

REVISION 0

# 2019 CONDITION ASSESSMENT OF THE MUNICIPAL WHARF







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# 1. INTRODUCTION

## 1.1 PROJECT BACKGROUND

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The Village of Tahsis retained McElhanney Ltd. (McElhanney) to complete a detailed condition assessment of the Municipal Wharf facility located in Tahsis, B.C. The scope of work included the following:

- Detailed review and verification of structural details of the municipal wharf structure.
- Detailed visual inspection of wharf elements above water to identify obvious evidence of damage or distress (mechanical, fire, marine borer, fungal decay, etc.)
- Hand drilling at the tops of the piles and pile caps at approximately 75% of the locations to confirm the remaining intact cross-section of the treated timber members.
- Based on the inspection results, complete a load rating analysis to the CSA S6-14 Canadian Highway Bridge Design Code to determine the capacity of the wharf both in its present and future anticipated condition (post repairs).
- Preparation of a detailed report providing inspection findings, the load rating analysis results, recommendations for phased repairs, residual life estimates, and cost estimates.

## 1.2 PROJECT PERSONNEL

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McElhanney personnel responsible for conducting the condition assessment of the facility included:

- Alex Fachler, A.Sc.T. – Structural Technologist
- Matthew Friderichs, P.Eng. – Marine Structural Engineer

## 1.3 EXISTING INFORMATION

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The following existing information was made available prior to the inspection:

- McElhanney inspection report for the wharf, dated May 2017
- Hand Coring results by Straight Grain Construction, April 2016 (Email Summary)

## 1.4 REFERENCE SYSTEM

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- The reference system used in the inspection is consistent with the drawings provided in Appendix A



## 2. DESCRIPTION OF FACILITY

### 2.1. GENERAL DESCRIPTION

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The municipal wharf facility consists of the following:

- Approach Trestle– Approximately 55m long by 10m wide and consisting of precast concrete deck panels, creosote timber stringers, pile caps, piles, and cross-bracing. The timber elements appear to be consistent with coastal douglas fir species.
  - Concrete Deck Panels – 3.0m long (span) x 1.8 m wide x 0.25 deep. Specific concrete properties and steel reinforcement is not known.
  - Treated Timber Stringers – 204mm deep x 156mm wide and spanning 3300 mm between approach pile bents.
  - Treated Timber Pile Caps – 305mm deep x 305mm wide and continuously spanning from Pile A to Pile C, approximately 6.1m long.
  - Treated Timber Piles – Approx. 305mm butt diameter. No pile embedment or pile driving information is available.
  
- Wharfhead
  - Concrete Deck Panels – 3.0m long (span) x 1.8 m wide x 0.25 deep. Specific concrete properties and steel reinforcement is not known.
  - Treated Timber Pile Caps – 305mm deep x 305mm wide. There are two elevations of pile caps as a result of the partial rebuild of the wharf following fire damage in 1971.
  - Treated Timber Piles – Approx. 305mm butt diameter. No pile embedment or pile driving information is available.

Photo 1 to 7 in Appendix B provides general views of the facility. Sheet 100 in Appendix A presents a general arrangement drawing.



## 3. INSPECTION METHODOLOGY AND LIMITATIONS

### 3.1 INSPECTION METHODOLOGY

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The inspection methodology was completed in accordance with the procedures and recommendations provided in “*Procedures for Inspection and Assessment of Fixed Timber Docks*”, by RG Sexsmith Ltd. and dated September 1994, 4<sup>th</sup> Edition. This documentation has widely been adopted by the Canadian Coast Guard, Department of Fisheries and Oceans Small Craft Harbours Branch, and Transport Canada in the evaluation and assessment of timber docks, piers, and wharves along the BC Coast.

The inspection methodology used is summarized as follows:

- Visual inspection of the timber elements from the seabed to underside of deck was completed in the intertidal zone by accessing the facility during a low tide window. Close visual inspection was also completed from a small boat allowing access to the top of piles, pile caps, and stringers at high tide.
- Timber coring was completed at the tops of the piles, pile caps, and stringers where steel drift pins are present. Based on previous experience, the drift pins are typically a primary location where fungal decay is present as water is allowed to penetrate the protective creosote shell and into the unprotected internal core of the member.
- The timber coring is completed using a 13mm diameter drill which extends approximately 50% to 75% through the timber member. Fungal decay has significantly less resistance for the drill and so the resultant torque and drill cuttings from fungal decay are obvious to the inspector.
- From timber coring, the extent of fungal decay and cross-sectional loss is expressed in intervals of 10%, 25%, and greater than 50%.

### 3.2 INSPECTION LIMITATIONS

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The following inspection limitations should be considered when evaluating the results of the inspection findings:

- Both *bankia* and *limnoria* marine borers species are actively present on the BC Coast and can damage the timber pilings from the seabed to the intertidal zone. This should be identified during underwater inspections by experienced and qualified commercial divers. An underwater inspection was not completed as part of this inspection.
- The inspection findings and recommendations are based on engineering judgment and familiarity with the design, construction, and maintenance requirements of similar structures.
- The findings and recommendations are for the use of the Village of Tahsis only.

- The inspection is based on examining and reporting only on the condition of the structure. It is not intended as a check of the original design.
- There is a possibility that hidden or latent defects have not been detected during the course of the inspection. Users of the facility should always report any unusual conditions so that they can be evaluated by a Professional Engineering registered in British Columbia.



## 4. INSPECTION FINDINGS

### 4.1 APPROACH TRESTLE

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#### 4.1.1 Topsides

The approach trestle topsides are generally in a serviceable condition. Typical inspection findings are as follows:

- The handrail and vehicle guardrail appear well secured. There is vegetation / moss growing on the concrete curb (Photo 8, Appendix B).
- The fire suppression utility service at the offshore end of the approach is not connected or in-service.

*Based on the future intended use of the wharf, consideration should be given to reinstating the fire utility service. Significant repairs are not recommended at this time, although continued monitoring should be carried out.*

#### 4.1.2 Deck Panels

The approach deck panels are generally in a serviceable condition. Typical inspection findings are as follows:

- The concrete appears sound with no significant damage, structural cracking, spalling or delamination (Photo 9, Appendix B).
- There is minimal corrosion staining to indicate significant corrosion of the internal reinforcing steel.
- The deck panel joints are either significantly damaged or missing and there is significant water draining onto the stringers and pile caps resulting in significant fungal decay. See Sections 3.1.3 and 3.1.4.
- There is no evidence that the deck panels have significant movement and generally appear well secured to the pile caps.

*Significant repairs are not recommended at this time, although continued monitoring should be carried out.*

#### 4.1.3 Stringers

The approach stringers have widespread severe fungal decay and have generally reached the end of their service lives (Photos 10 and 11, Appendix B). Typical inspection findings are as follows:

- Sheet 101 in Appendix 1 provides a location map of stringers identified with severe fungal decay.
- Approximately 60% of the location drilled during the timber coring inspection identified fungal decay with severity ranging from minor (less than 25%) to severe (greater than 50%)
- There is moderate fire damage to approximately 30% stringers from the historical fire occurring in 1971.

*As part of the rehabilitation plan for the wharf, significant replacement or repairs to the stringers should be completed.*

#### **4.1.4 Pile Caps**

The approach pile caps have widespread severe fungal decay and have generally reached the end of their service lives. Typical inspection findings are as follows:

- Sheet 101 in Appendix 1 provides a location of pile caps identified with severe fungal decay.
- Approximately 50% of the pile cap locations drilled during the timber coring inspection identified fungal decay, typically severe.
- The stringers supporting the concrete panels and deck loads are located directly over the piles so the approach pile caps do not see significant bending moment loads. There is significant bearing and shear force loads.
- The internal fungal decay appears widespread and has progressed to consecutive pile bents. No locations were identified with evidence of structural overloading or crushing.

