CGW
Consulting Engineers

Life Expectancy and Durability Assessment

Water Take Resource Consent

Nelson City Council

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1. Executive Summary

CGW has been engaged by Nelson City Council (NCC) to complete a structural and life cycle assessment of two dams, the Maitai Dam Intake Structure – South Branch and the Roding Dam Structure.

This assessment involved a site inspection to assess the condition of visible sections of the dam and associated components. The inspection did not include any destructive testing, nor was it a dam safety/dam break assessment.

This assessment found that the Maitai Dam Intake Structure – South Branch is generally in sound aged condition with some aesthetic defects. Overall, the residual design life of the key structural components is estimated to be in the order of 30 years. It is likely this could be extended with regular maintenance. The service life of some ancillary components could be less than 30 years, for example deep pitting was observed on the steel sluice valve and this should be subject to a more detailed condition assessment.

Components of the Roding Dam critical to system operation were generally found to be in acceptable condition consistent with the age of the infrastructure. The residual service life of the intake structure is estimated to be in the order of 30 years however it is noted that the depth of concrete spalling cannot be assessed whilst the structure remains in operation. Again, it is likely that routine maintenance, for example the application of a mortar topping to the inlet structure, could prolong this estimate.

A number of defects were observed in the pipeline leading to the Roding Water Tunnel including a significant leak. Without adequate maintenance, these defects may lead to a failure of the pipeline.

A number of aspects of the Western Roding Dam access way were found to be in poor condition or non-compliant with current standards. Sections of the Eastern Roding Dam access way were found to have effectively reached the end of their service life and further work is required to ensure access can continue in a safe manner.

It is recommended that an inspection and maintenance schedule is implemented for both of these structures. This will allow deterioration of critical features to be better understood over time, improving the accuracy of life cycle assessments.

2. Introduction

CGW has been engaged by Nelson City Council (NCC) to complete a structural, life cycle and durability assessment of the Maitai Dam Intake Structure – South Branch and the Roding Dam Structure.

Durability and life cycle assessment of components or a structure without comprehensive destructive testing relies on a number of assumptions.

This assessment is based on the study of the available original construction drawings and site visits to inspect the visible portions of each structure to provide visual cues of degradation.

The main factors affecting life cycle which may call for upgrading of these structures are as follows:

i. Changes in the design criteria based on information obtained since the initial design
ii. Changes in methods of analysis and new safety concepts
iii. Results of risk assessments
iv. Ageing of construction and foundation materials and components.

This report is focussed on item iv above being ageing of construction and foundation materials and components.

Residual Life Estimate

Where possible, a residual service life has been estimated for critical components. In cases where observed wear could not be estimated with a reasonable degree of certainty, a residual service life has not been estimated. A residual service life has not been estimated for all ancillary components where the impact of their failure is considered unlikely to prevent operation of the system.

Where a structure is worn, the residual life has been estimated based on the following factors

- Expected design life
- Age of the structure
- Observed wear compared to the minimum acceptable standard for the component to remain in service

In cases where adequate information was available in as-built drawings, design service life has been estimated based on AS/NZS 3101 (Standards New Zealand, 2006). In the absence of more detailed information, the residual service life for ancillary concrete structures has been calculated assuming a design service life of 100 years. This is based on AS/NZS 4058 which states that the design life for buried concrete pipe is 100 years (Standards New Zealand, 2007). The empirically calculated remaining service life was compared to the condition of a given structure to estimate a residual service life. Where a structure is currently damaged to the

extent that it is unusable or assessed to be unsafe, it has been assigned a residual life of 0 years

It is accepted that concrete structures on site were not built to current standards and structures which are not buried are likely to be subjected to a more aggressive environment. It is recognised that well maintained structures can exceed this design life.

The Transit New Zealand Bridge Inspection and Maintenance Manual was used to provide guidance on assessing both concrete and steel structures. This document does not provide specific design lives for structures, recognising that the design life is dependent on the completion of maintenance (Transit New Zealand, 2001).

The New Zealand Concrete Code (Standards New Zealand 2001) has been consulted for guidance in assessing concrete components. The Steel Structures Standard (Standards New Zealand, 2009) chapter 5 was also referred to for guidance on corrosion protection requirements.

Defect Classification

Defects observed in structures and associated components have been classified as follows.

Critical: The observed defect could lead to a failure which will prevent the operation of the infrastructure for its required purpose, the diversion of water to the NCC Water Treatment Plant.

