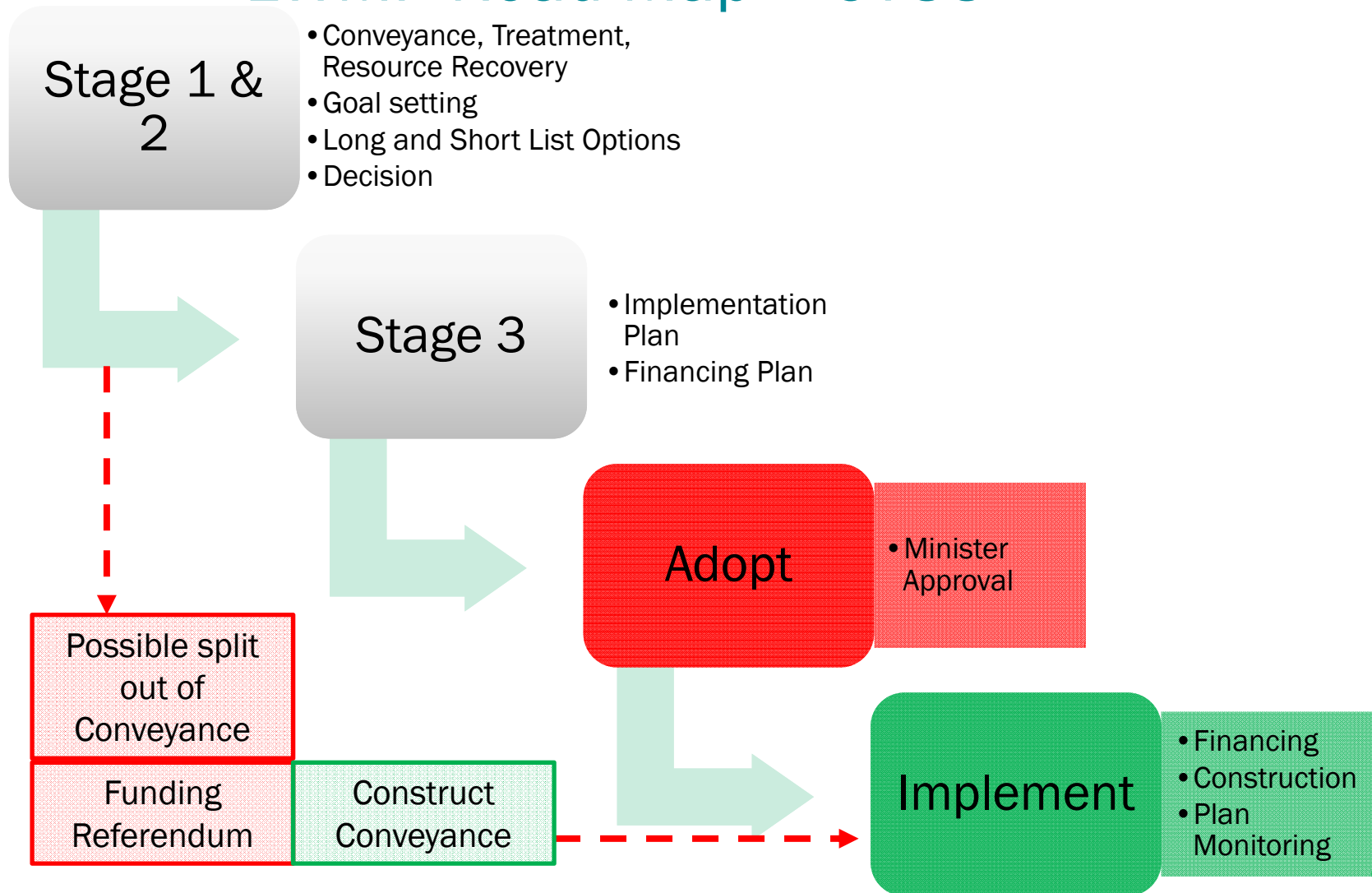


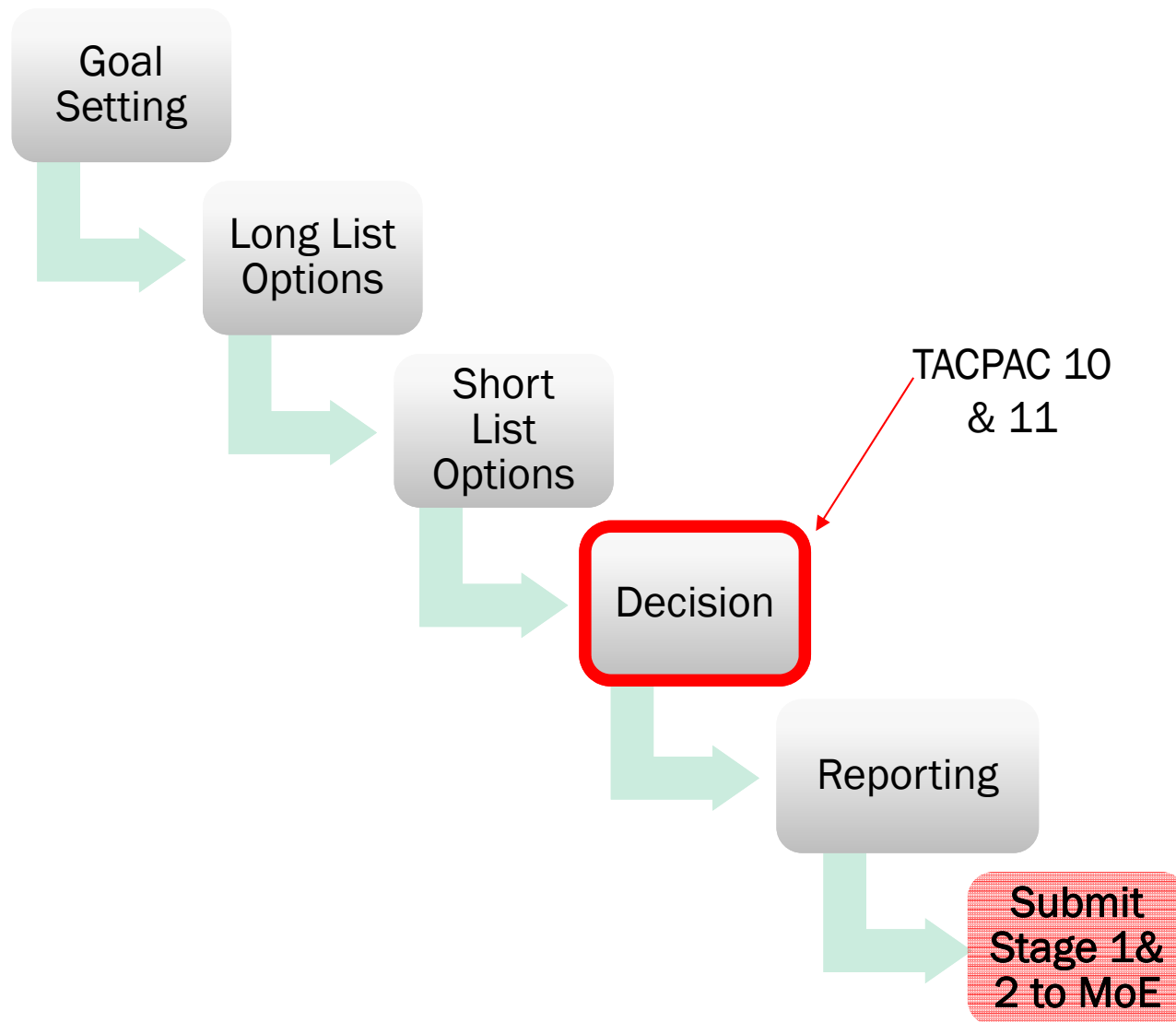
# Reclaimed Water at CVWPCC

- TACPAC asked for the Business Case to be brought back to the next meeting
- This had to be sideline because of COVID-19
- CVRD will commit to studying the Business Case/feasibility study as part of site master planning process.