*As part of the rehabilitation plan for the wharf, significant replacement or repairs to the pile caps should be completed.*

#### **4.1.5 Piles**

The approach piles are generally in a serviceable condition. Typical inspection findings are as follows:

- The piles appear well secured to the pile caps.
- In a number of locations, there is additional pile straps and pile clamps added to the top of the piles to address misalignments and splitting.
- A number of piles at the inshore end are founded on concrete footings.
- Pile Nos. 2C and 7C were identified with minor fungal decay at the top of the piles (see Sheet 101 in Appendix 1).

*Significant repairs are not recommended at this time, although continued monitoring should be carried out.*

#### **4.1.6 Cross-Bracing**

The approach crossing bracing is generally in a serviceable condition. Typical inspection findings are as follows:

- There is minor fungal decay and marine borer attack at the lower bolted connections in the intertidal zone (Photo 12).
- The bracing appears generally well secured with no evidence of excessive movement or distress.

*Significant repairs are not recommended at this time, although continued monitoring should be carried out.*

## 4.2 WHARFHEAD

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### 4.2.1 Topsides

The wharfhead topsides are generally in a serviceable condition (Photo 13, Appendix B). Typical inspection findings are as follows:

- There is no handrail installed along the north, south, or west sides of the wharfhead (Photo 14, Appendix B). Additionally, at low tide there is insufficient water depth to prevent a falling pedestrian from injury on the foreshore slope.
- The hiab crane located between Pile Nos. 12A and 13A appears to be in a serviceable condition (Photo 15, Appendix B). Although an inspection to the crane itself was not completed, the supporting deck and pile cap saddles appear well secured with no evidence of distress or significant movement. *The pier cap at Bent Nos. 13 was identified with severe fungal decay and limiting the use of the hiab crane is recommended.*
- The upper gangway connection to the wharf has evidence of structural failure and rotation of the supporting plate due to the pile cap supporting the gangway connection having severe fungal decay (Photo 16 and 17). The gangway is connected to the wharf by hanging bars and a hinge pin supported by a steel plate bolted into the concrete panel on the top of the wharf. The hanging bars do not line up with the supporting plate at the inshore connection resulting in the hinge pin spanning approximately 150 mm. Additionally, with the gangway not sitting perpendicular to the wharf there is wearing on the hinge pin at the inshore side of the connection.
- There are safety ladders installed along the berthface of the wharf. Typically, the ladders have shackle connections are not moused which could result in the loss of the shackle pin and failure of the ladder.
- The vessel mooring bollards/cleats located along the berthface appear well secured. There is no evidence of significant crushing or distress due to overloading. It is recommended that large vessels (greater than 20m, not be permitted to moor to the wharf for an extended period of time or during adverse weather conditions).
- The building located on the wharf was not accessible or inspected. It was noted that the water draining off the building roof and onto the wharf is resulting in significant deterioration of the deck panel joints in this area.

*Installation of a timber handrail along the north, south, and west sides of the wharfhead is recommended. Alternatively, signage and “do-not-cross” delineation of the edge 2.0m could prevent pedestrian access from the unguarded wharf edge. Continued monitoring should be carried out.*

### 4.2.2 Deck Panels

The wharfhead concrete deck panels are generally in a serviceable condition. Typical inspection findings are as follows:

- The concrete appears sound with no widespread significant damage, structural cracking, spalling or delamination (Photo 18, Appendix B). There is some minor spalling adjacent to drain holes and electrical utility holes (Appendix 19, Appendix B).
- There is minimal corrosion staining which could indicate significant corrosion of the internal reinforcing steel.
- The deck panel joints are either significantly damaged or missing and there is significant water draining onto the pile caps resulting in significant fungal decay. See Sections 3.1.4

- There is no evidence that the deck panels have significant movement and generally appear well secured to the pile caps. In several locations, the pile caps have failed and are severely crushed resulting in settlement of the deck panels above.

*Significant repairs are not recommended at this time, although continued monitoring should be carried out.*

### **4.2.3 Pile Caps**

The wharfhead pile caps have widespread severe fungal decay and have generally reached the end of their service lives (Photos 20 to 25, Appendix B). Typical inspection findings are as follows:

- Sheet 101 in Appendix 1 provides a location of pile caps identified with severe fungal decay.
- Bent Nos. 6 to 15 were drilled, and 8 / 10 of those bents had fungal decay present.
- The internal fungal decay appears widespread and has progressed to consecutive pile bents.
- There are multiple locations identified with pile cap structural failure at consecutive pile locations as a result of shear and bearing failure. Notably, this is evident at Bent Nos. 2 to 7, Piles A to E where there is widespread evidence of pile cap bearing / shear failure above the piles.

*As part of the rehabilitation plan for the wharf, significant replacement or repairs to the pile caps should be completed. See Section 6 for further discussion.*

### **4.2.4 Piles**

The wharfhead piles are generally in a serviceable condition. Typical inspection findings are as follows:

- There are a number of locations where the severe deterioration of the pile caps has resulted in the piles “punching” through the pile caps resulting in bearing loss.
- In a number of locations, there are pile straps and pile clamps added to the top of the piles to address misalignments and splitting.
- From the timber coring, 10 piles were identified with severe fungal decay at the top. This extent of fungal decay is typical for wharf structures approximately 50 years old and is attributed to water penetration at the drift pin connection.
- The batter piles appear well secured to the vertical piles with no obvious evidence of movement or elongation of the bolted connections.

*Based on the future intended use of the wharf, consideration should be given to repairing / replacing the timber piles identified with severe fungal decay.*



## 5. RESIDUAL LIFE ESTIMATES

For the purposes of this evaluation, the residual life represents the estimated period of time that will elapse between the inspection date and the time when the component in the condition observed will typically require repair or replacement. For timber docks in a salt water environment, the residual life estimate is based on the follow:

- Where creosote or salt treated timbers have been examined for the presence of decay and is found to be in good condition, an estimated life in excess of ten years is appropriate.
- Where evidence of decay has been found, but is limited in extent, the component can be assumed to have a residual life on order of four to eight years.
- Where a component has a significantly weakened cross-section due to severe fungal decay, the residual life should be taken as negligible and the component considered unreliable for structural loads.
- The estimates are approximate as fungal decay in timbers can spread quickly once established in the structure and conditions are favorable. Additionally, the rate of deterioration may differ between similar members.

Based on our understanding of the environment, usage, and familiarity with similar structures, Table 1 provides the estimates of the remaining service life of the wharf elements:

*Table 1 – Residual Life Estimates*

Location / Structure	Residual Life Estimate
<b>APPROACH TRESTLE</b>	
Topsides	+10 Years
Deck Panels	8-10 Years
Stringers	0-2 Years
Pile Caps	0-2 Years
Piles	5-7 Years
Cross-Bracing	5-7 Years
<b>APPROACH TRESTLE</b>	
Topsides	+10 Years
Deck Panels	8-10 Years
Pile Caps	0-2 Years
Piles	0-2 Years



## 6. STRUCTURAL LOAD EVALUATION

As part of the assessment, McElhanney has completed a preliminary load rating analysis to assess the ability of the wharf to sustain reduce loading, given the inspected results.

### 6.1 METHODOLOGY AND ASSUMPTIONS

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The following summarizes the methodology and assumptions made for the structural load evaluation:

- The wharf structure was evaluated in accordance with the Canadian Highway Bridge Design Code (CAN/CSA S6-15)
- The existing construction material strengths are based on the CAN/CSA S6-15 allowances for Douglas Fir, No. 1 grade. As no material reference information is available, these values are typically used for wharf structures constructed in the 1960s.
- The effective member cross-sections are based on the inspection results described in Section 3. In particular, the pile caps and stringers are assumed to have uniform 75% CSL due to internal fungal decay based on the average extent of deterioration identified at individual locations during the timber drilling program.
- As the wharf is currently barricaded from vehicle traffic and not subjected to large pedestrian crowds, a live load of 2.4 kPa has been assumed.
- The future potential for the wharf to support small emergency vehicles was assessed by evaluating the wharf to support a 5,000 lb. axle load from an ambulance vehicle.
- As there is unknown geotechnical information and the piles have relatively minor damage compared with the pile caps and stringers, the piles are not considered to be the critical. Subsequently, a load evaluation of the piles was not completed.
- No information was available for the deck panels such as material properties or reinforcement type and spacing. Based on previous experience and given the light and uniform loading, the deck panels are not considered critical at this time. If significant rehabilitation of the wharf for future vehicle access is required, McElhanney recommends that concrete inspection to confirm material type and reinforcement be completed to determine the structural capacity of the deck panels.

