

## Technical Memorandum

**DATE:** August 22, 2025

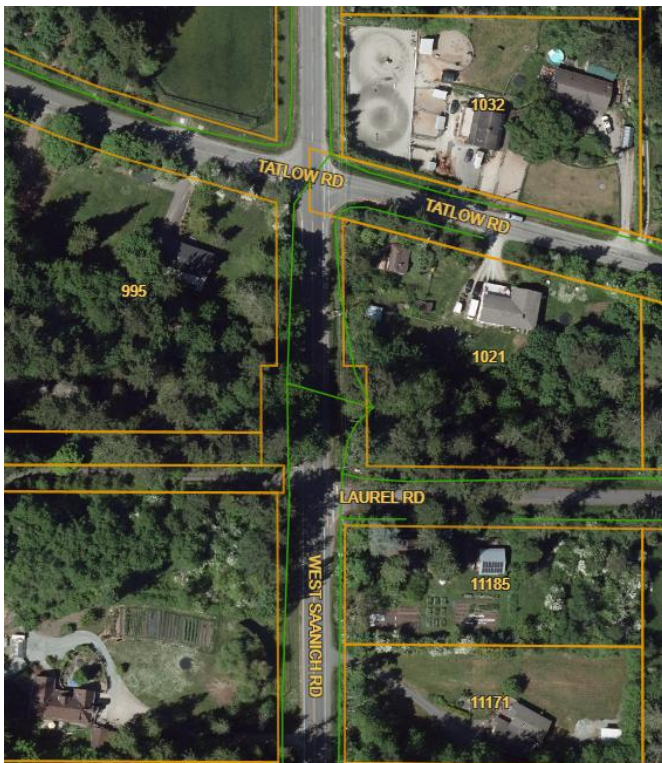
**TO:** Ben Martin  
Director of Infrastructure Services  
District of North Saanich

**FROM:** Sam Eichenberger, P.Eng.

**RE: CHALET CREEK CULVERT REPLACEMENT AT WEST SAANICH ROAD  
Preliminary Design  
Our File 2148.025-300**

### 1. Introduction

Kerr Wood Leidal Associates Ltd. (KWL) has been retained by the District of North Saanich (District) to provide engineering services to complete a preliminary design for replacement of the culvert which allows Chalet Creek to cross below West Saanich Road between Tatlow Road and Laurel Road as shown in Figure 1 below.



**Figure 1: Location Plan**



Currently, this crossing consists of an undersized 600 mm diameter culvert comprised of one section of wood-stave pipe between two sections of reinforced concrete pipes and is a total of approximately 36 m in length with a slope of 2.7%. The wood-stave pipe and concrete pipes are in poor condition and pose a risk to the stability of West Saanich Road, the embankment and utilities under the road, which include the Capital Regional District's (CRD) only transmission main for water supply to this area of the District.

The District has been monitoring the culvert by conducting CCTV inspections on a monthly basis during the winter and early spring months to have a visual inspection of the pipe condition in efforts to further assess the risk of collapse. Until full replacement of the culvert can be implemented it is recommended that the CCTV inspections continue, particularly after large rain events. Visual inspections of the culvert inlet and outlet during and after large rain events is also warranted if staff resources are available.

Additional monitoring measures that could be implemented include installing a water level sensor with a data logger and transmitter with an alarm level established for District crews to monitor; and/or installing cameras that are web enabled for viewing remotely.

This design brief provides a high-level assessment the required culvert capacity, viable construction methods, key considerations, and a review of the required permitting and approvals needed for construction, along with a recommended option for replacement of the culvert crossing. Multiple construction approaches were reviewed to determine the most technically feasible, cost-effective, and constructible solution that minimizes disruption to local traffic, existing utilities, and the surrounding environment. The selected approach also supports long-term operational sustainability and ease of maintenance for the District.

## **2. Design**

The primary objective of this project is to replace the existing undersized 600 mm culvert with a new structure capable of safely conveying high flows in Chalet Creek during extreme storm events, thereby reducing the risk of localized flooding and infrastructure damage. The project aims to improve the hydraulic performance and resiliency of the crossing while considering environmental sensitivities and improving riparian habitat and fish passage. This section provides a review of the design criteria, hydraulic assessment, site conditions and regulatory requirements.

### **2.1 Design Criteria**

The District's current criteria for the major drainage system is to safely convey flows during a 25-year return period storm event; however, there is a desire to meet a higher level of service for this creek and culvert crossing given the potential consequences of failure. In such case, it was determined that the culvert should be designed with a capacity to convey the 200-year peak flow without the water level at the culvert inlet exceeding the top of the culvert.

The culvert design criteria was developed to comply with the Water Sustainability Act (WSA) Section 11 requirements per direction from Swell Environmental Consulting and the District of North Saanich. In addition, the culvert design includes features to allow fish passage and reduce velocities during high flow events.



