Comox Valley REGIONAL DISTRICT

Agenda

Notice of meeting of the

SEWER EXTENSION SOUTH LIQUID WASTE MANAGEMENT PLAN ADDENDUM JOINT TECHNICAL AND PUBLIC ADVISORY COMMITTTEES (TACPAC)

Wednesday, November 23, 2022
CVRD Civic Room, 770 Harmston Ave and Zoom
9:00am – 2:00pm

Join Zoom Meeting
https://us02web.zoom.us/j/89056057127?pwd=WVZGSXN0L29wQVNGZSs2elJBT2s1dz09
Meeting ID: 890 5605 7127
Passcode: 762039
1 778 907 2071 Canada

Item, Time	Description	Owner
2.1 9:00 – 9:05	Call to Order and Territorial Acknowledgement	Facilitator
2.2 9:05 – 9:15	Welcome and Introductions	CVRD
2.3 9:15 – 9:25	Meeting #1: Meeting minutes, follow up items	Facilitator
2.4 9:25 – 9:35	Recap: Project overview, purpose and objectives	CVRD/Facilitator
2.5 9:35 – 10:15	CVRD updates • Septic system records (Island Health) • Septic system regulatory options • Value planning workshop	CVRD/ Island Health
2.6 10:15 – 10:30	Break	
2.7 10:30 – 11:00	Discussion paper #1: Forcemain design, costs, phasing considerations	WSP
2.8 11:00 – 11:20	Committee process: Forcemain alignment, project phasing	Facilitator
2.9 11:20 – 11:50	Discussion Paper #2: Collection system options, cost comparison	WSP
2.10 11:50 – 12:10	Committee process: Collection system options	Facilitator
2.11 12:10 – 12:40	Lunch	
2.12 12:40 – 1:10	Discussion Paper #3: Pump station design options, cost comparison	CVRD
2.13 1:10 – 1:30	Committee process: Pump station design options	Facilitator
2.14 1:30 – 1:45	Meeting #3 Preview	Facilitator
2.15 1:45 – 2:00	Roundtable	Facilitator
2.16 2:00	Adjournment	Facilitator

Comox Valley REGIONAL DISTRICT

Minutes

Minutes of the meeting of the Sewer Extension South (SES) Liquid Waste Management Plan (LWMP) Addendum Joint Technical and Public Advisory Committee (TACPAC) held on September 21, 2022 in the CVRD Civic Room at 770 Harmston Avenue, Courtenay, and via Zoom conference commencing at 12:30 pm

PRESENT:

A. Habkirk, Chair & Facilitator	Facilitator
M. Rutten, General Manager of Engineering Services	CVRD
D. Monteith, Manager of Liquid Waste Planning	CVRD
V. Van Tongeren, Environmental Analyst	CVRD
C. Wile, Senior Manager of Strategic Initiatives	CVRD
A. Mullaly, General Manager of Planning and Development Services	CVRD
T. Trieu, Manager of Planning Services	CVRD
M. Briggs, Branch Assistant – Engineering Services	CVRD
M. Simhon	Associated Engineering
I. Snyman	WSP
M. Levin	WSP
C. Peters	WSP
C. Davidson, City of Courtenay	TAC
C. Marshall, City of Courtenay	TAC
S. Ashfield, Town of Comox	TAC
M. Kamenz, Town of Comox	TAC
G. Kosmider, Fisheries and Oceans Canada	TAC
N. Clements, Island Health	TAC
E. Derby, Island Health	TAC
M. Mamoser, Ministry of Environment and Climate Change Strategy	TAC
L. Johnson, Ministry of Health	TAC
I. Munro, Electoral Area A Alternate Director	PAC
M. Hewson, Association for Denman Island Marine Stewards	PAC
N. Prins, BC Shellfish Growers Association	PAC
M. Cowen, BC Shellfish Growers Association	PAC
C. Pierzchalski, Comox Valley Conservation Partnership	PAC
A. Gower, Comox Valley Chamber of Commerce	PAC
I. Heselgrave, School District No.71	PAC
M. Atkins, Underwater Harvesters Association	PAC
N. Prince, Craigdarroch Resident Representative	PAC
R. Steinke, Craigdarroch Resident Representative	PAC
T. Donkers, Royston Resident Representative	PAC
K. Newman, Royston Resident Representative	PAC
J. Elliott, Union Bay Resident Representative	PAC
R. Lymburner, Union Bay Resident Representative	PAC

Item	Description	Owner
1.1	**Call to Order and Territorial Acknowledgement** The meeting was called to order at 12:30 pm. A. Habkirk acknowledged that the committee is meeting on and the Sewer Extension South Project will be constructed and operated on the unceded traditional territory of the K'ómoks First Nation (K'ómoks).	**A. Habkirk**
1.2	**Welcome** D. Monteith welcomed the committee members to the CVRD office and first TACPAC meeting.	**D. Monteith**
1.3	**Introductions** The committee members introduced themselves to the committee. A. Habkirk introduced the topics to be discussed this meeting and set the goals for the day.	**A. Habkirk**
1.4	**Discussion Paper #1: LWMP objectives and purpose** I. Snyman explained the common acronyms for the project, as well as detailed WSP's involvement in the project and previous experience with LWMPs. Explained the objectives and purpose of the LWMP process. LWMP is a three-stage process for managing liquid waste. Stage 1 identifies existing conditions and community goals, and develops a wide range of options for managing liquid waste. Stage 2 involves a detailed evaluation of shortlisted options and selection of preferred option. Stage 3 includes further development of the selected option and final submittal of plan to the Ministry of Environment and Climate Change Strategy (MoE) for approval. LWMP is set up with three committees: the Steering Committee, Public Advisory Committee (PAC), and Technical Advisory Committee (TAC). The SES LWMP Addendum's steering committee is the Electoral Areas Service Committee (EASC). The PAC represents community and stakeholder interests. The TAC provides input on regulatory and technical requirements. Q: Is the Stage 1 and 2 LWMP currently completed, or just at Stage 1? A: The Comox Valley Sewer Service (CVSS) LWMP is being completed as a combined Stage 1 and 2 plan. The draft plan is currently out for review and approval before being submitted to Ministry of Environment and Climate Change Strategy (MoECCS). The SES LWMP will be added as an addendum to the Stage 2 and 3 CVSS LWMP. An update was provided on the CVSS LWMP status. The CVSS TACPAC looked at various options for pump stations, conveyance, treatment and resource recovery, and developed a short list of options before deciding upon a preferred solution for each. The Stage 1 and 2 LWMP is currently being reviewed by Kómoks and the CVSS	**I. Snyman**

	TACPAC. Stage 3 will follow after MoECCS review of the Stage 1 and 2 plan. An overview was provided for why the SES LWMP addendum is needed. In August 2022, the CVRD Board approved the expansion of the CVSS service boundary to include a portion of Electoral Area A and K'ómoks First Nation lands due to the need to protect Baynes Sound and support reconciliation. Sewer Extension South project development work will follow the LWMP process and be submitted as addendum to CVSS Stage 1 and 2 LWMP. Both processes will then move forward together with development of a combined Stage 3 LWMP. Some items are already included in CVSS LWMP so not required for the addendum, such as reclaimed water, combined overflows, wastewater treatment, stormwater management, and integrated resource recovery. A brief overview was given of what will be discussed at each meeting. Q: Has the identification of alternatives to the SES been excluded due to the LWMP being an addendum or are alternatives being considered? A: CVRD went through a previous LWMP process that identified long-listed and short-listed options. Will be building off previous work completed, focusing on the concept of a regional sewerage service, but will look at options for phasing, collection, etc. Q: Will this become an extension of the existing service rather than separate service in respect to taxes and user fees? A: Yes and no. The south region will be included in the regional service, but there will also be individual service areas for local collection works, with residents paying into both the local collection system service and regional service. Q: What is an example of a service area? A: Catchment areas will be shown in presentation, but roughly follow major neighbourhood boundaries.	
1.5	**Public Consultation – SES LWMP Addendum** C. Wile gave an overview of public consultation for the SES LWMP Addendum. CVRD follows the International Association of Public Participation's engagement spectrum to identify the level of involvement with the public. Focused on informing the community on next steps and project status, consulting residents for feedback on options and working with First Nations, and collaboration with stakeholders and partners. K'omoks First Nation is project partner. Province identifies roughly a dozen First Nations with land or marine territory in Royston, Union	**C. Wile**

	Bay, and Baynes Sound. CVRD has reached out about interest in project and how they'd like to be engaged. Public engagement will occur in four phases. Phase 1 is project initiation; phase 2 is phasing, collection system, and pump stations; phase 3 is development of draft addendum; and phase 4 is review/approval.	
1.6	**Discussion Paper #2: Summary of past work** M. Simhon gave an overview of previous work done for the 2014-2015 South Region Stage 1 and 2 LWMP, including Associated Engineering's involvement in the process. Previous work dates as far back as the 1970s, but focus will be on Associated Engineering's work done from 2014-2016. Identified legislation relevant to the LWMP process, including the Municipal Wastewater Regulation, Vancouver Island Phophorus In-Stream Objective, and Wastewater Systems Effluent Regulation. Noted that an Environmental Impact Study is done separate from the LWMP. The Stage 1 and 2 study was not completed. The South Region LWMP work included First Nation consultation, three open houses, and five meetings of a combined TACPAC. Associated Engineering worked with the South Region TACPAC to develop raw elements of what's important to the members, screened options, developed them into more comprehensive scenarios, and then compared the options. Nine discharge options were developed, and then reviewed during TACAC Meeting #3 to identify obstacles, concerns, and benefits. Narrowed down to four: discharge to Baynes Sound, discharge to Strait of Georgia, treatment in south region and discharge to Lazo outfall, and discharge to sub-surface ground. Connection to existing CVSS system initially eliminated since it involved forcemain across estuary. Discharge to Trent River/Washer Creek, discharge to ground (both single and multiple locations, and management and improvement of existing on-site systems were ruled out. Evaluations compared environmental, economic (capital costs and life cycle costs), and social (truck traffic for sludge) factors, as well as risks (items that did not fit other categories but could impact preferred solution). Developed multi-criteria approach to quantify options and apply a scenario score. First looked at results of environmental, economic, and social factors without risk, with the options ranked from highest to lowest as Baynes Sound, ground discharge, Cape Lazo, and Strait of Georgia. The TACPAC decided to remove the social aspect and add risk, with the options now ranked from highest to lowest as Cape Lazo, Baynes Sound, and Strait of Georgia. Cape Lazo had lowest risk due to less regulatory requirements due to existing outfall system,	**M. Simhon & D. Monteith**

	as well as lower risk to shellfish and other unknown factors. Cape Lazo put forth as preferred option. LWMP process paused as referendum was held in 2016 on preferred option. The referendum failed and staff then looked to collaborate with the Sewage Commission. Q: How many trucks per day were expected to be leaving the treatment facility? Comox Valley Water Pollution Control Centre (CVWPCC) likely only 1-2 trucks per day. A: TACPAC felt looking at social factors wasn't worth considering, so did not investigate in depth. 5-6 trucks mentioned only as an example; actual number not certain. Q: What other social factors were considered besides truck traffic? A: At the time, only truck traffic was considered. D. Monteith gave an update on what has changed since the 2016 referendum. Environmental issues in south region still not resolved. Sewage Commission supported request to investigate impacts of extending service to Electoral Area A in 2018. Sewage Commission agreed to accept wastewater from Electoral Area A in 2020. Initial grant in 2020 was not successful, but CVRD submitted second grant in 2022 with K'ómoks as partner. Identified the various reasons for why a sewer service is needed, including Baynes Sound water quality, aging septic system (70% over 25 years old), high density of homes (some areas similar to municipalities), poor soil conditions, environmental impacts, proposed growth in areas (Union Bay as designated settlement area), to support community services, and to support reconciliation with K'ómoks. Provided background information on the CVRD-K'ómoks Community Benefit Agreement. Commits both parties to work together to implement sewer services south. Provided background information on the CVSS. Treats wastewater from Courtenay, Comox, K'ómoks IR#1, and Department of National Defence at the CVWPCC, and discharges to Cape Lazo. Benefits to connecting to existing system includes improving efficiencies (no need for independent treatment plant), shared costs, reduced regulatory requirements, protecting Baynes Sound by using existing outfall, and providing access to high quality treatment. CVSS already meets regulatory requirements, has secondary treatment and will add UV treatment, and has operators available 24/7. Septic systems require regular maintenance and discharges to ground. Poorly maintained systems may pose environmental and health risk, and older systems predate provincial regulations. Replacement may cost as much as	

	$15,000-$50,000+ depending on conditions of lot. CVRD looking at additional regulatory tools for addressing septic issues. Gave an overview of the project, including a rough map of the potential service areas and forcemains. Q: Where does the current forcemain go? A: To West Courtenay. Q: Why was the 2020 grant unsuccessful? A: There was a lot of competition for a small amount of money. Other projects likely scored higher. Q: What is the anticipated chance of success for the 2022 grant? A: Currently uncertain, but have been communicating regularly with the Province and other agencies. Comment: Costs were primary reason for failed referendum and should be kept down. Existing residents shouldn't be paying for new system designed for 2060 that will service new areas. Should be cost offset, especially if Union Bay Estates (UBE) does not provide expandable treatment system as part of Master Development Agreement (MDA). Staff have heard similar concerns from residents and are taking them into consideration. Costs will be reviewed at later meeting. Comment: Important to show what costs will be if we don't have sewer. Q: What happens if we don't get grant? A: Project will be expensive, so senior government funding will be important however, LWMP is needed regardless of current grant and developing plan will prove key to any future grant opportunities. Q: How much is grant request and what percent will be covered? A: $27 million. Unsure what overall percentage will be until costs determined. Project partners will also provide contributions. Q: Why step away from referendum? A: Staff identified many benefits to LWMP process over referendum. Gives opportunity to take in public feedback and consultation and involve them in the process. Q: Has there been investigative work into reusing water? A: CVSS LWMP looked at options for water reuse. Q: Any more work done on looking at separate community treatment facilities?	

	A: Significant benefit to not develop standalone treatment, including reduced costs. Proposal to develop separate treatment plant failed at referendum. Q: What proportion of waterfront properties on Baynes Sound included? A: Unsure of percentage, but properties shown in orange on map included. Discussion on phasing covered later in process. Q: Any discussion of extending to Fanny Bay? A: Not at the moment. Union Bay may cover the maximum extent that the wastewater can be pumped without causing additional technical or operational issues. Q: Has UBE confirmed partnership on the project? A: The MDA commits them to providing sewer amenities to the community. Q: UBE already has lots up for sale. Will they have septic systems? A: Work being done by UBE is anticipatory. MDA still requires lots to be connected to sewer system. Q: Would tertiary treatment improve the options of what can be done with the wastewater? A: Will discuss later in meeting when discussing CVSS LWMP. Q: For newly developed areas with good septic systems, how does the LWMP anticipate including areas that are currently excluded? A: Will be determined by land-use policies, zoning and public/environmental health considerations. It's inefficient to service larger rural lots.	
1.7	**Break** The committee took a 15-minute break at 2:15pm.	
1.8	**Discussion Paper #3: South wastewater flows and loads, treatment objectives, Comox Valley Sewer Service LWMP** I. Snyman provided background on the south region sewer extension proposal. Wastewater will be conveyed by a series of pump stations into CVSS, starting in Union Bay. Issue with onsite septic systems needs to be addressed and shouldn't keep being deferred. WSP looked at high, medium, low growth scenarios over 50 years (2020-2070). Provided an overview of the proposed catchment areas based on topography, slopes and other factors. Explained the various flows that are considered such as average dry weather flow, peak dry weather flow, inflow and infiltration (I&I), and	**I. Snyman**

peak wet weather flow. The CVSS does not have a combined stormwater and wastewater system, but infiltration may occur.

Q: Is stormwater included in the process?
A: Not included and will not have combined storm/sanitary system.

Q: Is there a formal stormwater system?
A: Rural areas rely on road ditching and drainage on individual properties.

Q: Do we have varying I&I numbers for age of the system? I&I rates seem high for brand new system.
A: Being conservative since there isn't any data available yet.

Gave conservative estimates of various flows for proposed catchment areas for 2025 and 2070.

Q: Has pipe sizing and flows been considered for staging of different service areas and the cost implications? Would we be required to use a smaller pipe if only servicing part of the area or can we install a larger pipe in anticipation of higher flows when phasing is completed?
A: Can only pump a certain amount of head with raw sewage, and the longer the pipe the greater the loss of head. 0.75 m/s flow required to keep solids and liquids together. Need to make sure velocity is high enough to ensure this, but not too high or will experience loss of head. Slower flows may also lead to increased odours. Will need to phase to accommodate.

Q: Estimated I&I flows for 2025 and 2070 seem similar. Has climate change been accounted for in estimates?
A: Wastewater system is meant to be separate from stormwater system, so ideally weather events should have minimal impact on sewer system. Impacts from climate change will only occur due to infiltration.

Secondary process is based on organic load, quantified based on five-day biochemical oxygen demand (BOD), total suspected solids (TSS), total kjeldahl nitrogen (TKN).

CVSS LWMP looked at average contribution of BOD by measuring it every day for a year and using those values to predict future values. Used similar calculations to estimate projections for south region.

CVSS LWMP included flow estimates for south region. Updated population projections are slightly higher, but minimal impact on system. <11% difference in 2040 and <1.2% difference for whole system.

Wastewater treatment, TSS and CBOD5 averages 5-15mg/L, which shows that the CVWPCC is operating very efficiently.

CVSS LWMP looked at treatment options. Stage 1 included high-level discussion of four options, and Stage 2 involved a high-level option assessment. Recommended maintaining current level of treatment with addition of UV treatment. SES flows and loads do not impact recommendation. UV treatment is physical process with no byproduct and effective at killing pathogens.

CVSS TACPAC thoroughly investigated UV treatment and considered it a strong recommendation. CVWPCC is currently conventional activated sludge plant. Cost of tertiary treatment considered high for small improvement so TACPAC felt existing secondary treatment was sufficient with potential for future tertiary treatment if needed.

Q: Are pharmaceuticals and microplastics currently measured at the CVWPCC?
A: Not at the moment, and is not currently being looked into by staff.

Noted that tertiary treatment and phosphorus removal typically used in inland treatment due to discharging to freshwater. Less of a concern for marine discharge.

Q: Plant in Edmonton met requirements but was warned that regulatory requirements may change in 10 years. Will we account for potential increased treatment requirements?
A: CVWPCC is currently working efficiently and there is space to expand if improved treatment is needed.

Q: Requested clarification on bypassing the plant. Current plant exceeds flow limits on permit, so can it accept south flows?
A: Everything will go through whole treatment process. Will seek revision to operational certificate if project goes forward to accommodate increased flows.

Staff are developing site master plan for CVWPCC. Looking at future plant expansion, options, placing of new infrastructure and when they will be required. Planning for 50-year horizon. Looking to maximize use of existing system and how to handle solids. Noted that treatment is outside scope of SES LWMP.

Q: Existing plant is somewhat configured to do BNR (Biological Nutrient Removal), but has there been thought to do BNR at plant?
A: BNR is biological nutrient removal process that removes nitrates and ammonia. Staff have not looked at modifying aeration basins to accommodate BNR.

Q: Has the anoxic zone been piped for return flow? Does that infrastructure exist already or does it have to be modified?
A: Unsure if currently is, but was at one point.

	Q: Is plant ready for stricter MoE regulations? A: Not aware of any upcoming changes, but have accommodated for future upgrades. Would be more of a challenge if there was limited space for expansion at the plant, which is not the case.	
1.9	**TAC/PAC Committee Process** A. Habkirk gave an overview of how the TAC and PAC will function, referencing the draft Terms of Reference (ToR). The TAC and PAC will serve as a joint committee unless otherwise needed. Decisions to be made by consensus. The TAC will focus on needs (regulatory requirements, environmental protection, engineering standards), while the PAC will focus on wants (community aspirations, capacity aesthetic, non-regulated quality, other benefits). Jointly decide on ideal project and then confront constraints (funding, timing, operational complexity, geography, geology) to determine the recommended project. TACPAC decisions will be focused on conveyance (Hwy 19A forcemain and pump stations) and collection system (type/configuration, phasing). Treatment is not included. Staff put forward the TAC and PAC ToR for adoption, and requested any recommendations or changes. Gave an overview of the code of conduct for TAC and PAC members. MOTION: Adopt the Technical Advisory Committee Terms of Reference – M. Mamoser SECONDED: E. Derby CARRIED UNANIMOUSLY MOTION: Adopt the Public Advisory Committee Terms of Reference – K. Newman SECONDED: I. Munro CARRIED UNANIMOUSLY The committee requested that the list of members be updated before adoption. Q: The ToR references electing a chair. How is that done? Is it done this meeting? A: Will leave to the committee to decide if there should be joint chair or separate for TAC or PAC. Can elect one chair for now and elect second if separate meetings required. A. Gower put forth his name as chair. Q: What is the purpose of the chair?	**A. Habkirk**

	A: The chair may be required to present to or communicate with the steering committee about the TACPAC's discussions and decisions. MOTION: To nominate A. Gower as chair of the Sewer Extension South Liquid Waste Management Plan Addendum Joint Technical and Public Advisory Committee – I. Munro SECONDED: R. Lymburner CARRIED UNANIMOUSLY	
1.10	**Preview of Meeting #2** A. Habkirk gave a summary of what will be covered at the next TACPAC meeting. Q: Union Bay residents have heard rumours of UBE proposing discharge to Washer Creek. Is this part of this project? A: This project is only considering conveyance to the CVWPCC. Q: Can the CVRD set specific wastewater quality requirements in an area after the LWMP is adopted? A: The MoECCS requires that permit applications must meet provincial regulations as well as requirements of any adopted LWMP in the affected areas. Q: How will information and agendas be shared with the committee? A: Agendas will be provided a week before each meeting, and the presentation will be shared with the committee.	**A. Habkirk**
1.11	**Round table discussion** Q: What is the expected timeline for when we can expect sewer in the south? A: Will depend on outcome of this LWMP process. Combined Stage 3 LWMP will follow. Also dependent on grant outcome. Still a few years away. Q: How long do Stage 3 LWMPs take? A: Likely a year to develop and 6-8 months to review by MoECCS. Plan must be endorsed by MoECCS. Q: Can properties opt out? A: Expensive project with small number of participants, so people opting out increases costs for everyone else. Currently not considering opting out option. Q: Is there a better map of areas included? A: Will be available for next meeting. Q: Are the boundaries set or changeable? A: Nothing is finalized and will take into consideration committee input.	**A. Habkirk**

	Q: Do we have bullet points of drivers for project, such as failing systems and growth/development? A: Environmental concerns and water quality are primary issues since this has been an ongoing issue since the 70s. Reconciliation with K'ómoks is also key priority. Comment: No one opposes protecting Baynes Sound, but this process is very much development driven, so the committee should consider that going forward. Q: During the 2015-2016 process, were there any other environmental concerns besides shellfish? A: Shellfish were considered a risk factor rather than environmental concern. Looked at greenhouse gas emission and carbon footprint of plant. Also included pharmaceuticals and other health factors. Q: Do we know the contributions of the project partners (since it will impact resident contribution)? A: Staff are still working with partners to determine contributions. More information will be shared at a future meeting during the discussion on costs.	
1.12	**Adjournment** The meeting adjourned at 4:07pm.	**A. Habkirk**

GENERAL:
The next SES LWMP Addendum Joint PACTAC meeting will be held on November 23, 2022 commencing at 9:00 am in the CVRD Civic Room at 770 Harmston Avenue, Courtenay, and via Zoom conference.

