

DATE July 30, 2021

REQUEST FOR PROPOSAL NO. PS20210991
CONSULTING SERVICES FOR THORNTON PARK PUMP STATION UPGRADES

ADDENDUM NO.1

RE: ADDITIONAL DOCUMENT ADDED

1. ADDED Thornton Park Pump Station Wet Well Condition Assessment

See attached for details.

This addendum must be completed, and attached to your Application form.

NAME OF VENDOR

SIGNATURE OF AUTHORIZED SIGNATORY

DATE

Jason Lo
Contracting Specialist

WATER STREET ENGINEERING LTD.

INFRASTRUCTURE PLANNING AND DESIGN

TECHNICAL MEMORANDUM

SUBJECT	Thornton Park Pump Station Wet Well Condition Assessment		
PROJECT	City of Vancouver Thornton Park Pump Station Repairs		
TO	Thomas Mah, PEng City of Vancouver	FROM	Stuart Fretwell, PEng
DATE	28 July 2021	FILE REF	WSE File #165.300
VERSION	A	STATUS	Draft

1. BACKGROUND

1.1. PURPOSE

This technical memorandum assesses the condition and suitability for service of the Thornton Park Pump Station wet well structure and associated piping and valves based on a visual inspection completed by Water Street Engineering Ltd. (WSE) and Gygax Engineering Associates Ltd. (GEA).

1.2. BACKGROUND

The Thornton Pump Station is located at the north-west corner of Station Street and Terminal Avenue in Vancouver, BC. The station was constructed in 1994 and is owned and operated by the City of Vancouver. The station includes an above-grade structure which houses the electrical and odour control rooms and a below-grade wet well and dry well.

There are currently three pumps (numbered 1, 2 and 4) installed in the wet well, which discharge to a common header in the dry well as shown in Figure 1. There is also an empty pump bay reserved for a future pump installation.

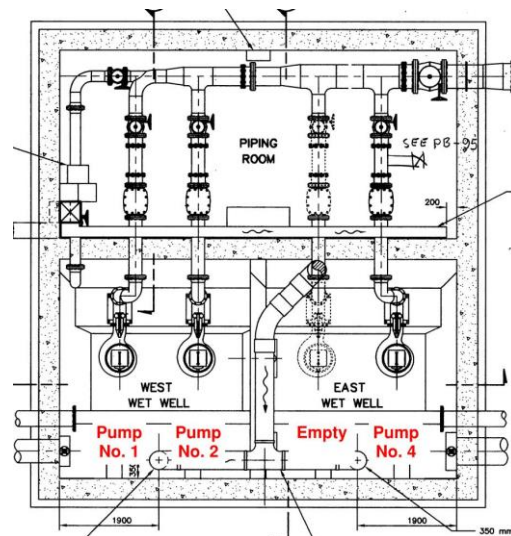


Figure 1: Thornton Park Pump Station wet well layout (record drawing)

A previous assessment of the station completed by AECOM in January 2020 ^{REF 1} was reviewed during preparation of this memorandum. The assessment included a range of recommendations for repair and replacement work including the following wet well elements as high-priority repair or replacement items:

- pump discharge piping
- sluice gates

The pump discharge piping in the wet well (up to the wall penetrations) and guiderails were replaced in 2021.

1.3. METHODOLOGY AND SCOPE OF WORK

WSE and GEA completed a site visit to enter the wet well on 04 Feb 2021 with ladder access and confined space entry requirements provided by Trittech Group Ltd (Trittech). The scope of the wet well condition assessment included a visual assessment of the following components:

