Our File: McElhanney Project #2451-0464-181

TECHNICAL MEMO

To	From
Sandy (Alexander) Edwards, AScT Manager, Projects - RDNO	Jeff Brackett, P.Eng. McElhanney Ltd.
Re	**Date**
RDNO PZ431 Reservoir Site Selection Review	August 20, 2024 (Final)

In April 2024, the Regional District of North Okanagan (RDNO) retained McElhanney (MCL) to provide design, tender and construction-related services for a new PZ431 1.4ML reservoir. The name PZ431 denotes that the pressure zone operates at a hydraulic grade line (HGL) of approximately 431m. The "PZ" naming convention for pressure zones is used throughout RDNO's water network. The PZ431 pressure zone is also referenced as the PZ425 pressure zone in RDNO resources, and we understand these terms reference the same portion of the network in the Okanagan Landing area. RDNO has requested that MCL complete a site selection review to determine if the proposed site is still the most beneficial and cost-effective location for the reservoir. The original proposal for this project had identified a site in the Mission Hill neighborhood as the proposed reservoir site. We understand that the Mission Hill site was originally selected based on a pre-design report from Aplin & Martin Consultants (AM) dated August 11, 2015. RDNO supplied a set of criteria and data to help identify other potential sites for the reservoir and assess these candidate sites.

1. Review for Site Selection

1.1. UNDERSTANDING OF THE ASSIGNMENT

MCL reviewed the data and criteria provided by RDNO. Information provided by RDNO included:

- GIS data showing the 431m contour range through the Okanagan Landing area. This contour range shows the 431m elevation contour, plus 5m on either side, to define the area where the reservoir could be sited without an elevated structure or major ground modification
- Identification of sites owned by RDNO or the City of Vernon (CoV)
- Water network pressure zones and PRVs

Criteria for site selection were developed based on discussions with RDNO staff to identify cost-drivers, schedule risks, and parameters for long-term operations and maintenance of the new facility. Overall criteria for the assessment of potential sites included:

A. The site would ideally already be owned by RDNO, CoV or the Crown, in that priority order.

B. For sites that are privately owned, preference would be given to properties owned by organizations (churches, etc.) that may be more willing to sell or lease the land.

C. The site should allow the placement of the reservoir in the 431m contour range to allow gravity supply without PRVs to PZ431.

D. The site should have good road access and a reasonably sloped access driveway to avoid issues with snow clearing in the winter.

E. The reservoir should have good proximity to a supply main with adequate flow. For this assignment we have assumed that a minimum 300mm supply main would be required. This aligns with the recommendations from the AM report to keep velocities at an acceptable level.

F. The reservoir should have good proximity to power and communications infrastructure, as well as sanitary sewers if required for an overflow outlet.

RDNO requested that 5-6 candidate sites be identified and assessed using these criteria, provided that many reasonable options were available. If multiple sites appeared to be good alternatives to the original site, the top 2-3 candidates would undergo further screening to identify any challenges related to archaeological history, environmental conditions, or geological conditions.

Following an April 16, 2024 meeting with RDNO staff to discuss preliminary results of the screening, the criteria was further refined to include:

G. Sites requiring construction of a new booster pump system should not be included due to the upfront and long-term costs of an additional dedicated booster station. The reservoir is to be gravity fed from an existing higher pressure zone.

H. The reservoir would ideally not be fed from a pressure zone that is itself being fed by a booster pump.

I. Sites which do not fall within the bounds of the 431m contour range could be considered if ground modification or an alternative reservoir type (such as a water tower or equivalent) is determined to be reasonable from a cost and risk standpoint.

For Criteria I, our team completed a further review of alternative reservoir types (water tower or equivalent) and concluded that they would not be a reasonable option from a cost and risk standpoint. Reasons for excluding elevated reservoirs from further consideration include:

- Building this type of reservoir to compensate for the relatively limited shortfall in elevation (4-12m) seen at the candidate sites is unlikely to be cost-effective. Elevated reservoirs are more commonly used in flatter areas where the elevated structure is providing all the required pressure head.

- Additional long-term operational and heating costs would be expected for an elevated structure compared to a reinforced concrete structure that can be set into a slope.

- The additional 1.0ML of future capacity (population triggered, in addition to proposed 1.4ML) identified for this facility could not easily be added to an elevated structure. An entirely new structure would likely be required in order to provide additional capacity.

- The contracting and engineering community in British Columbia has limited experience with the design and construction of this type of facility, increasing the likelihood that contractors from outside the province would need to design and build the facility.

- There could be additional risks in the operation and maintenance of the facility due to the lack of local familiarity and experience with water towers.

1.2. SITE SCREENING

A list of potential sites was developed and reviewed with RDNO in a meeting on April 16, 2024. Some sites further to the southwest in the Okanagan Landing area were excluded on the basis that they were too far from existing infrastructure and would incur excessive costs for extending services. The final list of sites contained four options, with one option having three potential locations for the facility within the overall site. This resulted in six potential locations under consideration for the reservoir.

These sites have been numbered and can be characterized as follows:

1. **Site 1** – The original Crown Agricultural Land Reserve (ALR) site identified in the Aplin & Martin report, in the Mission Hill neighborhood.

2. **Site 2** – A City of Vernon-owned ALR site in the lower Commonage area, southwest of Site 1.

3. **Site 3** – This ALR parcel is owned by the City of Vernon, with a portion leased to another user. The overall site is southwest of Davison Orchards and has three potential options for reservoir siting:

    a. **Site 3A** – Located at the southwest corner of the overall site, this location is outside of the parcel which is currently being leased. The location is below the 431m contour range but is constrained from moving higher up the slope due to the presence of a bedrock outcropping.

    b. **Site 3B** – Located towards the middle of the overall site, this location is at the bottom end of the 431m contour range but is again constrained by the presence of a bedrock outcropping to the north.

    c. **Site 3C** – Located at the east/northeast corner of the overall site, this location is on land currently leased by another user. An existing home is present on the slope above this location, limiting options for siting.

4. **Site 4** – This parcel is owned by the City of Vernon and is currently zoned as a park. This area is still being developed, and the site is still vacant in the most recently available orthographic imagery. We have assumed this site will have road access to the southwest and northeast once buildout of the adjacent subdivision is complete.

RDNO reviewed a draft of the site selection memo dated May 15, 2024. Based on their feedback, our team has added the Davison Orchards property for further review:

5. **Site 5** – This parcel is owned by Davison Orchards and is within the ALR. Much of the contour range passes through the site's primary tourism areas and parking lots. Outside of those areas, we have identified two potential options for reservoir siting:

a. **Site 5A** – Located southwest of the Davison Orchards buildings, this site is ALR land that is currently being cultivated. The site is within the contour range, but subsurface conditions are unknown at this time.

b. **Site 5B** – Located northeast of the Davison Orchards parking lots, this site is ALR land that is not currently being cultivated. The area appears to be used for overflow parking or storage, based on historical imagery. It has been cultivated in the past. The site is at the upper end of the contour range and subsurface conditions are unknown.

Refer to **Appendix A** for a context plan highlighting the potential reservoir locations. Refer to **Appendix B** for breakdowns of each of the individual sites, including information on potential servicing options, property reports, and information on the status of the land.