# LWMP Road Map – CVSS



# LWMP Road Map – CVSS Stage 1 & 2

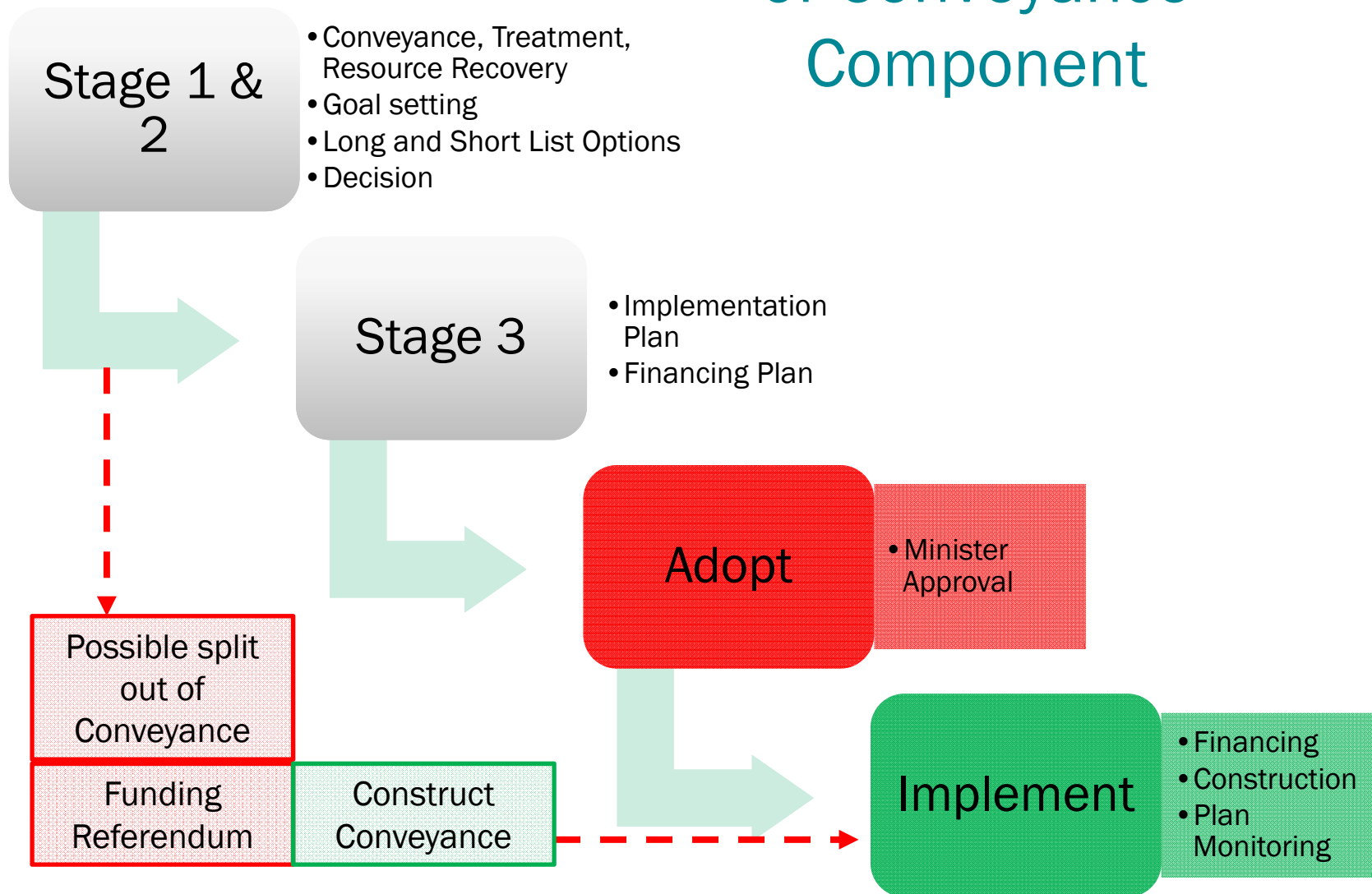


# Decision Process

TACPAC Recommendations go to the;

- Public, for review and input
- Back to the TACPAC
- CVRD Sewage Advisory
- CV Sewage Commission (Steering Committee) for *Decision*.
- Into the LWMP “Plan”

# Optional “Split out” of Conveyance Component



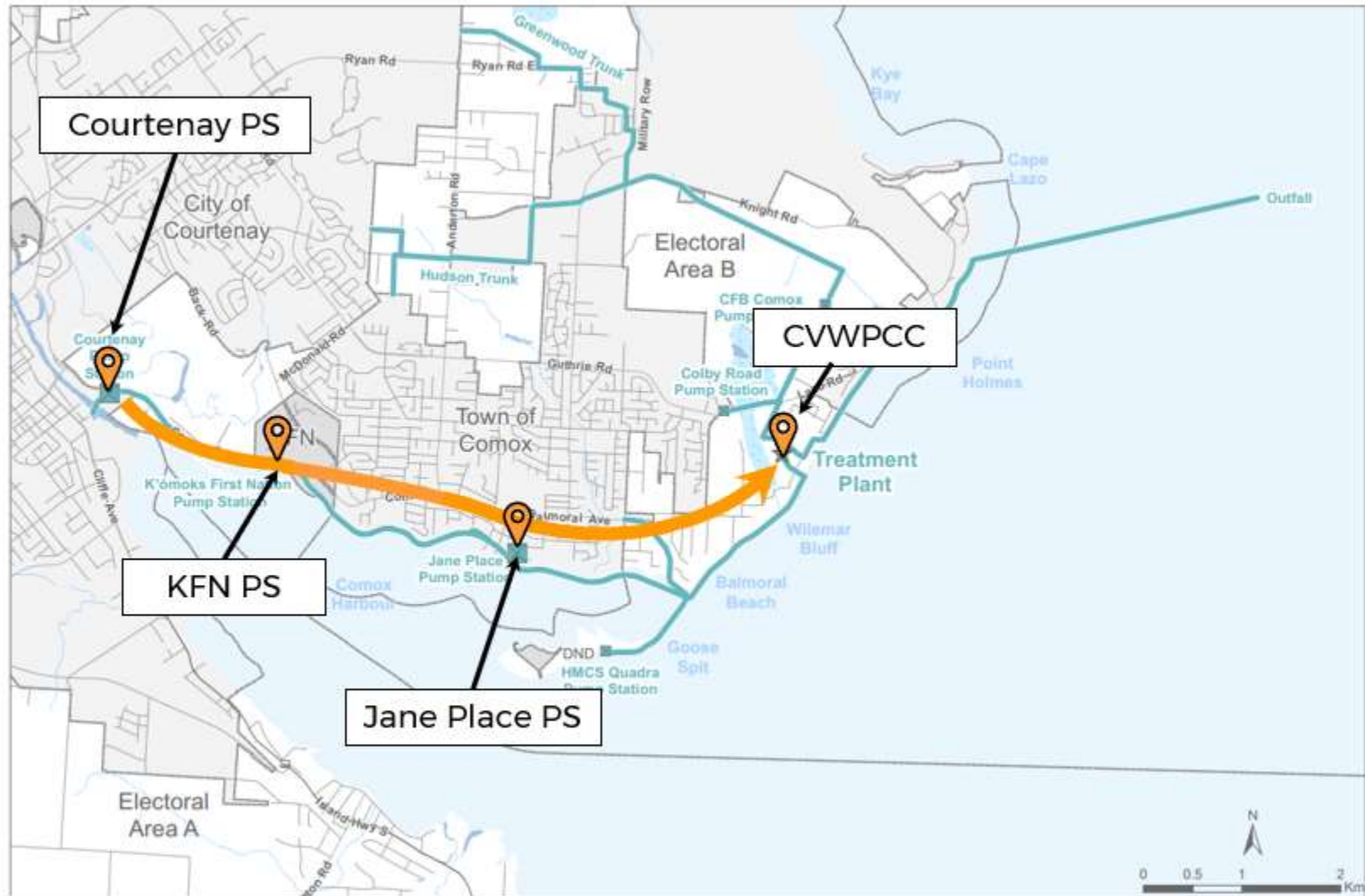
# **LWMP Stage 2 Conveyance System Assessments**

September 28th, 2020





# Stage 2 Options



## Stage 2 Conveyance Options Assessment

*The Stage 2 conveyance assessment further evaluates the preferred options from the Stage 1 shortlisted options.*

### Stage 2 Options

- Option 2A: Overland Forcemain (cut & cover);
- Option 3: Optimal Tunnelling
  - Option 3A: Tunnel through Comox Road Hill and Lazo Road Hill;
  - Option 3B: Tunnel through Lazo Road Hill;
  - Option 3C: Gravity Tunnel from Comox to CVWPCC.



- Option 1: **Cut & Cover** Forcemain Installation;
- Option 2: **Trenchless** Forcemain Installation;
- Option 3: **Phased Trenchless** Forcemain Installation.



Stage 2  
Conveyance  
Options  
Assessment

## Stage 2 Options

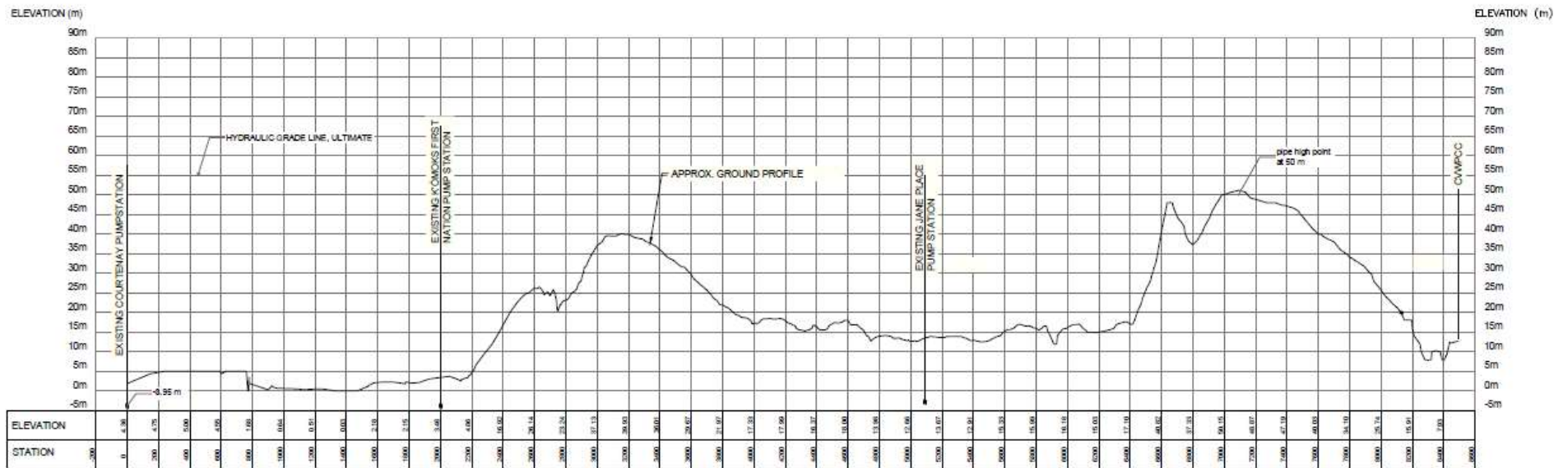
*The Stage 2 conveyance assessment further evaluates the preferred options from the Stage 1 shortlisted options.*



## Stage 2 Conveyance Options Assessment

*The Stage 2 conveyance assessment further evaluates the preferred options from the Stage 1 shortlisted options.*