COMOX VALLEY SEWERAGE SYSTEM LIQUID WASTE MANAGEMENT PLAN, SEWER EXTENSION SOUTH ADDENDUM

PUBLIC ADVISORY COMMITTEE

Background
The communities of Royston and Union Bay rely on on-site septic systems for wastewater management; these systems are at risk of failure, causing impacts to the local environment, and posing potential public health risks. Sewer servicing proposals for these Electoral Area A communities have a long history, with studies dating back several decades. In 2015, a nearly completed stage 2 Liquid Waste Management Plan (LWMP) identified discharge of treated effluent at the existing Cape Lazo location as the leading option for management of south region liquid waste. At the time, this option consisted of building a stand-alone wastewater treatment facility in the south region, and conveying treated effluent from this facility for discharge at the Cape Lazo outfall.

After a proposal based on this option failed to find the support of the electors in 2016, extensive collaboration with the Comox Valley Sewage Commission has resulted in the current project concept whereby untreated wastewater from the south region would be conveyed into the existing Comox Valley Sewer Service (CVSS) infrastructure for treatment at the Comox Valley Water Pollution Control Centre, and discharge at the Cape Lazo outfall. Efforts continue on several fronts to advance this proposal, termed the Sewer Extension South Project.

Concurrent to these efforts, the CVSS is part way through a LWMP process with consideration to three components of the service – conveyance, treatment, and resource recovery. Following a successful AAP process last year, work is now underway to upgrade or replace a significant portion of existing CVSS conveyance infrastructure, based upon the preferred conveyance option from the LWMP process. The final Stage 1 & 2 report outlining the preferred options for conveyance, treatment and resource recovery is in development for submission to the province in summer 2022.

The CVRD is now embarking on an addendum to the CVSS LWMP to consider sewer servicing options for the south region. This addendum once complete and approved will become part of the overall LWMP for the entire CVSS service area, which will include those parts of Electoral Area A anticipated to be serviced by the Sewer Extension South project.

Role of the Committees and the PAC
While the responsibility for the management of the LWMP ultimately rests with the CVRD Board of Directors, the Steering Committee, Technical Advisory Committee (TAC) and Public Advisory Committee (PAC) will assist in this responsibility by providing input, perspective, specific expertise and recommendations. Members of these committees are expected to participate in meetings and assist with:

- Identifying goals and challenges;
- Generating and reviewing ideas to meet them; and
- Working towards consensus solutions.

To assist with communication and understanding of the process, committee members will be sent the meeting agenda packages and meeting notes for all three committees. All meetings are envisioned to be joint TAC-PAC meetings, and the CVRD may combine the two committees into one if it proves advantageous to do so.

The PAC is an advisory group whose primary role is to represent "community interests" – the people, areas and environments that are served and potentially impacted by the south addendum, and provide advice to the Steering Committee accordingly. The PAC will:

- Consider community goals as represented by major planning documents (OCP's, Sustainability Plans, etc);
- Consider public opinion and feedback related to the LWMP on behalf of the Steering Committee;
- Provide feedback on documents provided by the CVRD Project Staff and/or the Consultant;
- Have the authority to provide input and recommendations to the Steering Committee on matters pertaining to the LWMP.

Role and Responsibilities of PAC Members

The role of PAC members is to develop and maintain a broad understanding of the issues and implications for stakeholders, residents and the environment in order to make appropriate recommendations to the Steering Committee. It is also the responsibility of the PAC members to review and become familiar with the Sewer Extension South project, how it fits within the CVRD's LWMP process and the function of the CVSS itself.

Participating in the PAC is both a privilege and an obligation. Members have an important liaison role with the responsibility to represent and inform the organizations or communities they have been selected to represent. They are expected to bring their own perspectives to the table, but must be prepared to provide to, and disseminate from the committee, the full range of perspectives, including those with which they may disagree.

It is intended that recommendations to the Steering Committee will be made by consensus, though there may be some that are recorded as non-consensus. A consensus recommendation may include the identification of a specific interest or concern to be noted in the record but not as a limiting factor. A non-consensus recommendation will be made if, after adequate deliberation, the member(s) is/are still not in accord with other members. The non-consensus party must provide a written submission for the record, outlining the rationale for the non-consensus recommendation, within one week of the distribution of the draft meeting notes.

Membership

The CVRD will seek and invite representation from key public, community, business, and stewardship stakeholders with interests in the project area (see attached list of invited public, community, business, and stewardship stakeholders). The total number of representatives will be at the discretion of the CVRD. Appointment of local resident representatives will be performed by the Electoral Area Services Committee to ensure the accountability of the process. A list of representatives will be attached once committee membership is finalized.

Members will submit one alternate for approval of the whole at the first meeting or immediately to CVRD Project Staff upon resignation of the primary or alternate, with the exception of resident representatives who may provide an alternate only if one is available.

Termination of a member that is falling short of his/her obligations, not considered to be actively participating, or is not abiding by the code of conduct (below) will be at the discretion of the CVRD.

The PAC will stand for the duration of the LWMP addendum process, which is expected to be approximately one to two years. At the completion of the LWMP addendum, the Sewer Extension South Addendum PAC will be dissolved and combined with the CVSS LWMP PAC for development of the final Stage 3 CVSS LWMP. Upon completion of the CVSS LWMP, a plan monitoring committee will be struck, and some PAC members will be encouraged to stand, to ensure continuity.

PAC Representatives to the TAC
The LWMP guidelines suggest each committee elect a chairperson to administer the committee. The committee shall elect the chairperson and alternate from amongst its members at the inaugural meeting. The role of the chairperson or alternate is to represent the PAC in discussions with the TAC, the Steering Committee, the CVRD Board and Project Staff, as needed. The proposed approach to hold all meetings as combined TAC-PAC meetings is intended to work towards the LWMP guidelines objective of forming linkages between committees to maximize cooperation. From time-to-time, the chairperson or alternate may also be responsible for in responding to media requests on behalf of the PAC.

Code of Conduct
During meetings, public events, and other activities related to the LWMP project, all participants of the committee will endeavour to conduct themselves as follows:

- Support an open and inclusive process;
- Disclose any potential conflicts of interest;
- Treat others with courtesy and respect;
- Listen attentively with an aim to understand;
- Speak in terms of interests versus positions;
- Where a member is espousing a favored position or course of action, they must fully and honestly disclose the reasons for their positions;
- Be open to outcomes, not attached to outcomes;
- Focus on service provision; and
- Share and discuss ideas from a professional perspective.

Members are responsible for coming prepared to meetings and to liaise with groups or organizations to which they are accountable or have a fiduciary responsibility.

Members are responsible for attending all meetings. If an occasion arises in which members are unable to participate in person, their appointed alternate should attend on their behalf.

Communications with the General Public
PAC members may find themselves from time liaising with the general public, and must do so in accordance with the code of conduct outlined above.

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Resources
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Honorarium
In acknowledgement of the volunteer nature of many of the representatives on the PAC, and to encourage participation through to the end of the process, committee members will be entitled to claim an honorarium of $125 per PAC meeting. Committee members will be required to submit a claim in writing or via email to receive the honorarium.

Member List

Organization	Representative	Alternate
Electoral Area A (Baynes Sound - Denman/Hornby Islands)	Daniel Arbour	Ian Munro
Association for Denman Island Marine Stewards	Melanie Hewson	Theresa Clinton
BC Shellfish Growers Association	Nico Prins	Malcolm Cowan
Comox Valley Chamber of Commerce	Andrew Gower	
Comox Valley Conservation Partnership	Caitlin Pierzchalski	Jennifer Sutherst
School District 71	Ian Heselgrave	
Underwater Harvesters Association	Mike Atkins	

Resident Members - Location	Name
Craigdarroch	Norm Prince
Craigdarroch	Rosanne Steinke
Royston	Tabitha Donkers
Royston	Ken Newman
Union Bay	Jim Elliott
Union Bay	Ryan Lymburner

COMOX VALLEY SEWERAGE SYSTEM LIQUID WASTE MANAGEMENT PLAN, SEWER EXTENSION SOUTH ADDENDUM

TECHNICAL ADVISORY COMMITTEE

Background

The communities of Royston and Union Bay rely on on-site septic systems for wastewater management; these systems are at risk of failure, causing impacts to the local environment, and posing potential public health risks. Sewer servicing proposals for these Electoral Area A communities have a long history, with studies dating back several decades. In 2015, a nearly completed stage 2 Liquid Waste Management Plan (LWMP) identified discharge of treated effluent at the existing Cape Lazo as the leading option for management of south region liquid waste. At the time, this option consisted of building a stand-alone wastewater treatment facility in the south region, and conveying treated effluent from this facility for discharge at the Cape Lazo outfall.

After a proposal based on this option failed to find the support of the electors in 2016, extensive collaboration with the Comox Valley Sewage Commission has resulted in the current project concept whereby untreated wastewater from the south region would be conveyed into existing Comox Valley Sewer Service (CVSS) infrastructure for treatment at the Comox Valley Water Pollution Control Centre, and discharge at the Cape Lazo outfall. Efforts continue on several fronts to advance this proposal, termed the Sewer Extension South Project.

Concurrent to these efforts, the CVSS is part way through a LWMP process with consideration to three components of the service – conveyance, treatment, and resource recovery. Following a successful AAP process last year, work is now underway to upgrade or replace a significant portion of existing CVSS conveyance infrastructure, based upon the preferred conveyance option from the LWMP process. The final Stage 1 & 2 report outlining the preferred options for conveyance, treatment and resource recovery is in development for submission to the province in summer 2022.

The CVRD is now embarking on an addendum to the CVSS LWMP to consider sewer servicing options for the south region. This addendum once complete and approved will become part of the overall LWMP for the entire CVSS service area, which will include those parts of Electoral Area A anticipated to be serviced by the Sewer Extension South project.

Role of the Committees and the TAC

While the responsibility for the management of the LWMP ultimately rests with the CVRD Board of Directors, the Steering Committee, Technical Advisory Committee (TAC) and Public Advisory Committee (PAC) will assist in this responsibility by providing input, perspective, specific expertise and recommendations. Members of these committees are expected to participate in meetings and assist with:

- Identifying goals and challenges;
- Generating and reviewing ideas to meet them; and
- Working towards consensus solutions.

To assist with communication and understanding of the process, committee members will be sent the meeting agenda packages and meeting notes for all three committees. All meetings are envisioned to be joint TAC-PAC meetings, and the CVRD may combine the two committees into one if it proves advantageous to do so.

The TAC is an advisory group who will consider technical information related to the south region LWMP amendment on behalf of the Steering Committee. It is the responsibility of the TAC to review and become familiar with the Sewer Extension South project and how it fits within the CVRD's LWMP process. The TAC will also provide input and feedback on relevant technical reports, discussion papers and other documents provided by CVRD Project Staff and the Consultant.

Role and Responsibilities of TAC Members

The role of TAC members is to develop and maintain a broad understanding of the issues and implications for stakeholders, residents and the environment in order to make appropriate recommendations to the Steering Committee. It is also the responsibility of the TAC members to review and become familiar with the Sewer Extension South project, how it fits within the CVRD's LWMP process and the function of the CVSS itself.

Participating in the TAC is both a privilege and an obligation. Members have an important liaison role with the responsibility to represent and inform the organizations or communities they have been selected to represent. They are expected to bring their own perspectives to the table, but must be prepared to provide to, and disseminate from the committee, the full range of perspectives, including those with which they may disagree.

It is intended that recommendations to the Steering Committee will be made by consensus, though there may be some that are recorded as non-consensus. A consensus recommendation may include the identification of a specific interest or concern to be noted in the record but not as a limiting factor. A non-consensus recommendation will be made if, after adequate deliberation, the member(s) is/are still not in accord with other members. The non-consensus party must provide a written submission for the record, outlining the rationale for the non-consensus recommendation, within one week of the distribution of the draft meeting notes.

Membership

The CVRD will seek and invite representation from key stakeholder agencies and organizations with interests or jurisdiction in the project area (see attached list of invited public, community, business, and stewardship stakeholders). The total number of representatives will be at the discretion of the CVRD. The appointments will be based on agency and organizational representation and will not be personal appointments. A list of representatives will be attached once committee membership is finalized.

Members will submit one alternate for approval of the whole at the first meeting or immediately to CVRD Project Staff upon resignation of the primary or alternate.

Termination of a member that is falling short of his/her obligations, not considered to be actively participating, or is not abiding by the code of conduct (below) will be at the discretion of the CVRD.

The TAC will stand for the duration of the LWMP addendum process at minimum. At the completion of the LWMP addendum, follow up activities may be required, the Sewer Extension South Addendum TAC will be dissolved and combined with the CVSS LWMP TAC for development of the final Stage 3 CVSS LWMP. Upon completion of the CVSS LWMP, a plan monitoring committee will be struck and some members may be asked to stand, to ensure continuity.

TAC Representative to the PAC

The LWMP guidelines suggest each committee elect a chairperson to administer the committee. The committee shall elect the chairperson and alternate from amongst its members at the inaugural meeting. The role of the chairperson or alternate is to represent the TAC in discussions with the PAC, the Steering Committee, the CVRD Board and Project Staff, as needed. The proposed approach to hold all meetings as combined TAC-PAC meetings is intended to work towards the LWMP guidelines objective of forming linkages between committees to maximize cooperation. From time-to-time, the chairperson or alternate may also be responsible for in responding to media requests on behalf of the TAC.

Code of Conduct

During meetings, public events, and other activities related to the LWMP project, all participants of the committee will endeavour to conduct themselves as follows:

- Support an open and inclusive process;
- Disclose any potential conflicts of interest;
- Treat others with courtesy and respect;
- Listen attentively with an aim to understand;
- Speak in terms of interests versus positions;
- Where a member is espousing a favored position or course of action, they must fully and honestly disclose the reasons for their positions;
- Be open to outcomes, not attached to outcomes;
- Focus on service provision; and
- Share and discuss ideas from a professional perspective.

Members are responsible for coming prepared to meetings and to liaise with groups or organizations to which they are accountable or have a fiduciary responsibility.

Members are responsible for attending all meetings. If an occasion arises in which members are unable to participate in person, their appointed alternate should attend on their behalf.

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Member List

Organization	Representative	Alternate
City of Courtenay	Chris Davidson Chris Marshall	
Town of Comox	Jordan Wall Shelley Ashfield Marvin Kamenz	
Fisheries and Oceans Canada	Gabrielle Kosmider	
Island Health	Nancy Clements	Ella Derby
Ministry of Agriculture and Food	Thom O'Dell	
Ministry of Environment and Climate Change Strategy	Melanie Mamoser	
Ministry of Health	Lindsay Johnson	Dave Fishwick

SEPTIC SYSTEM REGULATORY OPTIONS
November 23, 2022

After the 2016 South Sewer Project referendum, the Comox Valley Regional District (CVRD) investigated options for an enhanced regional district role in septic systems management. Out of this research, the CVRD septic systems education program was established in the fall of 2018. The program, modelled after programs in other BC regional districts, includes a dedicated webpage, supported by education workshops, occasional social media outreach and sharing of resources from industry associations.

In 2020, WSP completed a study (link) for the CVRD identifying options for a regional district regulatory program for septic systems. This study drew upon a 2016 study completed for the BC Ministry of Health, applying it to the CVRD context, and including program cost estimates. Beyond the homeowner education program already in place, additional septic management program options identified in the study include the following:

- Mandatory Pump-Out
- Mandatory Inspection
- Mandatory Inspection and Maintenance

Table No. 1 below includes a summary of these three program types, including their benefits and drawbacks.

Table No. 1: Septic Management Program Options

Program Type	Description	Advantages	Disadvantages
Mandatory Pump-Out Program	A program requiring septic system pump-outs at a set interval (i.e. 5 years)	• Familiar, due to similarities with Capital Regional District's Onsite Wastewater Management Program • Lower cost than inspection-based programs	• Requires administrative capacity to track pump-out records • "One size fits all" approach may not be appropriate for all systems or household use patterns (i.e. two-person household vs larger family or addition of carriage home), and may result in public pushback • Can create perception that systems are being maintained, even though pump-outs are only one component of proper septic care and maintenance

Mandatory Inspection Program	Each septic system participating in the program is inspected by an Authorized Person, and the homeowner is provided with a maintenance plan	• Flexible, inspection based approach provides homeowners with information tailored to the needs of their system • Can develop an inventory of onsite systems, and thus help improve understanding of cumulative impacts • Can have measurable impact through identification of system maintenance requirements	• Requires administrative and technical capacity to coordinate and conduct inspections • May be considered intrusive by some homeowners • Requires a mechanism to enforce inspections • Does not include enforcement capacity for required maintenance
Mandatory Inspection and Maintenance Program	Similar to the Mandatory Inspection Program, with the addition of an enforcement component to ensure maintenance plan is followed by homeowner	• Inspection-based approach identifies required maintenance and enforcement ensures maintenance is completed • Can have measurable impact through identification of systems that require maintenance and follow up to ensure maintenance is completed • Can develop an inventory of onsite systems, and thus help improve understanding of cumulative impacts	• Requires administrative, technical and enforcement capacity to coordinate and conduct inspections, and confirm required maintenance is completed • High level of intrusiveness may not be popular with some homeowners

The study also included a preliminary screening of septic system failure risk in CVRD electoral areas, based partially on a 2008 GIS analysis of geomorphological factors contributing to poor septic system performance, as well as an assessment of residential dwelling density and potable water sources. This screening identified seven areas at an elevated risk of septic system failures; both Royston and Union Bay are on this list.

Mandatory maintenance program cost estimates provided in the WSP report ranged from $1.1-1.8 million per year, assuming program implementation across all three CVRD electoral areas. For program implementation across all seven identified high risk areas, annual program costs would range from $330,000 to $580,000. These cost estimates assume the CVRD would be collecting taxation to pay for and arrange pump-outs and/or inspections. Program taxation impacts would be reduced if responsibility for pump-out and/or inspection costs were left to individual property owners; however, overall costs to individual property owners would likely be the same or higher. An additional consideration regarding costs to homeowners will arise in instances where inspections identify issues, resulting in significant costs for repair or replacement of their septic systems. Dependent on the type of septic system required, replacement costs can range from $15,000 to over $50,000.

Program effectiveness is another consideration identified in the WSP study, as no program option will solve issues related to improperly installed or sited septic systems, particularly in areas with poor ground conditions, steep slopes, high winter water table or urban levels of dwelling density. This is also reflected in the 2015 Associated Engineering memo "Feasibility of Continuing to Use Private Septic Systems as Primary Wastewater Strategy" (link) that was referenced during the previous TACPAC meeting, and the rejection of this option during the 2014-2015 South Region LWMP process.

There is only one example of a regional district septic regulatory program in BC—the Capital Regional District's program requires property owners in Saanich, Langford, Colwood and View Royal with Type 1 systems to have their septic tanks pumped every five years; those with Type 2 or 3 systems are required to maintain their systems annually in accordance with their maintenance plan.

The CVRD is in regular contact with staff at Island Health and the Ministry of Health to explore the implementation of a mandatory maintenance program in the CVRD's electoral areas. Further information on program implementation options will be presented for consideration by the CVRD Electoral Areas Services Committee in early 2023.

COMOX VALLEY REGIONAL DISTRICT
REPORT NUMBER: 18P-00276-00

DISCUSSION PAPER 1: CONVEYANCE PIPING DESIGN AND PROJECT PHASING

CONFIDENTIAL

NOVEMBER 23, 2022

wsp

1 BACKGROUND

The Comox Valley Regional District (CVRD) operates and maintains the sewerage system for the Comox Valley Sewer Service (CVSS) which provides service to the City of Courtenay and the Town of Comox, and to the K'ómoks First Nation and Department of National Defence (under contracts with each).

The South Region of the CVRD, also known as Electoral Area 'A', is located south of the City of Courtenay. The area does not have a centralized sewage collection system, and privately owned onsite septic systems are utilized for wastewater management. These systems are reported to have a history of failures, with the potential to impact the surrounding environment and public health. In 2022 the CVSS service area boundary was expanded to include portions of Electoral Area 'A', including Royston, Union Bay and K'ómoks First Nation (KFN) lands. Consideration is now being given to the extension of sewage infrastructure south through an addendum to the Stage 1/2 CVSS Liquid Waste Management Plan.

The proposed design involves the collection of sewage from neighborhoods in the Royston and Union Bay area through collection systems to eight pump stations. It will then be pumped to the existing Courtenay River Siphon and conveyed to CVSS treatment works. The servicing of these areas is proposed to be completed in phases given the high cost of servicing these areas. The discussion paper will outline the following:

- Design constraints
- Proposed project phasing and process flow diagrams
- Forcemain design
- Forcemain Class "C" cost estimate

The forcemain design development will focus on the forcemain for Phase 1A as shown in **Figure 1** below.

