Our File: 2231-27317-01

# TECHNICAL MEMO

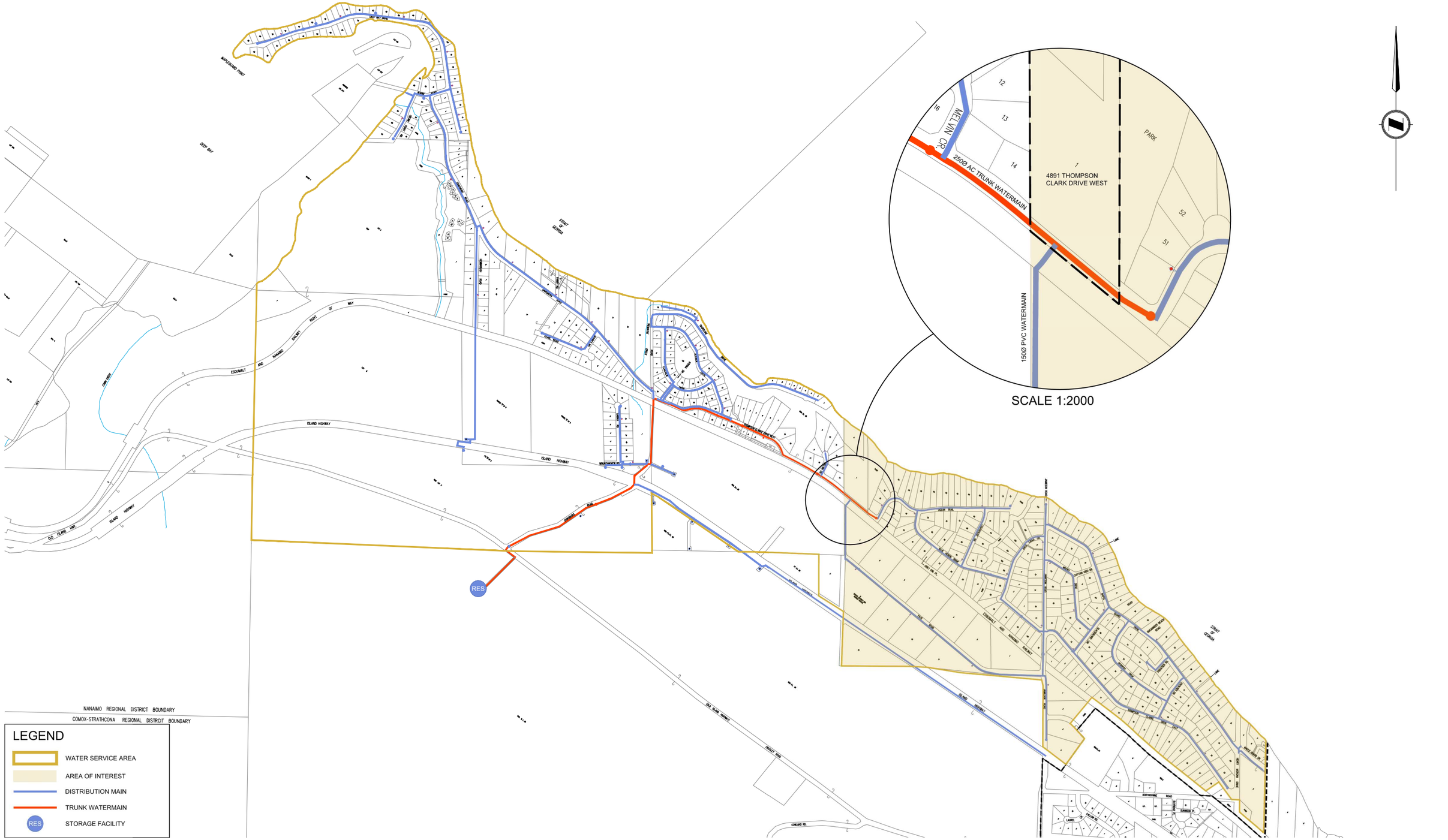
| To | From |
|---|---|
| John Marsh, CPA, CMA – Administrator<br>Deep Bay Improvement District | Sean O'Connor, P.Eng. – Civil Division Manager |
| **Re** | **Date** |
| Deep Bay Improvement District<br>Thompson Clarke West, Watermain Review | April 14, 2023 |

## 1. Introduction

McElhanney Ltd. (McElhanney) has been retained by the Deep Bay Improvement District (the District) to provide a watermain option review related to the trunk watermain located within a right-of-way on 4891 Thompson Clarke Drive West. This watermain replacement option review was triggered by the following:

- A portion of this watermain is located near the crest of an eroding embankment slope which was the subject of a slope stability assessment completed in November 2022. The watermain is at risk of damage / failure due to the eroding embankment slope and could also be at risk during potential slope stabilization repairs.
- This section of existing Asbestos Concrete (AC) watermain has been identified for replacement in the District's AC Watermain Replacement Program which was recently completed by McElhanney in April 2023.
- A portion of the existing watermain does not have legal tenure where is crosses 4891 Thompson Clarke Drive West to the south.

Refer to **Figure 1A** for details on the overall water service area and area serviced from the section of watermain in question. It should be noted that this section of 250mm diameter AC trunk watermain conveys water to the eastern end of the District.




## LEGEND

- WATER SERVICE AREA
- AREA OF INTEREST
- DISTRIBUTION MAIN
- TRUNK WATERMAIN
- RES — STORAGE FACILITY

| Rev | Date | Description | Drawn | Design | App'd |
|---|---|---|---|---|---|
| A | 2023-03-24 | ISSUED FOR MEMO | SO | | |



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ORIGINAL DWG SIZE: ANSI D (22" x 34")

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# DEEP BAY IMPROVEMENT DISTRICT

5031 MOUNTAIN VIEW RD, BOWSER, BC V0R 1G0

## THOMPSON CLARK WEST WATERMAIN OPTION REVIEW WATER SERVICE AREA & AREA OF INTEREST

Drawing No.

# FIGURE 1A

| Project Number | Rev. |
|---|---|
| 2231-27317-01-SK | A |

# 2. Background

## 2.1. GENERAL

The Deep Bay Water System has been constructed in Phases over a period of approximately 5 decades, with most of the piping installed circa 1970's. Approximately 80% of the system was constructed using Asbestos Cement (AC) pipe and the remainder is Polyvinyl Chloride (PVC) pipe.

Most of the lines were constructed with 150 mm diameter pipe. Larger pipe was used along Gainsburg Road and Thompson Clarke Drive to provide a trunk main to feed water from the reservoir to the eastern end of the system.

The District has retained McElhanney to undertake a watermain review for the approximately 130m long section of 250mm diameter AC trunk watermain located within a right of way on 4891 Thompson Clarke Drive West. The intent of the review is to determine the following:

- Importance of the existing trunk watermain to the system's hydraulic capacity.
- Alternate replacement options to maintain the system's hydraulic capacity, and
- A preferred replacement option.

## 2.2. STUDY APPROACH / WORK PLAN

The work plan adopted for this study is as follows:

- Undertake a site visit to review the existing conditions and potential replacement routes / configurations.
- Undertake a system hydraulic model review to confirm if the trunk watermain is required and to confirm what adjacent upgrades are needed to maintain existing hydraulic capacity if this section is removed or abandoned.
- Undertake a replacement option review. This includes review / considerations on the following:
    - Horizontal and Vertical Alignment
    - Land Tenure Requirements
    - Environmental Impacts (high level)
    - Geotechnical Impacts (high level)
    - Permitting Requirements
    - Construction Cost Estimates

# 3. Analysis Criteria

In establishing the capacity of the distribution system, three levels of water demand are normally considered, in addition to fire flows. These are:

Average Day Demand (ADD) = $\frac{\text{Total annual consumption}}{365 \text{ days}}$

Maximum Day Demand (MDD) = Day with highest demand for the year

Peak Hour Demand (PHD) = Highest flow rate maintained for one hour
*(generally occurring on maximum day of the year)*

## 3.1.DISTRIBUTION SYSTEM

The water distribution system must be capable of delivering all demands as well as delivering fire flow demands during maximum day demands while operating within acceptable pressure ranges.

The criteria used for sizing the various water system components are provided in a number of the referenced standards and guideline documents. The 2008 Water System Evaluation report recommended the following design criteria for the Deep Bay Improvement District:

- Water distribution systems are sized to supply peak water consumption. The critical design criteria are typically based on either, Maximum Day Demand (MDD) plus Fire Flow or Peak Hour Demand (PHD).
- MDD plus Fire Flow is found to be the more stringent requirement for smaller water systems and has been used as the design case for this review.

