53	120.0	0.10	906.1	907.0	902.94	902.82	3.2	4.1	3.6	900	20.0	1300	\$	26,000	100.0	1	\$ -	3.2	1800	3400	\$ 10,710	
MH 53	MH 54	72.0	0.10	907.0	907.3	902.82	902.75	4.1	4.6	4.3	900	72.0	1415	\$	101,880		1	\$ -	4.1	1800	3400	\$ 14,076	
MH 54	MH 55	80.0	0.10	907.3	907.8	902.75	902.67	4.6	5.2	4.9	900	80.0	1415	\$	113,200		1	\$ -	4.6	1800	3400	\$ 15,477	
MH 55	MH 56	120.0	0.10	907.8	907.4	902.67	902.55	5.2	4.9	5.0	900	120.0	1415	\$	169,800		1	\$ -	5.2	1800	3400	\$ 17,585	\$ 187,385
MH 56	Ex. MH	62.0	0.10	907.4	907.4	902.55	902.49	4.9	4.9	4.9	900	62.0	1415	\$	87,730		1	\$ -	4.9	1800	3400	\$ 16,565	
	1	6275.5										5261.4			,	1014.1						Sub-total	

 Sub-total
 \$ 11,096,112

 Contingency (20%)
 \$ 2,219,222

 Sub-total
 \$ 13,315,335

70 Street Connection \$ 430,170 Land Acquisition \$ 210,059

Total Construction Cost \$ 13,955,564

Engineering and Construction Administration (10%) \$ 1,395,556

Permits and Approvals (2%) \$ 279,111

Total Estimated Project Cost \$ 15,630,231

Table H-2d Alignment 2 **Alternative 2 Flows**

Pump Stat	ion and For	cemain Opt	tion										Open Cut			Trenchless			U	/S MH			
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)	Cost	Length (m)	Unit Cost (\$/m)	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)	Cost		Total
MH 1	MH 2	120.0	1.50	935.8	934.1	930.77	928.98	5.0	5.1	5.0	375	120.0	915	\$ 109,800			\$ -	5.0	1200	2400	\$ 12,072	\$	121,872
MH 2	MH 3	120.0	1.50	934.1	929.6	928.00	926.20	6.0	3.4	4.7	375	120.0	915	\$ 109,800			\$ -	6.0	1200	2400	\$ 14,520	\$	124,320
MH 3	MH 4	60.0	1.50	929.6	928.1	925.80	924.90	3.8	3.2	3.5	375	60.0	870	\$ 52,200			\$ -	3.8	1200	2400	\$ 9,048	\$	61,248
MH 4	MH 5	60.0	1.50	928.1	927.6	924.90	924.00	3.2	3.6	3.4	375	60.0	870	\$ 52,200			\$ -	3.2	1200	2400	\$ 7,680	\$	59,880
MH 5	MH 6	120.0	1.50	927.6	926.1	924.00	922.20	3.6	3.9	3.8	375	120.0	870	\$ 104,400			\$ -	3.6	1200	2400	\$ 8,736	\$	113,136
MH 6	MH 7	120.0	1.50	926.1	924.7	922.20	920.40	3.9	4.3	4.1	375	120.0	915	\$ 109,800			\$ -	3.9	1200	2400	\$ 9,408	\$	119,208
MH 7	MH 8	120.0	0.22	924.7	923.4	919.31	919.05	5.4	4.3	4.9	600	120.0	1015	\$ 121,800			\$ -	5.4	1200	2400	\$ 12,936	\$	134,736
MH 8	MH 9	120.0	0.22	923.4	922.6	919.05	918.78	4.3	3.8	4.1	600	120.0	1015	\$ 121,800			\$ -	4.3	1200	2400	\$ 10,378	\$	132,178
MH 9	MH 10	120.0	0.22	922.6	922.4	918.78	918.52	3.8	3.8	3.8	600	120.0	970	\$ 116,400			\$ -	3.8	1200	2400	\$ 9,187	\$	125,587
MH 10	MH 11	120.0	0.22	922.4	922.2	918.52	918.25	3.8	4.0	3.9	600	120.0	970	\$ 116,400			\$ -	3.8	1200	2400	\$ 9,197	\$	125,597
MH 11	MH 12	120.0	0.22	922.2	921.9	918.25	917.99	4.0	3.9	3.9	600	120.0	970	\$ 116,400			\$ -	4.0	1200	2400	\$ 9,518	\$	125,918
MH 12	MH 13	120.0	0.22	921.9	922.0	917.99	917.73	3.9	4.3	4.1	600	120.0	1015	\$ 121,800			\$ -	3.9	1200	2400	\$ 9,288	\$	131,088
MH 13	MH 14	120.0	0.22	922.0	922.3	917.73	917.46	4.3	4.8	4.5	600	120.0	1015	\$ 121,800			\$ -	4.3	1500	3000	\$ 12,912	\$	134,712
MH 14	MH 15	120.0	0.22	922.3	923.6	917.46	917.20	4.8	6.4	5.6	600	120.0	1090	\$ 130,800			\$ -	4.8	1500	3000	\$ 14,364	\$	145,164
MH 15	MH 15A	33.9	0.22	923.6	923.8	917.20	917.12	6.4	6.7	6.5	600			\$ -	33.9	3650	\$ 123,735	6.4	1500	3000	\$ 19,146	\$	142,881
MH 15A	MH 16	86.1	0.10	923.8	921.9	914.46	914.37	9.3	7.5	8.4	750			\$ -	86.1	4350	\$ 374,535	9.3	1500	3000	\$ 28,050	\$	402,585
MH 16	MH 17	73.0	0.10	921.9	920.1	914.37	914.30	7.5	5.8	6.6	750			\$ -	73.0	4350	\$ 317,550	7.5	1500	3000	\$ 22,488	\$	340,038
MH 17	MH 18	86.1	0.10	920.1	918.9	914.30	914.21	5.8	4.6	5.2	750	20.0	1240	\$ 24,800	66.1	4350	\$ 287,535	5.8	1500	3000	\$ 17,367	\$	329,702
MH 18	Ex. MH	4436.4	N/A	918.9	918.4	915.86	915.44	3.0	3.0	3.0	600	4436.4	970	\$ 4,303,308				3.0	1500	3000	\$ 9,000	\$	4,312,308
		6275.5										6016.4			259.1						Sub-total	Ċ	7 182 159

6275.5 6016.4 259.1 Sub-total \$ 7,182,159

Contingency (20%) \$ 1,436,432 Sub-total \$ 8,618,590

70 Street Connection \$ 955,110 Pump Station \$ 2,983,500

Land Acquisition \$ 210,059

Total Construction Cost \$ 12,767,259

Engineering and Construction Administration (10%) \$ 1,276,726

Permits and Approvals (2%) \$ 255,345

Total Estimated Project Cost \$ 14,299,330

Table H-3a Alignment 3 Alternative 1 Flows

Gravity Sev	ver Option												Open Cut	:			Trenchless				U	I/S MH		
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	iameter (mm)	Length (m)	Unit Cost (\$/m)		Cost	Length (m)	Unit Cost (\$/m)	C	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)	Cost	Total
MH 1	MH 2	120.0	1.50	935.0	932.0	930.00	928.20	5.0	3.8	4.4	300	120.0	805	\$	96,600			\$	-	5.0	1200	2400	\$ 12,072	\$ 108,672
MH 2	MH 3	120.0	1.50	932.0	928.5	927.20	925.40	4.8	3.1	3.9	300	120.0	750	\$	90,000			\$	-	4.8	1200	2400	\$ 11,448	\$ 101,448
MH 3	MH 4	60.0	1.50	928.5	926.7	924.40	923.50	4.1	3.2	3.6	300	60.0	750	\$	45,000			\$	-	4.1	1200	2400	\$ 9,840	\$ 54,840
MH 4	MH 5	60.0	1.50	926.7	925.0	922.50	921.60	4.2	3.4	3.8	300	60.0	750	\$	45,000			\$	-	4.2	1200	2400	\$ 10,056	\$ 55,056
MH 5	MH 6	120.0	1.50	925.0	923.2	921.11	919.31	3.9	3.9	3.9	300	120.0	750	\$	90,000			\$	-	3.9	1200	2400	\$ 9,264	\$ 99,264
MH 6	MH 7	120.0	1.50	923.2	921.4	919.31	917.51	3.9	3.9	3.9	300	120.0	750	\$	90,000			\$	-	3.9	1200	2400	\$ 9,264	\$ 99,264
MH 7	MH 8	120.0	0.50	921.4	920.5	917.36	916.76	4.0	3.8	3.9	375	120.0	810	\$	97,200			\$	-	4.0	1200	2400	\$ 9,672	\$ 106,872
MH 8	MH 9	120.0	0.50	920.5	919.9	916.76	916.16	3.8	3.8	3.8	375	120.0	810	\$	97,200			\$	-	3.8	1200	2400	\$ 9,048	\$ 106,248
MH 9	MH 10	120.0	0.50	919.9	919.4	916.16	915.56	3.8	3.8	3.8	375	120.0	810	\$	97,200			\$	-	3.8	1200	2400	\$ 9,000	\$ 106,200
MH 10	MH 11	120.0	0.50	919.4	918.9	915.56	914.96	3.8	4.0	3.9	375	120.0	810	\$	97,200			\$	-	3.8	1200	2400	\$ 9,216	\$ 106,416
MH 11	MH 12	120.0	0.50	918.9	918.0	914.96	914.36	4.0	3.6	3.8	375	120.0	810	\$	97,200			\$	-	4.0	1200	2400	\$ 9,504	\$ 106,704
MH 12	MH 13	120.0	0.50	918.0	917.8	914.36	913.76	3.6	4.0	3.8	375	120.0	810	\$	97,200			\$	-	3.6	1200	2400	\$ 8,712	\$ 105,912
MH 13	MH 14	120.0	0.10	917.8	917.6	913.62	913.50	4.1	4.1	4.1	525	120.0	975	\$	117,000			\$	-	4.1	1200	2400	\$ 9,912	\$ 126,912
MH 14	MH 15	120.0	0.10	917.6	923.7	913.50	913.38	4.1	10.3	7.2	525	40.0	975	\$	39,000	80.0	3400		272,000	4.1	1200	2400	\$ 9,768	\$ 320,768
MH 15	MH 16	120.0	0.10	923.7	918.6	913.38	913.26	10.3	5.3	7.8	525	80.0	975	\$	78,000	40.0	3400	\$	136,000	10.3	1200	2400	\$ 24,672	\$ 238,672
MH 16	MH 17	120.0	0.10	918.6	918.9	913.26	913.14	5.3	5.8	5.6	525	120.0	1045	\$	125,400			\$	-	5.3	1200	2400	\$ 12,816	\$ 138,216
MH 17	MH 18	120.0	0.10	918.9	921.6	913.14	913.02	5.8	8.6	7.2	525	30.0	1045	\$	31,350	90.0	3400		306,000	5.8	1200	2400	\$ 13,896	\$ 351,246
MH 18	MH 19	120.0	0.10	921.6	923.9	913.02	912.90	8.6	11.0	9.8	525			\$	-	120.0	3400		408,000	8.6	1200	2400	\$ 20,640	\$ 428,640
MH 19	MH 20	120.0	0.10	923.9	925.2	912.90	912.78	11.0	12.4	11.7	525			\$	-	120.0	3400		408,000	11.0	1200	2400	\$ 26,304	\$ 434,304
MH 20	MH 21	120.0	0.10	925.2	925.2	912.78	912.66	12.4	12.5	12.4	525			\$	-	120.0	3400		408,000	12.4	1200	2400	\$ 29,688	\$ 437,688
MH 21	MH 22	120.0	0.10	925.2	924.6	912.66	912.54	12.5	12.1	12.3	525			\$	-	120.0	3400		408,000	12.5	1200	2400	\$ 29,976	\$ 437,976
MH 22	MH 23	120.0	0.10	924.6	921.3	912.54	912.42	12.1	8.9	10.5	675			\$	-	120.0	3850		462,000	12.1	1500	3000	\$ 36,240	\$ 498,240
MH 23	MH 24	124.4	0.10	921.3	916.1	912.42	912.30	8.9	3.8	6.3	675			\$	-	124.4	3850	+	478,940	8.9	1500	3000	\$ 26,580	\$ 505,520
MH 24	MH 25	95.5	1.00	916.1	912.1	909.52	908.57	6.5	3.5	5.0	675	95.5	1135	\$	108,393			\$	-	6.5	1500	3000	\$ 19,620	\$ 128,013
MH 25	MH 26	201.6	0.58	912.1	910.7	908.37	907.20	3.7	3.5	3.6	675	201.6	1040	\$	209,664			\$	-	3.7	1500	3000	\$ 11,100	\$ 220,764
MH 26	MH 27	120.0	0.10	910.7	911.0	907.20	907.08	3.5	3.9	3.7	675	120.0	1040	\$	124,800			\$	-	3.5	1500	3000	\$ 10,408	\$ 135,208
MH 27	MH 28	120.0	0.10	911.0	911.0	907.08	906.96	3.9	4.0	4.0	675	120.0	1040	\$	124,800			\$	-	3.9	1500	3000	\$ 11,728	\$ 136,528
MH 28	MH 29	120.0	0.10	911.0	911.5	906.96	906.84	4.0	4.6	4.3	675	120.0	1085	\$	130,200			\$	-	4.0	1500	3000	\$ 12,028	\$ 142,228
MH 29	MH 30	120.0	0.10	911.5	912.0	906.84	906.72	4.6	5.3	4.9	675	120.0	1085	\$	130,200			\$	-	4.6	1500	3000	\$ 13,828	\$ 144,028
MH 30	MH 31	120.0	0.10	912.0	911.5	906.72	906.60	5.3	4.9	5.1	675	120.0	1135	\$	136,200			\$	-	5.3	1500	3000	\$ 15,868	\$ 152,068
MH 31	MH 32	120.0	0.10	911.5	911.5	906.60	906.48	4.9	5.0	5.0	675	120.0	1085	\$	130,200			\$	-	4.9	1500	3000	\$ 14,668	\$ 144,868
MH 32	MH 33	120.0	0.10	911.5	913.5	906.48	906.36	5.0	7.1	6.1	675	60.0	1135	\$	68,100	60.0	3850		231,000	5.0	1500	3000	\$ 15,088	\$ 314,188
MH 33	MH 34	120.0	0.10	913.5	914.7	906.36	906.24	7.1	8.4	7.8	675			\$	-	120.0	3850		462,000	7.1	1500	3000	\$ 21,328	\$ 483,328
MH 34	MH 35	120.0	0.10	914.7	916.0	906.24	906.12	8.4	9.9	9.1	675			\$	-	120.0	3850	+	462,000	8.4	1500	3000	\$ 25,228	\$ 487,228
MH 35	MH 36	120.0	0.10	916.0	916.1	906.12	906.00	9.9	10.1	10.0	675			\$	-	120.0	3850	\$	462,000	9.9	1500	3000	\$ 29,668	\$ 491,668
MH 36	MH 37	120.0	0.10	916.1	914.8	906.00	905.88	10.1	8.9	9.5	675			\$	-	120.0	3850	\$	462,000	10.1	1500	3000	\$ 30,238	\$ 492,238
MH 37	MH 38	120.0	0.10	914.8	914.2	905.88	905.76	8.9	8.4	8.7	675			\$	-	120.0	3850		462,000	8.9	1500	3000	\$ 26,818	\$ 488,818
MH 38	MH 39	120.0	0.10	914.2	912.2	905.76	905.64	8.4	6.5	7.5	675			\$	-	120.0	3850		462,000	8.4	1500	3000	\$ 25,288	
MH 39	MH 40	120.0	0.10	912.2	910.1	905.64	905.52	6.5	4.6	5.6	675	120.0	1135	\$	136,200		<u> </u>	\$	-	6.5	1500	3000	\$ 19,618	
MH 40	MH 41	158.4	0.10	910.1	909.3	905.52	905.36	4.6	3.9	4.3	675	158.4	1085	\$	171,864		<u> </u>	\$	-	4.6	1500	3000	\$ 13,828	
MH 41	MH 42	120.0	0.10	909.3	908.3	903.19	903.07	6.1	5.2	5.7	675			\$	-	120.0	3850		462,000	6.1	1500	3000	\$ 18,360	
MH 42	MH 43	120.0	0.10	908.3	908.8	903.07	902.95	5.2	5.9	5.5	675			\$	-	120.0	3850		462,000	5.2	1500	3000	\$ 15,630	
MH 43	MH 44	120.0	0.10	908.8	908.2	902.95	902.83	5.9	5.4	5.6	675			\$	-	120.0	3850		462,000	5.9	1500	3000	\$ 17,670	
MH 44	Ex. MH	98.1	0.10	908.2	907.4	902.83	902.73	5.4	4.7	5.0	675			\$	-	98.1	3850	\$	377,685	5.4	1500	3000	\$ 16,110	
		5238.0										3065.5				2172.5	; ;						Sub-total	\$ 11,696,501

5238.0 Sub-total \$ 11,696,501

Contingency (20%) \$ 2,339,300 Sub-total \$ 14,035,801 70 Street Connection \$ 210,210 Land Acquisition \$ 210,059

