Capital Regional District

625 Fisgard St.,
Victoria, BC V8W 1R7

Notice of Meeting and Meeting Agenda
Skana Water Service Committee

Tuesday, March 4, 2025 | **9:30 AM** | **Goldstream Conference Room, 479 Island Hwy, Victoria BC V9B 1H7**

Members of the public can view the live meeting via MS Teams link: **Click here**
Alternatively, to hear the meeting via telephone:
Call: 1-877-567-6843 and enter the Participant Code 536 008 531#

P. Brent (EA Director), R. Anthony, M. Bentley, B. Hill, W. Korol

The Capital Regional District strives to be a place where inclusion is paramount and all people are treated with dignity. We pledge to make our meetings a place where all feel welcome and respected.

1. Territorial Acknowledgement

2. Election of Chair

3. Election of Vice Chair

4. Approval of Agenda

5. Adoption of Minutes

5.1. 25-0226 Minutes of the Skana Water Service Committee Meeting of October 31, 2024

Recommendation: That the minutes of the Skana Water Service Committee Meeting of October 31, 2024 be adopted as circulated.

Attachments: Minutes - October 31, 2024

6. Chair's Remarks

7. Presentations/Delegations

The public are welcome to attend CRD meetings in-person.

Delegations will have the option to participate electronically. Please complete the online application at www.crd.bc.ca/address no later than 4:30 pm two days before the meeting and staff will respond with details.

Alternatively, you may email your comments on an agenda item to the Committee at legserv@crd.bc.ca.

8. Commission Business

8.1. 25-0228 Senior Manager's Verbal Update

Recommendation: There is no recommendation. This verbal update is for information only.

8.2. 25-0215 Capital Projects and Operational Update - March 2025

Recommendation: There is no recommendation. This report is for information only.

Attachments: Staff Report: Capital Projects and Operational Update - March 2025

Appendix A: Technical Memorandum - Tank Replacement Options Analysis

9. Notice(s) of Motion

10. New Business

11. Adjournment

The next meeting is at the call of the Chair.

To ensure quorum, please advise Megan MacDonald (mmmacdonald@crd.bc.ca) if you or your alternate cannot attend

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MINUTES OF A MEETING OF THE Skana Water Service Committee, held Thursday, October 31, 2024 at 9:30 a.m., In the Goldstream Conference Room, 479 Island Highway, Victoria, BC

PRESENT: **Committee Members:** W. Korol (Chair); R. Anthony (Vice Chair); P. Brent (EA Director); B. Hill (EP)
Staff: J. Marr, Senior Manager, Infrastructure Engineering; D. Robson, Manager, Saanich Peninsula and Gulf Islands Operations; J. Kelly, Manager, Capital Projects, L. Xu, Manager, Local Services and Corporate Grants; C. Moch, Manager, Water Quality; L. Hardiman, Manager, Asset Management; M. Risvold (Recorder)

REGRETS:

EP = Electronic Participation

The meeting was called to order at 9:30 am.

1. TERRITORIAL ACKNOWLEDGEMENT

The Chair provided the Territorial Acknowledgement.

2. APPROVAL OF AGENDA

The order of committee business was amended:
7.1 Capital Project Status Reports and Operational Updates – October 2024
7.2 Asset Replacement Report Card
7.3 2025 budget

Two items were added to New Business:
9.1 Issuance of agenda
9.2 Disinfection Byproducts Update

MOVED by W. Korol, **SECONDED** by R. Anthony,
That the agenda be approved as amended.

CARRIED

3. ADOPTION OF MINUTES

MOVED by R. Anthony, **SECONDED** by W. Korol,
That the minutes of the February 16, 2024 Skana Water Service Committee meeting be adopted as circulated.

CARRIED

4. CHAIR'S REMARKS

The Chair's detailed remarks are attached to the minutes for the record.

The following concerns were shared:

- The community wants a chance to have their voices heard.
- The community is aware of the current water system challenges.
- The importance of community engagement.

Director Brent suggested that the committee could hold an informal meeting with the community, similar to other small water systems, to keep the water system users informed.

5. PRESENTATIONS/DELEGATIONS

There were none.

6. SENIOR MANAGER'S REPORT

D. Robson provided the following updates:

- The Capital Regional District (CRD) is running a campaign to inform homeowners within small water systems the benefits of winterizing their properties to prevent leaks during the cold season. Information has been shared on social media platforms and on the respective CRD Drinking Water Systems webpages.
- The Skana Water System is currently on Stage 3 water restrictions. Water quantity has been improving and water consumption has been reducing. It is anticipated that the current water restrictions will be removed in the coming weeks.
- CRD was successful in receiving a grant from the Union of British Columbia Municipalities for permanent water conservation signage. The signage will display current water restriction levels and will be installed in the community, replacing the current sandwich boards. It is anticipated that there will be no cost to the service for the signs or installation.

Discussion ensued regarding:

- The ability to share CRD content on Mayne Island's social media webpages.
- The ability to improve the current water conservation initiatives.
- Different water conservation measures taken for other small water systems on Mayne Island.
- The Committee wants a minimum of three water conservation signs installed in the community.

7. COMMITTEE BUSINESS

7.1. Capital Project Status Reports and Operational Updates – October 2024

Staff spoke to item 7.1.

Discussion ensued on the following items:

- **Project 24-02 Storage Tank Options Assessment:** Staff confirmed Associated Engineering is the consultant. The consultant was asked to review material options, supervisory control and data acquisition (SCADA) data, and site configuration. Staff also wanted a life cycle aspect but are aware of financial implications. The committee requested greater detail on report tables to indicate project completion status. Staff confirmed that completed projects are marked as complete, and dates indicated in the future are forecasted.
- **Decommissioning Unused Wells**: Letters were sent to specific homeowners. A right-of-way is in place for CRD-owned wells. Two private wells couldn't be located and are assumed buried.

Additional discussion points include:

- Potential implications or liability regarding another water system using a CRD well.
- Concerns of saltwater intrusion.
- The lowest value solution for protecting the water supply and storage tanks.
- Options for reusing the existing tanks.

- **Water Operations Update**: 42 cubic meters of water were delivered to Skana Water Service to allow Wells #13 and #8 to recover. Drought response claims were submitted to Emergency Management and Climate Readiness (EMCR), covering water delivery fees but not staff time.
- **Skana Water System**: Inquiry about individual water meters and tiered rate structure. Skana Water Service has meters but operates on a fixed fee structure, which does not incentivize water conservation.
- **Contract Completion for On-Island Operator**: The award for an on-island operator is complete, and the contract is in process. Training for the new operator is ongoing.
- **Level of Service for the Water System**: The operator will likely work two days per week, with additional days as required. Contract services will be provided to both Surfside and Skana Water Systems on Mayne Island.

Additional discussion points include:

- Water conservation bylaw enforcement and Mayne Island-specific water restrictions
- Frequency of operators conducting well maintenance
- Reservoir flushing
- Publishing recorded meetings on YouTube
- Public consternation regarding upcoming capital work to the storage tank
- Community apprehension regarding an alternative approval process (AAP).

- **AAP Public Engagement**: Materials provided to the committee are published on the CRD website. Director Brent would attend a public meeting on Mayne Island prior to the AAP. The Chair will provide a date and time that is best to capture the community.
- **Water Quality Complaint**: Director Brent attended to a customer complaint. Additional water samples were tested for bacteriological and various metals, and results showed no concerns regarding water quality.

The report was received for information.

7.2. Asset Replacement Report Card

Staff spoke to item 7.2.

Discussion ensued regarding:

- Condition of water storage tanks
- Well assessments
- The use of fire hydrants for water flushing
- 2025 AAP and loan authorization

The report was received for information.

7.3. Skana Water Service 2025 Operating and Capital Budget

Staff spoke to item 7.3.

The committee discussed the budget preparation for the Skana Water Service, scheduled for July. They emphasized the importance of this information for potential budget revisions. Staff mentioned that this is the standard budgeting process for 200 services within the CRD and that the budget materials presented are forecasted.

MOVED by R. Anthony, **SECONDED** by B. Hill,
That the 2025 operating and capital budget for Skana Water Service be approved as presented and that the 2024 actual operating deficit be balanced on the 2024 Reserve Funds transfer (Capital Reserve Fund and/or Operating Reserve Fund).

CARRIED

MOVED by R. Anthony, **SECONDED** by B. Hill,
That the Skana Water Service Committee recommends that Electoral Areas Committee recommend to the Capital Regional District Board that the 2025 Operating and Capital Budget and the five-year Financial Plan for the Skana Water Service be approved as presented.

CARRIED

The committee shared that homeowners have expressed concerns and distress regarding the water system. Staff acknowledged the committees' concerns, stating this is a highly regulated drinking water service. There are compliance issues and aging infrastructure to maintain for service delivery.

8. CORRESPONDENCE

There was no correspondence.

9. NEW BUSINESS

9.1. Issuance of Agenda

The committee asked to receive their agendas 10 business days prior to the meeting date. Staff advised that all standing committees follow the same corporate protocol for issuing agendas and meeting materials 72 hours prior to the meeting date. The CRD Board and Standing Committees meet on Wednesdays and the agendas are published on Fridays.

9.2. Disinfection Byproducts (DBP) Update

Staff reported that the DBP levels are within the guidelines and expressed optimism regarding the success of the well decommissioning project. The second sampling station at Waugh Road was also below the health guideline limits.