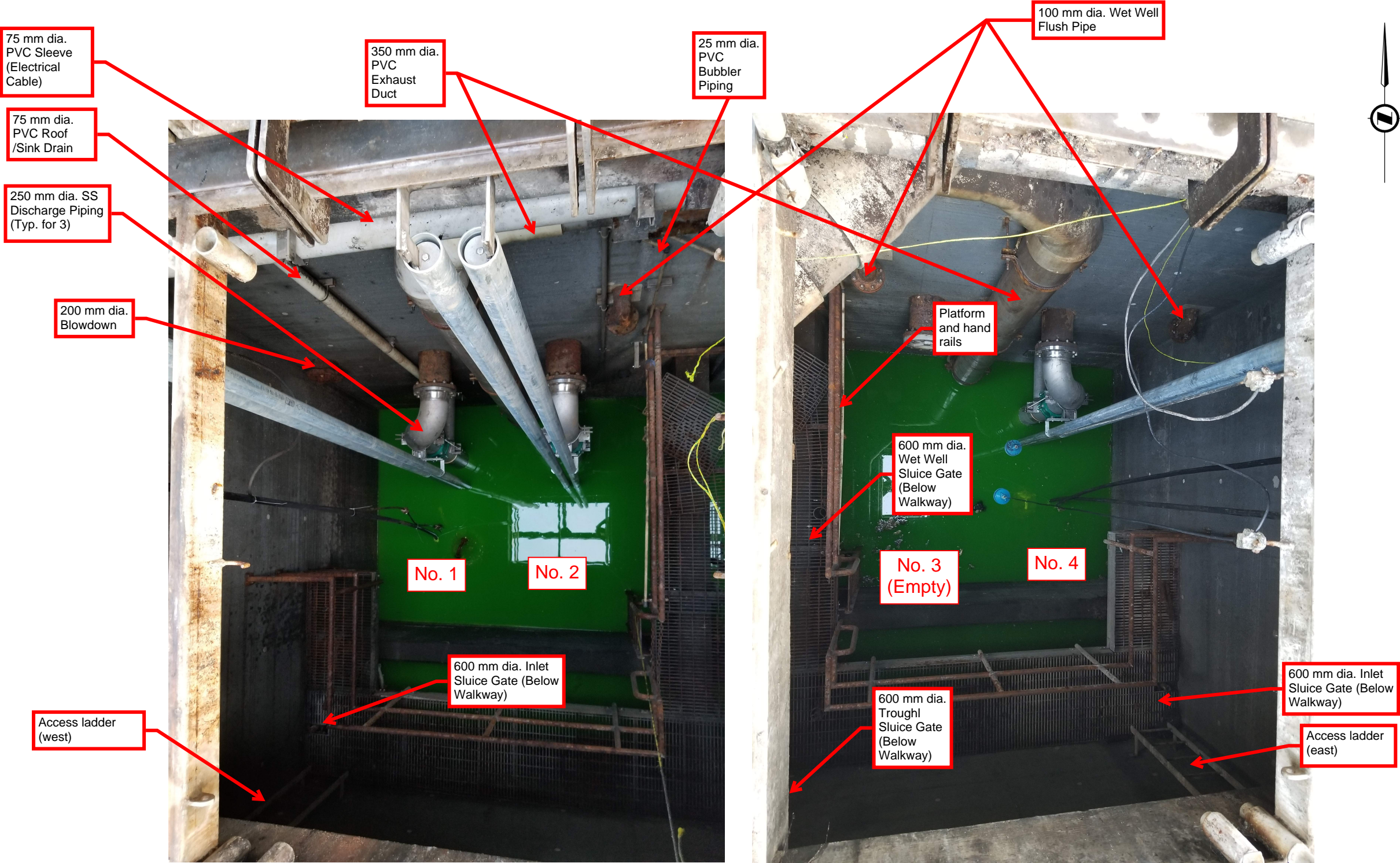
- Structural
 - Wet well concrete (troughs, walls, benching and floors)
 - Wet well platforms, guardrails, supports and ladders
- Process Equipment
 - Pump discharge bases, anchors and associated hardware
 - Sluice gates (4) and frames
 - Inlet trough openings
 - Pipe wall penetrations and discharge piping
 - Guiderails
 - Miscellaneous piping and wall penetrations
- Ventilation Equipment
 - Supply and exhaust ducting and supports (wet well only)

An overview of the wet well components is shown in Figure 2 and photos and condition ratings are included in Appendix 1.

1.4. LIMITATIONS AND EXCLUSIONS

All assessments are based on visual observations. No structural analysis, destructive or non-destructive materials testing was completed as part of the assessment.

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SCALE	
DATE: 11 May 2021	
CLIENT: City of Vancouver	
Thornton Park Pump Station Wet Well Condition Assessment	
Component Plan	
Figure 2	REV 0

2. ASSESSMENT CRITERIA

2.1. RATING SCALE

A five-point condition rating scale was used to rate the condition of each component.

Table 2-1: Condition Rating Scale

Rating	Condition	Guidance for Evaluation
1	very good	Very good condition Only normal maintenance required, no immediate work required Asset likely to perform adequately with routine maintenance for 10 years or more.
2	good	Minor Defects Only Minor maintenance required (5%) Minimal short-term failure risk but potential for deterioration or reduced performance in medium term (5-10 years). Minor (if any) work required.
3	fair	Maintenance required to return to accepted level of service Significant maintenance required (10-20%) Failure unlikely within 2 years but further deterioration likely and major replacement required within next 5 years. Work required but asset is still serviceable.
4	poor	Requires Renewal Significant renewal/upgrade required (20-40%) Likely need to replace most or all of asset within 2 years, no immediate risk to health or safety but work required within 2 years to ensure asset remains safe. Substantial short-term work required, almost unserviceable
5	very poor	Asset Unserviceable Over 50% of asset requires replacement Failed or imminent failure with a high risk of breakdown with a serious impact on performance. No life expectancy; asset cannot be serviced/operated without risk to personnel. Major work or replacement required urgently.

The 'Rating' and 'Condition' terms are as typically used by the City, and should therefore be consistent with other assessments. The City typically defines the 'Condition' based on the percent 'Expected Life Remaining'. However, the expected life of an asset is often undefined, unknown, and/or subject to a wide range of variation, particularly in the corrosive wet well environment. Therefore, the 'Guidance for Evaluation' in Table 2-1 was used. This was taken from the International Infrastructure Management Manual ^{REF 2}.

For components requiring repairs, the extent of the repair is assessed in accordance with Table 2-2.

Table 2-2: Repair Category

Value	Definition
1	None required
2	Minor repair
3	Major repair
4	Replacement

3. CONDITION ASSESSMENT

The following sections provide a general discussion for each component assessed. A summary of the elements including their condition ratings, repair categories, and recommendations along with additional photos, are included in Appendix 1. Additional information on the structural assessment is contained in Appendix 2.

3.1. STRUCTURAL

CONCRETE STRUCTURE

The wet well is constructed of reinforced concrete and is approximately 8 m deep. It includes a central dividing wall which splits the wet well into east and west wet wells. At the time of the assessment, the wet well walls were cleaned and visible to full height. Portions of the wet well floor slab were covered with liquid and not visible at the time of the assessment.

The interior faces of the concrete walls and visible portions of the base slab are in generally good condition. The lower walls (below normal operating liquid levels) have some areas with exposed aggregate. The maximum depth of erosion was assessed to be 5 mm.