### 6.2 LOAD EVALUATION RESULTS

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Table 2 provides the summary of the load evaluation results. In reviewing the table, please note the following:

Table 2 - Load Evaluation Results

Structural	Original Capacity		Deteriorated Capacity		Capacity Reduction (%)	
	Mr	Vr	Mr	Vr	Mr	Vr
Approach Stringers	88.0	237.3	57.7	75.7	35%	68%
Approach Pile Caps	96.2	173.4	49.2	56.9	49%	67%
Wharfhead Pile Caps	96.2	173.4	49.2	56.9	49%	67%

Structural	Dead Load Only					
	Mf	Original D/C	Current D/C	Vf	Original D/C	Current D/C
Approach Stringers	29.5	34%	51%	35.8	15%	47%
Approach Pile Caps	---	---	---	35.8	21%	63%
Wharfhead Pile Caps	29.5	31%	60%	35.8	21%	63%

Structural	Dead Load + 2.4 kPa (50 psf) Pedestrian Load					
	Mf	Original D/C	Current D/C	Vf	Original D/C	Current D/C
Approach Stringers	48.9	56%	85%	59.3	25%	78%
Approach Pile Caps	---	---	---	59.3	34%	104%
Wharfhead Pile Caps	48.9	51%	99%	59.3	34%	104%

Structural	Dead Load + Vehicle Axle Load (5000 lbs)					
	Mf	Original D/C	Current D/C	Vf	Original D/C	Current D/C
Approach Stringers	62.5	71%	108%	75.8	32%	100%
Approach Pile Caps	---	---	---	75.8	44%	133%
Wharfhead Pile Caps	62.5	65%	127%	75.8	44%	133%

- All units of moment resistance (Mr) and moment load (Mf) are in units of kilonewton-metres (kNm)
- All units of shear resistances (Vr) and shear load (Vf) are in units of kilonewtons (kN).
- The D/C ratio shows the structural demand (load) compared with the structural capacity. A ratio greater than 100% indicates that the factored demand is greater than the capacity and the element likely does not meet current code requirements.

- Ratios of D/C are given for the members in both the original condition (newly built with no deterioration) and the present condition with consideration for deterioration.
- For deteriorated members, the fungal decay is assumed to act at the center of the member's cross-section resulting in a shell effect.

## 6.3 DISCUSSION OF RESULTS

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The Tahsis Municipal Wharf is reaching the end of its service life and based on the load evaluation cannot support original design loads such as small vehicles. Noted during the load evaluation:

- The concrete deck panels impart significant dead load on the timber superstructure, approximately 5.9 kPa (123 psf).
- The concrete deck panels are all single spanning between pile caps and so there is no lateral load distribution between stringers (approach) or pile caps (wharfhead).
- The pile caps on the approach have no discernable moment load as the stringers are located above the pile caps.
- The stringers / pile caps are largely critical for shear and bearing loads on the dock as there are no heavy concentrated point loads from vehicle wheels.

*As previously discussed with the Village of Tahsis, until significant repairs or rehabilitation to the wharf is completed, McElhanney recommends that the wharf be completely barricaded from any vehicle loads. Light pedestrian loads may be acceptable on the wharf provided this is minimized, and no groups/crowds of people are permitted.*

*Timber elements are typically flexible and provide early indications of overstressing or failure. As the condition of the wharf will continue to deteriorate, regularly scheduled inspections will be required to identify early warning signs of structural distress or overloading prior to catastrophic collapse.*

## 6.4 GANGWAY HINGE CONNECTION STRUCTURAL REVIEW

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The gangway providing access to the floating dock is in moderate to severe condition. As previous discussed in Section 4.2.1, the connection from the wharf to the gangway consists of hanger plates with a hinge pin. As the hanger plates are misaligned, the hinge pin is now spanning with significant deflection and evidence of structural overloading.

McElhanney completed a preliminary structural analysis of the system to determine if load restriction to the gangway should be recommended to reduce the bending stress on the hinge pin. The findings are summarized as follows:

- As there are no reference drawings for the gangway, a dead load estimation was completed based on our experience with similar ramps. The total ramp weight was estimated to be 2737 lbs.
- The gangway was checked for the structural reaction loads at both high and low tides. The critical loading for lateral loads found to be at low tide and gravity / live loads was found to be at high tide.
- The mounting plate which is attached to the wharf side is rotating however the loads are fairly low and the plate is secured to the concrete deck panels.
- Given the anticipated lateral forces, the deck panel to pile cap interface should have sufficient combined friction and connection pin shear to resist the lateral forces of the gangway at low tide.

- The hinge pin of the gangway was found to be the critical element of the hinge system since the hinge pin acts as a cantilever span at the inshore connection.

*McElhanney strongly recommends to load restrict the gangway ramp to a maximum of 500 lbs. This load restriction would consist of 1-2 occupants on the gangway at a time. No assembly or groups of people on the gangway is permitted. Load restriction signs should be clearly marked at both ends of the gangway.*



## 7. REHABILITATION OPTIONS

The Tahsis Municipal Wharf will need considerable rehabilitation / repair if continued usage is desired by the Village of Tahsis. Rehabilitation could be phased so that the approach and north half of the wharfhead (Bent Nos. 9 to 15) are completed first (Phase 1) and then the south half of the wharfhead (Bent Nos. 1 to 8) is completed second (Phase 2)

The concrete deck panels are all single spanning on the stringers (approach) or pile caps (wharfhead) and so any work to the supporting elements below, must be completed after the concrete panel loads are either temporarily shored or removed.

Given there are approximately 64 concrete panels along approach and another 60 panels along the wharfhead (Bent Nos. 9 to 15), individually shoring each panel to complete substructure timber work is likely not feasible.

As previously discussed, McElhanney recommends the following rehabilitation procedure for Phase 1:

- Prior to the mobilization of a marine contractor, local Tahsis public works would uncover the lifting lugs for the deck panels along the approach and at the wharfhead between Bent Nos. 9 to 15.
- A marine contractor would remove the concrete deck panels and locate them onto a material scow for offsite disposal.
- The stringers and pile caps would be entirely removed and disposed along the approach and wharfhead.
- With open access to the tops of the timber piles, piles can be repaired or replaced as necessary.
- New treated timber pile caps would be installed
- New timber stringers would be installed, however not grouped above the piles but evenly distributed across the pile caps. This would allow for much greater redundancy and load sharing effects.
- Consideration should be given to replacing the concrete deck panels with sawn timber (4x12) decking which would allow light vehicle loads and pedestrian traffic. The sawn timber decking is typically much easier to repair and can allow easy access to the timber elements below for future repair works. This arrangement is typical with timber wharves along the BC Coast.

Figures 1 and 2 provide a proposed phasing plan and cross-sectional of the rebuilt approach trestle, respectively.