Discussion ensued regarding:

- Rainfall and atmospheric river impacts
- Aquifer recharge after wet weather

10. ADJOURNMENT

MOVED by B. Hill, **SECONDED** by R. Anthony,
That the October 31, 2024 Skana Water Service Committee meeting be adjourned at 12:24 pm.

CARRIED

_____
CHAIR

_____
SECRETARY

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REPORT TO SKANA WATER SERVICE COMMITTEE
MEETING OF TUESDAY, MARCH 4, 2025

SUBJECT **Capital Projects and Operational Update - March 2025**

ISSUE SUMMARY

To provide the Skana Water Service Committee with capital project status reports and operational updates.

BACKGROUND

The Skana Water System is located on the north side of Mayne Island in the Southern Gulf Islands Electoral Area and provides drinking water to approximately 52 customers. Capital Regional District (CRD) Infrastructure and Water Services is responsible for the overall operation of the water system. The design and construction of water system facilities are overseen by the CRD Infrastructure, Planning and Engineering and Infrastructure Water Operations divisions. The day-to-day operations and maintenance is currently being performed by CRD Infrastructure Operations. The quality of drinking water provided to customers in the Skana Water System is overseen by the CRD Water Quality division.

CAPITAL PROJECT UPDATE

17-04 | Well #8 Upgrade

Project Description: Conduct well improvements including new well liner, replacement of well seal and SCADA automation; relocate first customer service line to achieve proper chlorine contact time.

Project Rationale: An inspection of Well #8 identified several deficiencies. Most recommended improvements were carried out in 2018 including the installation of a new well liner, replacement of the well seal, and steel casing. Relocation of the first customer's service line was completed in July 2022. The remaining scope is related to Supervisory Control and Data Acquisition (SCADA) automation and staff are reviewing the scope and available funding into the first quarter (Q1) of 2025.

Project Update and Milestones:

Milestone	Completion Date
SCADA Automation – The work associated with the automation of Well #8 requires rescoping and overall project delivery to ensure all aspects of the project requirements are identified to establish project budget. The available budget is not sufficient to complete SCADA Automation but approximately $10,000 will be used to develop a scope and rough budget to better define a future capital project.	Q4 2024 to Q1 2025 (Target)
Project planning phase	Completed
Relocation of the first customer service line is being evaluated on delivery through CRD staff or contracted services	Completed
Service line replacement and well improvements	Completed

24-01 | Source Water Surveillance

Project Description: Design and install new well surveillance and water monitoring systems. 2024 funding is for initial assessment only.

Project Rationale: To provide operational flexibility and increased monitoring that will improve operational awareness and the ability to analyze trends. The improvements can also be used to improve response times related to water supply issues.

Project Update and Milestones:

Milestone	Completion Date
Scope Definition and Estimate	Q1 2025 (Target)
Project Planning Initiated	May 31, 2024
Funding Approved	March 2024

24-02 | Storage Tank Options Assessment

Project Description: Conduct an engineering assessment on options available for replacement of the Skana Water storage tanks. The assessment is to include material options and associated costing, as well as a high-level assessment on installation feasibility.

Project Rationale: Prior to proceeding with tank replacement, a revised options assessment has been proposed to better inform on the potential options and cost implications prior to proceeding to an alternative approval process (AAP) to secure debt for this replacement project.

Project Update and Milestones:

- Associated Engineering (B.C.) Ltd. have submitted their final draft of the Storage Tank Options Analysis Memo, which recommends replacement with two 46 cubic meter (m^3) shop-fabricated welded steel tanks with epoxy coatings. The preliminary cost estimate for this improvement was estimated at $940,000. A copy of this options analysis is attached as Appendix A for information. CRD will review the attached report with the Committee and discuss direction forward, including options for community engagement.

Milestone	Completion Date
Tank Replacement Options Analysis Memo - Final Draft	February 2025
Engineering Consultant Site Visit	Q4 2024
Engineering Consultant Scope Approved	Q3 2024
Project Planning Initiated	May 31, 2024
Funding Approved	March 2024

OPERATIONAL UPDATE

This is an operational update reporting period from October 2024 through January 2025.

- Water tanks drained, cleaned and visually inspected on November 19, 2024. The tank was last cleaned and inspected in 2021. Interior tank observations indicated a heavy number of carbuncles and corrosion in 2021 and similar findings during the most recent inspection.
- Corrective maintenance of the chlorine analyzer system. The chlorine probe required replacement primarily due to age and the requirement for a greater accuracy reading.

- Ongoing contract operator training continued during this period.
- Water quality concern brought forward from a resident. Operational response included additional water quality sampling and testing performed. Test results were all within normal parameters.
- Emergency response due to water quality concern. Reports of discoloured water were received from several residents. The cause was attributed to a rapid recharge of the well aquifer shortly after a significant rainfall event. A water quality advisory was issued for the service indicating that the discolouration poses no health or safety risks, and the water is safe to drink.
- Emergency call-out due to hydro power outage on December 14, 2024. Standby generator was deployed due to the length of time the water treatment plant was without power.

RECOMMENDATION

There is no recommendation. This report is for information only.

Submitted by:	Dan Robson, A.ScT., Manager, Saanich Peninsula and Gulf Islands Operations
Submitted by:	Jared Kelly, P.Eng., Manager, Capital Projects
Concurrence:	Joseph Marr, P.Eng., Senior Manager, Infrastructure Planning and Engineering
Concurrence:	Jason Dales, B.Sc., WD IV., Senior Manager, Wastewater Infrastructure Operations
Concurrence:	Alicia Fraser, P.Eng., General Manager, Infrastructure and Water Services

ATTACHMENTS

Appendix A: Associated Engineering Technical Memorandum: Skana Water Service Tank Replacement Options Analysis

APPENDIX A

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

TECHNICAL MEMORANDUM

Capital Regional District
Mayne Island

Skana Water Service
Tank Replacement Options Analysis

FEBRUARY 2025

APPENDIX A

TABLE OF CONTENTS

1 ISSUE

The Skana Water System is a small water system located on Mayne Island, operated by the Capital Regional District (CRD). The Skana Water System consists of two groundwater wells (Wells 8 and 13) and two treatment facilities (Skana and Sandy Hook), one for each well to chlorinate the groundwater.

Skana water treatment plant feeds a set of two gravity storage tanks which provide water at pressure, via distribution pipe. The existing horizontal cylindrical welded steel tanks have been identified as having significant corrosion. They are at the end of their 40-year lifetime and are not believed to meet post disaster seismic design requirements. Consideration of options for their replacement is required.

2 BACKGROUND

2.1 Existing System

The Skana Water System is located on Mayne Island, serving homes on Waugh Road, Aya Reach Road, Skana Road, and Sandy Hook Road, near Lighthouse Point, generally on the north of the Island. The system is served by Skana water treatment plant and tanks which are located south of Waugh Road, as well as by Sandy Hook water treatment plant, northwest of Sandy Hook Road, as illustrated in **Figure 2-1**. The system currently serves approximately 53 parcels, with a current capacity of 45.3 m³ per tank, 91 m³ in total. The system has the ability to be developed up to a maximum of 73 parcels.

The tanks are located at an approximate elevation of 50 m. By gravity, a series of 100 mm PVC pipes supply water at a residual pressure reported to be up to 350 kPa (50 psi), to parcels along Waugh Road, Aya Reach Road, and Sandy Hook Road, at an approximate elevation of 20 m. The location of the existing Skana water system tanks is suitable for gravity storage tanks, and is accessible from Waugh Road, for ease of maintenance and operation requirements. The tanks were constructed in the 1970s and are constructed as horizontal steel cylinders, each supported on two concrete saddles. Tank 1 is shown in **Figure 2-2** with the second tank out of view behind it.