Non-Critical: The observed defect is unlikely to lead to a failure which will prevent the diversion of water to the Water Treatment Plant.

Safety: Failure of this item presents a risk to operator or public safety.

3. Maitai Intake Structure – South Branch

The South Branch Intake is located approximately 985m upstream of the North Branch confluence in the vicinity of the Maitai Dam. In plan, this structure is cross shaped constructed of precast concrete walls shown to be tied together on the design drawings with post tensioned super strand. Overall design dimensions show 6.35m x 5.30m. As-built drawing information provided by NCC indicates that this intake was constructed in 1986.

Only the visible and easily accessible portions of the intake were inspected and have been considered in this report.

Plate 1 - Maitai Intake Structure – South Branch

3.1. Intake Structure

Part	Classification	Issue	Possible Remediation	Estimated Residual life (yrs)
Post Stress strands	Critical	Where the ends of the post stresses were accessible, grouted ends appear to be in good condition. They were grouted the whole way through so are likely to be ok throughout the duct, assuming consistent construction.	N/A	30
Steel Lids and manhole covers	Non-critical	Most of the steel lids are in an aged condition. Surface rust is present but does not look to have caused considerable pitting at this stage. Their housings are held down with ramset inserts and/or a mortar pack beneath them. These hold downs are either in poor condition, missing or not used. This could go missing in a flood event.	Repaint the steel lids with an appropriate coating. Replace ramset inserts and secure lids as originally designed. Will likely need an oversize chemical set anchor as the original hole is damaged. Mortar pack around one of the manholes lids could be replaced	
Grout seam between Precast Panels	Non-critical	This seam is in moderate condition for the most of the seam. In some points it has started to peel off of the concrete and was able to be picked off with a fingernail.	To improve this the old grout will require removal and repacking with an equivalent product.	0
Concrete Spalling	Critical	Small portion of concrete spalling at normal flow water level on the vertical trailing edges of the structure. Maximum original concrete cover is likely to be 63mm. NZS 3101 states concrete cover requirements are 45mm for 50 year durability. At time of construction 63mm cover translates to approximately 70 year durability. Concrete cover to reinforcing steel could now be less than required in areas of spalling.	Over all areas of spalling, including possible ones not noted internal to structure, remove loose concrete and trowel a mortar topping over to the desired original level.	30

Precast Retaining walls	Critical	As these were buried and unable to be seen without excavation, no external wall inspection was carried out.	N/A	
Manhole lids	Non-critical/Safety	One of these was neither locked nor bolted down and was able to be lifted off freely, posing a safety hazard.	Lock lid and fasten properly.	
Steel Sluice	Critical	Surface corrosion is evident with significant pitting noted below the water level. Further assessment of sluice gate guides is required	Replace sluice gate	
Valve false cap	Non-Critical	This has been damaged and inserts have pulled out on one side. Access to valve and operation of valve in flood flows is significantly reduced.	Remove valve cap, remove inserts, reinstate valve cap with chemical inserts. Review operations and location.	
Roof Hold Down Bolt detail	Non-critical	One of the hold down bolts has become exposed as the concrete has spalled. No reinforcement has been exposed. This hold down bolt is anchored to the top of the roof.	Remove loose concrete and trowel a mortar topping over to the desired original level.	
Site concrete	Non-critical	Some site concrete poured on top of river bank, true right downstream of intake. This has now been undermined.	This poses no immediate threat to the life cycle of the intake structure but will require maintenance.	2
Screen Hut Discharge Pipe	Non-critical	Pipe end degraded or damaged and reinforcing has been exposed.	No immediate risk to life cycle of intake structure but will require maintenance.	
Foundations	Critical	Not inspected.	N/A	
Overflow weir screen and chamber	Critical	Not inspected.	N/A	

3.2. Screen Hut

Part	Classification	Issue	Possible Remediation	Estimated Residual life (yrs)
Screen Hut	Non-critical	Good overall condition. In times of flood flows this hut becomes inundated and access is impeded. Flooding of will have an effect of design life of building and equipment.	Review operations and location	

3.3. Maitai Intake Structure Summary and Recommendations

Inspections have shown that the structure is in good aged condition with some aesthetic defects, however some areas need attention with regard to design, maintenance and review of operational procedures. In particular the steel sluice valve should be assessed further and replaced if required. Lack of maintenance and difficult operational procedures have an effect on the life expectancy of the structure. Overall this structure is considered to have weathered well and is estimated to have a residual life expectancy of approximately 30 years.

