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ESPERANCE JETTIES CONDITION ASSESSMENTS

Condition Inspection and Maintenance Strategy Report

Reference: R-J15028-1
Date: December 2015
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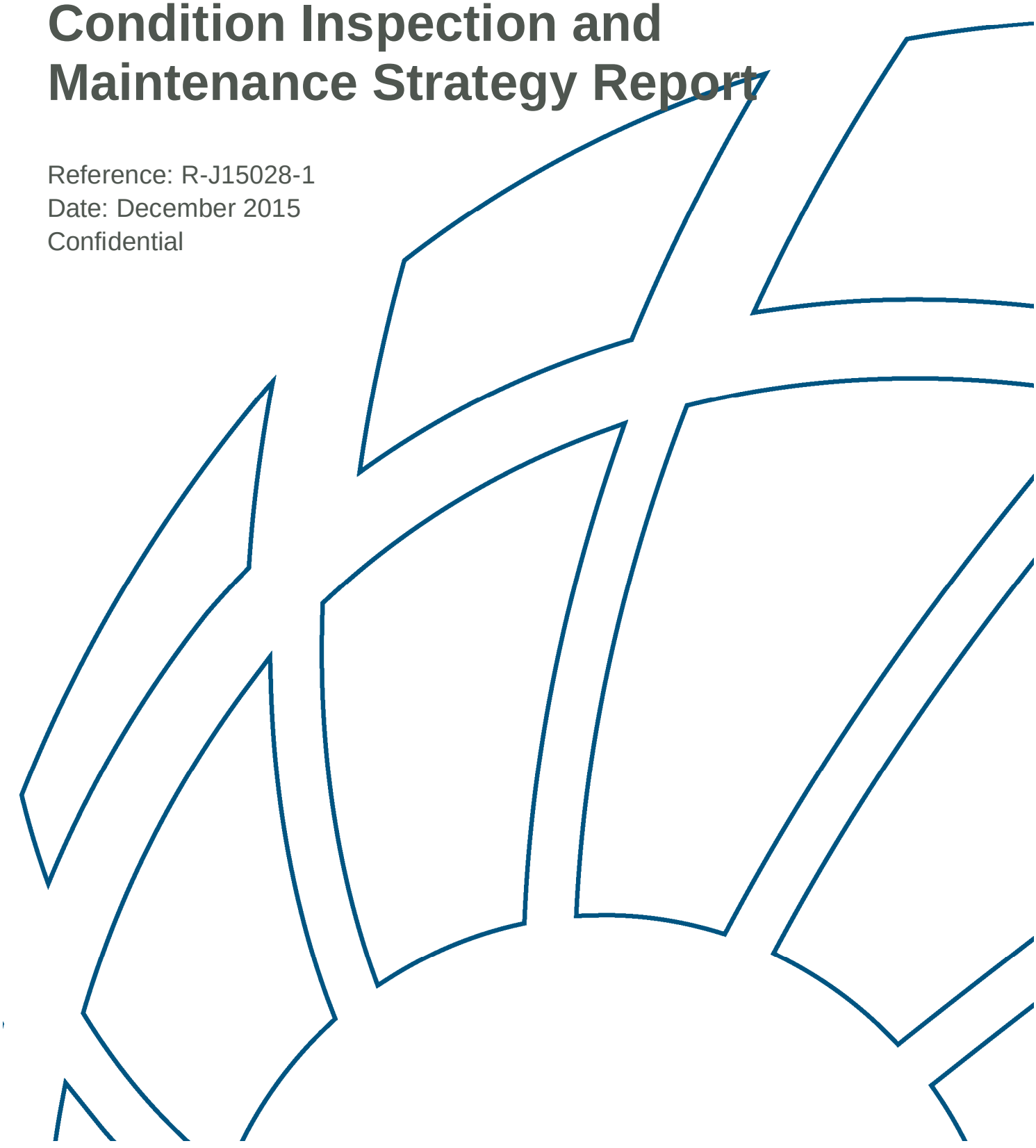

SHIRE OF ESPERANCE

ESPERANCE JETTIES CONDITION ASSESSMENTS

CONDITION INSPECTION AND MAINTENANCE STRATEGY REPORT

Prepared for

By

Rev	Issue	Prepared by	Submitted to	Date	Copies
A	Draft – First Review	J Fifield	B Saunders	30/11/15	1 Elec
B	Preliminary Draft for Client Review	J Fifield	G Harris (SoE)	1/12/15	1 Elec
0	Stage 1 Issue	J Fifield	G Harris (SoE)	9/12/15	1 Elec
1	Stage 2 Issue				

Document Information	
Client:	Shire of Esperance
Project	Esperance Jetties Condition Assessments
Title	Condition Inspection and Maintenance Strategy Report
Author	J Fifield
Doc Reference	R-J15028-1
Current Revision	Rev 0

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1 INTRODUCTION

1.1 Project Background

BMT JFA Consultants Pty Ltd (BMT JFA) were engaged by the Shire of Esperance to undertake condition inspection of the Esperance Tanker Jetty, Town Boat Ramp Jetty and James Street Swimming Jetty.

Inspections of all three Jetties were undertaken on the 11th (underwater ROV) by Justin Fifield and Adam Kayser (Ocean Eyre) and 17th/19th November (Above Water) by Brad Saunders and Justin Fifield. The condition inspection and assessments have been undertaken in accordance with the Ports Australia Wharf Structures Condition Assessment Manual (WSCAM) 2014.

1.2 Site Description

1.2.1 Tanker Jetty

The Esperance Tanker Jetty is situated approximately 2km north of Esperance Port. It extends approximately 700m from the beach in an easterly/south-easterly direction. It was constructed in 1934 and then refurbished in 1991 replacing the piles. Only the outer (North and South) piles were replaced during the refurbishment. The shoreward section (Pile frames 1-30) has been demolished to allow construction of a headland. The Jetty has been joined to the headland with an aluminium pedestrian walkway span.

The remaining section of the Tanker Jetty is approximately 600m long. The jetty was originally constructed of pile frames at 4.5m spacing made up of 3 piles. During the 1991 refurbishment, replacement piles, for a 2 pile frame, have been constructed outside, to the north and south, of the original piles.

The pile frame substructure consists of the piles and half caps which support the deck superstructure. The piles, of each pile frame, are connected by 2 half caps, which are seated into and bolted to both sides of the pile tops. The pile frames support the deck superstructure on the half caps.

The superstructure is comprised of the main longitudinal stringers, deck planks and the concrete deck. The main longitudinal stringers are supported on bearing corbels over the half caps at each pile frame. The 5 longitudinal stringers support deck planks, arranged transversely, which are topped with concrete pavement.

The substructure pile frames are a critical load path for the dead and pedestrian live loading. The piles are also subject to wave loading and have continued to deteriorate with failures, including ‘necking’, at the seafloor and at sea level. In addition the connections of the half caps at the top of some of the piles have also suffered at least one failure, including crushing.

1.3 Condition Assessment Framework

The jetty was subject to a high level condition inspection in accordance with the Ports Australia Wharf Structure Condition Assessment Manual’s (WSCAM) procedures. The

WSCAM rates the various elements condition from 1 New to 7 Failed. The condition rating scale is clarified in Figure 1-1.

Table A9.1: Timber Condition Rating Scale

CONDITION STATE	DESCRIPTION	EXPECTED REM. LIFE (% of original design life)	RECOMMENDED ACTIONS
1	New with no visible defects/damage.	100	No repairs required. Re-inspection at next scheduled inspection may be considered.
2	As new. Minor splits and checks, no measurable section loss.	55-100	No repairs required. Re-inspection at next scheduled inspection may be considered
3	Minor marine organism attack and pipe rot, decay or necking resulting in up to 5% of section area loss. There may be minor splits or checks evident.	40-55	Planned and preventative maintenance works may be considered.
4	Moderate pipe rot, decay, marine organism attack or necking resulting in up to 5-20% of cross section loss. There may be moderate splits or checks evident.	25-40	Further testing; reactive maintenance and some minor upgrades may be considered.
5	Heavy marine organism attack, evidence of termite activity, pipe rot, decay or necking resulting in up to 20-35% section loss. Major splits or checks evident.	15-25	Structural assessment is recommended. Further investigation may be required to inform the structural assessment. Maintenance; upgrade or rehabilitation works may be considered.
6	Severe marine organism or termite attack, pipe/ surface rot, decay or necking resulting in up to 35-50% section loss. Major splits or checks evident in critical zones mid and end spans.	0-15	Structural assessment is recommended. Further investigation may be required to inform the structural assessment. Rehabilitation or renewal works may be considered.
7	Severe marine organism or termite attack, pipe/surface rot, decay or necking resulting in greater than 50% section loss. Component has failed.	0	Rehabilitation required immediately or replace component/asset.. Structural assessment is recommended where rehabilitation works are to be undertaken. Further investigation may be required to inform the structural assessment.

Notes:

1. The expected remaining life provided in the table is indicative only. Predictive modelling based on physical assessment would be required to obtain an accurate indication of the expected remaining life.

Figure 1-1: Timber Condition Rating Scale (WSCAM 2014)

A high level visual inspection was undertaken, therefore, not all elements were inspected but a sample selected on the basis of previous inspection findings.

1.4 Inspection Preparation and Target Creation

The 2010 P09171, and 2013 R-224.07-1 reports were reviewed identifying areas where defects were identified and where repairs were specified. These areas were mapped prior to undertaking the inspection.

2 SCOPE OF WORK

The scope of services, as outlined in the Project Brief, is for the condition inspection, reporting, and subsequent development of fully costed asset maintenance plans, in two stages, for the following jetty structures:

- The Esperance Tanker Jetty
- Town Boat Ramp (Finger) Jetty (Separate Report)
- James Street Swimming Jetty (Separate Report)

2.1 Stage 1 – Condition Assessment

For each of the above mentioned structures, the Stage 1 scope includes the following activities:

- Review previous information, drawings, reports and specifications as provided by the Shire of Esperance
- Analyse the existing structures for structural integrity
- Based on the previous information determine the best procedure to determine the condition of the existing jetties and each of its components both above and below the waterline
- Assessment of the condition of main structural components and assignment of a score representative to its current condition
- Prepare a summary report of the condition inspections outlining the findings and recommendations for stage 2 of the works to be completed
- Present the results of the condition inspections and assessments to Councillors and Officers of the Shire of Esperance.

2.2 Stage 2 – Fully Costed Asset Maintenance Plan

For each of the above mentioned structures, the stage 2 scope includes the following activities:

- Utilising the condition information obtained from stage 1 produce detailed documentation that outlines a prioritised list of maintenance costs for the existing facilities based on work required to prevent failure and ensure the structures' conditions are suitable for their designated purposes
- Develop Preliminary Asset Management Strategies based on weighted scores and failure criteria to allow for Shire of Esperance feedback
- Submit final Asset Management Strategy documents for each structure, including costings to the Shire of Esperance for implementation.

2.3 Stage 1 – As detailed in Proposal Q-P15.30-2

2.3.1 Desktop Review

A review of the available drawings, reports and other information for the Tanker Jetty has been undertaken providing insight into the inspection planning.

Assessment of the structures appreciate load paths has been undertaken to determine of the critical areas and elements of the structure as well as areas of redundancy.

2.3.2 Condition Inspection

In accordance with discussions between BMT JFA and the Shire of Esperance, the inspections will likely be targeted at the critical areas. A high-level inspection of the whole structure will be undertaken to identify any new critical areas, before assessing the specific areas identified to be at most risk.

(BMT JFA offered, as additional scope, a detailed inspection of the whole tanker jetty if required as assessment of critical areas does carry some risk of defects going unnoticed. The most recent detailed inspection of the Tanker Jetty was undertaken nearly 5 years ago in 2010. This was not undertaken as part of the works.)

The condition inspections themselves have rated the critical structural elements, in the Heat Map (Appendix A) in accordance with the Ports Australia Wharf Structures Condition Assessment Manual criteria for wharves and other marine structures. BMT JFA provided guidance during the development of these guidelines which are similar to the New York Waterfront Inspection Guidelines - 1999 (NYWIG) used to provide the criteria for the inspection and assessment of the Tanker Jetty in 2013 (R-224.07-1).

2.3.3 Condition Summary Report

A simple colour coded Condition Summary Report can be found in Appendix B to identify critical areas which require repairs and outlining what those repairs would be and their priority.

This report includes:

- Summary high level assessment of the global structure and critical defects
- A catalogue of the photographs taken during the inspection (Provided separately to report)
- Tabulated report of areas where repairs are required and when these repairs should be undertaken.

This report is intended as a summary of inspections in accordance with our proposal and updates information in less detail than the 2013 report, R224.07-1. The findings focus on critical issues in the short term ahead of an expected closure or replacement.

2.3.4 Presentation

BMT JFA have presented initial findings to the Councillors and Officers of the Shire of Esperance on the condition and any necessary structural repairs to the three Jetties and outline the potential strategy options and advantages and disadvantages for the proposed remedial approaches.

2.4 Stage 2 - As detailed in Proposal Q-P15.30-2

2.4.1 Maintenance Costing

The maintenance cost list will expand the summary report schedule to include the individual maintenance tasks. Costs will be apportioned for the identified tasks as well as future estimated maintenance costs over the remaining life of the structure.