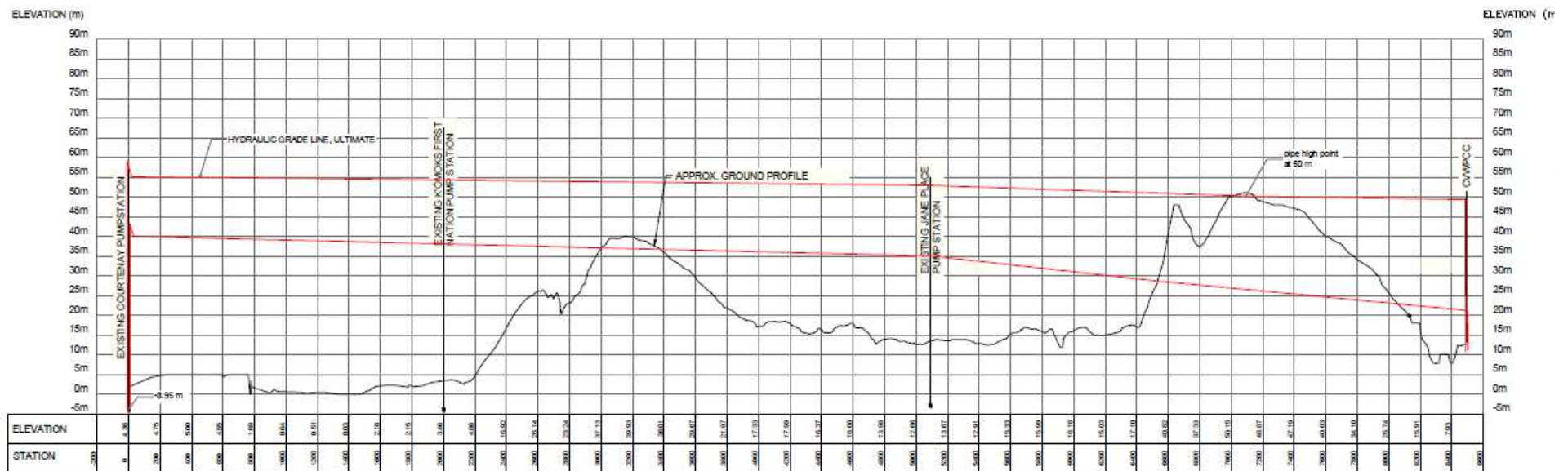
# Stage 2 Options



## Stage 2 Conveyance Options Assessment

The Stage 2 conveyance assessment further evaluates the preferred options from the Stage 1 shortlisted options.

# Stage 2 Options





Stage 2  
Conveyance  
Options  
Assessment

*The Stage 2 conveyance assessment further evaluates the preferred options from the Stage 1 shortlisted options.*

## What new assessments were done (1 of 2)?

- Condition and capacity of existing infrastructure.
- Resilience to climate change (sea level rise).
- Potential to upgrade, rather than replace, the existing pump stations.
- Potential to phase upgrades.
- Advance trenchless concepts of Lazo Road Hill and Comox Road Hill sections.
- Geotechnical investigations for trenchless option.
- Hydraulics/pump selections.
- Wet well/Dry well inspections.

Stage 2  
Conveyance  
Options  
Assessment

*The Stage 2 conveyance assessment further evaluates the preferred options from the Stage 1 shortlisted options.*

## What new assessments were done (2 of 2)?

- Environmental: *CVRD Sanitary Forcemain – Marine and Inland Options Study*, Current Environmental, August 12, 2019
- Archaeological: *AOA of Comox Road from 17<sup>th</sup> St. to KFN IRI*, Baseline Archaeological Services Ltd., August 9, 2019; *Archaeological Site Summary: Comox Sewer Line, K'ómoks IR 1 to Curtis Road*, Baseline Archaeological Services Ltd., August 12, 2019
- Hydrogeological: *Preliminary Hydrogeological Assessment of Tunnel Options*, GW Solutions, July 29, 2019
- Trenchless Installations (tunneling): *Conceptual Trenchless Design*, McMillen Jacobs Associates, October 4, 2019

**Forcemain to  
be replaced  
and raised  
from the  
foreshore onto  
a land routing**

## Forcemain – What is its condition?

- The forcemain was found to be in good condition
- The forcemain is rated to operate up to a working pressure of 100 psi (70 m)
- Capacity of forcemain is well above the projected 2060 flows in the forcemain
- Section along Willemar Bluffs exposed and must be replaced out of the foreshore, due to erosion risk/high risk of failure and long response time to respond to failure, and environmental damage.
- Remaining sections to be replaced as well due to same concerns.





**Due for upgrade  
for flow  
capacity and  
dated  
components;  
existing  
structures can  
continue to be  
used.**

## Pump Stations – What is their condition?

- Both CPS and JPS are at capacity in peak wet weather events when pumping simultaneously (mitigated by Greenwood/Hudson trunk sewers).
- Structural components (wet well) of the pump stations are generally in a sound condition with limited signs of deterioration.
- Other components (mechanical and electrical, etc.) are aged and need to be replaced or upgraded.



**Upgrades to  
consider current  
Post Disaster  
seismic criteria  
and climate  
change.**

## Pump Stations – What is their condition? – Other considerations

- “Post Disaster” seismic standards were not applied to wastewater pump station structures at the time of their construction (1982).
- Local sea levels are projected to rise about one meter over the next century, and the effects of sea level rise should be planned for:
  - *flood protection measures; or*
  - *rebuilding stations on higher ground.*

*Replace or upgrade  
existing stations*

**Upgrading each  
station, as  
opposed to  
constructing a  
replacement  
station, is  
possible.**

## Upgrade or Replace Pump Stations?

- Pump station wet wells can physically accommodate larger pumps that can provide greater flows and higher heads.
- Upgrading would include installing larger pumps and replacing piping and valves, electrical equipment, HVAC equipment, backup power and ancillary items.
- However, CPS will require more significant modifications and be more challenging to upgrade due to wet well/dry well configuration.

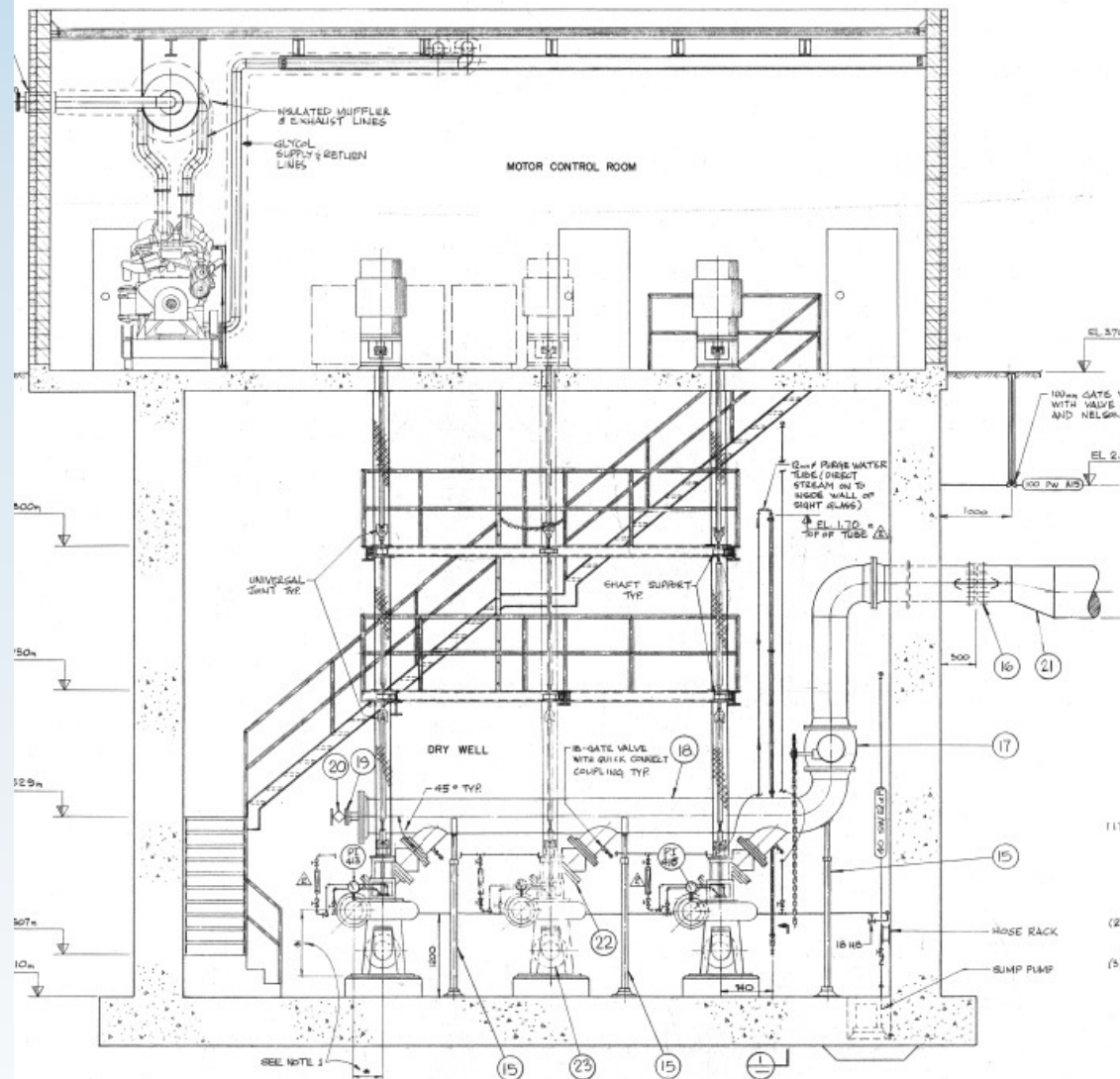
## Stage 2 Conveyance Options Assessment

