TECHNICAL MEMORANDUM

PROJECT NO.: WGA192080
DATE: 28 OCTOBER 2022

COMPANY NAME	District Council of Tumby Bay
ATTENTION	Damian Windsor
SUBJECT	Tumby Bay Jetty Storm Damage

Dear Damian,

1. INTRODUCTION

This memorandum is to summarise the inspection of the storm damage and high-level assessment of the Tumby Bay jetty that was completed by Wallbridge Gilbert Aztec (WGA) for the District Council of Tumby Bay (Council). From this inspection, the risks associated with the current condition of the structure and required remedial works are to be conveyed to Council to inform the ongoing use of the jetty.

A condition assessment of the Tumby Bay Jetty was previously completed in 2020 by WGA for Council with both the above water and below water condition of the structure assessed, refer to WGA report WGA192080-RP-MA-0002 for further information. This assessment was conducted in accordance with the Basic Visual Assessment criteria outlined in the Ports Australia Wharf Structures Condition Assessment Manual (WSCAM).

The condition assessment of the structure was updated in 2022 for the Department for Infrastructure and Transport (DIT) during their “Pilot Jetties” project to include a rot test of the top of girders, for further information refer to WGA report WGA202246-RP-MA-0011. This inspection was limited to the girder rot test and no update to condition rating of the deck, below deck substructure and piles were completed.

A condition distribution table of the jetty from the subsequent DIT inspection is shown in Appendix A.

2. SITE INSPECTION SUMMARY

The inspection of the Tumby Bay jetty storm damage and high-level assessment of the overall structure was completed by Alastair Oliver on the 21 October 2022. The below deck inspection was completed via boat which was supplied by Council and the above deck inspection from the jetty deck. A full WSCAM inspection of the structure was not completed, however the WSCAM rating scale from the “Basic Visual Assessment” was used as a reference when outlining the condition of members. The inspection was limited to above the waterline and no members or components were removed to facilitate the viewing of members.

The need to undertake this inspection was due to the damage to a pile and crosshead observed by Council that has been attributed by them to the storm events during the week of the 3rd October 2022. Since this observation, access to the jetty has been closed to the public due to safety concerns.

In general, from the high-level inspection the general condition of the jetty substructure and superstructure were similar as the previous inspection completed in 2020. However, there has been significant deterioration in the condition of a few concrete encased piles and connecting members which have adversely affected the safety of the jetty. These concrete encased piles are a previous remedial works that involved installing a sleeve over the existing timber pile and filling the void between with insitu concrete. Updated condition ratings for these components are outlined in Table 1, with photos of each of the components from the inspection shown in Figure 1 to Figure 8.

The jetty deck has noticeably dropped at numerous areas along the length of structure which typically coincided with the failed pile locations. This movement has become significantly worse since the 2020 inspection with dropping previously only identified at Bent 38 to 40 where a cluster of condition 6 and 7 piles were located. It should be noted that from comparisons with previous inspection photos this movement of this area has not been exacerbated during the recent storm events.

Table 1: Updated Component Condition Ratings

COMPONENT	LOCATION[1]	PREVIOUS CONDITION RATING[2]	NEW CONDITION RATING	COMMENTS
Crosshead	18L	**4**	**7**	• Northern member of spliced crosshead significantly split, rotated and broken along full length. • Southern member split and broken around bolts. • Damage of crosshead due to failure of 18A pile. • Corbel 18A also dropped and detached due to movement of crosshead. • Refer to Figure 1 and Figure 2.
Crosshead	18S	**5**	**6**	• Splitting of member at northern end due to failure of 18A pile. • Bolts connected to 18A pile sheared off. • Refer to Figure 3.
Pile	18A	**4**	**7**	• Pile failed, dropped and rotated. • Failure appears to have occurred below waterline, most likely at the base of the pile. • Refer to Figure 4 and Figure 5
Pile	21A	**4**	**7**	• According to Council, pile previously failed at seabed and was hanging from crosshead. Pile was demolished due to safety concerns. • Area is currently unsupported due to only redundant timber piles in area. • Refer to Figure 6.
Pile	25B	**4**	**7**	• Pile failed, dropped and rotated. Failure appears to have occurred below waterline, most likely at the base of the pile. • Failure of the pile has caused the connected stairs to drop and rotate. • Refer to Figure 7 and Figure 8

[1] – Location naming convention as per WGA reports WGA192080-RP-MA-0002 and WGA202246-RP-MA-0011. With the following 00X referring to the following:

- 00 – Denotes bent number
- X – Denotes location in bent. Component “A” to “Z” from left to right when face the sea in the direction of the jetty. Component “L”, landside of the jetty bent and component “S”, seaside of the jetty bent.