BMT JFA will use their extensive catalogue of repair and replacement costs for marine infrastructure to provide the basis for accurate costing. This will include net present value (NPV) calculations. Discount rates for the NPV calculations are to be supplied by the Shire of Esperance.

2.4.2 Asset Management Strategies

Once the basic repair costs have been identified the strategies for replacement can be compared. BMT JFA developed costs for the replacement of the Tanker Jetty as part of a previous project. The repair vs replacement strategies can be compared to optimise the most appropriate time to undertake closure or replacement of a structure before it becomes uneconomical to maintain.

3 TANKER JETTY DEFECTS

The Tanker Jetty has the following defects:

- Cracking and displacement of the **deck concrete topping panels**
- Rot and deterioration of **deck planks**
- Rot and deterioration of **stringers**
- Rot and crushing of **corbels**
- Rot and crushing of end distance on **half caps**
- Splitting of **pile tops**
- Surface and underwater teredo worm and rot damage to **piles**
- Corrosion and section loss of **bolts** and other **steelwork.**

3.1 Critical Elements Identified

As noted in section 1.2.1 the superstructure, when supported according to the original design, has overall sufficient load path redundancy and flexibility to accommodate the loads it is subjected to. Whereas the substructure pile frames are a critical load path for the dead and pedestrian live loading. The piles are also subject to wave loading which has a critical load path up into the superstructure to share the loads amongst the surrounding piles.

Both the dead and pedestrian live loading and wave loading load paths are critical and both pass through the same critical elements and connections. These are:

- Piles
- Half Caps (particularly the Pile to Half Caps connection).

The piles have continued to deteriorate with failures, including ‘necking’, at the seafloor and at sea level. In addition the connections of the half caps at the top of some of the piles have also suffered at least one failure, including crushing.

The Tanker Jetty inspections have found numerous significant defects subsequent to those reported in BMT JFA’s 2013 report R-224.07-1.

The most significant defects were; completely failed piles 54 North, 93 North and crushing of both half caps at their northern bearing support adjacent to the bridged section at missing pile 39 North (including 35-38 North, and 40 North).

The condition of the critical elements has been summarised in the heat map in Appendix A, where the elements have been scored based on their condition in accordance with WSCAM.

3.2 Piles

The piles identified as in a critical condition in order of WSCAM scoring 7 to 1.

3.2.1 7 - Failed / Greater than 50% loss of section

- 54 North – Appears to have failed between surface and sea bed

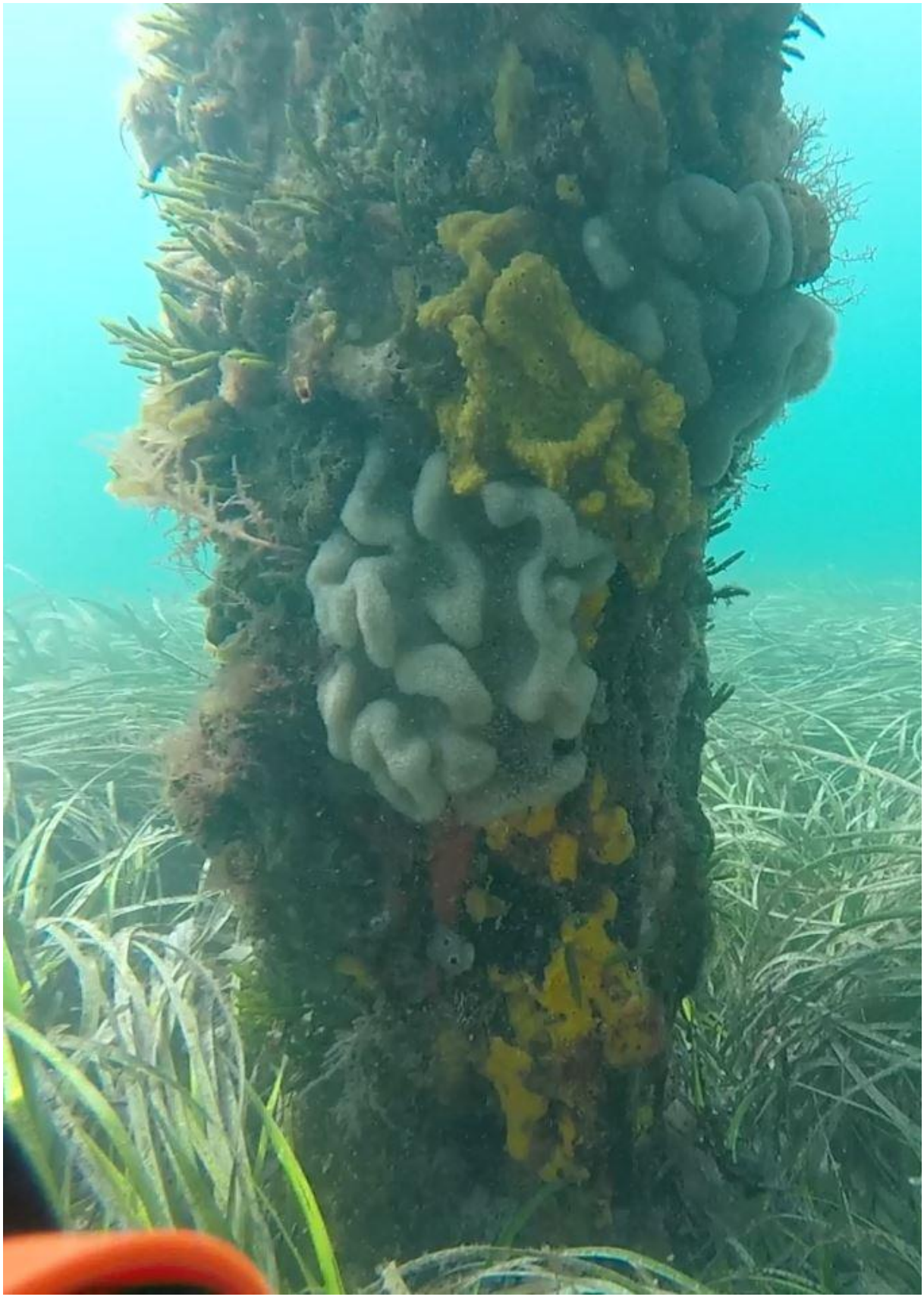

Figure 3-1: 54 North 11/11/15 – Severe necking at base (prior to failure identified 17/11/15)

- 93 North - Failed at water surface.