*Replace or upgrade  
existing stations*

**Upgrading each  
station, as  
opposed to  
constructing a  
replacement  
station, is  
possible.**

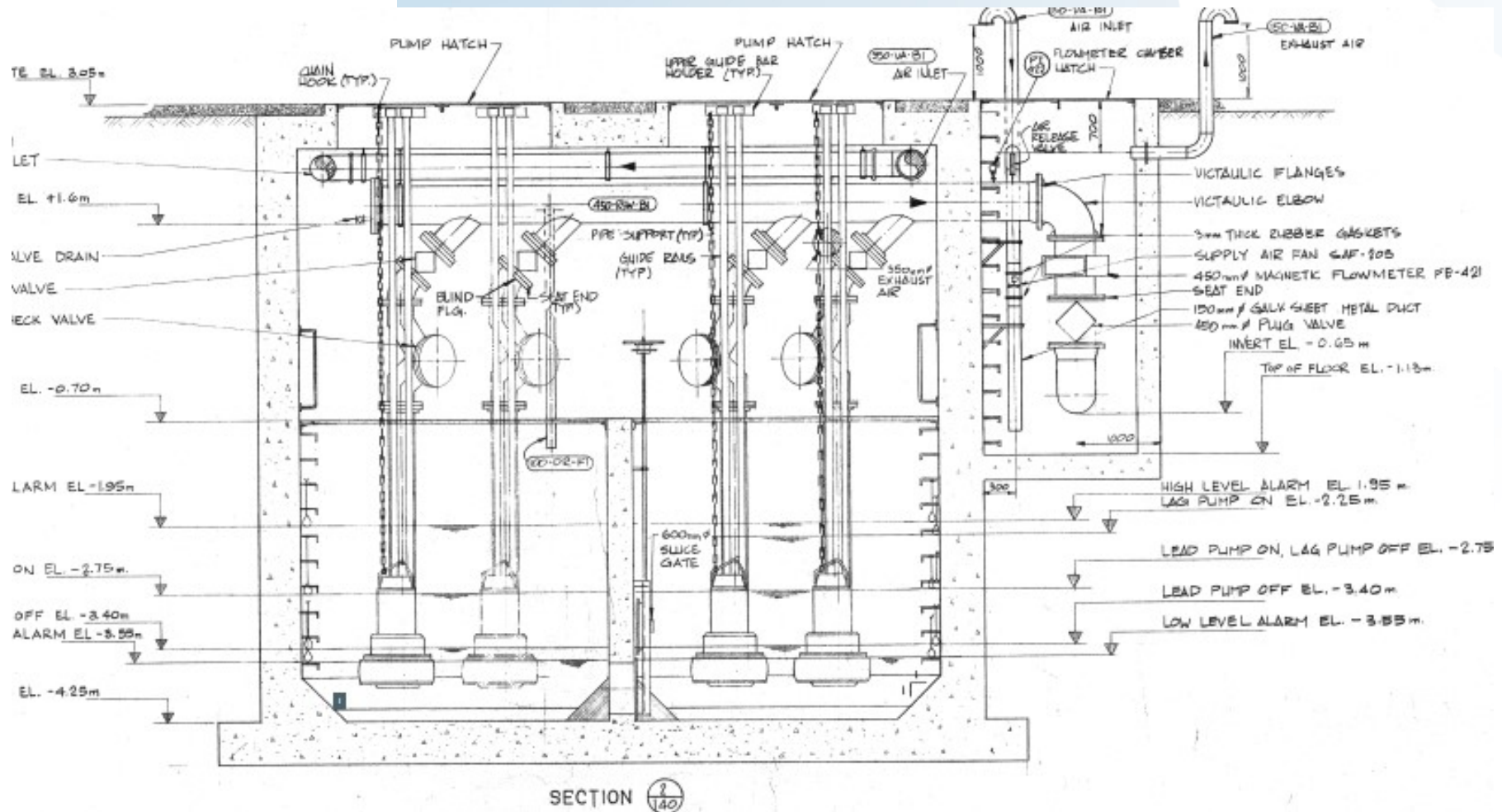


# Upgrade or Replace Pump Stations?



Stage 2  
Conveyance  
Options  
Assessment

# Upgrade or Replace Pump Stations?





**Phasing is possible for trenchless option.**

## Can the project be phased?

*Phasing is likely only viable for trenchless forcemain option, as the pump discharge pressures in the forcemain for the cut & cover option are very close to the working pressure of the existing pipe.*

— Phase 1:

- *Construct new forcemain from JPS to CVWPCC;*
- *Upgrade JPS;*
- *Upgrade/Replace CPS;*
- *Upgrade KFNPS.*

— Phase 2:

- *Replace forcemain from CPS to JPS.*



Archaeological monitoring will be conducted throughout construction including conducting a pre-dig in sensitive areas prior to construction

## Archaeological Assessment

- Area between 17th Street (location of CPS) and the Rotary Wildlife Viewing Park is *“largely characterized by deposits of native sterile material and fill and is considered to have a low archaeological potential based on its location within the Courtenay River flood plain.”*
- Area between the Rotary Park Viewing Center and the boundary of IR1 was assessed as *“having a high archaeological potential based on the presence of previously recorded archaeological sites and its location on higher terrain above the Courtenay River and Comox Harbour”*.
- Area between IR1 to Curtis Road, there are ten known archaeological sites that are located within, or partially within, this study area. However, all are close to or in foreshore area and away from the proposed relocated forcemain.

Stage 2  
Conveyance  
Options  
Assessment

*Environmental*

## Environmental Assessment

Chainage (approximate)	Feature(s)	Potential Risks
0 km @ Courtenay PS	<ul style="list-style-type: none"> <li>Courtenay River estuary</li> <li>Comox Bay Farm (controlled by Ducks Unlimited Canada and other conservation partners)</li> </ul>	<ul style="list-style-type: none"> <li>Release of deleterious substances to adjacent sensitive habitat</li> <li>Impacts to nesting avians during typical breeding period (Mar 1 – Aug 31)</li> <li>Impacts to seasonal occurring avian species associated with K'omoks (BC272) IBA, including Comox Bay Farm</li> </ul>
0 – 2 km	<ul style="list-style-type: none"> <li>Courtenay River estuary</li> <li>Glen Urquhart Cr</li> <li>wet sites at east end of #1 IR</li> <li>K'omoks (BC272) IBA</li> <li>Comox Bay Farm</li> </ul>	<ul style="list-style-type: none"> <li>Release of deleterious substances to adjacent sensitive habitat</li> <li>Impacts to nesting avians during typical breeding period (Mar 1 – Aug 31)</li> <li>Impacts to migrating and rearing salmonids</li> <li>Impacts to seasonal occurring avian species associated with K'omoks (BC272) IBA, including Comox Bay Farm</li> </ul>
2 – 6 km	<ul style="list-style-type: none"> <li>Port Augusta Cr (~km 3.8)</li> <li>Golf Cr (~km 4.6)</li> <li>Brooklyn Cr (~km 5.6)</li> </ul>	<ul style="list-style-type: none"> <li>Release of deleterious substances to adjacent sensitive habitat</li> <li>Impacts to nesting avians (Mar. 1 – Aug. 31) and raptors (Jan. 1 – Aug. 31) during typical breeding periods.</li> <li>Impacts to migrating and rearing salmonids</li> </ul>
6 – 8 km	<ul style="list-style-type: none"> <li>Lazo Marsh-Northeast Comox Wildlife Management Area (127 ha)</li> <li>other existing forest and thicket stands</li> </ul>	<ul style="list-style-type: none"> <li>Release of deleterious substances to adjacent sensitive habitat</li> <li>Impacts to nesting avians (Mar. 1 – Aug. 31) and raptors (Jan. 1 – Aug. 31) during typical breeding periods.</li> <li>Impacts to at-risk amphibians</li> <li>Impacts to wildlife species associated with Lazo Marsh-Northeast Comox Wildlife Management Area</li> </ul>
8 km @ CVWPCC	Existing forest and thicket stands	Impacts to nesting avians (Mar. 1 – Aug. 31) and raptors (Jan. 1 – Aug. 31) during typical breeding periods.

**Any potential adverse effects can be mitigated to result in no, or negligible, impacts.**

## Environmental Assessment

*Based on this preliminary environmental assessment, the construction and operation of the CVRD Sanitary Forcemain ..... is expected to be completed without significant environmental effects. Any potential adverse effects can be mitigated to result in no, or negligible impacts. Measures should be in place to respond to accidents and malfunctions that have the potential to affect the environment. Provided that this project follows the mitigation hierarchy described in Section 4, temporary encroachment and permanent alterations of the sensitive habitats identified in this technical memorandum are not expected to have an adverse effect on the environment*

## Trenchless Considerations

Category	Shield tunnelling	Micro-tunnelling	Horizontal Direction Drilling
<b>Groundwater / Face Control</b>	Not designed to work below the water table	Can operate above and below the water table.	Can operate above and below the water table.
<b>Typical Diameter Installed</b>	2.2 m or larger	0.5 m to 2.7 m	0.1 m to 1.5 m
<b>Typical Length Installed</b>	No limitations	Installed lengths are typically in the range of 600 m, however 1,100 m has been installed before	Up to 1,500 m
<b>Relative Cost</b>	x2.3	x2	x1

## Trenchless Construction Considerations

- *HDD offers significant cost advantages over the other methods reviewed*
- *The micro-tunnel option and the shield tunneling option do not offer any advantages for this application.*
- ***The primary drawback to horizontal directional drilling is the laydown room needed to fuse a pipe string long enough for one continuous pullback or to fuse two or three sections that are welded together during pullback.***

## Geotechnical Investigation

### **Comox Road Hill:**

- soils consist of dense to very dense silty sand generally, with varying amounts of fines and cobbles. These conditions are, in general, favourable for horizontal directional drilling.

### **Lazo Road Hill:**

- soils consist of dense to very dense sand, which is favorable for horizontal directional drilling.
- In some boreholes, the drilling and pressure measurement operations encountered difficulties which were attributed to potential formation squeezing and relatively high horizontal pressures; these conditions are considered manageable.