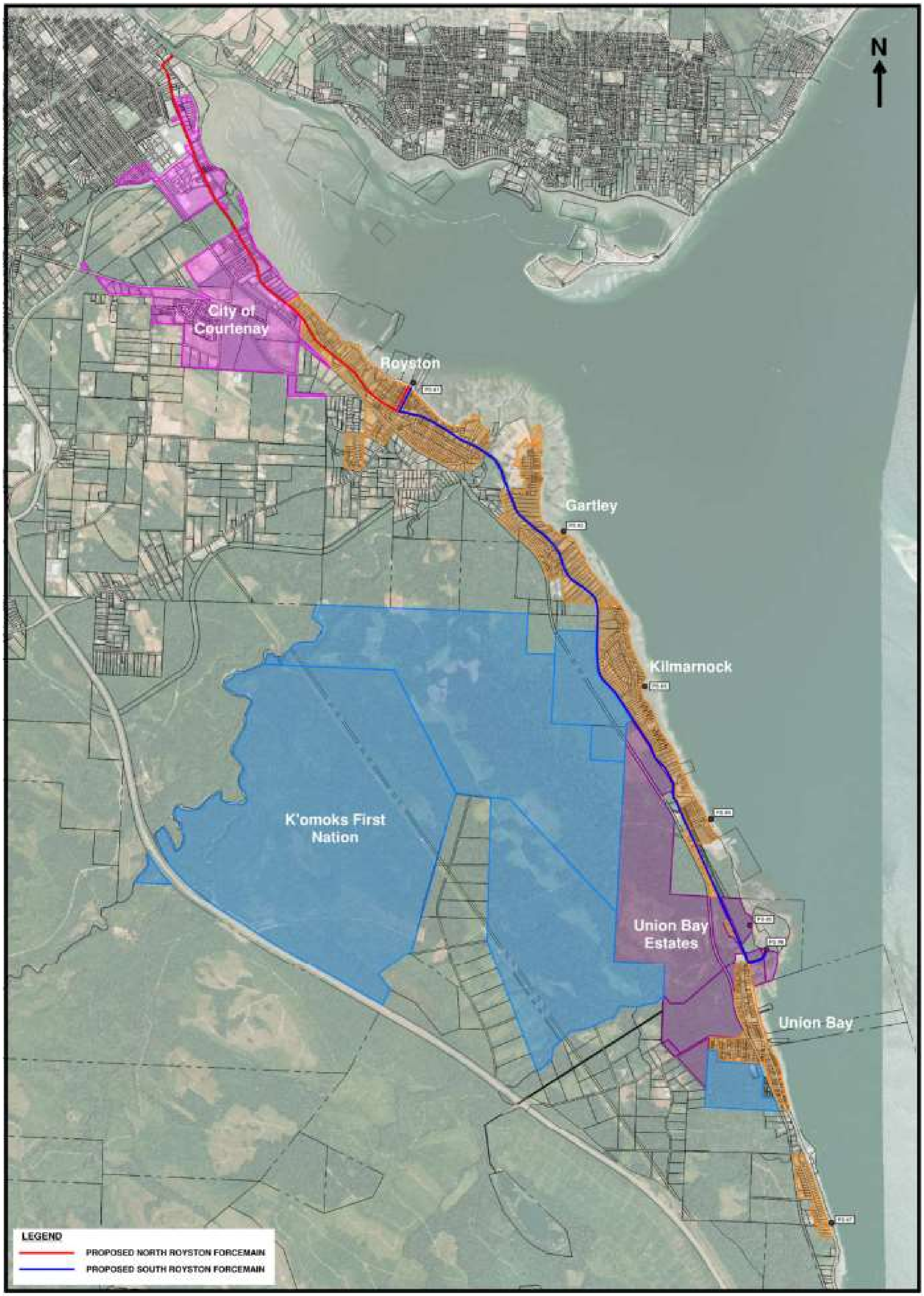


Figure 1: Forcemain Alignment

1.1 POPULATION PROJECTIONS

The population growth projections of the existing and future developments are summarised in **Table 1** below. The populations are shown in 5-year increments from 2020 to 2070.

Table 1: Population Projections

POPULATION	ROYSTON	GARTLEY	KILMARNOCK	UNION BAY	FUTURE NEW DEVELOPMENTS	TOTAL
2025	1,011	381	608	839	258	**3,098**
2030	1,037	391	623	861	1,548	**4,460**
2035	1,063	401	639	882	2,488	**5,473**
2040	1,090	411	655	905	3,428	**6,489**
2045	1,117	421	672	928	6,258	**9,396**
2050	1,146	432	689	951	9,088	**12,305**
2055	1,175	443	706	975	9,488	**12,787**
2060	1,204	454	724	1,000	9,888	**13,270**
2065	1,235	465	742	1,025	10,288	**13,755**
2070	1,266	477	761	1,051	10,688	**14,243**

The following assumptions were used to develop the population projections:

- The number of dwellings in the existing developed areas was obtained from the 2017 CVRD South Regional Sewer Service Map.
- A residential density of 2.1 persons/property from the 2016 Census for the CVRD for Area ‘A’ was used for determining the base population.
- A medium growth scenario was assumed for the existing developed areas and K’ómoks First Nation.
- Union Bay Estates future development population was assumed to be consistent with McElhanney’s Kensington Union Bay Estates Sanitary Master Plan (2019).

The total catchment areas, comprised of existing and future new development areas, for each of the seven pump stations are outlined in **Table 2**. The catchment areas are shown in **Figure 2**.

Table 2: Pump Station Contributing Areas

	AREA (HA)
Pump Station No. 1 (PS#1) (1)	133
Pump Station No. 2 (PS#2)	81
Pump Station No. 3 (PS#3)	145
Pump Station No. 4 (PS#4)	169
Pump Station No. 5 (PS#5)	206
Pump Station No. 6 (PS#6)	163
Pump Station No. 7 (PS#7)	15
Total	**912**

(1) Under future phasing, an eighth pump station will be constructed. Pump Station No. 1 will be transitioned to pump local flows from the Pump Station No. 1 Catchment to the new Regional Pump Station collecting flows from all upstream catchments No. 1 through No. 7. Refer to Discussion Paper No.1 for more details.

The following assumptions were used in establishing the pump station contributing areas:

- The areas are the assumed contributing areas for 2070 flow.
- The contributing areas have been allocated to the pump stations due to proximity to pump station and phasing.

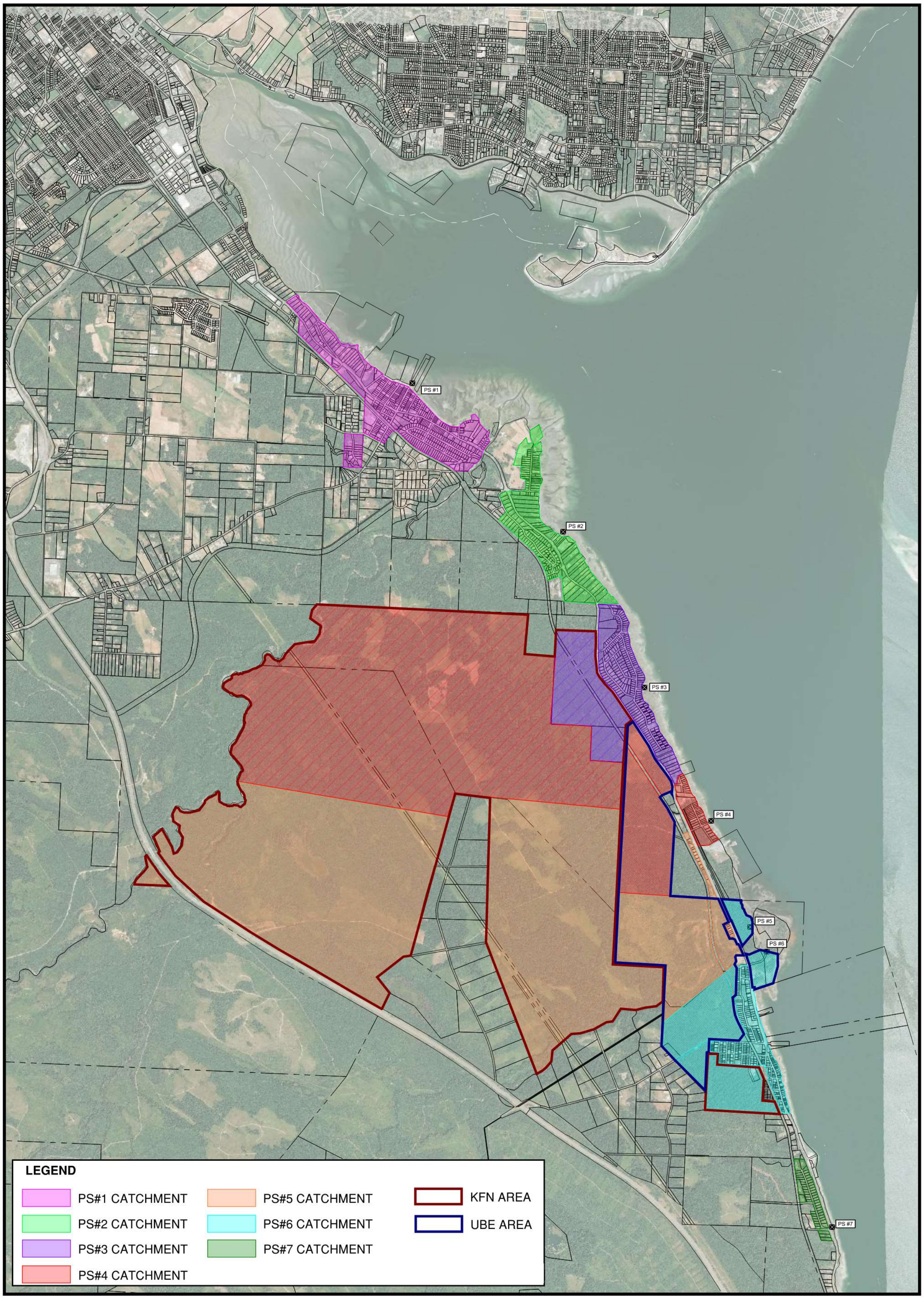


Figure 2: Pump Station Catchment Areas

1.2 WASTEWATER FLOWS

The flow projections for the Peak Wet Weather Flow (PWWF) in 2025 and 2070 of each pump station contributing area are summarised in **Table 3** below.

Table 3: Contribution Flow Rates

	2025 FLOW CONTRIBUTION (L/S)	2070 FLOW CONTRIBUTION (L/S)
PS#1	17.0	19.2
PS#2	8.2	9.1
PS#3	15.5	71.4
PS#4	8.3	35.8
PS#5	10.1	45.6
PS#6	14.6	46.4
PS#7	1.8	2.1

Table 4 summarises the contributing Average Dry Weather Flow (ADWF) and Peak Wet Weather Flow (PWWF) for the projected populations in 2025 and 2070 for each pump station catchment.

Table 4: Pump Station Catchment Population, Area and Flow

		PS#1 Catchment	PS#2 Catchment	PS#3 Catchment	PS#4 Catchment	PS#5 Catchment	PS#6 Catchment	PS#7 Catchment
2025	Population	1011	381	547	155	120	776	108
	Area (ha)	133	81	72	115	151	128	15
	Peaking Factor	3.2	3.2	-	-	-	-	3.2
	ADWF (L/s)	2.8	1.1	3.5	0.4	0.3	2.2	0.3
	PDWF (L/s)	9.0	3.4	11.2	1.4	1.1	6.9	1.0
	I&I (L/s)	8.0	4.9	4.3	6.9	9.1	7.7	0.9
	PWWF (L/s)	17.0	8.2	15.5	8.3	10.1	14.6	1.8
2070	Population	1266	477	2943	3111	4085	3615	135
	Area (ha)	133	81	145	169	206	163	15
	Peaking Factor	3.2	3.2	-	-	-	-	3.2
	ADWF (L/s)	3.5	1.3	20.9	8.6	11.3	11.8	0.4
	PDWF (L/s)	11.3	4.2	62.7	25.6	33.3	36.6	1.2
	I&I (L/s)	8.0	4.9	8.7	10.2	12.3	9.8	0.9
	PWWF (L/s)	19.2	9.1	71.4	35.8	45.6	46.4	2.1

The following assumptions were used in the calculation of the flows:

- 240 L/cap/day was used as specified in the 2014 MMCD Design Guidelines for ADWF.
- The peaking factor was calculated using the formula from the 2014 MMCD Design Guidelines of $PF = 3.2/P^{0.105}$, where P is the population in thousands rounded to the nearest thousand.
- The inflow and infiltration (I&I) rate for all existing and proposed developments is 0.06 L/s/ha as specified in the 2014 MMCD Design Guidelines.
- The PWWF was calculated using the formula for design flow from the 2014 MMCD Design Guidelines, where the design flow, Q = population x per capita flow x peaking factor + I&I contribution.

1.3 DESIGN CONSTRAINTS

WSP developed concepts for an overall system configuration that could accommodate the wide range of flows anticipated between the system initiation and the ultimate build-out projections. The following subsections outline the design considerations and engineering principles accounted for during the development of the system configuration.

1.3.1 MINIMUM FLUSHING VELOCITY

The forcemains should be designed to achieve a minimum velocity to reduce the settlement of solids and subsequently reduce the accumulation of solids within the pipe by ensuring remobilization during every pump cycle. The flow within the pipe should achieve the 0.75 m/s (Master Municipal Construction Document (MMCD) Design Guidelines 2014) to ensure flushing velocities. If this velocity is not achieved, solids can accumulate along the bottom of the pipe and eventually reduce the pipe's capacity.

Further to the flow in the pipe not reaching flushing velocities, limited flow in the pipe would create anaerobic conditions due to raw sewage stagnation within the pipe. This will create odour and gas formation concerns with the buildup of H_2S gasses in the pipe as well as in the pump stations. Both accumulation of solids and H_2S gas can lead to operational issues including equipment corrosion, odour nuisance, and increased operations and maintenance costs.

Table 5 outlines the flow required to achieve the minimum flushing velocity for a range of pipe sizes.

Table 5: Required Flows to Achieve 0.75 m/s Flushing Velocity with DR17 HDPE Pipes

PIPE SIZE (NOMINAL, MM)	PIPE SIZE (ID, MM)	MINIMUM FLOW TO ACHIEVE 0.75 M/S FLUSHING VELOCITY (L/S)
200	192	21.7
250	239	33.7
300	283	47.3

1.3.2 WET WELL SIZING

To mitigate low flows and velocities in pipes sized for future build-out conditions, incoming flows could be contained in the pump station wet well until sufficient volume has accumulated to facilitate pumping at the required higher flow rate required to meet flushing velocity criteria. However, this approach has several implications, including:

— The wet well would initially be oversized relative to the volume of the incoming flow;
— The residence time in the wet well is greater, leading to odour problems requiring robust odour control systems such as aeration and Granular Activated Carbon (GAC) filters at both the upstream and downstream pump stations;
— Pumps are initially oversized relative to the incoming flows, resulting in larger pump motors that have higher installed instantaneous energy demand; and
— Anaerobic conditions within the forcemain due to infrequent pumping.

1.3.3 SYSTEM REFINEMENT, OPTIMIZATION & PHASING

The preferred approach to mitigating low flows is to refine the system configuration and forcemain sizing through development of an overall phased implementation strategy that considers the level of development at the initial stage as well as the ultimate build out scenario. It is challenging to implement one system that is suitable for both the initial level of development and the anticipated future development without additions or upgrades to the system when there is a wide range of anticipated flows.

1.3.4 PUMP CAPABILITY

The preferred pump used by the CVRD's operational staff are Flygt submersible pumps. In general, wastewater pumps need to be of a centrifugal type that can handle solids and abrasive grit in the wastewater. These requirements will be considered in the design.

1.3.5 TRANSIENT PRESSURES

Transient pressure is the changes in the flow in the forcemains, caused by valve closure and opening or pump speed changes, resulting in pressure surges which propagate along the pipe from the source. For the South Region Royston Union Bay sewer extension, the high pressures are attributed to the long forcemain lengths, velocity and flow variance over the long planning horizon between 2025 and 2070.

There are a number of risks associated with high pressure including pipe material, equipment selection, operating practices and upset conditions. The pressures are typically mitigated through the following measures:

- Pipe material such as HDPE;
- Specification levels of valves, air/vacuum breaks, fittings and specials at the pump station;
- VFDs on the pumps; and
- Dampened check valves.

At higher than typical operating pressures, the risk related to the transient pressure increases and requires management. The management of transient pressure will be implemented at the detailed design stage, once the parameters are sufficiently clarified to conduct a transient pressure study.

2 PROCESS FLOW DIAGRAMS

The Process Flow Diagram (PFD) is used as an illustration to show the relationship between the major components of the CVRD South Region conveyance system.

1 Phase 1A (Short term)
2 Phase 1B (Medium term)
3 Future phase (Long term)
4 Ultimate build out phase

The scope of this work focuses primarily on Phase 1A and 1B. The Future phase and Ultimate Build Out phase will vary according to the master planning and the availability of funding for future phasing. The level of uncertainty at this stage of the project creates challenges in determining the flows and the sequencing of the phasing due to the various stakeholders and partners that CVRD is engaged with.

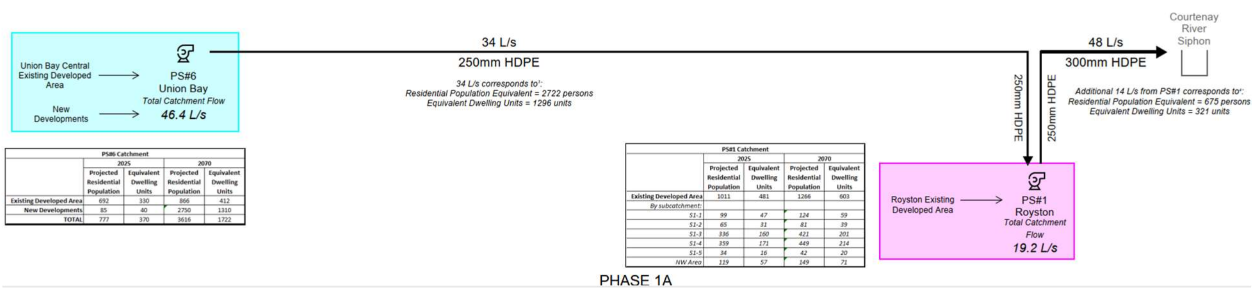
The following subsections outline the design considerations and engineering principles accounted for during the development of the system phasing and PFDs.

2.1.1 PHASE 1A

The PFD for Phase 1A is shown in **Figure 3** below. Phase 1A includes two pump stations, PS#1 and PS#6 and two forcemains. The contributing sub catchments for PS#1 and PS#6 include:

— PS#1: Royston existing developed area
— PS#6: Union Bay central existing developed area, and future new development areas

To satisfy the design considerations outlined in Section 3.1, a 250 mm HDPE forcemain will convey 34 L/s from PS#6 to PS#1 to maintain the minimum flushing velocity as discussed in Section 1.3.1. This flow corresponds to a population equivalent of 2722 persons and an equivalent dwelling unit number of 1296 dwellings.48 L/s will be conveyed from PS#1 to the Courtenay River Siphon through a 250 mm HDPE between PS#1 and Highway 19A, and then increasing to a 300 mm HDPE forcemain from the highway to the Courtenay River siphon.



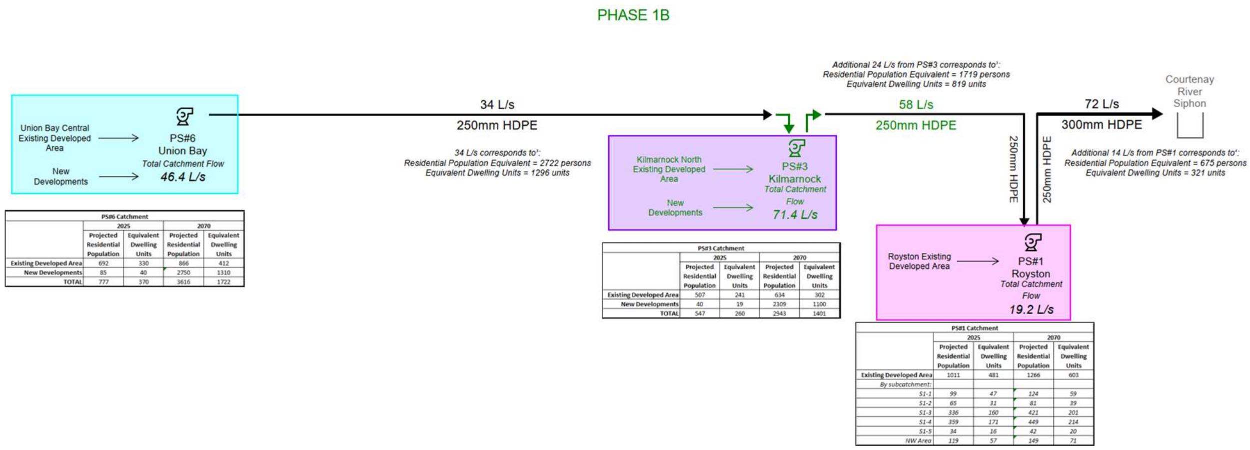
PS#6 Catchment	2025		2070	
	Projected Residential Population	Equivalent Dwelling Units	Projected Residential Population	Equivalent Dwelling Units
Existing Developed Area	692	330	866	412
New Developments	85	40	2750	1310
TOTAL	777	370	3616	1722

PS#1 Catchment	2025		2070	
	Projected Residential Population	Equivalent Dwelling Units	Projected Residential Population	Equivalent Dwelling Units
Existing Developed Area	1011	481	1266	603
By subcatchment:				
S1-1	*99*	*47*	*124*	*59*
S1-2	*65*	*31*	*81*	*39*
S1-3	*336*	*160*	*421*	*201*
S1-4	*359*	*171*	*449*	*214*
S1-5	*34*	*16*	*42*	*20*
NW Area	*119*	*57*	*149*	*71*

Figure 3: PFD – Phase 1A

2.1.2 PHASE 1B

The PFD for Phase 1B is shown in **Figure 4** below. This phase includes the addition of PS#3 located between PS#6 and PS#1. The contributing sub catchments for PS#3 include the Kilmarnock North existing developed area and future new developments. There is uncertainty about when the new developments will be constructed. This phase accommodates the flow of the new developments that will be constructed within PS#3's catchment area. As in Phase 1A, the collection flow from PS#6 is 34 L/s to maintain the minimum flushing velocity as outlined in Section 1.3.1. This flow is conveyed to PS#3 through the 250 mm HDPE forcemain. From PS#3, 58 L/s is conveyed to PS#1 through the 250 mm HDPE forcemain. The additional 24 L/s from PS#3 corresponds to a population equivalent of 1719 persons and equivalent dwellings of 819 units. The configuration downstream of PS#1 is the same as Phase 1A, 72 L/s will be conveyed through this section in Phase 1B.