1.3. ASSESSMENT OF SITES

The sites were compiled and assessed against the criteria noted in **Section 1.1**. Criteria of regular importance are scored on a 1-5 scale, where a higher score is more favorable. Criteria of higher importance, which have a larger impact on the probable costs and benefits of the site, are scored on a 1-10 scale, where a higher score is more favorable. This results in a higher weighting for these more important items. A matrix showing the results of this qualitative assessment is provided in **Appendix C**.

1.4. COST ESTIMATES FOR PREFERED SITES

Following review of a previous draft memo, RDNO staff have requested cost estimates for their preferred candidate sites. These are Sites 1, 3B, 5A and 5B. High-level (Class D) cost estimates for the preferred sites have been completed and are included in **Appendix D**. Cost estimating has been completed in advance of surveys, geotechnical investigations, and structural design, meaning that the estimates rely heavily on assumptions to assess expected costs. The estimates contain a number of assumptions, and the following factors should be considered when reviewing the Class D estimates:

- Additional information on site conditions, especially subsurface soil and bedrock, may have significant impacts on costs for site work and structures. RDNO should complete survey and geotechnical investigations for the top candidate site(s) to prove out assumptions on site conditions.

- Estimates don't factor in longer-term operational or maintenance costs that could be incurred after the facility is operational.

- Estimates do not include factors such as the cost of land acquisition, long-term leasing, land swaps or habitat rehabilitation. The top five candidate sites are all located within the ALR. We recommend that RDNO engage in discussions with the landowners and applicable regulatory bodies to help determine these costs for candidate sites.

- Estimates are "Class D" and carry a 40% contingency allowance. Engineers and Geoscientists BC (EGBC) defines Class D as a "preliminary estimate which, due to little or no site information, indicates the approximate magnitude of cost of the proposed project, based on the client's broad requirements. This overall cost estimate may be derived from lump sum or unit costs for a similar project. It may be used in developing long term capital plans and for preliminary discussion of proposed capital projects."

- The spread of costs (approximately ±10% of the average value) is well within the contingency allowance, suggesting that the differences between assumed and actual site conditions or constraints could affect the ranking of sites.

The results of the preliminary costing review are summarized below:

Site	Class D Cost Estimate Value (±40%)
5A	$4,172,000
3B	$4,587,000
1	$4,858,000
5B	$5,157,000

1.5. FINDINGS FOR SITE SELECTION

Based on our evaluations of the candidate sites (refer to **Appendix C**), the sites are ranked as noted below. Estimated costs from **Appendix D** are included for RDNO's preferred options but are not factored into the rankings from **Appendix C** due to the high degree of uncertainty in these preliminary cost estimates.

1. **Site 1: Original Mission Hill site**

   Estimated Cost: $4,858,000

   The original proposed site presents some challenges with access roads and utility installation due to steep slopes and a ravine. However, it otherwise has good proximity to road access and utilities, and a land tenure agreement is already in place. A preliminary review of the hydraulics by RDNO staff suggests that this site would have reduced headlosses and water age when compared to the Bella Vista locations.

2. **Site 5A: Davison Orchards Lands, southwest at farmland**

   Estimated Cost: $4,172,000

   This site is located southwest of the Davison Orchards buildings. This site is ALR land that is currently being farmed. The site is within the contour range, but subsurface conditions are unknown at this time. There is a good degree of flexibility for placement of the facility within the contour range but will result in the loss of actively cultivated land for the orchard. The assumed access road would also pass through the CoV leased parcel to the south. This cost estimate only provides connections to the nearest water mains within the applicable pressure zones, and does not include potential upgrades (if required or feasible) to the existing water network to improve hydraulics.

3. **Site 3B: Site 3A: Non-leased CoV ALR parcel southwest of Davison Orchards, eastern portion**

   Estimated Cost: $4,587,000

   This site is a short distance off Bella Vista road, but the access road and utilities would need to pass through a leased parcel which is currently under cultivation. The flatter portions of the site are below the 431m contour range and would require significant ground modification to be a viable location for a gravity reservoir. This type of ground modification may not be feasible from a cost or permitting perspective. CoV may not allow ground modification and construction due to the site being identified as a "Natural Area" in the City of Vernon Parks Master Plan (2015). This cost estimate only provides connections to the nearest water mains within the applicable pressure zones, and does not include potential upgrades (if required or feasible) to the existing water network to improve hydraulics.

4. **Site 5B: Davison Orchards Lands, northeast at overflow parking**

   Estimated Cost: $5,157,000

   This site is located northeast of the Davison Orchards parking lots. The site is ALR land that is not currently being farmed. The area appears to be used for overflow parking or storage, based on historical imagery. It has been cultivated in the past. The site is at the upper end of the contour range, suggesting that more of the building will need to be below grade, but subsurface conditions are unknown. Development at this location has a greater potential to impact operations at Davison Orchards since it would require access and trenching via Davison Road, which is currently the only public access to the property. The location of the site would also require some of the longest watermain installations contemplated in this review. This cost estimate only provides connections to the nearest water mains within the applicable pressure zones, and does not include potential upgrades (if required or feasible) to the existing water network to improve hydraulics.

5. **(TIE) Site 2: CoV-owned ALR parcel above Okanagan Ave and Longacre Drive**

   Estimated Cost: Not requested for this site

   This site would permit placement of a reservoir at the 431m contour on a CoV owned parcel, but it has serious drawbacks regarding servicing and access costs. The nearest existing access point is approximately 970m down the slope, not accounting for switchbacks that may be required in the road. Similarly, utility servicing would need to travel at least 970m in one direction. The site does not have proximity to an existing PZ483 main and would need to be fed from the PZ431 network itself, possibly requiring an additional booster to account for losses.

   (TIE) Site 4: CoV-owned park near Turtle Mountain at the top of Davison Road

   Estimated Cost: Not requested for this site

   This site is a CoV owned parcel zoned for park use but does not yet appear to have been developed. This is likely the most favorable site in terms of access and likelihood of acquisition, but it is well above the 431m contour range (±481m). A PRV would be required for the connection to the existing 425/431 pressure zone. The reservoir could be fed by existing mains at Turtle Mountain, but those mains are being fed by an existing boosted reservoir. Additional booster capacity could be required for the area, leading to significant additional operational costs for the new reservoir.

6. **Site 3A: Non-leased CoV ALR parcel southwest of Davison Orchards, western portion**

   Estimated Cost: Not requested for this site

This site is immediately off Bella Vista road with excellent access to water and utilities. However, the site contains steep bedrock outcroppings at the 431m contour range and would require significant ground modification to be a viable location for a gravity reservoir. This type of ground modification may not be feasible from a cost or permitting perspective. CoV may not allow ground modification and construction due to the site being identified as a “Natural Area” in the City of Vernon Parks Master Plan (2015).

7. **Site 3C: CoV-owned leased ALR farm parcel immediately southwest of Davison Orchards**

   Estimated Cost: Not requested for this site

   This site is a CoV owned parcel but is reportedly under lease to Davison Orchards until at least 2051. A Notice of Lease appeared in Vernon’s The Morning Star newspaper, dated February 6, 2011, offering a 40 year lease on the parcel. The site is under active cultivation and appears to contain a residential dwelling. The portion of site which is not being farmed or inhabited is well below the 431m contour range (approximately 421m) and would require significant ground modification to be a viable site for a gravity reservoir. This type of ground modification may not be feasible from a cost or permitting perspective and would be further complicated by the presence of a leaseholder on the property.