## 2.2 Hydraulic Assessment

The District’s existing Drainage Master Plan (Parsons, 2023) included an assessment of the culvert for the existing and future 10-year (minor system) and 25-year (major system) design storm events but does not provide any recommendation for upsizing. In such case, the PCSWMM drainage model was updated to include a 200-year design storm event developed specifically for the project to determine the corresponding maximum daily flow and required culvert capacity.

A frequency analysis was completed to determine the scaling factor needed to estimate 200-year rainfall amounts from the existing 100-year Intensity-Duration-Frequency (IDF) curve. The frequency analysis included a review of rainfall volumes using the annual maximum rolling 1-day average values from 1965 to 2017 for the Environment and Climate Change Canada VICTORIA INTL A (1018621) Station. It was determined that a scaling factor of 1.11 should be used to estimate the 200-year rainfall.

In addition, the rainfall data was updated to include an allowance for climate change. The future climate change IDF curves for the Year 2100 climate projection periods using the SSP5.85 emissions scenario, which is the high emissions status quo scenario, are shown in Table 1 below.

**Table 1: Rainfall Intensity (Future Year 2100)**

Rainfall Intensity (mm/hr)					
Duration	5-year	10-year	25-year	100-year	200-year
1-hour	12.9	15.1	18.3	23.3	25.9
2-hour	9.9	11.6	14.1	18.4	20.4
6-hour	7.0	7.9	8.9	10.4	11.5
12-hour	5.1	5.9	7.0	8.4	9.3
24-hour	3.5	4.1	5.0	6.3	6.9

To determine the 200-year peak flow in Chalet Creek, two different design storm methods were assessed for input to the model and compared. A 24-hour US Soil Conservation Service (SCS) Type 1A 100-year design storm was scaled up to represent the 200-year rainfall amounts and Canadian Atmospheric Environment Service (AES) design storms were developed for 5 durations (1-, 2-, 6-, 12-, and 24-hour) for a 200-year return period. After the initial review the SCS Type 1A was determined to be too conservative so the analysis completed using the AES design storm.

Peak flows for Chalet Creek at West Saanich Road under the future land use and climate change conditions for both design storms are shown in Table 2. Note that for the future land use scenario the Chalet Creek culvert catchment has an average impervious area of approximately 20%.

**Table 2: Future 200-year Peak Flows for Chalet Creek at West Saanich Road**

Design Storm	Future 200-Year Peak Flow
AES Design Storm	
1-hour	0.89 m <sup>3</sup> /s
2-hour	1.12 m <sup>3</sup> /s
6-hour	1.34 m <sup>3</sup> /s
<b>12-hour</b>	<b>3.25 m<sup>3</sup>/s</b>
24-hour	2.46 m <sup>3</sup> /s



The design flow for the culvert was selected to be 3.25 m/s based on the AES 12-hour 200-year future peak flow assessment. During the initial phases of the hydraulic model assessment using the new 200-year design storm it was noted that a significant amount of water was being lost from the system reducing the 200-year peak flows through the Chalet culvert. The modelled nodes in the catchment area had been set up to include a surcharge depth of 0.5 m above the ground elevation to mimic surface ponding, which resulted in water being lost from the system when the water surcharged above this depth and was happening at a significant number of nodes in the 200-year storm. To address this issue, the surcharge at each node was increased to allow more ponding and keep the water in the system such that no volume is lost and the water eventually drains out of the system.

In addition, the current hydraulic model does not account for storage within the wetland area upstream of the culvert crossing at West Saanich Road. This is deemed to be an acceptable and conservative approach given the wetland could already be at capacity during the wet weather periods.

## 2.3 Culvert Sizing

The proposed culvert sizing was completed using HY-8 to allow for varying roughness coefficients in the pipe to a mimic fish gravel/cobble substrate bottom of pipe and smooth side walls and top of pipe.

Due to the slope of the existing culvert and the downstream channel, it is unlikely that the culvert will become backwatered, such that the culvert is assumed to be under inlet control while flowing full.

Based on the information presented above and the required inclusion of a 300 mm depth of fish gravel/cobbles substrate and baffles through the culvert it is recommended that an 1,800 mm wide X 1,500 mm high box culvert is constructed at this location.

Key design parameters used for the culvert sizing with HY-8 include:

- Slope: 2.7% (based on the GIS/model culvert inverts)
- Manning's N values:
  - 0.025 for the open channel upstream and downstream
  - 0.012 for the culvert top/sides
  - 0.035 for the culvert bottom to represent fish gravel and baffles
- Design flow rate of 3.25 m<sup>3</sup>/s (AES 200-year 12-hour)

The HY-8 model results indicate that the depth of flow is 1.08 m for the peak flow in the 1,800 mm X 1,500 mm box culvert.