Total Construction Cost \$ 14,456,070

Engineering and Construction Administration (10%) \$ 1,445,607

Permits and Approvals (2%) \$ 289,121

Total Estimated Project Cost \$ 16,190,799

Table H-3b Alignment 3 Alternative 1 Flows

Pump Stat	ion and For	cemain Opt	ion										Open Cut			Trenchless			U	/S MH			
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)	Cost	Length (m)	Unit Cost (\$/m)	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)	Cost	7	Total
MH 1	MH 2	120.0	1.50	935.0	932.0	930.00	928.20	5.0	3.8	4.4	300	120.0	805	\$ 96,600			\$ -	5.0	1200	2400	\$ 12,072	\$	108,672
MH 2	MH 3	120.0	1.50	932.0	928.5	927.20	925.40	4.8	3.1	3.9	300	120.0	750	\$ 90,000			\$ -	4.8	1200	2400	\$ 11,448	\$	101,448
MH 3	MH 4	60.0	1.50	928.5	926.7	924.40	923.50	4.1	3.2	3.6	300	60.0	750	\$ 45,000			\$ -	4.1	1200	2400	\$ 9,840	\$	54,840
MH 4	MH 5	60.0	1.50	926.7	925.0	922.50	921.60	4.2	3.4	3.8	300	60.0	750	\$ 45,000			\$ -	4.2	1200	2400	\$ 10,056	\$	55,056
MH 5	MH 6	120.0	1.50	925.0	923.2	921.11	919.31	3.9	3.9	3.9	300	120.0	750	\$ 90,000			\$ -	3.9	1200	2400	\$ 9,264	\$	99,264
MH 6	MH 7	120.0	1.50	923.2	921.4	919.31	917.51	3.9	3.9	3.9	300	120.0	750	\$ 90,000			\$ -	3.9	1200	2400	\$ 9,264	\$	99,264
MH 7	MH 8	120.0	0.50	921.4	920.5	917.36	916.76	4.0	3.8	3.9	375	120.0	810	\$ 97,200			\$ -	4.0	1200	2400	\$ 9,672	\$	106,872
MH 8	MH 9	120.0	0.50	920.5	919.9	916.76	916.16	3.8	3.8	3.8	375	120.0	810	\$ 97,200			\$ -	3.8	1200	2400	\$ -,	\$	106,248
MH 9	MH 10	120.0	0.50	919.9	919.4	916.16	915.56	3.8	3.8	3.8	375	120.0	810	\$ 97,200			\$ -	3.8	1200	2400	\$ 9,000	\$	106,200
MH 10	MH 11	120.0	0.50	919.4	918.9	915.56	914.96	3.8	4.0	3.9	375	120.0	810	\$ 97,200			\$ -	3.8	1200	2400	\$ 9,216	\$	106,416
MH 11	MH 12	120.0	0.50	918.9	918.0	914.96	914.36	4.0	3.6	3.8	375	120.0	810	\$ 97,200			\$ -	4.0	1200	2400	\$ 9,504	\$	106,704
MH 12	MH 13	120.0	0.10	918.0	917.8	914.36	914.24	3.6	3.5	3.6	375	120.0	810	\$ 97,200			\$ -	3.6	1200	2400	\$ 8,712	\$	105,912
MH 13	MH 14	120.0	0.10	917.8	917.6	913.62	913.50	4.1	4.1	4.1	525	120.0	975	\$ 117,000			\$ -	4.1	1200	2400	\$ 9,912	\$	126,912
MH 14	MH 15	120.0	0.10	917.6	923.7	913.50	913.38	4.1	10.3	7.2	525	40.0	975	\$ 39,000	80.0	3400	\$ 272,000	4.1	1200	2400	\$ 9,768	\$	320,768
MH 15	MH 16	120.0	0.10	923.7	918.6	913.38	913.26	10.3	5.3	7.8	525	80.0	975	\$ 78,000	40.0	3400	\$ 136,000	10.3	1200	2400	\$ 24,672	\$	238,672
MH 16	MH 17	120.0	0.10	918.6	918.9	913.26	913.14	5.3	5.8	5.6	525	120.0	1045	\$ 125,400			\$ -	5.3	1200	2400	\$ 12,816	\$	138,216
MH 17	Ex. MH	3438.0	N/A	918.9	923.9	915.93	920.86	3.0	3.0	3.0	400	3438.0	810	\$ 2,784,780				3.0	1200	2400	\$ 7,200	\$	2,791,980
		5238.0										5118.0			120.0						Sub-total	\$	4,773,444

Contingency (20%) \$ 954,689

Sub-total \$ 5,728,133 70 Street Connection \$ 955,110

Pump Station \$ 2,018,250

Land Acquisition \$ 210,059

7,956,442 Total Construction Cost \$

Engineering and Construction Administration (10%) \$ 795,644

Permits and Approvals (2%) \$ 159,129

Total Estimated Project Cost \$ 8,911,215

Table H-3c Alignment 3 **Alternative 2 Flows**

Gravity Sew	er Option												Open Cut				Trenchless			· ·	J/S MH		1	
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)	(Cost	Length (m)	Unit Cost (\$/m)	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)	Cost		Total
MH 1	MH 2	120.0	1.50	935.0	932.0	930.00	928.20	5.0	3.8	4.4	450	120.0	915	\$	109,800			\$ -	5.0	1200	2400	\$ 12,072	\$	121,872
MH 2	MH 3	120.0	1.50	932.0	928.5	927.20	925.40	4.8	3.1	3.9	450	120.0	870	\$	104,400			\$ -	4.8	1200	2400	\$ 11,448		115,848
MH 3	MH 4	60.0	1.50	928.5	926.7	924.40	923.50	4.1	3.2	3.6	450	60.0	870	\$	52,200			\$ -	4.1	1200	2400	\$ 9,840	\$	62,040
MH 4	MH 5	60.0	1.50	926.7	925.0	922.50	921.60	4.2	3.4	3.8	450	60.0	870	\$	52,200			\$ -	4.2	1200	2400	\$ 10,056		62,256
MH 5	MH 6	120.0	1.50	925.0	923.2	921.11	919.31	3.9	3.9	3.9	450	120.0	870	\$	104,400			\$ -	3.9	1200	2400	\$ 9,264		113,664
MH 6	MH 7	120.0	1.50	923.2	921.4	919.31	917.51	3.9	3.9	3.9	450	120.0	870	\$	104,400			\$ -	3.9	1200	2400	\$ 9,264		113,664
MH 7	MH 8	120.0	0.50	921.4	920.5	917.36	916.76	4.0	3.8	3.9	525	120.0	930	\$	111,600			\$ -	4.0	1200	2400	\$ 9,672		121,272
MH 8	MH 9	120.0	0.50	920.5	919.9	916.76	916.16	3.8	3.8	3.8	525	120.0	930	\$	111,600			\$ -	3.8	1200	2400	\$ 9,048		120,648
MH 9	MH 10	120.0	0.50	919.9	919.4	916.16	915.56	3.8	3.8	3.8	525	120.0	930	\$	111,600			\$ -	3.8	1200	2400	\$ 9,000		120,600
MH 10	MH 11	120.0	0.50	919.4	918.9	915.56	914.96	3.8	4.0	3.9	525	120.0	930	\$	111,600			\$ -	3.8	1200	2400	\$ 9,216		120,816
MH 11	MH 12	120.0	0.50	918.9	918.0	914.96	914.36	4.0	3.6	3.8	525	120.0	930	\$	111,600			\$ -	4.0	1200	2400	\$ 9,504		121,104
MH 12	MH 13	120.0	0.50	918.0	917.8	914.36	913.76	3.6	4.0	3.8	525	120.0	930	\$	111,600			\$ -	3.6	1200	2400	\$ 8,712		120,312
MH 13	MH 14	120.0	0.10	917.8	917.6	913.62	913.50	4.1	4.1	4.1	675	120.0	1085	\$	130,200			\$ -	4.1	1500	3000	\$ 12,390	_	142,590
MH 14	MH 15	120.0	0.10	917.6	923.7	913.50	913.38	4.1	10.3	7.2	675	60.0	1085	\$	65,100	60.0	3850	\$ 231,000	4.1	1500	3000	\$ 12,210		308,310
MH 15	MH 16	120.0	0.10	923.7	918.6	913.38	913.26	10.3	5.3	7.8	750	80.0	1400	\$	112,000	40.0	4350	\$ 174,000	10.3	1500	3000	\$ 30,840		316,840
MH 16	MH 17	120.0	0.10	918.6	918.9	913.26	913.14	5.3	5.8	5.6	750	120.0	1400	\$	168,000			\$ -	5.3	1500	3000	\$ 16,020		184,020
MH 17	MH 18	120.0	0.10	918.9	921.6	913.14	913.02	5.8	8.6	7.2	750	20.0	1400	\$	28,000	100.0	4350	\$ 435,000	5.8	1500	3000	\$ 17,370		480,370
MH 18	MH 19	120.0	0.10	921.6	923.9	913.02	912.90	8.6	11.0	9.8	750			\$	-	120.0	4350	\$ 522,000	8.6	1500	3000	\$ 25,800		547,800
MH 19	MH 20	120.0	0.10	923.9	925.2	912.90	912.78	11.0	12.4	11.7	750			\$	-	120.0	4350	\$ 522,000	11.0	1500	3000	\$ 32,880		554,880
MH 20	MH 21	120.0	0.10	925.2	925.2	912.78	912.66	12.4	12.5	12.4	750			\$	-	120.0	4350	\$ 522,000	12.4	1500	3000	\$ 37,110		559,110
MH 21	MH 22	120.0	0.10	925.2	924.6	912.66	912.54	12.5	12.1	12.3	750			\$	-	120.0	4350	\$ 522,000	12.5	1500	3000	\$ 37,470	_	559,470
MH 22	MH 23	120.0	0.10	924.6	921.3	912.54	912.42	12.1	8.9	10.5	900			\$	-	120.0	4800	\$ 576,000	12.1	1800	3400	\$ 41,072		617,072
MH 23	MH 24	124.4	0.10	921.3	916.1	912.42	912.30	8.9	3.8	6.3	900			\$	-	124.4	4800	\$ 597,120	8.9	1800	3400	\$ 30,124		627,244
MH 24	MH 25	95.5	1.00	916.1	912.1	909.52	908.57	6.5	3.5	5.0	900	95.5	1500	\$	143,250			\$ -	6.5	1800	3400	\$ 22,236		165,486
MH 25	MH 26	201.6	0.58	912.1	910.7	908.37	907.20	3.7	3.5	3.6	900	201.6	1300	\$	262,080			\$ -	3.7	1800	3400	\$ 12,580		274,660
MH 26	MH 27	120.0	0.10	910.7	911.0	907.20	907.08	3.5	3.9	3.7	900	120.0	1300	\$	156,000			\$ -	3.5	1800	3400	\$ 11,796		167,796
MH 27	MH 28	120.0	0.10	911.0	911.0	907.08	906.96	3.9	4.0	4.0	900	120.0	1300	\$	156,000			\$ -	3.9	1800	3400	\$ 13,292		169,292
MH 28	MH 29	120.0	0.10	911.0	911.5	906.96	906.84	4.0	4.6	4.3	900	120.0	1415	\$	169,800			\$ -	4.0	1800	3400	\$ 13,632		183,432
MH 29	MH 30	120.0	0.10	911.5	912.0	906.84	906.72	4.6	5.3	4.9	900	120.0	1415	\$	169,800			\$ -	4.6	1800	3400	\$ 15,672		185,472
MH 30	MH 31	120.0	0.10	912.0	911.5	906.72	906.60	5.3	4.9	5.1	900	120.0	1500	\$	180,000			\$ -	5.3	1800	3400	\$ 17,984		197,984
MH 31	MH 32	120.0	0.10	911.5	911.5	906.60	906.48	4.9	5.0	5.0	900	120.0	1415	\$	169,800			\$ -	4.9	1800	3400	\$ 16,624		186,424
MH 32	MH 33	120.0	0.10	911.5	913.5	906.48	906.36	5.0	7.1	6.1	900	60.0	1500	\$	90,000	60.0	4800	\$ 288,000	5.0	1800	3400	\$ 17,100		395,100
MH 33	MH 34	120.0	0.10	913.5	914.7	906.36	906.24	7.1	8.4	7.8	900			\$	-	120.0	4800	\$ 576,000	7.1	1800	3400	\$ 24,172		600,172
MH 34	MH 35	120.0	0.10	914.7	916.0	906.24	906.12	8.4	9.9	9.1	900			\$	-	120.0	4800	\$ 576,000	8.4	1800	3400	\$ 28,592		604,592
MH 35	MH 36	120.0	0.10	916.0	916.1	906.12	906.00	9.9	10.1	10.0	900			\$	-	120.0	4800	\$ 576,000	9.9	1800	3400	\$ 33,624		609,624
MH 36	MH 37	120.0	0.10	916.1	914.8	906.00	905.88	10.1	8.9	9.5	900			\$	-	120.0	4800	\$ 576,000	10.1	1800	3400	\$ 34,270		610,270
MH 37	MH 38	120.0	0.10	914.8	914.2	905.88	905.76	8.9	8.4	8.7	900			\$	-	120.0	4800	\$ 576,000	8.9	1800	3400	\$ 30,394		606,394
MH 38	MH 39	120.0	0.10	914.2	912.2	905.76	905.64	8.4	6.5	7.5	900			\$	-	120.0	4800	\$ 576,000	8.4	1800	3400	\$ 28,660		604,660
MH 39	MH 40	120.0	0.10	912.2	910.1	905.64	905.52	6.5	4.6	5.6	900	120.0	1500	\$	180,000			\$ -	6.5	1800	3400	\$ 22,234		202,234
MH 40	MH 41	158.4	0.10	910.1	909.3	905.52	905.36	4.6	3.9	4.3	900	158.4	1415	\$	224,136			\$ -	4.6	1800	3400	\$ 15,672		239,808
MH 41	MH 42	120.0	0.10	909.3	908.3	903.19	903.07	6.1	5.2	5.7	900			\$	-	120.0	4800	\$ 576,000	6.1	1800	3400	\$ 20,808		596,808
MH 42	MH 43	120.0	0.10	908.3	908.8	903.07	902.95	5.2	5.9	5.5	900			\$	-	120.0	4800	\$ 576,000	5.2	1800	3400	\$ 17,714		593,714
MH 43	MH 44	120.0	0.10	908.8	908.2	902.95	902.83	5.9	5.4	5.6	900			\$	-	120.0	4800	\$ 576,000	5.9	1800	3400	\$ 20,026		596,026
MH 44	Ex. MH	98.1	0.10	908.2	907.4	902.83	902.73	5.4	4.7	5.0	900			\$	-	98.1	4800	\$ 470,880	5.4	1800	3400	\$ 18,258		489,138
		5238.0										3075.5				2162.5						Sub-total	\$	14,490,881

Contingency (20%) \$ 2,898,176 Sub-total \$ 17,389,058 70 Street Connection \$ 210,210 Land Acquisition \$ 210,059 Total Construction Cost \$ 17,809,327

Engineering and Construction Administration (10%) \$ 1,780,933 Permits and Approvals (2%) \$ 356,187

Total Estimated Project Cost \$ 19,946,446

Table H-3d Alignment 3 **Alternative 2 Flows**

Pump Stat	ion and For	cemain Opt	ion										Open Cut				Trenchless			U	/S MH				
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)	Cos	st	Length (m)	Unit Cost (\$/m)	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)		Cost	т	Гotal
MH 1	MH 2	120.0	1.50	935.0	932.0	930.00	928.20	5.0	3.8	4.4	450	120.0	915	\$ 10	109,800			\$ -	5.0	1200	2400	\$	12,072	\$	121,872
MH 2	MH 3	120.0	1.50	932.0	928.5	927.20	925.40	4.8	3.1	3.9	450	120.0	870	\$ 10	104,400			\$ -	4.8	1200	2400	\$	11,448	\$	115,848
MH 3	MH 4	60.0	1.50	928.5	926.7	924.40	923.50	4.1	3.2	3.6	450	60.0	870	\$.	52,200			\$ -	4.1	1200	2400	\$	9,840	\$	62,040
MH 4	MH 5	60.0	1.50	926.7	925.0	922.50	921.60	4.2	3.4	3.8	450	60.0	870	\$.	52,200			\$ -	4.2	1200	2400	\$	10,056	\$	62,256
MH 5	MH 6	120.0	1.50	925.0	923.2	921.11	919.31	3.9	3.9	3.9	450	120.0	870	\$ 10	104,400			\$ -	3.9	1200	2400	\$	9,264	\$	113,664
MH 6	MH 7	120.0	1.50	923.2	921.4	919.31	917.51	3.9	3.9	3.9	450	120.0	870	\$ 10	104,400			\$ -	3.9	1200	2400	\$	9,264	\$	113,664
MH 7	MH 8	120.0	0.50	921.4	920.5	917.36	916.76	4.0	3.8	3.9	525	120.0	930	\$ 1	11,600			\$ -	4.0	1200	2400	\$	9,672	\$	121,272
MH 8	MH 9	120.0	0.50	920.5	919.9	916.76	916.16	3.8	3.8	3.8	525	120.0	930	\$ 1	11,600			\$ -	3.8	1200	2400	\$	9,048	\$	120,648
MH 9	MH 10	120.0	0.50	919.9	919.4	916.16	915.56	3.8	3.8	3.8	525	120.0	930	\$ 1	11,600			\$ -	3.8	1200	2400	\$	9,000	\$	120,600
MH 10	MH 11	120.0	0.50	919.4	918.9	915.56	914.96	3.8	4.0	3.9	525	120.0	930	\$ 1	11,600			\$ -	3.8	1200	2400	\$	9,216	\$	120,816
MH 11	MH 12	120.0	0.50	918.9	918.0	914.96	914.36	4.0	3.6	3.8	525	120.0	930	\$ 1	11,600			\$ -	4.0	1200	2400	\$	9,504	\$	121,104
MH 12	MH 13	120.0	0.10	918.0	917.8	914.36	914.24	3.6	3.5	3.6	525	120.0	930	\$ 1	11,600			\$ -	3.6	1200	2400	\$	8,712	\$	120,312
MH 13	MH 14	120.0	0.10	917.8	917.6	913.62	913.50	4.1	4.1	4.1	675	120.0	1085	\$ 1	30,200			\$ -	4.1	1500	3000	\$	12,390	\$	142,590
MH 14	MH 15	120.0	0.10	917.6	923.7	913.50	913.38	4.1	10.3	7.2	675	60.0	1085	\$	65,100	60.0	3850	\$ 231,000	4.1	1500	3000	\$	12,210	\$	308,310
MH 15	MH 16	120.0	0.10	923.7	918.6	913.38	913.26	10.3	5.3	7.8	750	80.0	1400	\$ 1	12,000	40.0	4350	\$ 174,000	10.3	1500	3000	\$	30,840	\$	316,840
MH 16	MH 17	120.0	0.10	918.6	918.9	913.26	913.14	5.3	5.8	5.6	750	120.0	1400	\$ 1	168,000			\$ -	5.3	1500	3000	\$	16,020	\$	184,020
MH 17	Ex. MH	3438.0	N/A	918.9	923.9	915.93	920.86	3.0	3.0	3.0	600	3438.0	970	\$ 3,3	34,860				3.0	1500	3000	\$	9,000	\$	3,343,860
		5238.0										5138.0				100.0						9	Sub-total	\$	5,609,716