## Horizontal Directional Drilling Laydown and Pulling

***The primary drawback to horizontal directional drilling is the laydown room needed to fuse a pipe string long enough for one continuous pullback or to fuse two or three sections that are welded together during pullback.***



## HDD Locations



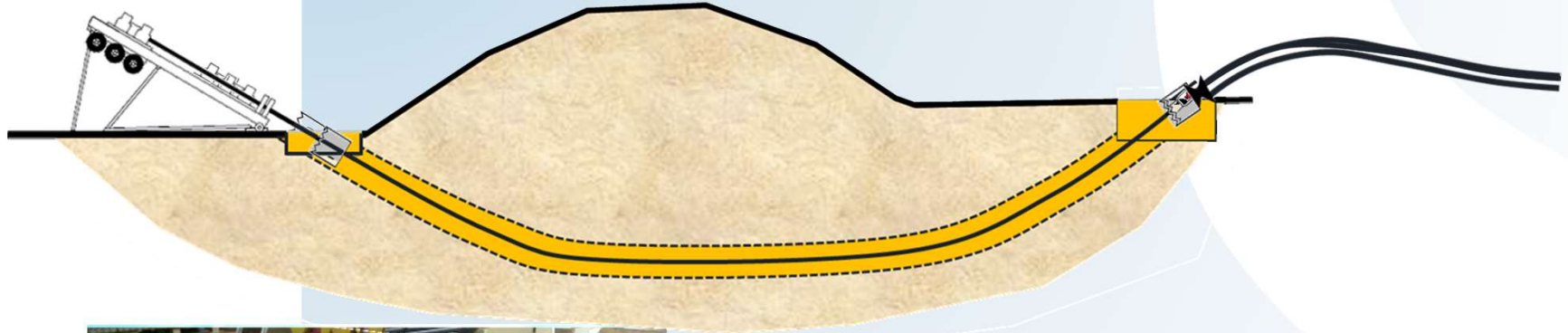
## HDD Locations



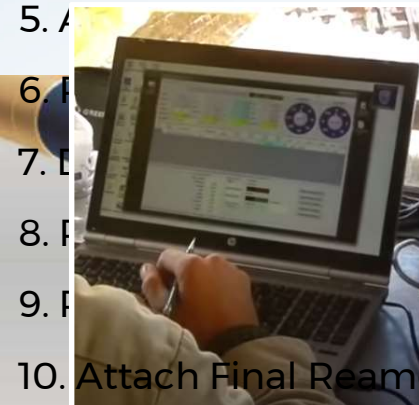


Stage 2  
Conveyance  
Options  
Assessment

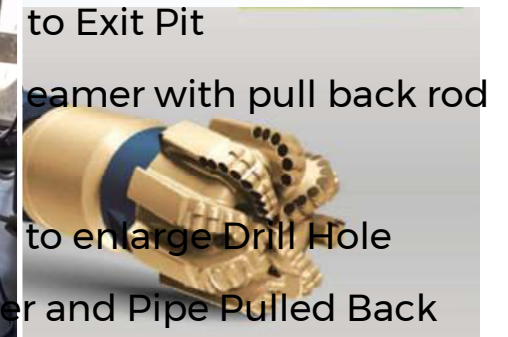
# HDD Construction Sequence



1. HDD Alignment Design
2. Prepare Entry and Exit Pits
3. HDD Drilling Rig - Pilot Hole Drill Bit
4. Advance Pilot Hole



5. Attach Pilot Hole Drill Bit
6. Advance Pilot Hole
7. Attach Reamer and Pull Back Rod
8. Pull Back Rod to Enlarge Drill Hole
9. Attach Final Reamer and Pipe Pulled Back



Stage 2  
Conveyance  
Options  
Assessment

# HDD Alignments and Laydown





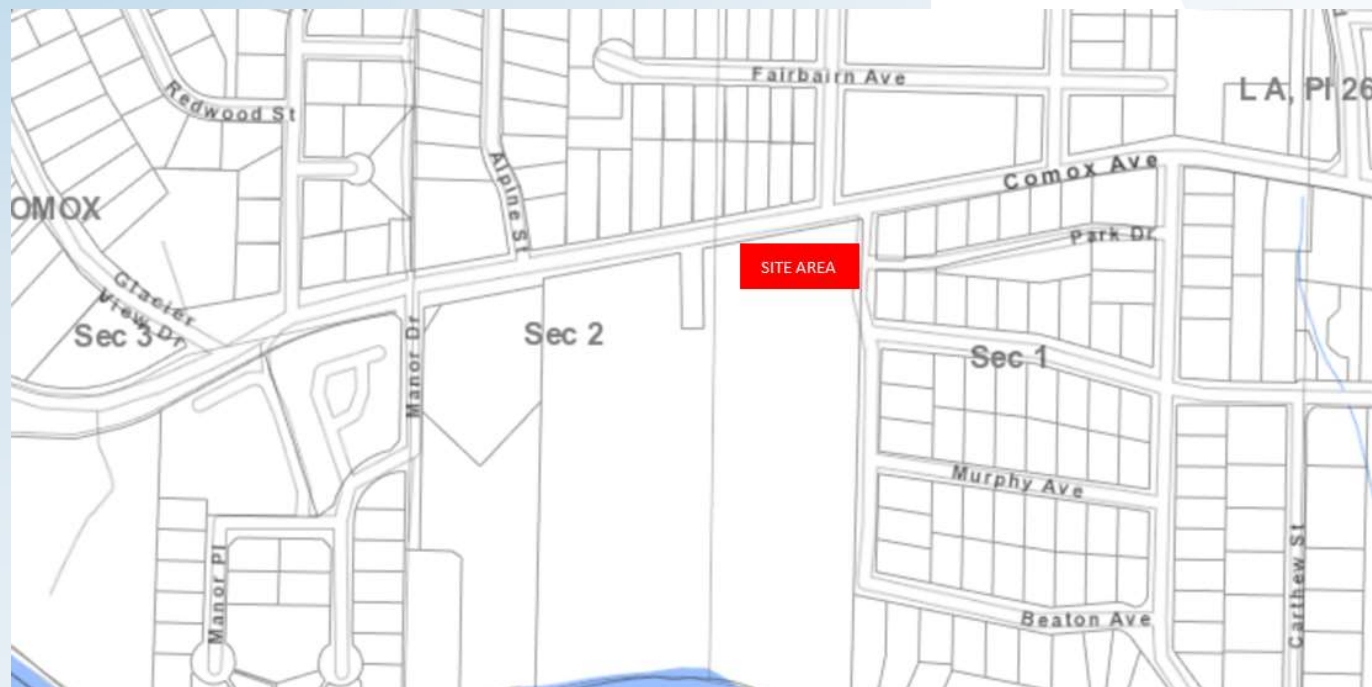
## HDD Alignment and Laydown – Comox Road Hill (~730 m)





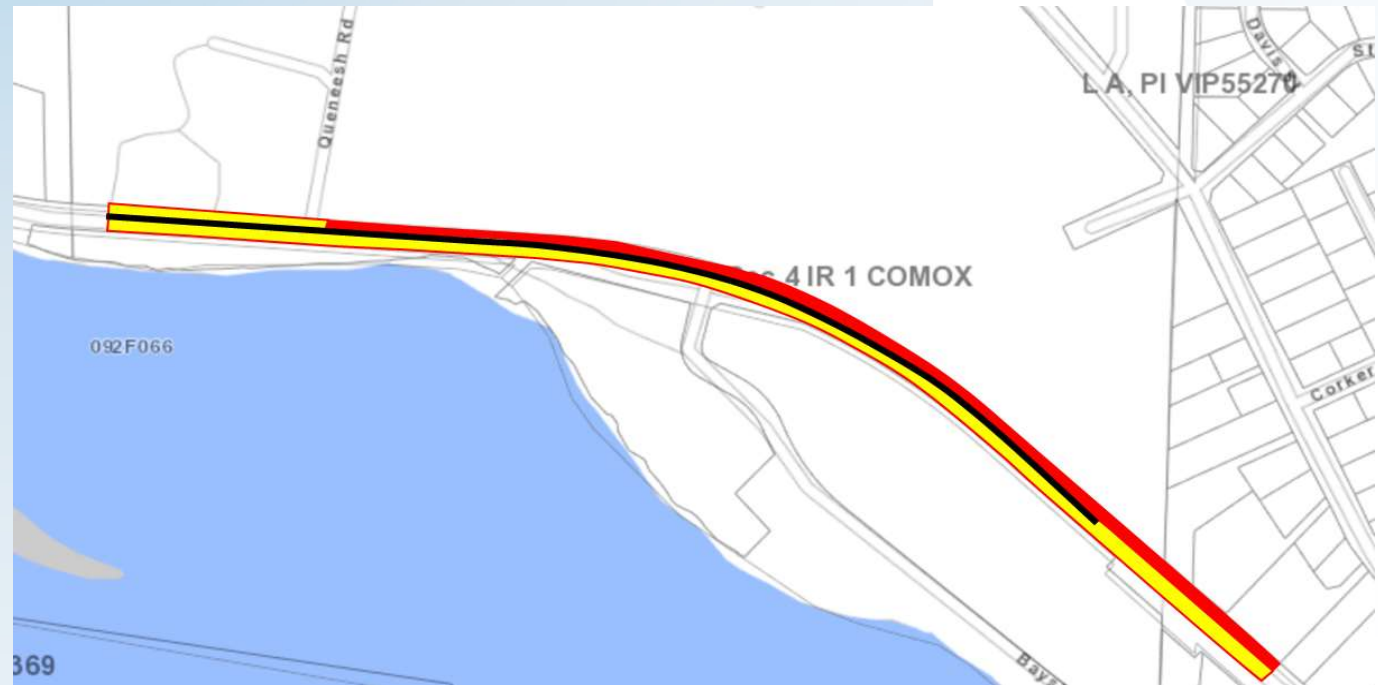
Stage 2  
Conveyance  
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## Comox Road Hill Entry Pit



 Site Area (30 m x 80 m): 7 weeks

## Comox Road Hill Exit Pit & Pipe Laydown



- Site Area 7 weeks. No through traffic along Comox Road
- Restricted Area: 7 weeks  
Restricted traffic:
  - Central 4m road occupied.
  - Comox Road split into north and south 3m wide, single lane two way traffic