A review of the next smaller size culvert (i.e. 1,800 mm x 1,200 mm) was completed to determine if the peak water level remained below the top of pipe; however, the addition of the gravel embedment depth resulted in a slight surcharge of the pipe. In such case it is recommended to keep the proposed size.

An open arch culvert was considered and assumed to result in higher cost and risk the surrounding utilities due to a larger excavation footprint and restoration area (i.e. asphalt and planting).



## 2.4 Site Conditions

It is assumed that the existing culvert was installed with imported fill material used to build up the road structure for West Saanich Road. The geotechnical conditions and materials used for backfill are unknown and represent a construction risk.

The creek bed and existing culvert is approximately 6 m below the road surface. The road allowance contains several other utilities including:

- A 300 mm ductile iron watermain owned by the Capital Regional District (CRD);
- An abandoned 250 mm Permastran watermain (CRD);
- A 150 mm asbestos cement (AC) watermain (DNS);
- A 114 mm DP/PE gas main owned by Fortis BC; and
- Overhead power and communications infrastructure.

The culvert extends approximately 36 m through the West Saanich Road allowance and connects Chalet Creek between two private properties. The culvert inlet extends into the private property of 1021 Tatlow Road and the outlet flows into 995 Tatlow Road.

In addition, there are roadside ditches along West Saanich Road that discharge into both the upstream and downstream sides of the culvert crossing.

## 2.5 Regulatory and Stakeholder Considerations

The primary regulatory requirement for the project is to submit a Change Approval application to the province under the Water Sustainability Act (WSA) Section 11 for changes in and about a stream.

Initially, there were discussions about submitting the project as a Notification; however, the works cannot be deemed emergency in nature as a failure event has not yet occurred and do not meet the criteria for the Notification process such that a Change Approval is anticipated to be required.

There may also be a requirement to submit a Request for Review for the project to the Fisheries and Oceans Canada (DFO).

Prior to initiating the works, it will be necessary to conduct a fish salvage, and the following permits are needed for this:

- DFO Scientific Fish Trapping Permits
- MFLNRO Scientific Fish Trapping Permits

It is anticipated that Swell Environmental Consulting Ltd. will be retained by the District to assist with the environmental permitting applications.

It is understood that the project area is not within a registered archaeological site so a permit under the Heritage Conservation Act is not required.

Potential stakeholders for the project include the utility companies with infrastructure in the area as well as First Nations and the immediate area residents. Notification and coordination with CRD for exposing the transmission main is required.



### 3. Construction Options

This section provides a review of potential construction methods for this type of culvert replacement project, which include open cut, tunneling, and pipe jacking.

Pipe bursting and cured-in-place pipe (CIPP) lining were initially considered as potential rehabilitation methods; however, they have been ruled out for this project due to their inability to meet the required increase in hydraulic capacity. Both techniques are primarily suited for trenchless renewal of existing pipes with minimal changes to diameter. In this case, the need to upsize the culvert from 600 mm to a much larger size (1,800 mm X 1,500 mm box culvert or equivalent circular pipe) to accommodate the 200-year design flow in Chalet Creek exceeds the practical limitations of these methods. As such, they do not provide a viable solution for the significant diameter increase required and have been excluded from further consideration in the preliminary options analysis.

#### 3.1 Tunneling or Pipe Jacking

Tunneling involves the construction of a subsurface bore using a tunnel boring machine (TBM) or similar technique, with access shafts at either end of the alignment. Pipe jacking is a trenchless technique that installs pre-cast concrete or steel pipes by hydraulic jacking from a drive shaft to a reception shaft. It is particularly well-suited to relatively short installations and allows for precise control over grade and alignment. These methods allow for the installation of a larger diameter culvert using the existing or an adjacent alignment. The advantages and disadvantages of both tunneling and pipe jacking are similar as noted below.

##### Advantages

- Minimal road surface disruption and the road would likely remain open with single lane alternating traffic controlled by traffic personnel or a temporary signal.
- Can accommodate a wide variety of soil conditions.
- Minimal shoring required.
- Crossing utilities do not require support through construction (although may need vibration monitoring particularly for the CRD feeder watermain).

##### Disadvantages

- Requires geotechnical investigation and extensive planning, and large boulders can slow productivity depending on the equipment in use (i.e. cutting teeth on the TBM and/or may require blasting for removal).
- Requires specialized equipment that is not readily available on Vancouver Island such that mobilization from mainland BC or beyond may be needed.
- Does not allow for installation of a box culvert, as circular pipes are typical for tunneling.
- Temporary impact to private property is expected due to the footprint for machinery at the inlet and outlet (approximately 8 m by 4 m clear area is needed upstream and downstream of the culvert).
- Major tree and riparian area loss expected due to the construction footprint and access.
- Increased erosion and sediment control measures are needed to protect downstream environments.