1.6. CLOSING AND OPINION FOR SITE SELECTION

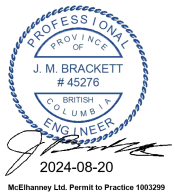
The original site (Site 1) remains the highest scoring site based on current site assessment criteria, but has the potential to be less cost-competitive than other sites due to challenging grades and the need to build an entirely new access road. Creating access to the site, with switchbacks passing over a steep ravine and utilities following the road alignment, appears to be the major upfront challenge for the site. However, the proposed reservoir can be sited precisely within the 431m contour range and has good access to water supply from PZ483. While we don't yet have geotechnical results from any site, we did not observe the presence of bedrock around the site or at existing soil cuts for the Okanagan College Connector Trail. Once access has been established, we expect that the site can be constructed and operated in accordance with RDNO's typical parameters for reinforced concrete reservoirs.

The recently added Site 5A appears to be the most cost-competitive based on current assumptions, and scored the second highest based on current site assessment criteria. However, while all of the top five ranked sites are in the ALR, Site 5A is being actively cultivated, which could present regulatory challenges. RDNO staff have also completed a preliminary review of system hydraulics in the Bella Vista area and flagged concerns about headlosses in the area and the resulting impacts to fire flow in the 25th Avenue corridor.

In summary, Site 5A appears to be the closest competitor with original site (Site 1) in terms of construction feasibility, offering the major benefit of simpler site access without the need to build an entirely new access road. However, the presence of bedrock southwest of Davison Orchards presents a significant unknown that could impact overall project costs. Additionally, Site 5A faces performance limitations due to a less optimal water network in the Bella Vista area. Addressing those limitations may not be feasible, or could result in significant additional costs, placing the site at a further disadvantage to Site 1.

Based on this assessment, Site 1 appears to be the preferable reservoir location, largely due to better apparent ground conditions and better connections to the existing water network. If further consideration of Site 5A is desired, we recommend that geotechnical investigations and survey be completed to provide more detailed information. The existing water network in the Bella Vista area would also need to be reviewed in greater detail to determine what upgrades (if any) could be completed to bring the expected hydraulic performance of Site 5A up to par with Site 1, and the expected cost of those upgrades.

Prepared by:



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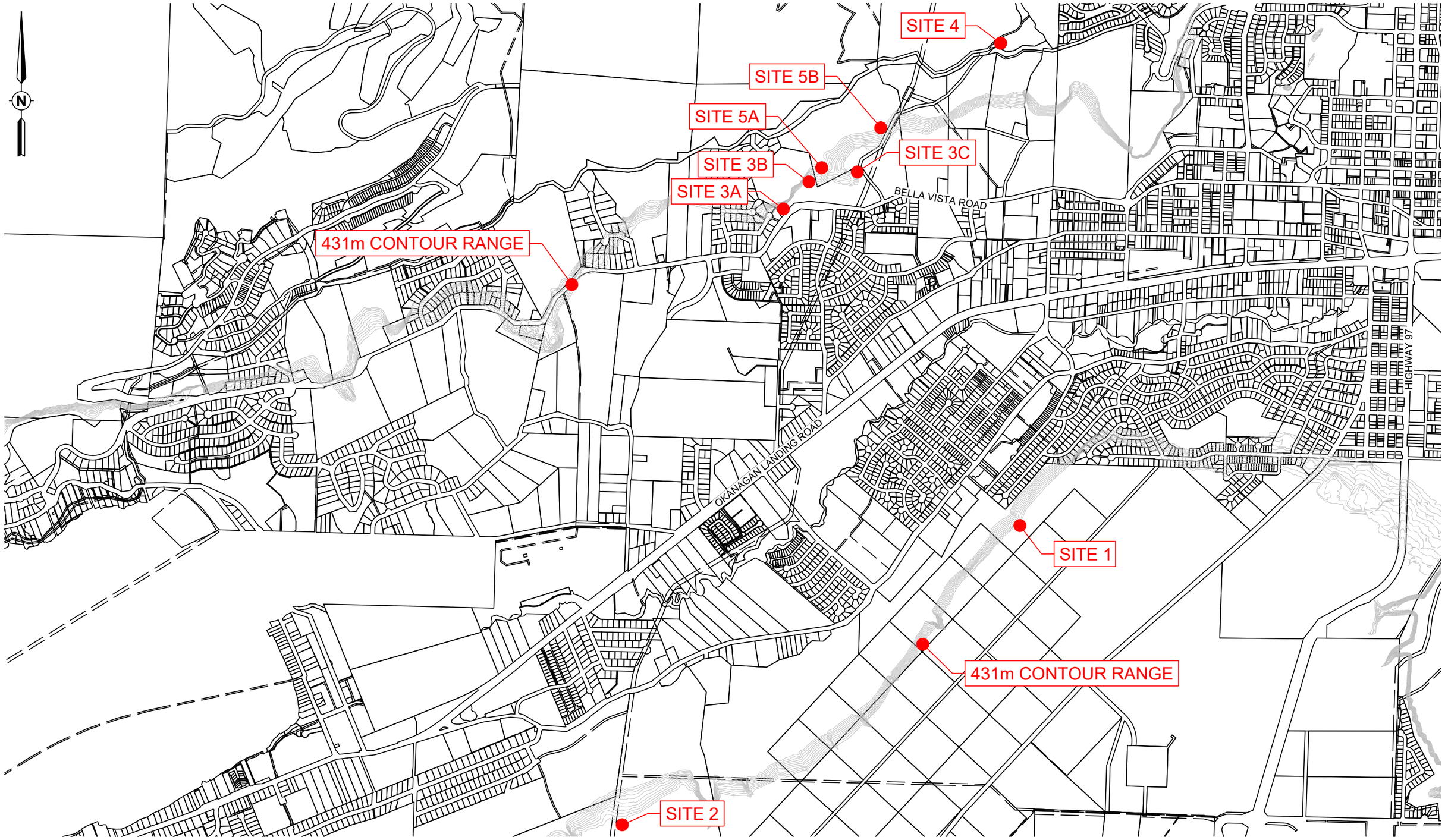
APPENDIX A

Overall Context Plan



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LOCATED AT: -
ELEVATION: -

ORIGINAL DWG SIZE: ANSI B (11" x 17")