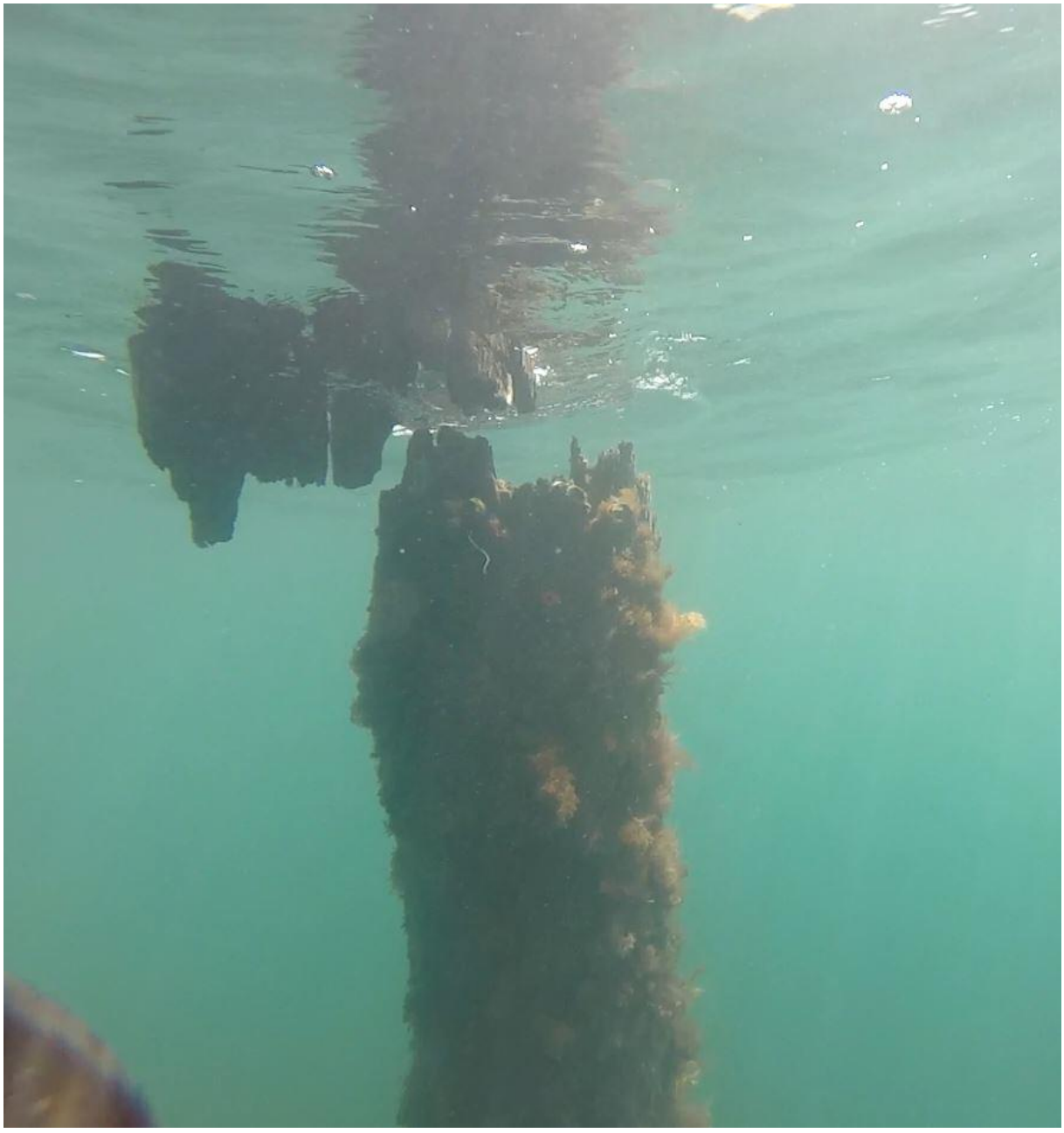

Figure 3-2: 93 North 11/11/15 – Failure at surface

3.2.2 6 - 35% to 50% loss of section

- 53 South

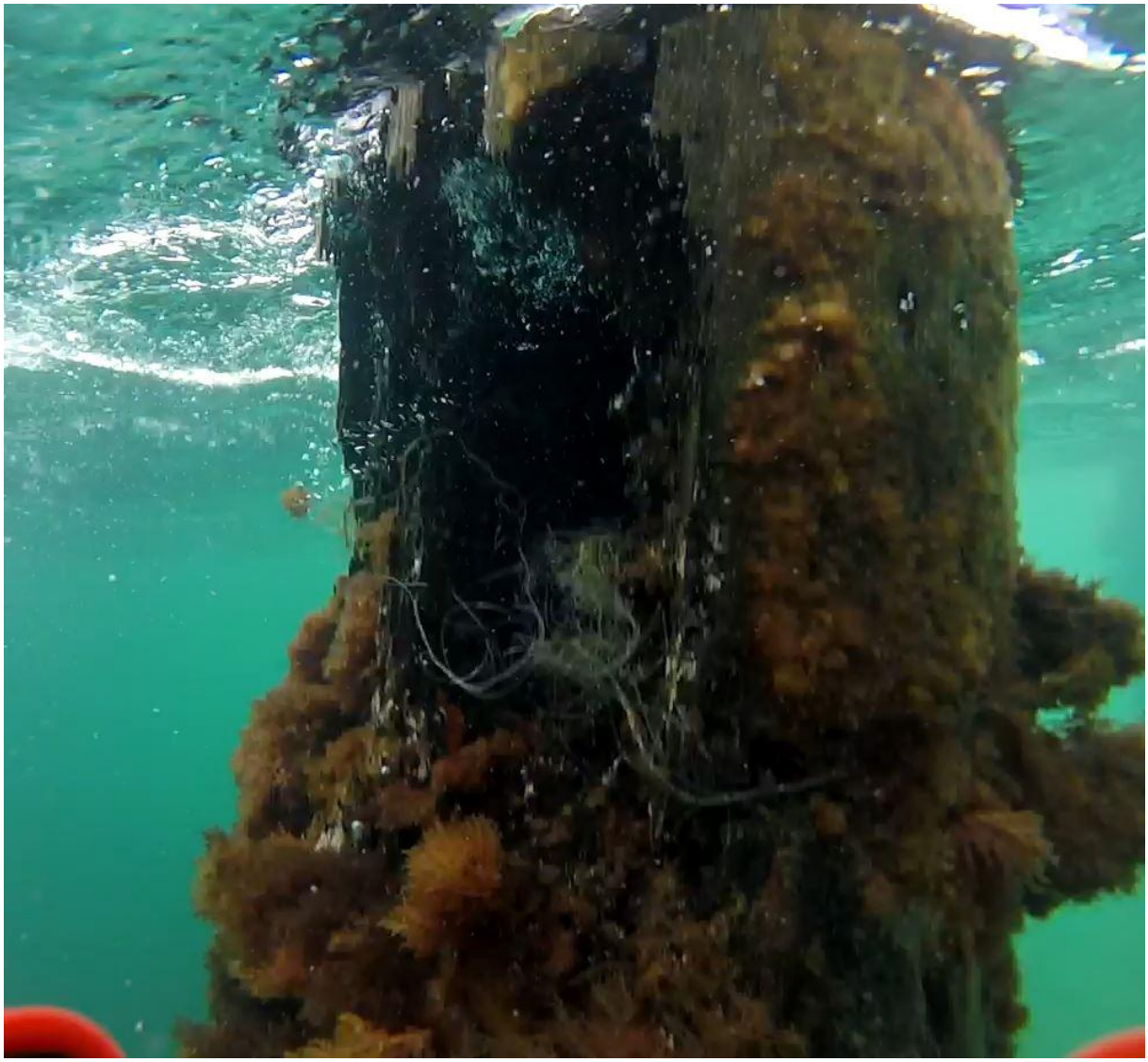

Figure 3-3: 53 South 11/11/15 – Severe section loss at surface

- 58 South

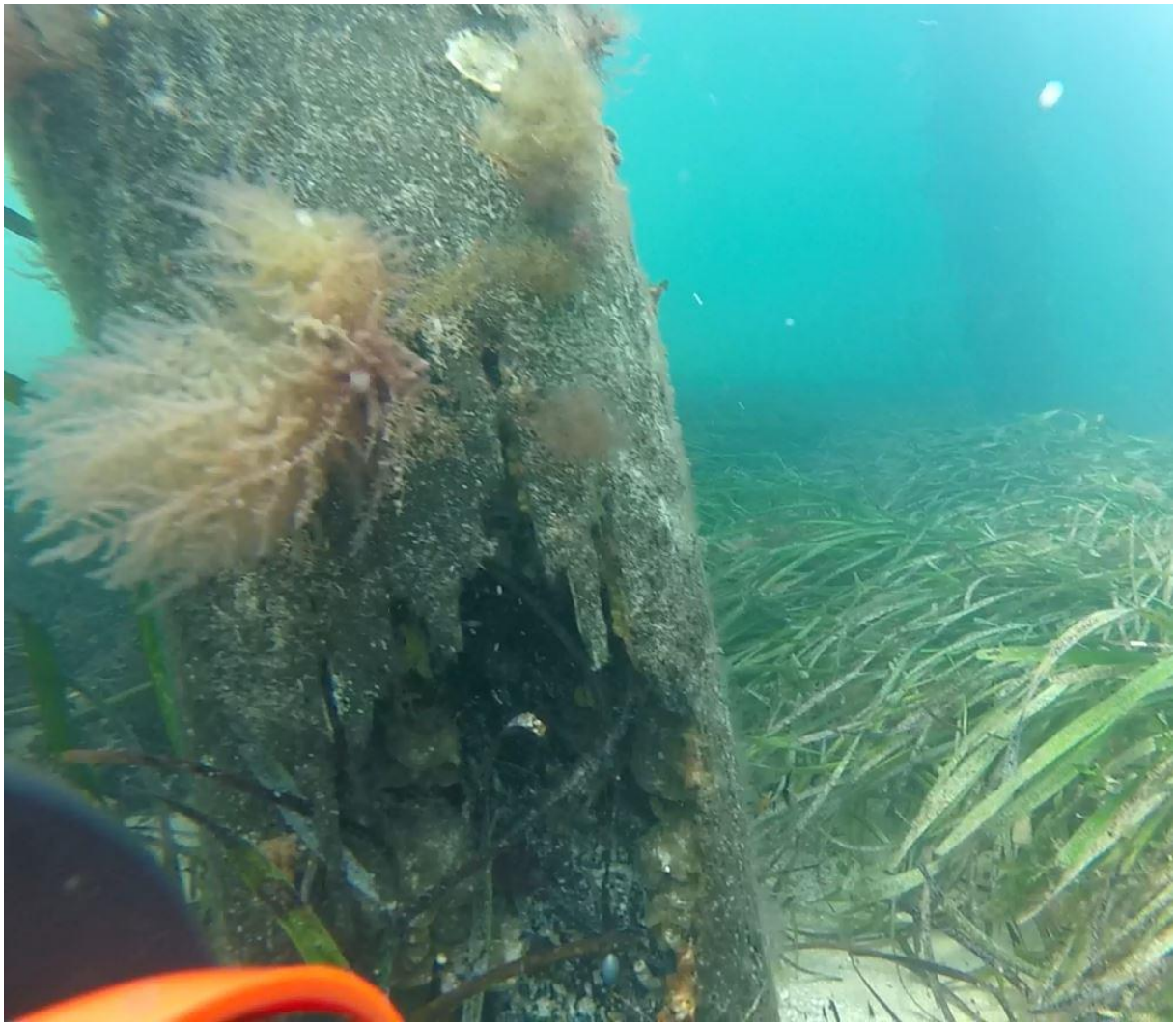

Figure 3-4: 58 South 11/11/15 – Severe section loss at base

- 66 North

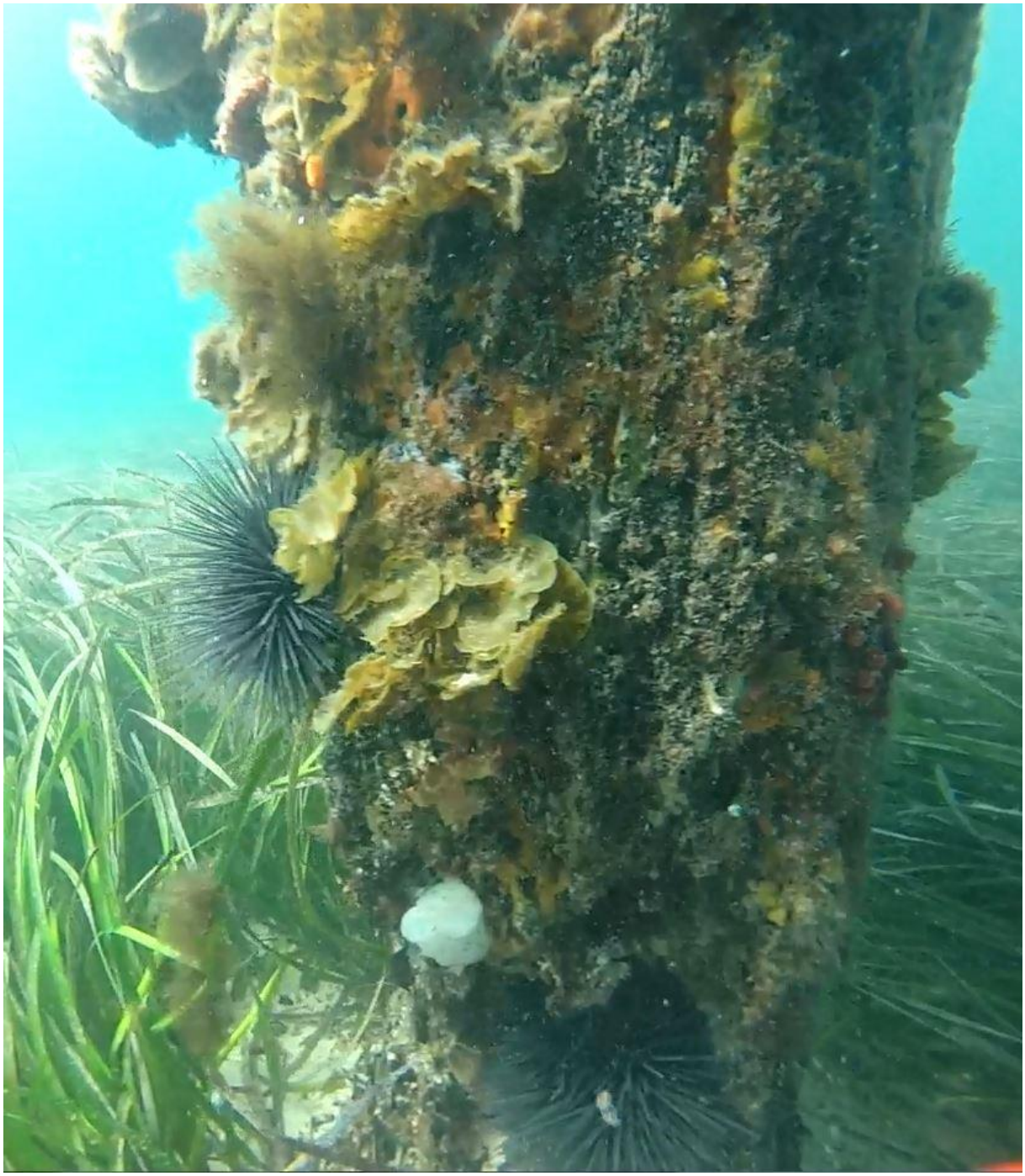

Figure 3-5: 66 North 11/11/15 – Severe section loss at base

- 70 South

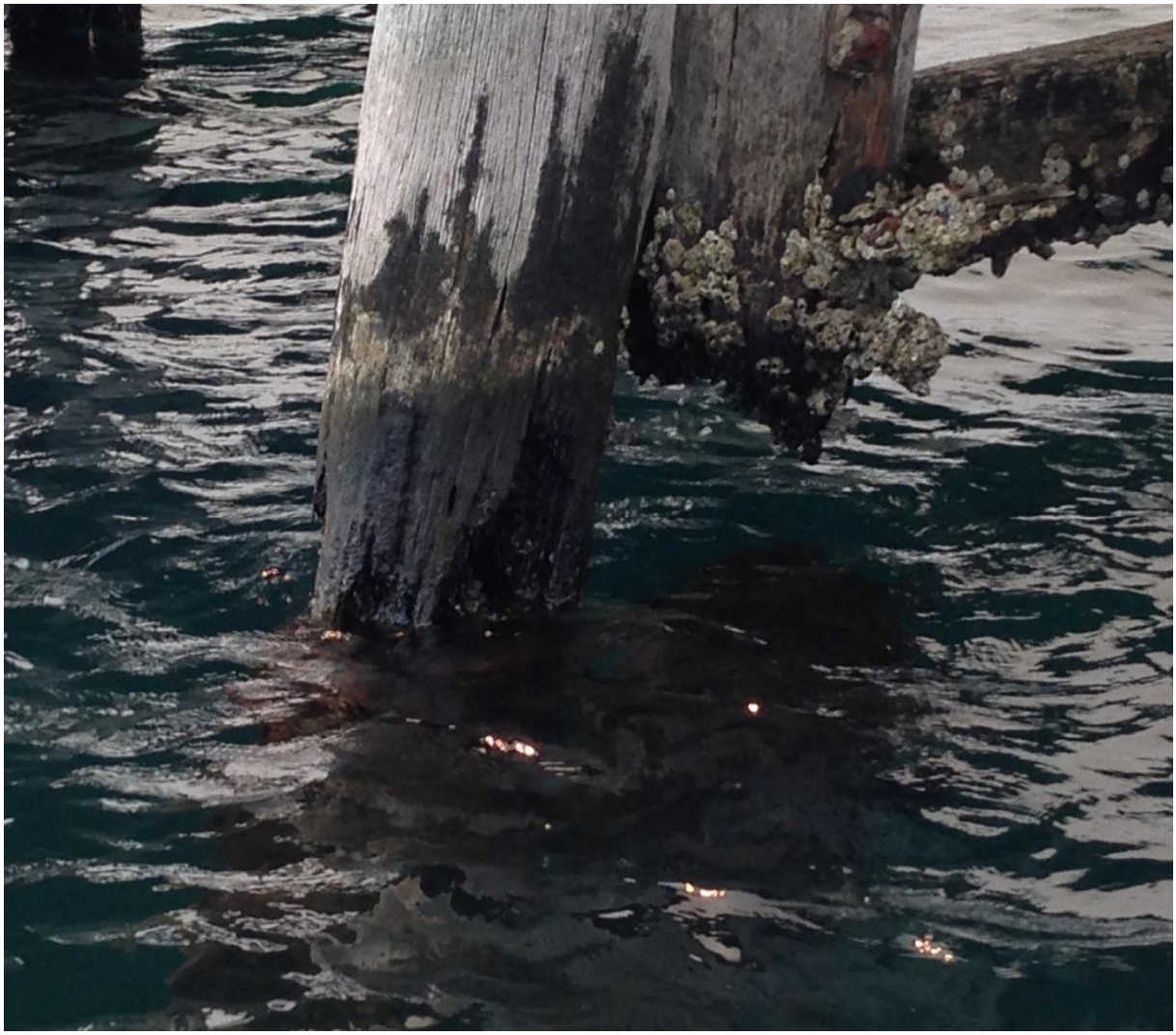

Figure 3-6: 70 South 17/11/15 – Severe section loss at surface (surface inspected only)

- 71 South.