- Natural creek bed will be significantly disturbed immediately upstream and downstream of the culvert resulting in a larger portion needing to be bypassed during construction and reinstated.
- Higher capital expenditure primarily due to the specialized equipment and mobilization costs.

### 3.2 Open Cut Replacement

Open cut replacement is the most traditional method for culvert installation and involves full excavation along the 36 m alignment to remove the existing 600 mm culvert and install a new 1,800 mm X 1,500 mm box culvert in its place.

#### Advantages

- Straightforward installation allowing for simple construction inspection and quality control.
- Allows for installation of a box culvert with baffles and creek substrate for fish passage and habitat.
- No impact to private property reducing the coordination effort with adjacent landowners.
- Impact to open creek channel is limited to immediate areas upstream and downstream of the culvert.
- Tree loss is reduced to the open cut trench area and access for the headwalls, road embankment and creek channel restoration at the inlet and outlet.
- More typical geotechnical investigation and less impact on design considerations.

#### Disadvantages

- Road surface disruption will lead to traffic impacts and a full road closure with a detour is recommended.
- Erosion and sediment control measures are needed to protect downstream environments.
- Deep excavation will require significant shoring and temporary supports for existing utilities.
- The District's AC watermain would need to be replaced with restrained ductile iron (or similar) pipe material prior to the culvert works.
- Increased coordination with CRD for protection and support of the feeder main is needed.
- Increased coordination with Fortis for protection and support of the gas main is needed.
- Creek bypass and isolation required although less impact due to smaller construction footprint.

### 3.3 Option Selection

Open cut excavation has been selected as the preferred method for culvert replacement. This approach offers several key advantages: it minimizes disturbance to adjacent private properties, reduces potential environmental impacts by allowing precise control of in-stream works, reduces risks associated with geotechnical findings and is expected have a lower overall capital expenditure compared to specialized methods such as pipe jacking and tunneling. Open cut will also allow for the installation of a box culvert where trenchless methods would require a circular pipe installation.

A high-level construction methods options comparison is included in Table 3 below.



**Table 3: Construction Options Comparison**

Construction Method	Traffic	Environmental	Private Property Impacts	Utilities	Costs
Open Cut	High	Medium	Low	High	Low
Tunneling	Medium	High	High	Low	High
Pipe Jacking	Medium	High	High	Low	High

#### 4. Preliminary Design Drawings

A preliminary design drawing (C-101) including plan, profile and initial details for installation of a box culvert is included as Appendix A.

#### 5. Opinion of Probable Cost

A class D cost estimate has been prepared for the open cut replacement of the culvert. Detailed cost tables are presented in Appendix B. The current cost estimate is \$909,000 excluding GST and includes a general contingency (30%), environmental allowance (7%) and engineering/construction management allowance (10%).

#### 6. Recommendations and Next Steps

It is recommended that the District proceed with the detailed design for the culvert replacement at Chalet Creek and West Saanich Road with an 1,800 mm X 1,500 mm box culvert to be constructed using open cut methods.

The following next steps are needed to further develop the detailed design and prepare a tender package for construction in summer of 2026:

- Coordinate with the District and Swell Environmental to review the preliminary design and findings of this Technical Memorandum and determine whether there is sufficient information and detail to initiate the permit application process under the WSA Section 11.
- Plan for initiating a topographic survey to fill any data gaps and refine the design drawings.
- Plan for initiating a geotechnical field investigation program to determine subsurface conditions (e.g., geotechnical boreholes) as per the work program proposed by Thurber Engineering.
- Retain an arborist to assess the trees to be removed and adjacent trees to remain.
- Continue coordination with CRD water and initiate coordination with other third-party utility companies.
- Begin the formal communication and notification process with the area residents.
- Determine the timeline for the detailed design and tender phases for optimal construction pricing and competitive bidding for the works.



**KERR WOOD LEIDAL ASSOCIATES LTD.**

Prepared by:

Reviewed by:

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Project Engineer

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Senior Engineer

SPE/aah

Encl.: Appendix A: Preliminary Design Drawing  
Appendix B: Class D Cost Estimate