PS#6 Catchment	2025		2070	
	Projected Residential Population	Equivalent Dwelling Units	Projected Residential Population	Equivalent Dwelling Units
Existing Developed Area	692	330	866	412
New Developments	85	40	2750	1310
TOTAL	777	370	3616	1722

PS#3 Catchment	2025		2070	
	Projected Residential Population	Equivalent Dwelling Units	Projected Residential Population	Equivalent Dwelling Units
Existing Developed Area	507	241	634	302
New Developments	40	19	2309	1100
TOTAL	547	260	2943	1401

PS#1 Catchment	2025		2070	
	Projected Residential Population	Equivalent Dwelling Units	Projected Residential Population	Equivalent Dwelling Units
Existing Developed Area	1011	481	1266	603
By subcatchment:				
S1-1	*99*	*47*	*124*	*59*
S1-2	*65*	*31*	*81*	*39*
S1-3	*336*	*160*	*421*	*201*
S1-4	*359*	*171*	*449*	*214*
S1-5	*34*	*16*	*42*	*20*
NW Area	*119*	*57*	*149*	*71*

Figure 4: PFD - Phase 1B

2.1.3 FUTURE PHASE

The PFD for the Future Phase is shown in **Figure 5** below. The phase includes the addition of the Future Regional Pump Station in Royston between PS#3 and Courtenay River Siphon. PS#3 will feed directly to the Future Regional Pump Station, and the existing 250 mm HDPE forcemain from PS#1 to Highway 19A will instead connect to the Future Regional Pump Station. The 300 mm forcemain from the Future Regional Pump Station to the siphon will convey 80 L/s. This phase accommodates the expected increase in flows from new developments and PS#1.

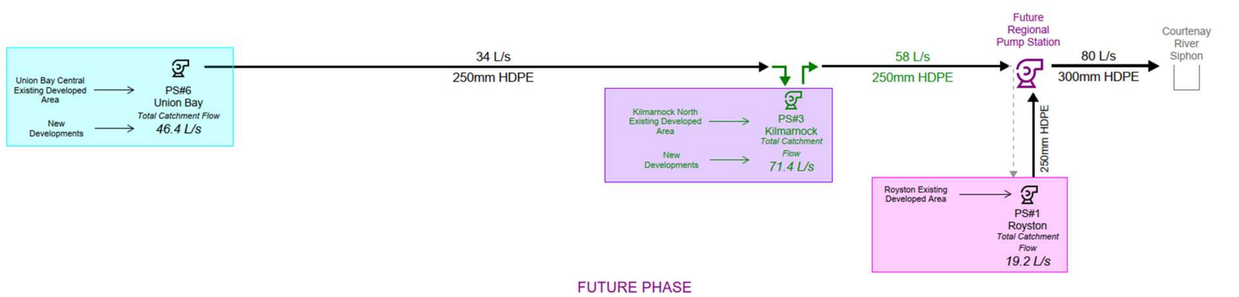


Figure 5: PFD - Future Phase

2.1.4 ULTIMATE BUILD OUT

The PFD for the Ultimate Build Out is shown in **Figure 6** below. In the Ultimate Build Out, all eight pump stations are in operation.

PS#7 has a catchment flow of 2 L/s which is pumped to PS#6, which is in operation from Phase 1A. The forcemain from PS#6 to PS#3 conveys 49 L/s in the ultimate build out.

PS#5 has a catchment flow of 46 L/s from the Union Bay North existing developed area and future new developments; this flow is conveyed to PS#4. PS#4 has a catchment flow of 36 L/s from the Kilmarnock South existing developed area and future new developments. The total flow from PS#4, 81 L/s, is conveyed through an additional forcemain to PS#3 which is in operation from Phase 1B.

A second forcemain from PS#3 conveys a flow of 143 L/s to the Future Regional Pump Station in addition to the 250 mm forcemain conveying 58 L/s from Phase 1B. PS#2, which collects flow (9 L/s) from the Gartley existing developed area, is conveyed to PS#1. A total of 28 L/s is then conveyed from PS#1 to the Future Regional Pump Station. Provision for an additional 75 L/s conveyed to the Future Regional Pump Station from South Courtenay has also been included.

In addition to the forcemain conveying 80 L/s from the Future Regional Pump Station to Courtenay River Siphon from the Future Phase, a second forcemain will convey the remaining 149 L/s (224 L/s if South Courtenay contribution is included) to the siphon.

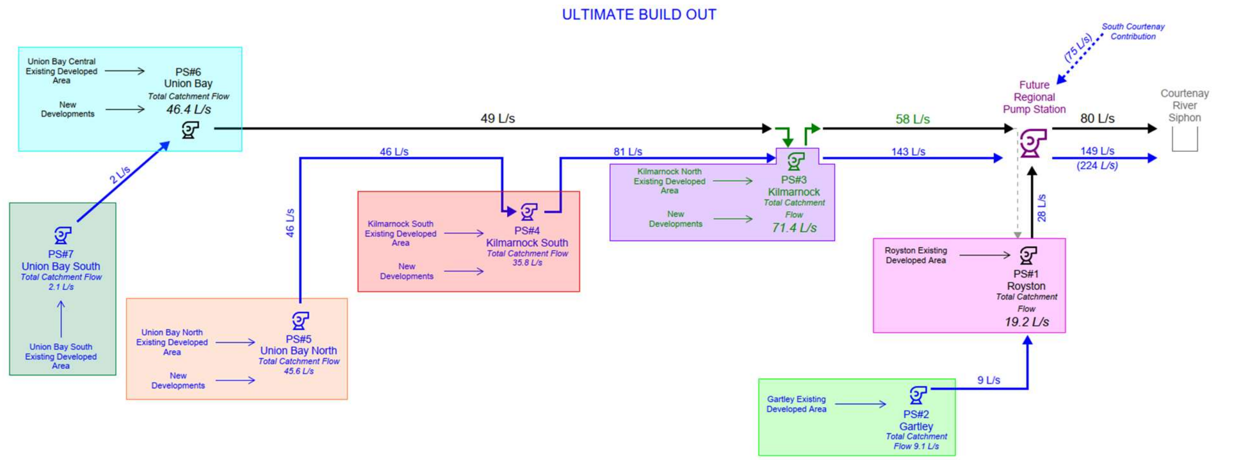


Figure 6: PFD - Ultimate Build Out

2.2 CATCHMENT SELECTION

As discussed in Section 1.3, the initial phase of the project involves the construction of PS#1 and PS#6. PS#1 will service the existing area of Royston. The catchment area for PS#6 includes the existing development of Union Bay central and future developments of K'ómoks First Nation and Union Bay Estates.

The catchment for PS#1 is shown in **Figure 7** below. The catchment area was selected based on proximity to the proposed pump station and discussions with the CVRD. Discussion Paper #2 provides further information on the Royston sub-catchment that is proposed for servicing in the initial phase of the project.

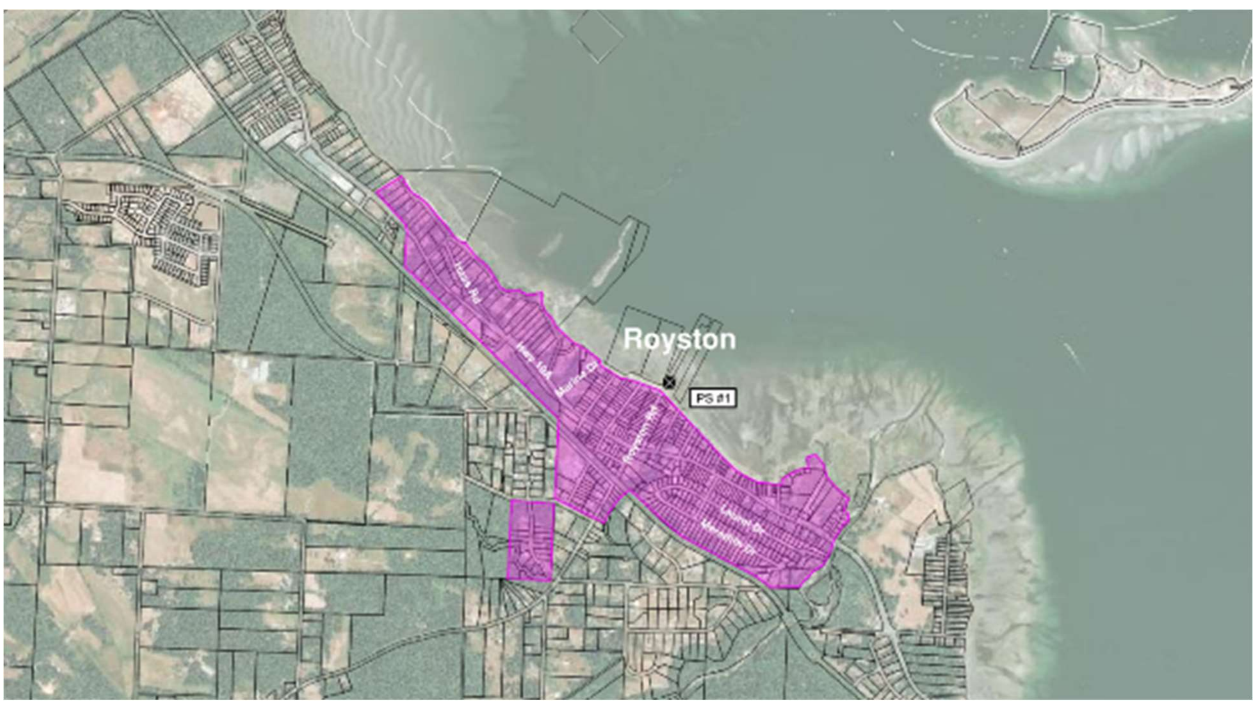


Figure 7: PS#1 Catchment

The catchment for PS#6 is shown in **Figure 8** below. The catchment area was selected based on proximity to PS#6 and discussions with the CVRD. The selection of the contributing area for the Union Bay Estates future development was based on the phasing provided in the Kensington Union Bay Estates Sanitary Master Plan (2019). The areas located in close proximity to PS#5 and PS#6 are part of Union Bay Estates proposed Phase 1 and as such are expected to be developed within the next 10 years. The remaining Union Bay Estates area included in the catchment is in the Master Plan Phase 2 and as such are expected to be developed in the next 20 years. K'omoks First Nation lands south of McLeod Road are also included in the catchment due to proximity to the proposed PS#6.

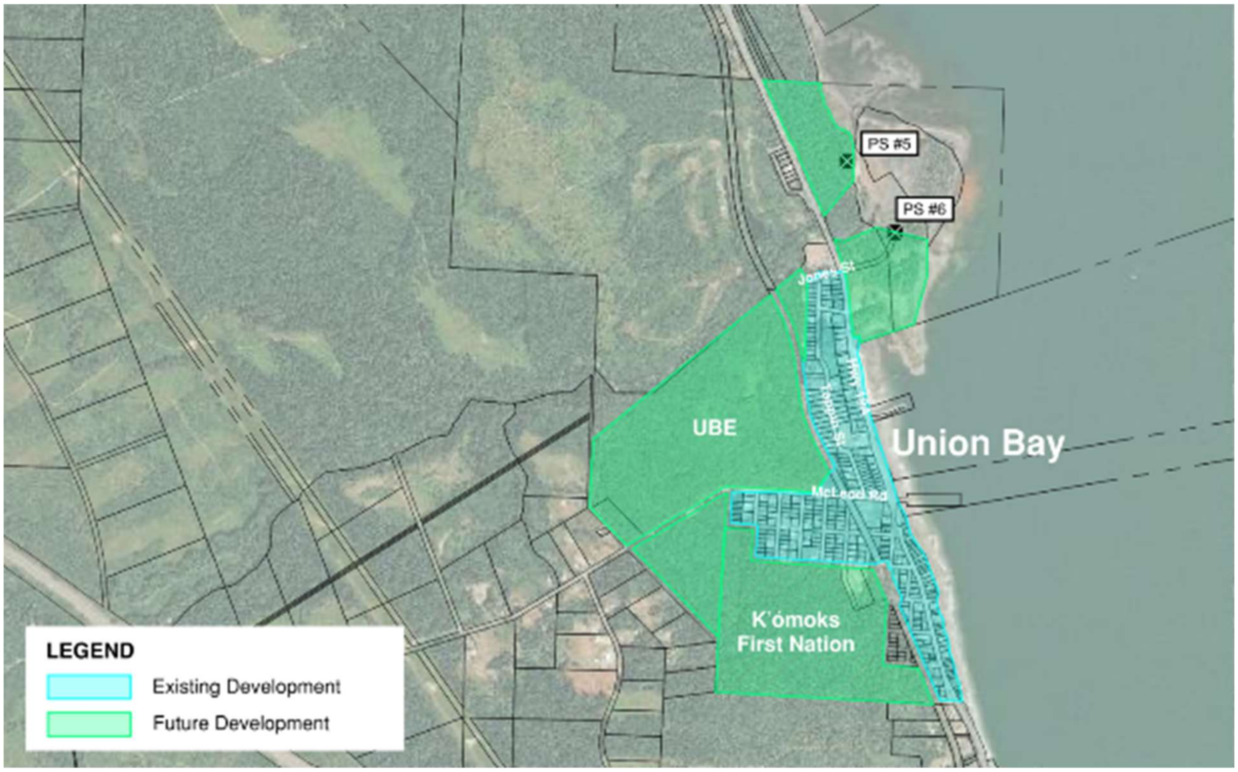


Figure 8: PS#6 Catchment

2.3 PHASING CONSIDERATIONS

As discussed in Section 1.3, due to the scale and uncertainty of the project, the project will need to be phased. The four main stages are listed below:

1. Phase 1A (Short term)
2. Phase 1B (Medium term)
3. Future phase (Long term)
4. Ultimate build out phase

These phases were selected based on technical, environmental and financial considerations. The technical considerations have been discussed in Section 1.2 design constraints. These constraints determined the overall system configuration including pump station sizing, location and forcemain sizing. Environmental considerations included future flood risk along the shore due to predicted changes in climate. The phasing was updated to add a Regional Pump Station out of the flood risk area to remove this risk of flooding. Additional considerations for phasing were provided by the CVRD, taking into account existing land use patterns and analysis of septic system records provided by Island Health. Phase 1A areas were identified as they have the highest dwelling density with a significant proportion of properties with septic system that are several decades old.

3 HIGHWAY 19A FORCEMAIN DESIGN DEVELOPMENT

The Highway 19A forcemain consists of two proposed forcemains, North Royston Forcemain and South Royston Forcemain. They are routed along Highway 19A to connect proposed PS#6 at Union Bay to the existing Courtenay River Siphon in Courtenay via proposed PS#1 at Royston. The siphon discharges into the existing Courtenay Pump Station for pumping to the CVWPCC. It is assumed that the proposed forcemains will be constructed within the BC Ministry of Transportation and Infrastructure (MOTI) road right of way and therefore no private property acquisition is required.

As the alignment is along a provincial secondary highway, MOTI approvals will be required. The pipe material for the forcemains is HDPE DR17. The proposed pipe depth varies along the length of the forcemains but generally follows the ground profile with a minimum cover of 1m as required by MMCD (2014). The pipe bedding and fill will follow MMCD “Utility Trench” Standard Detail Drawing.

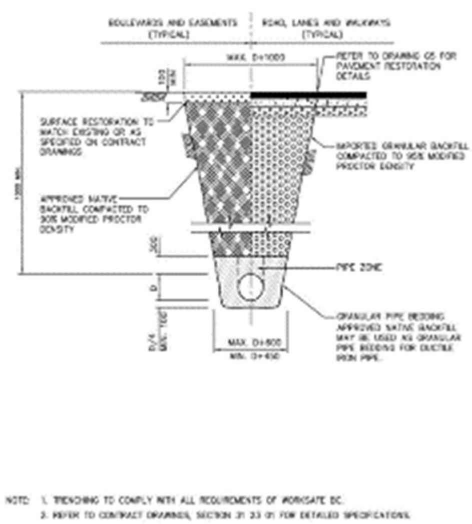


Figure 9: Trench Detail (MMCD, 2009)

The forcemain alignments outlined in the following sections were selected using information from the City of Courtenay, available survey at Royston, BC One Call information and CVRD GIS data, including land parcels and utilities (watermains, FortisBC, BC Hydro, Telus and Shaw).

3.1 NORTH ROYSTON FORCEMAIN

3.1.1 ALIGNMENT

The North Royston forcemain conveys flow from PS#1 to the existing Courtenay River Siphon at 20th Street as shown in **Figure 10**. The proposed forcemain has two different diameters along the route. The initial 275 m of the forcemain from PS#1 on Royston Road to Highway 19A will be a 250 mm HDPE pipe. For the remaining 5.125 km to the siphon, the pipe increases to a 300 mm HPDE forcemain in anticipation of future flows in future phases. The forcemain ties into an existing sanitary manhole upstream of the Siphon on 20th Street. The installation method of the pipe is proposed to be open cut.

The alignment along the highway begins at Royston Road which is rural highway. From Anfield Road to the siphon at 20th Street, the alignment will be in the urban roadway. The alignment has been selected to maintain minimum clearances to existing utilities and minimize conflicts as well as minimising traffic impacts. The utilities identified along the alignment include buried watermains and gas mains as well as overhead communication and hydro lines and poles. A minimum horizontal clearance of 3m to the existing watermains is provided along the route to comply with MMCD (2014) utility clearance requirements. A minimum horizontal clearance of 3 m has been provided for hydro poles and gas mains.

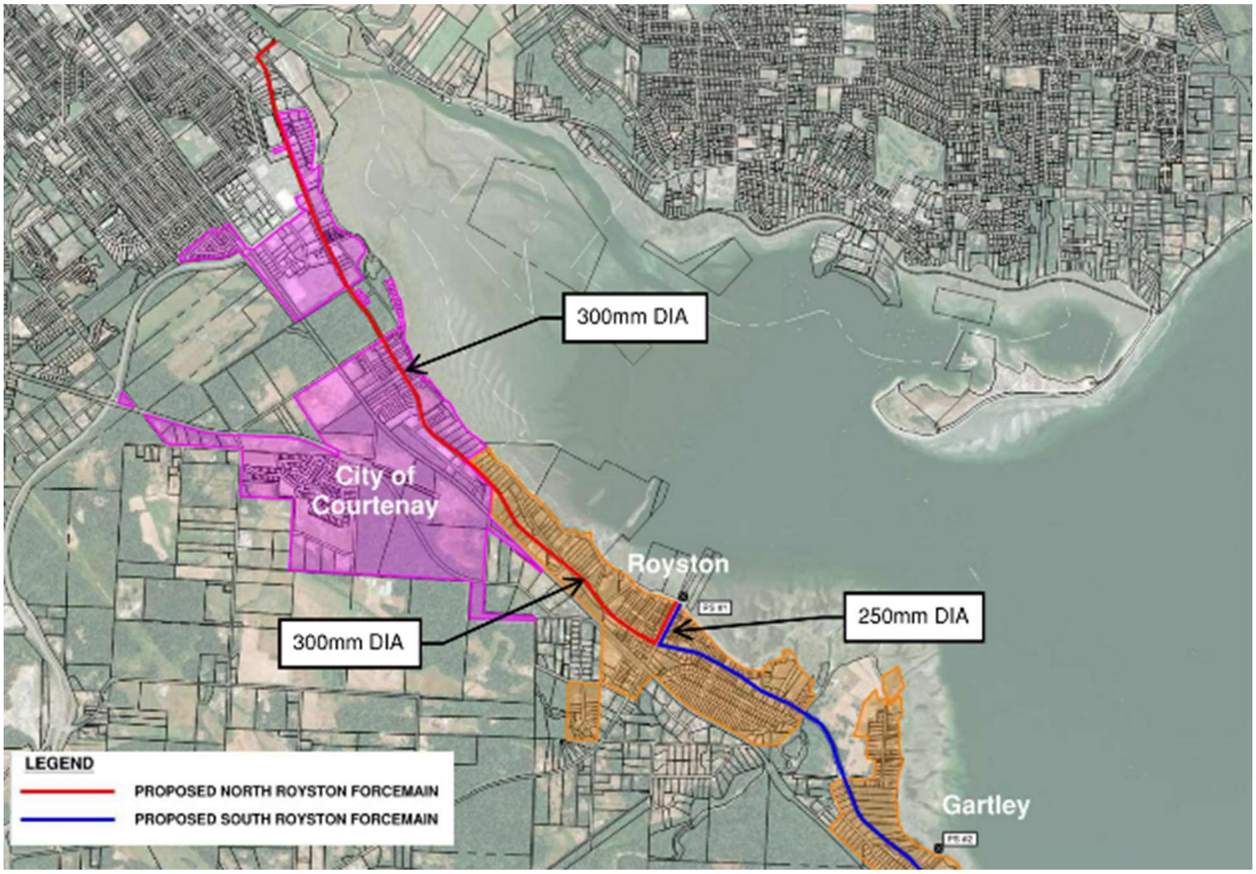


Figure 10: North Royston Forcemain Alignment

3.1.2 ALTERNATIVE ALIGNMENT IN CITY OF COURTENAY

An alternative alignment for the forcemain in Courtenay was identified in WSP's February 2020 memo *"CVRD LWMP – South Region Forcemain Cost Estimate".* The forcemain would be routed along the Courtenay Riverway Walk from Mansfield Drive to 20th Street. This alignment would reduce traffic impacts that would be experienced if the forcemain was routed through Cliffe Avenue.

This option was reviewed and found the walkway has several existing utilities including a 450mm storm sewer, 350mm twin sanitary sewers and a Telus conduit at locations along the route. This option was eliminated due to the congested utility corridor being unable to accommodate the proposed forcemain and the future twin forcemain required for future conditions, while complying with minimum clearance requirements.