It is recommended that a regular inspection and maintenance program is implemented to ensure deterioration in observed conditions can be identified and repaired as required. In particular, depth of concrete spalling should be monitored and a protective coating should be applied if the rate of spalling rapidly increases. Further inspection of steel sluice valve should be completed to determine the extent of corrosion on the sluice gate and guide channels. This may involve inspection from the waterway.

4. Roding Dam

Based on the supplied drawings, it is understood that construction of the Roding Dam commenced construction in 1937 prior to supply of water to Nelson in 1941. The dam wall was raised by 1.5m in 1972 to increase the volume of water stored in the dam and increase the maximum diversion rate to 24,000 m3/day (Bathgate, J, 2008). Drawings supplied by NCC indicate that a new intake structure was added in 1986. The dam consists of a concrete weir with additional structures and components required for operational activities including

- A steel bridge and walkways
- Cantilevered concrete stairs
- Inlet screen
- Chlorination hut

All of the visible and easily accessible portions these components were included in the scope of this assessment. Some components have been replaced following flood damage, for example the steel bridge. Other components, for example a steel section of the walkway, appear to have been temporarily repaired following a slip event; this repair has subsequently become a permanent feature of the site. Site observations indicate that structures may be used for purposes not considered in the original design, for example, the winching of gates and sluices from the bridge. Individual components are discussed in more detail subsequently.