### 3.1.1. Pressures & Velocities

The adequacy of the distribution system for various demand conditions is judged by the residual pressure available throughout the system and by the maximum velocity in the mains. The criteria applied to this study are listed in **Table 3-1** which are consistent with the MMCD standard requirements and previous District reporting.

*Table 3-1: Pressure & Velocity Design Criteria*

| Parameter | Value | |
|---|---|---|
| **Under Peak Hour Demand Conditions** | | |
| Minimum working pressure | 275 kPa | (40 psi) |
| Maximum working pressure | 700 kPa | (100 psi) |
| Maximum pipe velocity | 2.0 m/s | (6.5 ft/s) |
| **Under Fire Flow Demand Conditions (during Maximum Day Demands)** | | |
| Minimum residual pressure at hydrant | 150 kPa | (22 psi) |
| Maximum pipe velocity | 3.5 m/s | (11.5 ft/s) |

### 3.1.2. Fire Flows

Fire flow requirements are presented for a typical single family residence using criteria outlined by Fire Underwriters Survey (FUS). The fire flow calculations to support this design fire flow are included in the 2008 Water System Evaluation Report (McElhanney). Calculation results for the Deep Bay Improvement District are presented in **Table 3-2**.

*Table 3-2: Fire Flows based on Fire Underwriters Survey Guidelines*

| Location | Calculated Fire Flow |
|---|---|
| Single Family Residences | 70 L/s (930 IGPM) |

## 3.2. PROJECTED WATER DEMAND

Projected water demand for build-out of the un-developed land base was calculated in the 2008 Water System Evaluation Report ( McElhanney) based on the current rates of consumption, projected growth, and peak factors. Future water demand is presented in **Table 3-3**.

*Table 3-3: Projected Water Demand*

| Year | # of Services | Average Consumption | Average Day Demand (ADD) | Maximum Day Demand (MDD) | Peak Hour Demand (PHD) |
|---|---|---|---|---|---|
| 2007 | 565 | 0.85 $m^3$/service/ day | 480 $m^3$/day | 1,440 $m^3$/day | 2,880 $m^3$/day |
| | | 0.01 L/s/service | 5.6 L/s | 16.7 L/s | 33.4 L/s |
| 2030 | 1080 | 0.85 $m^3$/service/ day | 918 $m^3$/day | 2,754 $m^3$/day | 5,508 $m^3$/day |
| | | 0.01 L/s/service | 10.6 L/s | 31.9 L/s | 67.8 L/s |

# 4. System Analysis

## 4.1. COMPUTER MODEL

A computer model that was previously developed for the Deep Bay Water System was transferred to a newer computer software program (WaterCAD) which was used to assess the capacity of a distribution system to meet delivery requirements.

WaterCAD is a powerful, user-friendly program created to analyse, design, and optimize water distribution systems. The programs many features include steady state and extended time modelling, multiple fire flow events modelling while evaluating flows and pressures across the entire system, and peak hour pressure analyses.

Model inputs define the physical characteristics of the system and the anticipated flows. The distribution system is modeled as a network of pipes interconnected at nodes. Pipes in the model are assigned the physical characteristics of pipes in the field (length, diameter and roughness), the nodes define the points of connection between the lines and define the points of water demand in the system (both domestic and fire flows).

The WaterCAD water model layout was developed to reflect the existing distribution system including various pipe sizes and materials. The computer model was updated to reflect distribution system upgrades including:

- Project: 27304, Longview & Shoreline Drive Watermain Replacement
- Project: 27311, Seaview Drive & Longview Drive Watermain Replacement

The water system layout including existing pipe size and materials is shown in **Figure 1B & 1C**.

The model was then used to assess a number of scenarios to review the hydraulic importance of the existing trunk watermain and replacement options that will maintain the existing hydraulic capacity of the system.

FIGURE 1C

NANAIMO REGIONAL DISTRICT BOUNDARY

COMOX-STRATHCONA REGIONAL DISTRICT BOUNDARY

## LEGEND

- WATER SERVICE AREA
- 121 / 21 — PIPE ### / NODE ##
- DISTRIBUTION MAIN
- TRUNK WATERMAIN
- RES — STORAGE FACILITY

| Rev | Date | Description | Drawn | Design | App'd |
|---|---|---|---|---|---|
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ORIGINAL DWG SIZE: ANSI D (22" x 34")

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Tel 250 716 3336

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# DEEP BAY IMPROVEMENT DISTRICT

5031 MOUNTAIN VIEW RD, BOWSER, BC V0R 1G0

## THOMPSON CLARK WEST WATERMAIN OPTION REVIEW EXISTING WATER SYSTEM LAYOUT PIPE & NODE PLAN (OVERVIEW)

Drawing No.

# FIGURE 1B

| Project Number | Rev. |
|---|---|
| 2231-27317-01-SK | A |

DESTROY ALL PRINTS BEARING PREVIOUS REVISION


## LEGEND

- WATER SERVICE AREA
- 121 / 21 — PIPE ### / NODE ##
- DISTRIBUTION MAIN
- TRUNK WATERMAIN
- RES — STORAGE FACILITY

| Rev | Date | Description | Drawn | Design | App'd |
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**PERMIT TO PRACTICE**
McElhanney Ltd.
PERMIT NUMBER: 1003299
Engineers and Geoscientists of BC

Approved Sealed

# DEEP BAY IMPROVEMENT DISTRICT

5031 MOUNTAIN VIEW RD, BOWSER, BC V0R 1G0

## THOMPSON CLARK WEST WATERMAIN OPTION REVIEW EXISTING WATER SYSTEM LAYOUT PIPE & NODE PLAN

Drawing No.

# FIGURE 1C

| Project Number | Rev. |
|---|---|
| 2231-27317-01-SK | A |

## 4.2. MODEL SCENARIOS

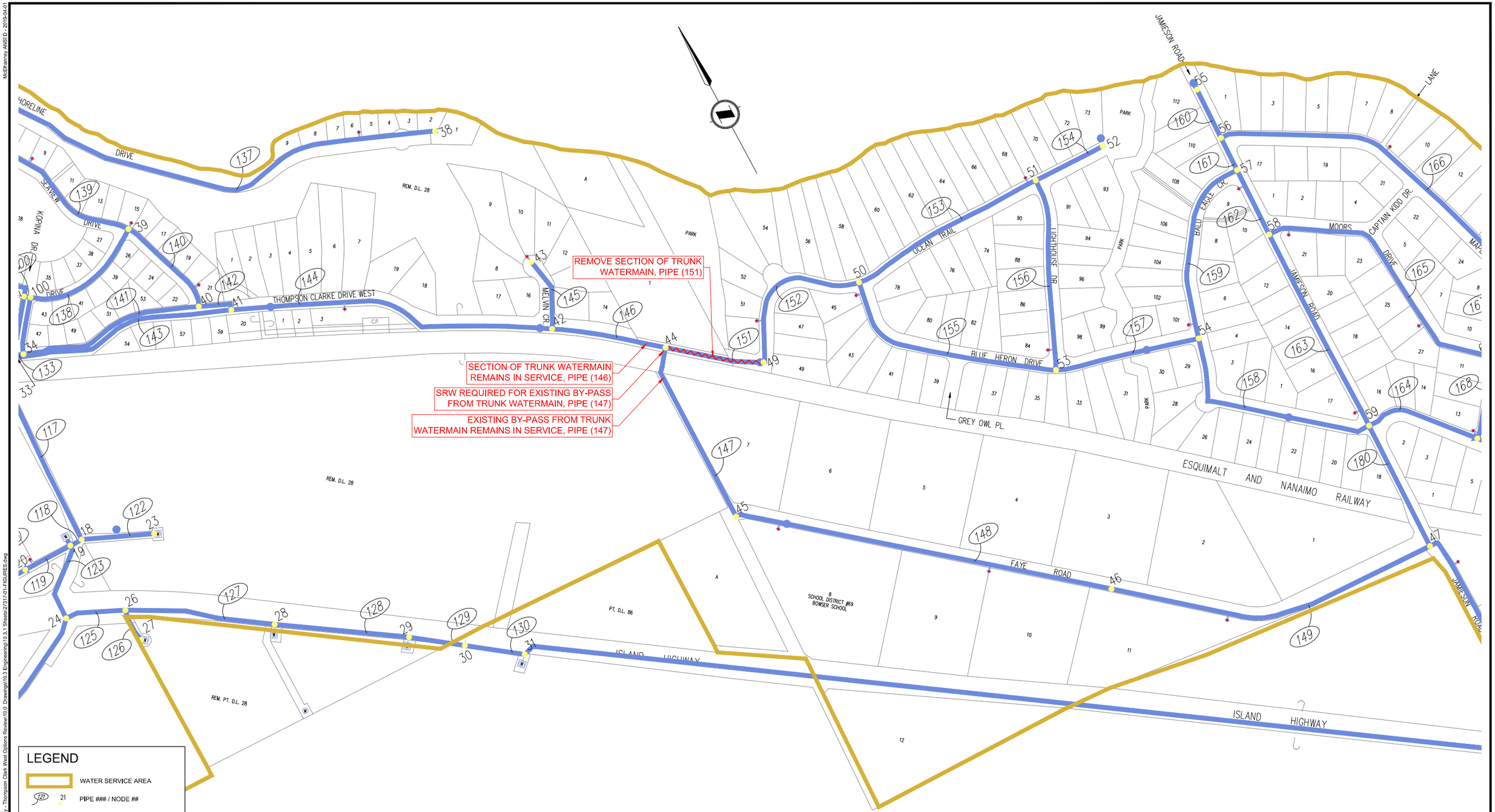
Several scenarios were assessed as part of the existing system hydraulic capacity review. The modeled scenarios are presented in **Table 4-1**.