[2] – As per WGA report WGA192080-RP-MA-0002 and WGA202246-RP-MA-0011.

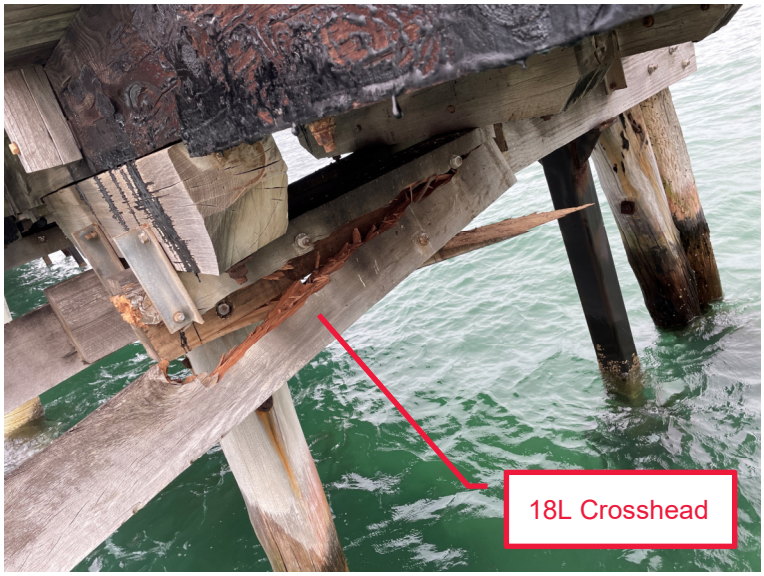


Figure 1: Bent 18L Crosshead Splitting and Failure

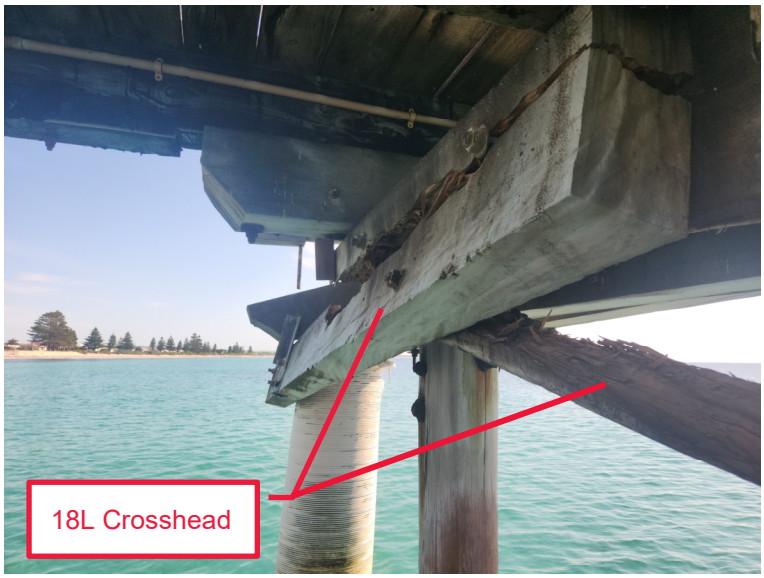


Figure 2: Bent 18L Crosshead Splitting, Rotation and Failure

Figure 3: Bent 18S Crosshead Splitting

Figure 4: Bent 18A Pile Failure and Dropping

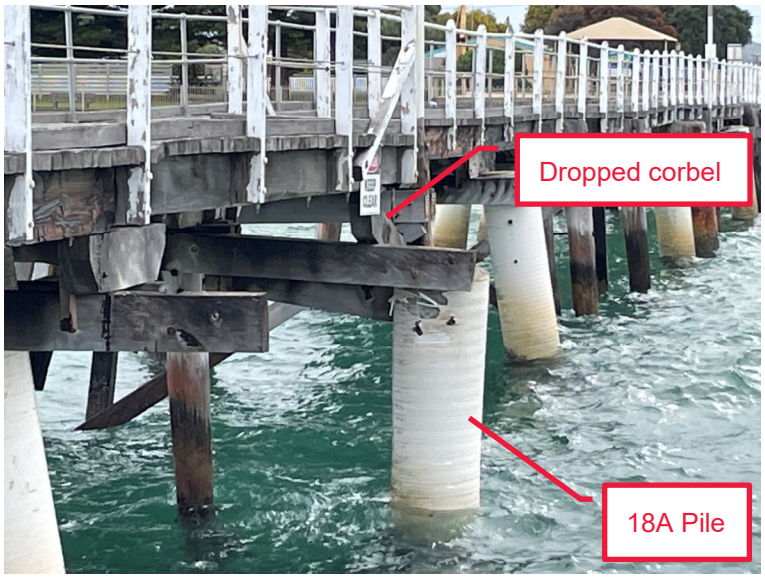


Figure 5: Bent 18A Pile Failure and Dropping

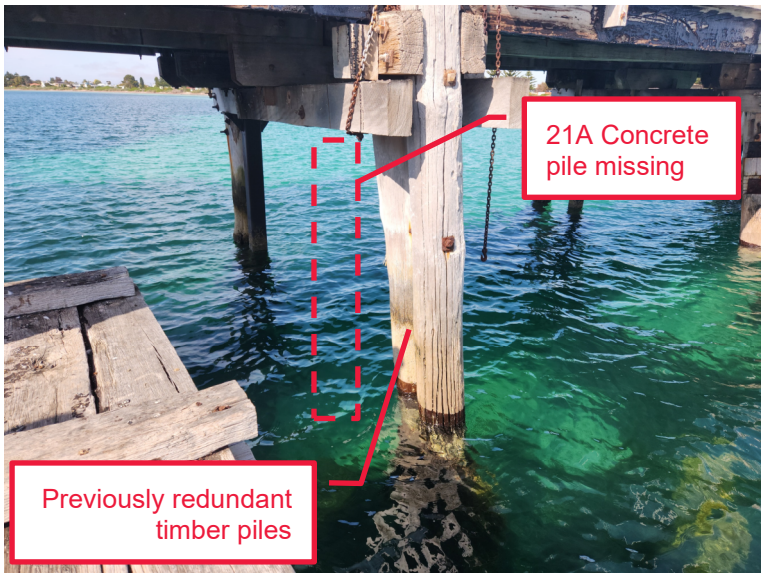


Figure 6: Bent 21A Pile Missing and Redundant Timber Pile

Figure 7: Bent 25B Pile Failure

Figure 8: Bent 25B Pile Failure and Rotation

It appears that the failure of the concrete encased piles (and connected structural members) outlined in Table 1 is likely due to shear failure of the concrete piles at their base. From what has previously been observed from the diver's inspection, the concrete and sleeves terminate above seabed which has resulted in the encased timber pile being exposed in this zone, allowing it to further deteriorate and eventually fail. The concrete filled sleeves also have the detrimental effect of increasing the tributary area of the pile and in turn the wave and current force imparted on the pile.

As the inspection was above the waterline only, there is the potential that additional piles have failed, or are close to failure that could not be observed.

From the inspection and the information provided by Council, the damage to the following components could be attributed to the recent storm events:

- Bent 18L Crosshead
- Bent 18S Crosshead
- Bent 18A Pile
- Bent 25B Pile

3. STRUCTURE RISK REVIEW

With the recent failure crossheads and concrete encased piles, there are multiple areas in the structure where there are groups of structural members that have failed (condition 7) or are close to the end of their service life (condition 6). These grouped defects pose a high risk and have the potential for the structure to fail under lateral (wave actions) or vertical loads (pedestrian loading). Extracts from the condition distribution table showing these grouped defects, including updates from the recent inspection our outlined in Figure 9 to Figure 11.