No items are flagged for further investigation, testing or immediate repair as a result of the assessment. Destructive or non-destructive testing, as well as seismic evaluation, were excluded from the scope of the condition assessment.

PLATFORMS, GRATING AND LADDERS

Access to the wet well is by hatch entry on the top east and west sides of the wet well. Ladders from the hatches provide access to the intermediate platform level. The base of the wet well can be accessed by ladders from the intermediate platform as shown in Figure 3. During the assessment, access to the wet well was provided by temporary ladder access.

The intermediate ladders and platforms are in fair overall condition; however, the guardrails are in generally poor condition. The lower ladders are in very poor condition and should be removed or replaced. Stainless steel anchor rods at supports were found to be in good condition with no visible evidence of corrosion.

It is recommended that the platforms are not used unless the guardrails are replaced or rehabilitated as described in the structural assessment memorandum included in Appendix 2.



Figure 3: Ladder, platforms and guard rails

3.2. PROCESS COMPONENTS

DIFFUSER TROUGHS AND OPENINGS

The inlet sewage diffuser troughs distribute the incoming wastewater between the wet wells. There are two openings in the bottom of each trough that can be manually plugged with steel plates to isolate each side of the wet well. The trough holes were fully or partially plugged during the assessment and were subsequently unplugged after the assessment.

The inlet trough openings should be routinely cleaned as they are prone to blockages by accumulated solids. No immediate repair work is recommended.



Figure 4: West diffuser trough

ISOLATION SLUICE GATES

There are four 600 mm dia. sluice gates in the wet well, which are configured to allow the wet wells to be isolated. Construction specifications for the station indicate that the gates are Armttec Model 20-10C or approved equal but this was not verified during the assessment. Based on email correspondence from the City, the west inlet sluice gate was replaced in 1999 with an Armttec Model 20-10C gate. It is assumed that all other sluice gates are original (1994 construction).



Figure 5: SG-4 Wet well dividing wall gate

The gates were not operated during the assessment but they were tested by a Contractor on 07 July 2020 as part of the construction project for repairs to the Thornton Park Pump Station:

- SG-1 (west inlet gate) was operable
- SG-3 (east inlet gate) and SG-4 (wet well dividing wall gate) were not operable
- SG-2 (inter trough gate) was not tested as it could not be accessed

SG-2, 3, and 4 are in very poor condition and require repairs or replacement as the units are inoperable. Each unit was observed as highly corroded, resulting in seizing of the gate discs and actuator mechanisms / valve stems, with some instances resulting in component deformation and breakage.

OVERFLOW PIPING CONNECTIONS

Overflow pipe connections (300 mm diameter) are installed between the wet well and inlet manholes on both the east and west sides of the station. The overflow piping connections are capped inside the wet well on both sides of the station with blind flanges as shown in Figure 6. The overflow piping was not tested as part of the assessment but the piping is assumed to be in similar condition to the other wall piping penetrations. Surface corrosion was noted on the flange, piping and bolts.



Figure 6: Overflow piping (blind flange installed)

If the City plans to use the overflow connections in the future, the surface of the piping should be cleaned and the wall thickness measured to check the suitability of the piping for service.

WALL PENETRATIONS AND MISCELLANEOUS PIPING

There are several pipes (excluding pump discharge and overflow piping) extending into the wet well from the dry well:

- 1 - 200 mm dia. steel blowdown
- 3 - 100 mm dia. steel wet well flushing discharge piping
- 1 - 50 mm dia. PVC sump discharge piping
- 1 - 25 mm dia. PVC bubbler piping

The 200 mm dia. steel blowdown wall piping and flange is in very poor condition and is heavily corroded as shown in Figure 7. If the City intends to use the blowdown piping, the wall piping should be replaced and the vertical drop piping re-installed (as shown on record drawings).



Figure 7: 200 mm dia. blowdown connection

The 100 mm dia. wet well flushing pipes, shown in Figure 8, are in poor condition and appear to have been replaced since original construction based on the appearance of concrete patches. Two of the three pipes have been capped with blind flanges and do not appear to be in use. If the City intends to use the flushing pipes in

the future, the surface corrosion should be removed and the piping inspected and re-coated or the piping should be replaced with stainless steel.



Figure 8: 100 mm dia. wet well flush pipes

The PVC piping for the bubbler system, handwash sink discharge and the sump pump discharge are all in fair condition but could be replaced in the future along with other work in the wet well.

PUMP DISCHARGE BASES

The pump bases are assessed to be in good condition with no need for major repair or replacement. Minor levels of corrosion were observed. All pump leak tests were completed with no signs of leakage at the pump discharge flanges or the discharge spool flanges. All mounting hardware for the bases should be inspected periodically but no visible corrosion was noted.



Figure 9: Pump #4 discharge elbow

3.3. WET WELL VENTILATION

FOUL AIR DUCTING

Wet well ducts were observed to be in generally fair condition, without signs of deformation or deterioration. Discoloration was observed on the surface of the ducts but is primarily attributed to the corrosion of duct supports and other metal components. Replacement or repair of the ducts is not considered necessary based on the condition of the ducts but the City may want to consider replacement of the relatively low-cost materials at the same time as the supports are replaced. Sizing of the ducts should also be reviewed as part of future upgrade work.