Contingency (20%) \$ 1,121,943

6,731,659 Sub-total \$ 70 Street Connection \$ 955,110

Pump Station \$ 2,983,500

Land Acquisition \$ 210,059

Total Construction Cost \$ 10,880,328

Engineering and Construction Administration (10%) \$ 1,088,033

Permits and Approvals (2%) \$ 217,607

Total Estimated Project Cost \$ 12,185,968

Table H-4a Alignment 4 Alternative 1 Flows

Gravity Sev	ver Option												Open Cut			Trenchless			U	/S MH			
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)	Cost	Length (m)	Unit Cost (\$/m)	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)	Cost		Total
MH 1	MH 2	120.0	1.50	935.0	933.0	930.00	928.20	5.0	4.8	4.9	300	120.0	865	\$ 103,800			\$ -	5.0	1200	2400		,072	\$ 115,872
MH 2	MH 3	120.0	1.50	933.0	928.5	927.20	925.40	5.8	3.1	4.4	300	120.0	805	\$ 96,600			\$ -	5.8	1200	2400	\$ 13	,824	\$ 110,424
MH 3	MH 4	60.0	1.50	928.5	926.7	924.40	923.50	4.1	3.2	3.6	300	60.0	750	\$ 45,000			\$ -	4.1	1200	2400	-	,792	\$ 54,792
MH 4	MH 5	60.0	1.50	926.7	925.0	922.50	921.60	4.2	3.4	3.8	300	60.0	750	\$ 45,000			\$ -	4.2	1200	2400		,032	\$ 55,032
MH 5	MH 6	120.0	1.50	925.0	923.1	921.11	919.31	3.9	3.8	3.8	300	120.0	750	\$ 90,000			\$ -	3.9	1200	2400	-	,240	\$ 99,240
MH 6	MH 7	120.0	1.50	923.1	921.3	919.31	917.51	3.8	3.8	3.8	300	120.0	750	\$ 90,000			\$ -	3.8	1200	2400	\$ 9	,168	\$ 99,168
MH 7	MH 8	120.0	0.50	921.3	920.5	917.33	916.73	4.0	3.7	3.9	375	120.0	810	\$ 97,200			\$ -	4.0	1200	2400	-	,600	
MH 8	MH 9	120.0	0.50	920.5	919.9	916.73	916.13	3.7	3.8	3.8	375	120.0	810	\$ 97,200			\$ -	3.7	1200	2400	\$ 8	,976	
MH 9	MH 10	120.0	0.50	919.9	919.4	916.13	915.53	3.8	3.8	3.8	375	120.0	810	\$ 97,200			\$ -	3.8	1200	2400	\$ 9	,072	\$ 106,272
MH 10	MH 11	120.0	0.50	919.4	918.9	915.53	914.93	3.8	3.9	3.9	375	120.0	810	\$ 97,200			\$ -	3.8	1200	2400		,168	\$ 106,368
MH 11	MH 12	120.0	0.50	918.9	918.0	914.93	914.33	3.9	3.6	3.8	375	120.0	810	\$ 97,200			\$ -	3.9	1200	2400		,432	\$ 106,632
MH 12	MH 13	120.0	0.50	918.0	917.6	914.33	913.73	3.6	3.9	3.8	375	120.0	810	\$ 97,200			\$ -	3.6	1200	2400	\$ 8	,688	\$ 105,888
MH 13	MH 14	120.0	0.10	917.6	917.5	913.53	913.41	4.1	4.1	4.1	525	120.0	975	\$ 117,000			\$ -	4.1	1200	2400	\$ 9	,864	\$ 126,864
MH 14	MH 15	120.0	0.10	917.5	918.4	913.41	913.29	4.1	5.1	4.6	525	120.0	975	\$ 117,000			\$ -	4.1	1200	2400	\$ 9	,840	\$ 126,840
MH 15	MH 16	120.0	0.10	918.4	919.5	913.29	913.17	5.1	6.4	5.7	525	120.0	1045	\$ 125,400			\$ -	5.1	1200	2400		,192	\$ 137,592
MH 16	MH 17	120.0	0.10	919.5	921.1	913.17	913.05	6.4	8.1	7.2	525			\$ -	120.0	3400	\$ 408,000	6.4	1200	2400	\$ 15	,288	\$ 423,288
MH 17	MH 18	120.0	0.10	921.1	923.1	913.05	912.93	8.1	10.1	9.1	525			\$ -	120.0	3400	\$ 408,000	8.1	1200	2400		,344	\$ 427,344
MH 18	MH 19	120.0	0.10	923.1	924.6	912.93	912.81	10.1	11.8	11.0	525			\$ -	120.0	3400	\$ 408,000	10.1	1200	2400	\$ 24	,312	\$ 432,312
MH 19	MH 20	120.0	0.10	924.6	925.0	912.81	912.69	11.8	12.3	12.0	525			\$ -	120.0	3400	\$ 408,000	11.8	1200	2400		,296	\$ 436,296
MH 20	MH 21	120.0	0.10	925.0	924.7	912.69	912.57	12.3	12.2	12.2	525			\$ -	120.0	3400	\$ 408,000	12.3	1200	2400	\$ 29	,496	\$ 437,496
MH 21	MH 22	120.0	0.10	924.7	924.3	912.57	912.45	12.2	11.9	12.0	525			\$ -	120.0	3400	\$ 408,000	12.2	1200	2400		,160	\$ 437,160
MH 22	MH 23	120.0	0.10	924.3	921.5	912.45	912.33	11.9	9.1	10.5	675			\$ -	120.0	3400	\$ 408,000	11.9	1500	3000	\$ 35	,670	\$ 443,670
MH 23	MH 24	120.0	0.10	921.5	915.9	912.33	912.21	9.1	3.7	6.4	675			\$ -	120.0	3400	\$ 408,000	9.1	1500	3000	\$ 27	,420	\$ 435,420
MH 24	MH 25	100.0	1.00	915.9	911.9	909.47	908.47	6.5	3.4	4.9	675	100.0	1085	\$ 108,500			\$ -	6.5	1500	3000	\$ 19	,380	\$ 127,880
MH 25	MH 26	118.4	1.00	911.9	911.1	908.47	907.29	3.4	3.9	3.6	675	118.4	1040	\$ 123,136			\$ -	3.4	1500	3000	\$ 10	,320	\$ 133,456
MH 26	MH 27	120.0	0.10	911.1	911.5	907.29	907.17	3.9	4.3	4.1	675	120.0	1085	\$ 130,200			\$ -	3.9	1500	3000	\$ 11	,562	\$ 141,762
MH 27	MH 28	120.0	0.10	911.5	911.1	907.17	907.05	4.3	4.1	4.2	675	120.0	1085	\$ 130,200			\$ -	4.3	1500	3000	\$ 12	,942	\$ 143,142
MH 28	MH 29	120.0	0.10	911.1	911.9	907.05	906.93	4.1	5.0	4.5	675	120.0	1085	\$ 130,200			\$ -	4.1	1500	3000	\$ 12	,282	\$ 142,482
MH 29	MH 30	120.0	0.10	911.9	912.1	906.93	906.81	5.0	5.3	5.1	675	120.0	1135	\$ 136,200			\$ -	5.0	1500	3000	\$ 14	,862	\$ 151,062
MH 30	MH 31	156.8	0.10	912.1	910.4	906.81	906.65	5.3	3.7	4.5	675	31.8	1085	\$ 34,503	125.0	3850	\$ 481,250	5.3	1500	3000	\$ 16	,002	\$ 531,755
MH 31	MH 32	120.0	0.10	910.4	909.5	904.82	904.70	5.5	4.8	5.2	675	120.0	1135	\$ 136,200			\$ -	5.5	1500	3000	\$ 16	,590	\$ 152,790
MH 32	MH 33	120.0	0.10	909.5	909.2	904.70	904.58	4.8	4.6	4.7	675	120.0	1085	\$ 130,200			\$ -	4.8	1500	3000	\$ 14	,490	\$ 144,690
MH 33	MH 34	120.0	0.10	909.2	909.1	904.58	904.46	4.6	4.6	4.6	675	120.0	1085	\$ 130,200			\$ -	4.6	1500	3000	\$ 13	,920	\$ 144,120
MH 34	MH 35	120.0	0.10	909.1	908.8	904.46	904.34	4.6	4.5	4.6	675	120.0	1085	\$ 130,200			\$ -	4.6	1500	3000	\$ 13	,890	\$ 144,090
MH 35	MH 36	120.0	0.10	908.8	908.6	904.34	904.22	4.5	4.4	4.4	675	120.0	1085	\$ 130,200			\$ -	4.5	1500	3000	\$ 13	,440	\$ 143,640
MH 36	MH 37	120.0	0.10	908.6	908.3	904.22	904.10	4.4	4.2	4.3	675	120.0	1085	\$ 130,200			\$ -	4.4	1500	3000	\$ 13	,110	\$ 143,310
MH 37	MH 38	120.0	0.10	908.3	908.1	904.10	903.98	4.2	4.1	4.2	675	120.0	1085	\$ 130,200			\$ -	4.2	1500	3000	\$ 12	,630	\$ 142,830
MH 38	MH 39	120.0	0.10	908.1	907.9	903.98	903.86	4.1	4.0	4.1	675	120.0	1085	\$ 130,200			\$ -	4.1	1500	3000	\$ 12	,420	\$ 142,620
MH 39	MH 40	120.0	0.10	907.9	907.9	903.86	903.74	4.0	4.1	4.1	675	120.0	1085	\$ 130,200			\$ -	4.0	1500	3000	\$ 12	,150	\$ 142,350
MH 40	MH 41	120.0	0.10	907.9	907.7	903.74	903.62	4.1	4.0	4.1	675	120.0	1085	\$ 130,200			\$ -	4.1	1500	3000	\$ 12	,330	\$ 142,530
MH 41	MH 42	120.0	0.10	907.7	907.9	903.62	903.50	4.0	4.4	4.2	675	120.0	1085	\$ 130,200			\$ -	4.0	1500	3000	\$ 12	,090	\$ 142,290
MH 42	MH 43	120.0	0.10	907.9	907.5	903.50	903.38	4.4	4.1	4.3	675	120.0	1085	\$ 130,200			\$ -	4.4	1500	3000		,170	
MH 43	MH 44	120.0	0.10	907.5	907.0	903.38	903.26	4.1	3.7	3.9	675	120.0	1040	\$ 124,800			\$ -	4.1	1500	3000	\$ 12	,450	\$ 137,250
MH 44	MH 45	120.0	0.10	907.0	906.6	903.26	903.14	3.7	3.5	3.6	675	120.0	1040	\$ 124,800			\$ -	3.7	1500	3000		,100	
MH 45	MH 46	120.0	0.10	906.6	906.5	903.14	903.02	3.5	3.5	3.5	675	120.0	1040	\$ 124,800			\$ -	3.5	1500	3000	\$ 10	,470	\$ 135,270
MH 46	MH 47	120.0	0.10	906.5	905.2	903.02	902.90	3.5	2.3	2.9	675	40.0	1040	\$ 41,600	80.0	3850	\$ 308,000	3.5	1500	3000	\$ 10	,440	\$ 360,040
MH 47	MH 48	120.0	0.10	905.2	906.2	902.90	902.78	2.3	3.4	2.9	675	35.0	1040	\$ 36,400	85.0	3850	\$ 327,250	2.3	1500	3000	\$ 6	,810	\$ 370,460
MH 48	MH 49	120.0	0.10	906.2	907.0	902.78	902.66	3.4	4.4	3.9	675	120.0	1040	\$ 124,800			\$ -	3.4	1500	3000	\$ 10	,290	\$ 135,090
MH 49	MH 50	120.0	0.10	907.0	907.7	902.66	902.54	4.4	5.2	4.8	675	120.0	1085	\$ 130,200			\$ -	4.4	1500	3000	\$ 13	,110	\$ 143,310
MH 50	Ex. MH	51.2	0.10	907.7	907.4	902.54	902.49	5.2	4.9	5.1	675	51.2	1085	\$ 55,552			\$ -	5.2	1500	3000	\$ 15	,600	\$ 71,152
		5826.4										4576.4		-	1250.0						Sub-1	otal	\$ 9,625,587

5826.4 1250.0 **Sub-total \$ 9,625,587**

Contingency (20%) \$ 1,925,117 Sub-total \$ 11,550,704 70 Street Connection \$ 210,210

Land Acquisition \$ 210,059

Total Construction Cost \$ 11,970,973

Engineering and Construction Administration (10%) \$ 1,197,097 Permits and Approvals (2%) \$ 239,419

Total Estimated Project Cost \$ 13,407,490

Table H-4b Alignment 4 Alternative 1 Flows

Pump Stat	ion and For	cemain Opt	ion										Open Cut			Trenchless			U	/S MH			
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)	Cost	Length (m)	Unit Cost (\$/m)	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)	Cost	T	otal
MH 1	MH 2	120.0	1.50	935.0	933.0	930.00	928.20	5.0	4.8	4.9	300	120.0	865	\$ 103,800			\$ -	5.0	1200	2400	\$ 12,072	\$	115,872
MH 2	MH 3	120.0	1.50	933.0	928.5	927.20	925.40	5.8	3.1	4.4	300	120.0	805	\$ 96,600			\$ -	5.8	1200	2400	\$ 13,824	\$	110,424
MH 3	MH 4	60.0	1.50	928.5	926.7	924.40	923.50	4.1	3.2	3.6	300	60.0	750	\$ 45,000			\$ -	4.1	1200	2400	\$ 9,792	\$	54,792
MH 4	MH 5	60.0	1.50	926.7	925.0	922.50	921.60	4.2	3.4	3.8	300	60.0	750	\$ 45,000			\$ -	4.2	1200	2400	\$ 10,032	\$	55,032
MH 5	MH 6	120.0	1.50	925.0	923.1	921.11	919.31	3.9	3.8	3.8	300	120.0	750	\$ 90,000			\$ -	3.9	1200	2400	\$ 9,240	\$	99,240
MH 6	MH 7	120.0	1.50	923.1	921.3	919.31	917.51	3.8	3.8	3.8	300	120.0	750	\$ 90,000			\$ -	3.8	1200	2400	\$ 9,168	\$	99,168
MH 7	MH 8	120.0	0.50	921.3	920.5	917.33	916.73	4.0	3.7	3.9	375	120.0	810	\$ 97,200			\$ -	4.0	1200	2400	\$ 9,600	\$	106,800
MH 8	MH 9	120.0	0.50	920.5	919.9	916.73	916.13	3.7	3.8	3.8	375	120.0	810	\$ 97,200			\$ -	3.7	1200	2400	\$ 8,976	\$	106,176
MH 9	MH 10	120.0	0.50	919.9	919.4	916.13	915.53	3.8	3.8	3.8	375	120.0	810	\$ 97,200			\$ -	3.8	1200	2400	\$ 9,072	\$	106,272
MH 10	MH 11	120.0	0.50	919.4	918.9	915.53	914.93	3.8	3.9	3.9	375	120.0	810	\$ 97,200			\$ -	3.8	1200	2400	\$ 9,168	\$	106,368
MH 11	MH 12	120.0	0.50	918.9	918.0	914.93	914.33	3.9	3.6	3.8	375	120.0	810	\$ 97,200			\$ -	3.9	1200	2400	\$ 9,432	\$	106,632
MH 12	MH 13	120.0	0.50	918.0	917.6	914.33	913.73	3.6	3.9	3.8	375	120.0	810	\$ 97,200			\$ -	3.6	1200	2400	\$ 8,688	\$	105,888
MH 13	MH 14	120.0	0.10	917.6	917.5	913.53	913.41	4.1	4.1	4.1	525	120.0	975	\$ 117,000			\$ -	4.1	1200	2400	\$ 9,864	\$	126,864
MH 14	MH 15	120.0	0.10	917.5	918.4	913.41	913.29	4.1	5.1	4.6	525	120.0	975	\$ 117,000			\$ -	4.1	1200	2400	\$ 9,840	\$	126,840
MH 15	MH 16	120.0	0.10	918.4	919.5	913.29	913.17	5.1	6.4	5.7	525	120.0	1045	\$ 125,400			\$ -	5.1	1200	2400	\$ 12,192	\$	137,592
MH 16	MH 17	120.0	0.10	919.5	921.1	913.17	913.05	6.4	8.1	7.2	525			\$ -	120.0	3400	\$ 408,000	6.4	1200	2400	\$ 15,288	\$	423,288
MH 17	Ex. MH	4026.4	N/A	921.1	923.1	918.11	920.06	3.0	3.0	3.0	400	4026.4	810	\$ 3,261,384				3.0	1200	2400	\$ 7,200	\$:	3,268,584
		5826.4										5706.4			120.0						Sub-total	\$!	5,255,832