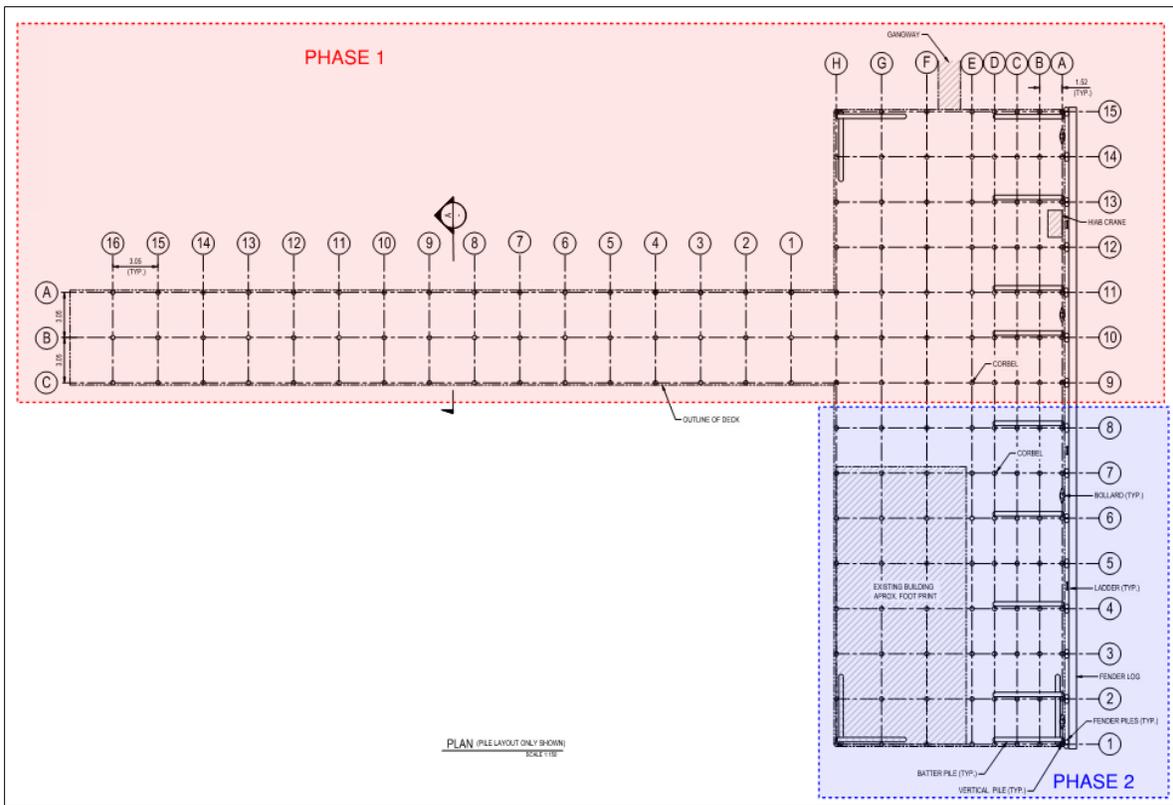


Figure 1 - Proposed Rehabilitation Phasing Plan

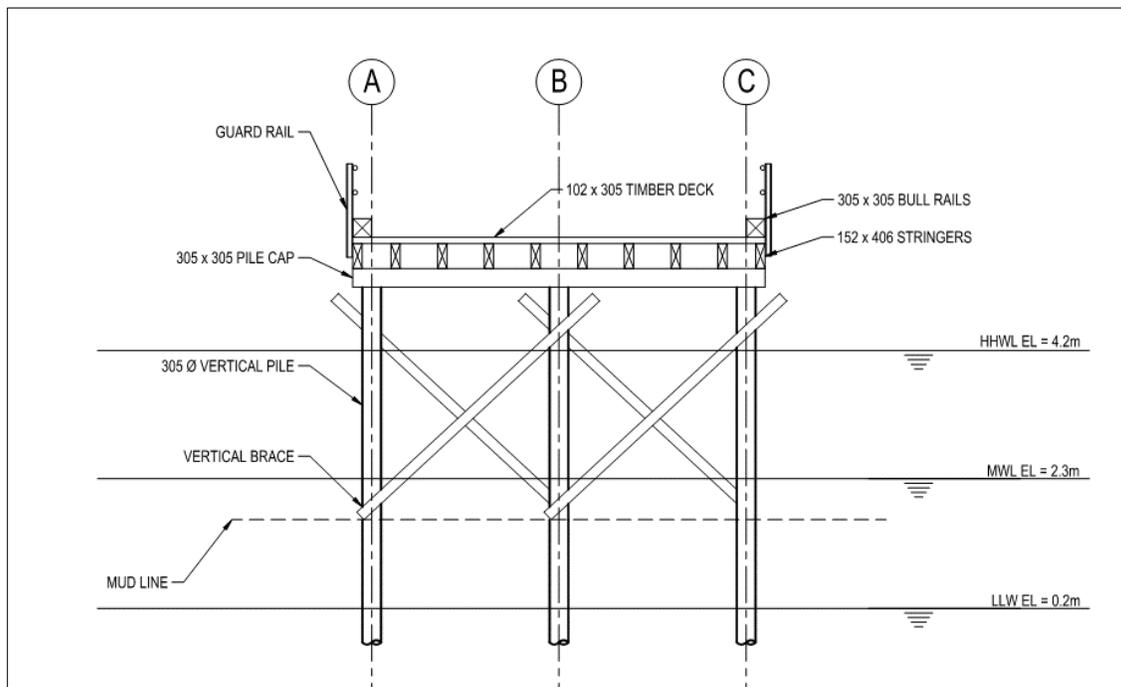


Figure 2 - Cross-Section of Proposed Rehabilitation Concept



## 8. SUMMARY AND COST ESTIMATES

The Tahsis municipal wharf is reaching the end of its service life with extensive deterioration to the timber substructure. Significant rehabilitation / replacement is recommended if the facility is intended to be operation. Load restriction including barricading the wharf from any vehicle access and only permitting very limited pedestrian access is strongly recommended. Table 3 below provides brief summary with cost estimates for anticipated work.

Table 3 - Summary and Cost Estimates

Item	Description	Units	Quantity	Unit Cost	Subtotal
<b>Short Term / Immediate Priority</b>					
1	Handrail Installation Along Wharfhead (North / South / West Faces)	Ea.	52	\$100	\$5,200
2	Gangway Ramp Upper Connection Repairs	Ea.	1	\$5,000	\$5,000
<b>Wharf Rehabilitation Program</b>					
3	Contractor Mobilization / Demobilization	Ea.	1	\$30,000	\$30,000
4	Prepare Deck Panels for Removal	Manhours	72	\$100	\$7,200
5	Temporary Removal of Deck Panels	LS	1	\$64,000	\$64,000
6	Approach - Pile Repairs / Replacement (Allowance)	Ea.	5	\$7,000	\$35,000
7	Approach - Pile Cap Replacement	Ea.	16	\$2,500	\$40,000
8	Approach - Stringer Replacement	Ea.	64	\$1,750	\$112,000
9	Approach - New Timber Deck	m <sup>2</sup>	348	\$150	\$52,200
8	Approach -Vehicle Guardrail / Handrail Replacement	m	97	\$350	\$33,950
8	Wharfhead - Pile Repairs / Replacement (Allowance)	Ea.	12	\$7,000	\$84,000
8	Wharfhead - Pile Cap Replacement	Ea.	21	\$2,500	\$52,500
8	Wharfhead - Stringer Installation	Ea.	60	\$1,750	\$105,000
8	Wharfhead - New Timber Deck	m <sup>2</sup>	278	\$150	\$41,700
11	Wharfhead - Vehicle Guardrail / Handrail Replacement	Ea.	42	\$350	\$14,700
Subtotal					\$682,450
Engineering, Environmental Monitoring, & Project Management (10%)					\$68,245
Contingency (25%)					\$170,613
<b>Total Estimated Cost (Taxes Excl.)</b>					<b>\$921,308</b>

In considering the cost estimates in Table 3, please note the following:

- The estimate is based on in-house experience and recent budget price quotations from contractors and suppliers for similar work.
- Taxes have not been included.
- An allowance for contractor mobilization/demobilization has been made, however, this is based on completing repair items concurrently by the contractor.
- A contingency of 25% has been assumed to provide for repair items/scope which is undefined at this point.
- The cost estimate is considered accurate to  $\pm 50\%$ .