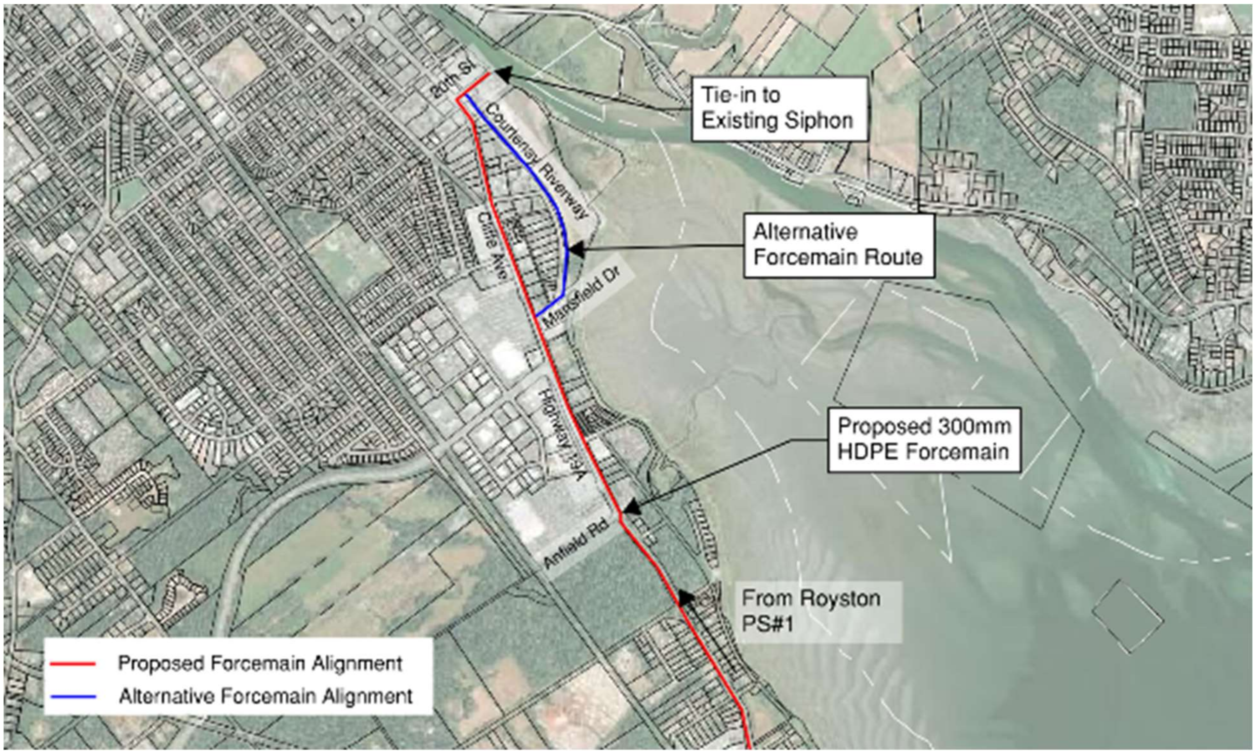


Figure 11: Alternative Forcemain Alignment

3.2 SOUTH ROYSTON FORCEMAIN

3.2.1 ALIGNMENT

The proposed forcemain from PS#6 to PS#1 is a 250mm HDPE pipe. The forcemain begins at PS#6 at Jones St, Union Bay and conveys flow along Highway 19A to PS#1 on Royston Road. The proposed length of the forcemain is 8.6 km.

The proposed alignment is located on the boulevard from PS#6 to PS#1. The forcemain is proposed to be on the shoulder of the west bound lane. The alignment has been selected to maintain minimum clearances to existing utilities and minimize conflicts. The utilities identified along the alignment include, watermains, gas mains and hydro poles. A minimum clearance of 3m to the existing watermains is provided along the route. A minimum clearance of 3 m has been provided for hydro poles and gas mains.

There are two river crossings on this section: the Trent River south of Royston, and Hart Creek, north of Union Bay. These crossing, 40m and 20m in length respectively, are proposed to be completed using horizontal directional drilling (HDD), with a pipe bridge under consideration for the Trent River crossing. The remaining forcemain will be installed using open cut methods.

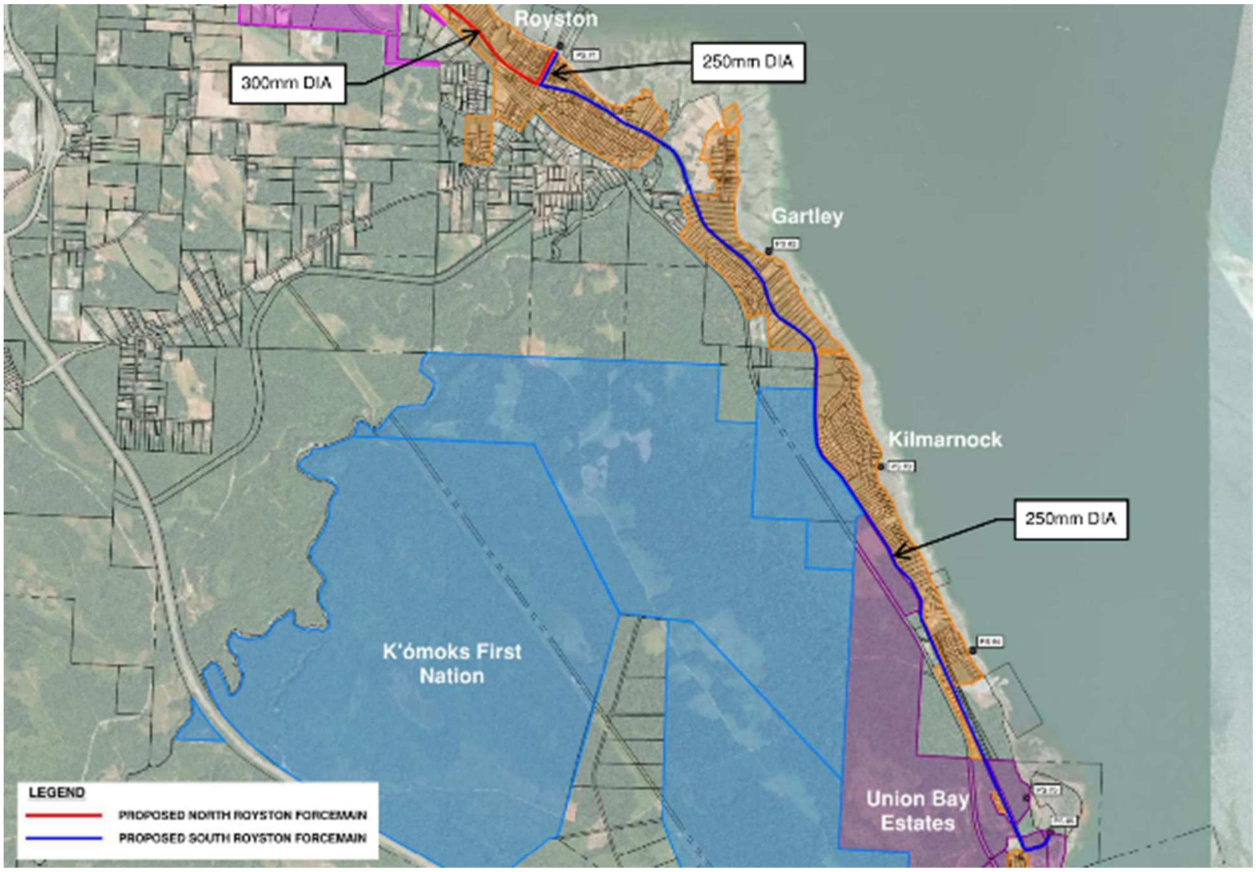


Figure 12: South Royston Forcemain

3.3 FUTURE PROVISION

The system configuration described above outlines a number of phases of development. This will involve the twinning of the forcemain along Highway 19A, from PS#6 to the siphon, in the ultimate build out phase. To avoid causing repeated traffic impacts, it is proposed that during the construction of the Phase 1A forcemains, concrete sleeves will be constructed at busy highway intersections. This will allow the future forcemain to be installed without closing the intersections. The sleeves will be 1800mm diameter concrete culverts.

At the watercourse crossings, it is proposed that the future twin forcemain will be installed at the same time by HDD. The twin pipe will be a larger diameter to accommodate the future flow. This will avoid having to use HDD to install the future forcemain which is expensive and time intense. This will reduce the impact to traffic.

The intersections and watercourse crossings where the allowance for future installation of the twin forcemains are made are outlined in the table below.

Table 6: River and Intersection Crossings to avoid disruption of future twin pipe installation

FORCEMAIN	CHAINAGE	TYPE	LOCATION
PS#6 to PS#1	1 + 440	Watercourse	Trent River
PS#6 to PS#1	8 + 240	Watercourse	Hart Creek
PS#6 to PS#1	1 + 980	Road Intersection	Highway 19A and Briardale Rd
PS#1 to Siphon	0 + 120	Road Intersection	Cliffe Ave and 29th St

PS#1 to Siphon	0 + 940	Road Intersection	Cliffe Ave and Mansfield Dr
PS#1 to Siphon	0 + 680	Road Intersection	Cliffe Ave and 26th St
PS#1 to Siphon	0 + 460	Road Intersection	Cliffe Ave and Mansfield Dr
PS#1 to Siphon	0 + 140	Road Intersection	Cliffe Ave and 21st St
PS#1 to Siphon	1 + 760	Road Intersection	Cliffe Ave and Anfield Road

3.4 CONSTRUCTION AND TRAFFIC IMPACTS

The alignment of the proposed forcemains is along Highway 19A as discussed in the previous sections. Highway 19A is a provincial secondary highway that serves as an alternative route to Highway 19 and connects several communities on the east coast of Vancouver Island. The majority of the highway consists of two lanes with narrow shoulders and ditches on both sides. This limits the available construction workspace and laydown area. The alignment was selected to reduce the traffic impacts by limiting construction to one lane of the highway. This will allow access to homes and businesses for local residents through traffic management measures. With the assumption of two crews installing 30m of pipe per day, the construction duration is expected to be 232 days. The two river crossings will involve trenchless installation of the pipes and take a month each to complete in addition to the 232 days estimated.

Construction of the forcemain through the urban area of Courtenay could have an impact on the local businesses and residents along Highway 19A/Cliffe Ave. The forcemain alignment also traverses several arterial intersections, which will have an added impact on traffic in the Courtenay region. Such impacts can be reduced through effective traffic management.

A potential benefit of this concept is the opportunity to incorporate improvements along the highway shoulder for active transportation in conjunction with the forcemain installation along Highway 19A.

3.5 ENVIRONMENTAL IMPACTS

Sea level rise is the most significant impact identified for this system. Sea level rise may lead to flooding along the coastline as well as contribute to increased coastal erosion. Sea level rise in combination with storm surge increases the risk of coastal flooding. The CVRD has recently completed the Coastal Flood Mapping Project which is the first phase of their Coastal Flood Adaptation Strategy. The Coastal Flood Mapping Project analyzed and modeled coastal flood hazards and included the development of regulatory coastal floodplain mapping. Future project design will integrate findings from the Coastal Flood Mapping Project and Adaptation Strategy in order to understand and adapt to risks related to coastal flooding. For infrastructure located in coastal flood zones, measures to monitor and reduce coastal erosion and protect infrastructure are required.

4 COST ESTIMATE

At the preliminary design stage of projects, a Class “C” cost estimate is prepared. Preliminary design is when the space program of a project has, for the most part, been developed but additional changes or additions to the program are still being made. The Class “C” cost estimate has a 30% contingency to account for any unforeseen changes in detailed design. A Class “B” cost estimate will be completed in the “Detailed Design” stage of the project as part of the Stage 3 LWMP.

The Class “C” cost estimate of the forcemains in Phase 1A is summarised in **Table 7**.

Table 7: Cost Estimate Summary

ITEM	DESCRIPTION	COST
1	**Highway 19A Forcemain**	
1.1	Forcemain	$ 14,341,000
1.2	Appurtenances and Tie-Ins	$ 2,420,000
1.3	Roadworks and Restoration	$ 1,466,000
1.4	Future Provision	$ 826,000
	Subtotal Item 1	$ 19,053,000
2	**General**	
2.1	Mobilization and demobilization (~3%)	$ 580,000
2.2	Health and safety (~3%)	$ 200,000
2.3	Environmental protection plan and monitoring (~3%)	$ 200,000
2.4	Allowance for water management and bypass pumping (~3%)	$ 290,000
2.5	Sediment and Erosion Control	$ 200,000
2.6	Coordination with Hydro	$ 175,000
2.7	Traffic Management	$ 928,000
2.8	Rock Clearing	$ 450,000
	Subtotal Item 2	$ 3,023,000
	Subtotal All Items	$ 22,076,000
	Contingency (30% of Subtotal)	$ 6,623,000
	Engineering (10% of Subtotal + Contingency)	$ 2,870,000
	Total	$ 31,569,000

The following general assumptions were used for preparing the cost estimate:

- All taxes are excluded.
- The estimate is based on prices in July 2022. Pricing and lead times are subject to change as they currently have shown to be volatile from materials & equipment suppliers within the industry, due to the current market conditions and other global issues.
- Does not include Owner costs or other soft costs (permitting, land acquisition, etc.)
- Complete with electrofusion coupling fittings (every 10m) & thrust blocks, trench excavation, bedding, backfill, and surface restoration. Surface restoration is assumed as trench width only for forcemains.
- Assumed HDD for the two river crossings, Trent River and Hart Creek.
- Air valves are located at high points of the profile and every 500 metres.
- Blowdowns are located at low points of the profile.
- Isolation valves and pigging stations located every 500 metres along the forcemain.
- Future provision includes 1800mm dia concrete culverts at insection and highway crossings and the additional costs installing twin forcemain with caps by HDD at river crossings.
- Construction of the forcemain is estimated to be 232 days.
- Traffic management is assumed as 2 crew x 2 flagger @$100/hour, 10hours/day for 232 days
- Rock Removal based on the Geotechnical Concept Level Review. A detailed review of rock clearing to be completed at detail design via GPR.
- Cost excludes contaminated soil allowance which will be reviewed in detail design.

COMOX VALLEY REGIONAL DISTRICT
REPORT NUMBER: 18P-00276-00

DISCUSSION PAPER 2: COLLECTION SYSTEM OPTIONS

CONFIDENTIAL

NOVEMBER 23, 2022

1 BACKGROUND

The Comox Valley Regional District (CVRD) operates and maintains the sewerage system for the Comox Valley Sewer Service (CVSS) which provides service to the City of Courtenay and the Town of Comox, and to the K'ómoks First Nation and Department of National Defence (under contracts with each).

The South Region of the CVRD, also known as Electoral Area 'A', is located south of the City of Courtenay. The area does not have a centralized sewage collection system, and privately owned onsite septic systems are utilized for wastewater management. These systems are reported to have a history of failures, with the potential to impact the surrounding environment and public health. In 2022 the CVSS service area boundary was expanded to include portions of Electoral Area 'A', including Royston, Union Bay and K'ómoks First Nation (KFN) lands. Consideration is now being given to the extension of sewage infrastructure south through an addendum to the Stage 1/2 CVSS Liquid Waste Management Plan.

The proposed design involves the collection of sewage from neighborhoods in the Royston and Union Bay area through collection systems to eight pump stations. It will then be pumped to the existing Courtenay River Siphon and conveyed to CVSS treatment works. The servicing of these areas is proposed to be completed in phases given the high cost of servicing these areas. The discussion paper will outline the following:

- Wastewater Collection System Options Overview & Evaluation
- Wastewater Collection System Conceptual Design
- PS#1 and PS#6 Short-Term Design Considerations and Class "D" Cost Estimate

2 WASTEWATER COLLECTION SYSTEM OPTIONS

This section summarizes the sewer collection systems options and alternatives that were previously identified and evaluated in WSP's February 2021 Report titled "Royston/Union Bay Local Collection System Options & Design Updates.". The 2021 Report identified and evaluated sewer collection system options and associated conceptual cost estimates for the South Region.

While the pumped conveyance system design has advanced and changed since the 2021 Report (including the number of pumps required for the proposed phased buildout), the options analysis and relative weighting of alternatives for the collection system in the 2021 Report remain valid and are summarized below.

In total, seven (7) different collection system alternatives were evaluated for a sanitary collection system to service the CVRD South Region:

1. Gravity Sewers
2. Low Pressure Sewer (LPS) System
3. Vacuum Sewer (VS) System
4. Septic Tank Effluent Gravity/Pump (STEG/STEP) Hybrid System
5. Gravity/LPS Hybrid System
6. Gravity/Vacuum Hybrid System
7. LPS/Vacuum Hybrid System

The hybrid gravity/vacuum sewer collection system option was the least expensive option identified on capital and operation and maintenance costs. However, due to the limited installation of vacuum sewer technology in Canada and the potential risks, this option did not score the highest overall, despite the lowest capital and O&M costs. Based on the detailed evaluation, a hybrid Gravity/LPS collection system has the highest comparative evaluation score and therefore offered the most benefit. Additionally, the Gravity/LPS system was found to be the third least expensive on a capital cost basis.

Table 1:Weighted Scoring of Sewage Collection System Alternatives

ALTERNATIVE	FINAL SCORE
GS/LPS	74.9
STEG/STEP	73.8
GS/VS	69.8
GS	67.4
LPS	59.0
LPS/VS	50.8

A hybrid Gravity Sewer - LPS system (with grinder pumps) was identified as the preferred approach to service the area. The properties located along the shoreline in Union Bay are proposed to be serviced by LPS, while remaining properties are anticipated to be provided gravity servicing. An alternative approach would be for properties on the west side of Hwy 19A (high ground elevation) to be accommodated by the gravity system, with those located on the east side of Hwy 19A (low ground elevation) being accommodated by LPS system.

The subsections below provide more detail on the gravity sewer and LPS options, as well as general advantages and disadvantages.

2.1 GRAVITY SEWER (GS)

Gravity sewer systems are most commonly used to collect and transport domestic wastewater. A well-designed system is reliable and requires a minimum level of maintenance that can handle grit and solids in sanitary sewage.

Compared to other alternatives, the gravity sewer system has a longer service life and lower operating costs. The wastewater from each source is conveyed through a building sewer to a collection main. If gravity flow is not possible throughout the system, lift stations are used. Lift stations are installed at the lowest elevations of the network to pump the sewage to convey it through the collection system and ultimately to the treatment plant.

2.1.1 CONSIDERATION

If deep excavation is required, the gravity system can result in a high construction cost. If the development is low-density and fewer lots are to be serviced; the gravity sewer cost is not feasible.

The site topography also plays a major role in determining the viability of gravity sewer construction. Significant elevation variations in the service area can result in a complex and high-cost gravity sewer system and may require multiple lift stations. A detailed list of the advantages and disadvantages of traditional gravity sewers is listed in Table 2: .

Table 2: General Advantages and Disadvantages of Gravity Sewer System

ADVANTAGES	DISADVANTAGES
Most common wastewater collection and conveyance system	Deep excavation may be required to achieve gravity flow
Suitable for areas with a natural slope towards the discharge location	Potential of leakage in pipes and manholes (Inflow & infiltration)
System primarily constructed in the road allowances	May require multiple lift stations depending on the area topography; manholes are also required at regular spacing, resulting in higher construction cost
No mechanical/electrical components required on private properties	Owner connection costs can be high for low-density development areas
Simultaneous removal of both liquid and solid components of wastewater from the property	The existing septic tanks need to be decommissioned by the owners
Low O&M cost of the gravity sewer	High O&M cost of the lift stations
	[1]High groundwater table will increase costs and leakage

[1]Gravity sewer will be difficult and expensive to construct in the ground with a high water table. This is more significant in the Union Bay area. A 2009 study determined the winter water table be approximately 0.1 - 0.6m below grade.

2.2 LOW PRESSURE SEWER SYSTEM (LPS)

In a Low Pressure Sewer (LPS) system, each connection point uses a two-chamber septic tank and effluent pump to transport the wastewater through the system. There are two predominant types of LPS systems: Septic Tank Effluent Pump (STEP) style and grinder pumps. Grinder pumps to serve individual homes are usually low horsepower of 1 – 2 H.P. STEP pumps are usually fractional horsepower.

The primary difference between the two types of LPS system is in solids handling. The STEP system is a two-chamber septic tank where the solids are separated, and only the liquid component is pumped into a pressure sewer network. Conversely, in a grinder pump style network, the pump sends all solids into the sewer creating the potential for long-term operational issues associated with the build-up of solids and odour generation.

The STEP style low pressure sewer and the separation of solids from the wastewater stream allow the system to operate at lower pressures and velocities as there is a minimal concern related to the deposition of solids.

The primary reason for the use of pressure sewers is economical, as the system requires a minimal depth of cover and is well suited to trenchless installation. In some areas experiencing slow growth development LPS is economically attractive to avoid the significant cost associated with lift stations and manholes. In some areas where the groundwater level is high, the decision to choose LPS is environmentally motivated.

LPS can also be used in conjunction with the gravity system. Where some low-lying properties do not allow gravity flow into a conventional fronting sewer, i.e., for waterfront properties in Union Bay, a grinder pump or a STEP can be used at those properties to discharge to the sewer.

2.2.1 CONSIDERATION

One of the main challenges that should be considered for the LPS system is the potential for bacterial upsets to occur in the septic tank caused by misuse of the system by residents, which can result in a severe undesirable downstream sludge release into the collection system and pipeline blockage.

Potential power outages can affect the overall system operation, and the impact and mitigation measures need to be determined on a case basis. There is limited storage capacity (up to 24 hr) in each septic tank/grinder pump tank, and power outages can cause system backup for each connection.

The ownership model of the sewer infrastructure, for all the options, is defined to be divided at the property line; where the CVRD would be responsible for infrastructure within the Right of Way (ROW) up to the property line, while the individual homeowners have the responsibility for infrastructure between the house and the property line.

For the LPS option, both the septic tank and pump are owned by each property owner located on private property, and the CVRD would bear no responsibility for the sewer infrastructure on the private properties. However, for project planning purposes, supply and installation costs for LPS pumps and tanks may be borne by the CVRD as part of the overall project. Homeowners also are responsible for the operation and maintenance (O&M) cost of the system on their property, e.g., pumping energy and sludge removal cost. Currently, the existing property owners in the study area with private septic systems are responsible for their systems' maintenance.

A detailed list of the advantages and disadvantages of LPS systems is listed in Table 3: .

Table 3: General Advantages and Disadvantages of LPS System

ADVANTAGES	DISADVANTAGES
Shallow and narrow excavation and potential for trenchless installation	Pump and tank units installed on private property
Pipeline can follow the ground topography	Ongoing operation and maintenance costs for each property owner
Minimal inflow and infiltration into the system	Each property owner required to supply and pay for power to the onsite pump
Lower initial capital costs due to shallow excavation and small size of pipes	Limited storage capacity in the septic tank during power outages
A portion of a sewage pre-treatment is provided onsite	Potential for pump blockages and malfunctions, and tank overflow
In the case of using a grinder pump, a smaller tank is required	Potential odour generation
Suitable to accommodate future growth and phasing	Regular tank cleanout is required

3 CONCEPTUAL DESIGN

This section discusses the conceptual design of the preferred sewer collection alternatives for the South Region (including Royston and Union Bay area) to connect the South Region sewer system to the CVSS. As discussed with the CVRD and presented in the previous sections, a hybrid Gravity Sewer - LPS system (with grinder pumps) was identified as the preferred approach to service the area.