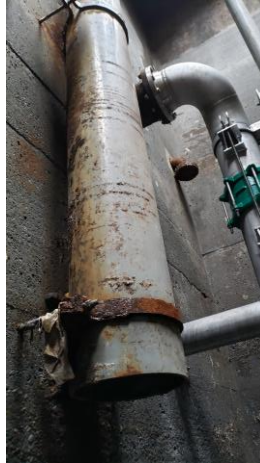


Figure 10: PVC ventilation ducting and supports

DUCT SUPPORTS

The duct supports are heavily corroded. Multiple supports also have signs of concrete or epoxy deterioration immediately surrounding the anchor rods,

Some anchor rods appear to have been replaced with stainless steel rods and those without visual signs of corrosion and concrete deterioration appear acceptable for continued service. All pipe clamps were noted as highly corroded and should be replaced.

Generally, all supports are recommended to be removed and replaced with stainless steel supports. Concrete deterioration at the bases of the anchor rods in the walls was noted; where required, wall penetrations should be repaired and replacement support rods should be anchored in the walls in new locations. All replacement metal works should be of 316 stainless steel construction to minimize corrosion.

4. RECOMMENDATIONS

Based on the visual assessment of the wet well, the following components are considered in poor or very poor condition and should be repaired or replaced if the pump station wet well is bypassed in the future.

- Lower wet well ladders (or remove permanently)
- Intermediate platform guardrails
- Intermediate platform grating
- Sluice gates
- Pipe wall penetrations
- Duct supports and hangers

WATER STREET ENGINEERING LTD.

Prepared by

Reviewed by

Stuart Fretwell, PEng
Project Engineer

Allan Bronsro, MSc, PEng
Senior Civil Engineer

REFERENCES

1. AECOM, *Thornton Park Pump Station Assessment-Upgrade Strategy*, January 2020.
2. Association of Local Government Engineering N.Z. Inc., *International Infrastructure Management Manual*, Version 3.0, 2006

STATEMENT OF LIMITATIONS

This document has been prepared by Water Street Engineering Ltd. (WSE) for the exclusive use and benefit of the intended recipient(s). No other party is entitled to rely on any of the conclusions, data, opinions, or any other information contained in this document.

This document represents WSE's best professional judgement based on the information available at the time of its completion and as appropriate for the project scope of work. Services performed in developing the content of this document have been conducted in a manner consistent with that level and skill ordinarily exercised by members of the engineering profession currently practicing under similar conditions. No warranty, express or implied, is made.

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REVISION HISTORY

Version	Status	Date	Description of Revisions	Author	Reviewer
A	Draft	28 July 2021	-	SF	AB

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Appendix 1: Wet Well Condition Assessment Component Tables


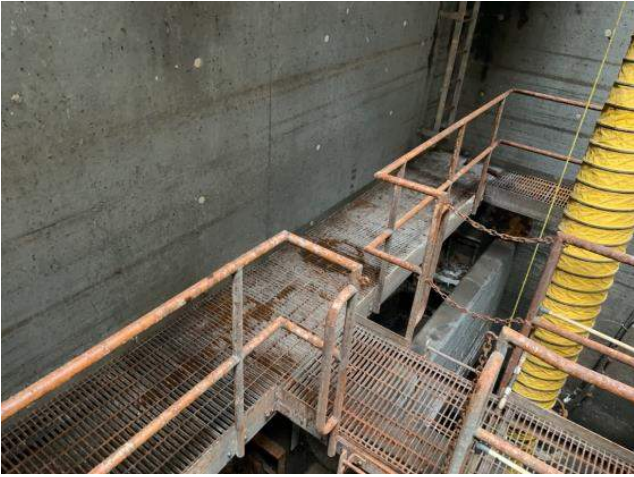

Condition Rating Scale


Rating	Condition	Guidance for Evaluation
1	Very Good	Very good condition Only normal maintenance required, no immediate work required Asset likely to perform adequately with routine maintenance for 10 years or more.
2	Good	Minor Defects Only Minor maintenance required (5%) Minimal short-term failure risk but potential for deterioration or reduced performance in medium term (5-10 years). Minor (if any) work required.
3	Fair	Maintenance required to return to accepted level of service Significant maintenance required (10-20%) Failure unlikely within 2 years but further deterioration likely and major replacement required within next 5 years. Work required but asset is still serviceable.
4	Poor	Requires Renewal Significant renewal/upgrade required (20-40%) Likely need to replace most or all of assets within 2 years but no immediate risk to health or safety but work required within 2 years to ensure asset remains safe. Substantial short-term work required, almost unserviceable
5	Very Poor	Asset Unserviceable Over 50% of asset requires replacement Failed or imminent failure with a high risk of breakdown with a serious impact on performance. No life expectancy; asset cannot be serviced/operated without risk to personnel. Major work or replacement required urgently.