## 9. CLOSURE

This document is for the sole use and reliance of the Village of Tahsis and McElhanney Ltd. The material in this report reflects McElhanney's best judgment based on the information available to it at the time of preparation. Any use of this report by a third party or any reliance on or decisions made based on it are the responsibility of such third parties. McElhanney accepts no responsibility for damages suffered by any third party as a result of decisions made or actions based on this report.

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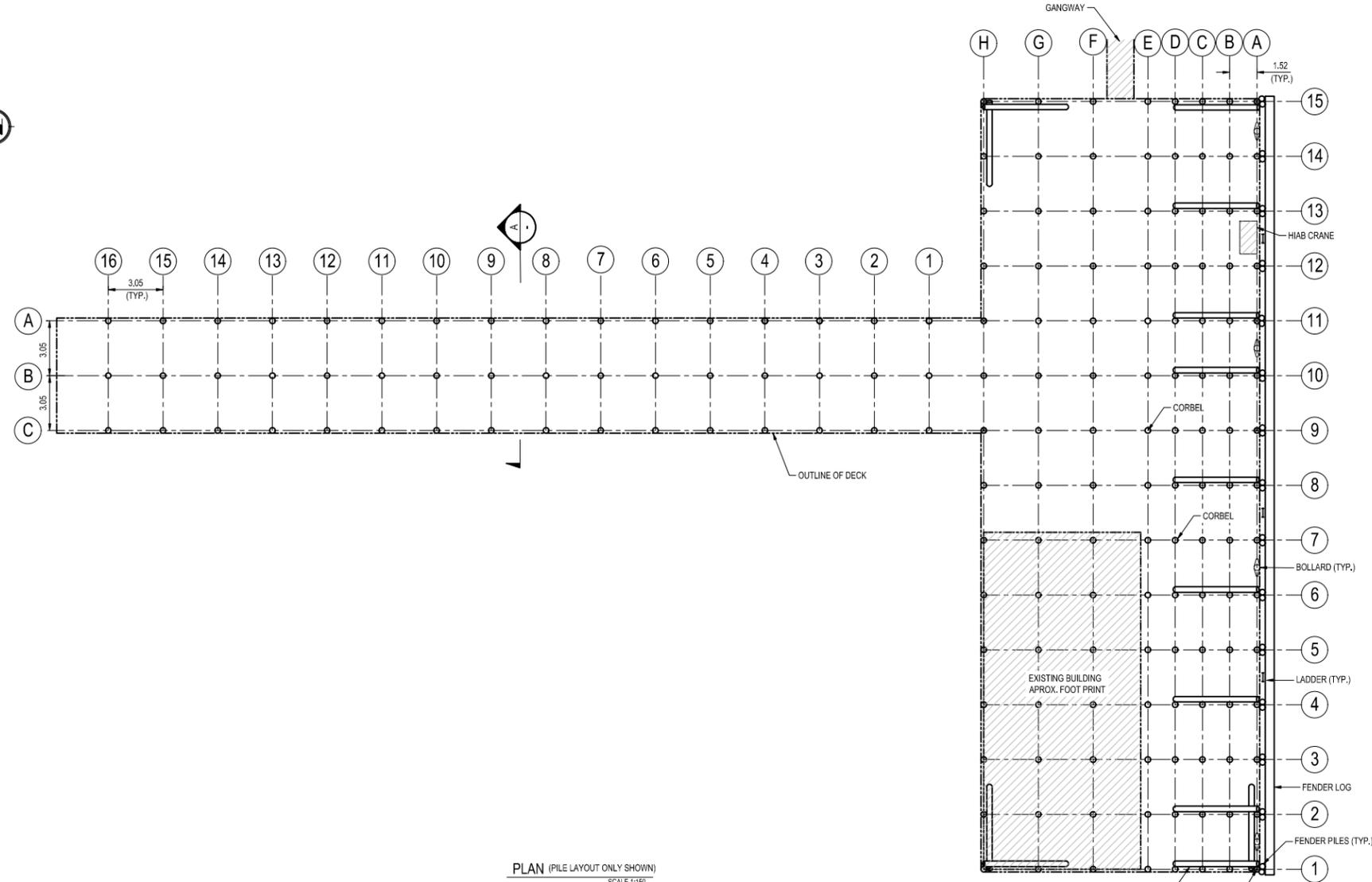
*Matthew Friderichs, P.Eng.  
Marine Structural Engineer*



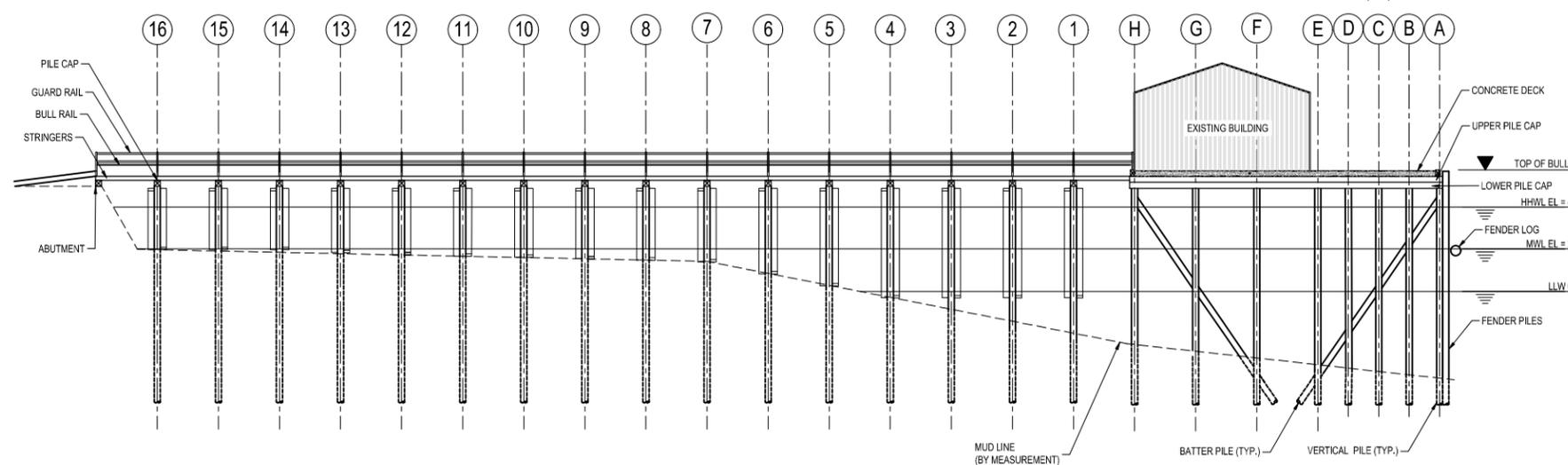
**APPENDIX A**  
**DRAWINGS**



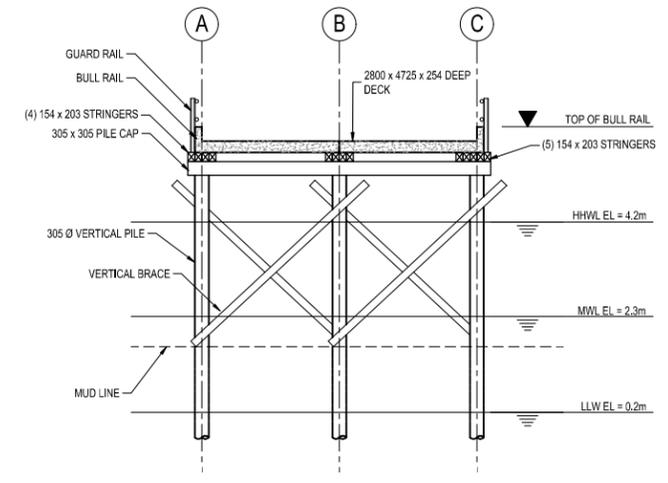
NOTES:  
1. WATER LEVELS ARE TO LOCAL TIDE AND CHART DATUM.