As part of the preferred hybrid approach, an LPS system is being considered for limited use in areas located on the east side of Highway 19A in Union Bay only. The generated wastewater from the remaining properties located on the west side of Highway 19A would be conveyed via gravity system.

3.1 LPS – GRINDER PUMPS

The LPS system has been discussed in detail in previous sections. The pressure sewers are typically small diameter sewer pipelines following the existing ground profile. The minimum depth of burial is usually dictated by the frost penetration depth and additional depths, if required, to avoid other buried utility interference. PVC or HDPE are the two types of pipe material used in LPS collection systems.

Each house on the LPS system will be connected to a common LPS main and will use a small pump to discharge to the main. Two types of pumps are in general use; a grinder pump and a septic tank effluent pump reviewed in the earlier stage of the study.

The concept of a grinder pump system consists of replacing the septic tank with a holding tank. All solids introduced into the sewage holding tank are ground and then pumped to the low-pressure sewer system. Each time the grinder pump is activated, the contents of the holding tank will be removed. Grinder pumps eliminate the septic tank so that there is no longer any need to pump solids from the septic tank. With the smaller tank capacity, grinder pumps pump fresher sewage, reducing odour problems. The grinder pump system will also reduce inflow and infiltration into the holding tank and, since each grinder pump station is similar, it provides a uniform approach.

It is generally recommended that cleanout or flush out assemblies be installed at key points in the pressure sewer system. The purpose of the cleanouts is to allow maintenance staff to flush the lines periodically to remove deposited sediments from sections of the sewer line. Clean out locations are generally placed at the following points to facilitate cleaning:

- The end of every line;
- Every connection to a branch line;
- Every sharp bend in the system; and,
- In the middle of long lengths of pipe (lengths greater than 1,000 m).

3.1.1 ENVIRONMENT ONE METHOD

In the LPS system, grinder pumps with a minimum 60-gallon holding tank do not all operate simultaneously. Published data shows that only a percentage of the grinder pumps operate simultaneously, under normal operating conditions. The larger the system, the less percentage of grinder pumps operate simultaneously.

The design handbook of Environment One Corporation, manufacturers of progressive cavity-type grinder pumps and effluent pumps, tabulates the number of pumps expected to be running simultaneously versus the number of pump cores connected to the system, as shown in Table 4.

Table 4: Maximum Number of Grinder Pumps Cores Operating Daily

NUMBER OF GRINDER PUMPS CONNECTED	MAXIMUM NUMBER OF GRINDER PUMPS OPERATING SIMULTANEOUSLY
1	1
2 – 3	2
4 – 9	3

NUMBER OF GRINDER PUMPS CONNECTED	MAXIMUM NUMBER OF GRINDER PUMPS OPERATING SIMULTANEOUSLY
10 – 18	4
19 – 30	5
31 – 50	6
51 – 80	7
81 – 113	8
114 – 146	9
147 – 179	10
180 – 212	11
213 – 245	12
246 – 278	13
279 – 311	14
312 – 344	15

Under typical conditions, the grinder pump's flow is approximately 0.69 L/s (11 gpm). The maximum anticipated design flow for the LPS zone can be determined by the product of 0.69 L/s (the pump's discharge rate) times the number of pumps running.

3.2 CONSTRUCTION CONSIDERATIONS

3.2.1 HIGHWAY CROSSINGS

In the proposed Gravity/LPS system, there will be eighteen (18) highway crossing locations throughout the South Region area. In these locations, the proposed sewer line crossing is assumed to be constructed via HDD to reduce interference with Highway 19A. Foreshore Installation Review

A high-level review of the proposed collection pipe location was completed in an effort to identify locations where the pipe may be proposed within the foreshore area. The following criteria was used to identify, at a high-level, whether an installation would be deemed as a foreshore installation:

- Along the cost, and
- Not under an existing road, and
- Not under an existing Right of Way (ROW), and
- Not under a known utility corridor.

Using the above criteria, the proposed gravity collection system layout was refined to eliminate foreshore installation of gravity sewer, to minimize sensitive habitat disturbance during construction and avoid difficult operation and maintenance over the lifecycle of the system (i.e. access for cleaning, inspections, working in tidal areas, etc). In areas where the proposed alignment was revised, LPS must be employed for collection.

4 SHORT-TERM DESIGN CONSIDERATIONS

Construction of the pump stations is proposed to be broken out over the following phases.

1. Phase 1A (Short term)
2. Phase 1B (Medium term)
3. Future phase (Long term)
4. Ultimate build out phase

Phase 1A includes the design of PS#1 at Royston and PS#6 at Union Bay. Refer to Discussion Paper 1 for the Process Flow Diagrams of each phase.

The feasibility of implementing the collection system for the PS#1 catchment area in phases rather than a full buildout at system onset was explored in WSP's February 2022 Technical Memorandum entitled "CVRD LWMP CCO#14 – South Region Collection & Conveyance Options" to provide flexibility to ensure costs remain reasonable. Sub-catchment areas were divided based upon areas with similar density composition, locations, and crossings required to carry out the servicing of each area, as shown in **Figure 1**. The subcatchment areas for PS#6 are shown **in Figure 2**.

For the purpose of the collection system, all PS#1 sub-areas require sub-area S1-3 to be completed before servicing can occur as this sub-area will include the installation of a 375 mm collection main conveying the sewage to the pump station. As such, S1-3 was identified as the first sub-area to be serviced if funding limitations preclude buildout of the entire PS#1 catchment area at system onset. The sub-area on the Northwest is not included as it can be incorporated into the collection system at a later phase.

It is worth noting that some sub-areas may be configured as an extension to other sub-areas and therefore phasing and additional cost-sharing should take this into consideration. As well, the entire PS#1 catchment has been considered in the capacity of the Phase 1A pump station design, even if the sub-area collection systems are not all built as part of the first phase of construction.

The development of the hydraulic sanitary model for PS#1 and PS#6 catchments to review the collector system sizing for Phase 1A is currently underway by WSP. Based on preliminary modelling, the pipe sizing for Royston and Union Bay collector systems is sufficient to convey 2070 design flows. A detailed assessment will be discussed in future TAC/PAC meetings, outlining the preliminary design of the PS#1 and PS#6 collector systems and incorporating feedback received from the Technical and Public Advisory Committee on the conceptual design presented in this paper.

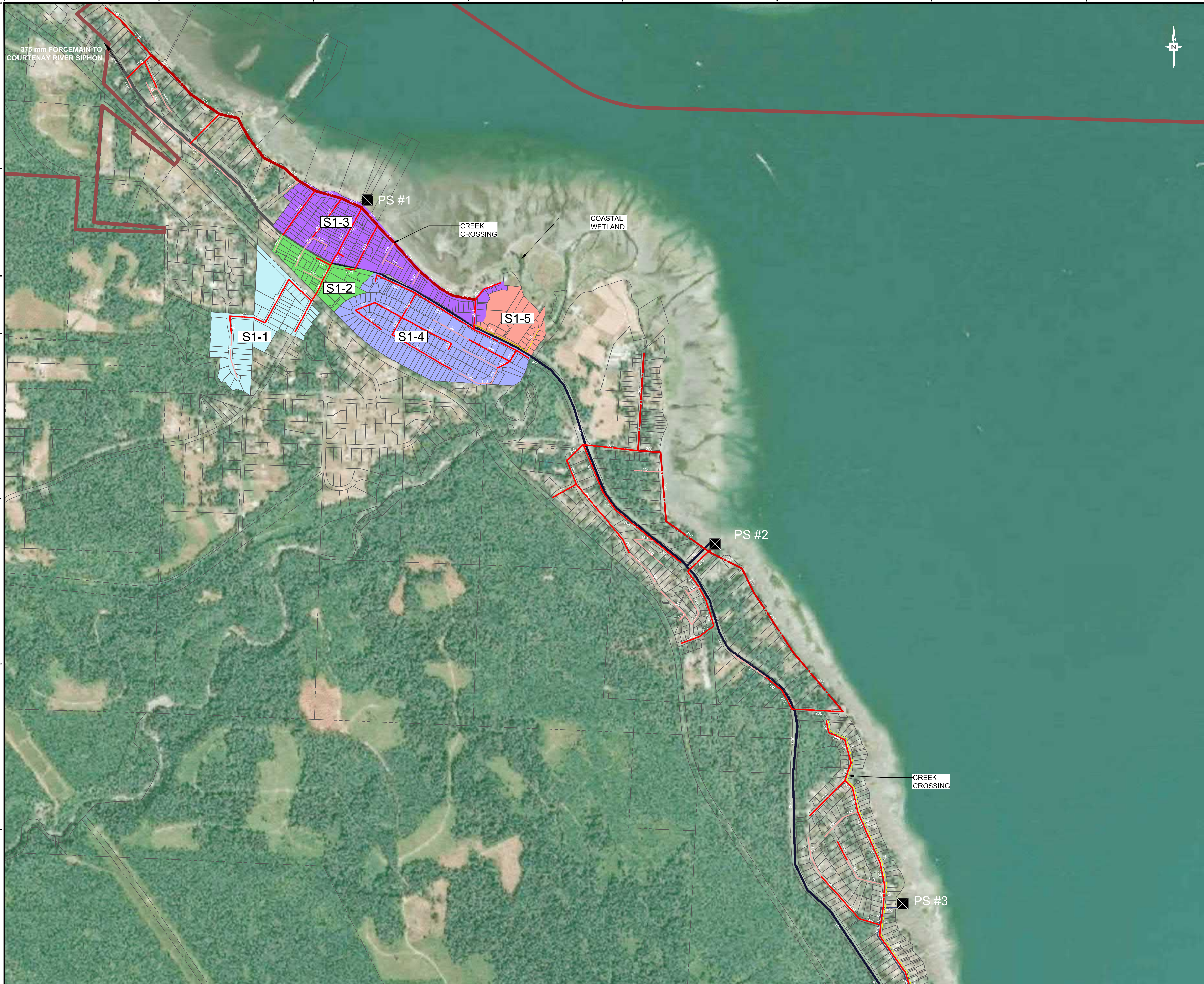
The collector system may have potential impacts on existing properties in some areas. A detailed study will be required to determine the actual ROW boundaries based on considerations for construction and operations. This is assumed to be completed during the detailed design phase as part of the Stage 3 LWMP.

The design criteria being used to review the Phase 1A collection system is in accordance with the MMCD design guidelines as summarized in Table .

Table 5: Design Criteria

DESIGN PARAMETER	VALUE
Minimum Velocity	Gravity sewers: 0.60 m/s
Minimum Pipe Diameter	200mm except for the upstream section of a residential sewer where future extension is not possible, in which case 150mm is acceptable.
Maximum/Full Depth	80% full (d/D=0.8)
Minimum Grade	Minimum grades of gravity sewers are as required to obtain the minimum velocity of 0.60 m/s except for the upstream section of a residential sewer serving a design population of 25 or less in which case the minimum grade is 0.6%, unless otherwise approved by the local authority.

Depth	Minimum cover without concrete encasement: 1.0 m. Maximum cover depth: 4.5 m, except under special circumstances and with local authority approval.
Manhole Locations	Manholes are required at the following locations: – Every change of pipe size. – Every change in grade. except as indicated in the Curved Sewers section. – Every change in direction, except as indicated in the Curved Sewers section. – Downstream end of curved sewers. – Every pipe intersection except for 100 mm and 150 mm service connections and junctions with trunk sewers 900 mm diameter and larger. – Upstream end of every sewer line. – Every future pipe intersection. – 150 m maximum spacing.
Hydraulic drops	Minimum drop in invert elevations across manholes: – Straight run: 5 mm drop – Deflections up to 45 degrees: 20 mm drop – Deflections 45 to 90 degrees: 30 mm drop



LEGEND:

- 150mm GRAVITY SEWER
- 200 mm GRAVITY SEWER
- 250 mm GRAVITY SEWER
- 300 mm GRAVITY SEWER
- 375 mm GRAVITY SEWER
- 75 mm LOW PRESSURE SEWER
- 100 mm LOW PRESSURE SEWER
- 150 mm LOW PRESSURE SEWER
- 100 mm FORCEMAIN
- 150 mm FORCEMAIN
- 200 mm FORCEMAIN
- 250 mm FORCEMAIN
- 300 mm FORCEMAIN
- 375 mm FORCEMAIN
- REGIONAL BOUNDARY
- EXISTING ROAD AND PROPERTY LINES
- PUMP STATION
- SX-X PUMP STA. CATCHMENT/SUB-CATCHMENT AREA

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WINNIPEG, MANITOBA
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PHONE: 204-477-6650 FAX : 204-474-2864
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CLIENT:

COMOX VALLEY REGIONAL DISTRICT

PROJECT:

ROYSTON / UNION BAY
LOCAL COLLECTION SYSTEM
OPTIONS & DESIGN UPDATES

ISSUED FOR – REVISION:

IS	RE	DATE	DESCRIPTION
0		2022-02-03	ISSUED FOR REVIEW

PROJECT NO: 18P-00276-00	DATE: 2022/02/03
ORIGINAL SCALE: AS SHOWN	IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE. 25mm
DESIGNED BY: E.K. / C.K.	
DRAWN BY: I.M. / E.S.	
CHECKED BY: M.S. / N.T.	

DISCIPLINE: MUNICIPAL / SEWER

TITLE:

GRAVITY AND LPS
ROYSTON, GARTLEY & KIMARNOCK
REGIONS

SHEET NUMBER: C203

SHEET #: 1 OF 2

ISSUE: ISSUED FOR REVIEW

REV #: 0

DATE OF: 2022-02-03

STAMP

LEGEND:

- 150mm GRAVITY SEWER
- 200 mm GRAVITY SEWER
- 250 mm GRAVITY SEWER
- 300 mm GRAVITY SEWER
- 375 mm GRAVITY SEWER
- 75 mm LOW PRESSURE SEWER
- 100 mm LOW PRESSURE SEWER
- 150 mm LOW PRESSURE SEWER
- 100 mm FORCEMAIN
- 150 mm FORCEMAIN
- 200 mm FORCEMAIN
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ROYSTON / UNION BAY
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OPTIONS & DESIGN UPDATES

ISSUED FOR – REVISION:

IS	RE	DATE	DESCRIPTION
0		2022-02-03	ISSUED FOR REVIEW

PROJECT NO: 18P-00276-00	DATE: 2022/02/03
ORIGINAL SCALE: AS SHOWN	IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE.
DESIGNED BY: E.K. / C.K.	
DRAWN BY: I.M. / E.S.	
CHECKED BY: M.S. / N.T.	25mm

DISCIPLINE: MUNICIPAL / SEWER

TITLE:

GRAVITY AND LPS
KILMARNOCK, UNION BAY ESTATES,
& UNION BAY REGIONS

SHEET NUMBER: C204

SHEET #: 2 OF 2

ISSUE: ISSUED FOR REVIEW

DATE OF: 2022-02-03

REV #: 0

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5 COST ESTIMATE

The Class "D" capital cost estimates for the collection systems in the PS#1 and PS#6 catchments are captured below in Tables 6 and 7. The costs are based on the unit rates from the 2021 Report, and include collection system costs for gravity and forcemain pipes, appurtenance and tie-ins, and service connection to property lines. Class "D" cost estimates are an order of magnitude cost estimate to inform decision making at feasibility or conceptual design stage; as such, the cost estimates below include 40% contingency and 15% allowance for engineering and contractor overhead and pricing. All costs were inflated to 2022 dollars and subtotals and totals are rounded to the nearest $10,000. Class "C" cost estimates as part of the preliminary design are being developed and will be presented to the committee at future meetings.

The following assumptions were made for the Class "D" cost estimation:

- All pipe installation is assumed to be cut and cover unless otherwise specified,
- Low-pressure property pumps and septic tanks are included in CVRD capital cost,
- Low-pressure service connection cost includes a valve chamber,
- The river/creek crossings are assumed to be constructed via HDD.

Table 6: PS#1 Catchment Capital Cost Estimate

ITEM	DESCRIPTION	UNIT	QTY	UNIT COST	PRICE
1	**Collection system**				
1.1	Gravity – PVC SDR35				
1.1.1	150 mm	lm	1735	$430	$747,000
1.1.2	200 mm	lm	4671	$470	$2,196,000
1.1.3	375 mm	lm	1150	$520	$598,000
1.2	Forcemain-HDPE DR17				
1.2.1	75 mm	lm	100	$200	$20,000
1.2.2	150 mm	lm	300	$300	$90,000
1.3	Appurtenances and Tie-Ins				
1.3.1	Manhole	each	60	$5,500	$330,000
1.3.2	Creek Crossing	LS	1	$265,000	$265,000
1.3.3	Highway 19A crossings	LS	5	$12,000	$60,000
1.3.4	Railroad crossing	LS	1	$127,000	$127,000
1.3.5	Road-way Allowance	lm	3978	$100	$398,000
1.4	Service Connection to prop. Line				
1.4.1	Gravity	LS	383	$2,327	$892,000
1.4.2	LPS	LS	20	$3,701	$75,000
1.4.3	LPS – Lift Station and Septic Tank	LS	20	$15,000	$300,000
				Subtotal 1 Collection System	**$6,098,000**
				Contingency (40% of Subtotal)	$2,439,000
				Engineering (15% of Subtotal All + Contingency)	$1,281,000
				Contractor Overhead and Pricing (15% of Subtotal All + Contingency)	$1,281,000
				Total	**$11,099,000**

Table 7: PS#6 Catchment Capital Cost Estimate

ITEM	DESCRIPTION	UNIT	QTY	UNIT COST	PRICE
1	**Collection system**				
1.1	Gravity – PVC SDR35				
1.1.1	150 mm	lm	3717	$430	$1,599,000
1.1.2	200 mm	lm	2077	$460	$977,000
1.1.3	375 mm	lm	875	$520	$455,000
1.2	Forcemain-HDPE DR17				
1.2.1	75 mm	lm	1110	$200	$222,000
1.3	Appurtenances and Tie-Ins				
1.3.1	Manhole	each	61	$6,000	$369,000
1.3.3	Creek Crossing	LS	1	$265,000	$265,000
1.3.4	Highway 19A crossings	LS	3	$12,000	$36,000
1.3.5	Road-Way Allowance	lm	3890	$100	$389,000
1.4	Service Connection to prop. Line				
1.4.1	Gravity	LS	259	$2,327	$603,000
1.4.2	LPS	LS	49	$3,701	$182,000
1.4.3	LPS – Lift Station and Septic Tank	LS	49	$15,000	$735,000
				Subtotal 1 Collection System	**$5,832,000**
				Contingency (40% of Subtotal)	$2,333,000
				Engineering (15% of Subtotal All + Contingency)	$1,225,000
				Contractor Overhead and Pricing (15% of Subtotal All + Contingency)	$1,225,000
				Total	**$10,615,000**

In addition to the costs noted above, each property owner will be responsible for costs associated with connecting to the regional services at their respective property lines. The cost of service connections between each house and property line have been estimated for ranges of connection lengths. The cost estimate includes a number of assumptions for gravity and low-pressure sewer connections. The service connection for gravity and LPS is assumed to be 100mm diameter pipes as per MMCD Design Guidelines (2014). The first 10m of the gravity and LPS connections from the property line cost $1,500 and $250 per meter after this. The connection costs presented in **Table 8** below are the maximum costs within each connection length range. Property connecting to the LPS system require a septic tank and lift station, which cost $8,000 and $7,000 respectively. The property estimates are subject to the extent of onsite structures and landscape encountered.

Table 9: Property Line to House Service Connection Costs

CONNECTION TO SYSTEM	CONNECTION LENGTH	CONNECTION[1]	LIFT STATION/ SEPTIC TANK[2]	TOTAL COST
Gravity	0-10m	$1,500	-	$1,500
	11-30m	$6,500	-	$6,500
	31-50m	$11,500	-	$11,500
Low Pressure	0-10m	$1,500	$15,000	$16,500
	11-30m	$6,500	$15,000	$21,500

Notes:

1 Cost provided correspond to the higher length in the range

2 Lift station and septic tank costs provided as a reference. The cost of the lift station and tank will not be a property owner cost.

COMOX VALLEY REGIONAL DISTRICT
REPORT NUMBER: 18P-00276-00

DISCUSSION PAPER 3: PUMP STATION DESIGN AND OPERATING COSTS

CONFIDENTIAL

NOVEMBER 23, 2022

1 DISCUSSION PAPER #3

1.1 BACKGROUND

The sewer extension south region, as outlined in Discussion Paper #1, consists of eight pump stations to convey sewerage from existing neighborhoods in the Royston and Union Bay area as well as future development to the existing Courtenay River Siphon. The location of the pump stations is shown in **Figure 1**. Construction of the pump stations is required to be phased, with the following phases proposed:

1. Phase 1A (Short term)
2. Phase 1B (Medium term)
3. Future phase (Long term)
4. Ultimate build out phase

Phase 1A involves the design of PS#1 at Royston and PS#6 at Union Bay. Refer to Discussion Paper #1 for the Process Flow Diagrams of each phase.