It should also be noted that the areas highlighted in Figure 9 to Figure 11 are groups of failed piles or, piles and girders. However, there are multiple additional areas in the structure where groups of failed girders occur which pose a risk to the structure, albeit a slightly reduced risk. For further information on these groups refer to the condition distribution table in Appendix A.

Bent or Bay No.	Pile			Crosshead		Corbel				Girder						
	A	B	C	L	S	A	B	C	D	A	B	C	D	E	F	G
11	6	6		3	3	6	6	6		4	6	4				
12	6	5		6						5	6	6				

Figure 9: Bent 11 to 12 Grouped Member Failure

Bent or Bay No.	Pile			Crosshead		Corbel				Girder						
	A	B	C	L	S	A	B	C	D	A	B	C	D	E	F	G
16	4	6		4	4	5	4	6		4	6	6				
17	6	4		3	3	4	4	6		4	4	5				
18	7	6	4	7	7	3	4	5	5	4	4	6				

Figure 10: Bent 16 to 18 Grouped Member Failure

Bent or Bay No.	Pile			Crosshead		Corbel				Girder						
	A	B	C	L	S	A	B	C	D	A	B	C	D	E	F	G
38	7	6		5	5	4	6	5		6	6	6				
39	4	7		4	4	6	5	5		5	6	6				
40	5	6		5	5	4	4	5		6	6	4				

Figure 11: Bent 38 to 40 Grouped Member Failure

At the locations highlighted in Figure 9 to Figure 11 as well as, Bent 25 and Bent 30 the structure can be seen to have dropped and can be felt to move under wave forces. From these deflections and sustained movement of the jetty, additional stresses are likely being imparted which the structure was not originally designed and could cause failure of other members in the area. In particular, this is an issue where members have already deteriorated and have a reduced structural capacity.

With the failure of multiple concrete encased piles since the initial inspection in 2020 there is a high risk that additional piles will fail going forward. Of the current 29No. concrete encased piles in the structure, 6No. are currently rated a condition 6 or 7. The remaining 23No. piles are distributed throughout the structure, typically in groups, which if they fail pose a significant risk to the structure. Refer to Figure 12 for the locations of the concrete encased piles.

Bent or Bay No.	Pile			
	A	B	C	D
0				
1	4	4		
2	4	4		
3	4	4		
4	5	4		
5	4	4		
6	4	4		
7	4	4		
8	4	5		
9	4	5		
10	4	4		
11	6	6		
12	6	5		
13	4	4		
14	4	4		
15	5	4		
16	4	6		
17	6	4		
18	7	6	4	
19	4	4		
20	5	5	4	
21	7	4		
22	4	5		
23	4	4	4	
24	5	5		
25	4	7		
26	5	4		
27	4	5		
28	5	4		
29	5	5		
30	4	7		

Bent or Bay No.	Pile			
	A	B	C	D
31	4	4		
32	4	4		
33	5	4		
34	5	5		
35	4	4		
36	4	4		
37	4	5		
38	7	6		
39	4	7		
40	5	6		
41	5	4		
42	4	4		
43	4	4	4	
44	4	4	5	4
45	4	4	6	5
46	4	4	5	5
47	5	4	4	4
48	5	4	4	4
49	4	6	4	5
50	4	4	4	4
51	4	5	5	4
52	4	4	4	5
53	4	4	4	4
54	4	4	5	5
55	4	4	4	4
56	7	4	4	4
57	4	4	7	4
58	5	4	5	5
59	4	4	5	4
60	4	5	4	5
61	4	4	5	5

Concrete encased Pile

Figure 12: Concrete Pile Locations (Highlight Green)

4. RECOMMENDATIONS

4.1 Full Remediation

It is strongly recommended that the Tumby Bay jetty remains closed to public access until remedial works are completed in the structure. To allow access it is WGA's recommendation that **all** condition 6 and 7 components, and **all** concrete encased piles are remediated. A high-level summary of the remedial works are as follows with further information outlined in the WGA report WGA202246-RP-MA-0011:

- Concrete Encased Piles: Install new 200x16 steel SHS (or equal approved) sister pile.
- Concrete Crosshead: Install new twin 300mm deep x 150mm wide crosshead.
- Timber Components: Like-for-like replacement.