PLAN (PILE LAYOUT ONLY SHOWN)  
SCALE 1:150



ELEVATION (LOOKING NORTH)  
SCALE 1:150



SECTION  
SCALE H:1.75  
V:1.75

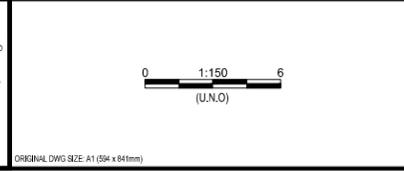
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Rev	Date	Description	Drawn	Design	App'd
PA	2019-04-30	ISSUED FOR REVIEW	GC	GC	MF

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**McElhanney**

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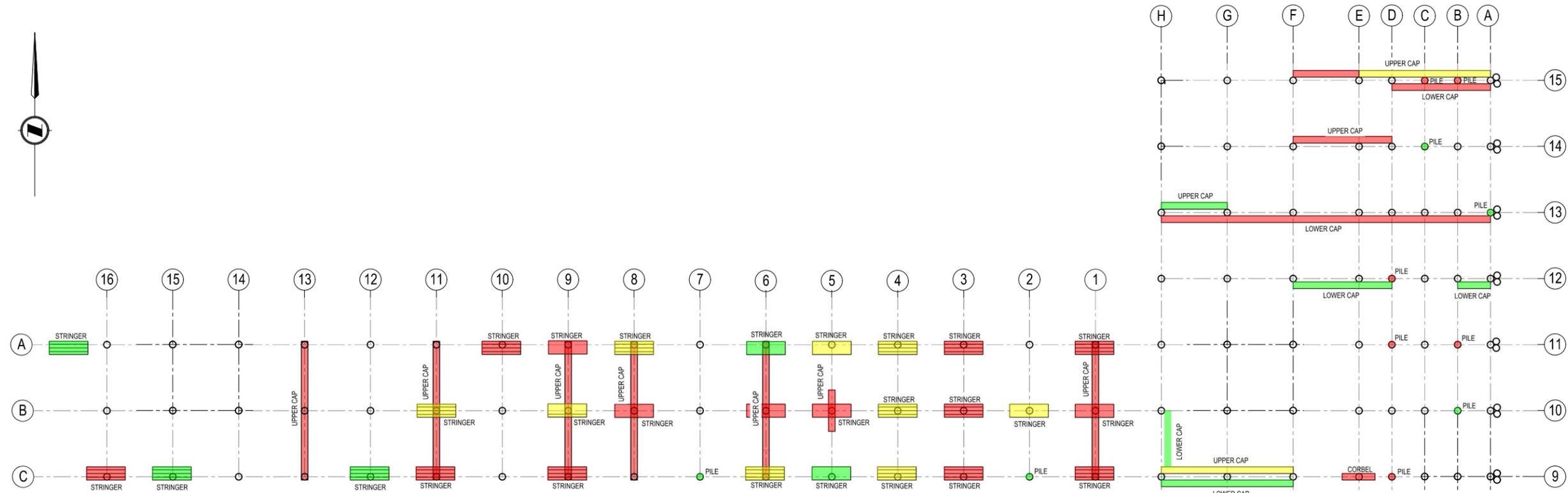
THIS DRAWING HAS NOT BEEN APPROVED  
AND MAY CONTAIN ERRORS AND OMISSIONS

VILLAGE OF TAHSIS  
TAHSIS, BC

VILLAGE WHARF  
PLAN, ELEVATION, AND SECTION  
GENERAL ARRANGEMENT

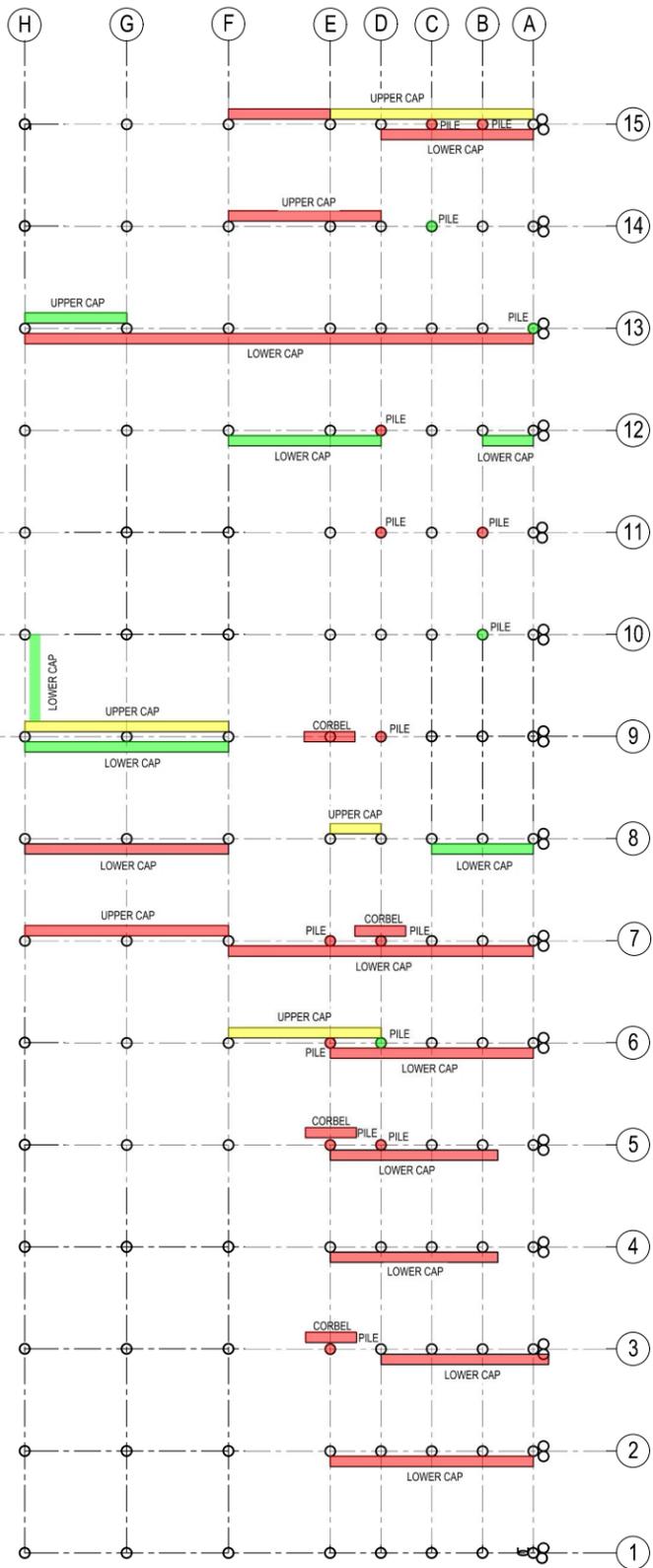
Drawing No.	100
Project Number	2221-49140 T2012
Rev.	PA

DESIGN: J. SMITH, ENGINEER; CHECKED: M. SMITH, ENGINEER



PLAN  
SCALE 1:100

LEGEND	
SEVERE DAMAGE TO:	REPRESENTED AS FOLLOWS:
UPPER PILE CAP (UPC)	UPPER CAP
LOWER PILE CAP (LPC)	LOWER CAP
CORBEL	CORBEL
STRINGER	STRINGER
PILE	PILE
> 50 % SECTION LOSS	
25 - 50 % SECTION LOSS	
10 - 25 % SECTION LOSS	



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ORIGINAL DWG SIZE: A1 (594 x 841mm)



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PRELIMINARY  
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CONSTRUCTION