Repair Category



Value	Definition
1	None required
2	Minor repair
3	Major repair
4	Replacement

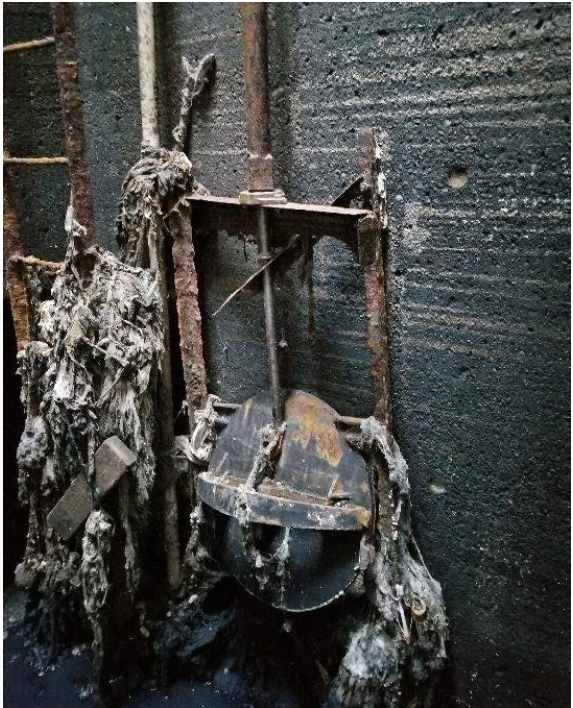

Item	Condition Rating	Repair Category	Condition Description	Recommended Repairs	Photo
Wet Well Concrete					
Wet well concrete (walls)	2	1	<p>Interior faces of wet well and visible portions of base slab appear to be in generally good condition.</p> <p>Lower portions of the walls below normal wet well liquid levels have minor erosion and exposed aggregate due to exposure to effluent and/or scour.</p>	<p>No items were identified for immediate repair. Portions of the base slab were not visible due to liquid levels in the wet well. These should be inspected during future pump station upgrades.</p>	  



Item	Condition Rating	Repair Category	Condition Description	Recommended Repairs	Photo
Ladders, Grating and Guardrails					
Ladders	2/4	3/4	<p>The intermediate ladders and platforms are assessed to be overall in fair condition.</p> <p>The lower ladders are assessed to be in very poor condition</p>	<p>Intermediate Ladders: Remove corrosion from material and inspect to confirm no significant section loss; re-coat material with suitable coating or replace with stainless steel or fiberglass</p> <p>Lower Ladders: Remove and replace ladders with stainless steel or fiberglass or remove permanent ladders from lower wet well if not intended for use in the future</p>	
Guardrails	3/4	3	<p>The guardrails for the intermediate platform are in fair to poor condition. They show extensive visible corrosion in some areas and likely have some section loss of structural steel. The thickness of remaining sound steel is unknown.</p>	<p>Remove corrosion from guardrails and inspect to confirm no significant section loss; re-coat material with suitable coating</p> <p>or</p> <p>replace all guardrails with new structure fabricated from 316 stainless steel or fiberglass</p>	
Platforms and platform supports	3	3	<p>The primary steel structure (channels and angles) and bar grating for the intermediate platform and ladder from the intermediate platform to the top of the wet well appear to generally be in fair condition. There is surface corrosion and loss of galvanized coating in many areas. There does not appear to be significant section loss of the structural steel.</p> <p>The anchor rods to the concrete are of stainless steel and appear to be free of corrosion.</p>	<p>Remove corrosion from base material and inspect to confirm no significant section loss; re-coat material with suitable coating</p> <p>or</p> <p>replace all materials with new structure fabricated from 316 stainless steel or fiberglass.</p>	



Item	Condition Rating	Repair Category	Condition Description	Recommended Repairs	Photo
Trough Inlets					
Inlet troughs / trough openings	1	1	Trough diffuser openings were fully/partially plugged prior to wet well cleaning	No repair work required. Increase frequency of opening clean out.	

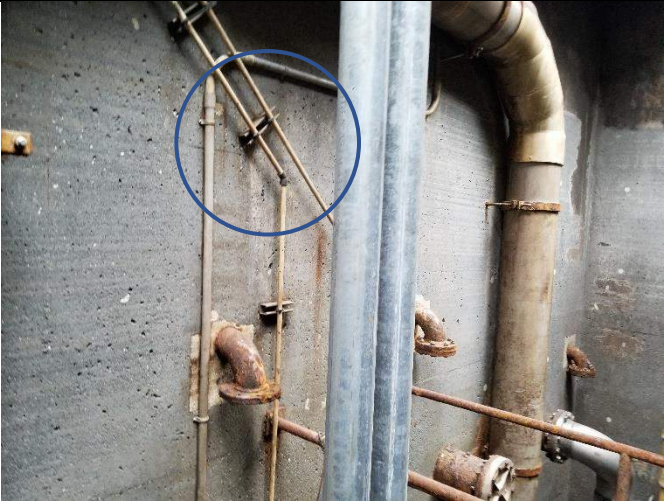

Item	Condition Rating	Repair Category	Condition Description	Recommended Repairs	Photo
Pump Discharge Elbows					
Discharge Elbow (Pump 1)	2	2	Minor corrosion noted, no significant deterioration on exterior body of elbow.	Mounting bolts/nuts should be inspected periodically for signs of deterioration	
Discharge Elbow (Pump 2)	2	2	Minor corrosion noted, no significant deterioration on exterior body of elbow.	Mounting bolts/nuts should be inspected periodically for signs of deterioration	



Item	Condition Rating	Repair Category	Condition Description	Recommended Repairs	Photo
Discharge Elbow (Pump 4)	2	2	Minor corrosion noted, no significant deterioration on exterior body	Mounting bolts/nuts should be inspected periodically for signs of deterioration	
Sluice Gates					
Sluice gate (West inlet)	3/4	3	Gate operable. Some corrosion/buildup noted on gate and frame.	Remove gate and frame for cleaning/servicing; inspect all hardware for loss of structural material	


Item	Condition Rating	Repair Category	Condition Description	Recommended Repairs	Photo
Sluice gate (Middle wet well dividing wall)	5	4	Gate inoperable. Significant deterioration of frame and mounting hardware	Remove and replace gate, frame and mounting hardware	
Sluice gate (East inlet)	5	4	Gate inoperable. Significant corrosion/buildup noted on gate and frame	Remove and replace gate, frame and mounting hardware	

Item	Condition Rating	Repair Category	Condition Description	Recommended Repairs	Photo
Sluice gate (Trough separation)	5	4	Significant corrosion/buildup noted on gate and frame. Gate operation was not tested	Remove and replace gate, frame and mounting hardware	
Miscellaneous Piping and Wall Penetrations					
Overflow Piping Connections	3	3	The overflow piping was not tested as part of the assessment but the piping is assumed to be in similar condition to the other wall piping penetrations. Surface corrosion was noted on the flange, piping and bolts.	Remove surface corrosion, check pipe wall thickness and re-coat with suitable coating. Or Replace piping, flange and bolts with stainless steel.	