4.2 Reduced Remediation

Dependent on a risk assessment by Council there may be the potential to reduce the remedial works to the following to allow short term public access to the jetty:

- Remediate all condition 6 and 7 piles and crossheads.
- Remediate condition 6 and 7 girders such that no bent has more than half the remaining members a condition 6, and no adjacent member is condition 6 or 7. Refer to Figure 13 for example remedial works.

Bent or Bay No.	Girder						
	A	B	C	D	E	F	G
10	5	3	4				
11	4	6	4				
12	5	6	6				
13	4	4	6				
14	6	4	6				
15	5	5	5				
16	4	6	6				
17	4	4	5				
18	4	4	6				
19	4	4	4	5			
20	4	4	4	4			
21	4	6	4	4			
22	4	4	4	5			
23	4	5	5	4			
24	6	4	6				
25	4	4	6				
26	5	6	5				
27	4	5	6				
28	5	6	4				
29	6	6	4				
30	4	4	5				

Girder to be remediated

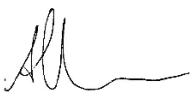
Figure 13: Reduced Remedial Works Girder Replacement (Highlighted Green)

To further reduce the amount of remedial works there may be the potential to keep the head of the jetty closed (from Bent 43 to 61) and not undertake any works in the area.

The reduced remedial works are a short-term solution only, and the remaining condition 6 girders will require replacement in the near further as they have reached or are close to reaching their service life. The risks associated with the likely continued failure of the concrete piles also needs to be addressed. These piles could be replaced on an as needs basis, however this would be cost prohibitive due to high contractor mobilisation/demobilisation costs

WGA recommends that all remedial works are undertaken in accordance with Section 4.1. If the reduced remedial works are undertaken in accordance with Section 4.2, Council should be aware of the risks associated with this option by undertaking their own risk assessment.

Yours Sincerely



Alastair Oliver
Senior Structural / Maritime Engineer
WALLBRIDGE GILBERT AZTEC

APPENDIX A CONDITION DISTRIBUTION TABLE (2022)

APPENDIX A
CONDITION DISTRIBUTION TABLE (2022)

JETTY HEAT MAP

Bent Ref: *Pile, Crosshead, Corbel, Crossbrace, etc*

Bay Ref: *Girder, Deck, Handrailing, Kerb, etc*

WSCAM Inspection

Assessed by **Wallbridge Gilbert Aztec** **on** **30 June 2022**

Tumby Bay Jetty

Bent or Bay No.	Pile					Crosshead		Corbel								Girder							Crossbrace		Cross Beam	Decking	Handrailing		Kerb	Light	Shelter	Sign	Ladder	Navigation Beacon	Stair Pile	Stair Beam	Stair Stringer	Stair Handrailing	Stair Treads
	A	B	C	D	I	L	S	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	L	S		Group	A	B	Group								Group	Group	Group
0																																							
1	4	4				5	5	4	4	4						5	6	6								4	3	4	3										
2	4	4				5	5	6	6	4						6	6	6								4	3	4	3										
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12	6	5				6										5	6	6								3	3	3	3										
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Bent or Bay No.	Pile					Crosshead		Corbel								Girder							Crossbrace		Cross Beam	Decking	Handrailing		Kerb	Light	Shelter	Sign	Ladder	Navigation Beacon	Stair Pile	Stair Beam	Stair Stringer	Stair Handrailing	Stair Treads
	A	B	C	D	I	L	S	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	L	S		Group	A	B	Group								Group	Group	Group
48	5	4	4	4		5	5	5	5	4	6	6	6	6		5	5	5	6	4	6	5		7		4	4	3	3										
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LL21	5	5																															3						
LL22	5	5														5	5									4			4							4	4	3
LL23	5	5														5	5									4			4										
LL41	5																																4						
LL42	5															4	4	4								4			3										
LL43																4	4	6								4			3							4	4	3