VILLAGE OF TAHSIS  
TAHSIS, BC  
VILLAGE WHARF  
TIMBER DAMAGE/ DETERIORATION  
DAMAGE PLAN

Drawing No.	101
Project Number	2221-49140 T2012
Rev.	PA



**APPENDIX B**  
**INSPECTION**  
**PHOTOS**



*Photo 1 - General View from Offshore*



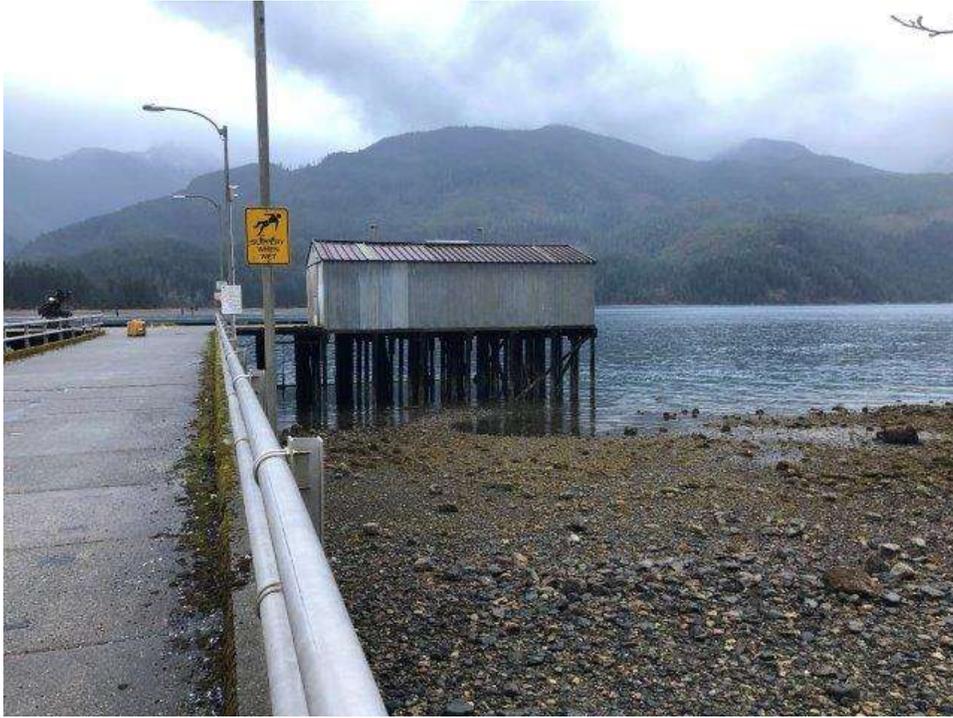
*Photo 2 - General View of Approach Trestle*



*Photo 3 - General View of Wharfhead from Shoreline*



*Photo 4 - General View of Wharfhead Building from Shoreline*



*Photo 5 - Approach Trestle South Guardrail*



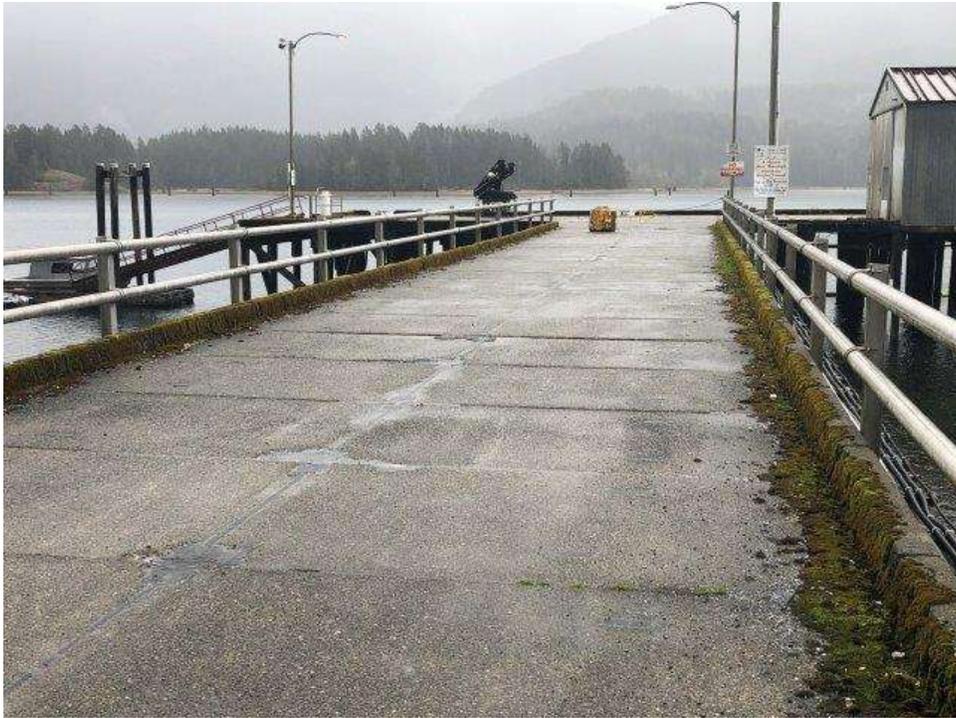
*Photo 6 - Approach Trestle North Guardrail*



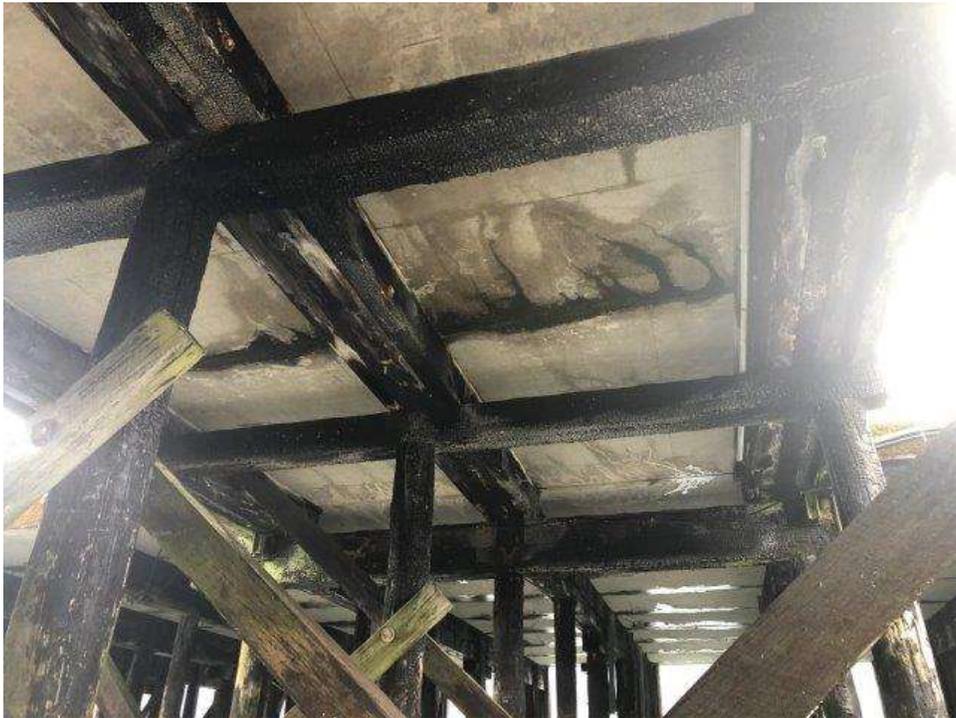
*Photo 7 – Approach Trestle Shoreline Transition*