*Table 4-1: Water Model Scenarios*

| SCENARIO | SYSTEM ADJUSTMENTS | OBSERVATIONS |
|---|---|---|
| Scenario 1: Existing System, 2030 MDD (31.9 L/s), Determine Available Fire Flow | - Current Water System (including capital works since last model update) | System can generally deliver a fire flow of >70 L/s with a residual pressure of 150 kPa (20 psi), with the exception of several dead-end sections in the area of interest * |
| Scenario 2: Remove TCDW Trunk Main, 2030 MDD (31.9 L/s), Determine Available Fire Flow **Figure 2** | - Remove trunk watermain that runs through 4891 TCDW (Pipe 151)<br>- Pipe 147 (150mm Diameter by-pass) kept in service | System can generally deliver a fire flow of 47 L/s with a residual pressure of 150 kPa (20 psi), with the exception of several dead-end sections in the area of interest. |
| Scenario 3: Add DL28 Main, 2030 MDD (31.9 L/s), Determine Available Fire Flow **Figure 3** | - Scenario 2 System Revisions<br>- Add DL28 Main (Pipe 201, Length = 450m), 200mm Dia Main between Island Highway and Faye Road (Node 30 to 45) | System can generally deliver a fire flow of 47 L/s with a residual pressure of 150 kPa (20 psi), with the exception of several dead-end sections in the area of interest. |
| Scenario 4: Upsize Faye Road Watermain, 2030 MDD (31.9 L/s), Determine Available Fire Flow **Figure 4** | - Scenario 3 System Revisions<br>- Replace Faye Road Watermain (Pipe 148 & 149, Length = 1000m), existing 150 PVC with 200mm Dia Main | System can generally deliver a fire flow of >70 L/s with a residual pressure of 150 kPa (20 psi), with the exception of several dead-end sections in the area of interest * |
| Scenario 5: Upsize from Gainsburg Trunk to DL28 Main, 2030 MDD (31.9 L/s), Determine Available Fire Flow **Figure 5** | - Scenario 4 System Revisions<br>- Remove Pipe 147 (150mm Diameter by-pass from TCDW Trunk Main)<br>- Upsize from Gainsburg Trunk to DL28 Main (Pipe 125, 127, 128, Length = 465m), existing 150 PVC with 200mm Dia Main | System can generally deliver a fire flow of >70 L/s with a residual pressure of 150 kPa (20 psi), with the exception of several dead-end sections in the area of interest * |
| Scenario 6: Replace TCDW Trunk Main, 2030 MDD (31.9 L/s), Determine Available Fire Flow **Figure 6** | - Restore Existing Water System Configuration with 250mm Diameter PVC Watermain (Pipe 146, 151, Length = 180 – 220m)<br>- Alternate alignment(s) to avoid eroding embankment. Slope to be reviewed. | System can generally deliver a fire flow of >70 L/s with a residual pressure of 150 kPa (20 psi), with the exception of several dead-end sections in the area of interest * |

** Several dead-end sections in the area of interest cannot achieve design fire flow of 70 L/s due to the max velocity criteria (a 150mm Dia. watermain can only provide 61 L/s @ 3.5 m/s)*

The model results (available fire flows) are summarized in **Table A-1** which is included in **Appendix A**.




| Rev | Date | Description | Drawn | Design | App'd |
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# DEEP BAY IMPROVEMENT DISTRICT

5031 MOUNTAIN VIEW RD, BOWSER, BC V0R 1G0

## THOMPSON CLARK WEST WATERMAIN OPTION REVIEW WATER MODEL SCENARIOS SCENARIO 2

Drawing No.

# FIGURE 2

| Project Number | Rev. |
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| 2231-27317-01-SK | A |

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REMOVE SECTION OF TRUNK WATERMAIN, PIPE (151)

SECTION OF TRUNK WATERMAIN REMAINS IN SERVICE, PIPE (146)

SRW REQUIRED FOR EXISTING BY-PASS FROM TRUNK WATERMAIN, PIPE (147)

EXISTING BY-PASS FROM TRUNK WATERMAIN REMAINS IN SERVICE, PIPE (147)

SRW REQUIRED FOR DL28 WATERMAIN, PIPE (201)

PROPOSED 200Ø DL28 WATERMAIN, ADD PIPE (201)

JAMIESON ROAD

SEAVIEW DRIVE

KOPINA DR

THOMPSON CLARKE DRIVE WEST

MELVIN CR.

OCEAN TRAIL

LIGHTHOUSE RD

BLUE HERON DRIVE

BALD EAGLE CR.

MOORS

CAPTAIN KIDD DR.

JAMIESON ROAD

GREY OWL PL.

ESQUIMALT AND NANAIMO RAILWAY

FAYE ROAD

ISLAND HIGHWAY

REM. D.L. 28

REM. PT. D.L. 28

PT. D.L. 86

PARK

SCHOOL DISTRICT #69 BOWSER SCHOOL

C.P.

## LEGEND

- WATER SERVICE AREA
- PIPE ### / NODE ## (e.g. 121 / 21)
- DISTRIBUTION MAIN
- PROPOSED WATERMAIN
- WATERMAIN REMOVAL

| Rev | Date | Description | Drawn | Design | App'd |
|---|---|---|---|---|---|
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# DEEP BAY IMPROVEMENT DISTRICT

5031 MOUNTAIN VIEW RD, BOWSER, BC V0R 1G0

## THOMPSON CLARK WEST WATERMAIN OPTION REVIEW WATER MODEL SCENARIOS SCENARIO 3

Drawing No.

# FIGURE 3

| Project Number | Rev. |
|---|---|
| 2231-27317-01-SK | A |

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

REMOVE SECTION OF TRUNK WATERMAIN, PIPE (151)

SECTION OF TRUNK WATERMAIN REMAINS IN SERVICE, PIPE (146)

SRW REQUIRED FOR EXISTING BY-PASS FROM TRUNK WATERMAIN, PIPE (147)

EXISTING BY-PASS FROM TRUNK WATERMAIN REMAINS IN SERVICE, PIPE (147)

SRW REQUIRED FOR DL28 WATERMAIN, PIPE (201)

PROPOSED 200Ø DL28 WATERMAIN, ADD PIPE (201)

UPSIZE 200Ø FAYE ROAD WATERMAIN, PIPE (148) & PIPE (149)

SEAVIEW DRIVE
KOPINA DRIVE
THOMPSON CLARKE DRIVE WEST
MELVIN CR.
OCEAN TRAIL
LIGHTHOUSE DR.
BLUE HERON DRIVE
GREY OWL PL.
BALD EAGLE CR.
MOORS
CAPTAIN KIDD DR.
JAMESON ROAD
ESQUIMALT AND NANAIMO RAILWAY
FAYE ROAD
ISLAND HIGHWAY
REM. D.L. 28
REM. PT. D.L. 28
PT. D.L. 86
PARK
C.P.
SCHOOL DISTRICT #69 BOWSER SCHOOL

## LEGEND

- WATER SERVICE AREA
- PIPE ### / NODE ## (e.g. 121 / 21)
- DISTRIBUTION MAIN
- PROPOSED WATERMAIN
- WATERMAIN REMOVAL

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5031 MOUNTAIN VIEW RD, BOWSER, BC V0R 1G0

## THOMPSON CLARK WEST WATERMAIN OPTION REVIEW WATER MODEL SCENARIOS SCENARIO 4

Drawing No.

