REGIONAL DISTRICT OF NANAIMO

French Creek Water Reservoir
Structural Assessment

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HEROLD ENGINEERING

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1 INTRODUCTION

Herold Engineering Limited (Herold) has completed a structural condition assessment of the steel structure and various components that comprise a water reservoir tank in French Creek.

It is our understanding that these condition assessments are to form part of the routine preventative maintenance program utilized by the Regional District of Nanaimo (RDN) – Water Services Department. The information outlined in this document determines whether deficiencies exist in the structure due to environmental degradation or damage and provides corrective actions when required.

2 SCOPE OF ASSESSMENT

The assessment was performed at the French Creek water reservoir located at 1225 Sunrise Drive, Parksville on April 6th, 2022. The assessments were made using visual, non-destructive, and tactile observations only. Access into the water reservoir structure was permitted and performed under the RDN's confined space entry permit and procedure. Access to some elements, such as the interior ceiling or the exterior perimeter of the roof, was limited by the configuration of the structure, locations of platforms and/or the safe ability to access.

It is our understanding that the structure was last assessed in 2019 by Associated Engineering and that report was provided to us. Herold was able to review this document and has kept it on file.

This assessment is limited to the steel structure and structural component conditions only. No evaluation of structural capacity has been performed. Condition assessments given in this report are intended to evaluate the structure and identify areas where maintenance, repair, and further inspection may be required. Elements are rated on a scale of Good/Fair/Poor, where:

- Elements in "Good" condition represent close to as-built conditions, with at least 10 years of estimated service life remaining.
- Elements in "Fair" condition show a degree of environmental deterioration or damage that does not affect the overall structural integrity of the element immediately but has reduced the estimated service life to approximately 5 years.
- Elements in "Poor" condition have deterioration and/or damage that has impacted the element's structural capacity and have a remaining service life of fewer than 5 years.

3 OBSERVATIONS & ASSESSMENT FINDINGS

The French Creek water reservoir is a 9.96m diameter by 4.9m high circular on-grade bolted steel tank built circa 1980, with a roof replacement completed in 2006 by the RDN. Entry into the interior of the reservoir can be achieved through a 0.61m inside diameter circular hatch that is normally bolted shut. At the time of the site visit, the RDN had unbolted this circular hatch for the reservoir once it was emptied to clean it and allow access to the interior for this assessment.

In general, Herold would rate the overall condition of the steel water reservoir structure as a broad range of good, fair, and poor, with the following observations noted:

- Exterior steel and its coating appear to be fair, except for the horizontal seam around the mid-height of the tank. This horizontal seam and the area immediately above would be rated as poor.

- Interior steel and its coating appear to be fair, except for the area above the normal water level of the tank and at the seam where the roof meets the walls of the tank, which has degraded and would be rated as poor.
    - Discussions with an RDN employee on-site suggested that there may be a chemical reaction that emits vapour when the high-iron water and the chemicals used to treat it are mixed. This could be a plausible cause of the degrading of the coating and corrosion of the steel on the interior, above the normal waterline, where the vapours can attack. However, it is not certain whether this is a particular cause or whether it is just typical degradation.
- Exterior roof steel and coating appear to be fair, except for the roof access hatch. The roof access hatch's perimeter steel is corroding at various locations and is causing the coating to peel and fall off. This would be rated as poor.
- Steel column and roof panels appear to be in good condition with no issues noted.
- Steel roof beams appear to be in good condition, with a few beams where corrosion was noted to vary in severity and would be rated from fair to poor.
    - There are approximately three beams that have coating missing and minor corrosion starting. These would be rated as fair.
    - There are an additional two beams that have what appear to be large areas of coating missing and major corroding. These would be rated as poor.
- Interior concrete slab appears to be in good condition but can only be observed on the interior of the reservoir.
- Build-up was noted on the interior of the tank at panel seams and on other steel components throughout the reservoir, which is believed to be iron from the water.

In general, Herold would rate the overall condition of the various components located in and around the water reservoir as a broad range of good to poor, with the following observations noted:

- Exterior guardrails for the roof access appear to be in a serviceable state and would be rated as good condition. However, the guardrails stop at the roof work area extents painted on the roof's steel. It is uncertain whether this follows the RDN's Fall Protection Plan for guards to extend past the work area, which would conform to the WorkSafe BC requirements, as we do not have access to the RDN's documentation.
- Steel venting and piping throughout the reservoir, both through the steel walls of the tank and the concrete slab, varies from no corrosion and in good condition, to heavily corroded and in poor condition. However, this is a non-structural-related item and most items are not in current use.

Some steel components located in the reservoir are non-structural and therefore those are out of the scope of our work. Comments made are for informational purposes only. Photographs of the concrete structure and steel components of the water reservoir taken during our assessment can be found in Appendix A.

Accessory items that were flagged on the Associated Engineering report in 2019 do not appear to have been completed prior to this assessment. This includes increasing the height of the roof vent to account for the potential roof snow height, installing a pressure relief mechanism for vents with insect screening, and installing a roof fall protection anchor as the roof guardrail does not extend sufficiently past the marked lines on the roof for WorkSafe BC requirements.