### Statement of Limitations

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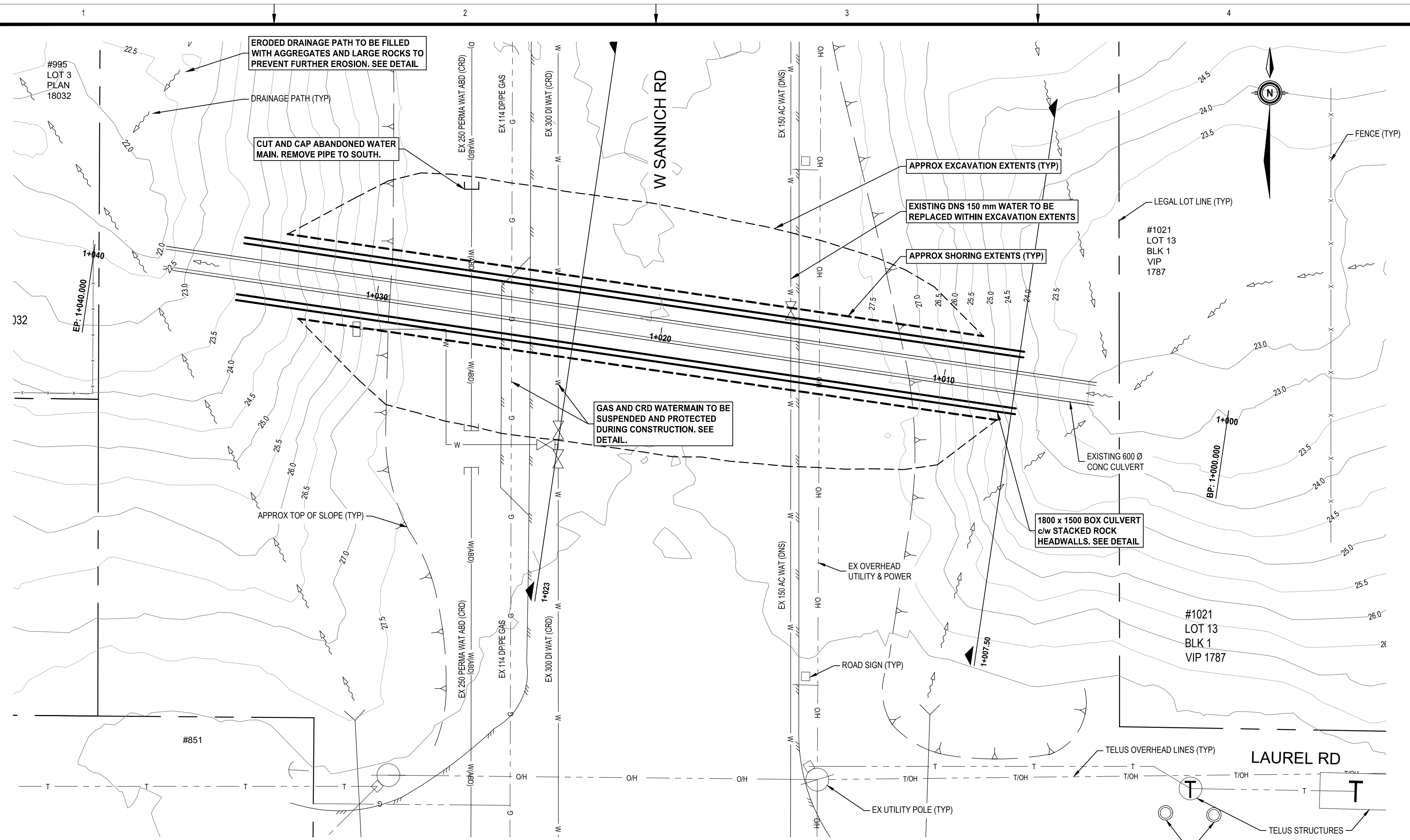
### Revision History

Revision #	Date	Status	Revision Description	Author
0	August 22, 2025	Final		SPE
A	May 30, 2025	Draft	For client review.	SPE