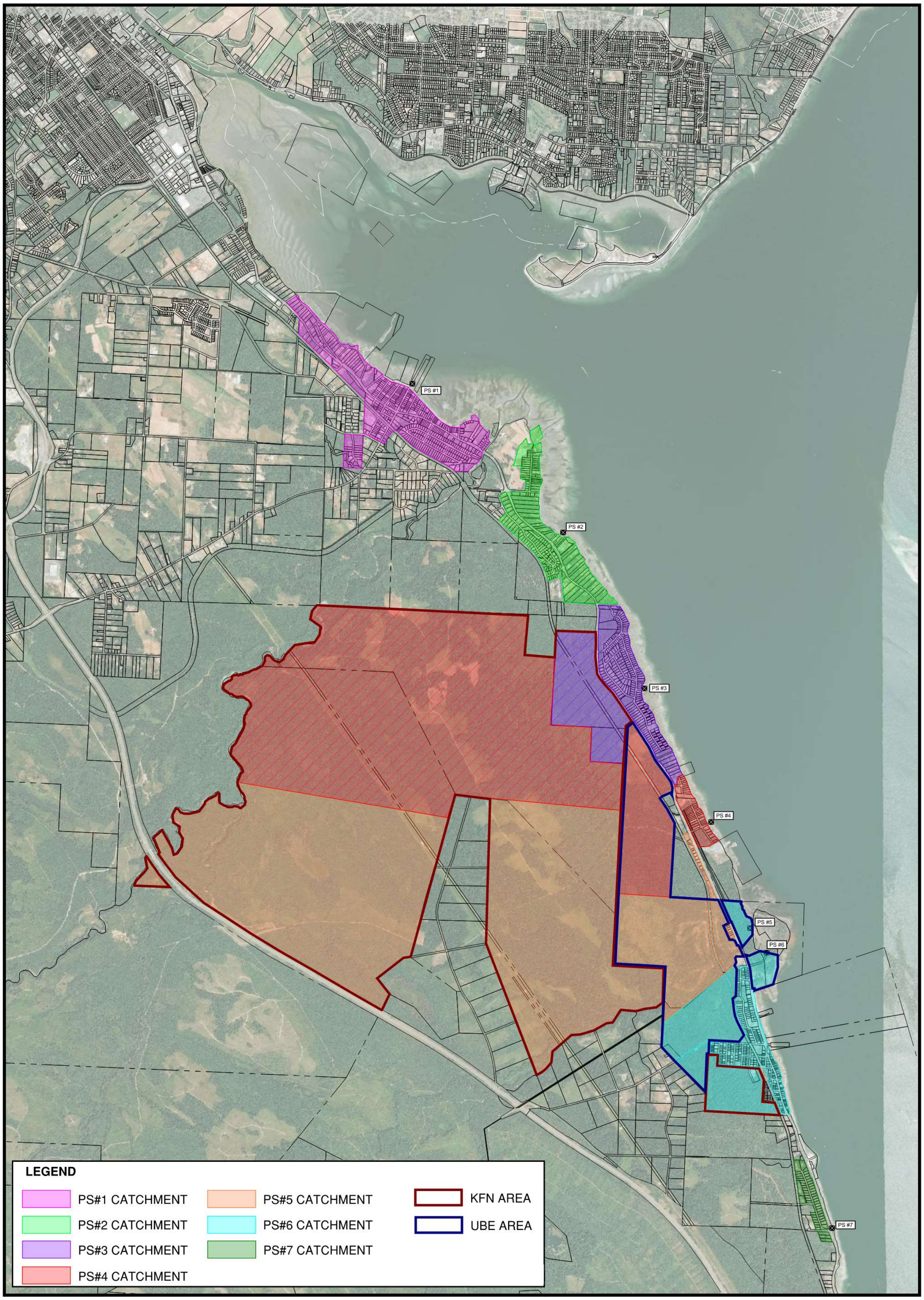

Figure 1: Pump Station Locations

1.2 BRIEF

The discussion paper includes the following information for PS#1 and PS#6, proposed to be constructed as part of Phase 1A:

- Summary of pump station siting options.
- Summary of pump station design.
- Summary of pump station cost estimate.

2 PUMP STATION DESIGN

A conceptual pump station sizing was completed for Phase 1A considering the information available at the time of assessment. Given the relatively long service life of asset infrastructure such as pump stations, it can be expected that the pump stations constructed in the initial phase will continue to be operated throughout the future phases of development up to build-out.

2.1 SITING CONSIDERATIONS

2.1.1 PS#1

PS#1 is located in Royston to collect the flow from the Royston catchment area as well as the South Royston Forcemain as shown in **Figure 2**. A previous study by Koers & Associates Engineering in 2016 reviewed locations for the pump station at Royston. Three site options where considered, two at the intersection of Marine Drive and Royston Road and one site at Marine Drive and Hayward Avenue. The options, Marine Drive at Royston Road (north) and Marine Drive at Royston Road (south), were recommended in the review as they had lower estimated costs.

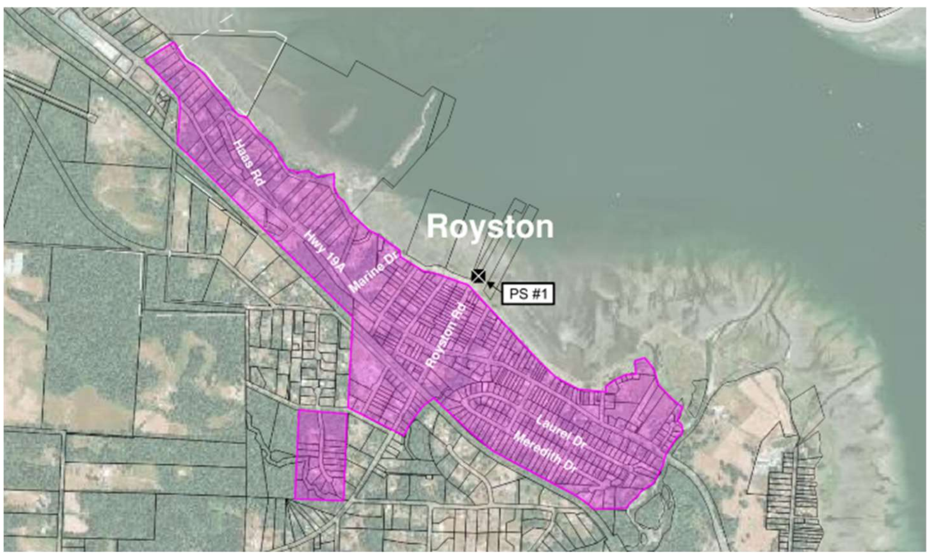

Figure 2: PS#1 Location

The Marine Drive at Royston Road (north) site (Location 1) is located on the grass area between the road shoulder and the Royston Seaside Trail gravel path on the northside of Marine Drive as shown in **Figure 3** below. The site is located within the dedicated road allowance owned by the Ministry of Transportation and Infrastructure (MoTI). The pump stations have two configuration options, building and kiosks, which are shown in the Siting figures below.

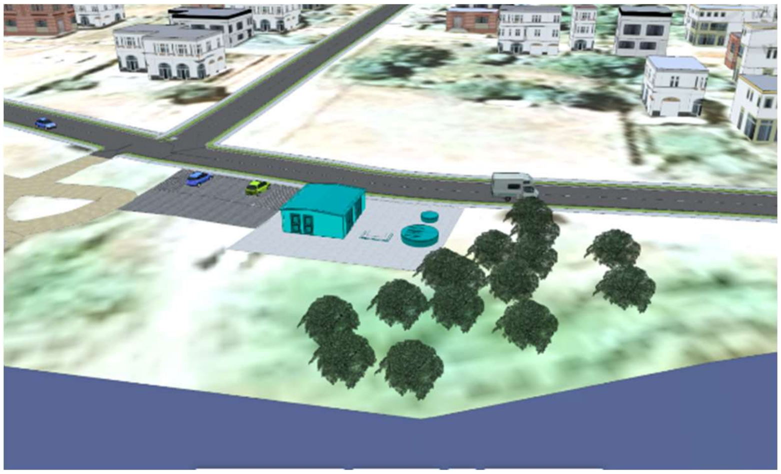

Figure 3: PS#1 Location 1 Option A

Figure 4: PS#1 Location 1 Option B

The Marine Drive at Royston Road (south) site option (Location 2) is located on the grass area between the road shoulder and the Royston Seaside Trail gravel path on the south side of Marine Drive as shown in **Figure 5** below. The site is also located within the dedicated road allowance owned by the Ministry of Transportation and Infrastructure (MoTI). The pump stations have two configuration options, building and kiosks, which are shown in the siting figures below.

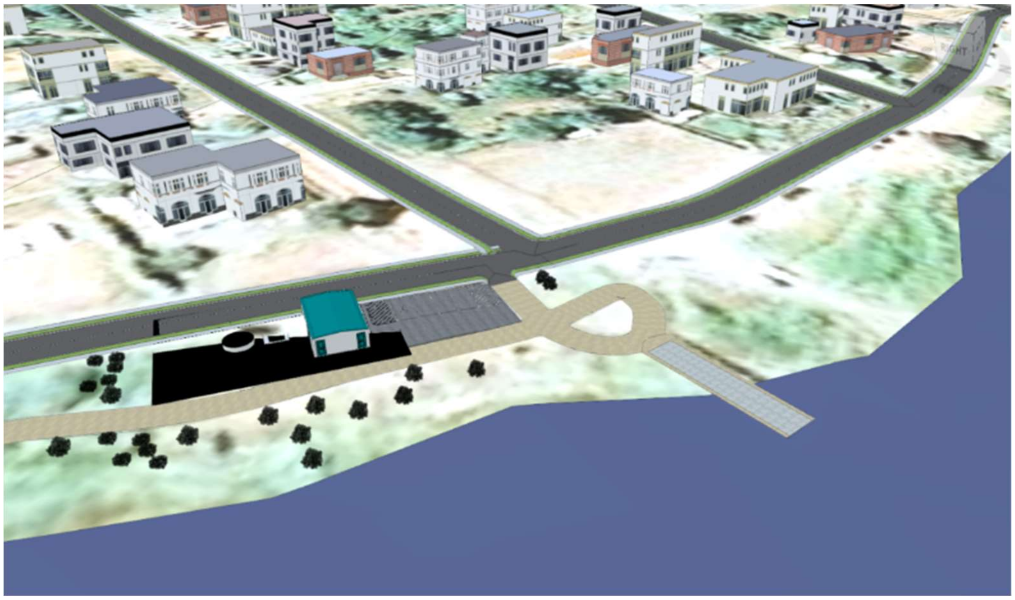

Figure 5: PS#1 Location 2 Option A

Figure 6: PS#1 Location 2 Option B

2.1.2 PS#6

A siting review was completed by Koers & Associates Engineering in 2016 for the pump station in Union Bay. Three options were considered, Highway 19A road allowance (opposite the parking lot of the Highwayman Pub), public boat ramp parking area, and south of the public boat ramp. The review recommended the Highway 19A road allowance site as it had the lowest estimated cost. Subsequent discussions have since led to consideration of an alternate preferred location north of the Highway 19A road allowance site. This site is located on Union Bay Estates land west of Jones Street as shown in **Figure 7** below.

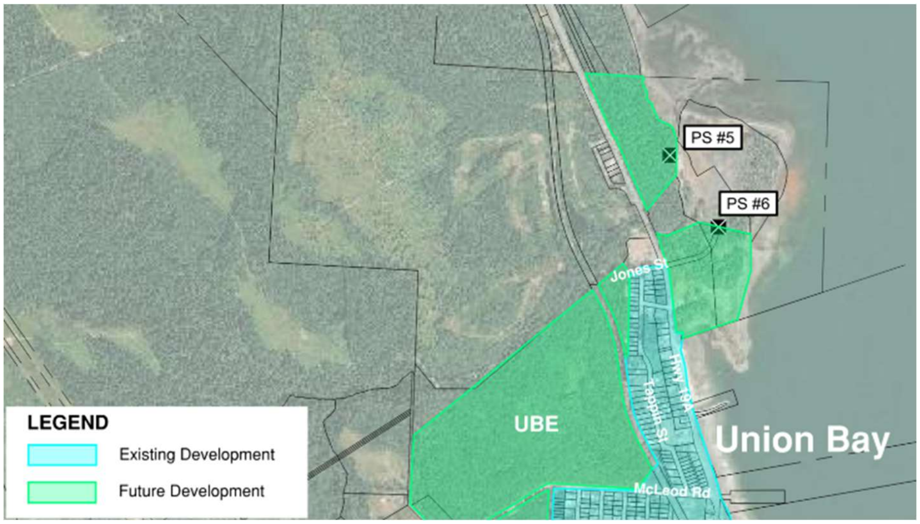

Figure 7: PS#6 Site Location

2.2 PRELIMINARY DESIGN

2.2.1 PUMP STATION #1

PS#1 is sized to convey a minimum flow of 48 L/s and maximum flow of 72 L/s to the existing Courtenay River Siphon. Once the regional pump station is constructed, PS#1 will only pump the required 28 L/s from PS#1 and PS#2 catchments to the regional pump station. The pump station will have a duty/standby configuration. An issue to consider is the coastal flooding risk of the pump station site. It is within Coastal Zone 64 which has a flood level of 5.1m according to available floodplain maps. The proposed ground level of the pump station is 3.3m to 3.5m. This indicates that the equipment could be approximately 1.6m below the flood level resulting in damage to the equipment. There are several measures that could be taken to eliminate or minimise the risk of a flood event on the pump station. The pump station will have submersible pumps and so will not be influenced by a flood event. The remaining pump equipment, such as valves and pipes, do not have electrical components that can be damaged by a flood event. The MCC and generator can be relocated to above the flood level.

PROPOSED PUMP STATION LAYOUT

Two options have been considered for the pump station configuration. Option A, pump station with a building, and Option B, pump station with kiosks, are outlined below.

OPTION A (BUILDING)

Option A consists of control building for the MCC, genset and odour control. The control building will contain backup generator, onboard fuel tank, an electrical room to accommodate the electrical equipment and SCADA system, odour control room and public washrooms.

The pump station will consist of a Fibre Reinforced Plastic (FRP) feeding manhole as shown in **Figure 8** for the collection of flow from the catchment areas as well as the forcemain from PS#6. This configuration also provides the possibility of constructing an additional manhole pump station in the future if this should be required, without the need to isolate PS#1. The pump station will have a 3.1m diameter FRP wet well and two submersible pumps. In the initial phases, two Flygt 85HP pumps will be installed. At a later phase they will be replaced with two Flygt 105HP pumps.

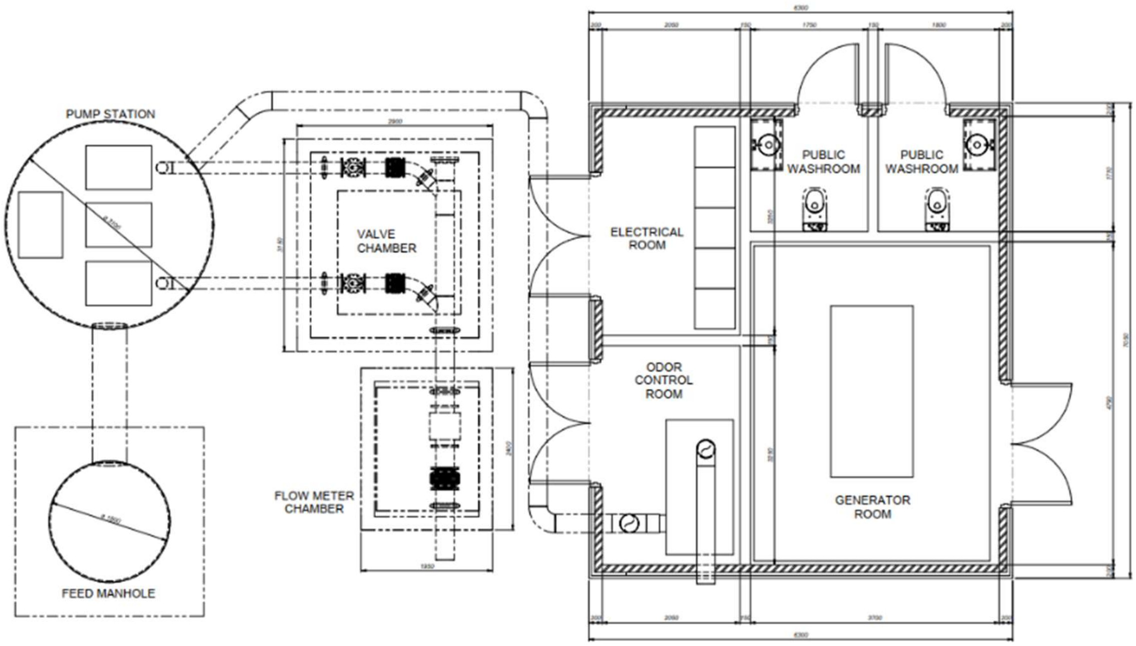

Figure 8: PS#1 Option A Plan

The 3.1m diameter wet well is sized to receive 72 L/s. To limit the standing/retention time of the sewage in the wet well, the operating levels can be reduced to ensure shorter standing time by pumping a smaller volume per cycle.

The configuration will also include a flowmeter located on the forcemain with an isolation valve for maintenance and a valve chamber with a separate hatch access. The pumps will be removed by a crane truck (or other suitable mobile rig) in lieu of an overhead gantry to limit the visual impact of the pump station on local residents.

The configuration of the pump station is shown in **Figure 9** below.

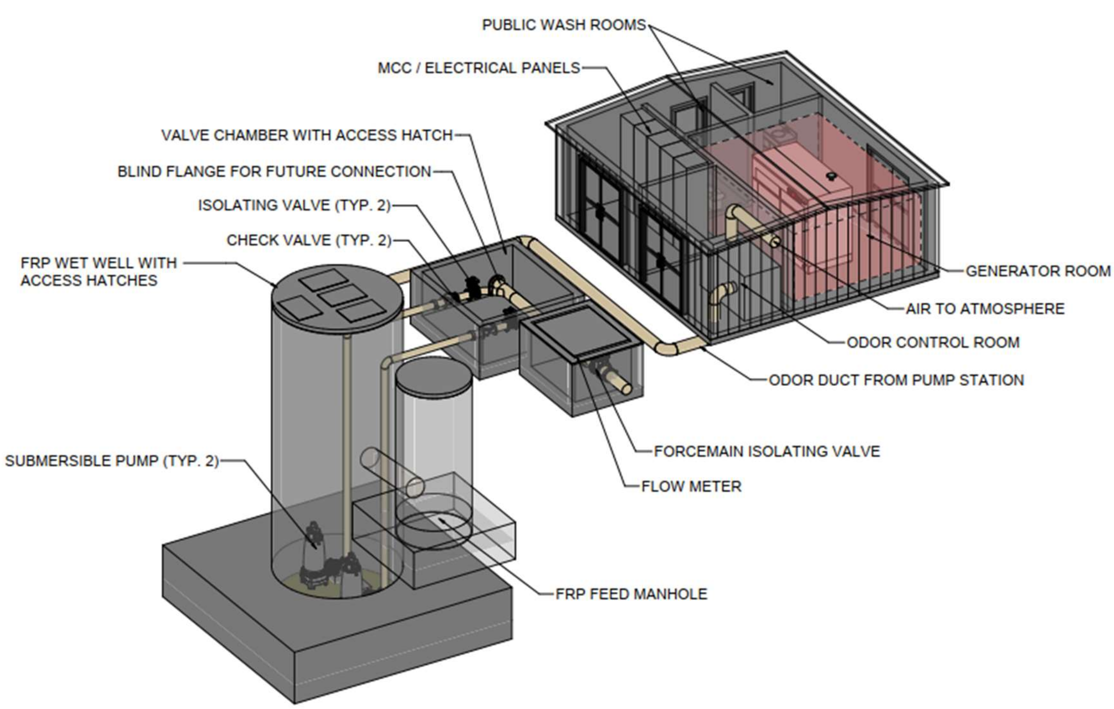

Figure 9: PS#1 Option A Configuration

OPTION B (KIOSKS)

The alternative option (Option B) for PS#1 configuration consists of individual units instead of a control building as shown in **Figure 10** and **Figure 11.** The generator, MCC and electrical kiosk and odour control unit would all be individual unitsFigure 10: PS#1 Option B Plan. The electrical equipment and SCADA system would be housed in the electrical kiosk. The pump station and valve chambers would be below ground level and have a similar configuration to Option A with a feed manhole, isolation valve chamber and flow meter chamber.

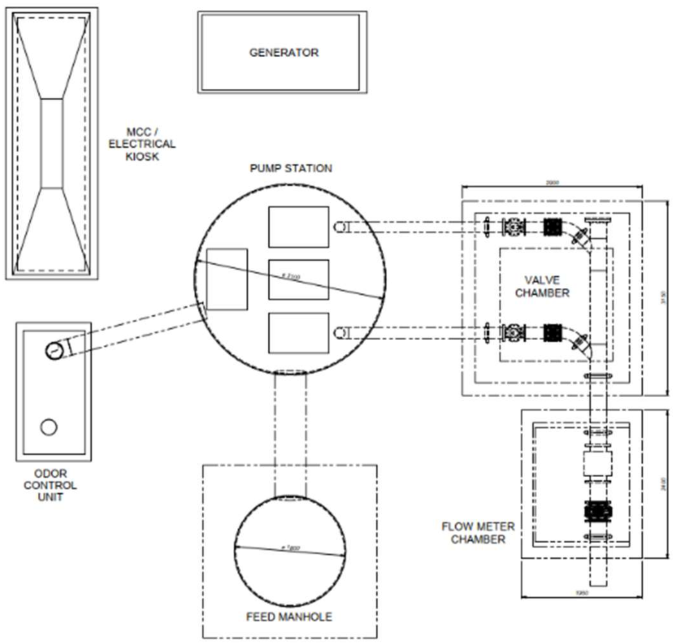

Figure 10: PS#1 Option B Plan

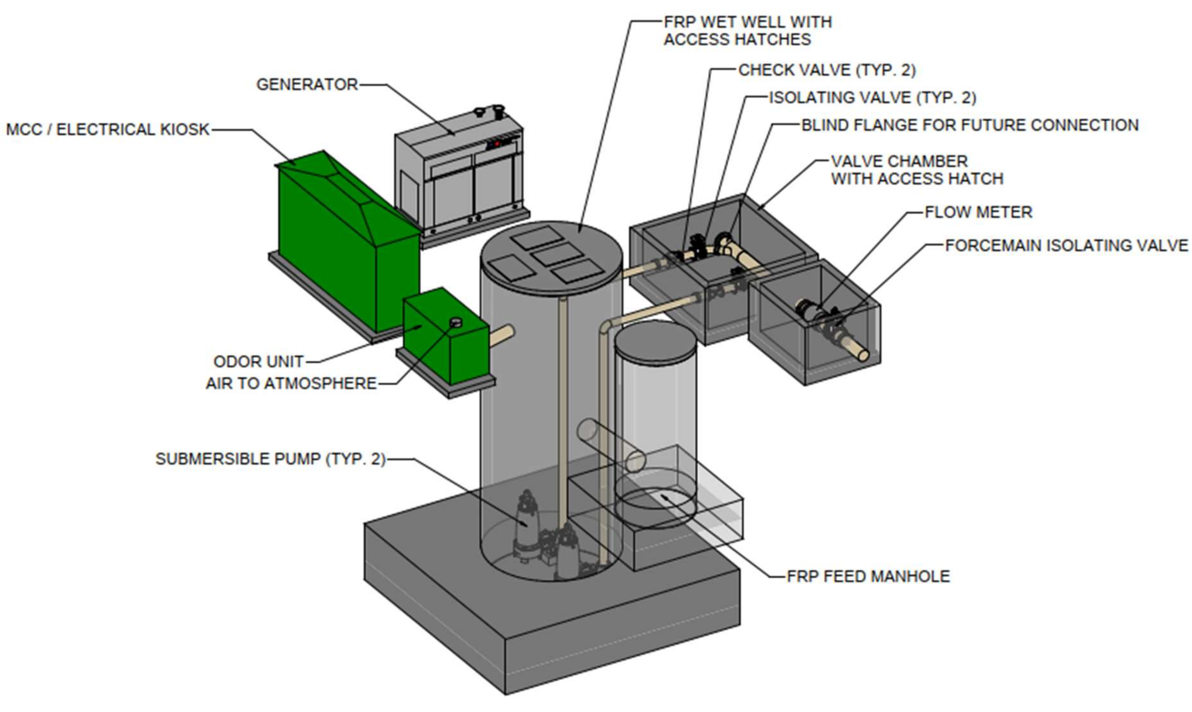

Figure 11: PS#1 Option B Configuration

This configuration requires less space than Option A, however there could be a noise issue during power failures when the generator is operational. The equipment would also be more susceptible to vandalism as they would not be enclosed with a fence or building.