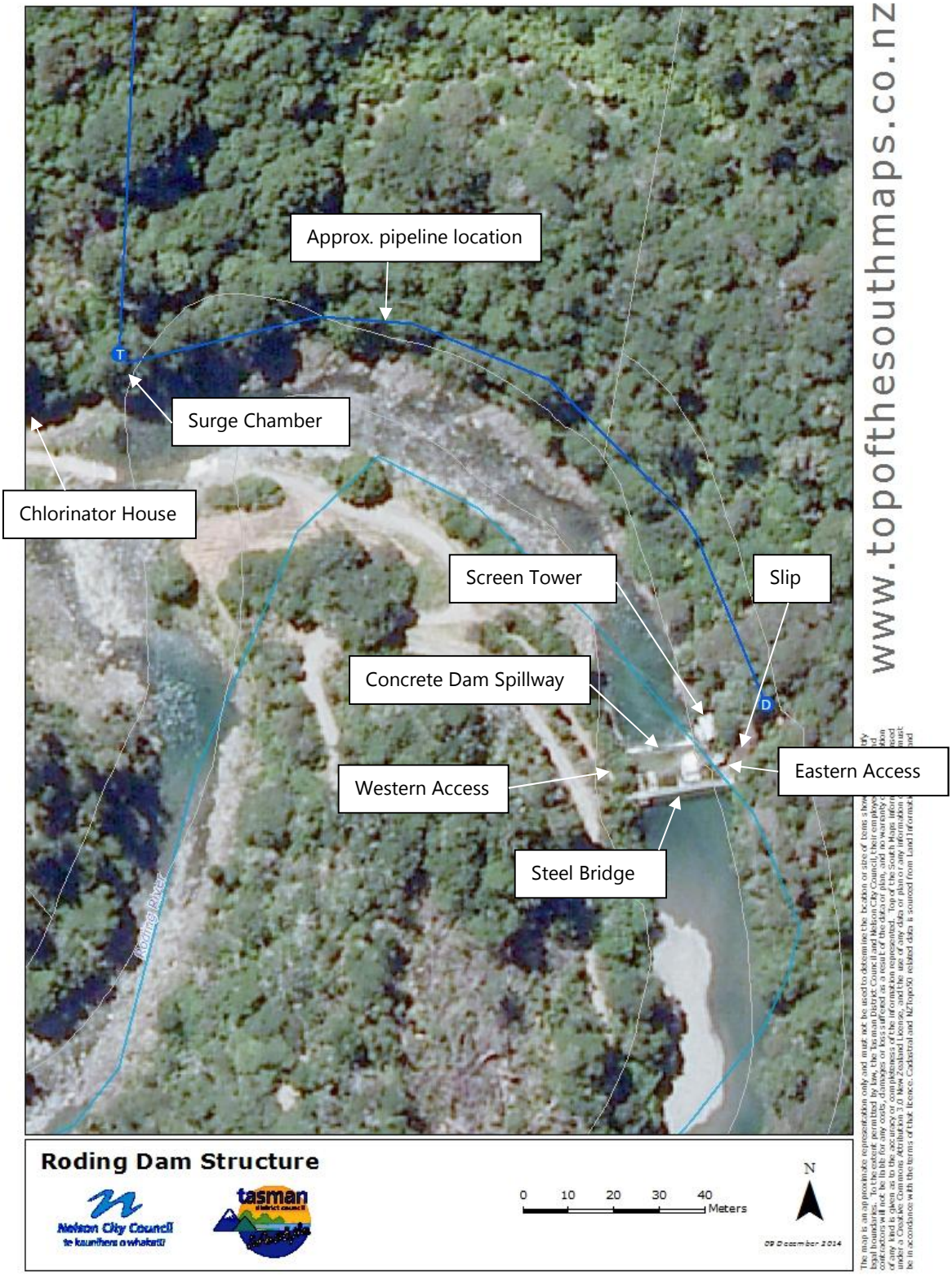


Plate 2 – Roding Dam Structure

4.1. Spillway Face

The concrete spillway face has steel channels directing the mean water flow over the intake structure. The intake structure was added to the spillway face in 1986. Behind the dam is full with gravels almost to the level of the spillway crest. It is not known whether the dam is reinforced or not, but it is expected that it is an unreinforced mass concrete structure.

Plate 3 - Spillway face and water intake

Item	Classification	Issue	Possible Remediation	Estimated Residual life (yrs)
Spillway Lime Leach 	Non-critical	Lime leach is present on the spillway face. This indicates the location of a concrete joint which water has seeped through. If structure is reinforced this could indicate that the steel has possibly corroded. Water seepage also lowers the pH of the concrete, reducing the concretes effectiveness of protecting the steel if present. As the dam/spillway structure is not expected to be reinforced water seepage is unlikely to have caused critical degradation.	Typically not a durability issue, Phenolphthalein test could indicate pH of cement paste and its remaining protection ability for the concrete. But as the steel content and layout is not known this would not be a complete test to verify any steel degradation.	Refer to discussion
Spillway Cracking	N/A	No major cracks noted. Some of the construction joints are of unknown quality. In some cases cracks were thought to be present, but were later deemed construction joints.	N/A	
Scarring from old fixings 	Non-critical	Throughout the dams life cycle fixings have been drilled through the dam face. Once removed or blown out in a storm event they have not been repaired adequately. This is mostly a cosmetic issue	Fill all holes/blowouts caused by old fixings with a grout pack.	

PFC Barrier Non-critical 	This looks to be a recent installation replacing an older structure. There is surface rust forming on most of the channels. The supporting strut base plate is bolted to site concrete which is unlikely to be reinforced, giving it little capacity. Remaining holes for the old structure are unfilled.	Recoat steel with appropriate coating which achieves at least 15 years durability until first maintenance.	
Water Intake Critical 	Designed in 1986; drawings indicate maximum likely concrete cover over reinforcing is 63mm. NZS 3101 states concrete cover requirements are 45mm for 50 year durability. At time of construction 63mm cover translates to approximately 70 year durability. Running water over the structure may have reduced cover to any reinforcing steel cover. This cannot be measured whilst structure is in operation	Overall not an immediate concern but a 25mm mortar topping applied to the concrete structure could extend the life of the intake structure.	30 years
Crest Plate Critical 	Most of the steel members on the dam face have at the very least some surface rust. Some of these are candidates for either immediate recoating or replacing. Close inspection was not possible	Closer inspection required. Recoat or replace members as required.	

The Roding dam spillway and intake structure were assessed to be in acceptable aged condition. Based on the construction and condition of the intake structure, the residual service life is estimated to be in the order of 30 years. Regular maintenance, for example the topping of the intake structure with an appropriate mortar could further prolong the service life. The spillway pre-dates the intake structure however this is likely to be a mass concrete structure, site observations did not reveal any defects which would lead the estimated residual service life to be reduced below that of the intake structure.

4.2. Steel Truss Bridge

Plate 4 – Steel Truss Bridge

The bridge spans approximately 20m and is of steel construction. The top rail is constructed from Square Hollow Section steel (SHS) and the bottom is a steel angle. There is a Parallel Flange Channel (PFC) transom running between the vertical truss members. There is no current load restriction on this bridge and it is open to public access.