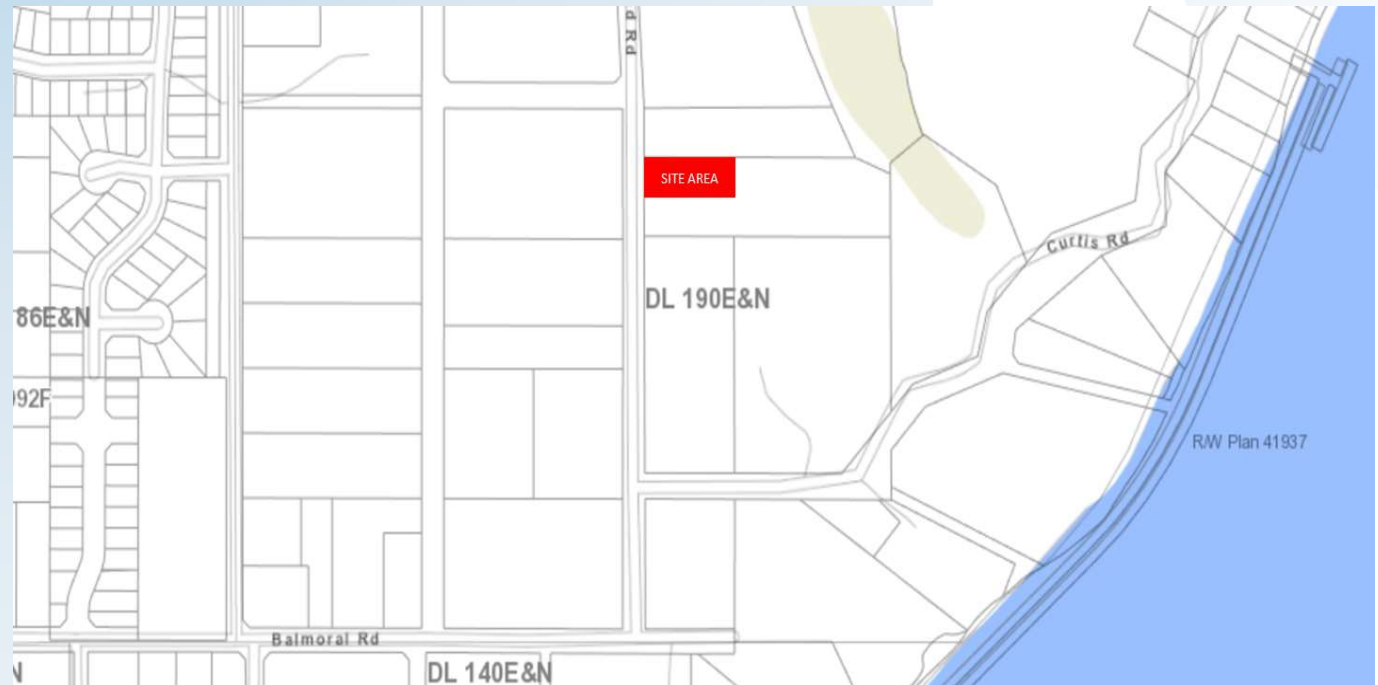
Stage 2  
Conveyance  
Options  
Assessment

## HDD Alignment and Laydown – Lazo Road Hill (~1,260 m)



Stage 2  
Conveyance  
Options  
Assessment

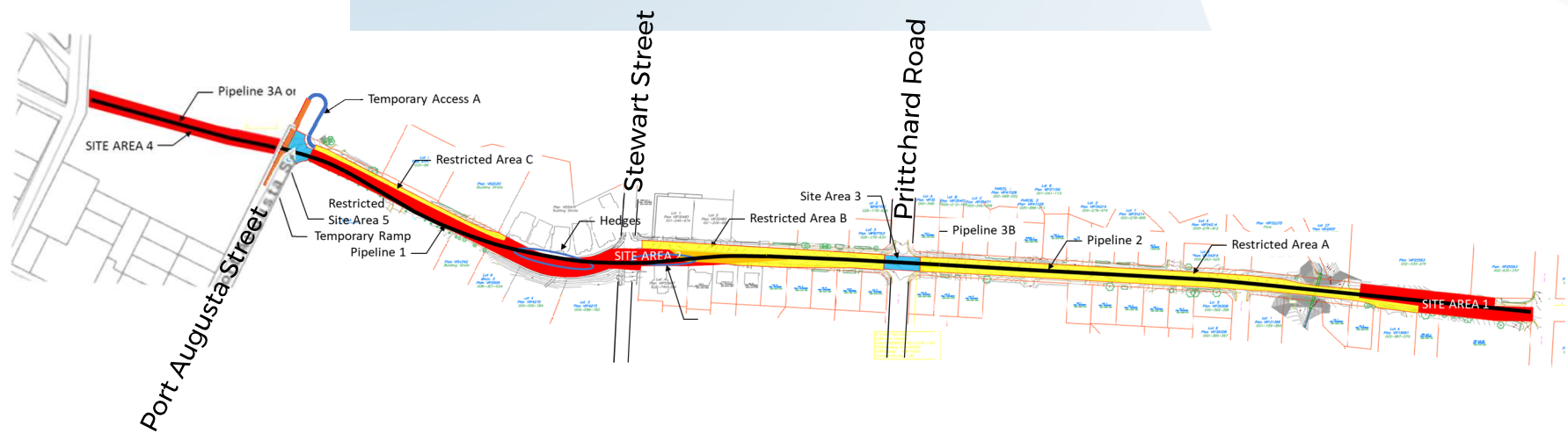
## Lazo Road Hill Entry Pit



 Site Area (30 m x 80 m): 8 weeks

Stage 2  
Conveyance  
Options  
Assessment

# Lazo Road Hill Exit Pit & Pipe Laydown



- Site Area: 8 weeks.
- Restricted Area: 8 weeks  
Restricted traffic:
  - Central 4m road occupied.
  - Balmoral Avenue split into north and south 3m wide, single lane two way traffic
- Balmoral Avenue/Prittchard Road Junction: 3 weeks



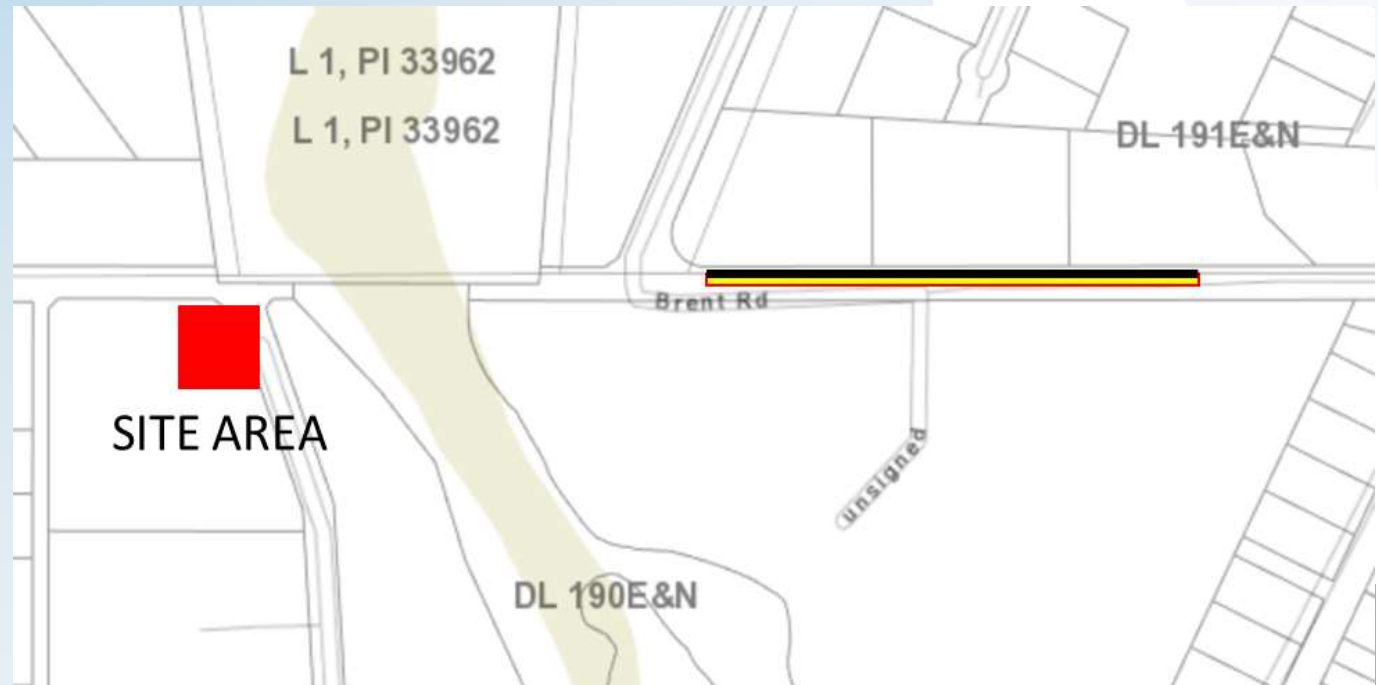
Stage 2  
Conveyance  
Options  
Assessment

## HDD Alignment and Laydown – Lazo Marsh (~250 m)





## Lazo Marsh Entry Pit, Exit Pit and Pipe Laydown



-  Site Area: 3 weeks
-  Restricted Area: 3 weeks  
Restricted traffic:
  - North side 5 m of Brent Road and verge occupied

## Trenchless Risks (1 or 2)

### Geotechnical Risks

- Squeezing ground;
- Obstructions including large cobbles;
- Geotechnical conditions different from those assumed;
- Soils which may contain archaeological or fill material that may be problematic (e.g., wood waste), particularly for the Comox Hill HDD entry and exit pits where previous construction activities had taken place.

### Right of Way Risks

- Availability of land, including land owners not interested in allowing the pipe to cross under their property.

## Trenchless Risks (2 of 2)

### Environmental Risks

- Permitting which involves multiple jurisdictions/agencies;
- Unidentified contamination;
- Restrictions on construction timing imposed by environmental considerations such as bird nesting or fish spawning windows;
- Restrictions on construction methods such as fluid returns for HDD installations.