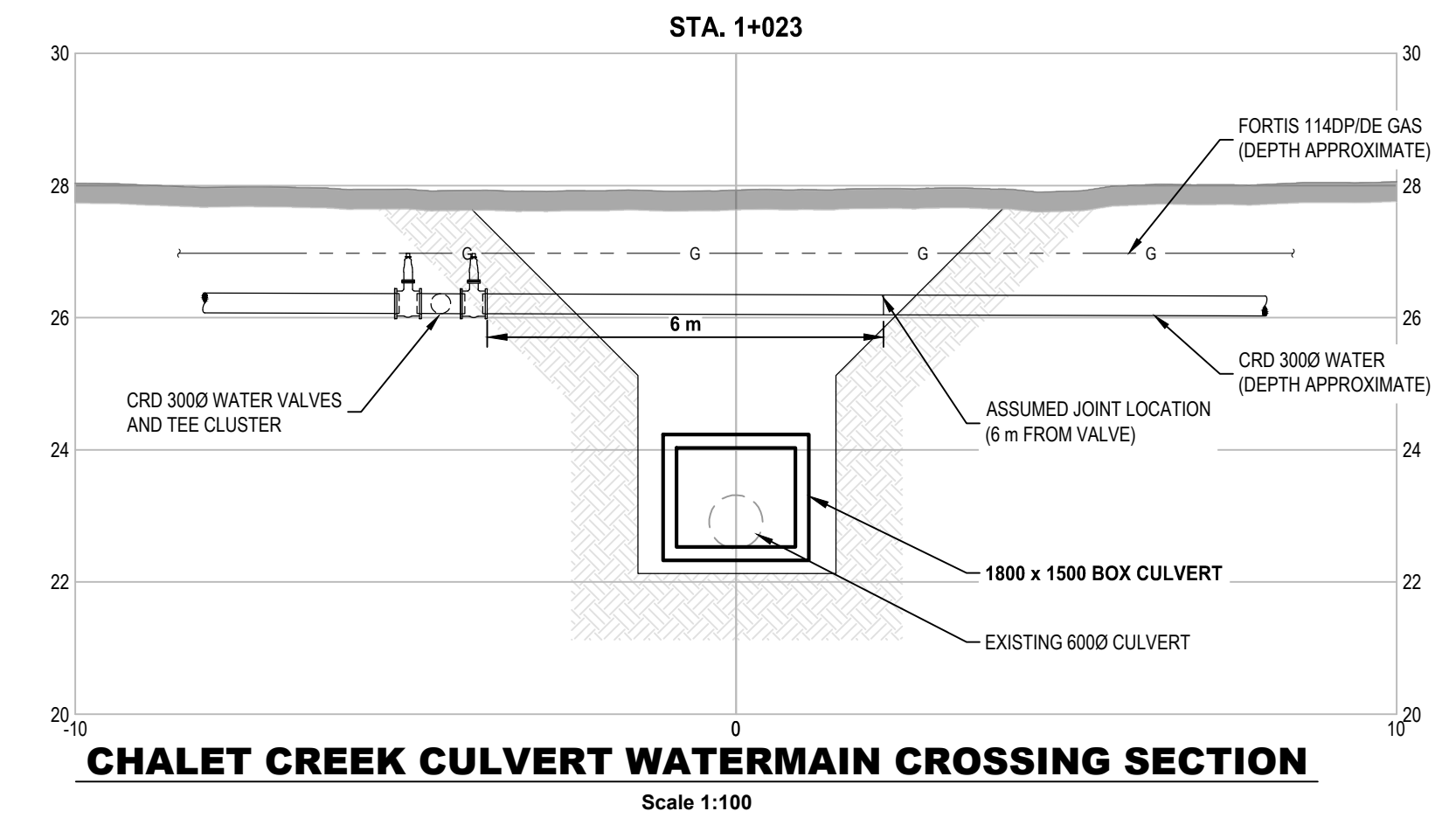
Appendix A

**Preliminary Design Drawing**

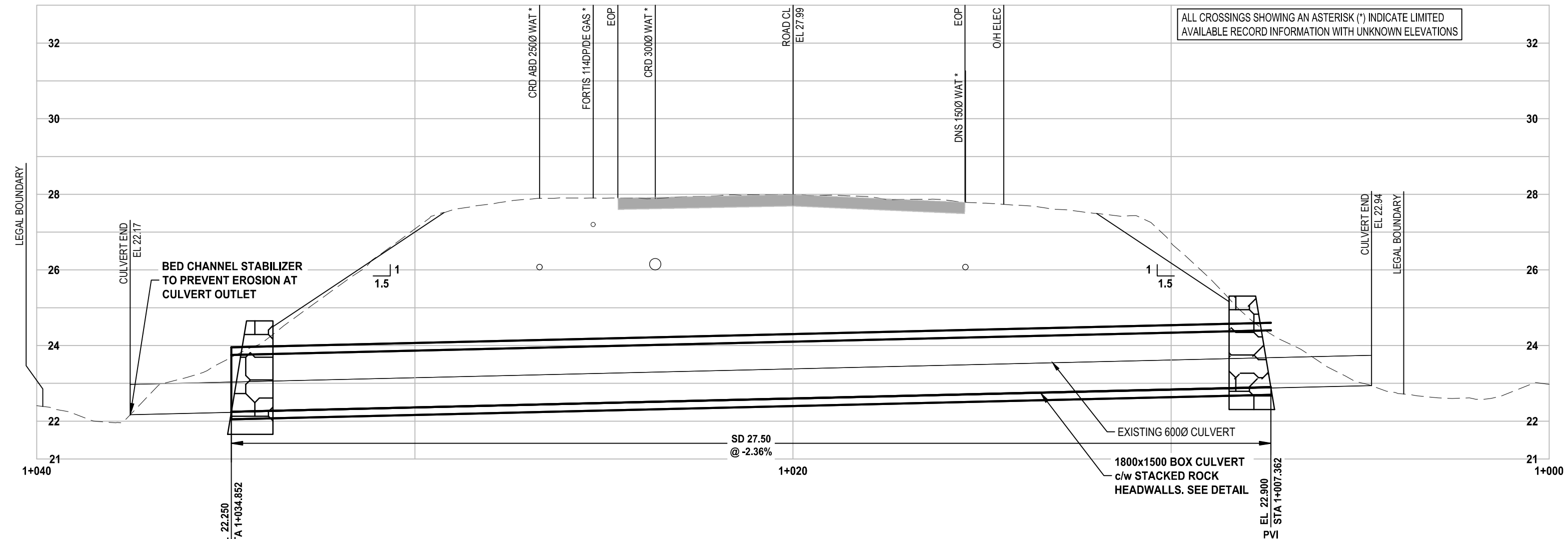
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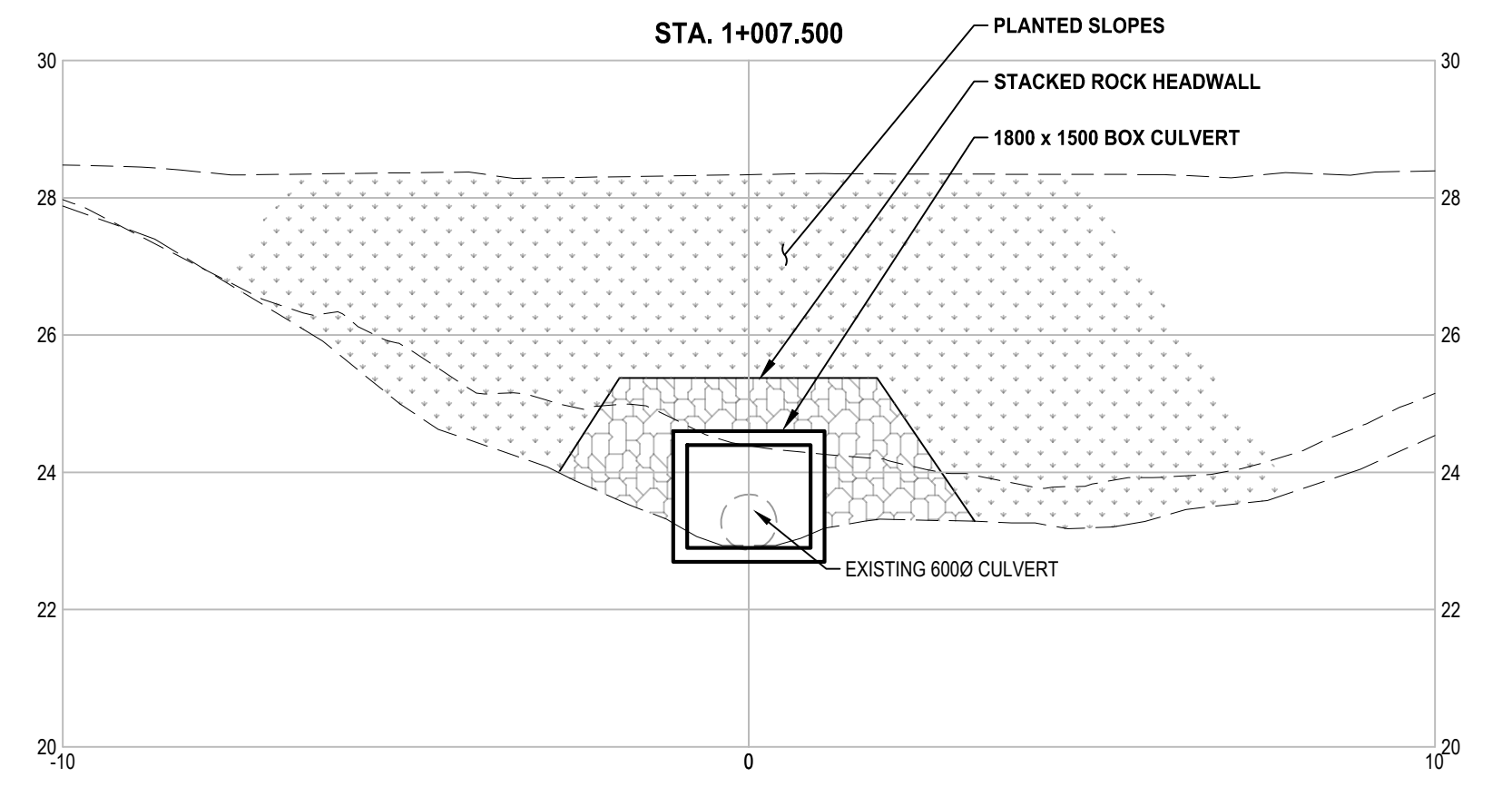
**CHALET CREEK CULVERT CROSSING PLAN**  
Scale 1:100



**CHALET CREEK CULVERT WATERMAIN CROSSING SECTION**  
Scale 1:100



**CHALET CREEK CULVERT CROSSING PROFILE**  
Scale 1:100



**CHALET CREEK CULVERT INLET SECTION**  
Scale 1:100



**DRAFT**  
FOR DISCUSSION  
PURPOSES ONLY

Rev	Date	Des	Dwn	Chk	Description	Rev	Date	Des	Dwn	Chk	Description
A	2025-05-22	SPE	KTK	SAB	DRAFT FOR DISCUSSION						