McElhanney
104 - 3310 32 Avenue,
Vernon BC V1T 2M6
Tel. 250 861 8783

PRELIMINARY
NOT FOR
CONSTRUCTION

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

REGIONAL DISTRICT OF NORTH OKANAGAN
9848 ABERDEEN ROAD, COLDSTREAM, BC, V1B 2K9

PZ431-1.4ML RESERVOIR DESIGN
SITE INVESTIGATION
SITE OPTIONS

Drawing No.
CF-04

Project Number	Rev.
2451-0464-181	A

APPENDIX B

Candidate Sites

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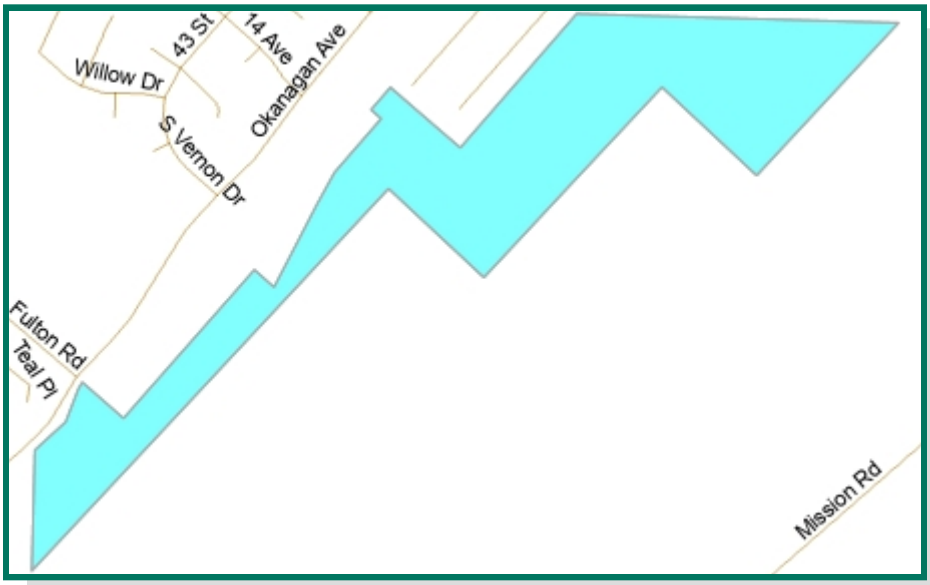
PZ431-1.4ML RESERVOIR DESIGN
SITE INVESTIGATION
SITE 1 OPTION

Drawing No.
CF-02

Project Number	Rev.
2451-0464-181	A

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

Property Report



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Legal Information:

Property Address: **OKANAGAN AVE**

Primary PID: **010-535-241** Legal Type: **LAND**

Lot: , Block: , Plan: **B3667**

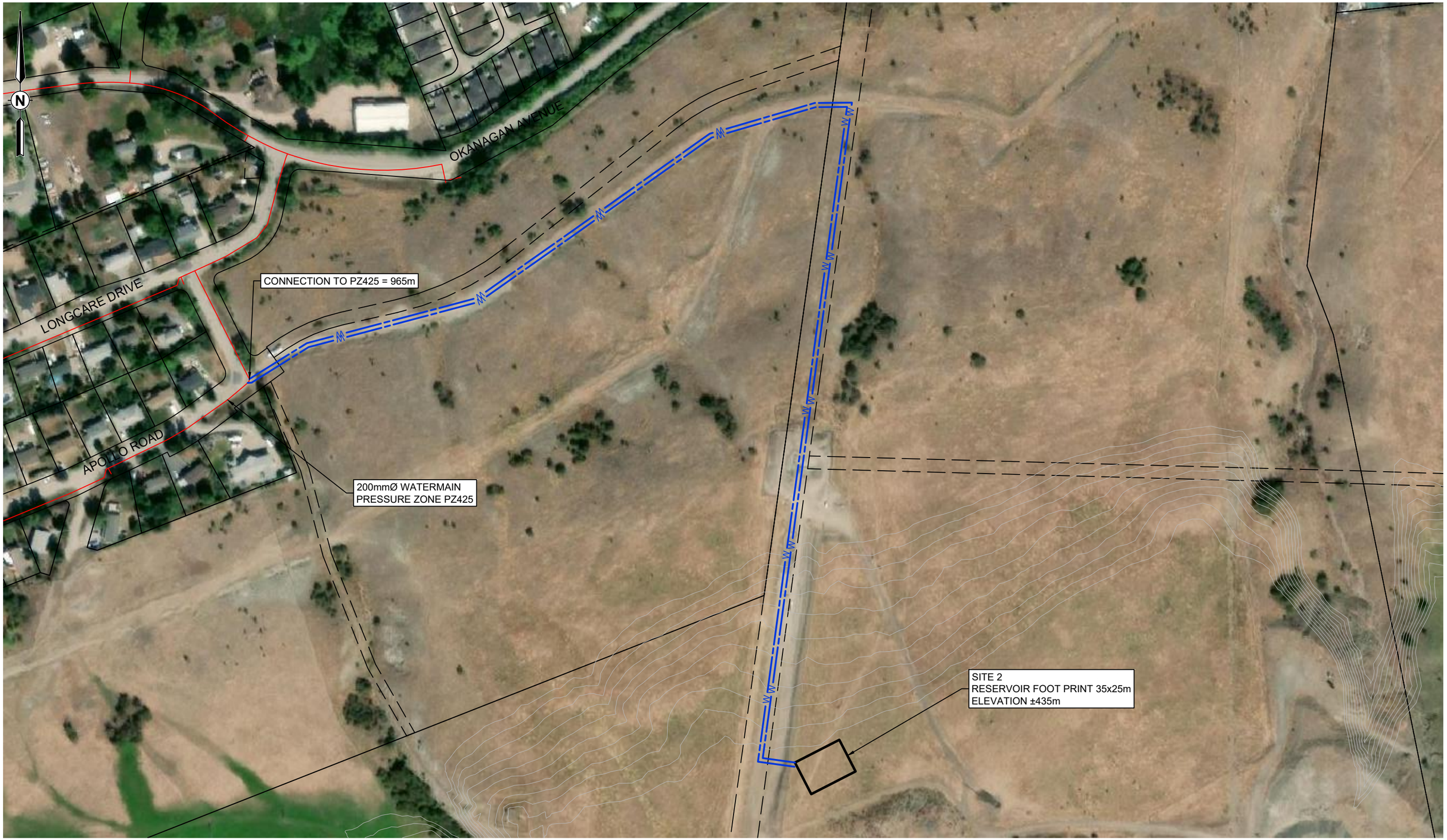
Long Form Legal:

PLAN B3667 SECTION 28 TOWNSHIP 9 OSOYOOS DIVISION YALE DISTRICT PART NW1/4 OF NW1/4 OF SW1/4, SEE 30002.000 & 30003.000 FOR MANAGEMENT UNIT 2 & MANAGEMENT UNIT 3 .

Assessment Information:

Folio	Assessment Set	Class	Net Land Value	Net Impr. Value	Net Total Value

10-May-2024



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ORIGINAL DWG SIZE: ANSI B (11" x 17")

McElhanney
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Tel. 250 861 8783

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REGIONAL DISTRICT OF NORTH OKANAGAN
9848 ABERDEEN ROAD, COLDSTREAM, BC, V1B 2K9

PZ431-1.4ML RESERVOIR DESIGN
SITE INVESTIGATION
SITE 2 OPTION

Drawing No.
CF-03

Project Number	Rev.
2451-0464-181	A

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

Property Report

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Legal Information:

Property Address: **6182 OKANAGAN AVE**

Primary PID: **010-994-394** Legal Type: **LAND**

Lot: **A** , Block: , Plan: **2591**

Long Form Legal:

LOT A PLAN 2591 TOWNSHIP 9 DISTRICT LOT 62 OSOYOOS DIVISION YALE DISTRICT SECTION 19&20, EXCEPT PLAN 18975 19925 KAP85838, & DL 63 AND 64, LOT B, PLAN 2591, DISTRICT LOT 64, OSOYOOS DIV OF YALE LAND DISTRICT, EXCEPT PLAN 3985, MANAGEMENT UNIT 9A.