Contingency (20%) \$ 1,051,166

6,306,998 Sub-total \$

70 Street Connection \$ 955,110 Pump Station \$ 2,018,250

Land Acquisition \$ 210,059

Total Construction Cost \$ 8,535,307

Engineering and Construction Administration (10%) \$ 853,531

Permits and Approvals (2%) \$ 170,706

Total Estimated Project Cost \$ 9,559,544

Table H-4c Alignment 4 Alternative 2 Flows

Gravity Sev	wer Option												Open Cut				Trenchless				U	/S MH			i
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)		Cost	Length (m)	Unit Cost (\$/m)	•	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)		Cost	Total
MH 1	MH 2	120.0	1.50	935.0	933.0	930.00	928.20	5.0	4.8	4.9	450	120.0	915	\$	109,800			\$	-	5.0	1200	2400	\$	12,072	\$ 121,872
MH 2	MH 3	120.0	1.50	933.0	928.5	927.20	925.40	5.8	3.1	4.4	450	120.0	915	\$	109,800			\$	-	5.8	1200	2400	\$	13,824	\$ 123,624
MH 3	MH 4	60.0	1.50	928.5	926.7	924.40	923.50	4.1	3.2	3.6	450	60.0	870	\$	52,200			\$	-	4.1	1200	2400	\$	9,792	\$ 61,992
MH 4	MH 5	60.0	1.50	926.7	925.0	922.50	921.60	4.2	3.4	3.8	450	60.0	870	\$	52,200			\$	-	4.2	1200	2400	\$	10,032	\$ 62,232
MH 5	MH 6	120.0	1.50	925.0	923.1	921.11	919.31	3.9	3.8	3.8	450	120.0	870	\$	104,400			\$	-	3.9	1200	2400	\$	9,240	
MH 6	MH 7	120.0	1.50	923.1	921.3	919.31	917.51	3.8	3.8	3.8	450	120.0	870	\$	104,400			\$	-	3.8	1200	2400	\$	9,168	
MH 7	MH 8	120.0	0.50	921.3	920.5	917.33	916.73	4.0	3.7	3.9	525	120.0	930	\$	111,600			\$	-	4.0	1200	2400	\$	9,600	
MH 8	MH 9	120.0	0.50	920.5	919.9	916.73	916.13	3.7	3.8	3.8	525	120.0	930	\$	111,600			\$	-	3.7	1200	2400	\$	8,976	
MH 9	MH 10	120.0	0.50	919.9	919.4	916.13	915.53	3.8	3.8	3.8	525	120.0	930	\$	111,600			\$	-	3.8	1200	2400	\$	9,072	
MH 10	MH 11	120.0	0.50	919.4	918.9	915.53	914.93	3.8	3.9	3.9	525	120.0	930	\$	111,600			\$	-	3.8	1200	2400	\$	9,168	
MH 11	MH 12	120.0	0.50	918.9	918.0	914.93	914.33	3.9	3.6	3.8	525	120.0	930	\$	111,600			\$	-	3.9	1200	2400	\$	9,432	
MH 12	MH 13	120.0	0.50	918.0	917.6	914.33	913.73	3.6	3.9	3.8	525	120.0	930	\$	111,600			\$	-	3.6	1200	2400	\$	8,688	
MH 13	MH 14	120.0	0.10	917.6	917.5	913.53	913.41	4.1	4.1	4.1	675	120.0	1085	\$	130,200			\$	-	4.1	1500	3000	\$	12,330	
MH 14	MH 15	120.0	0.10	917.5	918.4	913.41	913.29	4.1	5.1	4.6	675	120.0	1085	\$	130,200			\$	-	4.1	1500	3000	\$	12,300	
MH 15	MH 16	120.0	0.10	918.4	919.5	913.29	913.17	5.1	6.4	5.7	750	120.0	1400	\$	168,000	40	40	\$	-	5.1	1500	3000	\$	15,240	
MH 16	MH 17	120.0	0.10	919.5	921.1	913.17	913.05	6.4	8.1	7.2	750			\$	-	120.0	4380	\$	525,600	6.4	1500	3000	\$	19,110	
MH 17	MH 18	120.0	0.10	921.1	923.1	913.05	912.93	8.1	10.1	9.1	750			\$	-	120.0	4380	\$	525,600	8.1	1500	3000	\$	24,180	
MH 18	MH 19	120.0	0.10	923.1	924.6	912.93	912.81	10.1	11.8	11.0	750			\$	-	120.0	4380	\$	525,600	10.1	1500	3000	\$	30,390	
MH 19	MH 20	120.0	0.10	924.6	925.0	912.81	912.69	11.8	12.3	12.0	750			\$	-	120.0	4380	\$	525,600	11.8	1500	3000	\$	35,370	
MH 20	MH 21	120.0	0.10	925.0	924.7	912.69	912.57	12.3	12.2	12.2	750			\$	-	120.0	4380	_	525,600	12.3	1500	3000	\$	36,870	
MH 21	MH 22	120.0	0.10	924.7	924.3	912.57	912.45	12.2	11.9	12.0	750			\$	-	120.0	4380	\$	525,600	12.2	1500	3000	\$	36,450	
MH 22	MH 23	120.0	0.10	924.3	921.5	912.45	912.33	11.9	9.1	10.5	900			\$	-	120.0	4800	\$	576,000	11.9	1800	3400	\$	40,426	
MH 23	MH 24	120.0	0.10	921.5	915.9	912.33	912.21	9.1	3.7	6.4	900			\$	-	120.0	4800		576,000	9.1	1800	3400	\$	31,076	
MH 24	MH 25	100.0	1.00	915.9	911.9	909.47	908.47	6.5	3.4	4.9	900	100.0	1415	\$	141,500			\$	-	6.5	1800	3400	\$	21,964	
MH 25	MH 26	118.4	1.00	911.9	911.1	908.47	907.29	3.4	3.9	3.6	900	118.4	1300	\$	153,920			\$	-	3.4	1800	3400	\$	11,696	
MH 26	MH 27	120.0	0.10	911.1	911.5	907.29	907.17	3.9	4.3	4.1	900	120.0	1415	\$	169,800			\$	-	3.9	1800	3400	\$	13,104	
MH 27	MH 28	120.0	0.10	911.5	911.1	907.17	907.05	4.3	4.1	4.2	900	120.0	1415	\$	169,800			\$	-	4.3	1800	3400	\$	14,668	
MH 28	MH 29	120.0	0.10	911.1	911.9	907.05	906.93	4.1	5.0	4.5	900	120.0	1415	\$	169,800			\$	-	4.1	1800	3400	\$	13,920	
MH 29	MH 30	120.0	0.10	911.9	912.1	906.93	906.81	5.0	5.3	5.1	900	120.0	1500	\$	180,000	125.0	4000	\$	-	5.0	1800	3400	\$	16,844	
MH 30	MH 31	156.8	0.10	912.1	910.4	906.81	906.65	5.3	3.7	4.5	900	31.8	1415	\$	44,997	125.0	4800	\$	600,000	5.3	1800	3400	\$	18,136	
MH 31	MH 32	120.0	0.10	910.4	909.5	904.82	904.70	5.5	4.8 4.6	5.2 4.7	900 900	120.0 120.0	1500	\$	180,000			\$	-	5.5 4.8	1800	3400	\$ ¢	18,802 16,422	
MH 32	MH 33	120.0 120.0	0.10 0.10	909.5 909.2	909.2	904.70 904.58	904.58 904.46	4.8	4.6	4.7	900	120.0	1415 1415	۶ د	169,800 169,800			\$	-	4.8	1800 1800	3400 3400	¢	15,776	
MH 33 MH 34	MH 34 MH 35	120.0	0.10	909.2	909.1 908.8	904.46	904.46	4.6	4.5	4.6	900	120.0	1415	ċ	169,800			¢	-	4.6	1800	3400	¢	15,742	
MH 35	MH 36	120.0	0.10	909.1	908.6	904.46	904.34	4.5	4.5	4.4	900	120.0	1415	ς ς	169,800			\$	-	4.5	1800	3400	¢	15,742	
MH 36	MH 37	120.0	0.10	908.6	908.3	904.34	904.22	4.5	4.4	4.4	900	120.0	1415	ς ς	169,800			\$		4.4	1800	3400	ر د	14,858	
MH 37	MH 38	120.0	0.10	908.3	908.1	904.22	903.98	4.4	4.2	4.3	900	120.0	1415	ς ς	169,800			¢		4.4	1800	3400	Ċ	14,314	
MH 38	MH 39	120.0	0.10	908.1	907.9	903.98	903.86	4.2	4.0	4.2	900	120.0	1415	Ś	169,800			\$	-	4.1	1800	3400	\$	14,076	\$ 183,876
MH 39	MH 40	120.0	0.10	907.9	907.9	903.86	903.74	4.0	4.0	4.1	900	120.0	1415	Ś	169,800			Ś		4.0	1800	3400	ς .	13,770	\$ 183,570
MH 40	MH 41	120.0	0.10	907.9	907.7	903.74	903.62	4.1	4.0	4.1	900	120.0	1415	Ś	169,800			Ś	_	4.1	1800	3400	Ś	13,770	
MH 41	MH 42	120.0	0.10	907.7	907.9	903.62	903.50	4.0	4.4	4.2	900	120.0	1415	Ś	169,800			Ś	_	4.0	1800	3400	Ś	13,702	
MH 42	MH 43	120.0	0.10	907.9	907.5	903.50	903.38	4.4	4.1	4.2	900	120.0	1415	Ś	169,800			Ś	_	4.4	1800	3400	Ś	14,926	
MH 43	MH 44	120.0	0.10	907.5	907.0	903.38	903.26	4.1	3.7	3.9	900	120.0	1300	Ś	156,000			Ś	_	4.1	1800	3400	Ś	14,110	
MH 44	MH 45	120.0	0.10	907.0	906.6	903.26	903.14	3.7	3.5	3.6	900	120.0	1300	Ś	156,000			\$	_	3.7	1800	3400	Ś	12,580	
MH 45	MH 46	120.0	0.10	906.6	906.5	903.14	903.02	3.5	3.5	3.5	900	120.0	1300	Ś	156,000			Ś	_	3.5	1800	3400	\$	11,866	
MH 46	MH 47	120.0	0.10	906.5	905.2	903.02	902.90	3.5	2.3	2.9	900	40.0	1300	Ś	52,000	80.0	4800	7	384,000	3.5	1800	3400	Ś	11,832	
MH 47	MH 48	120.0	0.10	905.2	906.2	902.90	902.78	2.3	3.4	2.9	900	35.0	1300	Ś	45,500	85.0	4800	Ś	408,000	2.3	1800	3400	Ś	7,718	
MH 48	MH 49	120.0	0.10	906.2	907.0	902.78	902.66	3.4	4.4	3.9	900	120.0	1300	\$	156,000	23.0	.500	Ś	-	3.4	1800	3400	\$	11,662	
MH 49	MH 50	120.0	0.10	907.0	907.7	902.66	902.54	4.4	5.2	4.8	900	120.0	1415	Ś	169,800			Ś	_	4.4	1800	3400	\$	14,858	
MH 50	Ex. MH	51.2	0.10	907.7	907.4	902.54	902.49	5.2	4.9	5.1	900	51.2	1415	\$	72,448			\$	-	5.2	1800	3400	\$	17,680	
		5826.4										4576.4		<u> </u>	-,	1250.0	1	<u>' ' </u>			1		<u> </u>	Sub-total	

5826.4 1250.0 **Sub-total \$ 12,176,801**

Contingency (20%) \$ 2,435,360 Sub-total \$ 14,612,161 70 Street Connection \$ 210,210

Land Acquisition \$ 210,059

Total Construction Cost \$ 15,032,430

Engineering and Construction Administration (10%) \$ 1,503,243

Permits and Approvals (2%) \$ 300,649

Total Estimated Project Cost \$ 16,836,322

Table H-4d Alignment 4 **Alternative 2 Flows**

Pump Stat	ion and For	cemain Opt	ion										Open Cut				Trenchless			U,	/S MH			
From	То	Length (m)	Pipe Slope (%)	U/S Rim Elev.	D/S Rim Elev.	U/S Inv. Elev.	D/S Inv. Elev.	U/S Depth (m)	D/S Depth (m)	Avg. Depth (m)	Diameter (mm)	Length (m)	Unit Cost (\$/m)	С	Cost	Length (m)	Unit Cost (\$/m)	Cost	Vt. m	MH Size Required (mm)	Unit Cost (\$/vt. m)	Cost	T	otal
MH 1	MH 2	120.0	1.50	935.0	933.0	930.00	928.20	5.0	4.8	4.9	450	120.0	915	\$	109,800			\$ -	5.0	1200	2400	\$ 12,072	\$	121,872
MH 2	MH 3	120.0	1.50	933.0	928.5	927.20	925.40	5.8	3.1	4.4	450	120.0	915	\$	109,800			\$ -	5.8	1200	2400	\$ 13,824	\$	123,624
MH 3	MH 4	60.0	1.50	928.5	926.7	924.40	923.50	4.1	3.2	3.6	450	60.0	870	\$	52,200			\$ -	4.1	1200	2400	\$ 9,792	\$	61,992
MH 4	MH 5	60.0	1.50	926.7	925.0	922.50	921.60	4.2	3.4	3.8	450	60.0	870	\$	52,200			\$ -	4.2	1200	2400	\$ 10,032	\$	62,232
MH 5	MH 6	120.0	1.50	925.0	923.1	921.11	919.31	3.9	3.8	3.8	450	120.0	870	\$	104,400			\$ -	3.9	1200	2400	\$ 9,240	\$	113,640
MH 6	MH 7	120.0	1.50	923.1	921.3	919.31	917.51	3.8	3.8	3.8	450	120.0	870	\$	104,400			\$ -	3.8	1200	2400	\$ 9,168	\$	113,568
MH 7	MH 8	120.0	0.50	921.3	920.5	917.33	916.73	4.0	3.7	3.9	525	120.0	930	\$	111,600			\$ -	4.0	1200	2400	\$ 9,600	\$	121,200
MH 8	MH 9	120.0	0.50	920.5	919.9	916.73	916.13	3.7	3.8	3.8	525	120.0	930	\$	111,600			\$ -	3.7	1200	2400	\$ 8,976	\$	120,576
MH 9	MH 10	120.0	0.50	919.9	919.4	916.13	915.53	3.8	3.8	3.8	525	120.0	930	\$	111,600			\$ -	3.8	1200	2400	\$ 9,072	\$	120,672
MH 10	MH 11	120.0	0.50	919.4	918.9	915.53	914.93	3.8	3.9	3.9	525	120.0	930	\$	111,600			\$ -	3.8	1200	2400	\$ 9,168	\$	120,768
MH 11	MH 12	120.0	0.50	918.9	918.0	914.93	914.33	3.9	3.6	3.8	525	120.0	930	\$	111,600			\$ -	3.9	1200	2400	\$ 9,432	\$	121,032
MH 12	MH 13	120.0	0.50	918.0	917.6	914.33	913.73	3.6	3.9	3.8	525	120.0	930	\$	111,600			\$ -	3.6	1200	2400	\$ 8,688	\$	120,288
MH 13	MH 14	120.0	0.10	917.6	917.5	913.53	913.41	4.1	4.1	4.1	675	120.0	1085	\$	130,200			\$ -	4.1	1500	3000	\$ 12,330	\$	142,530
MH 14	MH 15	120.0	0.10	917.5	918.4	913.41	913.29	4.1	5.1	4.6	675	120.0	1085	\$	130,200			\$ -	4.1	1500	3000	\$ 12,300	\$	142,500
MH 15	MH 16	120.0	0.10	918.4	919.5	913.29	913.17	5.1	6.4	5.7	750	120.0	1400	\$	168,000			\$ -	5.1	1500	3000	\$ 15,240	\$	183,240
MH 16	MH 17	120.0	0.10	919.5	921.1	913.17	913.05	6.4	8.1	7.2	750			\$	-	120.0	4380	\$ 525,600	6.4	1500	3000	\$ 19,110	\$	544,710
MH 17	Ex. MH	4026.4	N/A	921.1	923.1	918.11	920.06	3.0	3.0	3.0	600	4026.4	970	\$ 3	,905,608				3.0	1200	2400	\$ 7,200	\$:	3,912,808
		5826.4										5706.4				120.0						Sub-total	\$ 6,24	47,252.00