Item	Classification	Issue	Possible Remediation	Estimated Residual life (yrs)
Joint at mid span of bridge – site welded 	Non-critical/Safety	This part of the bridge is under the largest bending moment demand. The joint is also the point where the most significant corrosion has occurred. At this stage rust penetration does not appear to be deep.	Further inspect corrosion depth and strengthen locally as required. It is possible that the entire bridge coating is reaching its life expectancy. Recoat entire bridge with appropriate paint system.	Refer to discussion
Anchor bolts/plate	Non-critical/Safety	Details of these bolts are not shown on plans. Possible issues for these bolts are edge distances, embedment depth, unknown substrate strength and unknown	Carry out a structural analysis on this bridge to determine reactions on bolts to determine their capacity.	

		abutment reinforcing details.		
No Sliding/doweled hole anchor detail	Non-critical/Safety	Temperature changes cause expansion or contraction of materials. Both ends of the bridge are pin connections and do not appear to allow movement. Temperature displacement are expected to be around 10mm. As no detrimental effects have been noted to date it is likely to not be an issue	No action	
Chain hitching point to western end of bridge. 	Non-critical/Safety	The bridge appears to be reasonably robust but may not be designed for anything more than pedestrian load use only. Block and tackles are routinely attached to lift gates and sluices, possibly overloading structure.	Confirm capacity of bridge to check resistance against the ultimate load being applied. Review design and operation procedures to lift gates and sluices.	

The durability of a steel bridge is limited by fatigue and the presence of any defects, for example corrosion (Transit New Zealand, 2001). Any fatigue of this structure which is likely to

have result from applied loads has not been assessed. Based on the site inspection, factors which could influence the service life of this bridge include

- Maintenance, in particular application of protective coatings
- Loads in excess of design loading
- Catastrophic event, for example damage during flood event

The Transit New Zealand Bridge Inspection Manual states that the re-application of protective coatings for a steel bridge should occur within 15-25 years of construction to ensure the service life is not compromised. In this case, it is understood the bridge was constructed in 1986 and it is unclear if any re-application of protective coatings has been completed since. The areas of the structure which could be observed during the site inspection revealed some corrosion which did not appear to have penetrated deeply at this stage. Actions recommended to prolong the life of this bridge are as follows

1) Treat corrosion and apply an appropriate protective coating
2) Complete an assessment of the loadings resulting from current work procedures and comment on any likely affect upon the service life of the bridge

4.3. Western Access

The dam access starts on a formed track before stairs onto the bridge. There is also a set of stairs down from the concrete abutments and onto a platform below the bridge.

Item	Classification	Issue	Possible Remediation	Estimated Residual life (yrs)
Track Handrail	Non-critical/Safety	Does not comply with current standards. It is attached with a scaffolding clamp.	Install adequate handrails and bannisters to comply with SNZ HB 8630	Refer discussion
Concrete steps 	Non-critical /Safety	These are cantilevered off of the abutment. Based on the original design drawings, it appears that steel mesh has been bent as reinforcing in the steps in a manner which would not be considered an acceptable solution based on current design standards. There has been significant spalling from the old handrail locations and off of the bottom of the staircase. Stairs are doweled into abutment, likely with plain round bars only.	Options include Replace with stairs which comply with current standards Make stairs inaccessible to the public. Remove stairs and replace with ladder	
Handrails	Non-critical/Safety	Removal of old handrail caused concrete to blowout. The handrail is generally just a single handrail. In some cases, deer fencing has been used in an attempt to block the gap between the stairs and hand rail. This does not comply	Replace with handrail compliant with current standards Mortar over the areas of damage.	

		with current standards		
Original Precast Steps 	Non-critical/Safety	On the downriver side on the west some precast steps were once installed. These have been removed or destroyed at some stage. The steel bars epoxied into the concrete remain protruding.	Remove excess steel and grout over.	
Anchor Bolt Damage 	Non-critical/Safety	Old anchor bolts left protruding. Concrete damage remains.	Remove excess steel and grout over.	
Bolt Distances	Non-critical/Safety	Some of the bolt distances for both the bridge and the handrail appear low. This is a concern if unreinforced concrete.	Scan concrete to locate steel justifying anchor locations. Accept possible risk of concrete spalling at these locations.	
Steel Cover – Lower platform 	Non-critical/Safety	Not bolted down and is able to be easily lifted and left open.	Bolt down	
Ladder down to dam face	Non-critical/Safety	Has suffered some damage to it. It does not comply with current accessibility	Review access in regard to current operations and	