4 CONCLUSIONS & RECOMMENDATIONS

The conditions that were found for the steel reservoir structure varied from minor corrosion and abrasion of the coating to major corrosion and coating failure requiring immediate remediation. Therefore, Herold believes the overall condition of the steel structure is rated as good to fair, with the recommended repairs to maximize the serviceability life of the steel water reservoir structure:

1. It is recommended that the interior walls, roof beams, and roof access hatch perimeter be cleaned and re-coated for protection from further corrosion and degradation above the normal water level as soon as possible. A cleaning and re-coating procedure should be obtained from a Coating Specialist (i.e. AMPP/NACE certified, etc.).
    i. **Note:** Re-coating for the interior steel should be completed with an appropriate NSF-ANSI Standard 61 "*Drinking Water System Components*" rated protective barrier.
2. In the next 1 – 3 years, the exterior roof and walls should be cleaned and re-coated to for protection from further corrosion or degradation. A cleaning and re-coating procedure should be obtained from a Coating Specialist (i.e. AMPP/NACE certified, etc.).
    i. Special attention shall be made to the horizontal seam, which has seen the most amount of corrosion and degradation and is rated poor.

The total cost of the above repair and maintenance work is estimated to be between $70,000 – $100,000. The estimated service life of this repaired and maintained steel structure, with the above recommendations undertaken and continued routine maintenance, should be well over 10 years. This estimate does not include items such as engineering work, replacement, routine maintenance, and other non-structural items outside of the scope of this report.

The conditions that were found for the various components throughout the reservoir varied and are rated in a range of good to poor. Comments made on the reservoir's non-structural related components are for informational purposes only to help give an idea of the best maintenance for the overall structure's life expectancy. The recommended repairs to maximize the serviceability life of the steel components of the water reservoir are as follows:

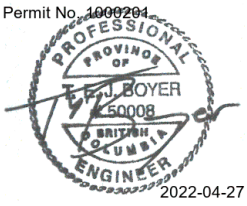
1. As recommended by Associated Engineering in 2019, the following items should be completed for the various accessory components throughout the reservoir:
    a. Raise the roof vent to 600mm minimum so that there is adequate snow clearance for the calculated roof snow height.
    b. Install a pressure-vacuum relief mechanism so that the tank is not susceptible to potential inward buckling due to a clogged vent.
    c. Depending on the RDN's review of their Fall Protection Plan, it may be suitable to decrease the roof work extents to conform to the minimum distance from work area to the guard, extend the roof guard, or install a roof fall protection anchor.

2. Commentary from our Civil Department on a previous structure's assessment recommended further inspection of the piping due to the reduction in diameter size from iron build-up. Since this may influence the serviceability of the water reservoir, it is recommended that a Professional with expertise in this field comment on the potential effects and provide recommendations for remediation as it is a non-Structural item.

We trust that this information is sufficient and meets the requirements of the assignment. Please do not hesitate to contact the undersigned if you have any questions or require additional information regarding the contents of this document.

Yours truly,

HEROLD ENGINEERING LIMITED



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APPENDIX A – PHOTOGRAPHS



Figure 1: 0.61m Circular Hatch to Access Tank



Figure 2: Interior Column Supporting Roof Beams



Figure 3: Exterior Steel and Coating Wear at and Above Horizontal Seam



Figure 4: Interior Steel and Coating Failure and Corrosion Above the Normal Water Level



Figure 5: Fair Roof Beam with Minor Corrosion



Figure 6: Poor Roof Beam with Major Corrosion

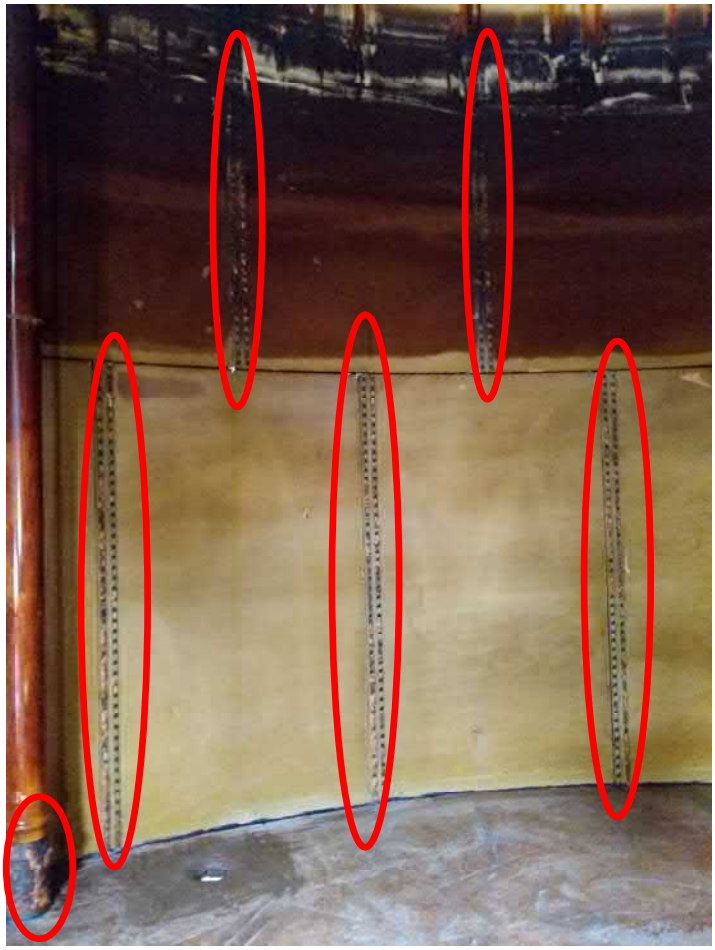


Figure 7: Believed to be Iron Build-Up on Piping and at Panel Seams



Figure 8: Believed to be Iron Build-Up Inside Drain



Figure 9: Various Steel Components with Believed to be Iron Build-Up



Figure 10: Roof Access Hatch Coating Failure and Steel Corrosion



Figure 11: Guardrail for Roof and Ladder



Figure 12: Painted Line of Roof Work Extents Matching End of Guard