Contingency (20%) \$ 1,249,450

Sub-total \$ 7,496,702

70 Street Connection \$ 955,110 Pump Station \$ 2,983,500

210,059

Land Acquisition \$

Total Construction Cost \$ 11,645,371

Engineering and Construction Administration (10%) \$ 1,164,537

Permits and Approvals (2%) \$ 232,907

Total Estimated Project Cost \$ 13,042,816

13890 Edson WEST Initial Cost Estimate for Scenario 1 Pump Station

Item		Description		Cost
1	General			
	1.1	Mobilization/Demobilization	\$	50,000
	1.2	Cash allowance for utilities (water, gas, electrical, and phone line)	\$	25,000
	1.3	Commissioning	\$	50,000
2	Site work			
	2.1	Clearing and relocating	\$	50,000
	2.2	Access road and fence	\$	30,000
	2.3	Gravity pipes and inlet manhole	\$	50,000
	2.4	Pressure pipes	\$	50,000
	2.5	Miscellaneous site work	\$	25,000
3	Structures	•	-	
	3.1	Wet Well	\$	100,000
	3.2	Valve Chamber	\$	100,000
	3.3	Building	\$	100,000
4	Mechanica		•	
	4.1	Sluice gates	\$	30,000
	4.2	Grinder and overflow screen	\$	65,000
	4.3	Pumps and accessories (duty + standby)	\$	150,000
	4.4	Lifting equipment	\$	20,000
	4.5	Piping and valves	\$	150,000
	4.6	HVAC	\$	100,000
	4.7	Plumbing	\$	25,000
5	Electrical			
	5.1	Electrical	\$	250,000
	5.2	Standby generator set	\$	75,000
6	Cost summ	nery		
	6.1	Construction subtotal	\$	1,495,000
	6.3	Estimated engineering and construction contingency (35%)	\$	523,250
	6.4	Total Project Costs	\$	2,018,250

Table H-5b 13890 Edson WEST Initial Cost Estimate for Scenario 2 Pump Station

Item		Description		Cost
1	General			
	1.1	Mobilization/Demobilization	\$	50,000
	1.2	Cash allowance for utilities (water, gas, electrical, and phone line)	\$	25,000
	1.3	Commissioning	\$	50,000
2	Site work			
	2.1	Clearing and relocating	\$	50,000
	2.2	Access road and fence	\$	30,000
	2.3	Gravity pipes and inlet manhole	\$	75,000
	2.4	Pressure pipes	\$	75,000
	2.5	Miscellaneous site work	\$	25,000
3	Structures	•	-	
	3.1	Wet Well	\$	350,000
	3.2	Valve Chamber	\$	150,000
	3.3	Building	\$	100,000
4	Mechanical			
	4.1	Sluice gates	\$	50,000
	4.2	Grinder and overflow screen	\$	85,000
	4.3	Pumps and accessories (duty + standby)	\$	200,000
	4.4	Lifting equipment	\$	20,000
	4.5	Piping and valves	\$	300,000
	4.6	HVAC	\$	100,000
	4.7	Plumbing	\$	25,000
5	Electrical			
	5.1	Electrical	\$	350,000
	5.2	Standby generator set	\$	100,000
6	Cost summ	ery		
	6.1	Construction subtotal	\$	2,210,000
	6.3	Estimated engineering and construction contingency (35%)	\$	773,500
	6.4	Total Project Costs	\$	2,983,500



Table H-6a 13890 Edson West Sanitary Sewer Trunk Life Cycle Costs Alignment 1, Alternative 1 or 2, Gravity Sewer

		Costs (2014\$)		\$4,791	\$4,656	\$4,524	\$4,396	\$4,272	\$4,151	\$4,033	\$3,919	\$3,808	\$3,700	\$3,596	\$3,494	\$3,395	\$3,299	\$3,206	\$3,115	\$3,027	\$2,941	\$2,858	\$2,777	\$2,698	\$2,622	\$2,548	\$2,476	\$2,406	\$2,337	\$2,271	\$2,207	\$2,145	\$2,084	\$810
	Future Costs	with Inflation		\$5,079	\$5,231	\$5,388	\$5,550	\$5,716	\$5,888	\$6,065	\$6,246	\$6,434	\$6,627	\$6,826	\$7,030	\$7,241	\$7,459	\$7,682	\$7,913	\$8,150	\$8,395	\$8,647	\$8,906	\$9,173	\$9,448	\$9,732	\$10,024	\$10,324	\$10,634	\$10,953	\$11,282	\$11,620	\$11,969	\$4,931
	Total Annual	Costs		\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931
	Conveyance	Maintenance	Cost	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931	\$4,931
		O&M	Cost																															
Operating Costs		Energy	Cost																															
Oper	Pumping	Energy	(KWH)																															
		Daily Run Time	hrs.																															
	Av Elow Pate		(L/s)																															
	Voor	במ		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
	Year	No.		1	2	3	4	2	9	7	8	6	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

\$246,563

\$152,861



Table H-6b 13890 Edson West Sanitary Sewer Trunk Life Cycle Costs Alignment 1, Alternative 1 with Pump Station

			_	Operating Costs	"					
Year	Voar Av Flow Rafe		Pumping			Conveyance		Total Annual		
		Daily Run Time	Energy	Energy	O&M	Maintenance	Refurb.	Costs	with Inflation	Costs (2014\$)
	(F/s)	hrs.	(KWH)	Cost	Cost	Cost	Cost			
	2015 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$42,133	\$39,748
	2016 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$43,397	\$38,623
	017 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$44,699	\$37,530
	1	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$46,040	\$36,468
	019 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$47,421	\$35,436
6 20	2020 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$48,843	\$34,433
	021 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$50,309	\$33,458
8 20	022 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$51,818	\$32,511
	023 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$53,372	\$31,591
10 20	024 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$54,974	269'0£\$
		1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$56,623	\$29,828
12 20		1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$58,322	\$28,984
	027 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$60,071	\$28,164
		1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$61,873	\$27,367
	029 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$63,729	\$26,592
	030 16	1.92	73,164	\$10,975	\$25,000	\$4,931	\$660,000	\$700,906	\$1,124,748	\$442,753
17 20	2031 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$67,611	\$25,108
		1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$69,639	\$24,398
		1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$71,728	\$23,707
	2034 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$73,880	\$23,036
		1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$76,096	\$22,384
		1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$78,379	\$21,751
		1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$80,731	\$21,135
	038 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$83,153	\$20,537
	039 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$85,647	\$19,956
	040	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$88,217	\$19,391
	041 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$90,863	\$18,842
	2042 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$93,589	\$18,309
	043 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	296,397	\$17,791
30 20	2044 16	1.92	73,164	\$10,975	\$25,000	\$4,931		\$40,906	\$99,288	\$17,287
	2045 16	1.92	73.164	\$10.975	\$25,000	\$4 931	\$660,000	906 002\$	8700 906	\$115 127

939	,
\$1 342	4-,04
& 3	401,10
\$2 588 074	* 2,000,011
\$1 320 000	000,020,10
\$152 861	02,00
\$775,000	0,000
\$340.210	0.12,0+00



Table H-6c 13890 Edson West Sanitary Sewer Trunk Life Cycle Costs Alignment 1, Alternative 2 with Pump Station

				Operating costs	n					
_	Vear Av Flow Rate		Pumping			Conveyance		Total Annual		
		Daily Run Time	Energy	Energy	O&M	Maintenance	Refurb.	Costs	with Inflation	Costs (2014\$)
	(L/s)	hrs.	(KWH)	Cost	Cost	Cost	Cost			
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$44,396	\$41,883
	2016 28	1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$45,727	\$40,697
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$47,099	\$39,545
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$48,512	\$38,426
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$49,968	\$37,339
6 2	2020 28	1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$51,467	\$36,282
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$53,011	\$35,255
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$54,601	\$34,257
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$56,239	\$33,288
10 20		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$57,926	\$32,346
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$59,664	\$31,430
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$61,454	\$30,541
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$63,298	\$29,676
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$65,196	\$28,836
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$67,152	\$28,020
		1.34	87,810	\$13,172	\$25,000	\$4,931	\$660,000	\$703,103	\$1,128,273	\$444,141
17 20		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$71,242	\$26,457
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$73,379	\$25,708
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$75,581	\$24,980
	2034 28	1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$77,848	\$24,273
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$80,183	\$23,586
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$82,589	\$22,919
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$85,067	\$22,270
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$87,619	\$21,640
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$90,247	\$21,027
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$92,955	\$20,432
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$95,743	\$19,854
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$98,615	\$19,292
		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$101,574	\$18,746
30 20		1.34	87,810	\$13,172	\$25,000	\$4,931		\$43,103	\$104,621	\$18,216
	2045 28	1 34	87.810	£12 170	000 363	£7.031	000 099	£702 402	£703 403	4115 188

1,386,853	
\$3,874,348 \$	
\$2,656,179	
\$1,320,000	
\$152,861	
\$775,000	
\$408,318	

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Table H-7a 13890 Edson West Sanitary Sewer Trunk Life Cycle Costs Alignment 2, Alternative 1 or 2, Gravity Sewer

Pumping
25.
(KWH)

\$125,444	
\$313,817	
\$194,556	
0\$	
\$194,556	
\$0	
\$0	

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Table H-7b 13890 Edson West Sanitary Sewer Trunk Life Cycle Costs Alignment 2, Alternative 1 with Pump Station

Year No.				J	Operating Costs	ur.					
Ö	2007	A.v. Elow Dato		Pumping			Conveyance		Total Annual	Future Costs	NPV Annual
	<u> </u>		Daily Run Time	Energy	Energy	O&M	Maintenance	Refurb.	Costs	with Inflation	Costs (2014\$)
		(F/s)	hrs.	(KWH)	Cost	Cost	Cost	Cost			
1	2015	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$43,517	\$41,054
2	2016	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$44,823	\$39,892
င	2017	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$46,167	\$38,763
4	2018	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$47,552	\$37,666
5	2019	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$48,979	\$36,600
9	2020	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$50,448	\$35,564
7	2021	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$51,962	\$34,557
8	2022	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$53,520	833,579
6	2023	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$55,126	\$32,629
10	2024	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$56,780	\$31,706
11	2025	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$58,483	\$30,808
12	2026	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$60,238	\$29,936
13	2027	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$62,045	\$29,089
14	2028	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$63,906	\$28,266
15	2029	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$65,823	\$27,466
16	2030	16	1.92	73,164	\$10,975	\$25,000	\$6,275	\$660,000	\$702,250	\$1,126,904	\$443,602
17	2031	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$69,832	\$25,933
18	2032	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$71,927	\$25,199
19	2033	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$74,085	\$24,486
20	2034	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$76,307	\$23,793
21	2035	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$78,597	\$23,120
22	2036	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$80,954	\$22,465
23	2037	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$83,383	\$21,829
24	2038	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$82,885	\$21,212
25	2039	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$88,461	\$20,611
26	2040	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$91,115	\$20,02\$
27	2041	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$93,848	\$19,461
28	2042	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$96,664	\$18,910
29	2043	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$99,564	\$18,375
30	2044	16	1.92	73,164	\$10,975	\$25,000	\$6,275		\$42,250	\$102,551	\$17,855
31	2045	16	1.92	73,164	\$10,975	\$25,000	\$6,275	\$660,000	\$702,250	\$702,250	\$115,348

\$1,369,803	
\$3,831,696	
\$2,629,735	
\$1,320,000	
\$194,525	
\$775,000	
\$340,210	



Table H-7c 13890 Edson West Sanitary Sewer Trunk Life Cycle Costs Alignment 2, Alternative 2 with Pump Station

Year				_	Operating Costs	ır					
	,,,,	A.v. Elow Bato		Pumping			Conveyance		Total Annual	Future Costs	NPV Annual
N O	160		Daily Run Time	Energy	Energy	O&M	Maintenance	Refurb.	Costs	with Inflation	Costs (2014\$)
		(L/s)	hrs.	(KWH)	Cost	Cost	Cost	Cost			
1	2015	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$45,780	\$43,189
2	2016	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$47,153	\$41,966
3	2017	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$48,568	\$40,779
4	2018	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$50,025	\$39,624
2	2019	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$51,526	\$38,503
9	2020	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$53,071	\$37,413
7	2021	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$54,664	\$36,354
80	2022	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$56,304	\$35,326
6	2023	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$57,993	\$34,326
10	2024	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$59,732	\$33,354
11	2025	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$61,524	\$32,410
12	2026	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$63,370	\$31,493
13	2027	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$65,271	\$30,602
14	2028	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$67,229	\$29,736
15	2029	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$69,246	\$28,894
16	2030	28	1.34	87,810	\$13,172	\$25,000	\$6,275	\$660,000	\$704,447	\$1,130,430	\$444,990
17	2031	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$73,463	\$27,282
18	2032	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$75,667	\$26,510
19	2033	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$77,937	\$25,759
20	2034	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$80,275	\$25,030
21	2035	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$82,684	\$24,322
22	2036	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$85,164	\$23,633
23	2037	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$87,719	\$22,965
24	2038	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$90,351	\$22,315
25	2039	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$93,061	\$21,683
26	2040	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$95,853	\$21,069
27	2041	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$98,729	\$20,473
28	2042	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$101,690	\$19,894
29	2043	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$104,741	\$19,331
30	2044	28	1.34	87,810	\$13,172	\$25,000	\$6,275		\$44,447	\$107,883	\$18,784
31	2045	28	1.34	87,810	\$13,172	\$25,000	\$6,275	\$660,000	\$704,447	\$704,447	\$115,709

\$1,413,716	
\$3,941,552	
\$2,697,843	
\$1,320,000	
\$194,525	
\$775,000	
\$408,318	



Table H-8a 13890 Edson West Sanitary Sewer Trunk Life Cycle Costs Alignment 3, Alternative 1 or 2, Gravity Sewer

Year No.				5	Operating costs					
No	\ reo\ reo	Av Flow Pate		Pumping			Conveyance	Total Annual	Future Costs	NPV Annual
	בפ	AV. FIOW Nate	Daily Run Time	Energy	Energy	O&M	Maintenance	Costs	with Inflation	Costs (2014\$)
		(L/s)	hrs.	(KWH)	Cost	Cost	Cost			
1	2015						\$5,238	\$5,238	\$5,395	060'5\$
2	2016						\$5,238	\$5,238	\$5,557	\$4,946
3	2017						\$5,238	\$5,238	\$5,724	\$4,806
4	2018						\$5,238	\$5,238	\$5,895	\$4,670
2	2019						\$5,238	\$5,238	\$6,072	\$4,538
9	2020						\$5,238	\$5,238	\$6,254	\$4,409
7	2021						\$5,238	\$5,238	\$6,442	\$4,284
8	2022						\$5,238	\$5,238	\$6,635	\$4,163
6	2023						\$5,238	\$5,238	\$6,834	\$4,045
10	2024						\$5,238	\$5,238	\$7,039	\$3,931
11	2025						\$5,238	\$5,238	\$7,251	\$3,820
12	2026						\$5,238	\$5,238	\$7,468	\$3,711
13	2027						\$5,238	\$5,238	\$7,692	\$3,606
14	2028						\$5,238	\$5,238	\$7,923	\$3,504
15	2029						\$5,238	\$5,238	\$8,161	\$3,405
16	2030						\$5,238	\$5,238	\$8,405	60£'£\$
17	2031						\$5,238	\$5,238	\$8,658	\$3,215
18	2032						\$5,238	\$5,238	\$8,917	\$3,124
19	2033						\$5,238	\$5,238	\$9,185	\$3,036
20	2034						\$5,238	\$5,238	\$9,460	\$2,950
21	2035						\$5,238	\$5,238	\$9,744	\$2,866
22	2036						\$5,238	\$5,238	\$10,037	\$2,785
23	2037						\$5,238	\$5,238	\$10,338	\$2,706
24	2038						\$5,238	\$5,238	\$10,648	\$2,630
25	2039						\$5,238	\$5,238	\$10,967	\$2,555
26	2040						\$5,238	\$5,238	\$11,296	\$2,483
27	2041						\$5,238	\$5,238	\$11,635	\$2,413
28	2042						\$5,238	\$5,238	\$11,984	\$2,344
29	2043						\$5,238	\$5,238	\$12,344	\$2,278
30	2044						\$5,238	\$5,238	\$12,714	\$2,214
31	2045						\$5,238	\$5,238	\$5,238	098\$

\$104,697

\$261,914

\$162,378



Table H-8b 13890 Edson West Sanitary Sewer Trunk Life Cycle Costs Alignment 3, Alternative 1 with Pump Station

				Operating costs	n					
Year Vear	ar Av Flow Rafe		Pumping			Conveyance		Total Annual		NPV Annual
		Daily Run Time	Energy	Energy	M&O	Maintenance	Refurb.	Costs	with Inflation	Costs (2014\$)
	(L/s)	hrs.	(KWH)	Cost	Cost	Cost	Cost			
2015	15 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$42,449	\$40,046
2016	16 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$43,722	\$38,913
	17 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$45,034	\$37,811
	18 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$46,385	\$36,741
		1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$47,777	\$35,701
6 2020		1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$49,210	\$34,691
	21 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$50,686	\$33,709
	22 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$52,207	\$32,755
9 202	23 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$53,773	\$31,828
10 202	24 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$55,386	\$30,927
		1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$57,048	\$30,052
12 202		1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$58,759	\$29,202
	27 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$60,522	\$28,375
		1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$62,338	\$27,572
	29 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$64,208	\$26,792
16 203		1.92	73,164	\$10,975	\$25,000	\$5,238	\$660,000	\$701,213	\$1,125,240	\$442,947
	31 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$68,118	\$25,297
		1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$70,162	\$24,581
		1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$72,266	\$23,885
2034	34 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$74,434	\$23,209
		1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$76,667	\$22,552
		1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$78,967	\$21,914
	37 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$81,336	\$21,294
	38 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$83,777	\$20,691
	39 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$86,290	\$20,105
	10 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$88,879	\$19,536
	11 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$91,545	\$18,983
3 2042	15 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$94,291	\$18,446
	13 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$97,120	\$17,924
30 2044	14 16	1.92	73,164	\$10,975	\$25,000	\$5,238		\$41,213	\$100,034	\$17,417
1 2045	15 16	1 02	73 16/	\$10 975	000 363	&E 238	000 099	£704 040	£701 013	6115179