Item	Condition Rating	Repair Category	Condition Description	Recommended Repairs	Photo
Pipe wall penetration: 200 mm dia. blow down	5	4	Heavy corrosion noted, resulting in surface deformation. PVC drop pipe and bend have been removed.	Complete replacement of wall spool recommended with stainless steel. Remove piping through wall if not used by the City	
100 mm diameter flush piping	3	3	Surface corrosion on all piping, PVC drop pipes have been removed, blind flanges installed on 2 of 3 pipes.	Replace piping through walls with stainless steel or remove surface corrosion and re-coat piping. Remove piping through walls if not used by City.	

Item	Condition Rating	Repair Category	Condition Description	Recommended Repairs	Photo
25 mm PVC bubbler piping	3	4	Pipe and supports appear to be in fair condition	Remove piping system if not used by the City	
Pump Discharge Piping, Wall Penetrations and Guide Rails					
Pump Discharge piping (pump #1, 2, 4)	1	1	Discharge piping and guiderails replaced in 2021	No repairs required	

Item	Condition Rating	Repair Category	Condition Description	Recommended Repairs	Photo
Pump Discharge piping wall penetrations	4	4	Surface corrosion on all piping; existing flange face (pump #2) in poor condition but currently maintains seal	Replace wall piping with stainless steel or remove surface corrosion and test wall thickness to confirm suitability for service. Re-coat piping with suitable coating.	
Ventilation					
Foul air ducting	3	2	Fair condition, no deformation or deterioration noted. Surface discoloration from support corrosion.	No significant repair or replacement required but ducting may be replaced at the same time as the supports due to low cost of replacement.	

Item	Condition Rating	Repair Category	Condition Description	Recommended Repairs	Photo
Duct supports and hangers	5	4	Heavy corrosion of brackets and anchors noted. Deterioration of concrete at anchors noted in several locations.	Replacement of all anchor rods and support brackets recommended with stainless steel.	

Appendix 2: Wet Well Structural Condition Assessment Memorandum

Hi STO : Water Street Engineering email : sfretwell@waterstreeteng.com

ATTN : **Stuart Fretwell, P.Eng**

FROM : **Adam Williams** FILE : 20000.001.421

DATE : 5 April 2021 TOTAL PAGES SENT: 10

PROJECT : City of Vancouver - Thornton Pump Station Wet Well

SUBJECT : **Wet Well Structural Condition Assessment**

Background

The Thornton Pump Station is a wastewater pump station owned and operated by the City of Vancouver, originally constructed in 1994. The station includes a wet well and dry well, both buried below grade, and a small above grade electrical / mechanical room located over the dry well.

Gygax Engineering Associates (GEA) were engaged by Water Street Engineering (WSE) to complete a structural condition assessment of the wet well including the interior concrete, access ladder, grating, supporting steel work and anchors. This assessment was scheduled to take place while the wet well was drained, cleaned and accessible in February 2021. The assessment scope was defined as a visual review of accessible components only, with provision for hammer sounding of concrete if required. No structural analysis, destructive or non-destructive materials testing was included in the assessment scope.

Wet Well Structure Configuration

A previous condition assessment of the pump station was completed by AECOM in January 2020. However, that assessment did not include condition assessment of the complete wet well structure as the station was in operation at that time.

Per the description of the structure provided in the AECOM report, including extracts of the original design drawings, the wet well is constructed of reinforced concrete, approximately 8 m deep.

The wet well has a split design with a central dividing wall between two wet well chambers, each housing up to two pumps, to allow for some redundancy of operation. Access is provided by removable access hatches at ground level, and permanent steel ladders and platforms.

Structural Condition Assessment, 04 February 2021

The wet well structure was assessed visually by Adam Williams (GEA) on 4th February 2021, together with personnel from Water Street Engineering, with access provided by Tritech Group Ltd. Access to the wet well was via a temporary ladder extending to the base of the wet well, with all roof hatches open.

At the time of the assessment, the walls were well cleaned and visible full height. Liquid covered the very lowest portion of the wet well base, so the concrete surface of the lowest floor elevation was not visible. In general, the wet well was well lit from light from the open hatches supplemented by flashlights, and the majority of the interior structure was visible. The exterior of the concrete walls are fully backfilled and not visible.

Concrete Condition Assessment

Based on the visual observation, the interior face of the wet well concrete walls and visible portions of the base slab and benching appear to be in generally good condition.

The only area of visible cracking to the concrete is on the upper half of the north wall, consisting of a vertical crack, with a width estimated at <0.5 mm (see Photo #4). There is no sign of efflorescence, water flow, rust staining or other visible deterioration to the crack or surrounding area. Based on the location and appearance, it is assessed to be a shrinkage crack and not a structural concern at this time.

For the upper 2/3rds of the wall height, above the wet well dividing wall, the inner formed concrete surface is in good condition. The wall has a smooth formed finish with minor bug holes dating from the original construction (see Photo #3).