Figure 2-1 Skana Water Service Area

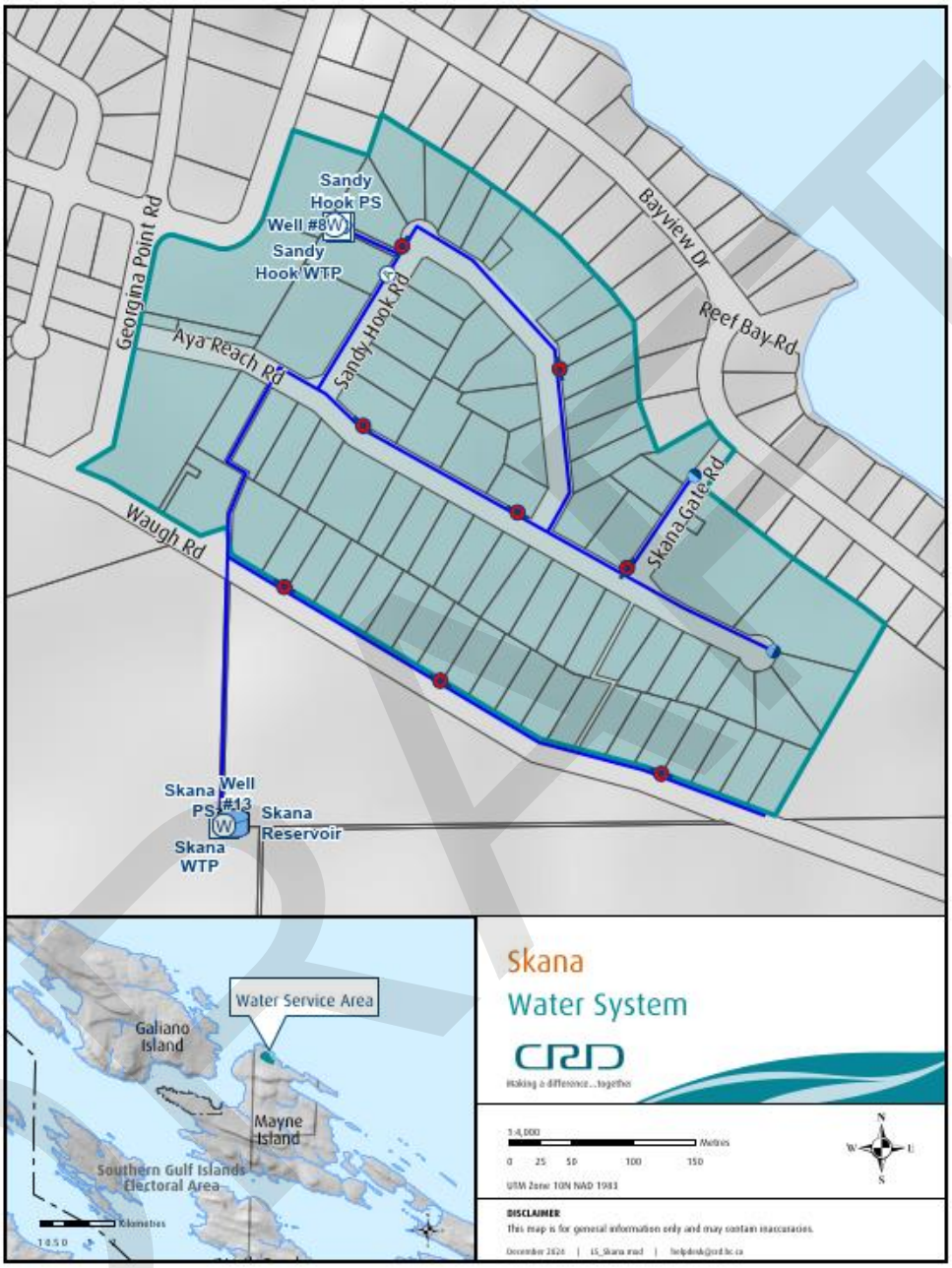


Figure 2-2 Skana Water Storage Tanks

Associated observed the concrete saddles for Tank 1 (closest tank in **Figure 2-2**) to have settled and sitting at an angle 0.4° to 2.7° off of level. The tank walls are understood to be 6 mm thick based on measurements written on the outer tank wall as well as a 2016 assessment report.

The tanks contain low- and high-level float switches, which are used to control the production of water. The level switch wires are routed in the same raceway as the PVC pipe, as illustrated in **Figure 2-2**.

The Water Treatment Plant is located on the same site, adjacent to the tanks. Single phase power is provided to the water treatment plant from a pole mounted transformer adjacent to the treatment plant building.

To understand the operation of the system, relevant background information was collected from the CRD and a site visit was conducted on 7 November 2024. Annotated photographs taken during the site visit are included in **Appendix B**. Background information reviewed included:

- Record Drawings
- Skana water system annual report (2023)
- Assessment of System Tanks, conducted by Stantec (2016)
- SCADA system overview

3 STAKEHOLDERS

The primary stakeholders for the tank replacement are stakeholders are property owners and residents within the service area boundary including customers whose potable water is supplied from the system. Other stakeholders include the Capital Regional District Infrastructure & Water Services (IWS) who own, operate and maintain the system.

4 OBJECTIVE

The objective of this memorandum is to review available information and recommend next steps for the future water storage needs of the Skana water system.

5 TECHNICAL REVIEW OF SYSTEM

5.1 Tank Sizing

Replacement tanks for the Skana Water System should be designed in accordance with the BC Ministry of Health's 2023 Design Guidelines for Drinking Water Systems in British Columbia (Guidelines). Mayne Island Trust Land Use Bylaw No. 146 was also considered, but the provincial guidelines provide the most comprehensive direction for reservoir design. Use of these recently introduced guidelines will be beneficial for obtaining the required Permit to Construct Waterworks, from Island Health Authority, at the completion of the tank design.

Sizing the tanks to include fire storage presents a problem for the Skana system. The demand on the system is typically low relative to the larger volume of water which would be required for fire storage. Fire storage would therefore result in high water age, and present water quality challenges. A comparison of storage volume with and without fire storage is presented in **Table 5-1**.

In lieu of a regulatory requirement, the CRD's July 2009 Engineering Specifications and Standards Drawings summarize requirements which are applied within the Juan de Fuca (JDF) distribution system, and these were used as a basis to develop tank sizing with fire storage. Section 4.12, Reservoirs, of the standards recommends:

- Equalization storage of 25% of maximum day demand (MDD)
- Fire storage of 1,200 m^3
- Emergency storage of 50% of average day demand (ADD)

The fire storage required by the JDF standards would result in extremely long residence time within the Skana tanks and would cause water quality issues. As an alternate, we recommend typical single family home fire flow of 4000 L/min for 1.5 hours, resulting in a volume of 360 m^3, as per the Fire Underwriter's Survey, Water Supply for Public Fire Protection Guidelines. However, the existing infrastructure at Skana water treatment plant and tanks is inadequately sized to deliver flows of 4000 L/min to hydrants within the Skana system. The existing 100mm diameter piping would also present limitations for fire flow, providing higher velocities than required to the hydrants. Fire storage was not further considered at this time.

Table 5-1 Tank Volume Comparison

	With fire storage (m^3)	Without fire storage (m^3)
Equalization storage 25% of maximum day demand (16.6 x 2.5 x 0.25)	11.4	-
Fire storage	360	-
Emergency storage 50% of average day demand (16.6 x 0.25)	8.3	-
Maximum day demand (16.6 x 2.5)	-	46
Total reservoir volume	**380**	**46**

As fire storage is not to be provided, the Guidelines indicate that storage equal to MDD should be provided. Water production records indicate a 2019 – 2023 ADD of 12m³/day (source: Skana Water Production spreadsheet provided by CRD). Scaling this value for maximum likely population growth to 73 parcels at build-out of the service area provides an ADD of 16.6 m³/day. The peaking factor of 2.75 from the Guidelines is then applied to the ADD figure to estimate MDD, providing a recommended 46 m³ of storage. This is approximately 50% of the volume available in the existing tanks.

Build-out capacity can be achieved through construction of a single 46 m³ tank, or through two 23 m³ tanks. A vertical tank solution is recommended for either tank configuration. Vertical tank(s) occupy a smaller site footprint, and design of foundations for seismic and gravity loads is simpler compared to a horizontal tank.

A larger tank could also be considered in order to provide additional emergency storage beyond the amount required by the guidelines. Providing additional storage will improve the resilience of the system, for example by allowing additional time for recovery of source wells or in case repair parts need to be mobilized to the island using scheduled ferries. A significantly larger tank can result in operational challenges due to high water age. Keeping the size of the existing tanks, at 91 m^3 total, has been demonstrated to provide a reasonable balance of these considerations and suitable for maintaining an adequate level of service to the water system users. The service area can experience extended power outages and is situated in a remote location, so having storage beyond the Guidelines calculation of 46 m³ will be useful.

5.2 Tank Material

Tanks suitable for potable water service may be manufactured from a wide variety of materials. For field-erected tanks away from large population centres, bolted steel tank construction is common. For small-scale tanks such as those required at Skana, shop fabricated tanks are available in a wider range of materials, including various polymers, coated steel or stainless steel.

Glass-fused (bolted) steel tanks have been used for many years for many applications including reservoir and other liquid storage purposes. This type of tank can provide an economical way to combine shop coating of panels with field erection for a robust tank. Historically, depending on the corrosiveness of the stored liquid, epoxy coated steel tanks have performed satisfactorily with the service life of the epoxy coating lasting at least 30 years. Glass-fused steel tanks have also been used in many similar applications where the estimated maintenance life can extend beyond 50 years. Cathodic protection is often used as an additional measure to protect these tanks and prolong the overall service life. These tanks can be assembled on site using relatively lightweight equipment.

When the required tank size is small enough to facilitate shipping of a complete tank, it is also practical to fabricate a steel tank off site, apply factory coatings to the entire fabrication, and deliver a complete tank to site. As tank sizes exceed 3.5 to 4 metres in diameter, transportation becomes increasingly challenging. Epoxy coated steel would be a likely choice, and coating life of at least 30 years could be expected. Fabrication quality can be better controlled compared to a field-fabricated tank. A large crane is required to lift a shop fabricated tank. Manufacturing for welded steel tank(s) could likely to be completed in BC and this option is therefore less prone to concerns around shipping disruption, Canadian Dollar value fluctuation, and import tariffs.

Cross-linked polyethylene (XLPE) is a polymer with excellent mechanical properties that can be manufactured into tanks within a manufacturing facility.

The material is suitable without protection for storage of potable water or for other materials such as chemical storage, and can be procured with NSF 61 certification. A carbon black additive can be added to the polymer during manufacturing to reduce the effects of UV exposure which can cause the material to become brittle over time. These tanks would absorb more solar radiation due to the black additive, resulting in higher water temperatures and requiring operational management to avoid water quality degradation. The mechanical properties of cross-linked polyethylene allow it to provide adequate performance even under seismic loading. An XLPE tank would be expected to last at least 20 years.