Table H-8c 13890 Edson West Sanitary Sewer Trunk Life Cycle Costs Alignment 3, Alternative 2 with Pump Station

					Operating Costs	ø					
Year	, ,	Av Flow Date		Pumping			Conveyance		Total Annual	Future Costs	NPV Annual
No.	rear		Daily Run Time	Energy	Energy	O&M	Maintenance	Refurb.	Costs	with Inflation	Costs (2014\$)
		(L/s)	hrs.	(KWH)	Cost	Cost	Cost	Cost			
_	2015	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$44,712	\$42,181
2	2016	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$46,053	\$40,987
3	2017	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$47,435	\$39,827
4	2018	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$48,858	\$38,700
2	2019	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$50,324	\$37,605
9	2020	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$51,833	\$36,540
7	2021	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$53,388	\$35,506
∞	2022	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$54,990	\$34,501
6	2023	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$56,640	\$33,525
10	2024	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$58,339	\$32,576
11	2025	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$60,089	\$31,654
12	2026	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$61,892	\$30,758
13	2027	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$63,748	\$29,888
14	2028	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$65,661	\$29,042
15	2029	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$67,631	\$28,220
16	2030	28	1.34	87,810	\$13,172	\$25,000	\$5,238	\$660,000	\$703,410	\$1,128,766	\$444,334
17	2031	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$71,749	\$26,645
18	2032	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$73,902	\$25,891
19	2033	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$76,119	\$25,158
20	2034	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$78,402	\$24,446
21	2035	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$80,755	\$23,754
22	2036	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$83,177	\$23,082
23	2037	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$85,672	\$22,429
24	2038	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$88,243	\$21,794
25	2039	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	068'06\$	\$21,177
26	2040	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$93,617	\$20,578
27	2041	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$96,425	\$19,995
28	2042	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$99,318	\$19,430
29	2043	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$102,297	\$18,880
30	2044	28	1.34	87,810	\$13,172	\$25,000	\$5,238		\$43,410	\$105,366	\$18,345
31	2045	28	1.34	87,810	\$13,172	\$25,000	\$5,238	\$660,000	\$703,410	\$703,410	\$115,538

ı		١
	\$1,392,989	
	\$3,889,699	
	\$2,665,696	
	\$1,320,000	
	\$162,378	
	\$775,000	
	\$408,318	



Table H-9a 13890 Edson West Sanitary Sewer Trunk Life Cycle Costs Alignment 4, Alternative 1 or 2, Gravity Sewer

Conveyance Total Annual O&M Maintenance Costs Cost Cost Costs Cost Cost Costs S5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826 \$5,826					Oper	Operating Costs					
2016 Cost COst Cost Cost Cost Cost Cost Cost Cost SS 826 SS	Year	\ 70.97	Av Flow Pate		Pumping			Conveyance	Total Annual		NPV Annual
2015 (L/s) hrs. (KWH) Cost Cost SS-826 SS-826 2016 2016 \$5.826 \$5	No.	פפ	AV. FIOW NAL		Energy	Energy	O&M	Maintenance	Costs	with Inflation	Costs (2014\$)
2016 \$5,826 \$5,826 \$5,826 2016 \$6,826 \$5,826 \$5,826 2017 \$6,826 \$5,826 \$5,826 2019 \$6,826 \$5,826 \$5,826 2021 \$6,826 \$5,826 \$5,826 2022 \$6,826 \$5,826 \$5,826 2023 \$6,826 \$5,826 \$5,826 2024 \$6,826 \$5,826 \$5,826 2025 \$6,826 \$5,826 \$5,826 2026 \$6,826 \$5,826 \$5,826 2026 \$6,826 \$5,826 \$5,826 2027 \$6,826 \$5,826 \$5,826 2028 \$6,826 \$5,826 \$5,826 2029 \$6,826 \$5,826 \$5,826 2024 \$6,826 \$5,826 \$5,826 2034 \$6,826 \$5,826 \$5,826 2034 \$6,826 \$5,826 \$5,826 2034 \$6,826 \$5,826 \$5,826			(F/s)	hrs.	(KWH)	Cost	Cost	Cost			
2016 2016 \$5,826 \$5,826 2017 2018 \$5,826 \$5,826 2018 2019 \$5,826 \$5,826 2019 \$5,826 \$5,826 \$5,826 2021 \$5,826 \$5,826 \$5,826 2021 \$5,826 \$5,826 \$5,826 2023 \$5,826 \$5,826 \$5,826 2024 \$5,826 \$5,826 \$5,826 2024 \$5,826 \$5,826 \$5,826 2024 \$5,826 \$5,826 \$5,826 2025 \$5,826 \$5,826 \$5,826 2026 \$5,826 \$5,826 \$5,826 2026 \$5,826 \$5,826 \$5,826 2027 \$5,826 \$5,826 \$5,826 2028 \$5,826 \$5,826 \$5,826 2030 \$5,826 \$5,826 \$5,826 2031 \$5,826 \$5,826 \$5,826 2032 \$5,826 \$5,826 \$5,826	1	2015						\$5,826	\$5,826	\$6,001	\$5,661
2017 \$6,826 \$6,826 \$6,826 2018 \$6,826 \$6,826 \$6,826 2019 \$6,826 \$6,826 \$6,826 2019 \$6,826 \$6,826 \$6,826 2020 \$6,826 \$6,826 \$6,826 2021 \$6,826 \$6,826 \$6,826 2022 \$6,826 \$6,826 \$6,826 2024 \$6,826 \$6,826 \$6,826 2026 \$6,826 \$6,826 \$6,826 2026 \$6,826 \$6,826 \$6,826 2024 \$6,826 \$6,826 \$6,826 2028 \$6,826 \$6,826 \$6,826 2028 \$6,826 \$6,826 \$6,826 2029 \$6,826 \$6,826 \$6,826 2028 \$6,826 \$6,826 \$6,826 2029 \$6,826 \$6,826 \$6,826 2034 \$6,826 \$6,826 \$6,826 2034 \$6,826 \$6,826 \$6,826	2	2016						\$5,826	\$5,826	\$6,181	\$5,501
2018 \$6,826 \$6,826 \$6,826 2019 \$6,826 \$6,826 \$6,826 2020 \$6,826 \$6,826 \$6,826 2021 \$6,826 \$6,826 \$6,826 2022 \$6,826 \$6,826 \$6,826 2023 \$6,826 \$6,826 \$6,826 2024 \$6,826 \$6,826 \$6,826 2024 \$6,826 \$6,826 \$6,826 2025 \$6,826 \$6,826 \$6,826 2026 \$6,826 \$6,826 \$6,826 2026 \$6,826 \$6,826 \$6,826 2029 \$6,826 \$6,826 \$6,826 2030 \$6,826 \$6,826 \$6,826 2031 \$6,826 \$6,826 \$6,826 2032 \$6,826 \$6,826 \$6,826 2034 \$6,826 \$6,826 \$6,826 2034 \$6,826 \$6,826 \$6,826 2034 \$6,826 \$6,826 \$6,826	3	2017						\$5,826	\$5,826	\$6,366	\$5,345
2019 \$5,826 \$5,826 \$5,826 2020 \$5,826 \$5,826 \$5,826 2021 \$5,826 \$5,826 \$5,826 2022 \$5,826 \$5,826 \$5,826 2023 \$5,826 \$5,826 \$5,826 2026 \$5,826 \$5,826 \$5,826 2026 \$5,826 \$5,826 \$5,826 2026 \$5,826 \$5,826 \$5,826 2028 \$5,826 \$5,826 \$5,826 2028 \$5,826 \$5,826 \$5,826 2039 \$6,826 \$5,826 \$5,826 2030 \$6,826 \$5,826 \$5,826 2031 \$6,826 \$5,826 \$5,826 2032 \$6,826 \$5,826 \$5,826 2033 \$6,826 \$5,826 \$5,826 2034 \$6,826 \$5,826 \$5,826 2034 \$6,826 \$5,826 \$5,826 2034 \$6,826 \$5,826 \$5,826	4	2018						\$5,826	\$5,826	\$6,557	\$5,194
2020 \$5,826 \$5,826 2021 \$6,826 \$5,826 2023 \$5,826 \$5,826 2024 \$5,826 \$5,826 2025 \$5,826 \$5,826 2026 \$5,826 \$5,826 2027 \$5,826 \$5,826 2028 \$5,826 \$5,826 2028 \$5,826 \$5,826 2028 \$5,826 \$5,826 2028 \$5,826 \$5,826 2029 \$5,826 \$5,826 2030 \$5,826 \$5,826 2031 \$5,826 \$5,826 2032 \$5,826 \$5,826 2034 \$5,826 \$5,826 2035 \$5,826 \$5,826 2034 \$5,826 \$5,826 2035 \$5,826 \$5,826 2034 \$5,826 \$5,826 2035 \$5,826 \$5,826 2036 \$5,826 \$5,826 2041 \$5,826 \$5,826 <td>2</td> <td>2019</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>\$5,826</td> <td>\$5,826</td> <td>\$6,754</td> <td>\$5,047</td>	2	2019						\$5,826	\$5,826	\$6,754	\$5,047
2021 \$5,826 \$5,826 2022 \$5,826 \$5,826 2024 \$5,826 \$5,826 2025 \$5,826 \$5,826 2026 \$5,826 \$5,826 2027 \$5,826 \$5,826 2028 \$5,826 \$5,826 2028 \$5,826 \$5,826 2029 \$5,826 \$5,826 2030 \$5,826 \$5,826 2031 \$5,826 \$5,826 2032 \$5,826 \$5,826 2033 \$5,826 \$5,826 2034 \$5,826 \$5,826 2035 \$5,826 \$5,826 2034 \$5,826 \$5,826 2035 \$5,826 \$5,826 2036 \$5,826 \$5,826 2037 \$5,826 \$5,826 2038 \$5,826 \$5,826 2039 \$5,826 \$5,826 2041 \$5,826 \$5,826 2042 \$5,826 \$5,826 2043 \$5,826 \$5,826 2044 \$5,	9	2020						\$5,826	\$5,826	\$6,957	\$4,904
2022 \$6,826	7	2021						\$5,826	\$5,826	\$7,165	\$4,765
2023 \$6,826	8	2022						\$5,826	\$5,826	\$7,380	\$4,630
2024 \$0.24 \$6.826 \$5.826 \$5.826 2025 \$0.25 \$0.82 \$5.826	6	2023						\$5,826	\$5,826	\$7,602	\$4,499
2025 \$5,826 \$5,826 2026 \$5,826 \$5,826 2027 \$5,826 \$5,826 2029 \$5,826 \$5,826 2030 \$5,826 \$5,826 2031 \$5,826 \$5,826 2032 \$5,826 \$5,826 2033 \$5,826 \$5,826 2034 \$5,826 \$5,826 2035 \$5,826 \$5,826 2036 \$5,826 \$5,826 2037 \$5,826 \$5,826 2036 \$5,826 \$5,826 2037 \$5,826 \$5,826 2039 \$5,826 \$5,826 2030 \$5,826 \$5,826 2030 \$5,826 \$5,826 2040 \$5,826 \$5,826 2041 \$5,826 \$5,826 2042 \$5,826 \$5,826 2043 \$5,826 \$5,826 2044 \$5,826 \$5,826 2045 \$5,826 \$5,826 2045 \$5,826 \$5,826 2046 \$5,	10	2024						\$5,826	\$5,826	\$7,830	\$4,372
2026 \$5,826 \$5,826 \$5,826 2027 \$5,826 \$5,826 \$5,826 2028 \$5,826 \$5,826 \$5,826 2039 \$5,826 \$5,826 \$5,826 2031 \$5,826 \$5,826 \$5,826 2032 \$5,826 \$5,826 \$5,826 2033 \$5,826 \$5,826 \$5,826 2034 \$5,826 \$5,826 \$5,826 2035 \$5,826 \$5,826 \$5,826 2034 \$5,826 \$5,826 \$5,826 2035 \$5,826 \$5,826 \$5,826 2036 \$5,826 \$5,826 \$5,826 2037 \$6,826 \$5,826 \$5,826 2038 \$6,826 \$5,826 \$5,826 2039 \$6,826 \$5,826 \$5,826 2041 \$6,826 \$5,826 \$5,826 2042 \$6,826 \$5,826 \$5,826 2044 \$6,826 \$5,826 \$5,826	11	2025						\$5,826	\$5,826	\$8,065	\$4,248
2027 \$5,826 \$5,826 \$5,826 2028 \$5,826 \$5,826 \$5,826 2030 \$5,826 \$5,826 \$5,826 2031 \$5,826 \$5,826 \$5,826 2032 \$5,826 \$5,826 \$5,826 2033 \$5,826 \$5,826 \$5,826 2034 \$5,826 \$5,826 \$5,826 2035 \$5,826 \$5,826 \$5,826 2036 \$5,826 \$5,826 \$5,826 2036 \$5,826 \$5,826 \$5,826 2036 \$5,826 \$5,826 \$5,826 2037 \$5,826 \$5,826 \$5,826 2038 \$5,826 \$5,826 \$5,826 2040 \$5,826 \$5,826 \$5,826 2041 \$5,826 \$5,826 \$5,826 2042 \$5,826 \$5,826 \$5,826 2043 \$5,826 \$5,826 \$5,826 2044 \$5,826 \$5,826 \$5,826 2044 \$5,826 \$5,826 \$5,826 2044	12	2026						\$5,826	\$5,826	\$8,306	\$4,128
2028 \$5,826	13	2027						\$5,826	\$5,826	\$8,556	\$4,011
2029 \$5,826 \$5,826 \$5,826 2030 \$5,826 \$5,826 \$5,826 2031 \$5,826 \$5,826 \$5,826 2032 \$5,826 \$5,826 \$5,826 2033 \$6,826 \$5,826 \$5,826 2034 \$6,826 \$5,826 \$5,826 2035 \$6,826 \$5,826 \$5,826 2036 \$6,826 \$5,826 \$5,826 2037 \$6,826 \$5,826 \$5,826 2038 \$6,826 \$5,826 \$5,826 2039 \$6,826 \$5,826 \$5,826 2040 \$6,826 \$5,826 \$5,826 2041 \$6,826 \$5,826 \$5,826 2042 \$6,826 \$5,826 \$5,826 2043 \$6,826 \$5,826 \$5,826 2043 \$6,826 \$5,826 \$5,826 2043 \$6,826 \$5,826 \$5,826 2044 \$6,826 \$5,826 \$5,826	14	2028						\$5,826	\$5,826	\$8,812	\$3,898
2030 \$5,826 \$5,826 \$5,826 2031 \$5,826 \$5,826 \$5,826 2032 \$5,826 \$5,826 \$5,826 2033 \$5,826 \$5,826 \$5,826 2034 \$5,826 \$5,826 \$5,826 2035 \$5,826 \$5,826 \$5,826 2036 \$5,826 \$5,826 \$5,826 2036 \$5,826 \$5,826 \$5,826 2038 \$6,826 \$5,826 \$5,826 2039 \$6,826 \$5,826 \$5,826 2040 \$6,826 \$5,826 \$5,826 2042 \$6,826 \$5,826 \$5,826 2042 \$6,826 \$5,826 \$5,826 2042 \$6,826 \$5,826 \$5,826 2043 \$6,826 \$5,826 \$5,826 2044 \$6,826 \$5,826 \$5,826 2044 \$6,826 \$5,826 \$5,826 2045 \$6,826 \$5,826 \$5,826	15	2029						\$5,826	\$5,826	\$9,077	\$3,787
2031 \$5,826 <td>16</td> <td>2030</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>\$5,826</td> <td>\$5,826</td> <td>\$9,349</td> <td>\$3,680</td>	16	2030						\$5,826	\$5,826	\$9,349	\$3,680
2032 \$5,826	17	2031						\$5,826	\$5,826	\$9,629	\$3,576
2033 \$5,826 \$5,826 \$5,826 2034 \$6,826 \$5,826 \$5,826 2035 \$6,826 \$5,826 \$5,826 2036 \$6,826 \$5,826 \$5,826 2038 \$6,826 \$5,826 \$5,826 2039 \$6,826 \$5,826 \$5,826 2040 \$6,826 \$5,826 \$5,826 2042 \$6,826 \$5,826 \$5,826 2042 \$6,826 \$5,826 \$5,826 2043 \$6,826 \$5,826 \$5,826 2043 \$6,826 \$5,826 \$5,826 2044 \$6,826 \$5,826 \$5,826 2044 \$6,826 \$5,826 \$5,826 2045 \$6,826 \$5,826 \$5,826 2045 \$6,826 \$5,826 \$5,826 \$6,826 \$6,826 \$5,826 \$5,826 \$6,826 \$6,826 \$5,826 \$5,826 \$6,826 \$6,826 \$5,826 \$5,826	18	2032						\$5,826	\$5,826	\$9,918	\$3,475
2034 \$5,826	19	2033						\$5,826	\$5,826	\$10,216	\$3,376
2035 \$5,826 <td>20</td> <td>2034</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>\$5,826</td> <td>\$5,826</td> <td>\$10,522</td> <td>\$3,281</td>	20	2034						\$5,826	\$5,826	\$10,522	\$3,281
2036 \$5,826 \$5,826 \$5,826 2037 \$5,826 \$5,826 \$5,826 2038 \$5,826 \$5,826 \$5,826 2040 \$6,826 \$5,826 \$5,826 2041 \$6,826 \$5,826 \$5,826 2042 \$6,826 \$5,826 \$5,826 2043 \$6,826 \$5,826 \$5,826 2044 \$6,826 \$5,826 \$5,826 2044 \$6,826 \$5,826 \$5,826 2045 \$6,826 \$5,826 \$5,826	21	2035						\$5,826	\$5,826	\$10,838	\$3,188
2037 \$5,826 <td>22</td> <td>2036</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>\$5,826</td> <td>\$5,826</td> <td>\$11,163</td> <td>\$3,098</td>	22	2036						\$5,826	\$5,826	\$11,163	\$3,098
2038 \$5,826 \$5,826 \$5,826 2039 \$5,826 \$5,826 \$5,826 2040 \$6,826 \$5,826 \$5,826 2041 \$6,826 \$5,826 \$5,826 2042 \$6,826 \$5,826 \$5,826 2043 \$6,826 \$5,826 \$5,826 2044 \$6,826 \$5,826 \$5,826 2045 \$6,826 \$5,826 \$5,826	23	2037						\$5,826	\$5,826	\$11,498	\$3,010
2039 \$5,826	24	2038						\$5,826	\$5,826	\$11,843	\$2,925
2040 \$5,826	25	2039						\$5,826	\$5,826	\$12,198	\$2,842
2041 \$5,826	26	2040						\$5,826	\$5,826	\$12,564	\$2,762
2042 \$5,826	27	2041						\$5,826	\$5,826	\$12,941	\$2,684
2043 \$5,826 \$5,826 \$5,826 2044 \$5,826 \$5,826 \$5,826 2045 \$5,826 \$5,826 \$5,826	28	2042						\$5,826	\$5,826	\$13,329	\$2,608
2044 \$5,826 \$5,826 2045 \$5,826 \$5,826	29	2043						\$5,826	\$5,826	\$13,729	\$2,534
2045 \$5,826 \$5,826	30	2044						\$5,826	\$5,826	\$14,141	\$2,462
	31	2045						\$5,826	\$5,826	\$5,826	\$957