Assessment Information:

Folio	Assessment Set	Class	Net Land Value	Net Impr. Value	Net Total Value

10-May-2024

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REGIONAL DISTRICT OF NORTH OKANAGAN
9848 ABERDEEN ROAD, COLDSTREAM, BC, V1B 2K9

PZ431-1.4ML RESERVOIR DESIGN
SITE INVESTIGATION
SITE 3 OPTIONS

Drawing No.
CF-01

Project Number	Rev.
2451-0464-181	A

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

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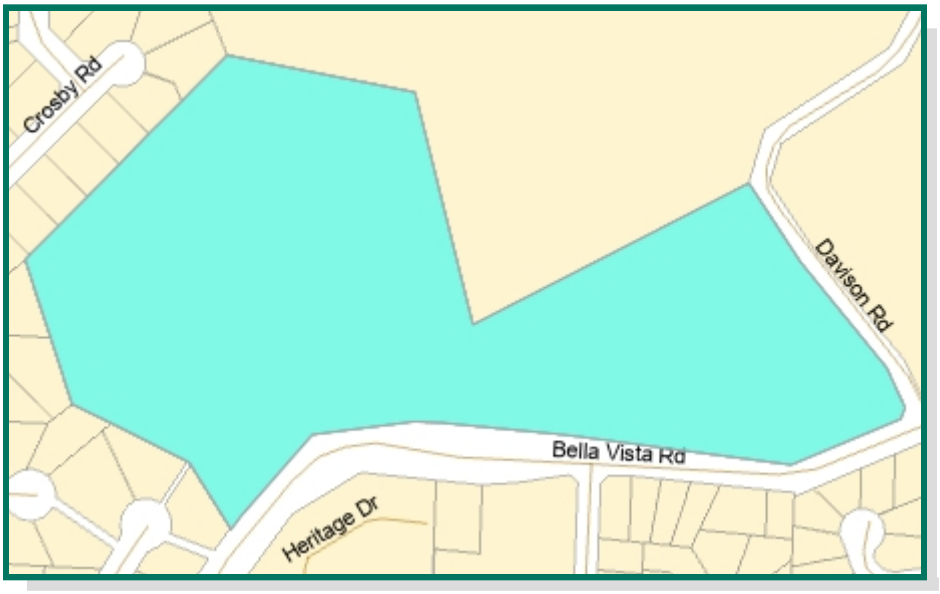

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Legal Information:

Property Address: **3097 DAVISON RD**

Primary PID: **005-637-368** Legal Type: **LAND**

Lot: **11** , Block: , Plan: **KAP1689**

Long Form Legal:

LOT 11 PLAN KAP1689 SECTION 32 TOWNSHIP 9 DISTRICT LOT 69 OSOYOOS DIVISION YALE DISTRICT SEC 24 (B) TAX ACT EXCEPT PLAN 40017.

Assessment Information:

Folio	Assessment Set	Class	Net Land Value	Net Impr. Value	Net Total Value
07428.500	2024 REVISED ROLL	9- Farm	$20179	$0	$20179

10-May-2024

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ELEVATION: -

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ORIGINAL DWG SIZE: ANSI B (11" x 17")

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Vernon BC V1T 2M6
Tel. 250 861 8783

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REGIONAL DISTRICT OF NORTH OKANAGAN
9848 ABERDEEN ROAD, COLDSTREAM, BC, V1B 2K9

PZ431-1.4ML RESERVOIR DESIGN
SITE INVESTIGATION
SITE 4 OPTION

Drawing No.
CF-04

Project Number	Rev.
2451-0464-181	A

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

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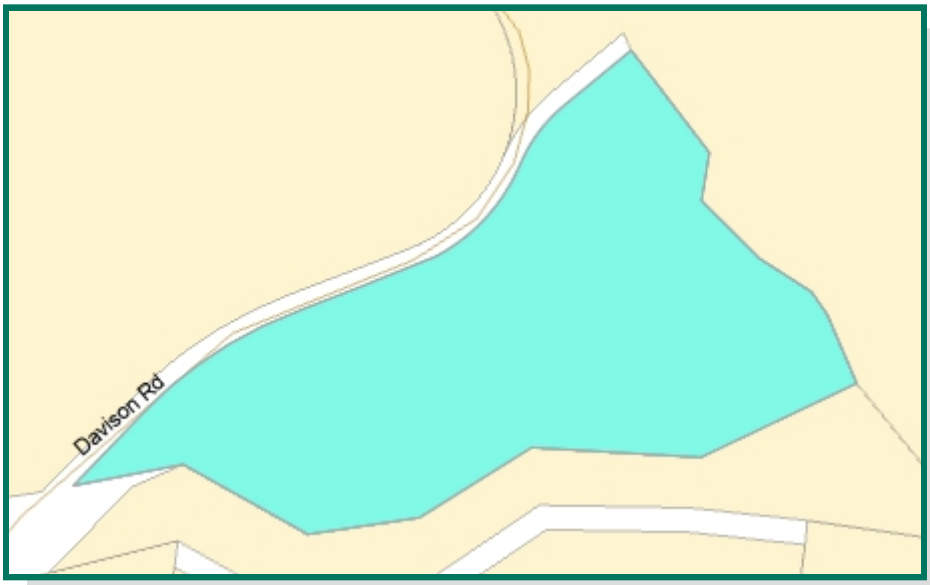

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Legal Information:

Property Address: **3300 DAVISON RD**

Primary PID: Legal Type: **LAND**

Lot: **PAR K** , Block: , Plan: **EPP114041**

Long Form Legal:

LOT PARK PLAN EPP80986 SECTION 4 TOWNSHIP 8 OSOYOOS DIVISION YALE DISTRICT

Assessment Information:

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07003.053	2024 REVISED ROLL	8- Rec	$0	$0	$0

10-May-2024

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BENCHMARK
ALL ELEVATION REFER TO CONTROL MONUMENT: -
LOCATED AT: -
ELEVATION: -

0 1:2,000 100

ORIGINAL DWG SIZE: ANSI B (11" x 17")

McElhanney
104 - 3310 32 Avenue,
Vernon BC V1T 2M6
Tel. 250 861 8783

PRELIMINARY
NOT FOR
CONSTRUCTION

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

REGIONAL DISTRICT OF NORTH OKANAGAN
9848 ABERDEEN ROAD, COLDSTREAM, BC, V1B 2K9

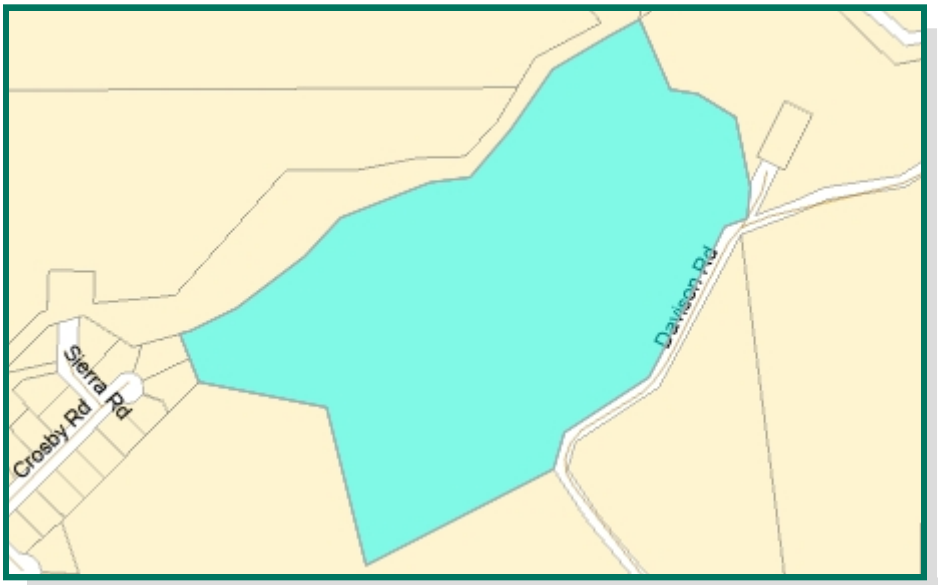
PZ431-1.4ML RESERVOIR DESIGN
SITE INVESTIGATION
SITE 5A OPTION