*Photo 8 – Approach Trestle Concrete Curb*



*Photo 9 – Approach Trestle Deck Panels*



*Photo 10 - Approach Trestle Stringers and Pile Caps*



*Photo 11 – Approach Trestle Stringers and Pile Caps*



*Photo 12 - Approach Trestle Pile Cross-Bracing*



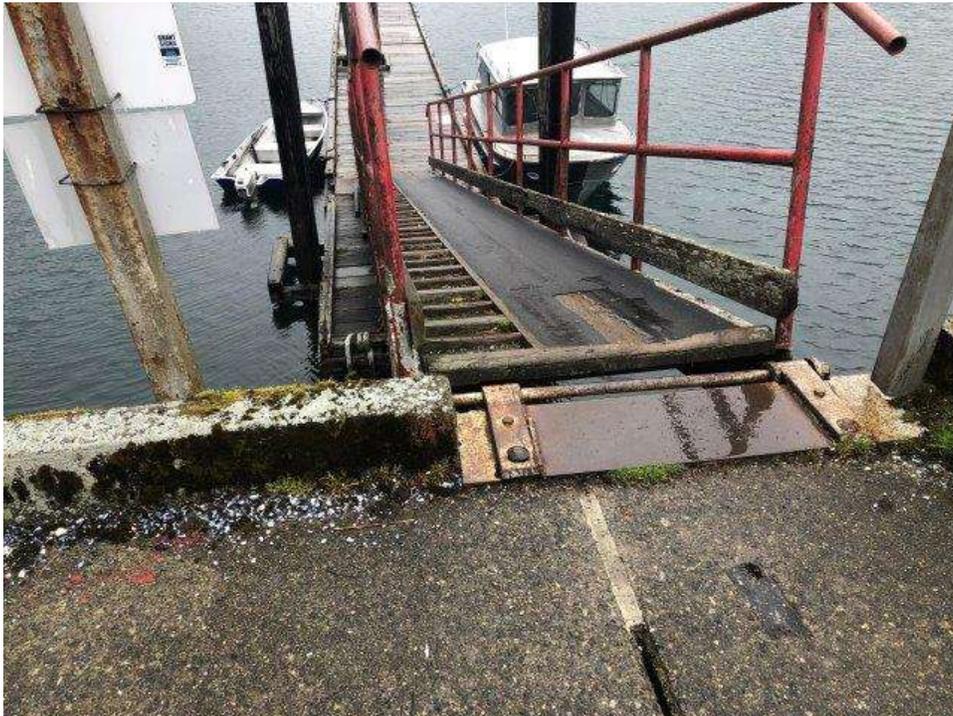
*Photo 13 – Wharfhead Topsides and Building Structure (Facing South)*



*Photo 14 - No Handrails Along West Face of Wharfhead*



*Photo 15 – Hiab Crane Located Between Bent Nos. 12-13*



*Photo 16 – Upper Gangway Connection to Wharf*



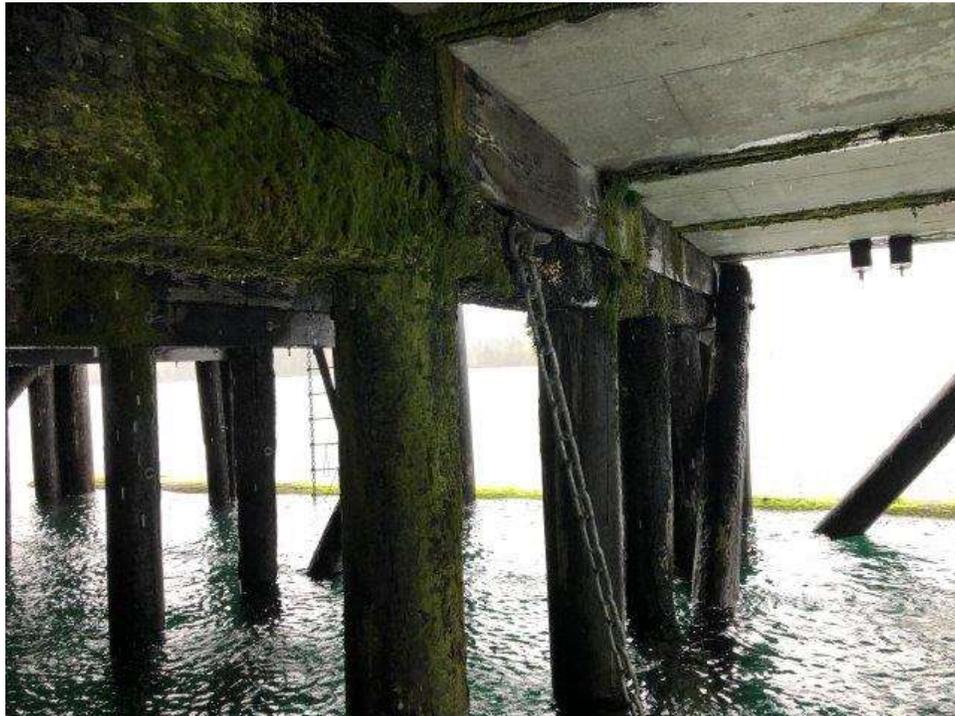
*Photo 17 - West Hinge With Wearing / Abrasion of the Hinge Pin*



*Photo 18 – Wharfhead Deck Panels with Settlement Due to Failure of the Pile Caps*



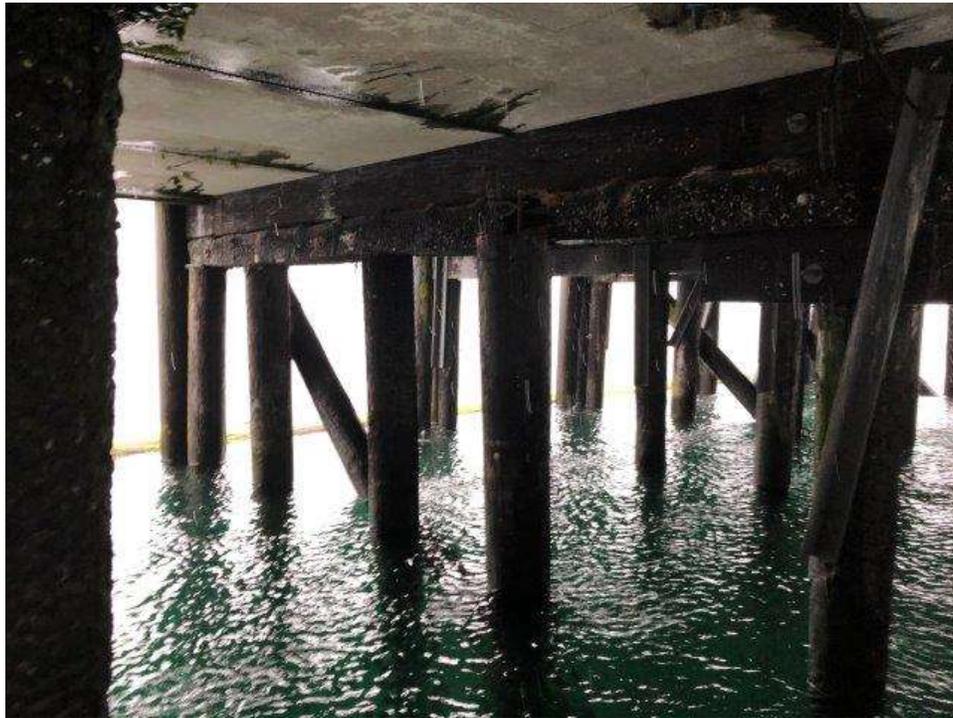
*Photo 19 – Wharhead Deck Panels With Spalling Adjacent to Drainage / Electrical Utility Holes*



*Photo 20 – Bent No. 2 Lower Pile Cap With Severe Fungal Decay*



*Photo 21 – Bent No. 3 Lower Pile Cap With Severe Fungal dEcay*



*Photo 22 – Bent No. 5 Lower Pile Cap With Severe Fungal Decay. Note Pile D is not in bearing with cap.*



*Photo 23 – Typical View of Pile “Punching” Through Pile Cap from Pile Cap Severe Fungal Decay*



*Photo 24 - Pile Punching Through Pile Cap at Pile No. 6T*



*Photo 25 – Hiab Support Bracket to Pile Cap at Bent No. 13*