**DISTRICT OF NORTH SAANICH  
CHALET CREEK CULVERT REPLACEMENT  
PLAN AND PROFILE**

Project No.	2148-025	Group	CIVIL	Drawing No.	C-101	Rev.	A
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**Appendix B**

**Class D Cost Estimate**

2148.025  
District of North Sannich

Chalet Creek at West Sannich Road  
Chalet Creek Culvert Replacement  
May-25

**Class D Cost Estimate**

Item	Description	Unit	Estimated Quantity	Unit Rate	Total Price \$
<b>1</b>	<b>GENERAL REQUIREMENTS</b>				
1.01	Utility Locates	LS	1	\$ 7,500.00	\$ 7,500.00
1.02	Temporary Facilities, Site Isolation, Creek Flow Bypass System	LS	1	\$ 35,000.00	\$ 35,000.00
1.03	Tree Removal	Each	10	\$ 300.00	\$ 3,000.00
	<b>Subtotal for Task</b>				<b>\$ 45,500.00</b>
<b>2</b>	<b>EARTHWORKS</b>				
2.01	Clearing and Grubbing	Sq.m	80	\$ 20.00	\$ 1,600.00
2.02	Mass Excavation and Stockpile of Native Material	Cu.m	600	\$ 40.00	\$ 24,000.00
2.03	Off-Site Disposal of Deleterious Material	Cu.m	300	\$ 60.00	\$ 18,000.00
2.04	Removal, and Disposal of Existing Infrastructure Including Existing 600mm Dia. Concrete Pipe	LS	1	\$ 15,000.00	\$ 15,000.00
2.05	Utility Protection during Construction	LS	1	\$ 10,000.00	\$ 10,000.00
2.06	Remove Existing 150mm dia. North Sannich AC Watermain	Lin.m	9	\$ 140.00	\$ 1,300.00
2.07	Replacement of the North Sannich AC Watermain with 150mm Dia. HDPE Pipe	Lin.m	9	\$ 600.00	\$ 5,400.00
2.08	Remove and Cap Existing Abandoned 250mm dia. Permastran Watermain	Lin.m	9	\$ 140.00	\$ 1,300.00
2.09	Supply and Installation of 1829mm x 1524mm Concrete Box Culvert	Lin.m	33	\$ 10,000.00	\$ 330,000.00
2.10	Install Backfill using Stockpiled Native Material	Cu.m	600	\$ 20.00	\$ 12,000.00
2.11	Supply and Install Imported Granular Fill	Cu.m	200	\$ 67.00	\$ 13,400.00
2.12	Riprap Headwall with Planted Slope	LS	2	\$ 30,000.00	\$ 60,000.00
2.13	Supply and Installation of Creek Substrate (300mm Thick)	Tonne	48	\$ 165.00	\$ 8,000.00
2.14	Supply and Installation of Channel Bed Boulders	Sq.m	30	\$ 500.00	\$ 15,000.00
	<b>Subtotal for Task</b>				<b>\$ 515,000.00</b>
<b>3</b>	<b>ROAD RESTORATION</b>				
3.01	Remove and Replace Existing Roadway to Accommodate Construction	LS	1	\$ 16,300.00	\$ 16,300.00
3.02	Reinstate Roadway Drainage Swales/Ditches	LS	1	\$ 6,000.00	\$ 6,000.00
	<b>Subtotal for Task</b>				<b>\$ 22,300.00</b>
<b>4</b>	<b>SITE IMPROVEMENTS</b>				
4.01	Import and Install Topsoil (100mm Thick)	Sq.m	80	\$ 45.00	\$ 3,600.00
4.02	Planting	LS	1	\$ 5,000.00	\$ 5,000.00
4.03	Erosion Control Matting	Sq.m	80	\$ 7.00	\$ 600.00
	<b>Subtotal for Task</b>				<b>\$ 9,200.00</b>
	<b>Construction Cost Subtotal (Items 1 to 4)</b>				<b>\$ 592,000.00</b>
	Bonding and Insurance	2%			\$ 8,900.00
	Mobilization and Demobilization	3%			\$ 17,800.00
	Traffic Control, Vehicle Access, Parking	2%			\$ 11,800.00
	Environmental	7%			\$ 41,400.00
	Engineering & Construction Management	10%			\$ 59,200.00
	Contingencies	30%			\$ 177,600.00
	<b>Total Amount (excl. GST)</b>				<b>\$ 909,000.00</b>

Note: Estimates have been prepared with little or no site information and as such indicates the approximate magnitude of the cost of the capital tasks, for project planning purposes only. The estimate has been derived from unit costs for similar projects.

KERR WOOD LEIDAL ASSOCIATES LTD.

Consulting Engineers

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