Drawing No.
CF-07

Project Number	Rev.
2451-0464-181	A

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

Property Report



Property highlighted in blue

Legal Information:

Property Address: **3111 DAVISON RD**

Primary PID: **011-379-189** Legal Type: **LAND**

Lot: **10** , Block: , Plan: **KAP1689**

Long Form Legal:

LOT 10 PLAN KAP1689 SECTION 32 TOWNSHIP 9 DISTRICT LOT 69 OSOYOOS DIVISION YALE DISTRICT

Assessment Information:

Folio	Assessment Set	Class	Net Land Value	Net Impr. Value	Net Total Value
07426.500	2024 REVISED ROLL	1- Res	$0	$401250	$401250
07426.500	2024 REVISED ROLL	9- Farm	$64794	$0	$64794
07426.500	2024 REVISED ROLL	6- Bus/Oth	$10400	$354000	$364400

Rev	Date	Description	Drawn	Design	App'd
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BENCHMARK
ALL ELEVATION REFER TO CONTROL MONUMENT: -
LOCATED AT: -
ELEVATION: -

0 1:2,500 100

ORIGINAL DWG SIZE: ANSI B (11" x 17")

McElhanney
104 - 3310 32 Avenue,
Vernon BC V1T 2M6
Tel. 250 861 8783

PRELIMINARY
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REGIONAL DISTRICT OF NORTH OKANAGAN
9848 ABERDEEN ROAD, COLDSTREAM, BC, V1B 2K9

PZ431-1.4ML RESERVOIR DESIGN
SITE INVESTIGATION
SITE 5B OPTION

Drawing No.
CF-06

Project Number	Rev.
2451-0464-181	A

DESTROY ALL PRINTS BEARING PREVIOUS REVISION

APPENDIX C

Candidate Sites Assessment Matrix

Site #	Land Type & Restrictions	Rating (1-5) (Regular Importance)	Site Topography	Rating (1-10) (Higher Importance)	Road/Site Access Access	Rating (1-5) (Regular Importance)	Water Servicing	Rating (1-10) (Higher Importance)	Utility Servicing	Rating (1-5) (Regular Importance)	Total Score (Higher is Better: Max 35)
1	Crown land (with existing land tenure agreement), ALR, no active cultivation.	4	Sparse vegation on soil, moderate slope on upper portion. Elevation ±435m, within contour range.	10	New switchback access from Bellevue expected. Ravine crossing. Relatively short access, less than 300m.	2	Supply line from PZ483 within 240m. Connection to PZ425 within 320m at Bellevue, or 540m at Okaganan Ave.	9	Feasible servicing within approximately 360m.	3	28
2	CoV-owned, ALR, no active cultivation.	4	Sparse vegation on soil, moderate slope. Elevation ±435m, within contour range.	10	Very long access road with potentially challenging grades and surface features. Minimum 970m before switchbacks.	1	Minimum 965m to PZ425 supply, plus 965m gravity line back from reservoir. Boosting may be required on supply line to make up for losses.	2	Feasible servicing within approximately 970m.	1	18
3A	CoV-owned, natural area, ALR. Identified as a "Natural Area" in CoV Parks Master Plan (2015).	2	Sparse vegation with adjacent bedrock, elevation ±419m. Soil retaining structures or tower required to bring within contour range.	1	Access directly from Bella Vista road, but potentially challenging grades to access site.	2	Supply line from PZ483 within 135m. Connection to PZ425 within 430m in an existing ROW. Potential headlosses due to smaller diameter mains.	7	Feasible servicing within approximately 25m.	5	17
3B	CoV-owned, farm/natural area, ALR. Access for road and utilies pass through southeastern portion of property under lease by Davison Orchard. Identified as a "Natural Area" in CoV Parks Master Plan (2015), but RDNO staff suggest the site may be feasible.	2	Treed area with adjacent bedrock, elevation ±427m. Soil retaining structures or elevated structure required to bring within contour range. Elevated structure is contemplated in current cost estimate.	4	Access to Bella Vista road via an existing driveway to orchard land. Passes through leased parcel being used as a farm.	4	Supply line from PZ483 within 155m, but passing through leased parcel without ROW. Connection to PZ425 within 440m, but passing through leased parcel without ROW. Potential headlosses due to smaller diameter mains.	6	Feasible servicing within approximately 170m.	4	20
3C	CoV-owned, leased, ALR. Within south-eastern portion of property under lease by Davison Orchard. Active farming within leased portion of parcel.	1	Treed area on steep slope, elevation ±421m. Soil retaining structures or tower required to bring within contour range.	1	Access directly from Davison Road may not be possible due to steep slopes. May require permission from Davison Orchard to enter leased parcel via their private property	2	Supply line from PZ483 within 220m in an existing ROW. Connection to PZ425 within 590m in an existing ROW. Potential headlosses due to smaller diameter mains.	5	Feasible servicing within approximately 20m.	5	14
4	CoV-owned, park designated.	5	Sparse vegation on soil, moderate slope. Elevation ±481m . Exceeds contour range, PRV required.	4	Future public road access from Southwest and Northeast as subdivision buildout continues, not overly steep.	5	Supply line from PZ483+ approximately 500m on existing ROW. Connection to PZ425 within 1500m on existing ROW. Score reduced due to boosted supply.	1	Feasible servicing within approximately 360m. Distance may be reduced further as subdivision buildout continues.	3	18
5A	Privately owned (Davison Orchards), ALR. Land is being actively farmed. RDNO suggests negotiation with land owner may be feasbile.	2	Sloped orchard land with unkown soil depth. Elevation within contour range with relatively flexible siting options within the contour.	9	Access to Bella Vista road via an existing driveway to orchard land. Passes through leased parcel being used as a farm. Similar to site 3B	4	Supply line from PZ483 within 220m, but passing through leased parcel without ROW. Connection to PZ425 within 500m, but passing through leased parcel without ROW. Potential headlosses due to smaller diameter mains.	5	Feasible servicing within approximately 250m.	3	23
5B	Privately owned (Davison Orchards), ALR.Land is not currently being farmed. Area appears to used for storage or overflow parking from Davison. RDNO suggests negotiation with land owner may be feasbile.	3	Sloped orchard land with unkown soil depth. Site is at the upper end of the contour range, ~435m, to avoid a conflict with the existing farm access road.	5	Access from Davison Road and private farm road. Roads already present and in use	5	Supply line from PZ483 within 430m, primarily in an existing ROW. Connection to PZ425, 825m primarily within an existing ROW. Potential headlosses due to smaller diameter mains.	2	Feasible servicing within approximately 45m.	4	19

APPENDIX D

Class D Cost Estimates

Assumptions:

1400 m3 storage, 2 storage cells

Assumed 20 m long x 10 m wide x 7.5 m high (0.5 m freeboard) - Partial bury
350 mm thick base, walls & roof
0.9m x 0.3m reinforced footings under walls
New supply line can connect to existing main at Bellevue
Assumed no bedrock within excavation
Assumed utility routing and access road design follow the Aplin Martin concept