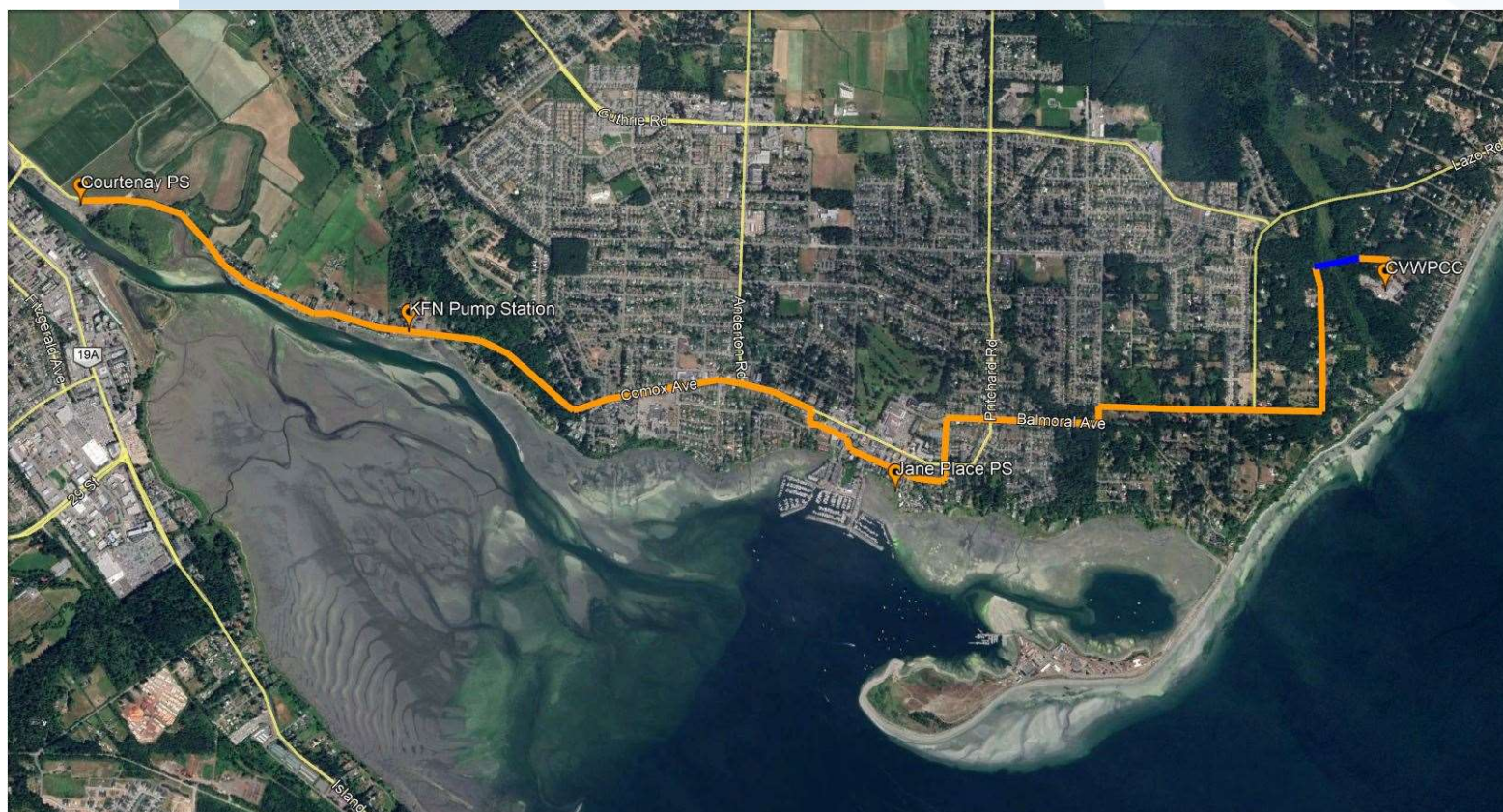
### Construction Risks

- Market considerations limiting the number of qualified firms;
- Longer trenchless sections have higher risks;
- Community impacts, such as traffic and access impacts, noise and working hours

Stage 2  
Conveyance  
Options  
Assessment

*Option 1*

# Option 1 – Cut & Cover Forcemain Installation

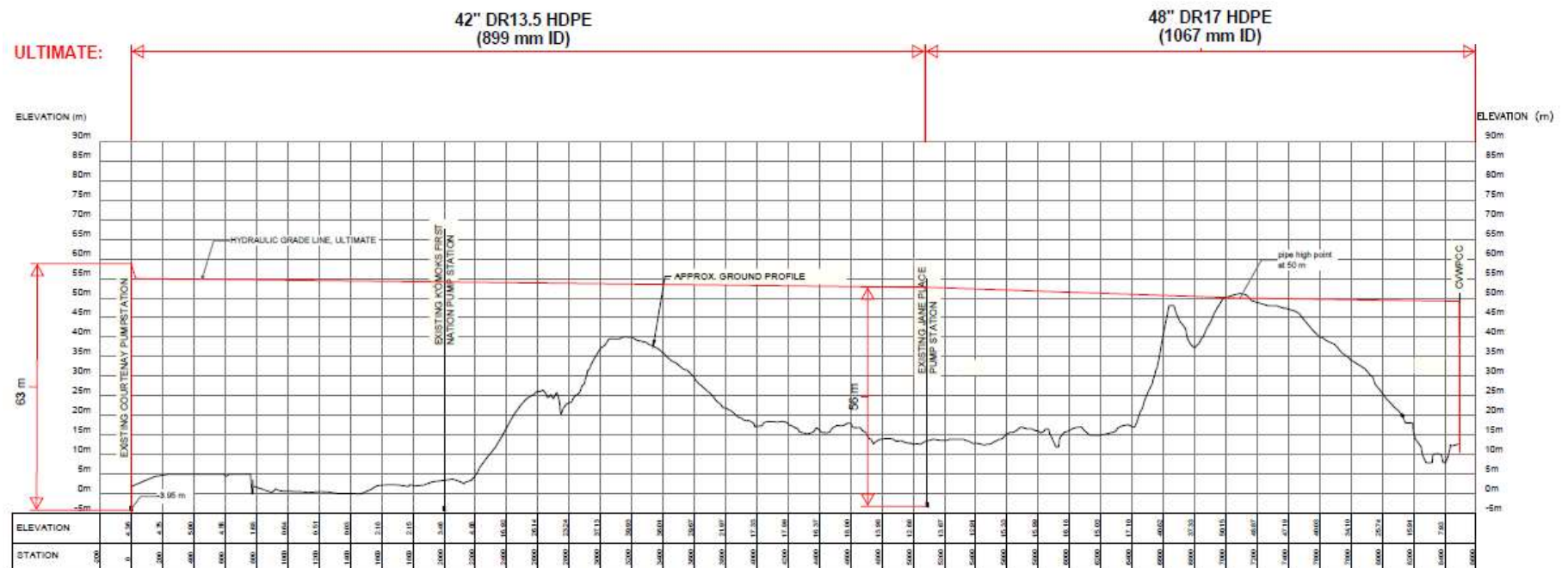




Stage 2  
Conveyance  
Options  
Assessment

# Option 1 – Cut & Cover Forcemain Installation

## Option 1



## Option 1 – Cut & Cover Forcemain Installation

- Replace 8,550m using conventional cut and cover installation following road ROWs; trenchless HDD under Lazo Marsh (250m)
- Pipe size 1067 (42") CPS to JPS, 1219 mm (48"), JPS to CVWPCC, HDPE
- Upgrade Courtenay PS with 3 new pumps (2+1), 335 hp (existing 2+1 x 170hp); more significant modifications due to the wet well/dry well configuration and size; discharge head 63m (now 26m to 33m)
- Upgrade Jane Place PS with 4 pumps (3 + 1), 130 hp (now 2+1 x 70HP); discharge head approx. 56 m (18m)
- KFN PS – pump to CPS
- Upgrade includes retaining the wet well (and dry well for CPS) physical structure and installing larger pumps, replacing piping and valves, electrical equipment, HVAC equipment, backup power and ancillary items.
- Possible seismic retrofit
- Flood proof for climate change



## Option 1 – Cut & Cover Forcemain Installation

- CPS pumps will have significantly higher discharge pressures (>60 m TDH); these pressures are considered very high for sanitary pumping systems; pumps will have greater maintenance requirements.
- Pumping energy costs will rise significantly from current costs.
- Larger forcemain size to decrease losses.
- Upgrading is feasible at JPS by installing new pumps in the existing wet well;
- CPS will require more significant modifications and be more challenging to upgrade, and, therefore replacement may be considered, also considering seismic retrofit.
- Pump discharge pressures approach the design working pressures of the forcemain, so phasing of the system upgrades is not recommended, due to increased risk of forcemain failure at higher pressures.

Stage 2  
Conveyance  
Options  
Assessment

Options 2 & 3

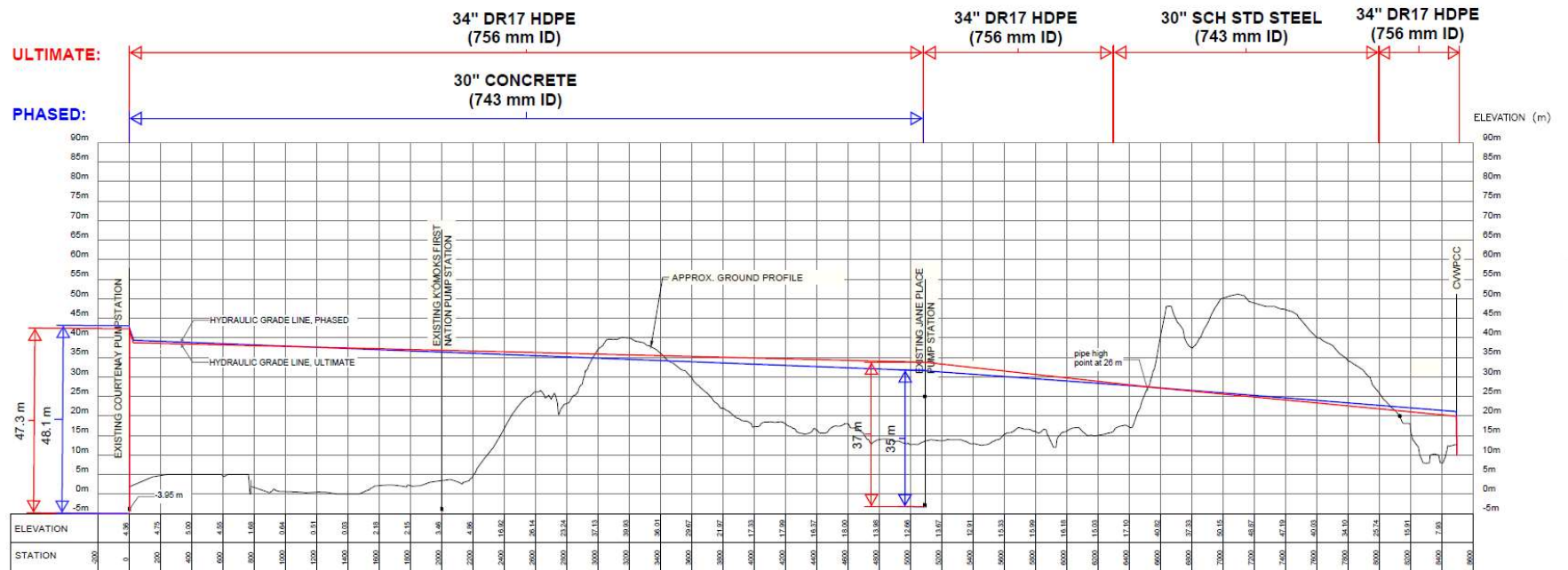
# Options 2 and 3 – Trenchless Forcemain Installation