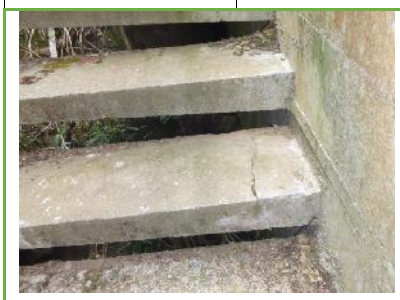
		requirements.	upgrade.	
Exposed studs/reinforcing	Non-critical/Safety	There are various studs/ reinforcing which should be removed properly.	Remove to below concrete level and mortar over.	

The western access stairs still perform their intended function of providing access to the dam as required for operational activities. They do not meet current standards and are accessible to the public. There are numerous areas of damage; for this reason their service life is considered to be over.

4.4. Eastern Access

This section considers the access structures from the bottom of the screen tower up to the steel bridge on the true right bank of the river.

Plate 5 – Eastern Access

Item	Classification	Issue	Possible Remediation	Estimated Residual life (yrs)
Steps on side of screen tower 	Non-critical/ Safety	There are two types of stairs, a precast cantilevered stair and an in situ stair. These finish in a cantilever platform off the screen tower. The insitu stairs are in good condition but the precast steps are at the end of their life cycle. The ends have spalled off and are poorly repaired. One step has a large crack through the entire the step.	Replace cantilevered stairs.	0
Handrail (Refer 2 in Plate 5 above)	Non-critical/Safety	The existing walkway handrails have suffered impact from slip debris causing damage to the fixings and concrete. The replacement handrail appears adequate however design requirements are unknown and the fixing bolt edge distances appear to be inadequate for the thin concrete slab.		
Mesh Grating at scour valve chamber (Refer 3 in Plate 5 above)	Non-critical/Safety	It has failed and permanently deformed.	Replace.	0
Walkway to scour valve chamber (Refer 4 in Plate 5 above)	Non-critical/Safety	Appears to be acting as a strut for the rest of the walkway resisting horizontal loads. This would represent unintended design forces on viewing platform abutments	Replace as part of walkway replacement works.	0
Temporary Metal Deck Walkway	Non-critical/Safety	Temporary solution using metal deck over slip damaged concrete	Redesign and replace.	0

(Refer 5 in Plate 5 above)		appears inadequate. The steel angles that provide most of the support are connected to concrete separate from the stable strata. This should have been extended past the failed portion of decking. Temporarily supported by an acrow prop.		
Upper Cantilever steps (Refer 6 in Plate 4 above) 	Non-critical/Safety	Similar issues to the other set of stairs, ends spalled off. Handrails are not connected to the steps here. It is assumed steps are doweled into abutments with round bars.		
Ledge on upstream face 	Non-critical/Safety	This is a timber deck supporting a winch. Its gravity support is met by two steel angles bolted to the concrete abutments. These angles are in poor condition, one in particular has a large bend, possibly due to storm damage. Surface rust is also forming. Bolt installation and condition is not known.	Redesign and replace structure.	0
Slip	Non-critical/Safety	Slip area does not appear stable. Risk of further frittering and damage.	Accept risk or design and install remedial measures.	0

The eastern access stairs are still providing access to the required sections of the dam. They do not meet current standards and are accessible to the public. The temporary metal deck walkway is of particular concern. There are numerous areas of damage; for this reason their

service life is considered to be over. Staff using this stairway should conduct regular inspections to ensure the walkway is not further deteriorating whilst a solution compliant with current standards is implemented. Consideration should be given to restricting public access until a permanent solution is implemented.