291,316 \$116,4	\$180,606	\$180,606	80	\$0
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Table H-9b 13890 Edson West Sanitary Sewer Trunk Life Cycle Costs Alignment 4, Alternative 1 with Pump Station

				Operating Costs	s					
Year	Av Flow Date		Pumping			Conveyance		Total Annual	Future Costs	NPV Annual
<u> </u>		Daily Run Time	Energy	Energy	M&O	Maintenance	Refurb.	Costs	with Inflation	Costs (2014\$)
	(L/s)	hrs.	(KWH)	Cost	Cost	Cost	Cost			
2015	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$43,055	\$40,617
2016	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$44,346	\$39,468
2017	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$45,677	\$38,351
2018	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$47,047	\$37,266
2019	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$48,458	\$36,211
2020	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$49,912	\$35,186
2021	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$51,409	\$34,190
2022	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$52,952	\$33,223
2023	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$54,540	\$32,282
2024	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$56,176	\$31,369
2025	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$57,862	\$30,481
2026	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$59,598	\$29,618
2027	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$61,385	\$28,780
2028	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$63,227	\$27,965
2029	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$65,124	\$27,174
2030	16	1.92	73,164	\$10,975	\$25,000	\$5,826	\$660,000	\$701,801	\$1,126,184	\$443,318
2031	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$69,090	\$25,658
2032	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$71,163	\$24,931
2033	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$73,297	\$24,226
2034	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$75,496	\$23,540
2035	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$77,761	\$22,874
2036	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$80,094	\$22,227
2037	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$82,497	\$21,597
2038	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$84,972	\$20,986
2039	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$87,521	\$20,392
2040	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$90,147	\$19,815
2041	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$92,851	\$19,254
2042	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$95,637	\$18,709
2043	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$98,506	\$18,180
2044	16	1.92	73,164	\$10,975	\$25,000	\$5,826		\$41,801	\$101,461	\$17,665
2045	16	1 92	73.164	\$10,975	000 565	85 826	\$660 000	\$701 801	\$701.801	\$115 274



Table H-9c 13890 Edson West Sanitary Sewer Trunk Life Cycle Costs Alignment 4, Alternative 2 with Pump Station

		_	1	_	1	1		1							1																		
Jenaa VON	Coete (2014¢)	COSIS (2014)	\$42 752	\$41,542	\$40,367	\$39,224	\$38,114	\$37,035	\$35,987	\$34,969	\$33,979	\$33,017	\$32,083	\$31,175	\$30,293	\$29,435	\$28,602	\$444,706	\$27,006	\$26,242	\$25,499	\$24,777	\$24,076	\$23,395	\$22,733	\$22,089	\$21,464	\$20,857	\$20,266	\$19,693	\$19,135	\$18,594	\$115,635
Entire Coete	ruture costs	With Initiation	\$45 317	\$46,677	\$48,077	\$49,520	\$51,005	\$52,535	\$54,111	\$55,735	\$57,407	\$59,129	\$60,903	\$62,730	\$64,612	\$66,550	\$68,547	\$1,129,709	\$72,721	\$74,903	\$77,150	\$79,464	\$81,848	\$84,304	\$86,833	\$89,438	\$92,121	\$94,885	\$97,731	\$100,663	\$103,683	\$106,794	\$703.998
Total Applial	Coete	costs	\$43 998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$703,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$43,998	\$703.998
	Dofinh	Cost	300															\$660,000															\$660,000
obusino)	Maintenance	Cost	\$5.826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826	\$5,826
	Mac	OSIM	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000
Operating Costs	Enorgy	Cost	\$13 172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13,172	\$13 172
O	Fumping	(KWH)	87.810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87,810	87.810
	Paily Dun Time	hrs hrs	1 34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1 34
	Av. Flow Rate	(5/1)	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
	Year		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
700	N CN	O		- 2	က	4	2	9	7	8	6	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

П	l
\$1,404,742	
\$3,919,101	
\$2,683,924	
\$1,320,000	
\$180,606	
\$775,000	
\$408,318	





Appendix I
Risk Assessment

islengineering.com March 2014 | APPENDIX

Edson - West Sanitary Sewer Trunk

Table I - 1 Alignment 1 - Gravity Option

Risk Quantification Worksheet

#	Risk / Concern	Consequence	Magn	itude	\$ Impact	Probability Rationale	Proba	bility		Risk Se	verity	Mitigation Strategy	Risk Cost
	Design											<u> </u>	
	Depth of gas and oil pipelines is unknown	- Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint	Mod	50	\$600,000	Gas/oil pipelines are generally at more shallow depths	Improbable	25	0.2	Acceptable	1250	Hydrovac utility crossings during detailed design. Use pump station and forcemain system. Forcemain can be installed at greater depths to avoid conflict	\$120,000
	Delays in acquiring approvals through environmental agencies	- Project delays	Low	10	\$150,000		Improbable	25	0.2	Acceptable	250	Send in applications as soon as possible during detailed design	\$30,000
	Easements may not be obtained in time because owners do not cooperate	- Project delays	Low	10	\$150,000		Improbable	25	0.2	Acceptable	250	Choose alignment and start land acquisition activities as soon as possible	\$30,000
	Additional backfill / restoration requirements in developed areas	- Increase Cost	Low	10	\$150,000	Backfill requirements will be addressed in design	Improbable	25	0.2	Acceptable	250		\$30,000
	Potential wetland west of Bench Breek may be impacted by design and construction.	 Wetland compensation may be required. Additional trenchless construction which may increase costs 	Low	10	\$150,000	Alignment goes directly through Wetland area. Need additional assessment during detailed design	Probable	100	0.8	Acceptable	1000	Wetland crossing requires further review during detailed design.	\$120,000
	Adequate cover cannot be maintained on downstream gravity sections	- Potential freezing of pipe flows	Mod	50	\$600,000	Downstream elevation constraints restrict the depth of the gravity sewer	Probable	100	0.8	Significant	5000	Use pump station and forcemain system. Forcemain can be installed at greater depths to ensure adequate cover	\$480,000
	Adequate cover cannot be maintained at Bench Creek Crossing	- Excessive erosion in creek resulting in significant environmenal damage and fines	Ser	300	\$6,000,000	Limited depth of cover due to downstream elevation constraints	Probable	100	0.8	Intolerable	30000	Use pump station and forcemain system. Forcemain can be installed at greater depths to ensure adequate cover	\$4,800,000
	Construction												
	Construction adjacent to HWY 16 undermines roadway	Worker and public safetyHighway closuresadditional cost to repair	High	100	\$1,500,000	Depth of pipe in open cut section is not great.	Improbable	25	0.2	Significant	2500	Use vertical trenching to reduce width of trenching activities	\$300,000
	Construction adjacent to HWY 16 undermines existing watermain	Worker and public safetyDisrupts water servicing to surrounding developmentadditional cost to repair	Mod	50	\$600,000	Depth of pipe in open cut section is not great.	Improbable	25	0.2	Acceptable	1250	Use vertical trenching to reduce width of trenching activities	\$120,000

Construction along 1A Avenue causes traffic backups	- Public complaints - construction delays -additional traffic accomodation	Mod	50	\$600,000	Use of proper public notification and traffic accomodation plans should limit complaints	Improbable	25	0.2	Acceptable	1250	Use vertical trenching to reduce width of trenching activities	\$120,000
Construction in front of businesses disrupts accesses	- Public complaints	Low	10	\$150,000	Use of proper public notification and traffic accomodation plans should limit complaints	Improbable	25	0.2	Acceptable	250	Provide adequate notification to businesses prior to construction	\$30,000
Construction adjacent to CN Rail undermines track	- Worker and public safety - Track closures -additional cost to repair	High	100	\$1,500,000	Alignment to be located at the required distance away from the track and zone of influence	Remote	10	0.02	Acceptable	1000	Keep the alignment at the required distance away from the track and zone of influence	\$30,000
Construction activities adjacent to existing (parallel) utilities or services	- Potential damage to existing utility main line or services	V Low	1	\$15,000	Minimal amount of utilities parallel to alignment	Ex Remote	1	0.01	Minor	1	Provide adequate notification to businesses prior to construction	\$150
Encounter poor ground conditions during trenchless installation of gravity pipe in deep sections	 Need to construct rescue shaft to recover equipment Additional construction costs and schedule delay 	High	100	\$1,500,000	- Geotechnical desktop study indicates high ground water table - Presence of bouders is possible in glacial till	Somewhat Likely	50	0.5	Significant	5000	Complete thorough getechnical borehole program especially in section where trenchless construction is proposed	\$750,000

49251 \$6,960,150

Edson - West Sanitary Sewer Trunk Table I - 2 Alignment 1 - Forcemain Option Risk Quantification Worksheet

#	Risk / Concern	Consequence	Magn	itude	\$ Impact	Probability Rationale	Proba	bility		Risk Se	verity	Mitigation Strategy	Risk Cost
	Design												
	Depth of gas and oil pipelines is unknown	- Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint	Mod	50	\$600,000	Gas/oil pipelines are generally at more shallow depths	Ex Remote	1	0.01	Minor	50	Hydrovac utility crossings during detailed design.	\$6,000
	Delays in acquiring approvals through environmental agencies	- Project delays	Low	10	\$150,000		Improbable	25	0.2	Acceptable	250	Send in applications as soon as possible during detailed design	\$30,000
	Easements may not be obtained in time because owners do not cooperate	- Project delays	Low	10	\$150,000		Improbable	25	0.2	Acceptable	250	Choose alignment and start land acquisition activities as soon as possible	\$30,000
	Additional backfill / restoration requirements in developed areas	- Increase Cost	Low	10	\$150,000	Backfill requirements will be addressed in design	Improbable	25	0.2	Acceptable	250		\$30,000
	and construction.	 Wetland compensation may be required. Additional trenchless construction which may increase costs 	Low	10	\$150,000	Alignment goes directly through Wetland area. Need additional assessment during detailed design	Probable	100	0.8	Acceptable	1000	Wetland crossing requires further review during detailed design.	\$120,000
	Adequate cover cannot be maintained on downstream sections	- Potential freezing of pipe flows	Mod	50	\$600,000	Forcemain can be installed at greater depth; does not require specific grade	Ex Remote	1	0.01	Minor	50		\$6,000
	Crossing	- Excessive erosion in creek resulting in significant environmenal damage and fines	Ser	300	\$6,000,000	Forcemain can be installed at greater depth; does not require specific grade Fracking out is a concern due to distance of crossing	Remote	10	0.02	Significant	3000		\$120,000
	Construction			T				•				,	
	Construction adjacent to HWY 16 undermines roadway	Worker and public safetyHighway closuresadditional cost to repair	High	100	\$1,500,000	Depth of pipe in open cut section is not great. Use vertical trenching to reduce width of trenching activities	Improbable	25	0.2	Significant	2500	Use vertical trenching to reduce width of trenching activities	\$300,000

Construction adjacent to HWY 16 undermines existing watermain	 Worker and public safety Disrupts water servicing to surrounding development -additional cost to repair 	Mod	50	\$600,000	Depth of pipe in open cut section is not great. Use vertical trenching to reduce width of trenching activities	Improbable	25	0.2	Acceptable	1250	Use vertical trenching to reduce width of trenching activities	\$120,000
Construction along 1A Avenue causes traffic backups	- Public complaints - construction delays -additional traffic accomodation	Mod	50	\$600,000	Use of proper public notification and traffic accomodation plans should limit complaints	Improbable	25	0.2	Acceptable	1250	Use vertical trenching to reduce width of trenching activities	\$120,000
Construction in front of businesses disrupts accesses	- Public complaints	Low	10	\$150,000	Use of proper public notification and traffic accomodation plans should limit complaints	Improbable	25	0.2	Acceptable	250	Provide adequate notification to businesses prior to construction	\$30,000
Construction adjacent to CN Rail undermines track	- Worker and public safety - Track closures -additional cost to repair	High	100	\$1,500,000	Forcemain can be installed at minimal depth outside the track zone of influence	Ex Remote	1	0.01	Minor	100	Keep the alignment at the required distance away from the track and zone of influence	\$15,000
Construction activities adjacent to existing (parallel) utilities or services	- Potential damage to existing utility main line or services	V Low	1	\$15,000	Minimal amount of utilities parallel to alignment	Ex Remote	1	0.01	Minor	1	Provide adequate notification to businesses prior to construction	\$150
Encounter poor ground conditions during trenchless installation of gravity pipe in deep sections	 Need to construct rescue shaft to recover equipment Additional construction costs and schedule delay 	Mod	50	\$600,000	Forcemain can be installed at minimal depth; does not require specific grade	Ex Remote	1	0.01	Minor	50	Complete thorough getechnical borehole program especially in section where trenchless construction is proposed	\$6,000

10251 \$933,150

Edson - West Sanitary Sewer Trunk
Table I - 3 Alignment 2 - Gravity Option
Risk Quantification Worksheet

#	Risk / Concern	Consequence	Magni	tude	\$ Impact	Probability Rationale	Proba	bility		Risk Se	verity	Mitigation Strategy	Risk Cost
	Design											•	
	Change in land use plan relocates future road ROW west of 75 Street	Need to adjust alignment of sewer	V Low	1	\$15,000	Land use plan has been approved by Town	Remote	10	0.02	Minor	10		\$300
	Depth of gas and oil pipelines is unknown	- Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint	Mod	50	\$600,000	Gas/oil pipelines are generally at more shallow depths	Improbable	25	0.2	Acceptable	1250	Hydrovac utility crossings during detailed design. Use pump station and forcemain system. Forcemain can be installed at greater depths to avoid conflict	\$120,000
	Delays in acquiring approvals through environmental agencies	- Project delays	Low	10	\$150,000		Improbable	25	0.2	Acceptable	250	Send in applications as soon as possible during detailed design	\$30,000
	Easements may not be obtained in time because owners do not cooperate	- Project delays	Low	10	\$150,000		Improbable	25	0.2	Acceptable	250	Choose alignment and start land acquisition activities as soon as possible	\$30,000
	Additional backfill / restoration requirements in developed areas	- Increase Cost	V Low	1	\$15,000	Backfill requirements will be addressed in design	Remote	10	0.02	Minor	10		\$300
	Adequate cover cannot be maintained on downstream gravity sections	- Potential freezing of pipe flows	Mod	50	\$600,000	Downstream elevation constraints restrict the depth of the gravity sewer	Probable	100	0.8	Significant	5000	Use pump station and forcemain system	\$480,000
	Imaintained at Bench (Teek	- Excessive erosion in creek resulting in significant environmenal damage and fines	Ser	300	\$6,000,000	Limited depth of cover due to downstream elevation constraints	Somewhat Likely	50	0.5	Critical	15000	Use pump station and forcemain system	\$3,000,000
	Construction											_	\$0
	Construction adjacent to CN Rail undermines track	- Worker and public safety - Track closures -additional cost to repair	High	100	\$1,500,000	Alignment to be located at the required distance away from the track and zone of influence	Remote	10	0.02	Acceptable	1000	Keep the alignment at the required distance away from the track and zone of influence	\$30,000
	Construction activities adjacent to existing (parallel) utilities or services	- Potential damage to existing utility main line or services	V Low	1	\$15,000	Minimal amount of utilities parallel to alignment	Ex Remote	1	0.01	Minor	1	Provide adequate notification to businesses prior to construction	\$150

during trenchless installation of	 Need to construct rescue shaft to recover equipment Additional construction costs and schedule delay 	High	100	\$1,500,000	- Geotechnical desktop study indicates high ground water table - Presence of bouders is possible in glacial till	Somewhat Likely	50	0.5	Significant	5000	Complete thorough getechnical borehole program especially in section where trenchless construction is proposed	\$750,000
										26001		\$4,440,750