Stage 2  
Conveyance  
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Assessment

# Options 2 & 3 – Trenchless Forcemain Installation

Options 2 and 3





## Option 2 & 3 – Trenchless Forcemain Installation

- Replace 6,070m using conventional cut and cover installation following road ROWs; trenchless HDD through Lazo Hill (1,270m) and Comox Hill (740), under Lazo Marsh (250m), total HDD = 2,260m.
- Pipe size 860 (34") except for HDD through Lazo Road Hill, 760 mm (30") steel.
- Upgrade Courtenay PS with 3 new pumps (2+1), 250 hp (now 2+1 x 170hp); more significant modifications due to the wet well/dry well configuration and size; discharge head 63m (26-33)
- Upgrade Jane Place PS with 3 pumps (2 + 1), 110 hp (now 2+1 x 70HP); discharge head approx. 56 m (18m)
- KFN PS – new pumps
- Upgrade includes retaining the wet well (and dry well for CPS) physical structure and installing larger pumps, replacing piping and valves, electrical equipment, HVAC equipment, backup power and ancillary items.
- Possible seismic retrofit
- Flood proof for climate change
- Can be phased (Option 3), where forcemain from CPS to JPS is deferred to 2040

## Option 2 & 3 – Trenchless Forcemain Installation

- Upgrades driven by hydraulic changes are required for the CPS, JPS, and KFNPS but are less than those for Option 1 and can be accommodated with pumps with higher discharge heads that would operate within typical ranges.
- Smaller forcemain size than cut and cover.
- Pumping energy costs will rise somewhat from current costs.
- As with Option 1, upgrading is feasible at JPS by installing new pumps in the existing wet well; CPS will require more significant modifications and be more challenging to upgrade, and, therefore replacement may be considered, also considering seismic retrofit.
- ROWs will be needed for trenchless sections which may cross several properties, including private properties.
- This option allows for phasing as the discharge pressures from CPS are within the working pressure range of the existing forcemain.
- Construction risks are higher for a trenchless installation. If risks are realized, potentially can be very costly.
- Community impacts associated with laydown and pull



## Option 1: Cut & Cover Forcemain Capital Costs

Infrastructure	Capital Cost (\$M)	Renewal Frequency (yrs)	Renewal (%)
Upgrade CPS (High Head)	\$10.462M	25	40
Upgrade JPS (High Head)	\$6.975M	25	40
Cut & Cover Forcemain - Courtenay to JPS	\$18.832M	60	100
Cut & Cover Forcemain - JPS to CVWPCC	\$16.588M	60	100
Cut & Cover Forcemain - JPS to Forcemain	\$0.693	60	100
Cut & Cover Forcemain - KFN PS to CPS	\$0.682M	60	100
Odour Control Facilities	\$0.465M	25	40
<b>TOTAL</b>	<b>\$54.698M</b>		
<b>ANNUAL O&amp;M COST (2020\$)</b>	<b>\$457,500</b>		

## Option 2 & 3: Trenchless Forcemain Capital Costs

Infrastructure	Capital Cost (\$M)	Renewal Frequency (yrs)	Renewal (%)
Upgrade CPS (Medium Head)	\$6.016	25	40
Upgrade JPS (Medium Head)	\$4.069	25	40
CPS to JPS Including Trenchless Section	\$15.255	60	100
JPS to CVWPCC Incl. Trenchless Section	\$23.961	60	100
Cut & Cover Forcemain - JPS to Forcemain	\$0.693	60	100
KFN PS Upgrade (Medium Head)	\$0.581	60	100
Odour Control Facilities	\$0.465	25	40
<b>TOTAL, unphased</b>	<b>\$51.039</b>		
<b>TOTAL , phased</b>	<b>\$53.420</b>		
<b>ANNUAL O&amp;M COST, (2020 \$), unphased</b>	<b>\$358,000</b>		
<b>ANNUAL O&amp;M COST, (2020 \$), phased</b>	<b>\$360,500</b>		

## Cost Model Assumptions

- Assets are replaced on a continuous basis
  - *Structures - every 25 years require 40% of their future value re-invested*
  - *Pipeline - every 60 years require 100% of their future value re-invested*
- Power
  - *Demand Charge - \$12.34/kW times highest demand during the billing month*
  - *Power Charge - \$0.0606/kW-hr times the 50% of the total system power (ie: average power draw)*
  - *Power cost increases 5% per year for both demand and energy costs.*
  - *Current rates are 3% higher over 2019*

## Cost Model Assumptions

- Labour
  - *Labour cost is \$100,000 per year to capture direct and indirect costs*
  - *Inflates at 3% per year*
- Construction Costs
  - *Construction costs are used to estimate future replacement value of assets*
  - *Rate based on 15-yr historic ENR index which is 3.0% per year*
- Interest Rates
  - *Interest is used to determine present value of a future asset.*
  - *MFA rates used at 3.5% per year*
- No adjustment is included to factor in increases in operating time per day due to growth
- No change in future asset replacement associated with growth

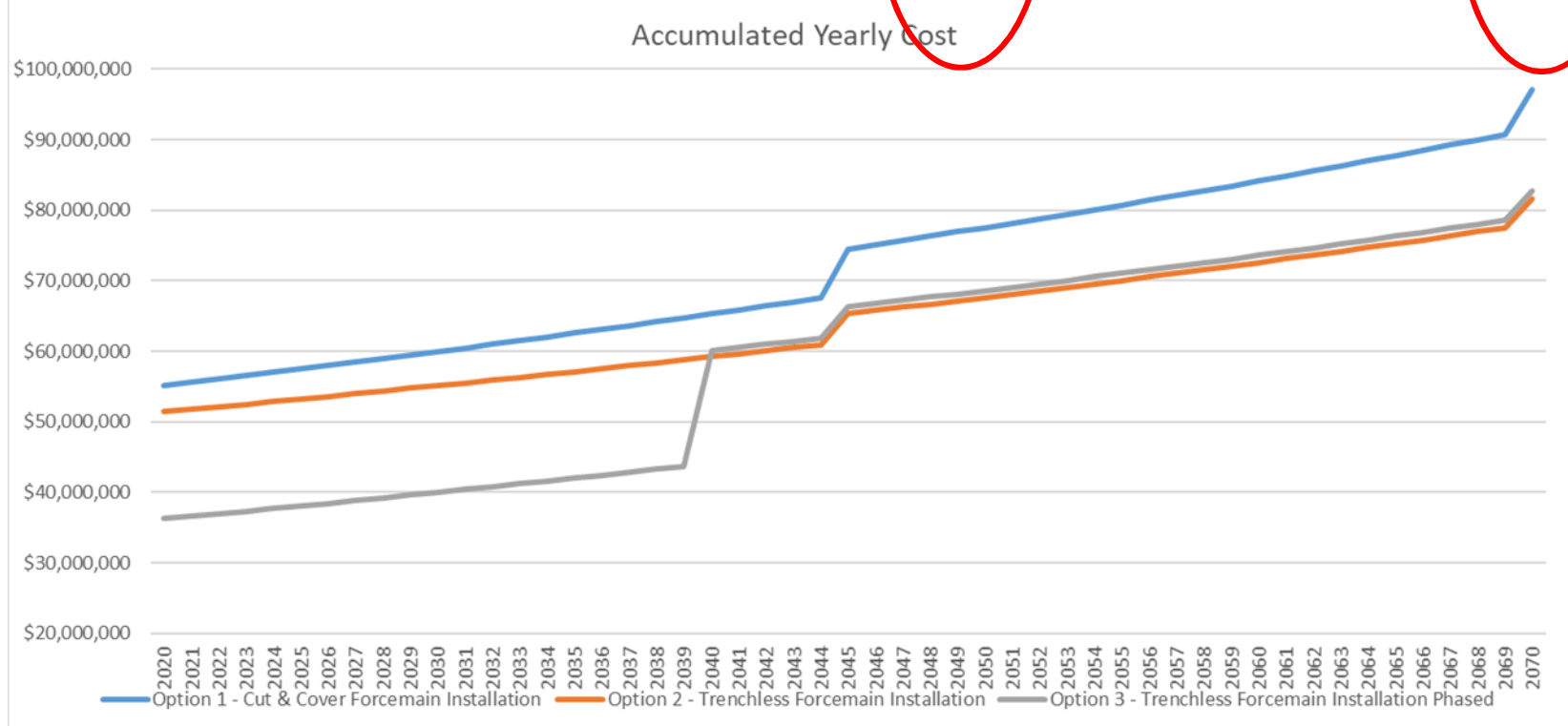


Stage 2  
Conveyance  
Options  
Assessment

# Options Life Cycle Costs

## Cost Model

Option	Options Description	Initial Capital Cost	Future Capital costs	30-Year Net Present Value				50-Year Net Present Value			
				Capital	Asset Renewal	O&M	Total	Capital	Asset Renewal	O&M	Total
1	Cut&Cover	\$ 54.7	\$ -	\$ 54.7	\$ 6.3	\$ 16.5	\$ 77.5	\$ 54.7	\$ 12.0	\$ 30.5	\$ 97.2
2	Trenchless	\$ 51.0	\$ -	\$ 51.0	\$ 3.9	\$ 12.6	\$ 67.6	\$ 51.0	\$ 7.5	\$ 23.1	\$ 81.6
3	Trenchless - Phased	\$ 35.9	\$ 17.5	\$ 51.9	\$ 4.0	\$ 12.7	\$ 68.6	\$ 51.9	\$ 7.6	\$ 23.3	\$ 82.7



Thank you!

*wsp.com*

wsp

## Map