4.5. Screen Tower

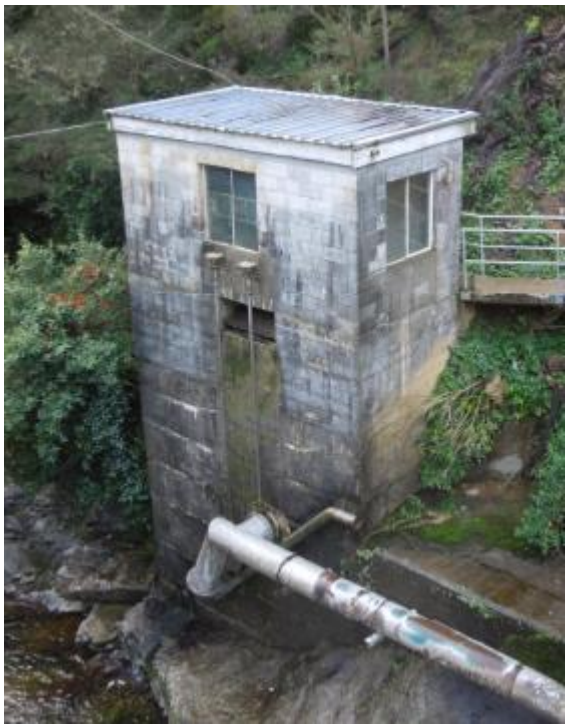


Plate 6

This is a reinforced concrete and reinforced masonry building. The overall construction seems to be in good condition and drawings show the concrete masonry portion to be well reinforced. This was built in two parts, the lower insitu concrete structure first c1937. Some concrete levelling was added to the original insitu portion with the masonry portion built on top c1972.

Item	Classification	Issue	Possible Remediation	Estimated Residual life (yrs)
Corrugate roofing 	Non-critical	There is significant corrosion on the roof. Likely to have gone too far to be remedied by recoating.	Replace with new steel	0
Concrete around bottom of structure 	Non-critical	Looks to be site concrete to contour site. Some cracking and very rough finish to concrete. Unlikely to be serving a structural purpose.	N/A	
Insitu structural concrete at bottom of structure (c1937)	Critical	Although old drawings indicate reinforcing the exact type and content as built is unknown. No major cracking noted. Foundations depths unknown.		20-30
Masonry Portion (c1972)	Critical	Good condition fully grouted and reinforced masonry. The openings are all trimmed out with reinforcing. Plans show reinforcing is doweled to structure below. There is a bond beam around the top of the entire structure. The masonry is uncoated. Coating with a suitable paint is likely to increase the service life of this structure		20-30
Hard Board Soffit	Non-critical	This has deteriorated. Likely to have been an oil based hardboard. Likely to be requiring replacement soon.	Replace at next maintenance	0
Door	Non-critical	Paint finish is peeling	Re paint	

Mildew/Mold	Non-critical	Due to the damp environment there is some fungal growth on the structure.	Wash regularly	
Overturning	Critical	As it is a slender, tall and heavy structure, it appears at risk to overturning in a seismic event.	Carry out further assessment.	

The service life of this structure is likely to be limited by the original concrete foundations upon which the newer masonry section of the building is constructed. Based on assumed service life of 100 years, and an age of approximately 77 years, the residual service life is expected to be in the order of 23 years. The structure appears in generally sound condition and with a maintenance program including replacement of the roof and application of an appropriate coating, the structure is likely to provide adequate service beyond this point.

4.6. Chlorinator House

This is a cavity-constructed masonry building. There are reinforced concrete columns and capping beams confining the masonry. There are two 150 blocks with a 50mm cavity in between.

Plate 7

Item	Classification	Issue	Possible Remediation	Estimated Residual life (yrs)
Soffits	Non-critical	These are hardboard which typically perform poorly outside.	Replace in next maintenance cycle.	0
Folding Vehicle Doors	Non-critical	Showing age, vents broken, paint finish poor	Recoat and repair vents	
Roof	Non-critical	Looks to be recently replaced and is in good condition	N/A	15
Overall	Non-critical	The structure is in quite good condition, moulds and mildews growing on some parts	Keep structure clean.	25

Overall, the chlorinator house is assessed to be in sound condition. A minimum residual service life of 25-30 years has been assumed based on an expected service life of 70 years and an age of approximately 40 years. With a regular maintenance program it is likely this service life can be extended.

4.7. Pipeline Walkway

Plate 8

The walkway follows the eastern access along the same path as the water supply pipeline to the tunnel through to Marsden Valley. The pipe has not been assessed, obvious defects are noted however.