Below the wet well dividing wall, in the area close to the normal liquid level in the wet well, some areas of concrete have eroded to expose the aggregate. We estimate there is a maximum depth of erosion of around 5 mm (see Photo #6), due to exposure to effluent and/or scour. The remaining concrete appears sound, and the walls are still assessed to be in generally good condition.

There was no visible sign of rust staining, unsound concrete, significant cold joints or significant movement or out-of-plumbness to any portion of the wet well walls.

There appears to be some limited leakage around the personnel access hatches (see Photo #11), with moisture visible during the assessment and staining / efflorescence to the concrete indicating some long-term leakage. This does not appear to have caused any significant deterioration to the concrete itself at this time.

Wet Well Ladders and Platforms

Wet well access is provided by permanent ladders and platforms. An intermediate platform, of galvanized steel with bar grating, is located at roughly mid-height of the wet well. Two fixed vertical ladders lead from the intermediate platform to personnel access hatches on the south-east and south-west corners of the wet well. Two further fixed ladders provide access down to the base of the wet well. None of the ladders are caged or provided with permanent fall arrest systems.

The primary steel structure (channels and angles) and bar grating for the intermediate platform and ladder from the intermediate platform to the top of the wet well appear to generally be in fair condition. There is surface corrosion and loss of galvanized coating in many areas. There does not appear to be significant section loss of the structural steel at this time. The anchor rods to the concrete are of stainless steel and appear to be free of corrosion. (see Photos #7, #8)

The guardrails for the intermediate platform are in fair to poor condition. They show extensive visible corrosion to some areas, particularly on the west side (see Photo #10), and likely have some section loss of structural steel to this area, although the thickness of remaining sound steel is unknown.

The ladders from the intermediate platform to the base of the wet well are in very poor condition. The west ladder has portions that have corroded full thickness with complete section loss (see Photo #12).

Recommendations

Wet Well Concrete

Based on the visual assessment of the interior of the wet well, the concrete is assessed to be in good condition. No items are flagged as requiring further investigation, testing or immediate repair as a specific result of this assessment.

Note that we have not completed any analysis of the structural capacity of the concrete wet well, including review of the capacity under extreme loading such as earthquake or flood loads, or assessment against the structural requirements of the current building code or other applicable legislation.

Wet Well Ladders and Platforms

The intermediate ladders and platforms are assessed to be overall in fair condition, with the guardrails in poor condition. Due to the poor condition of the guardrails, we recommend these platforms are not used for access unless they are rehabilitated as described below.

If the platforms are to remain in use, they should be rehabilitated by cleaning of corrosion product to sound metal, inspecting to confirm there is no significant section loss (particularly to the guardrails), and re-coated

with a suitable coating system. Alternatively, it may be more cost effective to replace with a new structure, ideally fabricated from 316 stainless steel or fiberglass to give improved durability.

The lower ladders to the wet well are in very poor condition and should be removed and, if required, replaced with new ladders fabricated from 316 stainless steel or fiberglass, suitable for the exposure conditions inside the wet well.

We understand that the ladders and platforms are rarely or never used by the City of Vancouver staff, due to limited need for access and the confined space conditions of the wet well. Based on this, it may be preferable to completely remove all ladders and platforms and rely on providing safe temporary access via a ladder through the main roof hatch as needed.

Closure

We trust the above information serves your current needs and are at your disposal for any clarifications.

Gygax Engineering Associates Ltd.

Prepared:

Reviewed:

Adam Williams, P.Eng. Struct.Eng., Principal

Aaron Guest, P.Eng., Principal

Photographs



Photo 1: Wet Well (west side)



Photo 2: Wet Well (east side)



Photo 3: Typical concrete wall condition, upper walls.



Photo 4: One visible crack, west wall, upper portion.

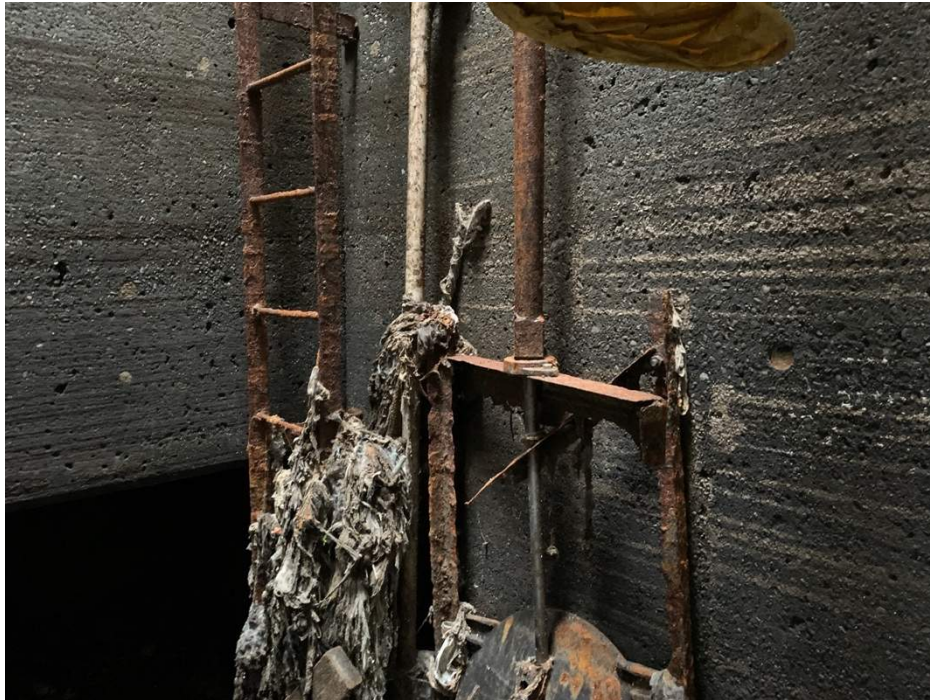


Photo 5: Concrete walls, lower wet well at dividing wall. Some erosion of concrete surface exposing aggregate.