Figure 3-7: 71 South 17/11/15 – Severe section loss at surface (surface inspected only)

- 74 North

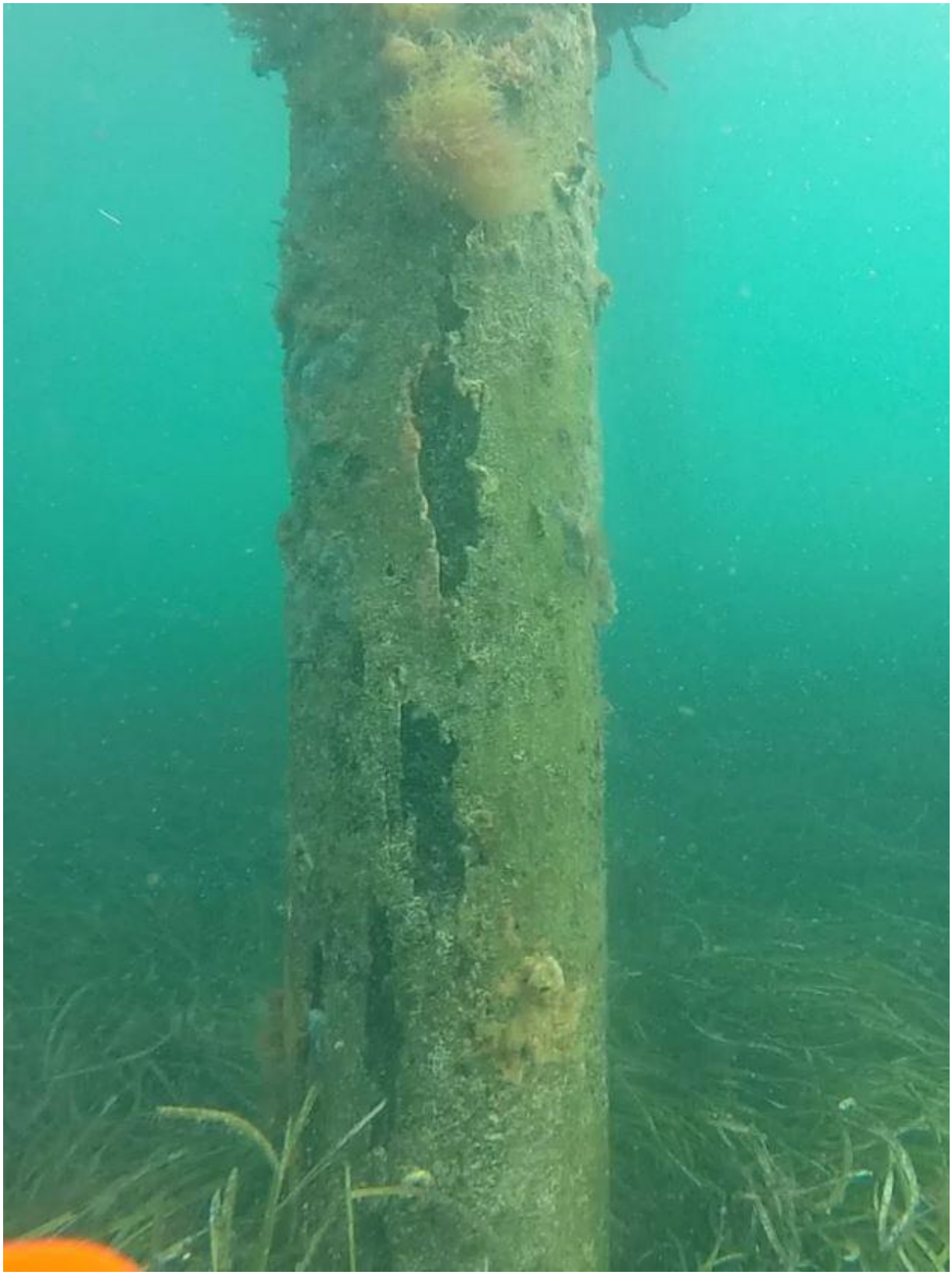

Figure 3-8: 74 North 11/11/15 – Section loss and splitting at many locations through water column