Item	Classification	Issue	Possible Remediation	Estimated Residual life (yrs)
Leak in pipe 	Critical	There is a large leak in the pipeline	Repair	Refer to discussion

Metal pipe by screen tower 	Critical	There is a dent in the pipe which requires confirmation whether this represents a critical structural weakness or is acceptable		Refer to discussion
Pathway Handrail 	Non-critical/Safety	This handrail is in overall poor condition.	Accept, remove or improve	0
Retaining wall/support to pipeline. 	Critical	A concrete/rock retaining wall is supporting the pipeline at or above ground level. Some loose material observed, no indication of substantial movement	Monitor condition of retaining walls. Consider installing a new structure if significant changes are observed.	Refer to discussion
Pipe supports 	Critical	These look to be vertical section of pipe inserted into the retaining walls than filled with a mortar underneath of the pipe. The mortar pack has been missing for a long time in some cases, reducing the bearing area on the pipe.	Repack with mortar to support pipe	Refer to discussion

Pipe Hold Downs 	Critical	These are connected to studs inserted into the pipe supports. They are mostly in poor condition with a wire or the stud is near the end of its life.	Replace	0
Walkway Timbers 	Non-critical/Safety	They are in poor condition and deflect a different amount each. Some are broken or rotten.	Replace	0
Bannister to pipe	Non-critical/Safety	This connection allows for rotation about the pipe in some places.	Replace Handrail	0
Steel pipe across long gully	The original design drawings (5/77 Sheet 4a) show a bridge to support the pipeline crossing. The actual pipeline crossing is a steel pipe with no bridge. It is unclear if this was a change made during construction in 1937 or a replacement section of pipe following damage to the original		Review NCC plans database or confirm structural adequacy for span.	N/A

Service life for concrete pipes designed in accordance with AS/NZS 4058: 2007 and AS/NZS 3725: 2007 can be expected to be in the order of 100 years (AS/NZS 4058, (2007)). It is recognised that this pipeline was not designed to comply with these standards. Most notably, these standards assume the pipeline is buried. It is understood this pipeline was constructed with the original dam structure in 1937-1941; it is likely to be in the order of 75-80 years old.

The observed deterioration of several components including the pipe supports and hold downs could result in a critical failure of the pipeline which would prevent the supply of water to Nelson via this system. The observed leak could lead to washout/erosion of material which could cause a similar failure.

4.8. Surge Chamber and associated structure

Item	Classification	Issue	Possible Remediation	Estimated Residual life (yrs)
In ground tank 	Non-critical	Fibreglass tape sealing top panels has begun to fail and is easily peeled off	Clean off and replace with mortar	25-30 years
Surge Chamber 	Non-critical	Some corrosion of steel components and weathering of concrete	Clean and treat steel corrosion. Consider application of an appropriate coating	
Thrust block/Support 	Non-critical	Undermined due to erosion. Unlikely to cause critical failure in short to medium term	Backfill material around thrust block and compact to prevent further erosion	

Steel Pipes		Original corrosion inhibitor has failed and is flaking off.	Carry out further pipe corrosion assessment. Treat corrosion and apply protective coating or replace.	
				

4.9. Roding Dam Summary and Recommendations

Inspections have shown that the Dam and Spillway structure are in acceptable aged condition with some aesthetic defects. Overall the concrete structure and associated buildings are considered to have weathered well and are estimated to have a residual life expectancy of approximately 25-30 years. The service life of the eastern and western access walkways has been assessed to be effectively over due to observed defects. Defects observed in the visible section of the Roding Tunnel pipeline are considered likely to impact upon the expected residual service life in the short to medium term.

It is recommended that a regular inspection and maintenance program is implemented to ensure deterioration in observed conditions can be monitored and rectified as required. The following activities should be prioritised.

- Complete regular maintenance/safety inspections of access ways. Consider restricting public access
- Allocate funding for replacement walkways
- Apply an appropriate coating to steel truss bridge
- Complete an assessment of bridge load rating and confirm if current operational activities are acceptable
- Complete a detailed condition assessment of pipeline with maintenance as required

5. Limitations

This report has been prepared solely for the benefit of Nelson City Council for the purpose of providing information relating to the condition and estimated residual service life of the structures identified in this report. The reliance by any other parties on the information or opinions contained in this report shall, without our prior agreement in writing, be at such parties' sole risk.

The information contained within this report is based on a visual inspection only of structures and associated components above the water level in the respective waterways at the time of inspection.

This report has been prepared solely to address the issues raised in our brief, and shall not be relied on for any other purpose.

This report is not a dam safety or dam break assessment and cannot be relied on to comment upon the likelihood or consequences of dam failure.

6. References

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