Edson - West Sanitary Sewer Trunk

Table I - 4 Alignment 2 - Forcemain Option

Risk Quantification Worksheet

#	Risk / Concern	Consequence	Magn	itude	\$ Impact	Probability Rationale	Proba	bility		Risk Se	verity	Mitigation Strategy	Risk Cost
	Design					•							
	future road ROW west of 75	-Need to adjust alignment of sewer	V Low	1	\$15,000	Land use plan has been approved by Town	Remote	10	0.02	Minor	10		\$300
	Depth of gas and oil pipelines is unknown	- Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint	Mod	50	\$600,000	Gas/oil pipelines are generally at more shallow depths	Ex Remote	1	0.01	Minor	50	Hydrovac utility crossings during detailed design.	\$6,000
	Delays in acquiring approvals through environmental agencies	- Project delays	Low	10	\$150,000		Improbable	25	0.2	Acceptable	250	Send in applications as soon as possible during detailed design	\$30,000
	Easements may not be obtained in time because owners do not cooperate	- Project delays	V Low	1	\$15,000		Improbable	25	0.2	Minor	25	Choose alignment and start land acquisition activities as soon as possible	\$3,000
	Additional backfill / restoration requirements in developed areas	- Increase Cost	V Low	1	\$15,000	Backfill requirements will be addressed in design	Remote	10	0.02	Minor	10		\$300
	Adequate cover cannot be maintained on downstream sections	- Potential freezing of pipe flows	Mod	50	\$600,000	Forcemain can be installed at greater depth; does not require specific grade	Ex Remote	1	0.01	Minor	50		\$6,000
	lmaintained at Rench (reek	- Excessive erosion in creek resulting in significant environmenal damage and fines	Ser	300	\$6,000,000	Forcemain can be installed at greater depth; does not require specific grade	Ex Remote	1	0.01	Acceptable	300		\$60,000
	Construction												
	Construction adjacent to CN Rail undermines track	Worker and public safetyTrack closures-additional cost to repair	High	100	\$1,500,000	Forcemain can be installed at minimal depth outside the track zone of influence	Ex Remote	1	0.01	Minor	100	Keep the alignment at the required distance away from the track and zone of influence	\$15,000
	Construction activities adjacent to existing (parallel) utilities or services	- Potential damage to existing utility main line or services	V Low	1	\$15,000	Minimal amount of utilities parallel to alignment	Ex Remote	1	0.01	Minor	1	Provide adequate notification to businesses prior to construction	\$150

	Encounter poor ground conditions during trenchless installation of gravity pine in deep sections	 Need to construct rescue shaft to recover equipment Additional construction costs and schedule delay 	Mod	50	\$600,000	Forcemain can be installed at minimal depth; does not require specific grade	Ex Remote	1	0.01	Minor	50	Complete thorough getechnical borehole program especially in section where trenchless construction is proposed	\$6,000)
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501 \$126,750

Edson - West Sanitary Sewer Trunk
Table I - 5 Alignment 3 - Gravity Option
Risk Quantification Worksheet

#	Risk / Concern	Consequence	Magn	itude	\$ Impact	Probability Rationale	Proba	bility		Risk Se	verity	Mitigation Strategy	Risk Cost
	Design												
	Depth of gas and oil pipelines is	- Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint	Mod	50	\$600,000	Gas/oil pipelines are generally at more shallow depths	Improbable	25	0.2	Acceptable	1250	Hydrovac utility crossings during detailed design. Use pump station and forcemain system. Forcemain can be installed at greater depths to avoid conflict	\$120,000
	Delays in acquiring approvals through environmental agencies	- Project delays	Low	10	\$150,000		Improbable	25	0.2	Acceptable	250	Send in applications as soon as possible during detailed design	\$30,000
	Easements may not be obtained in time because owners do not cooperate	- Project delays	Low	10	\$150,000		Somewhat Likely	50	0.5	Acceptable	500	Choose alignment and start land acquisition activities as soon as possible	\$75,000
	Additional backfill / restoration requirements in developed areas	- Increase Cost	Low	10		Backfill requirements will be addressed in design	Probable	100	0.8	Acceptable	1000		\$120,000
	Adequate cover cannot be maintained on downstream gravity sections	- Potential freezing of pipe flows	Mod	50	\$600,000	Downstream elevation constraints restrict the depth of the gravity sewer	Probable	100	0.8	Significant	5000	Use pump station and forcemain system	\$480,000
	Adequate cover cannot be maintained at Bench Creek Crossing	- Excessive erosion in creek resulting in significant environmenal damage and fines	Ser	300	\$6,000,000	Limited depth of cover due to downstream elevation constraints	Somewhat Likely	50	0.5	Critical	15000	Use pump station and forcemain system	\$3,000,000
	Construction		<u>.</u>									•	
	Construction adjacent to HWY 16 undermines roadway	Worker and public safetyHighway closures-additional cost to repair	High	100	151 500 000	Depth of pipe in open cut section is not great.	Improbable	25	0.2	Significant	2500	Use vertical trenching to reduce width of trenching activities	\$300,000
	Construction adjacent to HWY 16 undermines existing watermain	 Worker and public safety Disrupts water servicing to surrounding development additional cost to repair 	Mod	50	1 5600 000	Depth of pipe in open cut section is not great.	Improbable	25	0.2	Acceptable	1250	Use vertical trenching to reduce width of trenching activities	\$120,000
	Construction along 1A Avenue causes traffic backups	- Public complaints- construction delays-additional traffic accomodation	Low	10	\$150,000	Use of proper public notification and traffic accomodation plans should limit complaints	Somewhat Likely	50	0.5	Acceptable	500	Use vertical trenching to reduce width of trenching activities	\$75,000

Construction in front of businesses disrupts accesses	- Public complaints	Low	10	\$150,000	Use of proper public notification and traffic accomodation plans should limit complaints	Somewhat Likely	50	0.5	Acceptable	500	Provide adequate notification to businesses prior to construction	\$75,000
Construction activities adjacent to existing (parallel) utilities or services	- Potential damage to existing utility main line or services	Mod	50	\$600,000		Improbable	25	0.2	Acceptable	1250		\$120,000
Encounter poor ground conditions during trenchless installation of gravity pipe in deep sections	 Need to construct rescue shaft to recover equipment Additional construction costs and schedule delay 	High	100	\$1,500,000	- Geotechnical desktop study indicates high ground water table - Presence of bouders is possible in glacial till	Somewhat Likely	50	0.5	Significant	5000	Complete thorough getechnical borehole program especially in section where trenchless construction is proposed	\$750,000

34000 \$5,265,000

Edson - West Sanitary Sewer Trunk
Table I -6 Alignment 3 - Forcemain Option
Risk Quantification Worksheet

#	Risk / Concern	Consequence	Magn	itude	\$ Impact	Probability Rationale	Proba	bility		Risk Se	verity	Mitigation Strategy	Risk Cost
	Design												
	Depth of gas and oil pipelines is unknown	- Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint	Mod	50	\$600,000	Gas/oil pipelines are generally at more shallow depths	Ex Remote	1	0.01	Minor	50	Hydrovac utility crossings during detailed design.	\$6,000
	Delays in acquiring approvals through environmental agencies	- Project delays	Low	10	\$150,000		Improbable	25	0.2	Acceptable	250	Send in applications as soon as possible during detailed design	\$30,000
	Easements may not be obtained in time because owners do not cooperate	- Project delays	Low	10	\$150,000		Somewhat Likely	50	0.5	Acceptable	500	Choose alignment and start land acquisition activities as soon as possible	\$75,000
	Additional backfill / restoration requirements in developed areas	- Increase Cost	Low	10	\$150,000	Backfill requirements will be addressed in design	Probable	100	0.8	Acceptable	1000		\$120,000
	Adequate cover cannot be maintained on downstream sections	- Potential freezing of pipe flows	Mod	50	\$600,000	Forcemain can be installed at greater depth; does not require specific grade	Ex Remote	1	0.01	Minor	50		\$6,000
	Adequate cover cannot be maintained at Bench Creek Crossing	- Excessive erosion in creek resulting in significant environmenal damage and fines	Ser	300	\$6,000,000	Forcemain can be installed at greater depth; does not require specific grade	Ex Remote	1	0.01	Acceptable	300		\$60,000
	Construction				•								
	Construction adjacent to HWY 16 undermines roadway	Worker and public safetyHighway closures-additional cost to repair	High	100	\$1,500,000	Depth of pipe in open cut section is not great. Use vertical trenching to reduce width of trenching activities	Improbable	25	0.2	Significant	2500	Use vertical trenching to reduce width of trenching activities	\$300,000
	Construction adjacent to HWY 16 undermines existing watermain	 Worker and public safety Disrupts water servicing to surrounding development additional cost to repair 	Mod	50	\$600,000	Depth of pipe in open cut section is not great. Use vertical trenching to reduce width of trenching activities	Improbable	25	0.2	Acceptable	1250	Use vertical trenching to reduce width of trenching activities	\$120,000

Construction along 1A Avenue causes traffic backups	- Public complaints - construction delays -additional traffic accomodation	Low	10	\$150,000	Use of proper public notification and traffic accomodation plans should limit complaints	Somewhat Likely	50	0.5	Acceptable	500	Use vertical trenching to reduce width of trenching activities	\$75,000
Construction in front of businesses disrupts accesses	- Public complaints	Low	10	\$150,000	Use of proper public notification and traffic accomodation plans should limit complaints	Somewhat Likely	50	0.5	Acceptable	500	Provide adequate notification to businesses prior to construction	\$75,000
Construction activities adjacent to existing (parallel) utilities or services	- Potential damage to existing utility main line or services	Mod	50	\$600,000		Improbable	25	0.2	Acceptable	1250		\$120,000
gravity pine in deep sections	 Need to construct rescue shaft to recover equipment Additional construction costs and schedule delay 	mod	50	\$600,000	Forcemain can be installed at minimal depth; does not require specific grade	Ex Remote	1	0.01	Minor	50	Complete thorough getechnical borehole program especially in section where trenchless construction is proposed	\$6,000

8200 \$993,000

Edson - West Sanitary Sewer Trunk
Table I - 7 Alignment 4 - Gravity Option
Risk Quantification Worksheet

#	Risk / Concern	Consequence	Magni	itude	\$ Impact	Probability Rationale	Proba	bility		Risk Se	verity	Mitigation Strategy	Risk Cost
	Design												
	Depth of gas and oil pipelines is unknown	- Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint	Mod	50	\$600,000	Gas/oil pipelines are generally at more shallow depths	Improbable	25	0.2	Acceptable	1250	Hydrovac utility crossings during detailed design. Use pump station and forcemain system. Forcemain can be installed at greater depths to avoid conflict	\$120,000
	Delays in acquiring approvals through environmental agencies	- Project delays	Low	10	\$150,000		Improbable	25	0.2	Acceptable	250	Send in applications as soon as possible during detailed design	\$30,000
	Additional backfill / restoration requirements in developed areas	- Increase Cost	Low	10		Backfill requirements will be addressed in design	Improbable	25	0.2	Acceptable	250		\$30,000
	Easements may not be obtained in time because owners do not cooperate	- Project delays	Low	10	\$150,000		Improbable	25	0.2	Acceptable	250	Choose alignment and start land acquisition activities as soon as possible	\$30,000
	Adequate cover cannot be maintained on downstream gravity sections	- Potential freezing of pipe flows	Mod	50	\$600,000	Downstream elevation constraints restrict the depth of the gravity sewer	Probable	100	0.8	Significant	5000	Use pump station and forcemain system	\$480,000
	maintained at Rench (reek	- Excessive erosion in creek resulting in significant environmenal damage and fines	Ser	300	\$6,000,000	Limited depth of cover due to downstream elevation constraints	Somewhat Likely	50	0.5	Critical	15000	Use pump station and forcemain system	\$3,000,000
	Construction							ı				•	
	Construction adjacent to HWY 16 undermines roadway	Worker and public safetyHighway closures-additional cost to repair	High	100	LS1.500.000	Depth of pipe in open cut section is not great.	Improbable	25	0.2	Significant	2500	Use vertical trenching to reduce width of trenching activities	\$300,000
	_	 Worker and public safety Disrupts water servicing to surrounding development -additional cost to repair 	Mod	50	5600 000	Depth of pipe in open cut section is not great.	Improbable	25	0.2	Acceptable	1250	Use vertical trenching to reduce width of trenching activities	\$120,000
	Construction along 1A Avenue causes traffic backups	- Public complaints - construction delays -additional traffic accomodation	Mod	50	\$600,000	Use of proper public notification and traffic accomodation plans should limit complaints	Improbable	25	0.2	Acceptable	1250	Use vertical trenching to reduce width of trenching activities	\$120,000

Construction in front of businesses disrupts accesses	- Public complaints	Low	10	\$150,000	Use of proper public notification and traffic accomodation plans should limit complaints	Improbable	25	0.2	Acceptable	250	Provide adequate notification to businesses prior to construction	\$30,000
Construction activities adjacent to existing (parallel) utilities or services	- Potential damage to existing utility main line or services	V Low	1	\$15,000	Minimal amount of utilities parallel to alignment	Ex Remote	1	0.01	Minor	1	Provide adequate notification to businesses prior to construction	\$150
Encounter poor ground conditions during trenchless installation of gravity pipe in deep sections	 Need to construct rescue shaft to recover equipment Additional construction costs and schedule delay 	High	100	\$1,500,000	- Geotechnical desktop study indicates high ground water table - Presence of bouders is possible in glacial till	Somewhat Likely	50	0.5	Significant	5000	Complete thorough getechnical borehole program especially in section where trenchless construction is proposed	\$750,000

32251 \$5,010,150

Edson - West Sanitary Sewer Trunk

Table I - 8 Alignment 4 - Forcemain Option

Risk Quantification Worksheet

‡	Risk / Concern	Consequence	Magn	itude	\$ Impact	Probability Rationale	Proba	bility		Risk Se	verity	Mitigation Strategy	Risk Cost
	Design												_
	Depth of gas and oil pipelines is unknown	- Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint	Mod	50	\$600,000	Gas/oil pipelines are generally at more shallow depths	Ex Remote	1	0.01	Minor	50	Hydrovac utility crossings during detailed design.	\$6,00
	Delays in acquiring approvals through environmental agencies	- Project delays	Low	10	\$150,000		Improbable	25	0.2	Acceptable	250	Send in applications as soon as possible during detailed design	\$30,00
	Easements may not be obtained in time because owners do not cooperate	- Project delays	Low	10	\$150,000		Improbable	25	0.2	Acceptable	250	Choose alignment and start land acquisition activities as soon as possible	\$30,00
	Additional backfill / restoration requirements in developed areas	- Increase Cost	Low	10	\$150,000	Backfill requirements will be addressed in design	Improbable	25	0.2	Acceptable	250		\$30,00
	Adequate cover cannot be maintained on downstream sections	- Potential freezing of pipe flows	Mod	50	\$600,000	Forcemain can be installed at greater depth; does not require specific grade	Ex Remote	1	0.01	Minor	50		\$6,00
	Adequate cover cannot be maintained at Bench Creek Crossing	- Excessive erosion in creek resulting in significant environmenal damage and fines	Ser	300	\$6,000,000	Forcemain can be installed at greater depth; does not require specific grade	Ex Remote	1	0.01	Acceptable	300		\$60,00
	Construction												
	Construction adjacent to HWY 16 undermines roadway	Worker and public safetyHighway closures-additional cost to repair	High	100	\$1,500,000	Depth of pipe in open cut section is not great. Use vertical trenching to reduce width of trenching activities	Improbable	25	0.2	Significant	2500	Use vertical trenching to reduce width of trenching activities	\$300,00
	Construction adjacent to HWY 16 undermines existing watermain	 Worker and public safety Disrupts water servicing to surrounding development additional cost to repair 	Mod	50	\$600,000	Depth of pipe in open cut section is not great. Use vertical trenching to reduce width of trenching activities	Improbable	25	0.2	Acceptable	1250	Use vertical trenching to reduce width of trenching activities	\$120,00

Construction along 1A Avenue causes traffic backups	- Public complaints - construction delays -additional traffic accomodation	Low	10	\$150,000	Use of proper public notification and traffic accomodation plans should limit complaints	Improbable	25	0.2	Acceptable	250	Use vertical trenching to reduce width of trenching activities	\$30,000
Construction in front of businesses disrupts accesses	- Public complaints	Low	10	\$150,000	Use of proper public notification and traffic accomodation plans should limit complaints	remote	10	0.02	Minor	100	Provide adequate notification to businesses prior to construction	\$3,000
Construction activities adjacent to existing (parallel) utilities or services	- Potential damage to existing utility main line or services	V Low	1	\$15,000	Minimal amount of utilities parallel to alignment	Ex Remote	1	0.01	Minor	1	Provide adequate notification to businesses prior to construction	\$150
gravity nine in deen sections	 Need to construct rescue shaft to recover equipment Additional construction costs and schedule delay 	Mod	50	\$600,000	Forcemain can be installed at minimal depth; does not require specific grade	Ex Remote	1	0.01	Minor	50	Complete thorough getechnical borehole program especially in section where trenchless construction is proposed	\$6,000

5301 \$621,150