- 91 North

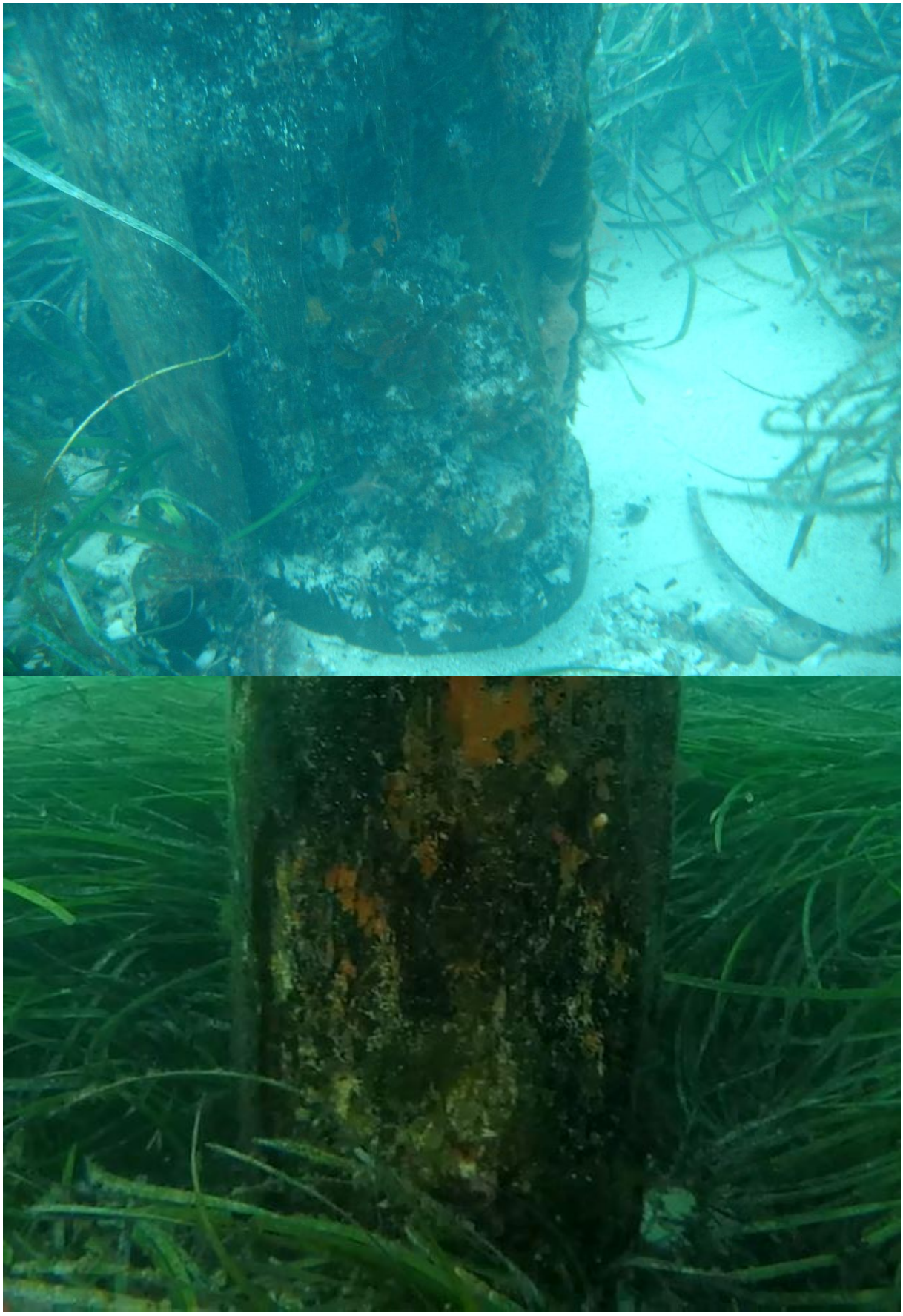

Figure 3-9: 91 North (Top-3/8/13, Bottom-11/11/15) – Severe section loss at base

- 101 North

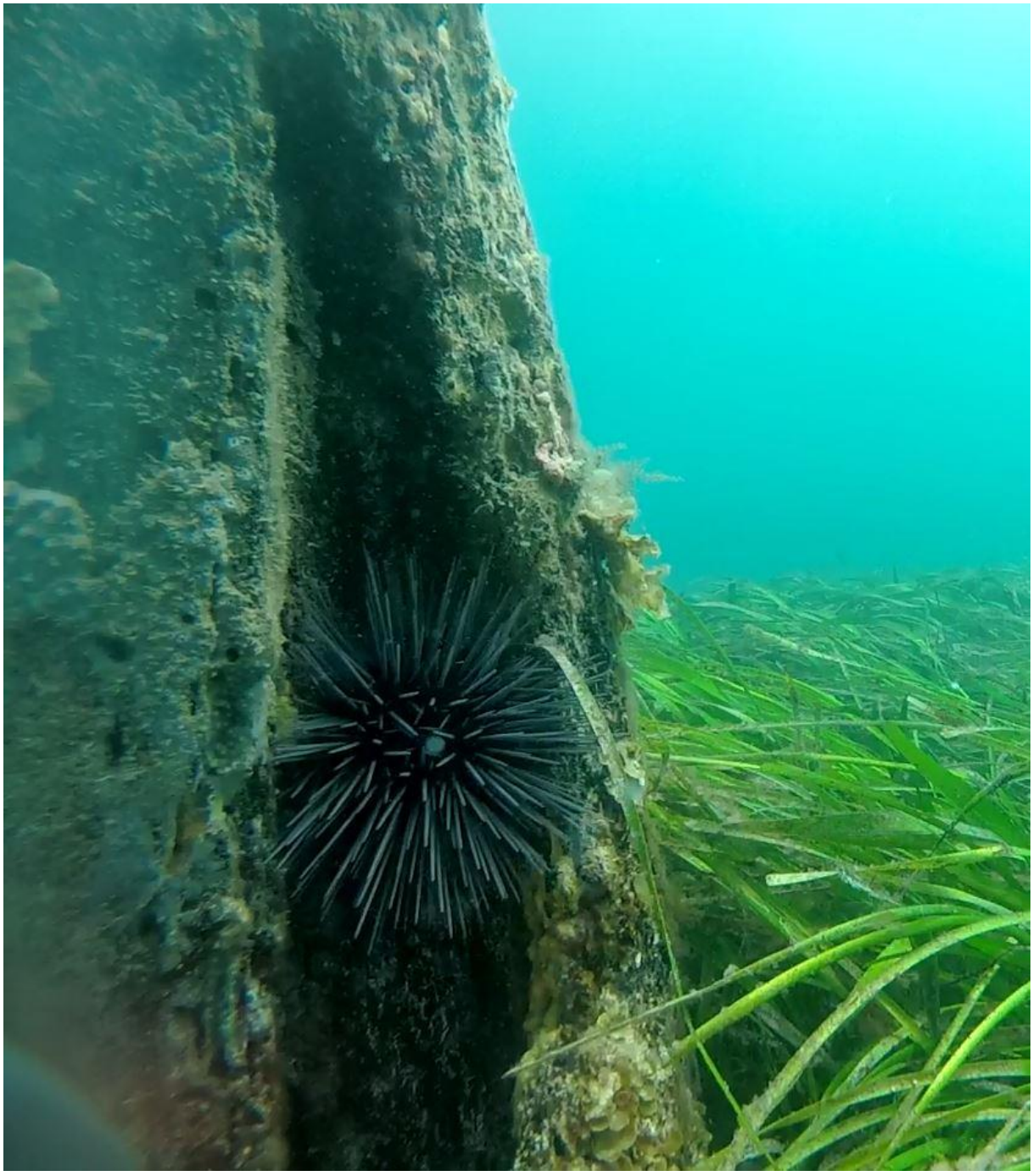

Figure 3-10: 101 North 11/11/15 – Severe section loss at base

- 112 North

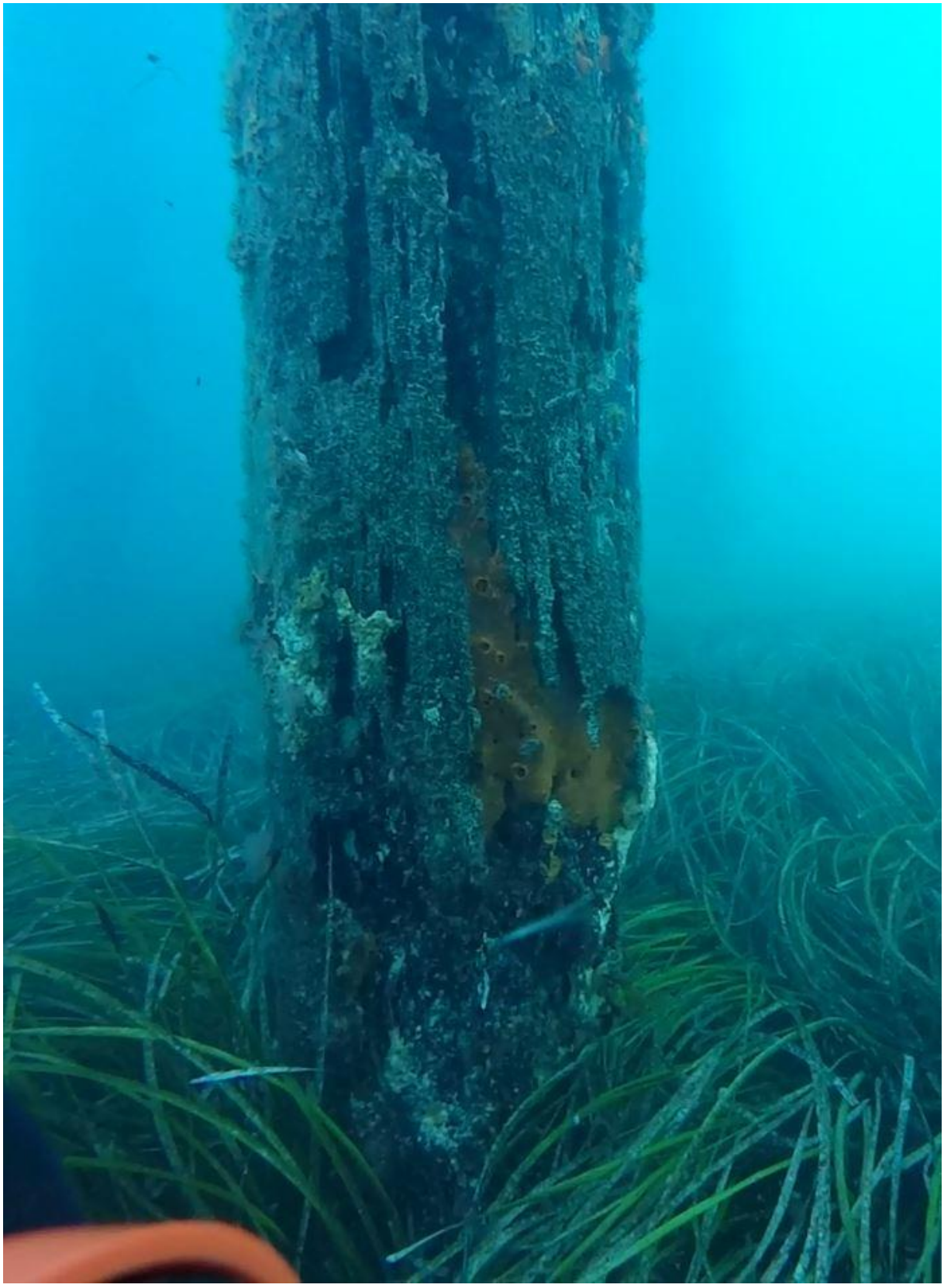

Figure 3-11: 112 North 11/11/15 – Severe section loss at base

- 129 South

Figure 3-12: 129 South 11/11/15 – Severe section loss at surface (top), section loss at base (bottom)

3.3 Half Caps

As there are two half caps there is some redundancy in the pile frame substructure unless both have significant defects. Therefore the critical locations noted in this position paper are where both half caps have suffered significant defects.

3.3.1 7 - Failed / Greater than 50% loss of section

- 95 South.

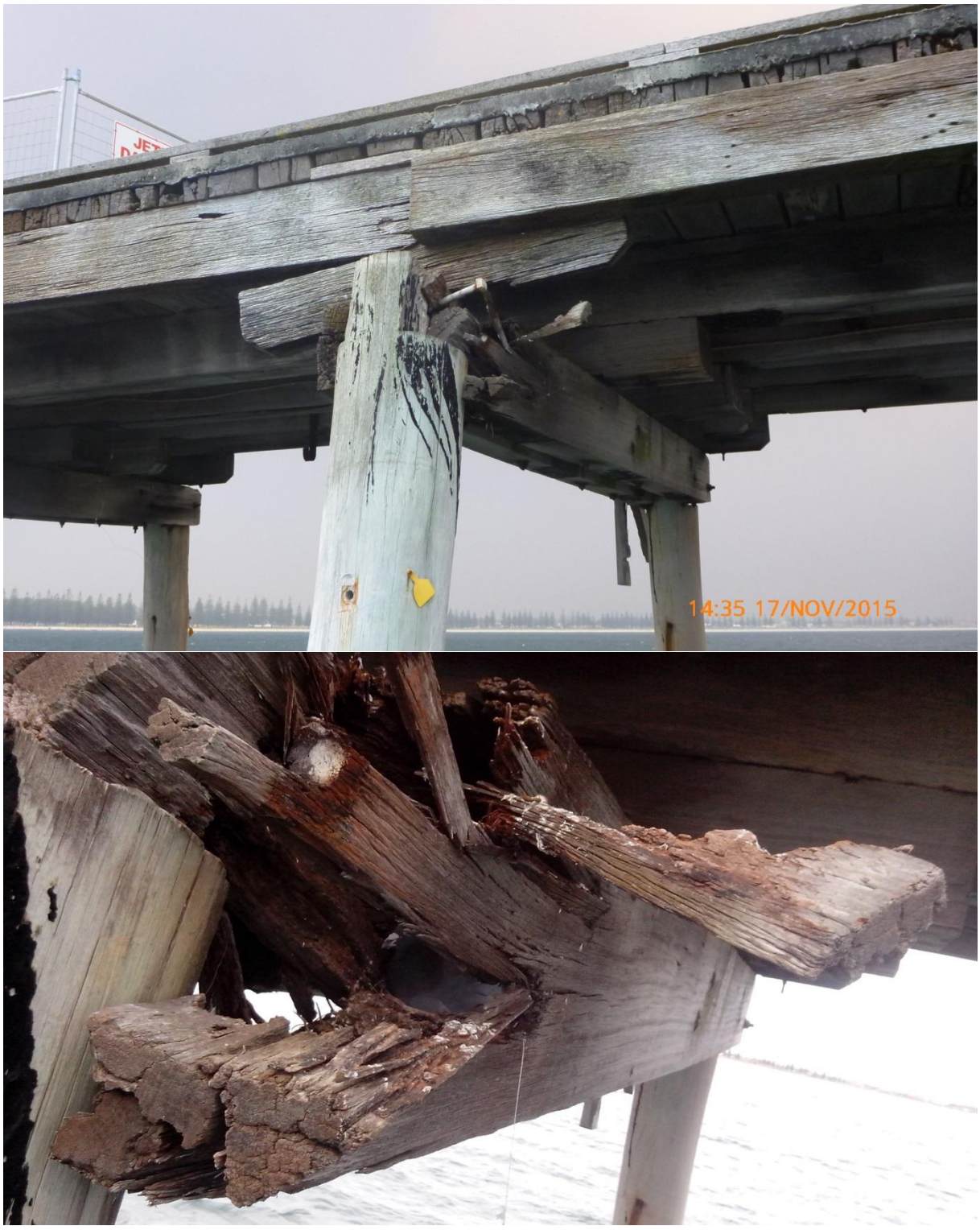

Figure 3-13: 95 Southeast (Top-17/11/15, Bottom 30/11/15) – Crushing failure of half caps