# FIGURE 4

| Project Number | Rev. |
|---|---|
| 2231-27317-01-SK | A |

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

REMOVE SECTION OF TRUNK WATERMAIN, PIPE (151)

REMOVE SECTION OF TRUNK WATERMAIN, PIPE (146)

REMOVE EXISTING BY-PASS WATERMAIN, PIPE (147)

SRW REQUIRED FOR DL28 WATERMAIN, PIPE (201)

PROPOSED 200Ø DL28 WATERMAIN, ADD PIPE (201)

UPSIZE 200Ø FAYE ROAD WATERMAIN, PIPE (148) & PIPE (149)

UPSIZE CONNECTION FROM GAINSBURG TRUNK TO DL28 MAIN, 200Ø PIPE (125), PIPE (127) & PIPE (128)

## LEGEND

- WATER SERVICE AREA
- PIPE ### / NODE ##
- DISTRIBUTION MAIN
- PROPOSED WATERMAIN
- WATERMAIN REMOVAL

| Rev | Date | Description | Drawn | Design | App'd |
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## THOMPSON CLARK WEST WATERMAIN OPTION REVIEW WATER MODEL SCENARIOS SCENARIO 5

Drawing No.

# FIGURE 5

| Project Number | Rev. |
|---|---|
| 2231-27317-01-SK | A |

DESTROY ALL PRINTS BEARING PREVIOUS REVISION



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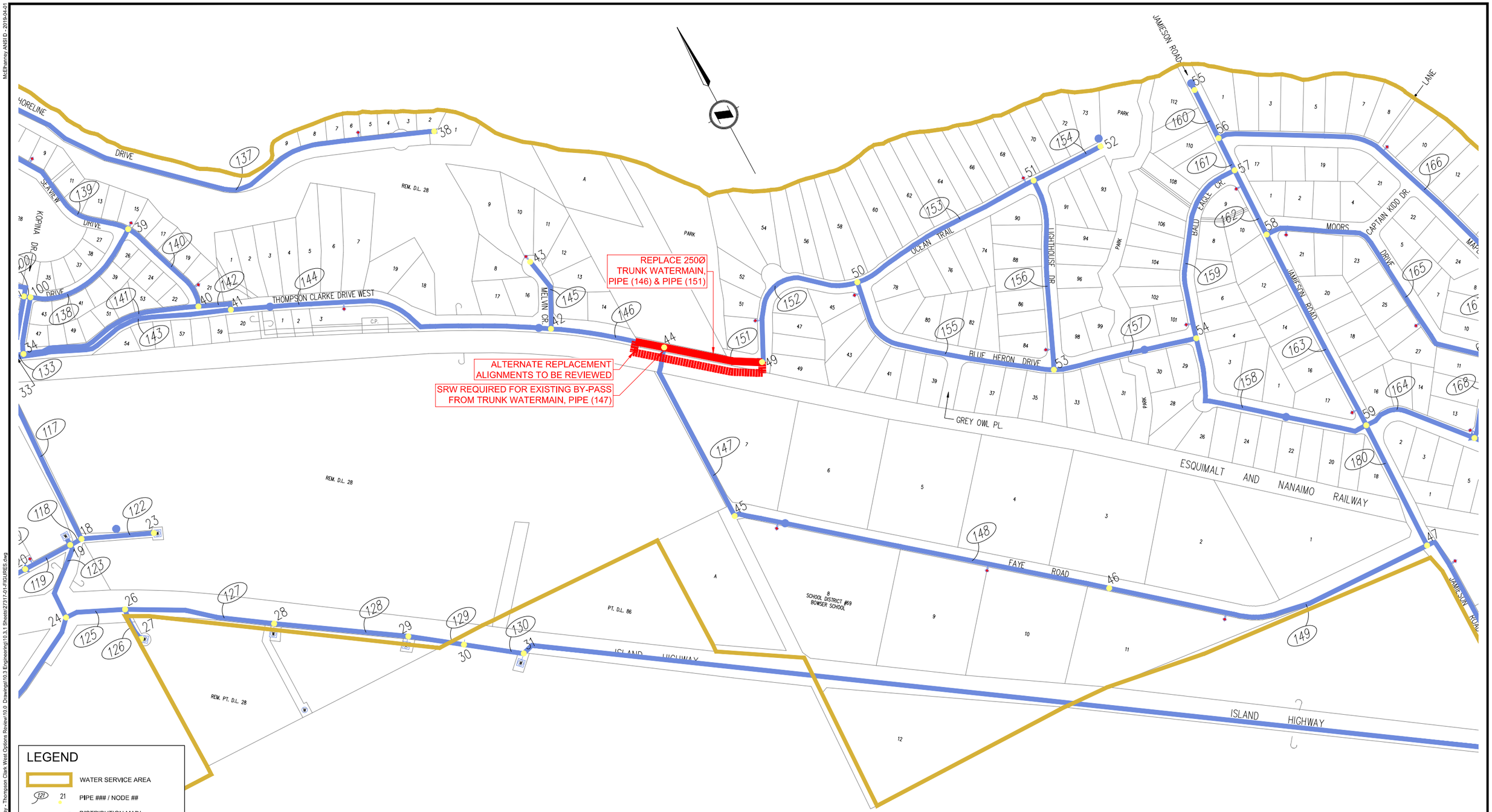


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5031 MOUNTAIN VIEW RD, BOWSER, BC V0R 1G0

## THOMPSON CLARK WEST WATERMAIN OPTION REVIEW WATER MODEL SCENARIOS SCENARIO 6

Drawing No.

# FIGURE 6

| Project Number | Rev. |
|---|---|
| 2231-27317-01-SK | A |

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

## 4.3. MODEL SCENARIOS FINDINGS

The findings from the scenario review are presented in **Table 4-2**.

*Table 4-2: Water Model Scenario Findings*

| SCENARIO | SYSTEM ADJUSTMENTS | FINDINGS | COST CONSIDERATIONS | * COST ESTIMATE – CLASS 'D' |
|---|---|---|---|---|
| Scenario 1 | • Existing System | • Base scenario for hydraulic comparison | • Slope restoration required | $155,000 |
| Scenario 2 | • Remove TCDW Trunk Main (~140m of 250mm Dia. AC) | • Hydraulic capacity reduced; fire flow is generally < 47L/s | • Least expensive option but does not maintain existing hydraulic capacity | - |
| Scenario 3 | • Scenario 2 +<br>• Add DL28 Main Connection (~450m of 200mm Dia. PVC) | • Hydraulic capacity reduced; fire flow is generally < 47L/s | • More expensive than Scenario 2 and does not maintain hydraulic capacity | $392,000 |
| Scenario 4 | • Scenario 3 +<br>• Upsize Faye Rd Watermain (~1,000m of 200mm Dia. PVC) | • Hydraulic capacity maintained; fire flow is generally > 70L/s | • More expensive than Scenario 6 but does maintain hydraulic capacity | $1,655,000 |
| Scenario 5 | • Scenario 4 +<br>• Remove TCDW Trunk Main (~160m of 250mm Dia. AC)<br>• Remove bypass from TCDW (~230m of 150mm Dia. PVC)<br>• Upsize from Gainsburg to DL28 Main (~465m of 200mm Dia. PVC) | • Hydraulic capacity maintained; fire flow is generally > 70L/s | • Most expensive option while maintaining hydraulic capacity | $2,242,295 |
| Scenario 6 | • Replace Section of TCDW Trunk Main (~150m of 250mm Dia. PVC) | • Hydraulic capacity maintained; fire flow is generally > 70L/s | • Least expensive option while maintaining hydraulic capacity | $587,000 |

* Note: cost estimates do not include allowance for removal / decommissioning of existing watermains

# 5. Option Review (4891 Thompson Clarke Drive West)

Based on our review of the various scenarios, we find that, Scenario 6, replacing the existing trunk watermain along a similar alignment will be the most economical and practical replacement option that will maintain the existing hydraulic capacity in the water system. As such, we have reviewed potential replacement options.