Capital Cost Estimate - Class D

Components	Unrounded Quantity	Quantity	Units	Unit price	Extended
PZ431 Reservoir - 1,400 m3 - SITE 1 (Crown Land above Bellevue Drive)					
Site Works			-	-	-
Site Preparation (Clearing, Grubbing, Grading)	5148.34	5,150	m^2	$25	$128,750
Excavation - 4 side slopes - 4 m deep - Onsite re-use	1344	1,340	m^3	$24	$32,160
Import engineered fill (tank back fill)	357	360	m^3	$125	$45,000
Import engineered fill (underslabs) - 300 mm	79.2	80	m^3	$125	$10,000
New access - Cut material	3174.62	3,170	m^3	$16	$50,720
New access - Fill with cut material and building excavation material	3174.62	3,170	m^3	$35	$110,950
New access - Balance of imported fill	185.43	190	m^3	$80	$15,200
New access - Retaining wall	175	180	m^2	$500	$90,000
New access - Culvert	47	50	m	$400	$20,000
Access driveway/parking	2182.939	2,180	m^2	$150	$327,000
Landscaping		1	LS	$10,000	$10,000
75mm Conduit (Comms)		7	m	$200	$1,400
100mm check valve drain		1	ea	$1,500	$1,500
300 mm check valve overflow		1	ea	$3,000	$3,000
Piping (inlet and outlet common trench) - 300mm - Built with access road	255	260	m	$750	$195,000
Piping (outlet) - 300mm - Premium due to steep slope	365	110	m	$900	$99,000
Piping Drain-100mm		10	m	$300	$3,000
Isolation Valves (1 inlet/outlet) - 300mm		2	ea	$3,500	$7,000
Isolation Valves (drain) -100mm		1	ea	$2,000	$2,000
Control valve - in kiosk		1	ea	$8,000	$8,000
Misc fittings		1	LS	$20,000	$20,000
Bldg perimeter drains, cleanouts and outlet to grade - 4 sides		70	m	$300	$21,000
Dechlorination manhole		1	ea	$5,000	$5,000
Fencing (allowance)		1	LS	$25,000	$25,000
All other work		1	LS	$20,000	$20,000
Site Works Subtotal			-	-	**$1,250,680**
Reservoir Structure and Valving			-	-	-
Concrete base, walls & roof		344	m^3	$2,500	$860,000
Exterior Ladder		1	ea	$6,500	$6,500
Roof Gaurdrails		46	m	$800	$36,800
Roof Hatch		2	ea	$6,500	$13,000
Mixer		2	LS	$25,000	$50,000
Valve Kiosk with control valve, isolation valves		1	LS	$150,000	$150,000
Reservoir Level control / hatch alarm / programming		1	LS	$25,000	$25,000
Utility Structure		1	LS	$50,000	$50,000
Electrical - non control		1	LS	$50,000	$50,000
BC Hydro - allowance		1	LS	$50,000	$50,000
Reservoir Subtotal			-	-	**$1,291,300**
Subtotal (1)					**$2,541,980**
Contingency		40.0%	-	-	$1,016,792
Subtotal (2)					**$3,558,772**
General Requirements					
Insurance/Bonding		2.0%	-	-	$71,175
Mobilization/Demobilization		8.0%	-	-	$284,702
General Requirements (QC/Testing/Layout/Traffic Management)		6.0%	-	-	$213,526
Enviro Plan		0.5%			$17,794
Subtotal (3)			-	-	**$587,197**
Engineering/Geotech/Survey		**20%**			**$711,754**
Project Total					**$4,858,000**

Assumptions:

1400 m3 storage, 2 storage cells

Assumed 20 m long x 10 m wide x 7.5 m high (0.5 m freeboard) - Limited bury, mostly above grade
350 mm thick base, walls & roof
0.9m x 0.3m reinforced footings under walls
Assumed at least 1.5m of soil present at reservoir location
Assumed 40% premium for cost of structure when fully above-ground vs. partial bury (formwork, reinforcing, structural loading, etc)

Capital Cost Estimate - Class D

Components	Unrounded Quantity	Quantity	Units	Unit price	Extended
PZ431 Reservoir - 1,400 m3 - SITE 3B (CoV Park SW of Davison Orchards)					
Site Works			-	-	-
Site Preparation (Clearing, Grubbing, Grading)	4567.02	4,570	m^2	$25	$114,250
Excavation - Soil (assumed 1.5m depth) (offsite disposal)	504	500	m^3	$65	$32,500
Excavation - Rock (assumed present below 1.5m) (offsite disposal) (allowance)	66	70	m^3	$65	$4,550
Import engineered fill (tank back fill)	114	110	m^3	$125	$13,750
Import engineered fill (underslabs) - 300 mm	79.2	80	m^3	$125	$10,000
Access driveway/parking	1031.62	1,030	m^2	$150	$154,500
Landscaping		1	LS	$10,000	$10,000
75mm Conduit (Comms)		7	m	$200	$1,400
100mm check valve drain		1	ea	$1,500	$1,500
300 mm check valve overflow		1	ea	$3,000	$3,000
Piping (inlet and outlet common trench) - 300mm - premium for limited road access)	150	150	m	$750	$112,500
Piping (inlet) - 300mm - assume 1 way flow	165	15	m	$500	$7,500
Piping (outlet) - 300mm - assume 1 way flow (premium for limited road access)	440	290	m	$650	$188,500
Piping Drain-100mm		10	m	$300	$3,000
Isolation Valves (1 inlet/outlet) - 300mm		2	ea	$3,500	$7,000
Isolation Valves (drain) -100mm		1	ea	$2,000	$2,000
Control valve - in kiosk		1	ea	$8,000	$8,000
Misc fittings		1	LS	$20,000	$20,000
Bldg perimeter drains, cleanouts and outlet to grade - 4 sides		70	m	$300	$21,000
Dechlorination manhole		1	ea	$5,000	$5,000
Fencing (allowance)		1	LS	$25,000	$25,000
All other work		1	LS	$20,000	$20,000
Site Works Subtotal			-	-	**$764,950**
Reservoir Structure and Valving			-	-	-
Concrete base, walls & roof (for above-grade structure)		344	m^3	$3,500	$1,204,000
Exterior Ladder		1	ea	$6,500	$6,500
Roof Gaurdrails		46	m	$800	$36,800
Roof Hatch		2	ea	$6,500	$13,000
Mixer		2	LS	$25,000	$50,000
Valve Kiosk with control valve, isolation valves		1	LS	$150,000	$150,000
Reservoir Level control / hatch alarm / programming		1	LS	$25,000	$25,000
Utility Structure		1	LS	$50,000	$50,000
Electrical - non control		1	LS	$50,000	$50,000
BC Hydro - allowance		1	LS	$50,000	$50,000
Reservoir Subtotal			-	-	**$1,635,300**
Subtotal (1)					**$2,400,250**
Contingency		40.0%	-	-	$960,100
Subtotal (2)					**$3,360,350**
General Requirements					
Insurance/Bonding		2.0%	-	-	$67,207
Mobilization/Demobilization		8.0%	-	-	$268,828
General Requirements (QC/Testing/Layout/Traffic Management)		6.0%	-	-	$201,621
Enviro Plan		0.5%			$16,802
Subtotal (3)			-	-	**$554,458**
Engineering/Geotech/Survey		**20%**			**$672,070**
Project Total					**$4,587,000**