3.3.2 6 - 35% to 50% loss of section

- 35 North

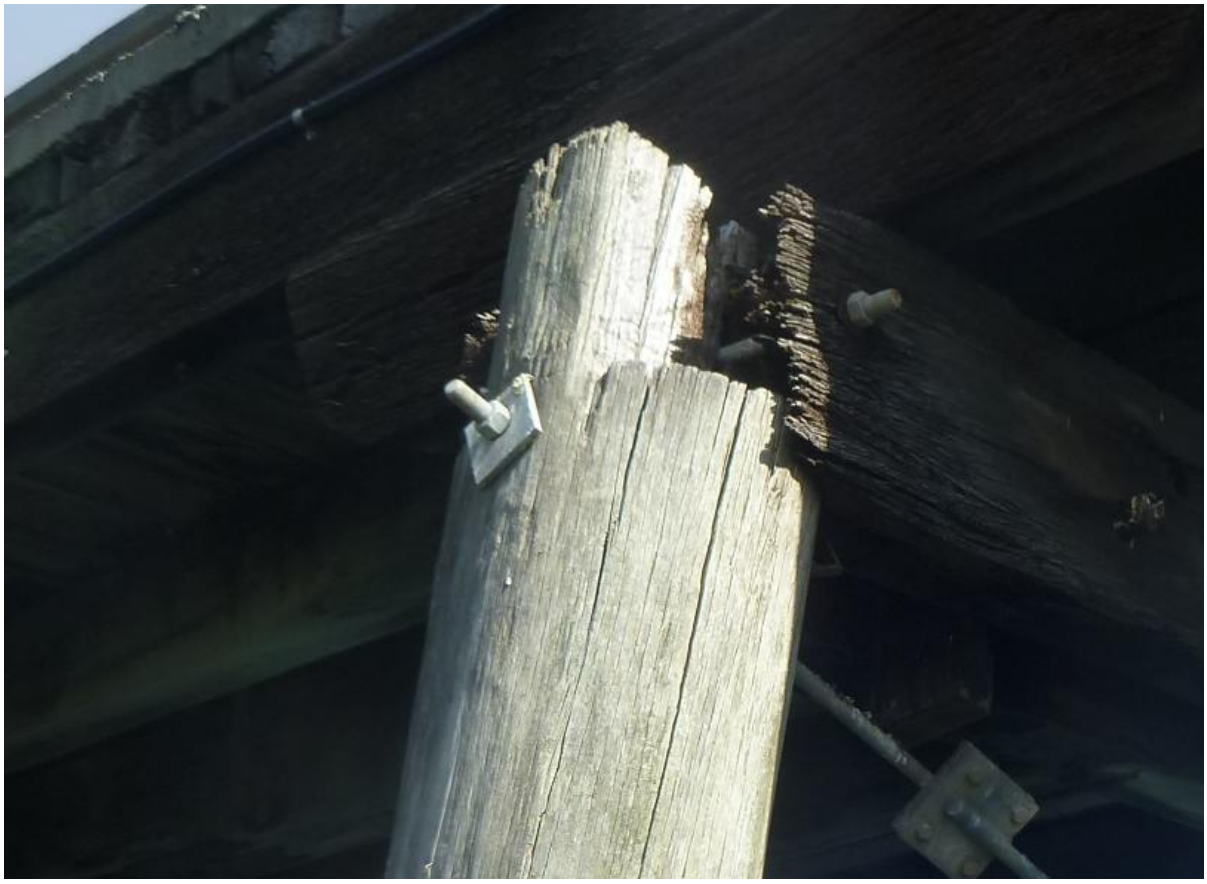

Figure 3-14: 35 North West 17/11/15 – Crushing of both half caps

- 36 North

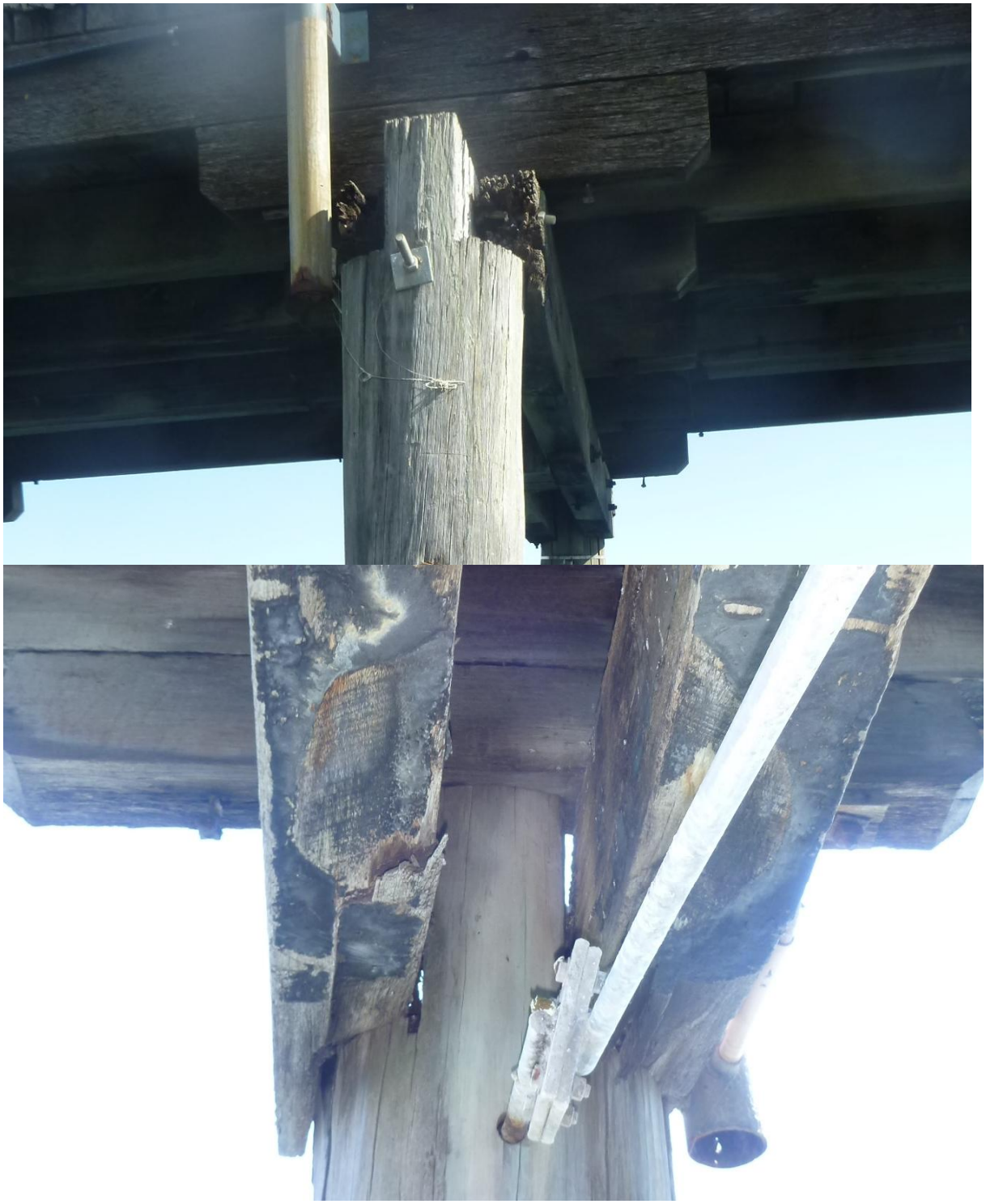

Figure 3-15: 36 North 17/11/15 – Crushing of both half caps

- 37 North

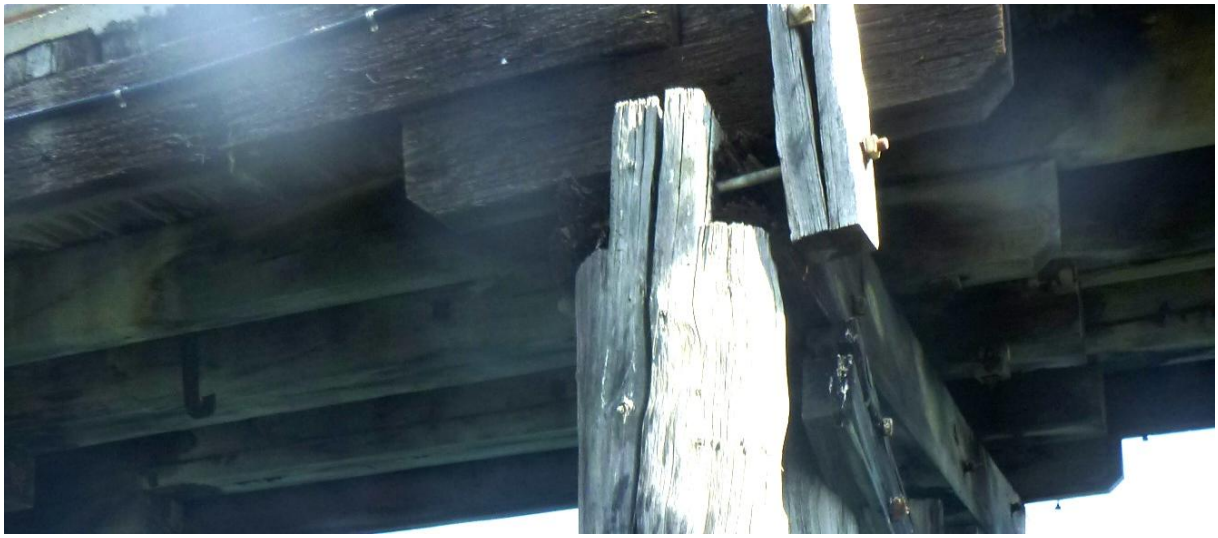

Figure 3-16: 37 North 17/11/15 – Crushing of both half caps

- 38 North

Figure 3-17: 38 North 17/11/15 – Crushing of both half caps

- 40 North

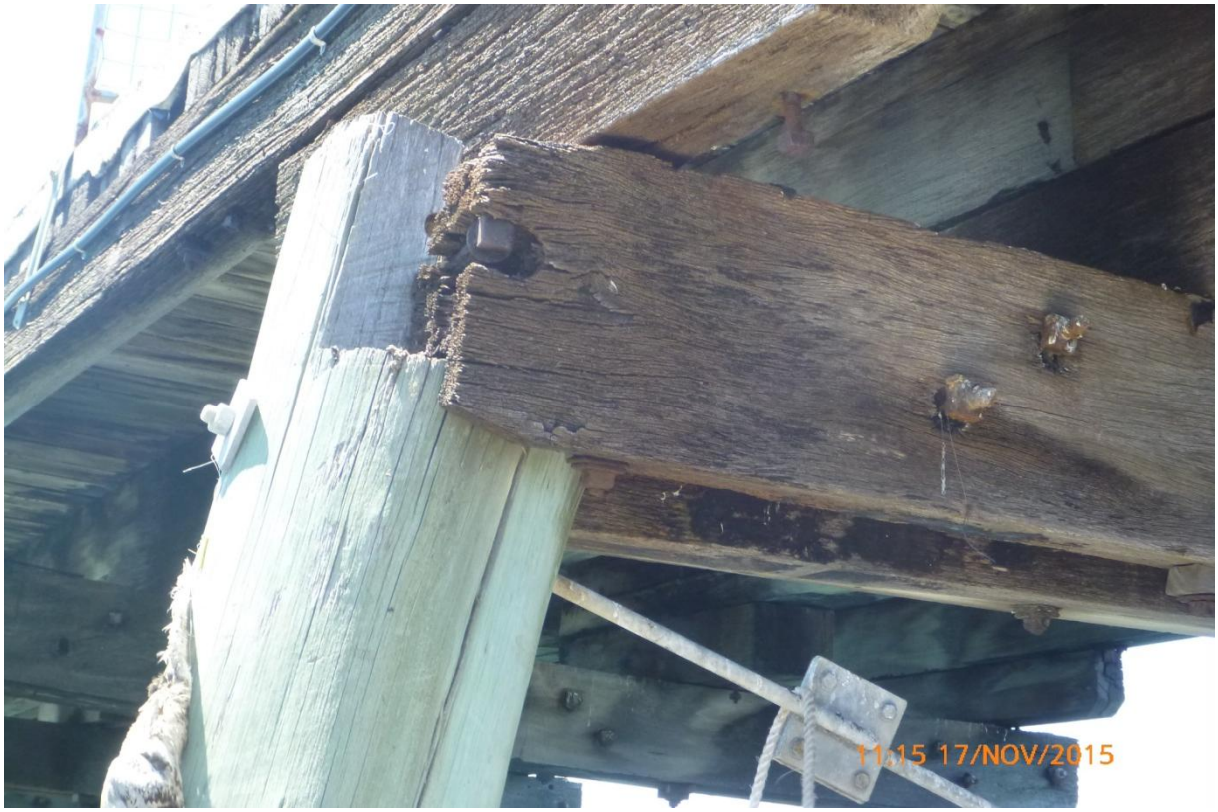

Figure 3-18: 40 North 17/11/15 – Crushing of both half caps

- 43 North

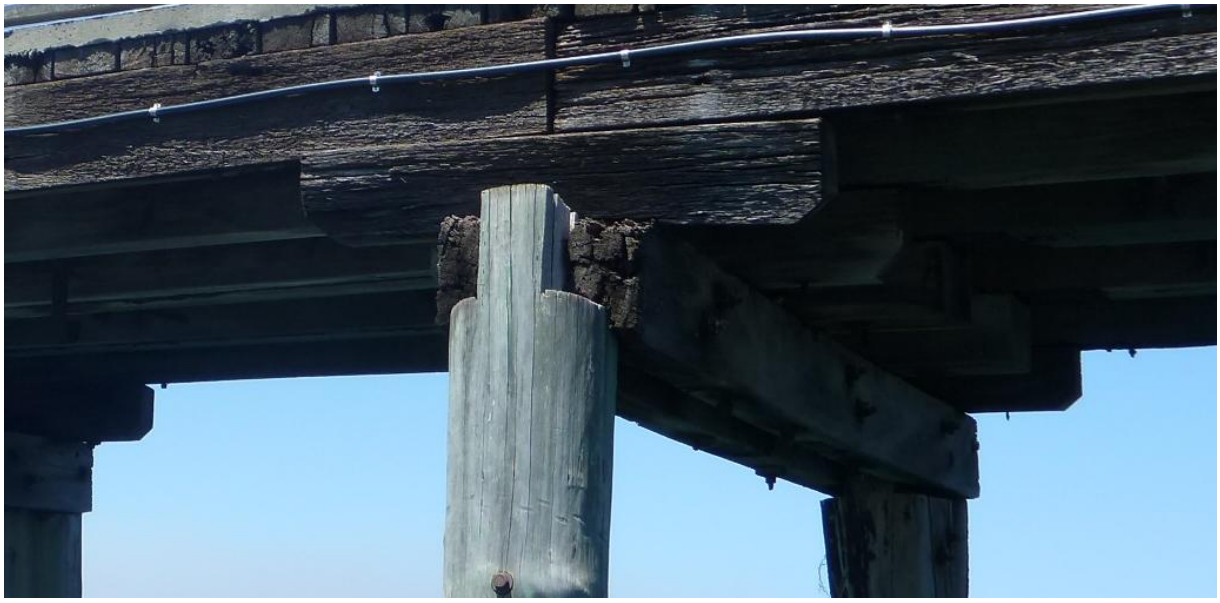

Figure 3-19: 43 North 17/11/15 – Crushing of both half caps

- 44 North

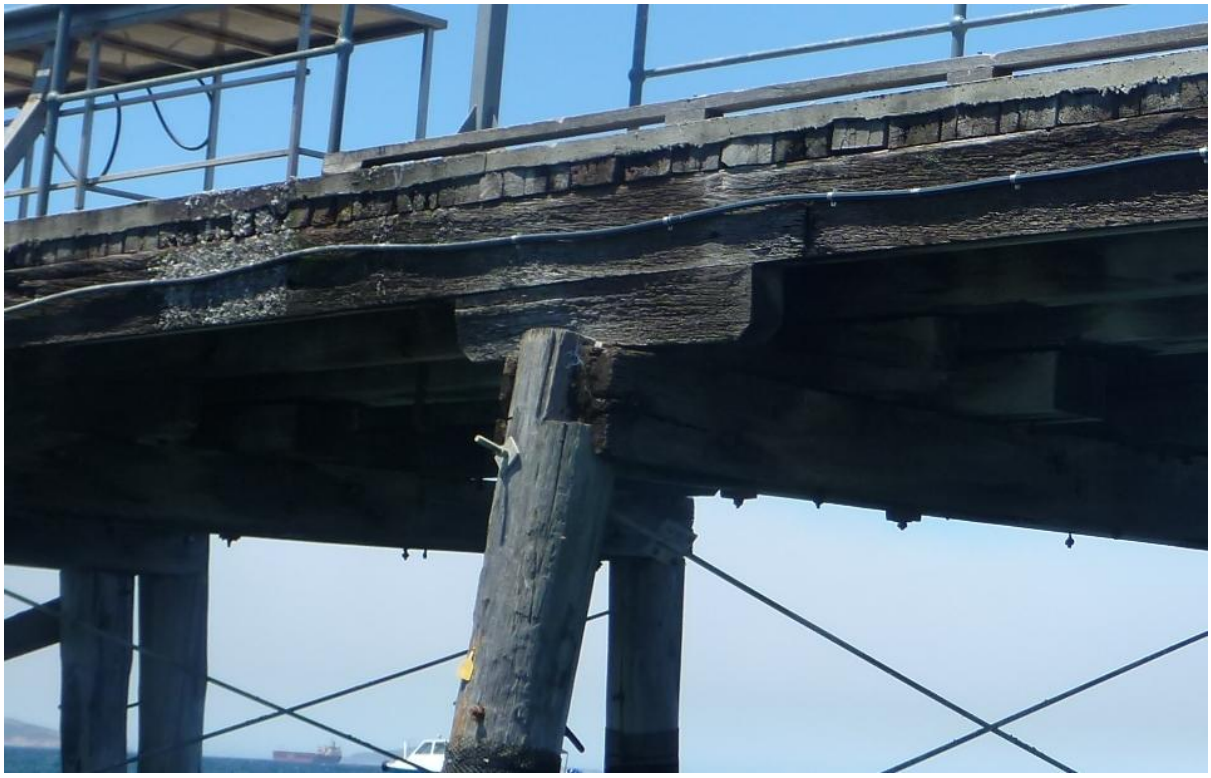

Figure 3-20: 43 North 17/11/15 – Crushing of both half caps

- 93 South

Figure 3-21: 93 South 17/11/15 – Crushing of both half caps

- 94 South

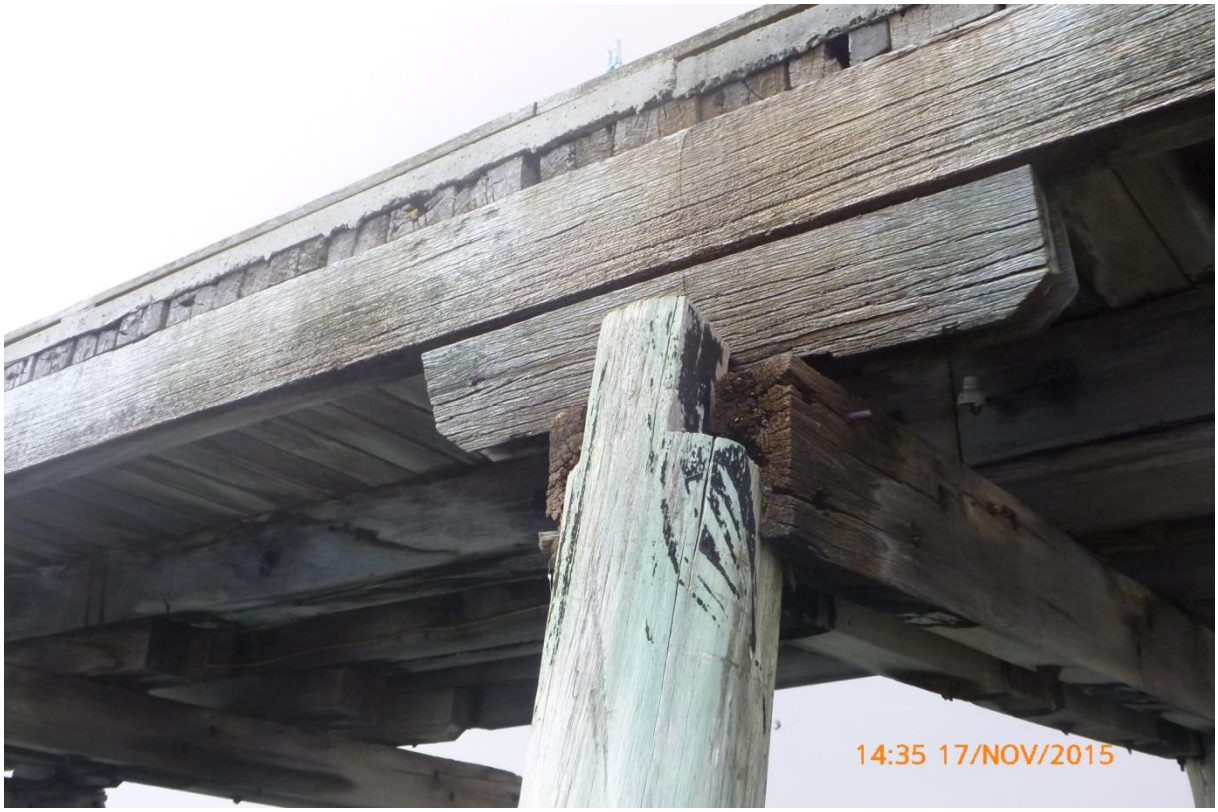

Figure 3-22: 94 South 17/11/15 – Crushing of both half caps

- 133 North

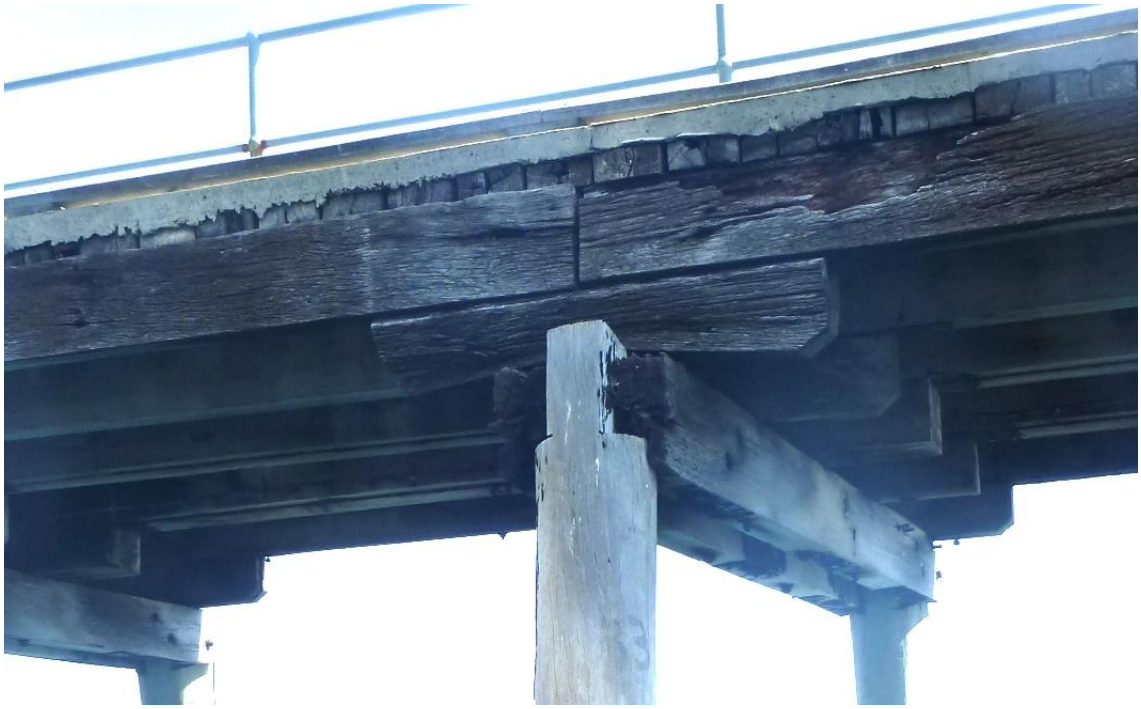

Figure 3-23: 133 North 17/11/15 – Crushing of both half caps

4 DISCUSSION

This section comments on the general condition, performance and remaining life of identified jetty components.

4.1 Concrete Deck Topping

This element is the running surface and merely transfers the pedestrian live load onto the timber deck planks. Cracking is visible in some locations but this crack does not appear to have increased or propagated further since the 2013 survey. The cracking that is present is understood to be due to the local movement and settlement of some sections of the jetty. The cracking tends to be prevalent around broken piles however it is also found in other areas. BMT JFA have confidence that the deck topping will continue to perform for a further 5 years, but may experience further localised differential settlement, translation and cracking.

4.1.1 Hand Railing

The hand railing sections inspected appear to have sufficient capacity for the expected remaining life of the jetty.

4.2 Timber Deck Planks

This element was the original deck surface. The top side is not visible (except in the far east end, 141-143) as it is covered in the concrete deck topping. Only localised defects were identified. These defects are not likely to affect the structural performance of the jetty. BMT JFA are confident that this element overall will continue to perform as it currently does for a further 5 years.

4.3 Timber Stringers

There are 5 timber stringers along the length of the jetty. The outer (north and south) stringers are in the worst condition and in some areas, particularly at the eastern end and on the north side, have deteriorated substantially to the point where they have effectively failed. The inner 3 (the centre and inner south were originally locomotive rail supporting stringers) stringers, are protected from the elements, and these alone are capable of supporting the deck dead and live loading from above if all substructure pile frames are present.

In areas where the piles or half caps of the substructure pile frames are failing and have settled, the stringers are spanning between the functioning pile frames. For this reason the stringers are using more of their capacity. This equates to a reduced level of redundancy in the superstructure.

If multiple pile frames settled or failed the timber stringers will go into a catenary. In this instance the vertical loads are supported under tension by the stringers anchored by the many pile frames on each side (there would be limited anchoring at the far east and west ends of the jetty).

Such catenary tensions would need to be transferred over sufficient length which would be greater than the length of an individual stringer beam. This would require the stringer longitudinal connections to transfer these tensions and rely on the bolts. The bolts are assumed to be the original or at least have not been replaced by maintenance teams for over

40 years. Bolts which have been recovered from the structure have shown significant corrosion losses with just a small fraction of the bolt shank remaining in the majority of instances. Because of this, it is vital that all substructure pile frames remain in good condition to avoid the possibility of progressive collapse.

4.4 Timber Corbels

To support the timber stringers there are 5 timber corbels supported by a pair of half caps on every substructure pile frame. The outer (north and south) corbels are generally in the worst condition and in some areas, particularly at the eastern end and on the north side, have deteriorated substantially to the point where they have split, failed or are missing. The inner 3 are protected from the elements, and these are generally in a good condition and capable of supporting the stringers above.

4.5 Timber Half Caps

This element acts as a cross beam between two piles to form a substructure pile frame. The weathered ends, north and south, are often in a poor condition and some have started failing or have failed. As there are two half caps at each pile frame there is some redundancy in the pile frame substructure unless both have significant defects. There is an inherent weakness in the pile to half cap connection as a result of the 1991 refurbishment replacing the outer piles. Using this method to insert piles outward of the original piles whilst still using the original half caps meant that there was a short bearing length. The short length available provided only sufficient room for a pair, but often only a single, 20mm diameter bolt to be fitted with insufficient (to be in accordance with AS 1720 Timber Structures) end distance. The insufficient end distance in combination with deterioration of the timber due to weathering has caused the shear failures when storm conditions have caused lateral pile movement.