## 5.1. OPTION 1

A conceptual design drawing (**Figure 7)** has been prepared to show scope of work related to Option 1. The option review considerations have been summarized below:

- Horizontal and Vertical Alignment
    - Follows similar alignment to existing trunk watermain but would be located away from eroding slope. It is anticipated that the RDN trail would be restored on top of the new alignment.
- Land Tenure Requirements
    - New SRW through 4891 Thompson Clarke Drive West would be required.
- Environmental Impacts (high level)
    - Drainage course crossing(s) and potential culvert extension would be required. If preferred the existing culvert(s) could be replaced. A Section 11 change approval or notification would be required depending on the scope of replacement.
    - Mature tree & vegetation removal would be required.
- Geotechnical Impacts (high level)
    - Existing eroding slope would need to be stabilized as part of the work. This would likely be done once the existing AC watermain is replaced and new watermain is in service.
- Permitting Requirements
    - MOTI Construction Permit would be required for the work within the Ministry right-of-way (Thompson Clarke Drive West & Ocean Trail).
    - Island Health Construction Permit would be required for the watermain replacement.
    - A Section 11 change approval or notification would be required depending on the impact on the nearby stream(s).
- Construction Cost Estimate
    - Cost Estimate – Class ‘D’ = $ 587,000 (including contingency, excluding GST)

## 5.2. OPTION 2

A conceptual design drawing (**Figure 8)** has been prepared to show scope of work related to Option 2. The option review considerations have been summarized below:

- Horizontal and Vertical Alignment
    - Follows railway alignment with bends at either end to allow for connection to existing alignment. It is anticipated that the offset from the railway tracks would be about 4-6m (5.5m shown), however this would need to be reviewed with the Island Corridor Foundation (ICF) and Southern Railway of Vancouver Island (SVI).
- Land Tenure Requirements
    - License of Occupation from ICF would be required. The ICF would charge an annual fee in perpetuity for the License.
- Environmental Impacts (high level)
    - Drainage course crossings (existing culverts) would be required. A Section 11 change notification would be anticipated.
    - Drainage course crossing (large ditch) would be required near east end. A Section 11 approval may be required.
    - Significant mature tree & vegetation removal would be required.
- Geotechnical Impacts (high level)
    - Proposed alignment would be along the top of existing slope which would likely be disturbed during construction and would require significant stabilization.
- Permitting Requirements
    - MOTI Construction Permit would be required for the work within the Ministry right-of-way (Thompson Clarke Drive West & Ocean Trail).
    - Island Health Construction Permit would be required for the watermain replacement.
    - A Section 11 change approval and/or notification would be required depending on the impact on the nearby stream(s).
    - ICF Permitting would be required for the work in the railway corridor.
- Construction Cost Estimate
    - Cost Estimate – Class ‘D’ = $ 706,500 (including contingency, excluding GST)

## 5.3. OPTION 3

A conceptual design drawing (**Figure 9)** has been prepared to show scope of work related to Option 3. The option review considerations have been summarized below:

- Horizontal and Vertical Alignment
    - First Segment: Follows railway alignment with bends at west end to allow for connection to existing alignment. It is anticipated that the offset from the railway tracks would be about 4-6m (5.5m shown), however this would need to be reviewed with the Island Corridor Foundation (ICF) and Southern Railway of Vancouver Island (SVI).
    - Transition: Proposed alignment transitions from railway grade to the existing trunk watermain alignment / grade to avoid impact on steep slope adjacent to railway.
    - Second Segment: Follows similar alignment to existing trunk watermain. It is anticipated that the RDN trail would be restored on top of the new alignment.
- Land Tenure Requirements
    - New SRW through 4891 Thompson Clarke Drive West would be required (limited to 20m section at east end).
    - License of Occupation from ICF would be required. The ICF would charge an annual fee in perpetuity for the License.
- Environmental Impacts (high level)
    - Drainage course crossing (existing culvert) would be required. If preferred the existing culvert could be replaced. A Section 11 change approval or notification would be required depending on the scope of replacement.
    - Significant mature tree & vegetation removal would be required.
- Geotechnical Impacts (high level)
    - Transition section from railway grade to existing trunk watermain alignment / grade would impact existing slope and the slope would need to be stabilized as part of the work.
- Permitting Requirements
    - MOTI Construction Permit would be required for the work within the Ministry right-of-way (Thompson Clarke Drive West & Ocean Trail).
    - Island Health Construction Permit would be required for the watermain replacement.
    - A Section 11 change approval or notification would be required depending on the impact on the nearby stream(s).
    - ICF Permitting would be required for the work in the railway corridor.
- Construction Cost Estimate
    - Cost Estimate – Class ‘D’ = $ 705,500 (including contingency, excluding GST)

1
PLAN 31751
4891 THOMPSON CLARK DR W

PLAN 31044
4871 OCEAN TRAIL

THOMPSON CLARK DRIVE WEST

CONNECT TO EXISTING 250Ø AC TRUNK WATERMAIN

APPROXIMATE LOCATION OF EXISTING SLOPE EROSION

APPROXIMATE LOCATION OF EXISTING CULVERT

EXISTING CULVERTS

CONNECT TO EXISTING 250Ø AC TRUNK WATERMAIN

0.914 WIDTH

RIGHT OF WAY

RIGHT OF WAY

F95738 (PART 1)

F95738 (PART 2)

EXISTING WOOD FENCE

CULVERT EXTENSION OR WATERCOURSE CROSSING REQUIRED

CONNECT TO EXISTING 150Ø PVC WATERMAIN

A
PLAN VIP68838

APPROXIMATE LOCATION OF EXISTING DITCH/CHANNEL

FUTURE 250Ø AC TRUNK WATERMAIN REPLACEMENT

ESQUIMALT AND NANAIMO RAILWAY

FAYE ROAD

APPROXIMATE LOCATION OF EXISTING CULVERT

APPROXIMATE LOCATION OF EXISTING CULVERT

EXISTING GROUND BASED ON RDN CONTOURS (RDN GIS MAP)

1+000 1+100 1+200 1+210

6.00 11.00 5.50

48.0 49.0 50.0 51.0 52.0 45.0 46.0 47.0 48.0 49.0

0 1:250 10

LEGEND
- EX 250Ø AC TRUNK WATERMAIN
- EX 150Ø PVC WATERMAIN
- FUTURE WATERMAIN
- REPLACEMENT ALIGNMENT OPTION 1 (250Ø WM)

0 1:300 15

EXISTING GROUND ALONG WATERMAIN ℄ (BASED ON RDN CONTOURS)

50 49 48 47 46 45 44 43 42

1+000 1+020 1+040 1+060 1+080 1+100 1+120 1+140 1+160 1+180 1+200 1+210

| Rev | Date | Description | Drawn | Design | App'd |
|---|---|---|---|---|---|
| A | 2023-03-24 | ISSUED FOR MEMO | SO | | |



ORIGINAL DWG SIZE: ANSI D (22" x 34")