ODOUR CONTROL

At the start-up stage of the project, the incoming flow could be very low compared to the design flows, if certain sub-catchments are not included in the initial collection scheme. The long standing/retention time in the wet well and forcemain may create odours that will need to be treated.

Wastewater contains a large spectrum of organic and inorganic compounds that are degraded by mainly anaerobic, anoxic and aerobic biological treatment processes. At wastewater pump stations, many odorous compounds may be formed, especially under anaerobic conditions as by-products of this natural degradation process.

We proposed to use active carbon adsorption columns for the odour control as default option. The active carbon adsorption columns have the following advantages:

- Simple operation in a variety of applications.
- Additive compounds (caustic, permanganate) can substantially increase the adsorption capacity.
- High air flows can be accommodated in multiple granular activated carbon (GAC) units.
- High removal efficiency of both H_2S and organic sulphur compounds.

The disadvantages are also important to note:

- Activated carbon is imported and expensive.
- Activate carbon has limited life depending on sulphur loading.
- Spent activated carbon must be regenerated and will lose adsorption capacity over time.

2.2.2 PUMP STATION #6

PS#6 is sized to convey a flow of 34 L/s to PS#1. Once PS#3 has been constructed (Phase 1B), PS#6 will pump a minimum flow of 34 L/s and maximum flow of 49 L/s to PS#3. The pump station will have a duty/standby configuration.

PROPOSED PUMP STATION LAYOUT

Two options have been considered for the pump station configuration. Option A, pump station with a building, and Option B, pump station with kiosks, are outlined below.

OPTION A (BUILDING)

The pump station will consist of an FRP manhole for the collection of flow from the catchment areas. This configuration also provides the possibility of constructing a future manhole pump station in the future if this should be required, without the need to isolate PS#6. PS#6 will have a 3.1m diameter FRP wet well and two submersible pumps with quick release couplings to remove the need for manual removal of the pumps. The wet well is sized to allow for the future installation of a third pump within the same wet well. The initial two pumps will be NP3171SH 35HP pumps with 100 mm discharge connections. For the future phases, a third NP3171SH 35HP can be installed in the wet well. The conceptual layout is shown in **Figure 12**.

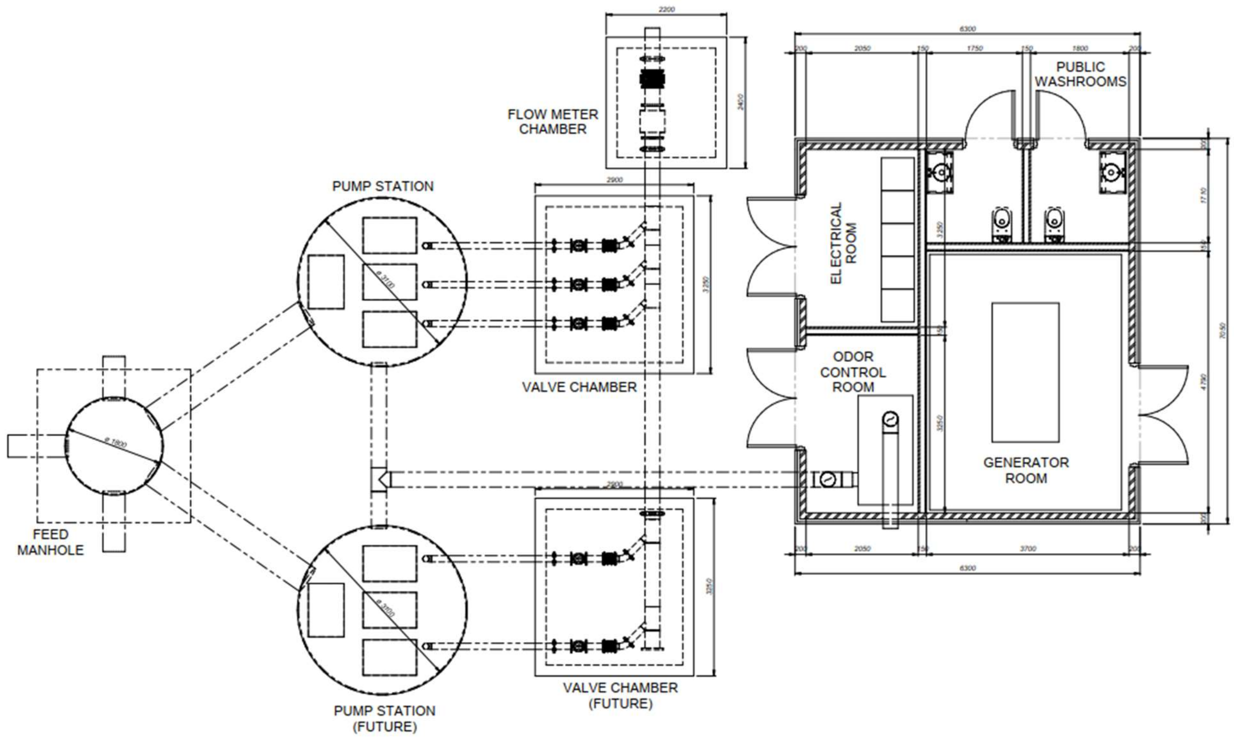

Figure 12: PS#6 Option A Plan Layout

The pump station will have a flowmeter chamber with a flow meter and isolation valve. Each pump outlet pipe will have an isolation valve and a non return valve in a valve chamber with a separate access hatch to the wet well. The pumps will be removed by a crane truck in lieu of an overhead gantry to limit the visual impact of the pump station on local residents.

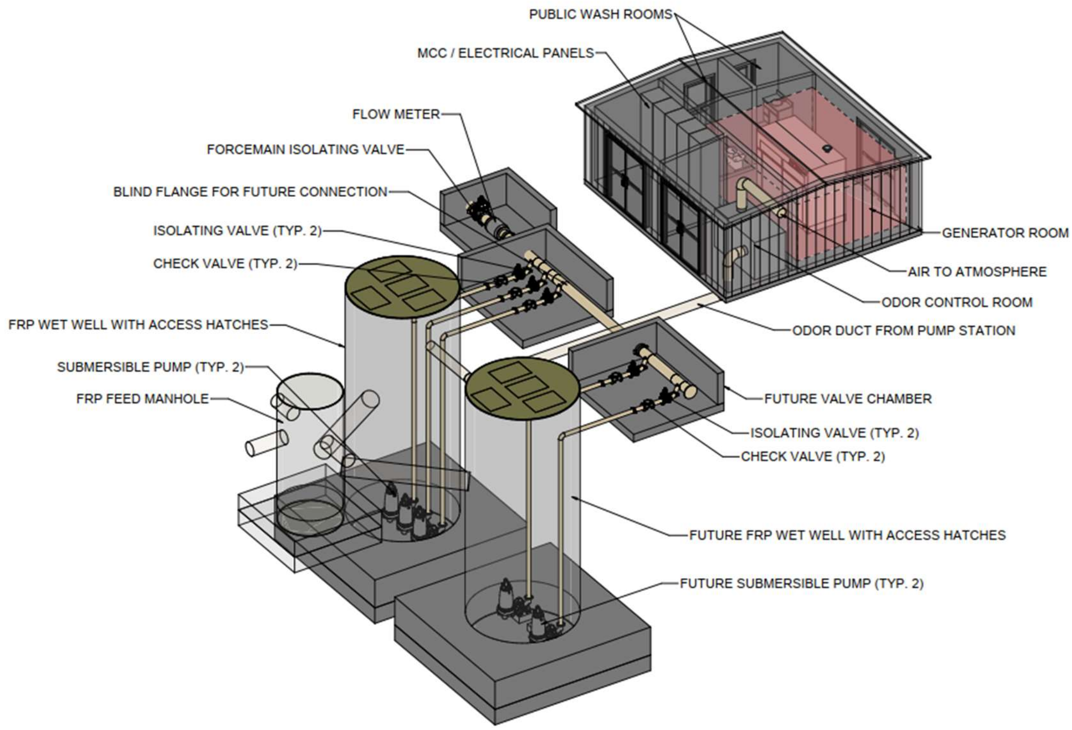

Figure 13: PS#6 Option A Configuration

Additional features of the pump station include a control building with a backup generator and an onboard fuel tank, an odour control room, and an electrical room to accommodate the electrical equipment and SCADA system as shown in **Figure 13**. The building will also house public washrooms.

OPTION B (KIOSKS)

Similar to PS#1, PS#6 Option B configuration consists of individual units for the generator, MCC and electrical and odour control as shown in **Figure 14** and **Figure 15** below. The electrical equipment and SCADA system will be housed in the electrical kiosk.

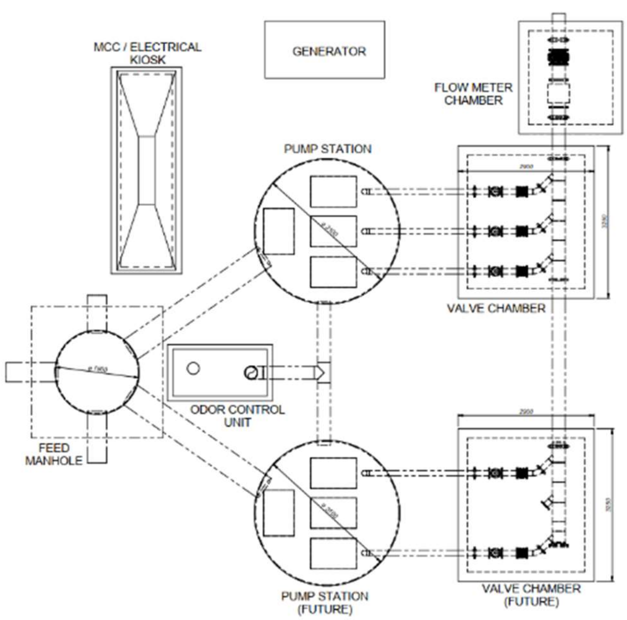

Figure 14: PS#6 Option B Plan Layout

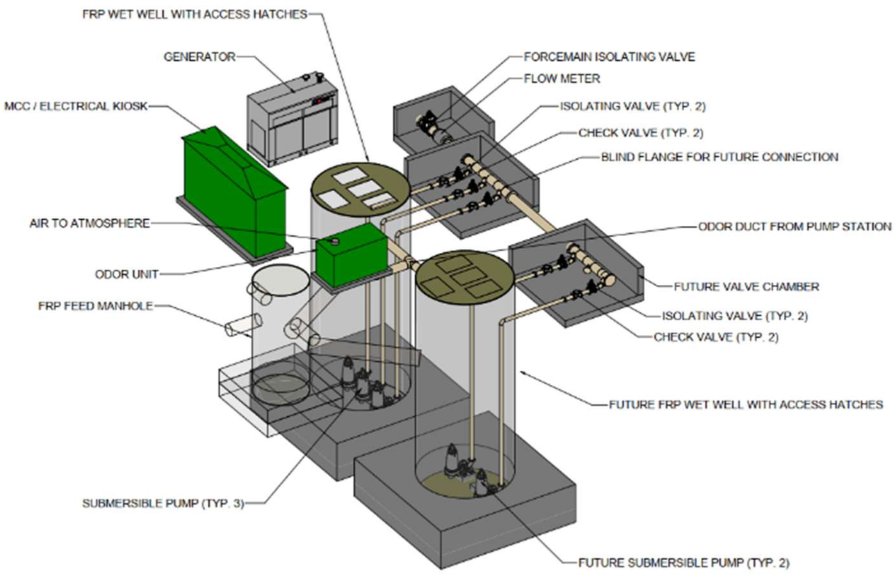

Figure 15: PS#6 Option B Configuration

The other elements of the pump station configuration are similar to Option A, with below ground wet well, valve chamber and flow meter chamber. This option has similar issues as PS#1, with a risk of vandalism and noise issues when the generator is in operation.

ODOUR CONTROL

Similar to PS#1, the incoming flows at system initiation will be low compared to the ultimate design flows, as the initial level of development and areas serviced by the collection system is smaller than the ultimate build out. With the initial low flows, long standing/retention time in the wet well and forcemain may create odour issues.

Wastewater contains a very large spectrum of organic and inorganic compounds that are degraded by mainly anaerobic, anoxic and aerobic biological treatment processes. At wastewater pump stations, many odorous compounds may be formed, especially under anaerobic conditions as by-products of this natural degradation process.

We proposed to use active carbon adsorption columns for the odour control as default option at PS#6 as well. Refer to Section 2.2.1 for advantages and disadvantages of active carbon adsorption columns.

2.2.3 PUMP STATION LAYOUT COMPARISON

The two options for the layout for PS#1 and PS#6 has been outlined in the sections above. There are two options, pump station with control building (Option A) and pump station with kiosks (Option B). The advantages and disadvantages of the options are summarized in the table below.

Table 1: Pump Station Layout Comparison

	OPTION A (BUILDING)	**OPTION B (KIOSKS)**
Advantages	• Opportunity for public facilities provided (washrooms)	• Reduces visual impact of the pump station • Lower cost associated with kiosks

Disadvantages	• Visual impact of the pump station building • Higher costs for construction of building	• Does not provide opportunity for any public facilities • Risk of vandalism • Increased noise, in particular if the genset is operating

2.3 FUTURE REGIONAL PUMP STATION

The Future Regional Pump Station will be constructed in the Future Phase of the project. It will convey a minimum flow of 80 L/s and maximum flow of 229 L/s to the Courtenay River Siphon. In the design flow scenario, the pump station will be conveying flow from all seven pump stations to the Courtenay River Siphon. There is also the potential for an additional 75 L/s from South Courtenay which will increase the flow to 304 L/s via two forcemains. The location of this regional pump station has not been confirmed and has not been included in this phase of design.

The primary reasoning for the addition of a regional pump station is due to the limited space available at the position of PS #1 as well as the visual impact for the community of a large pump station on the waterfront. Further to the construction of the regional pump station, the proposed position of PS#1 is within the Coastal flooding zone. The chosen position of the regional pump station should be outside the coastal flood level ensuring this pump station is not damaged should a coastal flood occur.

2.4 MITIGATION

VISUAL

As outlined in Section 2.3, the addition of the Future Regional Pump Station is to mitigate a number of concerns with having a large pump station at the location of PS#1. The addition of the Future Regional Pump Station reduces the size of pump station required for PS#1 which is proposed to be located at the waterfront along Marine Drive. The reduced pump station size at PS#1 reduces the visual impact for the local community at this location.

The option of constructing the kiosks and units rather than a control building further reduces the visual impact of the pump station; this is particularly beneficial for PS#1.

CLIMATE CHANGE

The location of PS#1 is within Coastal Zone 64 which has a flood level of 5.1m according to the floodplain maps. The addition of the Future Regional Pump Station at a location out of the coastal flooding zone will ensure that the large pump station is undamaged from coastal flooding. Flooding impacts will be limited to the smaller PS#1. There are several measures that can be incorporated into the design to reduce the risk of damage from a flood event at PS#1. Refer to Section 2.1.1 for the mitigation measures discussed.

ODOUR

As outlined in Discussion Paper #1, the wet wells are initially oversized to the volume of in the incoming flow. This may lead to increased retention time and so active carbon adsorption columns for the odour control are proposed for PS#1 and PS#6 as discussed in the previous sections.

2.5 COST ESMITATE

2.5.1 CAPITAL COST

As discussed in Discussion Paper 1, at the preliminary design stage of projects a Class "C" cost estimate is prepared. The Class "C" cost estimate has a 30% contingency to account for any unforeseen changes in detailed design.

The "Class C" cost estimate of PS#1 and PS#6 in Phase 1A is summarised in **Table 2**. The summary costs of Option A for both pump stations and Option B for both pump stations are outlined in the table.

Table 2: Cost Estimate Summary

ITEM	DESCRIPTION	OPTION A	OPTION B
1	**Pump Station 1**		
1.1	Earthworks and Site Works	$ 67,000	$ 52,000
1.2	Building	$ 223,000	$ 100,000
1.3	Mechanical	$ 675,000	$ 528,000
1.4	Electrical	$ 471,000	$ 453,000
	Subtotal Item 1	$ 1,436,000	$ 1,133,000
2	**Pump Station 6**		
2.1	Earthworks and Site Works	$ 70,000	$ 49,000
2.2	Building	$ 201,000	$ 100,000
2.3	Mechanical	$ 632,000	$ 451,000
2.4	Electrical	$ 405,000	$ 453,000
	Subtotal Item 2	$ 1,308,000	$ 1,053,000
3	**General (Pump Stations)**		
3.1	Mobilization and demobilization (~3%)	$ 90,000	$ 80,000
3.2	Health and safety (~3%)	$ 90,000	$ 80,000
3.3	Environmental protection plan and monitoring (~3%)	$ 90,000	$ 80,000
3.4	Allowance for water management and bypass pumping (~3%)	$ 90,000	$ 80,000
3.5	Sediment and Erosion Control	$ 90,000	$ 90,000
3.6	Coordination with Hydro	$ 50,000	$5 0,000
	Subtotal Item 3	$ 500,000	$ 460,000
	Subtotal All Items	$ 3,244,000	$ 2,646,000
	Contingency (30% of Subtotal)	$ 974,000	$ 794,000
	Engineering (10% of Subtotal + Contingency)	$ 422,000	$ 344,000
	Total	$ 4,640,000	$ 3,784,000

The following general assumptions were used for preparing the cost estimate:

- Pump cost for PS#1 based on 1 duty + 1 standby, Flygt Model NP 3301 HT, 468 330mm impeller, 63 kW (85 HP), 600 V, 3 phase. Cost for upgraded pumps not included.
- Mechanical installation is based on 2 people, 15 days, $100/hr
- Odour control is assumed to be Pureair Odor Control Unit w/ Dry Chemical media, draw thru blower, mist eliminator - 250 cfm, w/ 1.5 HP motor, 600V/3 Ph, Class 1 Div 1 rated. A detailed study is required to confirm the odour control.
- Paving area estimated as 100m^2 for option A and 50m^2 for Option B, area to be confirmed at detail design.
- Option A cost include costing of a concrete pump station building, with separate underground wet well, flowmeter and valve chambers. Option B cost include costing of individual kiosks and units for the MCC, odour control and genset, with separate underground wet well, flowmeter and valve chambers.

2.5.2 OPERATING COST

The operating costs of PS#1 and PS#6 are presented in **Table 3** and **Table 4** below. The annual O&M costs includes operating costs, energy costs and maintenance costs per year. The non-annual replacement cost includes the replacement of pumps (every 25 years) and electrical equipment, HVAC and Odour Control and Genset (every 20 years) for the 50-year life cycle period.

Table 3: PS#1 O&M Cost

O&M COST ITEM	PS#1 (OPTION A)	PS#1 (OPTION B)
Annual Operating Cost		
Overhead	-	-
Operator Salary	$91,000	$91,000
Subtotal	**$91,000**	**$91,000**
Annual Energy/Fuel Cost		
Average Annual Pump cost	$10,868	$10,868
Energy (HVAC/Lighting/Odour/Plumbing)	$31,663	$1,666
Genset Fuel	$7,200	$7,200
Subtotal	**$49,732**	**$19,734**
Annual Maintenance and Repair Cost		
Building Maintenance	$4,460	-
Process Mechanical Maintenance	$4,200	$4,440
Process Electrical Maintenance & Genset	$8,880	$8,880
Odour Control & HVAC Maintenance	$6,350	$5,100
Subtotal	**$23,890**	**$18,420**
Total Annual O&M Costs	**$164,622**	**$129,154**
Non-annual Replacement or Upgrade Cost		
Replacement	$$748,000	$$664,000
Total Non-Annual O&M Costs	**$$748,000**	**$$664,000**

O&M COST ITEM	PS#1 (OPTION A)	PS#1 (OPTION B)
LCC		
Total Net Present Value (NPV)	**$15,177,689**	**$10,538,323**

Table 4: PS#6 O&M Costs

O&M COST ITEM	PS#6 (OPTION A)	PS#6 (OPTION B)
Annual Operating Cost		
Overhead	-	-
Operator Salary	$91,000	$91,000
Subtotal	**$91,000**	**$91,000**
Annual Energy/Fuel Cost		
Average Annual Pump cost	$3,510	$3,510
Energy (HVAC/Lighting/Odour/Plumbing)	$31,663	$1,666
Genset Fuel	$7,200	$7,200
Subtotal	**$42,374**	**$12,376**
Annual Maintenance and Repair Cost		
Building Maintenance	$4,020	$0
Process Mechanical Maintenance	$3,700	$3,670
Process Electrical Maintenance &Genset	$8,940	$8,880
Odour Control & HVAC Maintenance	$6,350	$5,100
Subtotal	**$23,010**	**$17,650**
Total Annual O&M Costs	**$156,384**	**$121,026**
Non-annual Replacement or Upgrade Cost		
Replacement	$745,250	$655,250
Total Non-Annual O&M Costs	$745,250	$655,250
LCC		
Total Net Present Value (NPV)	**$13,988,260**	**$9,712,446**

The following general assumptions were used for preparing the cost estimates:

- All costs are in 2022 dollars,
- Building maintenance annual costs are 2% of the building capital costs, process mechanical maintenance process and electrical maintenance annual costs are 1% of equipment capital costs

- Net present value costs are based on 50 years of operation, maintenance, and component replacement,
- All taxes are excluded,
- Inflation and escalation to account for actual expected prices at the time of tendering have not been accounted for at this time, and
- Life cycle costs have been estimated based on inflation factor of 1.48 %, energy cost escalation of 3.0% and the present value factor of 2%.