Stainless steel is another candidate material which offers many of the benefits of steel while being more resistant to environmental corrosion. Stainless steels are generally still susceptible to corrosion in the presence of chloride (salt), including the sodium hypochlorite which is added to the Skana water for disinfection. When tank size becomes small and the relative cost of applying coatings is more significant, this can be a good option. Stainless steel can be passivated, rapidly forming a thin layer of oxide which prevents more significant corrosion. A stainless-steel tank with proper maintenance would be expected to last more than 50 years if chloride levels are carefully managed. Stainless steel was not considered further due to the additional care required for management of chlorides.

Corrosion within a steel tank often takes place above the water line within the tank where excessive moisture exchanges with oxygen create corrosion when metal is exposed. Therefore, regular maintenance and monitoring programs to inspect for corrosion will help extend the overall service life of any metallic tank. Such programs can be performed through observation at the rooftop hatch of the tank, and a permanent access ladder can be provided to facilitate the required access. For larger tanks, two access manways should be installed at the bottom of the tank at opposite sides. This will improve the safety access from a confined space and improved ventilation.

Tank material options can be considered in more detail as the work progresses, and it is also possible to procure a tank in such a way that a contractor will propose the tank that provides the best value to the Skana system from more than one acceptable solution.

5.3 Tank Replacement

Construction of replacement tanks would result in a water system that operates in the same way as the existing system. This would require the construction of new tanks complete with foundations, piping tie-in to the 100 mm PVC inlet and outlet, and instrumentation. Since these tanks would be hydraulically similar to the existing tanks, it is not anticipated that any modifications to the treatment plant would be required.

Three options were considered for a single 73 m^3, or pair of 46 m^3 vertical tanks to accommodate the required volume: cross-linked polyethylene, glass-fused (bolted) steel and shop fabricated (welded) steel tanks. Using paired tanks will allow the CRD greater flexibility in terms of maintenance and eventual tank replacement. With concrete foundation slabs, ladders and roof hatches, the cost for these tanks is estimated in **Table 5-2**, for each material type.

Table 5-2 Class D Opinion of Probable Cost (+/- 50%)

Option	Likely capital cost	Estimated Life
One 73 m^3 glass-fused steel tank*	$1,210,000	30
Twin 46 m^3 welded steel tanks	$940,000	50
Twin 46 m^3 XLPE tanks	$790,000	20

*Smallest available size of glass-fused steel tank.

The smallest available size of glass-fused steel tank is 73 m^3, which is approximately 1.6 times the required capacity. The cost of a glass-fused steel tank in this size is relatively high, and consequently glass-fused steel is not commonly used for tanks of this size unless there are significant access constraints for a site that preclude lifting of a shop fabricated tank into place. This site does not have such access constraints. Despite the operational flexibility having two tanks allows for, a single glass-fused steel tank is proposed as two 73 m^3 tanks, at 146 m^3 volume, is excessive volume for maintenance of suitable water quality. The cost of two glass-fused steel tanks would also be prohibitive.

Based on a welded steel tank, or tanks, with foundations, piping and instrumentation, the total installed cost is expected to be in the range of $940,000 +/- 50%.

Cross-linked polyethylene tank(s) would provide a lower up-front capital cost; however, they also have the shortest anticipated service life. To allow comparison of the tank options with different service life expectancy, a life cycle analysis was conducted. This analysis indicates that in using an extreme discount rate of 9.5%, the longer life expectancy of the steel tanks is expected to provide an equivalent annual capital cost to the XLPE tanks. The findings are presented in Appendix D.

A geotechnical investigation is recommended to be conducted at the location of the replacement tank(s), due to proximity to the adjacent slope. This is to be considered in conjunction with the design of tank foundation envelope and depth, and with consideration for seismic requirements.

It is anticipated the existing chlorine recirculation pump in Skana water treatment plant, can be re-used for tie-in to the new tank(s), and configured to the new tank(s) volume to achieve the required chlorine residual of the system.

It is recommended that the construction of the new tanks be staged to ensure a tie-in sequence that minimizes service disruptions. Initially, one existing tank will be decommissioned while the other remains in service. During this time, the new tank—or one of the two new tanks—will be constructed. Once completed, the second existing tank will be decommissioned, and service will be fully transitioned to the new tank(s).

Wired level transmitters with backup float switches can be used for the new tank(s), providing comparable information to the existing setup. A more significant upgrade to the existing control system may be appropriate at the same time, given the age of the existing controls.

6 RECOMMENDATIONS

Based on this analysis, it is recommended that the CRD proceed with design and procurement of a pair of 46 m³ shop-fabricated welded steel tanks with an epoxy coating. This option provides good operational flexibility at reasonable cost with the ability to conduct good quality control in a factory setting and minimize site disruption. Using paired tanks will allow the CRD greater flexibility in terms of ongoing operation and maintenance.

CERTIFICATION PAGE

This report presents our findings regarding the Capital Regional District Mayne Island Skana Water Service Tank Replacement Options Analysis

Respectfully submitted,

Associated Engineering (B.C.) Ltd.
Engineers & Geoscientists BC Permit Number 1000163

Prepared by:	Reviewed by:
Shane Duggan Mechanical Designer	Jonathan Musser, M.A.Sc., P.Eng. Process Engineer

SD/JM/nhd

APPENDIX A - CLASS D OPINION OF PROBABLE COST

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

Project #: 2021-2386-05
Client: CRD Mayne Island
Project Name: Skana Reservoir
Revision Date: 09-Jan-25
Author: SD

Capital Cost Estimate - Preliminary

Estimate Classification - Class D +/- 50%
Expected accuracy per CEABC/EGBC definition:

			73 m^3 glass-fused steel tank		twin 46 m^3 welded steel tanks		twin 46 m^3 XLPE tanks	
Item	**qty**		**Cost**	**Total**	**Cost**	**Total**	**Cost**	**Total**
Mob/demob	LS		$ 30,000	$ 30,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000
Demolition	LS		$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Site piping	LS		$ 10,000	$ 10,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000
Sitework/grading	LS		$ 10,000	$ 10,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000
	LS		$ -	$ -	$ -	$ -	$ -	$ -
	LS		$ -	$ -	$ -	$ -	$ -	$ -
Reservoir	LS		$ 410,000	$ 410,000	$ 250,000	$ 250,000	$ 174,000	$ 174,000
Foundations	LS		$ 70,000	$ 70,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Controls	LS		$ 20,000	$ 20,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000
Subtotal				$ 555,000		$ 420,000		$ 344,000
Geotechnical investigation				$ 25,000		$ 25,000		$ 25,000
Engineering allowance				$ 75,000		$ 75,000		$ 75,000
General Costs (contractor)		15%		$ 83,250		$ 63,000		$ 51,600
Inflation		20%		$ 111,000		$ 84,000		$ 68,800
Remoteness		25%		$ 138,750		$ 105,000		$ 86,000
Contingency		40%		$ 222,000		$ 168,000		$ 137,600
Total				**$ 1,210,000**		**$ 940,000**		**$ 790,000**