McElhanney
Suite 1
1351 Estevan Road
Nanaimo BC
Canada V9S 3Y3
Tel 250 716 3336

PRELIMINARY
NOT FOR CONSTRUCTION

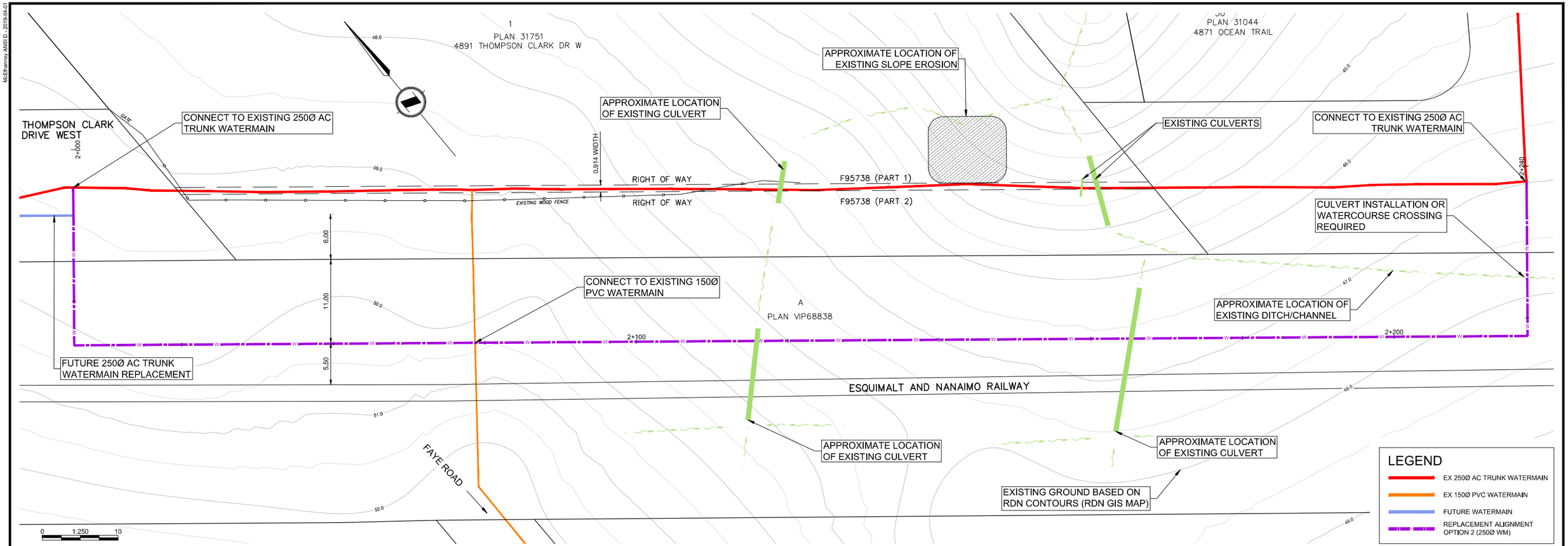
THIS DRAWING HAS NOT BEEN APPROVED AND MAY CONTAIN ERRORS AND OMISSIONS

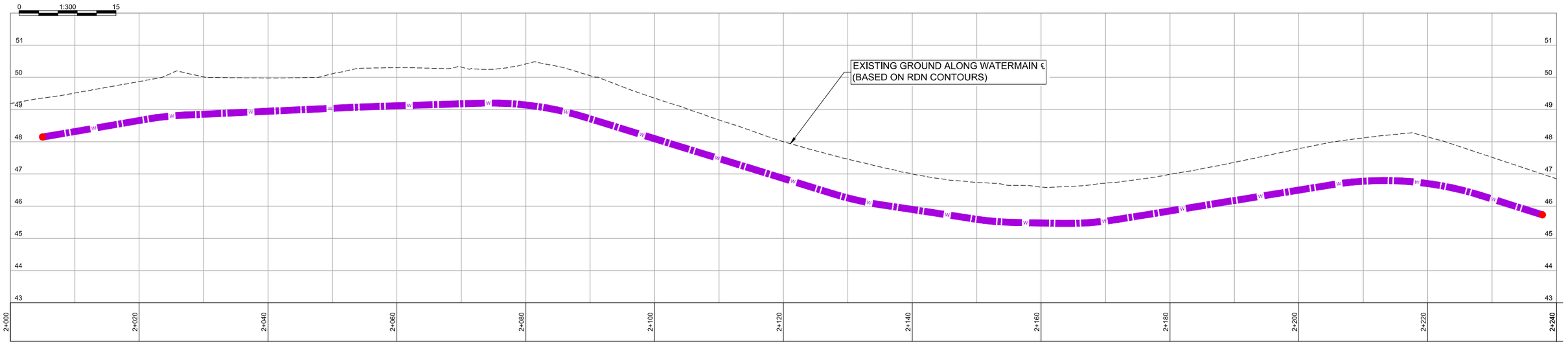
DEEP BAY IMPROVEMENT DISTRICT
5031 MOUNTAIN VIEW RD, BOWSER, BC V0R 1G0

# THOMPSON CLARK WEST WATERMAIN OPTION REVIEW WATERMAIN REPLACEMENT OPTION 1

Drawing No.
# FIGURE 7

Project Number: 2231-27317-01-SK
Rev.: A




| Rev | Date | Description | Drawn | Design | App'd |
|---|---|---|---|---|---|
| | | | | | |
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| | | | | | |
| | | | | | |
| | | | | | |
| A | 2023-03-24 | ISSUED FOR MEMO | SO | | |



ORIGINAL DWG SIZE: ANSI D (22" x 34")

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Tel 250 716 3336

PRELIMINARY
NOT FOR CONSTRUCTION

THIS DRAWING HAS NOT BEEN APPROVED AND MAY CONTAIN ERRORS AND OMISSIONS

# DEEP BAY IMPROVEMENT DISTRICT

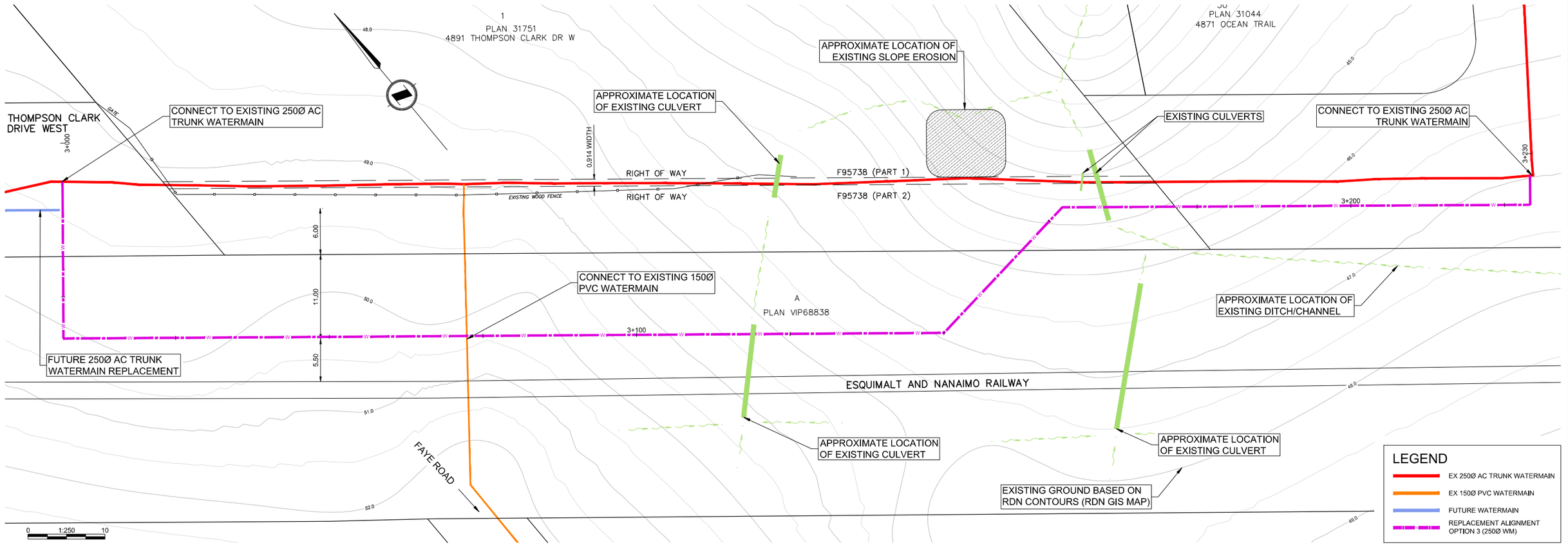
5031 MOUNTAIN VIEW RD, BOWSER, BC V0R 1G0

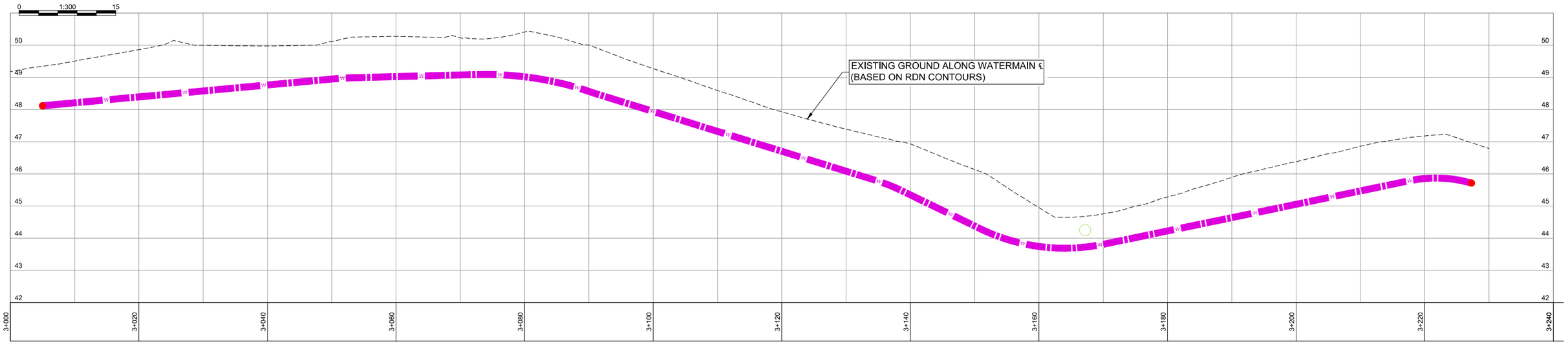
## THOMPSON CLARK WEST WATERMAIN OPTION REVIEW WATERMAIN REPLACEMENT OPTION 2

Drawing No.