Assumptions:
1400 m3 storage, 2 storage cells
Assumed 20 m long x 10 m wide x 7.5 m high (0.5 m freeboard) - Full height partial bury
350 mm thick base, walls & roof
0.9m x 0.3m reinforced footings under walls
Assumed at least 1.5m of soil present at reservoir location

Capital Cost Estimate - Class D

Components	Unrounded Quantity	Quantity	Units	Unit price	Extended
PZ431 Reservoir - 1,400 m3 - SITE 5A (Western Area of Davison Orchards) (Full height partial bury)					
Site Works			-	-	-
Site Preparation (Clearing, Grubbing, Grading)	2160	2,160	m^2	$25	$54,000
Excavation - Soil (assumed 1.5m depth) (offsite disposal)	504	500	m^3	$65	$32,500
Excavation - Rock (assumed 2.5 cut below soil) (offsite disposal)	660	660	m^3	$130	$85,800
Import engineered fill (tank back fill)	408	410	m^3	$125	$51,250
Import engineered fill (underslabs) - 300 mm	79.2	80	m^3	$125	$10,000
Access driveway/parking	1285	1,290	m^2	$150	$193,500
Landscaping		1	LS	$10,000	$10,000
75mm Conduit (Comms)		7	m	$200	$1,400
100mm check valve drain		1	ea	$1,500	$1,500
300 mm check valve overflow		1	ea	$3,000	$3,000
Piping (inlet and outlet common trench) - 300mm - premium for limited road access)	205	210	m	$750	$157,500
Piping (inlet) - 300mm - assume 1 way flow	220	15	m	$500	$7,500
Piping (outlet) - 300mm - assume 1 way flow (premium for limited road access)	500	295	m	$650	$191,750
Piping Drain-100mm		10	m	$300	$3,000
Isolation Valves (1 inlet/outlet) - 300mm		2	ea	$3,500	$7,000
Isolation Valves (drain) -100mm		1	ea	$2,000	$2,000
Control valve - in kiosk		1	ea	$8,000	$8,000
Misc fittings		1	LS	$20,000	$20,000
Bldg perimeter drains, cleanouts and outlet to grade - 4 sides		130	m	$300	$39,000
Dechlorination manhole		1	ea	$5,000	$5,000
Fencing (allowance)		1	LS	$25,000	$25,000
All other work		1	LS	$20,000	$20,000
Site Works Subtotal			-	-	**$928,700**
Reservoir Structure and Valving			-	-	-
Concrete base, walls & roof		344	m^3	$2,500	$860,000
Exterior Ladder		1	ea	$6,500	$6,500
Roof Hatch		2	ea	$6,500	$13,000
Mixer		2	LS	$25,000	$50,000
Valve Kiosk with control valve, isolation valves		1	LS	$150,000	$150,000
Reservoir Level control / hatch alarm / programming		1	LS	$25,000	$25,000
Utility Structure		1	LS	$50,000	$50,000
Electrical - non control		1	LS	$50,000	$50,000
BC Hydro - allowance		1	LS	$50,000	$50,000
Reservoir Subtotal			-	-	**$1,254,500**
Subtotal (1)					**$2,183,200**
Contingency		40.0%	-	-	$873,280
Subtotal (2)					**$3,056,480**
General Requirements					
Insurance/Bonding		2.0%	-	-	$61,130
Mobilization/Demobilization		8.0%	-	-	$244,518
General Requirements (QC/Testing/Layout/Traffic Management)		6.0%	-	-	$183,389
Enviro Plan		0.5%			$15,282
Subtotal (3)			-	-	**$504,319**
Engineering/Geotech/Survey		**20%**			**$611,296**
Project Total					**$4,172,000**

Assumptions:

1400 m3 storage, 2 storage cells

Assumed 20 m long x 20 m wide x 4.0 m high (0.5 m freeboard) - Buried to finished grade with rock cut
350 mm thick base, walls & roof
0.9m x 0.3m reinforced footings under walls
Assumed at least 1.5m of soil present at reservoir location

Capital Cost Estimate - Class D

Components	Unrounded Quantity	Quantity	Units	Unit price	Extended
PZ431 Reservoir - 1,400 m3 - SITE 5B (Eastern Area of Davison Orchards)					
Site Works			-	-	-
Site Preparation (Clearing, Grubbing, Grading)	985	990	m^2	$25	$24,750
Excavation - Soil (assumed 1.5m depth) (offsite disposal)	864	860	m^3	$65	$55,900
Excavation - Rock (assumed present below 1.5m) (offsite disposal)	1440	1,440	m^3	$130	$187,200
Import engineered fill (tank back fill)	408	410	m^3	$125	$51,250
Import engineered fill (underslabs) - 300 mm	145.2	150	m^3	$125	$18,750
Access driveway/parking	410	410	m^2	$150	$61,500
Landscaping		1	LS	$10,000	$10,000
75mm Conduit (Comms)		7	m	$200	$1,400
100mm check valve drain		1	ea	$1,500	$1,500
300 mm check valve overflow		1	ea	$3,000	$3,000
Piping (inlet and outlet common trench) - 300mm - premium for limited road access)	417	420	m	$900	$378,000
Piping (inlet) - 300mm - assume 1 way flow (premium for limited road access)	425	8	m	$650	$5,200
Piping (outlet) - 300mm - assume 1 way flow (premium for limited road access)	825	408	m	$650	$265,200
Piping Drain-100mm		10	m	$300	$3,000
Isolation Valves (1 inlet/outlet) - 300mm		2	ea	$3,500	$7,000
Isolation Valves (drain) -100mm		1	ea	$2,000	$2,000
Control valve - in kiosk		1	ea	$8,000	$8,000
Misc fittings		1	LS	$20,000	$20,000
Bldg perimeter drains, cleanouts and outlet to grade - 4 sides		110	m	$300	$33,000
Dechlorination manhole		1	ea	$5,000	$5,000
Fencing (allowance)		1	LS	$25,000	$25,000
All other work		1	LS	$20,000	$20,000
Site Works Subtotal			-	-	**$1,186,650**
Reservoir Structure and Valving			-	-	-
Concrete base, walls & roof		447	m^3	$2,500	$1,117,500
Exterior Ladder		1	ea	$6,500	$6,500
Roof Hatch		2	ea	$6,500	$13,000
Mixer		2	LS	$25,000	$50,000
Valve Kiosk with control valve, isolation valves		1	LS	$150,000	$150,000
Reservoir Level control / hatch alarm / programming		1	LS	$25,000	$25,000
Utility Structure		1	LS	$50,000	$50,000
Electrical - non control		1	LS	$50,000	$50,000
BC Hydro - allowance		1	LS	$50,000	$50,000
Reservoir Subtotal			-	-	**$1,512,000**
Subtotal (1)					**$2,698,650**
Contingency		40.0%	-	-	$1,079,460
Subtotal (2)					**$3,778,110**
General Requirements					
Insurance/Bonding		2.0%	-	-	$75,562
Mobilization/Demobilization		8.0%	-	-	$302,249
General Requirements (QC/Testing/Layout/Traffic Management)		6.0%	-	-	$226,687
Enviro Plan		0.5%			$18,891
Subtotal (3)			-	-	**$623,388**
Engineering/Geotech/Survey		**20%**			**$755,622**
Project Total					**$5,157,000**

APPENDIX E

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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