APPENDIX B - SITE PHOTOS

Figure B-1 Tank

Figure B-2 Exterior Base of Tank 1

Figure B-3 Raceway Between Tanks

Figure B-4 Flange Connection/Corrosion

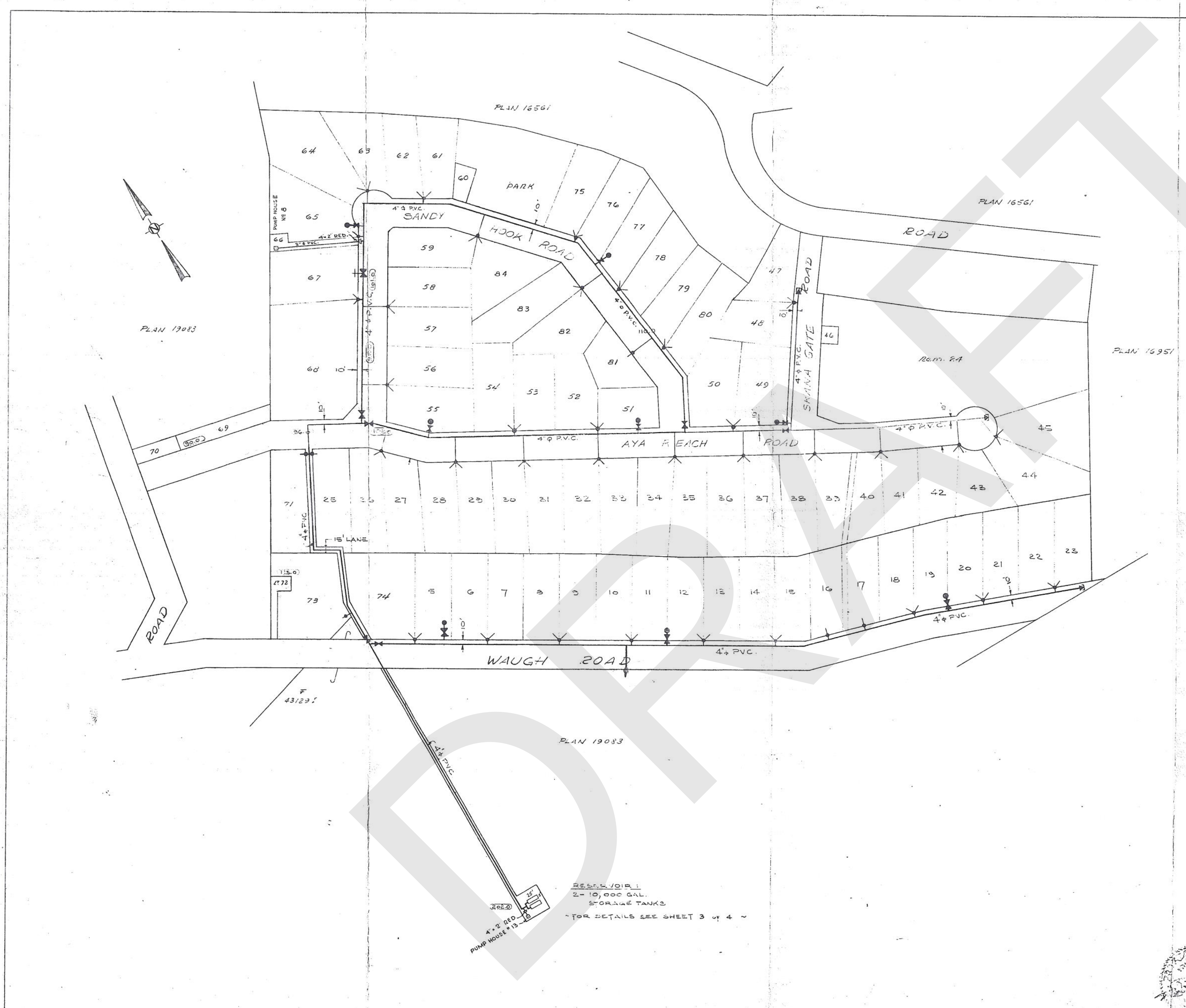
Figure B-5 Raceway to WTP

Figure B-6 Exterior Top of Tank

Figure B-7 Front of Tank 2

Figure B-8 Exterior Base of Tank 2

APPENDIX C - EXISTING INSTALLATION DOCUMENTATION



LEGEND:

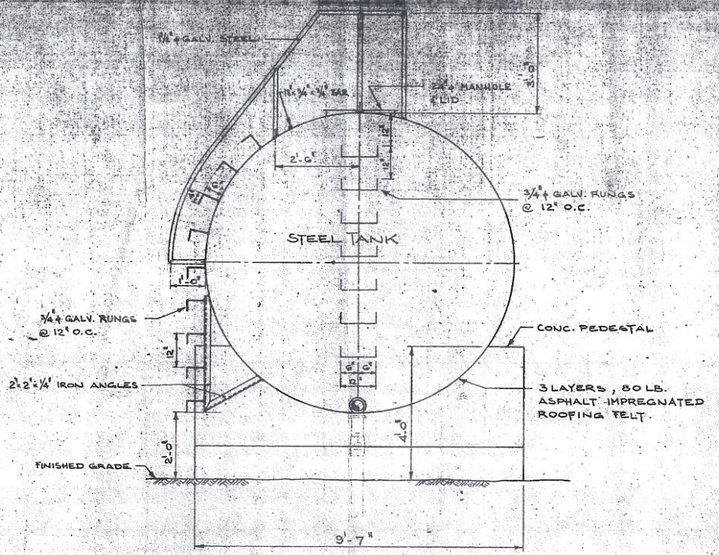
- PROPOSED WATER SYSTEM
- AIR RELIEF VALVE
- GATE VALVE
- STANDARD BLOW-OFF
- HOUSE CONNECTION (TO BE INSTALLED AT REQUEST OF PROPERTY OWNER). DOUBLE / SINGLE
- FIRE HYDRANT & GATE VALVE

NOTE:

1. ALL PIPE TO BE PVC., TYPE I, GRADE II, NORMAL IMPACT, CLASS 160 IN ACCORDANCE WITH ASTM STD. D1784 & D2241 AND SUITABLE FOR POTABLE WATER SUPPLY.
2. ALL MAINS TO BE STERILIZED AS PER A.W.W.A. SPECIFICATIONS C-601-68 FOLLOWING PRESSURE TESTS.
3. ALL MAINS UNDER TRAVELLED PORTIONS OF THE ROAD ARE TO BE ENCASED IN NO-CO-RODE CARRIER PIPE.
4. ALL GATE VALVES WILL BE UNDERWRITERS & F.M. APPROVED (175 p.s.i. WATER).
5. FOR CONSTR. DETAILS SEE SHEET 4 of 4.
6. ELEVATIONS SHOWN (114.0) ARE RELATED TO AN ARBITRARY BENCH MARK. TOP OF EXIST. STEEL CASING AT PUMP HOUSE #1 ELEVATION = 73.3
7. THRUST BLOCKS OF 1 CU.FT. CONCRETE POURED IN PLACE AND BEARING ON UNDISTURBED SOIL REQUIRED AT ALL HYDRANTS, BLOW-OFF, BRANCHES & DEFLECTIONS GREATER THAN 30°.
8. LOCATION OF AIR RELIEF VALUES TO BE ESTABLISHED IN FIELD.

Rev. #5 Jan. 3/72 - RELOCATE MAIN TO N. SIDE AYA REACH ROAD
Rev #4 July 1971 - ADD WELL 13 Delete 5 & 6. Add Lots 75-84
Rev #3 - June 7/71 RE-LOTTING & ADD WELLS 5, 6 & 8
REV. #2 - MAR 31 1971 - RE-LOTTING
REV #1 - MAR 13 1971 - RE-LOTTING, & RE-LOCATION OF MAINS. DELETE WELL & PUMPHOUSE #2.

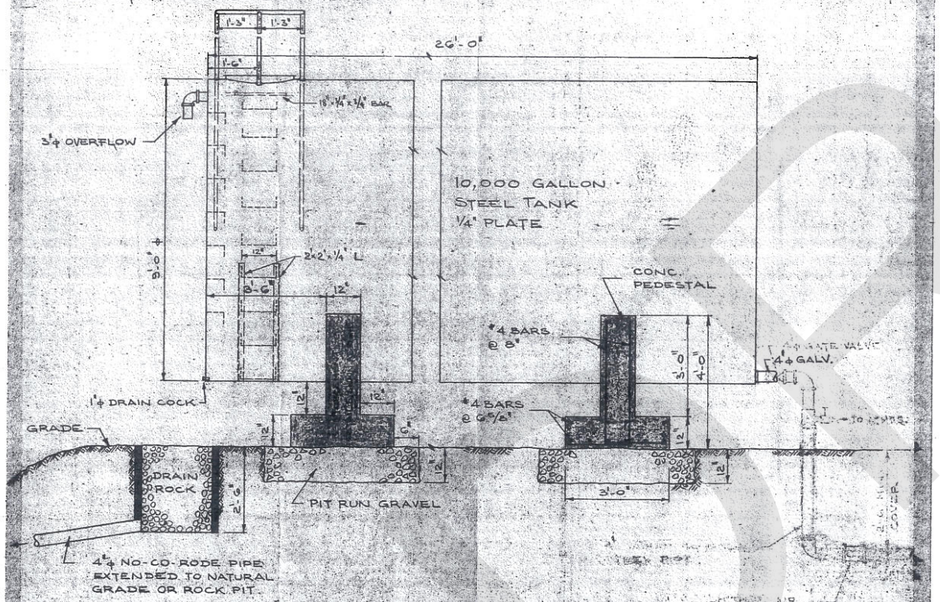
SKANA INVESTMENTS LTD.	
WATER DISTRIBUTION SYSTEM	
MATSON, PECK & TOPLISS 815 COOK RD., RICHMOND PHONE 278-9674	British Columbia Land Surveyors and Civil Engineers
DRAWN H.Q.	SCALE 1" = 100' HORIZONTAL VERTICAL
CH'K'D.	
APPR'D. HGT	DATE MAY 1, 70
JOB No. M 3107 W-2A	DWG. No. 1 of 4



FRONT VIEW

NOTES:

1. OUTSIDE TANK SURFACE TO RECEIVE ONE COAT OF T/O PAINT AS MANUFACTURED BY: TIDY WELDERS.
2. CONC. TO HAVE 3000 P.S.I., 28 DAY STRENGTH
3. PVC. PIPE WILL BE CLASS 160, NORMAL IMPACT.
4. ALL REINFORCING TO HAVE MIN. 1½" COVER.
5. ALL PIPE & FITTINGS TO BE 125 LB. C.I. GALV.

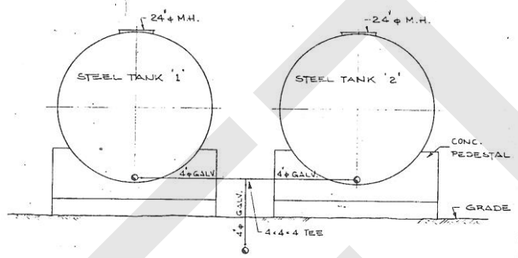


SIDE VIEW

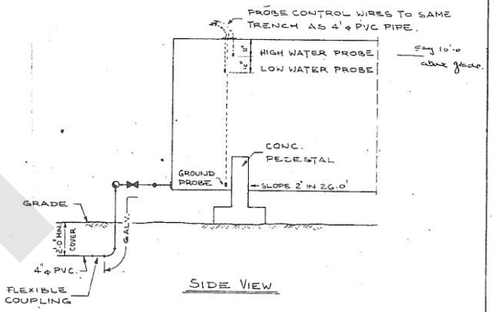
STORAGE TANK DETAILS

SCALE: ¼" = 1'-0"

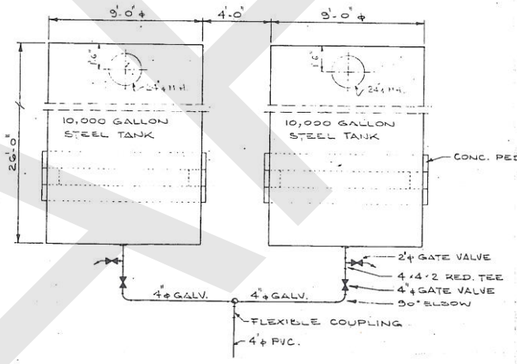
NOTE: PROBE CONTROLS TO BE INSTALLED IN ONE TANK ONLY.



FRONT VIEW



SIDE VIEW



PLAN VIEW

NOTE:

- ALL EXPOSED PIPES & FITTINGS MUST BE INSULATED WITH WEATHER-PROOFED ZERO PIPE INSULATION AS SUPPLIED BY JOHNS-MANVILLE OR APPROVED EQUAL.
- ALL PIPES & FITTINGS TO BE ECHED. 40, C.I. GALV.
- ALL GATE VALVES TO BE 125 LBS. STD. C.I. UNDERWRITERS & F.M. APPROVED.
- FOLLOWING RESERVOIR INSTALLATION, DISINFECT RESERVOIR WITH 25 ppm CHLORINE SOLUTION HELD FOR 24 HRS. MIN. CL. RESIDUAL - 10 ppm.

STORAGE TANKS - LAYOUT DETAILS

SCALE: ¼" = 1'-0".

British Columbia Land Surveyors and Civil Engineers

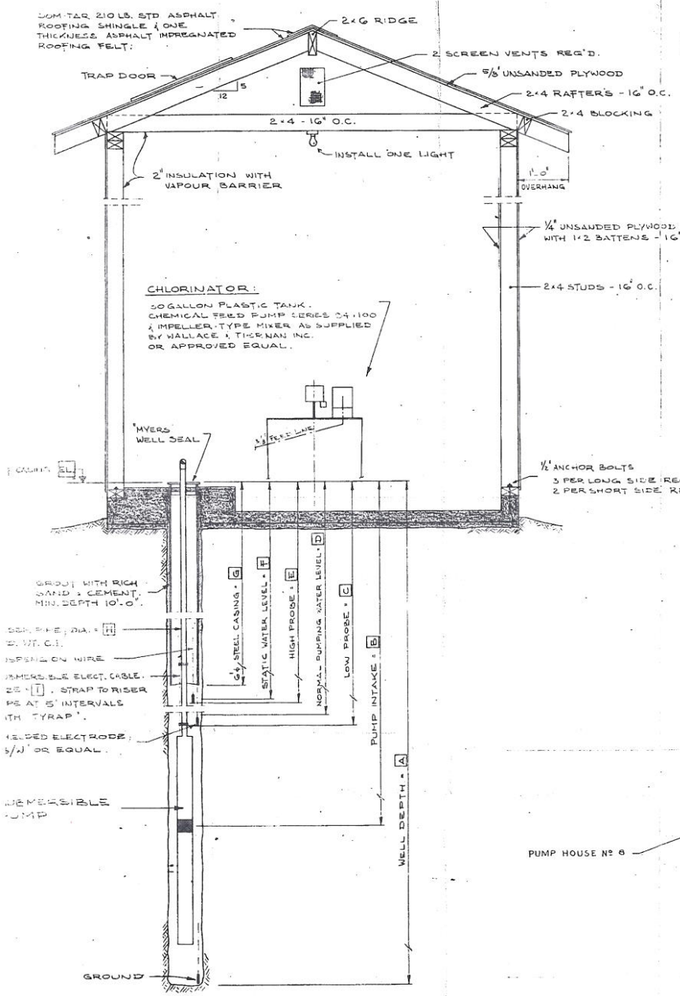
SKANA INVESTMENTS LTD.

STORAGE TANK DETAILS

MATSON, PECK & TOPLISS

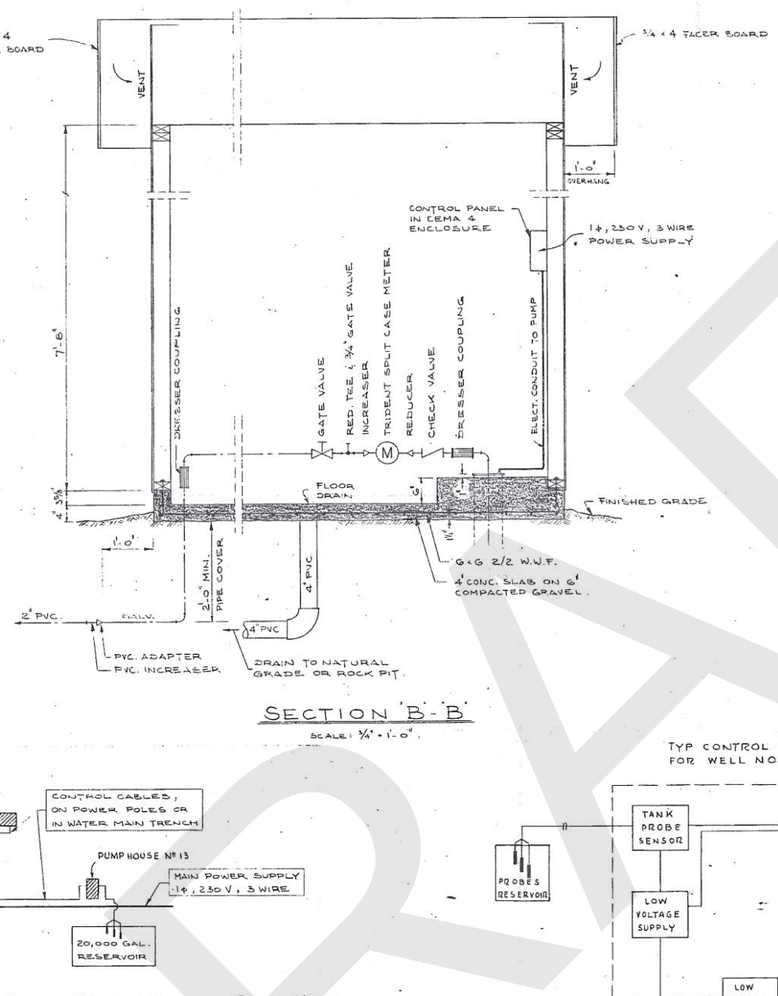
815 COOK RD., RICHMOND PHONE 278-9674

DRAWN	H.Q.	SCALE AS SHOWN HORIZONTAL VERTICAL	JOB No. M 3107 W-2A	DWG. No. 3 of 4
CH'K'D.				
APPR'D.	1167	DATE APR. 28, 70		



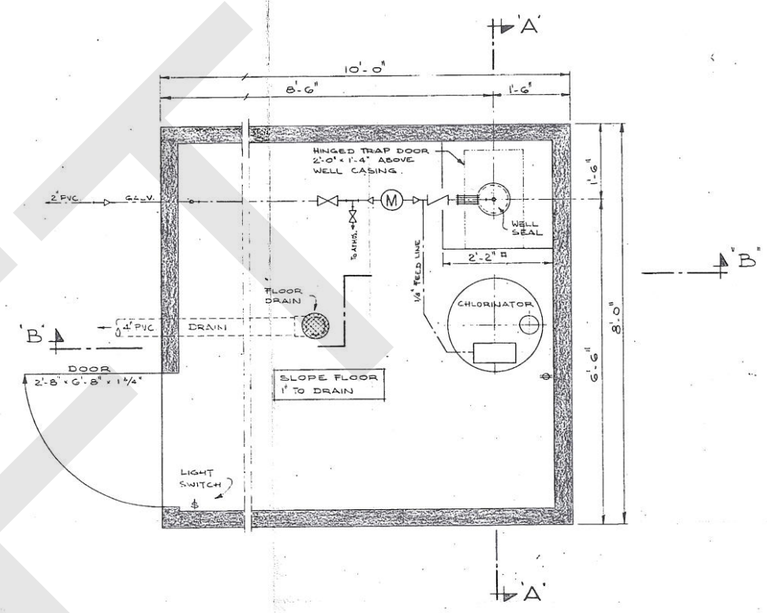
SECTION 'A-A'

SCALE: 3/4" = 1'-0"



SECTION 'B-B'

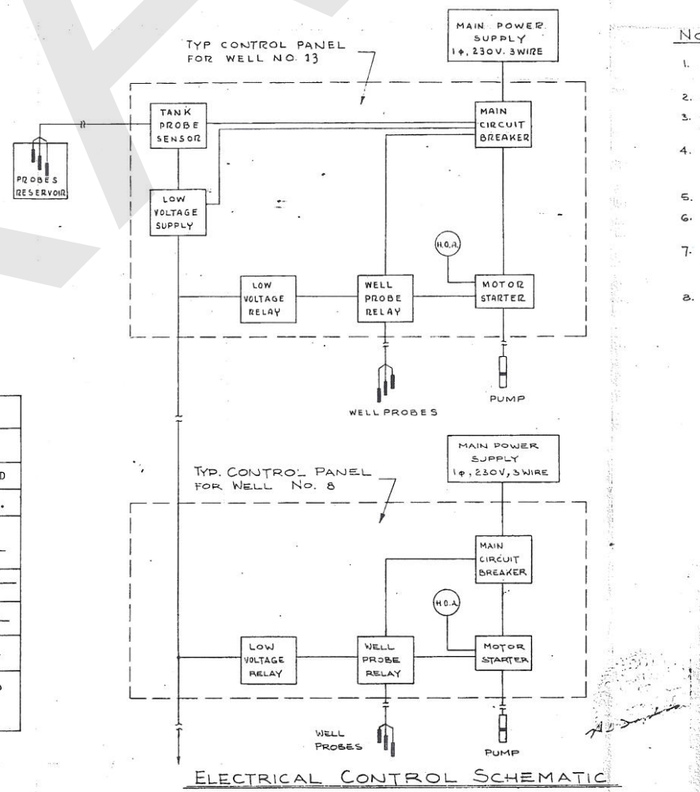
SCALE: 3/4" = 1'-0"



PLAN VIEW

SCALE: 3/4" = 1'-0"

SCHEMATIC OF PUMP HOUSE OPERATION - PLAN VIEW



ELECTRICAL CONTROL SCHEMATIC

WELL NO.	RATED FLOW AT DRAWDOWN	WELL DEPTH	PUMP INTAKE	LOW PROBE	PUMP LEVEL	HIGH PROBE	STATIC WATER LEVEL	CASING	RISER PIPE	METER	MOTOR CABLE	TOP OF CASING	TANK T.W.L.	T.D.H.	PUMP DATA SINGLE ϕ -- 230 V PUMPS MAKE	H.P.	FLOW	HEAD
	G.P.M.	A FT.	B FT.	C FT.	D FT.	E FT.	F FT.	G FT.	H INS.	M INS.	I GAUGE	EL. FT.	FT.	FT.	MODEL NO.		G.P.M.	FT.
~~1~~	~~4.0~~	~~165~~	~~160~~	~~150~~	~~150~~	~~20~~	~~12~~	~~+20~~	~~1~~	~~5/8~~	~~14~~	~~115~~	~~202~~	~~252~~	~~Myers SD5C-21 17 Stages~~	~~1/2~~	~~5~~	~~250~~
~~5~~	~~2.0~~	~~225~~	~~205~~	~~195~~	~~213~~	~~10~~	~~5~~	~~13~~	~~1~~	~~5/8~~	~~14~~	~~92~~	~~202~~	~~321~~	~~"Myers" SD5C-21 17 Stages~~	~~1/2~~	~~4~~	~~320~~
~~6~~	~~3.0~~	~~365~~	~~340~~	~~330~~	~~265~~	~~8~~	~~3~~	~~13~~	~~1~~	~~5/8~~	~~14~~	~~93~~	~~202~~	~~454~~	~~"Myers" SD7C-21 24 Stages~~	~~3/4~~	~~4~~	~~450~~
8	4.5	215	190	180	205	25	31	4	1	5/8	14	90	202	307	"Myers" SD7C-21 24 Stages	3/4	6+	300
13	13.0	115	87	77	60	20	ARTESIAN	20'	1	5/8	14	195	202	100'	"MYERS" SD7A-21 15-STAGES	3/4	15+	100

NOTE:

1. ALL PIPING IN PUMPHOUSES TO BE 1" ϕ GALV. SCHEDULE 40.
2. SCREWED FITTINGS TO BE 125 LBS. CAST IRON GALV.
3. GATE VALVES TO BE UNDERWRITERS AND F.M. APPROVED WITH RISING STEM (175 p.s.i. WATER).
4. THE ELECTRICAL CONTRACTOR WILL SUPPLY SHOP DRAWINGS OF PUMP & RESERVOIR CONTROL SYSTEM FOR ENGINEERS APPROVAL PRIOR TO INSTALLATION.
5. CONCRETE TO HAVE 3000 p.s.i. 28 DAY STRENGTH.
6. ALL EXPOSED PIPE & FITTINGS TO BE COATED WITH EPOXY ENAMEL SUITABLE FOR POTABLE WATER SUPPLY.
7. ALL EXTERIOR WOODEN SURFACES TO RECEIVE ONE COAT OF C.I.L. #989 EXTERIOR PRIMER & ONE COAT OF C.I.L. EXTERIOR ACRYLIC LATEX.
8. ALL INTERIOR WOODEN SURFACES TO RECEIVE TWO COATS OF INTERIOR C.I.L. SATIN LATEX, (WHITE).

Rev # 3 July 19, 1971 - ADD WELL 13 - Delete 5 & 6
REV # 2 June 7, 1971 - ADD WELLS 5, 6 & 8
REV # 1 MAR 18 1971 - DELETE WELL # 2

British Columbia Land Surveyors and Civil Engineers

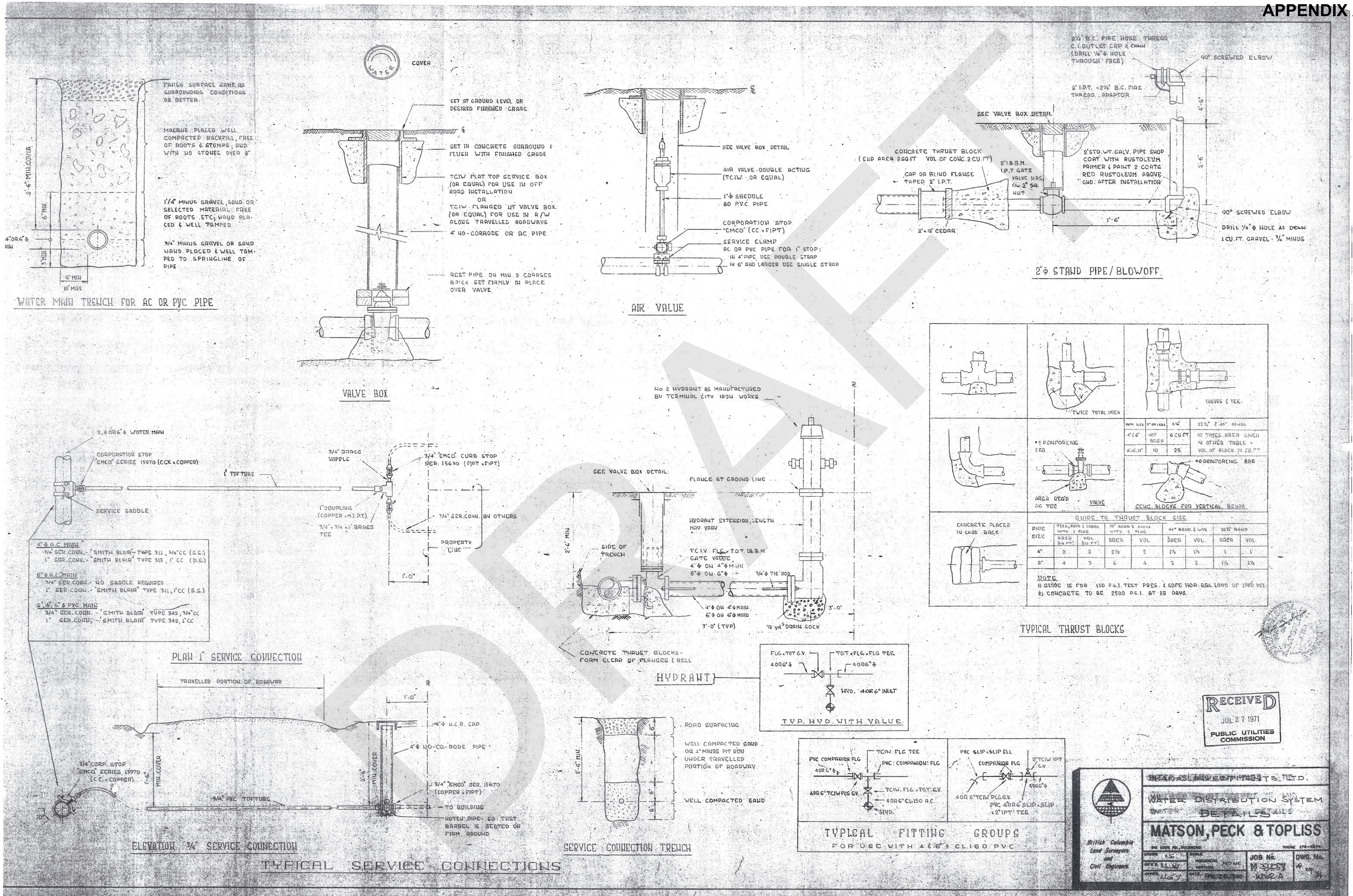
SKANA INVESTMENTS LTD.

PUMP HOUSE No. 1, 8 & 13 LAYOUT & DETAILS

MATSON, PECK & TOPLISS

815 COOK RD., RICHMOND PHONE 278-9674

DRAWN	H.G.	SCALE	AS SHOWN HORIZONTAL VERTICAL	JOB No.	DWG. No.
CH'K'D.		DATE	APR. 29, 70	M 3107 W-2A	2 OF 4
APP'D.	H&T				


WATER MAIN TRENCH FOR AC OR PVC PIPE
FINISH SURFACE SAME AS SURROUNDING CONDITIONS OR BETTER
MACHINE PLACED WELL COMPACTED BACKFILL, FREE OF ROOTS & STUMPS AND WITH NO STONES OVER 8"
1 1/4" MINUS GRAVEL, SAND OR SELECTED MATERIAL FREE OF ROOTS ETC; HAND PLACED & WELL TAMPED
3/4" MINUS GRAVEL OR SAND HAND PLACED & WELL TAMPED TO SPRINGLINE OF PIPE
2'-6" MIN. COVER
VALVE BOX
COVER
WATER
SET AT GROUND LEVEL OR DESIRED FINISHED GRADE
SET IN CONCRETE SURROUND & FLUSH WITH FINISHED GRADE
TCIW FLAT TOP SERVICE BOX (OR EQUAL) FOR USE IN OFF ROAD INSTALLATION
OR
TCIW FLANGED LNT VALVE BOX (OR EQUAL) FOR USE IN R/W ALONG TRAVELLED ROADWAYS
4" NO-CORRODE OR AC PIPE
REST PIPE ON MIN. 2 COARSES BRICK SET FIRMLY IN PLACE OVER VALVE
AIR VALVE
SEE VALVE BOX DETAIL
AIR VALVE - DOUBLE ACTING (T.C.I.W. OR EQUAL)
1" SHEDDLE 80 P.V.C. PIPE
CORPORATION STOP "EMCO" (CC x FIPT)
SERVICE CLAMP
AC OR PVC PIPE FOR 1" STOP: IN 4" PIPE USE DOUBLE STRAP IN 6" AND LARGER USE SINGLE STRAP
2" STAND PIPE/BLOWOFF
2 1/2" B.C. FIRE HOSE THREAD C.I. OUTLET CAP & CHAIN (DRILL 1/8" HOLE THROUGH FACE)
90° SCREWED ELBOW
2" I.P.T. x 2 1/2" B.C. FIRE THREAD ADAPTOR
SEE VALVE BOX DETAIL
CONCRETE THRUST BLOCK (END AREA 2 SQ.FT. VOL. OF CONC. 2 CU.FT.)
CAP OR BLIND FLANGE TAPED 2" I.P.T.
2" I.B.B.M. I.P.T. GATE VALVE N.R.S. C/W 2" SQ. NUT
2" STD. WT. GALV. PIPE SHOP COAT WITH RUSTOLEUM PRIMER & PAINT 2 COATS RED RUSTOLEUM ABOVE GND. AFTER INSTALLATION
2" x 12" CEDAR
90° SCREWED ELBOW
DRILL 1/8" HOLE AS DRAIN
1 CU.FT. GRAVEL - 3/4" MINUS
TYPICAL THRUST BLOCKS
TWICE TOTAL AREA
VALVES & TEE
#2 REINFORCING BAR
AREA REQ'D AS TEE
VALVE
#6 REINFORCING BAR
CONC. BLOCKS FOR VERTICAL BENDS
CONCRETE PLACED IN SAND BAGS
PIPE SIZE | 5° OR LESS | 11 1/4° | 22 1/2° & 45° BENDS
4" & 6" | NOT REQ'D | 6 CU.FT | 10 TIMES AREA GIVEN IN OTHER TABLE = VOL. OF BLOCK IN CU.FT
8, 10, 12" | 10 | 25
GUIDE TO THRUST BLOCK SIZE
PIPE SIZE | TEES, ENDS & CROSS WITH 1 PLUG AREA (SQ.FT.) VOL. (CU.FT.) | 90° BEND & CROSS WITH 2 PLUG AREA VOL | 45° BEND & WYE AREA VOL | 22 1/2° BEND AREA VOL
4" | 2 | 2 | 2 1/2 | 2 | 1 1/2 | 1 1/2 | 1 | 1
6" | 4 | 3 | 6 | 4 | 3 | 2 | 1 1/2 | 1 1/2
NOTE
1) GUIDE IS FOR 150 P.S.I. TEST PRES. & SAFE HOR. BRG. LOAD OF 1500 PSI
2) CONCRETE TO BE 2500 P.S.I. AT 28 DAYS
PLAN 1" SERVICE CONNECTION
2, 4 OR 6" WATER MAIN
CORPORATION STOP "EMCO" SERIES 15970 (CCX x COPPER)
SERVICE SADDLE
1" TUFTUBE
3/4" BRASS NIPPLE
3/4" EMCO CURB STOP SER. 15630 (FIPT x FIPT)
1" COUPLING (COPPER x M.I.P.T.)
3/4" x 3/4" x 1" BRASS TEE
3/4" SER. CONN. BY OTHERS
PROPERTY LINE
4" A.C. MAIN
3/4" SER. CONN. - SMITH BLAIR TYPE 311, 3/4" CC (S.S.)
1" SER. CONN. - SMITH BLAIR TYPE 313, 1" CC (D.S.)
6" A.C. MAIN
3/4" SER. CONN. - NO SADDLE REQUIRED
1" SER. CONN. - SMITH BLAIR TYPE 311, 1" CC (S.S.)
2", 4", 6" & PVC MAIN
3/4" SER. CONN. - SMITH BLAIR TYPE 342, 3/4" CC
1" SER. CONN. - SMITH BLAIR TYPE 342, 1" CC
HYDRANT
No. 2 HYDRANT AS MANUFACTURED BY TERMINAL CITY IRON WORKS
SEE VALVE BOX DETAIL
FLANGE AT GROUND LINE
HYDRANT EXTENSION, LENGTH MAY VARY
SIDE OF TRENCH
T.C.I.W. FLG. x T.O.T. I.B.B.M. GATE VALVE 4" ON 4" MAIN 6" ON 6"
3/4" TIE ROD
4" ON 4" MAIN 6" ON 6" MAIN
7'-0" (TYP)
1/2 yd³ DRAIN ROCK
CONCRETE THRUST BLOCKS - FORM CLEAR OF FLANGES & BELL
TYP. HYD. WITH VALVE
FLG. x TOT G.V.
TOT. x FLG. x FLG. TEE
HYD. 4 OR 6" INLET
ELEVATION 3/4" SERVICE CONNECTION
TRAVELLED PORTION OF ROADWAY
3/4" CORP. STOP EMCO SERIES 15970 (C.C. x COPPER)
3/4" PVC TUFTUBE
4" N.C.R. CAP
4" NO-CORRODE PIPE
3/4" EMCO SER. 15670 (COPPER x FIPT)
TO BUILDING
NOTCH PIPE SO THAT BARREL IS SEATED ON FIRM GROUND
SERVICE CONNECTION TRENCH
ROAD SURFACING
WELL COMPACTED SAND OR 2" MINUS PIT RUN UNDER TRAVELLED PORTION OF ROADWAY
WELL COMPACTED SAND
TYPICAL SERVICE CONNECTIONS
TYPICAL FITTING GROUPS
FOR USE WITH 4 & 6" CL 160 PVC
PVC COMPANION FLG
TCIW FLG TEE
PVC COMPANION FLG
TCIW FLG x TOT G.V.
4 OR 6" CL 150 A.C.
HYD.
PVC SLIP x SLIP ELL
COMPANION FLG
PVC 4 OR 6 SLIP x SLIP x 2" IPT TEE
RECEIVED
JUL 27 1971
PUBLIC UTILITIES COMMISSION
WATER DISTRIBUTION SYSTEM DETAILS
MATSON, PECK & TOPLISS
British Columbia Land Surveyors Civil Engineers
JOB No.
DWG. No.

APPENDIX D – LIFE CYCLE ANALYSIS

APPENDIX A

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

Project #: 2021-2386-05
Client: CRD Mayne Island
Project Name: Skana Reservoir
Revision Date: 09-Jan-25
Author: SD

Life Cycle Analysis

Option	Estimated capital cost	Estimated life	Equivalent Annual Capital Cost					
discount rate	*0%*	*2%*	*4%*	*6%*	*8%*	*9.5%*
73 m3 glass-fused steel tank	$ 1,210,000	30	$ 40,000	$ 54,000	$ 70,000	$ 88,000	$ 107,000	$ 123,000
twin 46 m3 welded steel tanks	$ 940,000	50	$ 19,000	$ 30,000	$ 44,000	$ 60,000	$ 77,000	$ 90,000
twin 46 m3 XLPE tanks	$ 790,000	20	$ 39,000	$ 48,000	$ 58,000	$ 69,000	$ 80,000	$ 90,000

$$Annual\ cost = \frac{cost \times r}{1 - \frac{1}{(1+r)^t}}$$

r = discount rate
t = number of years
(note r=0 is calculated using lim(r -> 0))

Sample calculation for
cost = 480,000
r = 2%
t = 30

$$Annual\ cost = \frac{cost \times r}{1 - \frac{1}{(1+r)^t}} = \frac{480000 \times 2\%}{1 - \frac{1}{(1+2\%)^{30}}} = \frac{9600}{1 - \frac{1}{1.8114}} = \frac{9600}{0.4479} = 21433$$