# FIGURE 8

| Project Number | Rev. |
|---|---|
| 2231-27317-01-SK | A |




| Rev | Date | Description | Drawn | Design | App'd |
|---|---|---|---|---|---|
| A | 2023-03-24 | ISSUED FOR MEMO | SO | | |



ORIGINAL DWG SIZE: ANSI D (22" x 34")

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PRELIMINARY
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# DEEP BAY IMPROVEMENT DISTRICT

5031 MOUNTAIN VIEW RD, BOWSER, BC V0R 1G0

## THOMPSON CLARK WEST WATERMAIN OPTION REVIEW WATERMAIN REPLACEMENT OPTION 3

Drawing No.
FIGURE 9

| Project Number | Rev. |
|---|---|
| 2231-27317-01-SK | A |

# 6. Findings & Recommendations

The following findings are summarized from our option review:

- Based on our review of the various scenarios, we find that, Scenario 6, replacing the existing trunk watermain along a similar alignment on 4891 Thompson Clarke Drive West and/or the Railway Corridor will be the most economical replacement option that will maintain the existing hydraulic capacity in the system.

- Based on our review of the various replacement options, we find that, Option 1, replacing the existing trunk watermain along a similar alignment on 4891 Thompson Clarke Drive West will be the most economical replacement option. In addition, this option has the least technical challenges.

We have the following recommendations based on the findings in our option review:

- Due to the potential impact on schedule and costs, it is recommended that the District review the conceptual design and required land acquisition with the property owner prior to proceeding with detailed design stage.
- Develop detailed design for the preferred replacement option (Option 1). Detailed design would generally consist of:
    - Phase 1: Preliminary Design (50% Design)
        - Topographic Survey and Base Drawings
        - Geotechnical Investigation (drilling)
        - Environmental Screening Report
        - Preliminary Design Drawings (50% Design)
        - Class ‘C’ Cost Estimate
    - Phase 2: 95% Detailed Design
        - 95% Design Drawings
        - Class ‘B’ Cost Estimate
        - Permit Applications
    - Phase 3: 100% Final Design
        - 100% Design Drawings
        - Class ‘A’ Cost Estimate

# 7. Closing

We trust that the information provided in this document is sufficient for your requirements. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Sincerely,

**McElhanney Ltd.**

**EGBC Permit No. 1003299**

Prepared by:


2023-04-14

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Reviewed by:

Chris Pogson, P.Eng.
Review Principal
cpogson@mcelhanney.com | 778-762-0667

| Date | Status | Revision | Author |
|---|---|---|---|
| **April 5, 2023** | Draft for Client Review | Revision 00 | S. O'Connor |
| **April 14, 2023** | Issued for Client Use | Revision 01 | S. O'Connor |
| | | | |

# APPENDIX A

Model Results Summary

**SYSTEM ANALYSIS - SCENARIO REVIEW**

Table A-2: Available Fire Flow (MDD + Fire Flow) Comparison

| SYSTEM INFORMATION | | | SCENARIO 1 | SCENARIO 2 | SCENARIO 3 | SCENARIO 4 | SCENARIO 5 | SCENARIO 6 |
|---|---|---|---|---|---|---|---|---|
| Zone | Node | Elevation (m) | Fire Flow (Available) (L/s) | Fire Flow (Available) (L/s) | Fire Flow (Available) (L/s) | Fire Flow (Available) (L/s) | Fire Flow (Available) (L/s) | Fire Flow (Available) (L/s) |
| East Zone (Area of Interest) | 71 | 23.0 | 61.1 | 47.0 | 47.3 | 61.1 | 61.1 | 61.1 |
| | 70 | 22.5 | 61.1 | 47.0 | 47.3 | 61.1 | 61.1 | 61.1 |
| | 69 | 33.3 | 61.3 | 47.0 | 47.3 | 61.3 | 61.3 | 61.3 |
| | 68 | 36.6 | 109.1 | 47.0 | 47.3 | 91.9 | 95.1 | 109.1 |
| | 67 | 32.1 | 99.5 | 47.0 | 47.3 | 91.9 | 95.1 | 99.5 |
| | 66 | 26.7 | 94.4 | 47.0 | 47.3 | 91.9 | 94.8 | 94.4 |
| | 65 | 28.0 | 27.4 | 27.4 | 27.4 | 27.4 | 27.4 | 27.4 |
| | 64 | 25.2 | 91.6 | 47.0 | 47.3 | 91.9 | 92.1 | 91.6 |
| | 63 | 26.1 | 87.2 | 47.0 | 47.3 | 87.7 | 87.7 | 87.2 |
| | 62 | 27.9 | 122.4 | 47.0 | 47.3 | 91.9 | 95.1 | 122.4 |
| | 61 | 37.4 | 136.6 | 47.0 | 47.3 | 91.9 | 95.1 | 136.6 |
| | 60 | 40.6 | 136.9 | 47.0 | 47.3 | 91.9 | 95.1 | 136.9 |
| | 59 | 43.6 | 137.1 | 47.0 | 47.3 | 91.9 | 95.1 | 137.1 |
| | 58 | 30.6 | 136.4 | 47.0 | 47.3 | 91.9 | 95.1 | 136.4 |
| | 57 | 26.2 | 135.3 | 47.0 | 47.3 | 91.9 | 95.1 | 135.3 |
| | 56 | 26.5 | 83.3 | 47.0 | 47.3 | 85.1 | 85.1 | 83.3 |
| | 55 | 13.0 | 27.4 | 27.4 | 27.4 | 27.4 | 27.4 | 27.4 |
| | 54 | 40.5 | 132.9 | 47.0 | 47.3 | 91.9 | 95.1 | 132.9 |
| | 53 | 40.9 | 126.2 | 47.0 | 47.3 | 91.9 | 95.1 | 126.2 |
| | 52 | 26.4 | 27.3 | 27.3 | 27.3 | 27.3 | 27.3 | 27.3 |
| | 51 | 32.0 | 119.7 | 47.0 | 47.3 | 91.9 | 95.1 | 119.7 |
| | 50 | 42.4 | 119.3 | 47.0 | 47.3 | 91.9 | 95.1 | 119.3 |
| | 49 | 48.0 | 139.9 | 47.0 | 47.3 | 91.9 | 91.9 | 139.9 |
| | 48 | 47.8 | 61.7 | 47.0 | 47.3 | 61.7 | 61.7 | 61.7 |
| | 47 | 45.9 | 139.9 | 47.0 | 47.3 | 91.9 | 95.1 | 139.9 |
| | 46 | 49.9 | 122.0 | 47.0 | 47.3 | 91.9 | 95.1 | 122.0 |
| | 45 | 59.1 | 85.6 | 47.0 | 91.9 | 91.9 | 95.1 | 85.6 |
| | 44 | 49.1 | 139.9 | 139.9 | 193.2 | 193.2 | 154.7 | 139.9 |
| | 43 | 49.5 | 27.2 | 27.2 | 27.2 | 27.2 | 27.2 | 27.2 |
| | 42 | 50.1 | 139.9 | 139.9 | 189.5 | 189.4 | 154.7 | 139.9 |
| | 41 | 47.1 | 139.9 | 139.9 | 177.8 | 177.8 | 154.7 | 139.9 |
| | 40 | 45.2 | 98.5 | 98.5 | 107.2 | 107.2 | 104.1 | 98.5 |
| | 39 | 37.4 | 85.7 | 85.7 | 92.1 | 92.1 | 90.4 | 85.7 |
| | 38 | 3.8 | 27.0 | 27.0 | 27.0 | 27.0 | 27.0 | 27.0 |
| | 37 | 3.8 | 27.4 | 27.4 | 27.4 | 27.4 | 27.4 | 27.4 |
| | 36 | 5.0 | 82.1 | 82.1 | 88.6 | 88.6 | 86.9 | 82.1 |
| | 35 | 27.7 | 82.1 | 82.1 | 88.6 | 88.6 | 86.9 | 82.1 |
| | J-100 | 51.7 | 80.9 | 80.9 | 87.8 | 87.8 | 86.1 | 80.9 |