Photo 6: Maximum observed erosion of concrete surface, lower walls of wet well

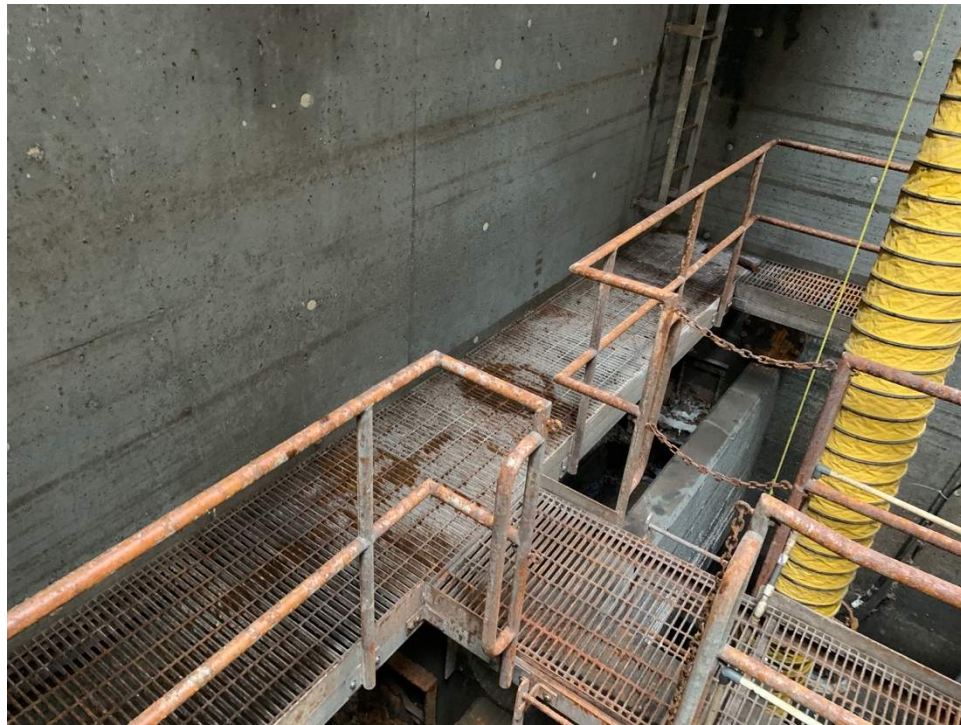


Photo 7: Intermediate platform. Steel in fair condition.



Photo 8: Intermediate platform, supporting steel in fair condition. Anchors to concrete appear stainless steel and with no visible corrosion.



Photo 9: Upper ladder, good to fair condition, limited surface corrosion only.

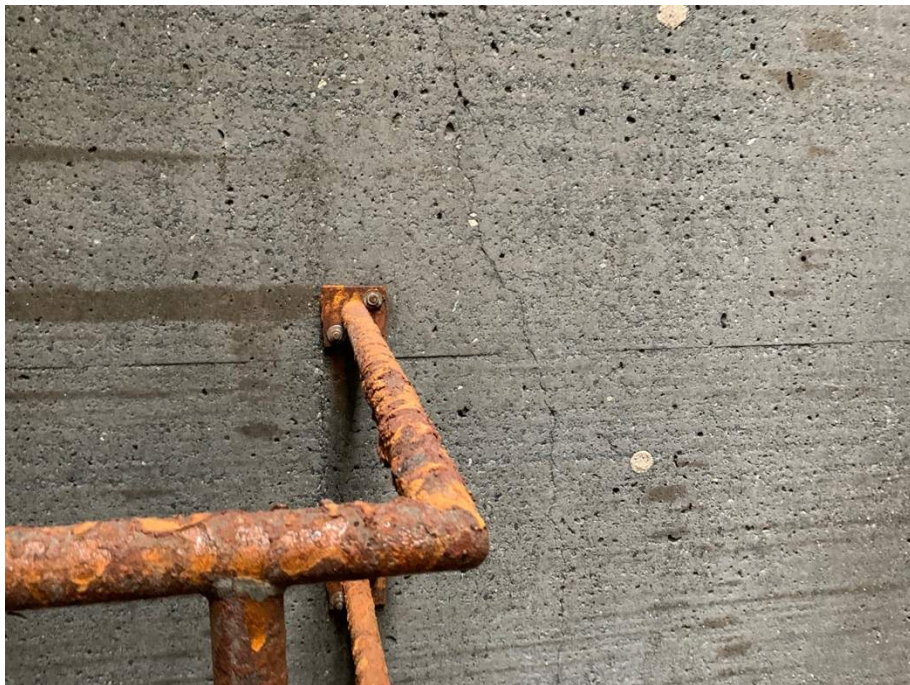


Photo 10: Intermediate platform, guardrail in poor condition. Significant corrosion, complete loss of coating, potential section loss.



Photo 11: South-west ladder and access hatch. Appears to be some leakage around hatch.



Photo 12: Lower ladder, very poor condition, complete section loss through side rail