Where the deterioration at the ends, which are open to weathering, has become critical the combination of the short bearing distance and reduced strength timber has resulted in crushing of the half caps. This has occurred in many instances on single half caps but which then relies on the other half cap to “take up the slack” and in some cases this increased load crushes the other. Partial crushing of both half caps, of a substructure pile frame, provides some support to the stringers (this includes all stringers at that, not just the nearest) above for a time. However once the crushing continues the stringers will be forced to span this substructure pile frame (at which point it becomes essentially redundant), this comes with additional problems – see section 4.3. If stringers are required to span further they provide additional load to the adjacent half caps/substructure pile frames increasing the likelihood of these crushing.

A repair is required before significant crushing has occurred to prevent stringers being required to span substructure pile frames.

4.6 Piles

The piles are the main supports for the structure. They are the most critical element of the substructure and structure providing support from the bed. They are found to be in a generally poor condition particularly at the surface and bed. Only a sample of piles were inspected by ROV however many of those chosen to be inspected were in a significantly worse condition than found during previous inspections.

Two failed piles were identified and a further 9 have lost significant section from a combination of rot and marine borer (Teredo) damage. Further investigation of the remaining piles would be prudent to identify the precise repairs required.

An observation is that the piles have reached a point where the protective pressure applied preservative treatment has largely become ineffective. The piles are generally now rapidly deteriorating from marine organism attack. As a result all piles that have been rated 6 require rehabilitation or renewal in the short term. Therefore, should life extension be necessary, this work would be required.

Where piles have failed the stringers are required to span between the adjacent substructure pile frames (9m as opposed to 4.5m standard spans) this provides additional load onto pile frame half caps and piles increasing the likelihood of their failure if defects are present.

4.7 Global stability

The global stability of the structure as a whole was highlighted as an issued in the 2013 report R-224.07-1. It was advised that existing cross bracing which in some sections isn't even present was ineffective. There appears to be increased flexibility and movement in the structure since the 2013 condition update, the evidence for this is:

- Apparent variance, off the linear, of the jetty deck in both line and level
- Apparent opening/greater translation of cracks in jetty deck
- Springiness of the deck around broken piles 54N and 93N
- Pile 54N breaking between the above water (11/11/15) and below water (17/11/15) inspections
- Increased number and severity of crushed half caps and split piles over the whole structure

As the flexibility of the structure increases with more failures there are knock on effects to the rest of the functioning elements. The majority of significant defects are occurring on the substructure pile frames which are required to absorb the loads from failed substructure pile frames.

4.8 Overall Condition Summary

As detailed in the heat map introduced in section 3.1 and presentation (Appendix A) a number of areas of high rating defects are evident.

As a result of the worsening condition of critical components and aggregation of defects identified, the overall condition of the jetty at some location can be assumed to have a WSCAM Criticality rating – **High**, and a Safety rating – **High** and therefore has zero remaining service life.

Global stability issues and further deterioration/failures may lead to progressive collapse which cannot be predicted but may occur at any time due to additional environmental or pedestrian live loadings requiring urgent action.

4.9 Stage 2 Jetty Repair Schedule

A Tanker Jetty Maintenance Schedule Sch-J15028-1 has been produced, which is included in Appendix B, that identifies the following prioritised actions.

Immediate

- 12 Pile repairs
- 11 Half Cap repairs
- 11 Corbel repairs

6 Month

- 18 Pile repairs
- Inspect all Piles (Dive inspection including cleaning)
- 29 Half Cap repairs
- 24 Corbel repairs

12 Month

- Wrap all Piles to extend remaining life (199 No.)
- 10 Half Cap repairs
- 4 Corbel repairs
- 5 Stringer repairs

Based on historical repair information, initial cost estimates indicate critical/immediate repairs would be in the order of $300K to $500K. Further less critical repairs costing at least the same order are required in a staged manner to address these areas within 6 months. A further expenditure of perhaps an even larger quantum is required to address the pile repair backlog and other less critical component repairs such as corbels, pile splits etc.

5 RISK ASSESSMENT

As a response to the worsening condition of the jetty components a risk assessment was undertaken based on the Shire of Esperance Council's Risk Management Policy criteria. The following notes document this process.

5.1 Likelihood Ranking – 4 - Likely

A score of **4** - **Likely** has been identified based on ongoing crushing failure and/or swell event that would destabilise half cap connections leading to a progressive failure that could endanger life. This event could occur this year.

5.2 Consequence Ranking – 5 - Catastrophic (Safety)

Scores have been identified for the Shire of Esperance Councils consequence categories:

- **Safety – 5** catastrophic if someone goes in the water with risk of drowning
- **Financial – 4** or **5** high due to compensation for near miss or death
- **Compliance – 3** Moderate – reputational risk with regulators (DoT et al)
- **Reputational – 4** to **5** depending on event
- **Environmental – 1** insignificant – no major environmental risk is identified.

Based on the maximum reasonable consequence rating the score is **5 – Catastrophic**.