**SYSTEM ANALYSIS - SCENARIO REVIEW**

Table A-2: Available Fire Flow (MDD + Fire Flow) Comparison

| SYSTEM INFORMATION | | | SCENARIO 1 | SCENARIO 2 | SCENARIO 3 | SCENARIO 4 | SCENARIO 5 | SCENARIO 6 |
|---|---|---|---|---|---|---|---|---|
| Zone | Node | Elevation (m) | Fire Flow (Available) (L/s) | Fire Flow (Available) (L/s) | Fire Flow (Available) (L/s) | Fire Flow (Available) (L/s) | Fire Flow (Available) (L/s) | Fire Flow (Available) (L/s) |
| West Zone | J-101 | 52.5 | 80.8 | 80.8 | 87.7 | 87.7 | 86.0 | 80.8 |
| | 34 | 63.2 | 77.9 | 77.9 | 83.6 | 83.6 | 82.4 | 77.9 |
| | 33 | 61.3 | 73.9 | 73.8 | 79.5 | 79.5 | 78.5 | 73.9 |
| | 32 | 60.8 | 139.9 | 139.9 | 172.9 | 172.9 | 154.7 | 139.9 |
| | 31 | 43.0 | 61.9 | 61.9 | 100.1 | 100.1 | 95.1 | 61.9 |
| | 30 | 43.1 | 61.9 | 61.9 | 100.1 | 100.1 | 95.1 | 61.9 |
| | 29 | 43.8 | 61.9 | 61.9 | 100.3 | 100.3 | 95.1 | 61.9 |
| | 28 | 41.9 | 61.9 | 61.9 | 99.9 | 99.9 | 95.1 | 61.9 |
| | 27 | 64.9 | 27.5 | 27.5 | 27.5 | 27.5 | 95.1 | 27.5 |
| | 26 | 41.4 | 61.9 | 61.9 | 82.4 | 82.4 | 95.1 | 61.9 |
| | 24 | 65.7 | 215.5 | 215.5 | 215.5 | 215.5 | 215.5 | 215.5 |
| | 23 | 63.7 | 61.9 | 61.9 | 61.9 | 61.9 | 61.9 | 61.9 |
| | 22 | 92.1 | 61.0 | 61.0 | 61.0 | 61.0 | 61.0 | 61.0 |
| | 21 | 64.6 | 61.0 | 61.0 | 61.0 | 61.0 | 61.0 | 61.0 |
| | 20 | 59.8 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 | 109.1 |
| | 19 | 52.1 | 139.9 | 139.9 | 157.4 | 157.4 | 154.7 | 139.9 |
| | 18 | 64.5 | 139.9 | 139.9 | 158.7 | 158.7 | 154.7 | 139.9 |
| | 17 | 44.5 | 139.9 | 139.9 | 172.3 | 172.3 | 154.7 | 139.9 |
| | 16 | 37.0 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 |
| | 15 | 38.9 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 |
| | 14 | 34.2 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 |
| | 13 | 34.0 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 |
| | 12 | 62.7 | 27.5 | 27.5 | 27.5 | 27.5 | 27.5 | 27.5 |
| | 11 | 61.7 | 48.7 | 48.7 | 49.0 | 49.0 | 49.0 | 48.7 |
| | 10 | 33.4 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 |
| | 9 | 28.4 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 |
| | 8 | 20.0 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 |
| | 7 | 4.7 | 27.3 | 27.3 | 27.3 | 27.3 | 27.3 | 27.3 |
| | 6 | 16.1 | 27.0 | 27.0 | 27.0 | 27.0 | 27.0 | 27.0 |
| | 5 | 7.6 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 |
| | 4 | 5.7 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 |
| | 3 | 3.8 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 |
| | 2 | 3.7 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 | 51.9 |
| | 1 | 3.8 | 26.8 | 26.8 | 26.8 | 26.8 | 26.8 | 26.8 |

Available fire flows, while maintaining minimum residual pressure in system of 150 kPa (22 psi), less than design fire flow of 70 L/s

# APPENDIX B

Cost Estimate – Class ‘D’

**WATERMAIN REPLACEMENT - OPTION REVIEW**

| General Note: Cost estimate reflects construction of each conceptual option based on McElhanney Ltd. Conceptual Design Drawings dated March 24, 2023. | | | **Class 'D' Cost Estimate (2023 Dollars)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ITEM NO. | DESCRIPTION | UNIT | QUANTITY | UNIT PRICE | AMOUNT | QUANTITY | UNIT PRICE | AMOUNT | QUANTITY | UNIT PRICE | AMOUNT |
| | | | **OPTION 1** | | | **OPTION 2** | | | **OPTION 3** | | |
| 1.1 | Mobilization and Demobilization | Lump Sum | 1.0 | $50,000.00 | $50,000.00 | 1.0 | $50,000.00 | $50,000.00 | 1.0 | $50,000.00 | $50,000.00 |
| 1.2 | Site Clearing | Lump Sum | 1.0 | $30,000.00 | $30,000.00 | 1.0 | $35,000.00 | $35,000.00 | 1.0 | $50,000.00 | $50,000.00 |
| 1.3 | Site Maintenance | Lump Sum | 1.0 | $25,000.00 | $25,000.00 | 1.0 | $25,000.00 | $25,000.00 | 1.0 | $25,000.00 | $25,000.00 |
| 1.4 | 250mm Diameter Watermain (imported backfill, surface restoration) | Lineal Meter | 200.0 | $600.00 | $120,000.00 | 235.0 | $600.00 | $141,000.00 | 225.0 | $600.00 | $135,000.00 |
| 1.5 | Storm Draiange / Culvert Replacements (includes armouring) | Each | 2.0 | $6,500.00 | $13,000.00 | 2.0 | $15,000.00 | $30,000.00 | 2.0 | $8,500.00 | $17,000.00 |
| 1.6 | Associated Works (connections, appurtenances) | Lump Sum | 1.0 | $40,000.00 | $40,000.00 | 1.0 | $50,000.00 | $50,000.00 | 1.0 | $50,000.00 | $50,000.00 |
| 1.7 | Slope Stablization Works | Allowance | 1.0 | $50,000.00 | $50,000.00 | 1.0 | $100,000.00 | $100,000.00 | 1.0 | $80,000.00 | $80,000.00 |
| 1.8 | Creek Crossing(s) / Environmental Mitigation | Allowance | 1.0 | $40,000.00 | $40,000.00 | 1.0 | $40,000.00 | $40,000.00 | 1.0 | $40,000.00 | $40,000.00 |
| 1.9 | Trail Reconstruction | Lineal Meter | 180.0 | $500.00 | $90,000.00 | 0.0 | $0.00 | $0.00 | 180.0 | $500.00 | $90,000.00 |
| | | | | **TOTAL CONSTRUCTED WORKS** | **$458,000.00** | | | **$471,000.00** | | | **$537,000.00** |
| | | | | **ENGINEERING & CONTINGENCY (50%)** | **$229,000.00** | | | **$235,500.00** | | | **$268,500.00** |
| | | | | **RDN CONTRIBUTION (TRAIL RE-CONSTRUCTION)** | **($100,000.00)** | | | **$0.00** | | | **($100,000.00)** |
| | | | | **TOTAL PROJECT (LESS GST)** | **$587,000.00** | | | **$706,500.00** | | | **$705,500.00** |

McElhanney

***Notes:***

**1)** Estimated costs are derived from recent experience on Vancouver Island, but there is no warranty that actual cost will not vary. McElhanney accepts no liability for actual cost which may vary from the estimated construction costs provided herein.

**2)** No allowance has been made for land acquisition costs, property negotiations or easements.

# APPENDIX C

Statement of Limitations

# Statement of Limitations

***Use of this Report.*** This report was prepared by McElhanney Ltd. ("**McElhanney**") for the particular site, design objective, development and purpose (the "**Project**") described in this report and for the exclusive use of the client identified in this report (the "**Client**"). The data, interpretations and recommendations pertain to the Project and are not applicable to any other project or site location and this report may not be reproduced, used or relied upon, in whole or in part, by a party other than the Client, without the prior written consent of McElhanney. The Client may provide copies of this report to its affiliates, contractors, subcontractors and regulatory authorities for use in relation to and in connection with the Project provided that any reliance, unauthorized use, and/or decisions made based on the information contained within this report are at the sole risk of such parties. McElhanney will not be responsible for the use of this report on projects other than the Project, where this report or the contents hereof have been modified without McElhanney's consent, to the extent that the content is in the nature of an opinion, and if the report is preliminary or draft. This is a technical report and is not a legal representation or interpretation of laws, rules, regulations, or policies of governmental agencies.

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***Information from Client and Third Parties.*** McElhanney has relied in good faith on information provided by the Client and third parties noted in this report and has assumed such information to be accurate, complete, reliable, non-fringing, and fit for the intended purpose without independent verification. McElhanney accepts no responsibility for any deficiency, misstatements or inaccuracy contained in this report as a result of omissions or errors in information provided by third parties or for omissions, misstatements or fraudulent acts of persons interviewed.

***Independent Judgments.*** McElhanney will not be responsible for the independent conclusions, interpretations, interpolations and/or decisions of the Client, or others, who may come into possession of this report, or any part thereof. This restriction of liability includes decisions made to purchase, finance or sell land or with respect to public offerings for the sale of securities.