5.3 Risk Matrix Outcomes

Risk Matrix outcomes are therefore on the above basis **Extreme** requiring urgent action at the highest level and constant attention. Mitigation measures that would have to be applied to manage would be urgent repairs and ongoing monitoring.

Existing controls that are currently in place including periodic structural monitoring would be considered inadequate at this time given the elevation of the current risk status based on the deterioration identified. Actions should include a review as to whether:

- the facility is immediately closed to public access to control, and
- the implementation of recommended repairs can be effective and justified at this time as a control measure to reduce the risk rating to an acceptable level as opposed to other options including mothballing and/or demolition as control measures. (Any repairs would at this point be extensive over a minimum of we estimate 3 to 4 areas along the jetty and require ongoing monitoring to maintain the current level of service as other components continue to deteriorate).

6 CONCLUSIONS & RECOMMENDATIONS

6.1 Conclusions

- The jetty inspection and condition assessments carried out found that as a result of aggregation of poor and failed component condition that the structure had insufficient structural capacity to ensure public safety.
- Urgent repairs of components highlighted in Section 4.10 as **Immediate** priority are required to Piles and Half Caps.
- Full detailed inspection of all piles is required to fully establish the rate of deterioration of these components.

6.2 Recommendations

- The Tanker Jetty is closed until at least the immediate priority repairs have been undertaken.
- Consideration be given to reducing the length of the jetty to reduce the backlog repair liability and cost.
- Stage 2 services focus on further definition of repair methodologies and cost estimates of the remaining half of the structure landward of Pier 87.

APPENDIX A:
CRITICAL ELEMENT (PILE AND HALF CAP) CONDITION RATING (WSCAM) HEAT MAP

Critical Element (Pile and Half Cap) Condition Rating (WSCAM) Heat Map

	Date	South			North			Revision		Status		South			North			
	9/12/2015	East	West			East	West	C		Draft		East	West			East	West	
Photo No.	Pier	Halfcaps	Halfcaps	Pile	Pile	Halfcaps	Halfcaps	Photo No.		Photo No.	Pier	Halfcaps	Halfcaps	Pile	Pile	Halfcaps	Halfcaps	Photo No.
388	Pier 31	2	2	3	4	2	2	823/824		489/490	Pier 88	2	2	4	4	2	2	712/713
391	Pier 32	3	3	4	4	3	3	822/823		491/492	Pier 89	3	3	5	4	3	3	710/711
390/393	Pier 33	2	2	4	4	5	5	820/821		493/494	Pier 90	3	3	4	4	3	3	708/709
	Pier 34	2	2	4	4	5	5	818/819		495/456	Pier 91	2	3	4	6	4	4	706/707
392	Pier 35	2	2	4	4	5	6	816/817		497/498	Pier 92	2	2	4	4	5	3	704/705
396	Pier 36	2	2	5	4	6	5	397/815		499/500	Pier 93	6	5	4	7	2	2	702/703
399	Pier 37	2	2	4	4	6	6	812/813		501/502	Pier 94	6	6	4	4	2	2	700/701
406	Pier 38	2	2	4	4	6	5	810/811		503/504	Pier 95	7	6	4	4	4	4	698/699
	Pier 39	2	2	3	7	3	3	809		505/506	Pier 96	2	2	5	5	2	2	696/697
	Pier 40	2	2	4	4	6	6	404/405		507/508	Pier 97	2	2	4	4	2	2	694/695
	Pier 41	3	3	4	4	4	3	805/806		509/510	Pier 98	3	4	4	4	3	3	692/693
	Pier 42	2	2	4	4	5	3	411/412		511/512	Pier 99	2	3	4	4	2	3	690/691
	Pier 43	2	2	5	4	5	6	801/802		513/514	Pier 100	2	3	4	4	2	2	688/689
	Pier 44	2	2	4	4	5	6	799/800		515/516	Pier 101	3	5	4	6	2	2	686/687
	Pier 45	2	2	4	4	4	4	797/798		517/518	Pier 102	3	3	4	4	3	5	684/685
	Pier 46	2	2	4	4	4	4	795/796		519/520	Pier 103	2	2	5	4	2	3	682/683
	Pier 47	2	2	4	4	3	4	793/794		521/522	Pier 104	3	3	4	4	3	3	680/681
416	Pier 48	3	5	4	4	3	4	791/792		524/525	Pier 105	2	2	5	4	2	3	678/679
	Pier 49	2	2	5	5	4	3	789/790		526/527	Pier 106	3	2	3	4	2	2	676/677
	Pier 50	2	2	4	4	3	4	787/788		528/529	Pier 107	3	2	4	4	2	2	674/675
	Pier 51	2	2	4	4	3	3	786		530/531	Pier 108	4	3	4	4	2	2	672/673
	Pier 52	2	2	4	4	2	2	784/785		532/533	Pier 109	3	3	4	4	3	3	670/671
	Pier 53	2	2	6	4	2	2	782/783		534/535	Pier 110	3	3	5	4	3	3	668/669
423	Pier 54	2	2	4	7	2	2	780/781		536/537	Pier 111	2	2	4	4	2	2	666/667
425	Pier 55	2	2	4	4	2	2	778/789		538/539	Pier 112	3	3	5	6	2	2	664/665
424	Pier 56	3	3	4	5	3	3	776/777		540/541	Pier 113	3	3	4	4	3	3	662/663
429	Pier 57	3	3	4	4	3	3	774/775		542/543	Pier 114	3	5	4	4	2	2	660/661
430	Pier 58	2	2	6	4	3	3	772/773		544/545	Pier 115	2	2	3	4	2	3	658/659
	Pier 59	2	2	4	4	2	2	770/771		546/547	Pier 116	4	4	4	4	3	3	656/657
432	Pier 60	3	3	4	4	4	5	768/769		548/549	Pier 117	3	3	4	4	3	3	654/655
	Pier 61	3	3	3	4	3	3	766/767		550/551	Pier 118	3	3	4	5	3	3	652/653
	Pier 62	2	2	3	4	3	3	764/765		552/553	Pier 119	4	3	4	4	2	2	650/651
440	Pier 63	5	5	4	4	3	5	762/763		554/555	Pier 120	3	3	5	4	3	3	648/649
	Pier 64	2	2	4	4	2	2	760/761		556/557	Pier 121	2	2	5	4	3	3	646/647
	Pier 65	3	2	4	4	3	3	758/759		558/559	Pier 122	2	2	4	4	2	2	644/645
444/445	Pier 66	3	2	4	6	2	2	756/757		560/561	Pier 123	3	3	4	4	3	3	642/643
446/447	Pier 67	3	2	4	4	4	4	754/755		562/563	Pier 124	2	2	4	4	2	2	640/641
448/449	Pier 68	2	3	4	4	3	3	752/753		564/565	Pier 125	3	3	4	4	4	4	638/639
450/451	Pier 69	3	2	4	5	3	2	750/751		566/567	Pier 126	2	2	4	4	2	3	636/637
452/453	Pier 70	2	2	6	4	2	2	748/749		568/569	Pier 127	3	3	4	4	3	3	634/635
454/455	Pier 71	2	2	6	4	5	4	746/747		570/571	Pier 128	2	2	4	4	2	2	632/633
457/458	Pier 72	2	2	4	4	2	2	744/745		572/573	Pier 129	2	2	6	4	2	2	630/631
459/460	Pier 73	4	3	4	4	3	4	742/743		574/575	Pier 130	3	3	4	4	2	2	628/629
461/462	Pier 74	2	2	4	6	2	3	740/741		576/577	Pier 131	2	2	5	4	3	2	626/627
463/464	Pier 75	2	2	4	5	5	5	738/739		578/579	Pier 132	2	2	4	4	4	4	624/625
465/466	Pier 76	3	3	4	4	3	3	736/737		580/581	Pier 133	5	3	4	4	6	6	622/623
467/468	Pier 77	2	2	4	4	2	2	734/735		582/583	Pier 134	3	3	4	4	3	3	620/621
469/470	Pier 78	2	2	4	4	3	3	732/733		584/585	Pier 135	4	4	4	4	3	3	618/619
471/472	Pier 79	2	2	4	4	2	2	730/731		586/587	Pier 136	4	4	4	4	3	3	616/617
473/474	Pier 80	2	2	4	4	2	2	728/729		588/589	Pier 137	3	3	4	5	4	4	614/615
475/476	Pier 81	2	2	4	4	2	2	726/727		590/591	Pier 138	3	3	4	4	3	3	612/613
477/478	Pier 82	3	3	4	4	3	5	724/725		592/593	Pier 139	3	2	4	4	2	2	610/611
479/480	Pier 83	2	2	5	4	3	3	722/723		594/595	Pier 140	3	3	4	4	4	4	608/609
481/482	Pier 84	2	2	4	4	2	2	720/721		596/597	Pier 141	4	4	4	4	2	2	606/607
483/484	Pier 85	2	2	4	4	2	2	718/719		598/599	Pier 142	2	2	4	4	5	3	604/605
485/486	Pier 86	2	3	4	4	3	2	716/717		600/601	Pier 143	2	2	4	4	2	2	602/603
487/488	Pier 87	3	2	4	4	2	2	714/715										

Notes:

1 Condition rating scoring, from 1 (new) to 7 (failed) are in accordance with Ports Australia Wharf Structures Condition Assessment Manual

2 If a cell has a border [ ] this demarcates that the element has been inspected as part of this, if a cell has no border it's condition is approximated based on previous findings inspections or on general condition findings

3 Piles which have not been inspected have been given a condition rating of 4

4 Recently (2013) repaired piles have been given a condition rating of 3

5 Photo numbers relate to the photo files provided as supplemenatry information with this report

APPENDIX B:
TANKER JETTY MAINTENANCE SCHEDULE –SCH-J15028-1

	Sch-J15028-1		Shire of Esperance				PROJECT PROGRAMME									
			BMT JFA CONSULTANTS	Job No.	J15028		BMT JFA Consultants - Shire of Esperance									
			Tanker Jetty Maintenance Schedule	Date	8/12/2015											
	Revision	A		By	JF		Jetty Maintenance Programme									
							2015	2016				2017				
							Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Category	Item	Condition	Activity	Report Ref	Priority											
				R-J15028-1												
Piles (Below Water)																
	54N, 93N	7	Splint and wrap the whole submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate										
	53S, 58S, 66N, 70S, 71S, 74N, 91N, 101N, 112N, 129S	6	Wrap submerged length of pile in a zipped jacket then grout.	Section 3.2	5	Immediate										
	36S, 43S, 49S, 49N, 56N, 69N, 75N, 83S, 89S, 96N, 96S, 105S, 110S, 118N, 120S, 121S, 131S, 137N	5	Wrap submerged length of pile in a zipped jacket then grout.		4	6 Months										
	All piles		Dive inspection including cleaning		4	6 Months										
	All piles (except those already repaired)	4	Wrap submerged length of pile in a zipped jacket then grout.		3	12 Months										
Piles (Above Water)																
	37N, 40N, 62N, 69N, 87N, 100N, 111N, 113S, 120S, 123S, 132N, 136S	Fair	Apply strapping to pile top; resin fill spaces with Epigen 0301MRD.		3	12 Months										
Half Caps		Combined														
	95S Both	13	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate										
	35N Both, 36N Both, 37N Both, 38N Both, 40N Both, 43N Both, 44N Both, 93S Both, 94S Both, 133N Both,	11	Repair connections between pile and half caps as per sketch - Appendix C	Section 3.3	5	Immediate										
	33N Both, 34N Both, 42N Both, 45N Both, 46N Both, 48S Both, 60N Both, 63S Both, 63N Both, 67N Both, 71N Both, 75N Both, 82N Both, 91N Both, 92N Both, 95N Both, 101S Both, 102N Both, 114N Both, 116N Both, 125N Both, 133S Both, 132N Both, 135S Both, 136S Both, 137N Both, 140N Both, 141S Both, 142N Both	8	Repair connections between pile and half caps as per sketch - Appendix C		4	6 Months										
	41N Both, 47N Both, 48 N Both, 49 N Both, 50N Both, 73S Both, 73N Both, 98S Both, 108S Both, 119S Both	7	Repair connections between pile and half caps as per sketch - Appendix C		3	12 Months										
Corbels																
	35N, 41N, 94S	7	Replace corbel/reinforce corbel with steel plates.		5	Immediate										
	51N, 52N, 84S, 93N, 104N, 114N, 126N, 133N,	7	Replace corbel.		5	Immediate										
	54S, 57S, 58N, 59S, 62N, 68N, 69N, 71S, 78N, 85N, 94N, 96N, 101N, 102N, 110N, 111N, 130N, 130S, 131N, 132S, 139N, 140N, 141N, 143N	6	Bolt corbel together at split / split end(s).		4	6 Months										
	53N, 85S, 95S, 103S	5	Slide corbel back into position and bolt with steel plates back into alignment.		3	12 Months										
Stringers																
	63N-64N, 72N - 74N, 134S - 136S, 132-133N, 139S - 141S	6	Replace stringers or reinforce stringer with new member on inside.		3	12 Months										

APPENDIX C:
SKETCH

BMT JFA Consultants "Where will our knowledge take you?"	Project Name:	Job Code:		Page: Of:
	Activity:	By:		Date:
	Title/Purpose:	REV:	CKD:	App'd:

Reference / Comments: