

16 December 2022
Job No: 1000057.2000

Wellington City Council
PO BOX 2199
WELLINGTON 6140

Attention: Katrina Gaston

Dear Katrina

Update on risk assessment to Shed 8, Shelly Bay, Wellington

1 Introduction

Tonkin & Taylor Ltd (T+T) provided a safety risk assessment report “Shelly Bay Shed 8, March 2022 geotechnical risk review” assuming limited access to the building (Shed 8). This letter provides an update of that safety risk assessment, including considering activities to upgrade/replace the building and adjoining wharf and seawall. The purpose of this updated risk assessment is to inform Wellington City Council (WCC) consideration of whether Shed 8 can be strengthened “safely” or whether the demolition of Shed 8 is a more suitable solution considering safety.

This letter has been prepared in accordance with our letter of engagement dated 14 December 2022.

2 Scope of work

Our risk assessment update has considered the following:

- T+T reports dated June 2020 and March 2022;
- Reports supplied by WCC:
 - New Zealand Consulting Ltd letter dated 9 December 2022 and titled “Structural Commentary on the condition & risks of Shed 8 & Shipwrights”;
 - Holmes letter dated 9 December 2022 and titled “Shelly Bay Redevelopment – Security of the existing wharf and adjacent seawall and structures”; and
 - Brian Perry Memo dated 7 December 2022 and titled “Shelly Bay Wharf Demolition and Seawall Renewal, Methodology & Associate Risks.
- Photographs of the wharf taken during a recent inspection by Greater Wellington Regional Council (GWRC). The photographs were received from GWRC on 15/12/22.
- Comments on stability of the Shed 8 structure supplied by Clendon, Burns and Park Ltd. Refer email dated 16/12/22 included in Appendix B.

Our scope of work has not included a site inspection. Note that the building’s foundations and seawall have not been inspected by T+T since June 2020.

3 Comparison with March 2022 geotechnical risk review

T+T's report "Shelly Bay Shed 8, March 2022 geotechnical risk review" provided a safety risk assessment assuming limited access to the building. This letter provides an update of that safety risk assessment, including considering activities to upgrade/replace the building and adjoining wharf and seawall. This updated risk varies from that reported in March 2022, as listed below:

- March 2022 considered limited access to the building. This update considers workers inside and/or adjoining the building during the upgrade/replacement of the building and adjoining wharf and seawall, i.e. increased exposure of people and consequences of instability of the building.
- Possible total or partial removal of the wharf and timber lagging above the seawall during construction, increasing exposure of the building's foundation subgrade to potential erosion, i.e. increased risk of erosion and consequently of foundation and building instability. Note that a temporary or permanent wave barrier could be installed to mitigate this effect.
- Vibration and other construction impact increasing the risk of foundation and building instability.
- Risk of additional erosion since the last inspection in 2020. The photographs of the wharf provided by GWRC did not present enough detail of the seawall to allow the erosion assessment to be updated.

4 Instability mechanisms presenting safety risk

Further to our July 2020 and March 2022 reports we describe the mechanisms presenting safety risk as follows:

- Ongoing coastal erosion and decay of timber piles has compromised the support provided to the seaward side of the building. Refer to Figures 1 and Figure 2 in Appendix A. There are 26 piles supporting the seaward side of the building. Twelve of these piles were exposed by coastal erosion allowing them to be inspected in 2015. Of these 12 inspected piles, eight were found to be eroded/decayed and did not provide support to their pile caps. Some support was reinstated by the installation of acro-props in 2015. The remaining 14 piles along the building's seaward edge were not exposed by coastal erosion and thus could not be inspected. The condition of these 14 piles is unknown. Some of these piles may not be providing support to their pile caps.
- In the event of a "change of conditions" one or more pile caps could lose support from their piles, allowing downward and possibly seaward movement of the pile caps of a number of 100's millimetres. Clendon, Burns and Park Ltd (CBP) has reviewed the building arrangement with respect with this possible movement and believe there is a very high likelihood that if this foundation movement were to occur, this will lead to collapse of a section of the roof (Refer email dated 16/12/22 Appendix B). Support of the pile caps from the soil directly beneath the pile caps is likely to be ineffective because that loose fill has limited lateral restraint (Refer Figure 1 Appendix A). Any of the following could represent a "change of conditions" triggering the mechanism of instability described above:
 - Earthquake shaking.
 - Vibration or other impacts from construction activities.
 - Further decay of the piles.
 - Coastal erosion beneath the pile caps.

5 Options for redevelopment and associated risk assessment

Upgrade/replacement of Shed 8, the seawall and the wharf are proposed. There is interdependency between these structures as outlined in Holmes' letter and Brian Perry's Memo. The potential instability of the building presents a hazard to seawall and wharf construction work. Options for sequencing the work as indicated in Brian Perry's memo and Holmes' letter are as follows:

- A. **Building strengthening first** as described by the following steps:
 - 1 Undertake temporary or permanent works to secure the building foundations and if necessary, the structure above. The hazard presented by building instability and the safety of undertaking these works would require consideration.
 - 2 Upgrade/replace the seawall and wharf by progressively working along the new wharf as it is constructed.
- B. **Wharf and seawall first** as described by the following steps:
 - 1 Upgrade/replace the seawall and wharf by progressively working along the new wharf as it is constructed. The hazard presented by the building and the safety of undertaking these works would require consideration.
 - 2 Undertake works to improve the building.
- C. **Demolish the building first** as described by the following steps:
 - 1 Demolish the building.
 - 2 Upgrade/replace the seawall and wharf working from land.

The hazard presented by building instability is similar for options A and B; possibly greater for option B depending on how the works are sequenced. Appendix C presents an initial risk assessment for options A and B.

A substantial contribution to this initial risk assessment is unknowns, and particularly the unknown condition of piles that have not been inspected to date. To inspect these piles would require excavation work which presents similar risks to the other proposed construction activities, i.e. triggering instability of the foundations and structure above. For this reason, further assessment of the existing foundations is not proposed.

Option C: Demolish the building first, presents health and safety issues due to asbestos and instability. A risk assessment would be required before embarking on demolition works. However, we are aware that following the Kaikoura Earthquake, buildings were demolished at CentrePort via crane-based deconstruction. These CentrePort buildings shared with Shed 8 issues of; proximity to water, instability and asbestos.

6 Conclusion

We have assessed that strengthening of Shed 8 and upgrade/replacement of the seawall and wharf has a high safety risk associated with the hazard of Shed 8 foundation movement and building instability. This high risk is assessed irrespective of whether the building foundations strengthening works are done before or after seawall and wharf works. We would expect that demolition of Shed 8 followed by the seawall and wharf upgrade/replacement works would present a lower overall safety risk than options including strengthening of Shed 8 building. However, a specialist demolition contractor would need to be consulted to confirm this.

The purpose of this updated risk assessment is to inform WCC consideration of whether Shed 8 can be strengthened "safely" or whether the demolition of Shed 8 is a more suitable solution considering safety. The information in this letter shall not be applied to any other purpose or be relied on by any other party.

7 Applicability

This report has been prepared for the exclusive use of our client Wellington City Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Recommendations and opinions in this report are based on data from discrete investigation/inspection locations. The nature and continuity of subsoil away from these locations are inferred but it must be appreciated that actual conditions could vary from the assumed model.

Tonkin & Taylor Ltd

Report prepared and authorised for Tonkin & Taylor Ltd by:



.....
Stuart Palmer
Principal Geotechnical Engineer/Project Director

Reviewed by Emilia Stocks, Senior Geotechnical Engineer

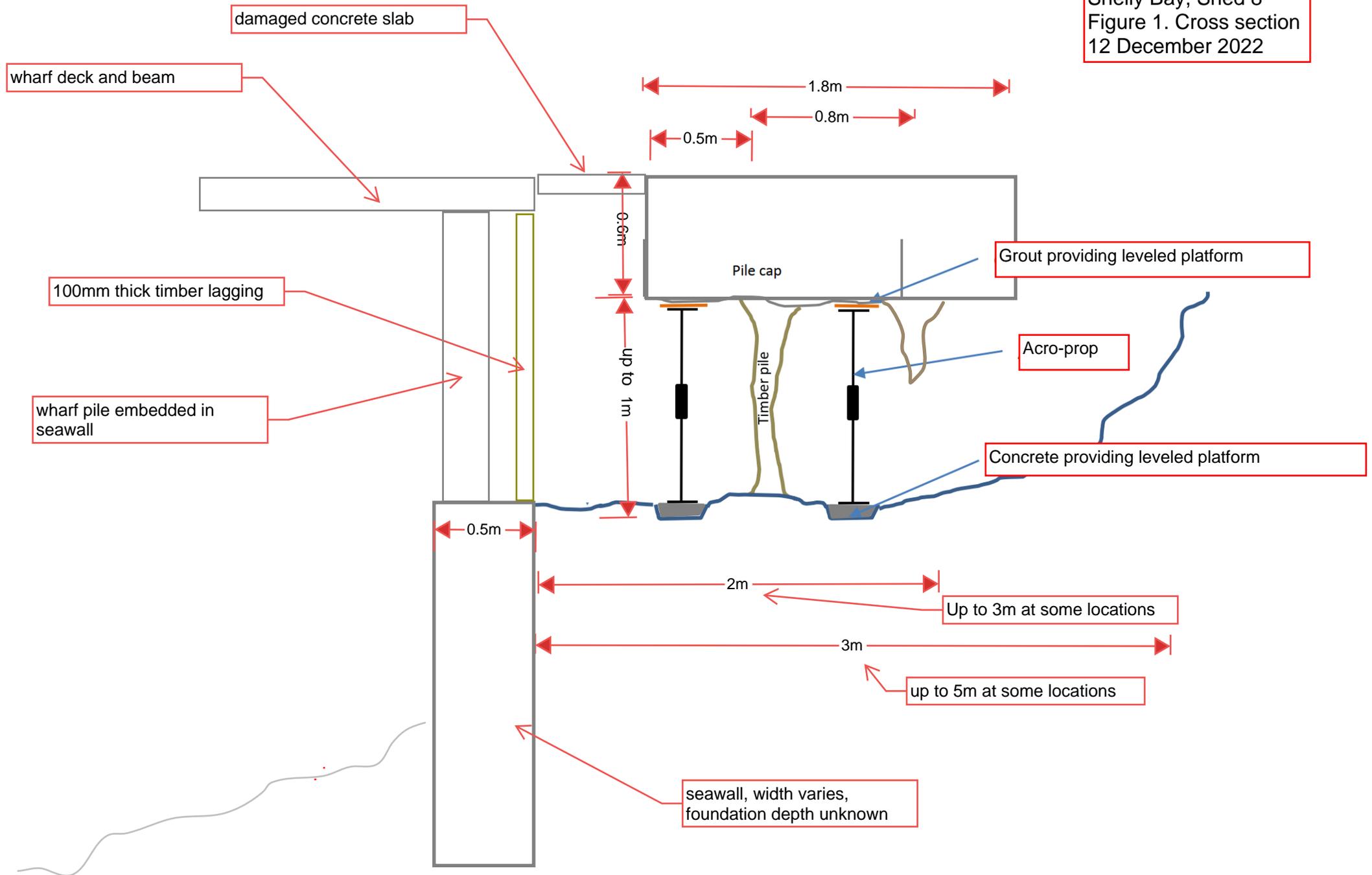
Attachments: Appendix A: Figures
Appendix B: Supporting information from Clendon Burns and Park Ltd
Appendix C: Initial risk assessment

16-Dec-22
\\ttgroup.local\corporate\wellington\tt projects\1000057\1000057.2000\workingmaterial\20221216.sjp.risk report.shed 8_shelly bay.docx

Appendix A Figures

- **Figure 1 – cross section**
- **Figure 2 – plan**

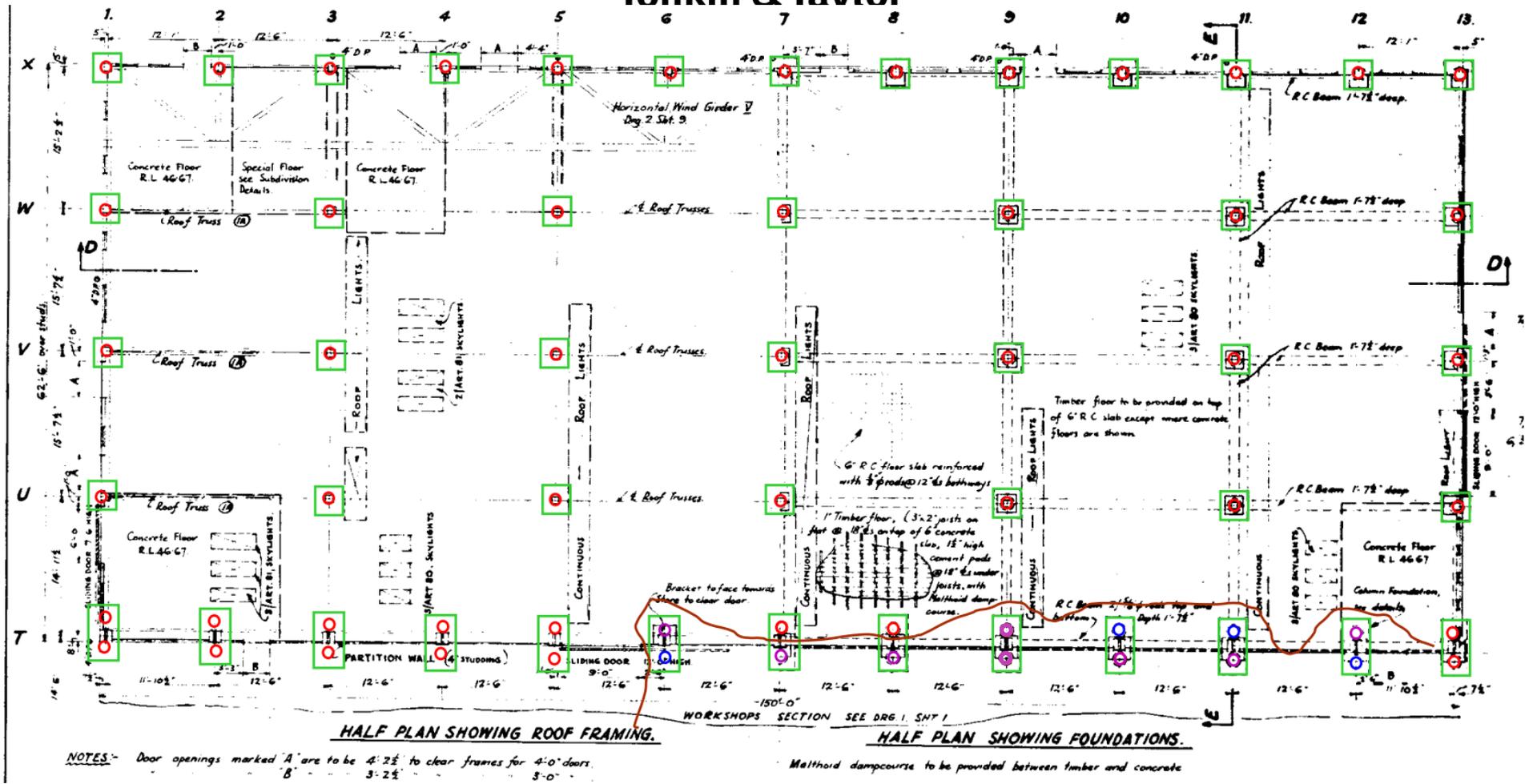
Shelly Bay, Shed 8
Figure 1. Cross section
12 December 2022





Tonkin & Taylor

Figure 2 – Foundation Plan



-  Piles not inspected
-  Inspected piles in acceptable condition
-  Damage piles, no support to pile cap
-  Pile cap
-  Approximate extent of undermining

**Appendix B Supporting information from Clendon
Burns and Park Ltd**

Emilia Stocks

From: Anthony Taylor <anthonyt@cbp.co.nz>
Sent: Friday, 16 December 2022 1:00 pm
To: Stuart Palmer
Cc: Emilia Stocks
Subject: RE: Shed 8 Shelly Bay

Hi Stuart,

That all seems reasonable. Happy to go with that.

Anthony Taylor
Director



ddi +64 4 495 1391 **p** +64 4 472 1412 **m** +64 27 437 7627 **w** www.cbp.co.nz
a 15a Everton Terrace PO Box 12 049 Thorndon Wellington New Zealand

Important: This email and any attachments are confidential and may contain material protected by copyright. No part of the email or attachments may be reproduced in any form or by any means without prior written permission. If you are not the intended recipient, do not read, use, disseminate, distribute or copy this email or its attachments. Instead, inform us immediately by return email, facsimile or telephone (call collect) and delete this email.

CLOSED: MIDDAY THURSDAY 22ND DECEMBER 2022.

REOPEN: MONDAY 9TH JANUARY 2023.



From: Stuart Palmer <SPalmer@tonkintaylor.co.nz>
Sent: Friday, 16 December 2022 12:47 pm
To: Anthony Taylor <anthonyt@cbp.co.nz>
Cc: Emilia Stocks <EStocks@tonkintaylor.co.nz>
Subject: RE: Shed 8 Shelly Bay

Hi Anthony

Confirming our discussion. Have tweaked your words to concentrate on “likelihood”. “Risk” is covered separately in our risk assessment.

In the event of change of conditions one or more pile caps could possibly lose support from their piles which could allow downward and possibly seaward movement of the pile caps of a number of 100's of mm. Clendon Burns and Park Ltd (CBP) has reviewed the building arrangement with respect to this possible movement and believe there is a very high likelihood that if this foundation movement were to occur this will lead to collapse of a section of the roof (Refer email dated 16/12/22 Appendix B).

We have deleted the discussion about the landward foundations for simplicity.

Regards
Stuart

From: Anthony Taylor <anthonyt@cbp.co.nz>
Sent: Thursday, 15 December 2022 5:12 pm
To: Stuart Palmer <SPalmer@tonkintaylor.co.nz>
Cc: Katrina Gaston <Katrina.Gaston@wcc.govt.nz>; Emilia Stocks <ESTocks@tonkintaylor.co.nz>
Subject: RE: Shed 8 Shelly Bay

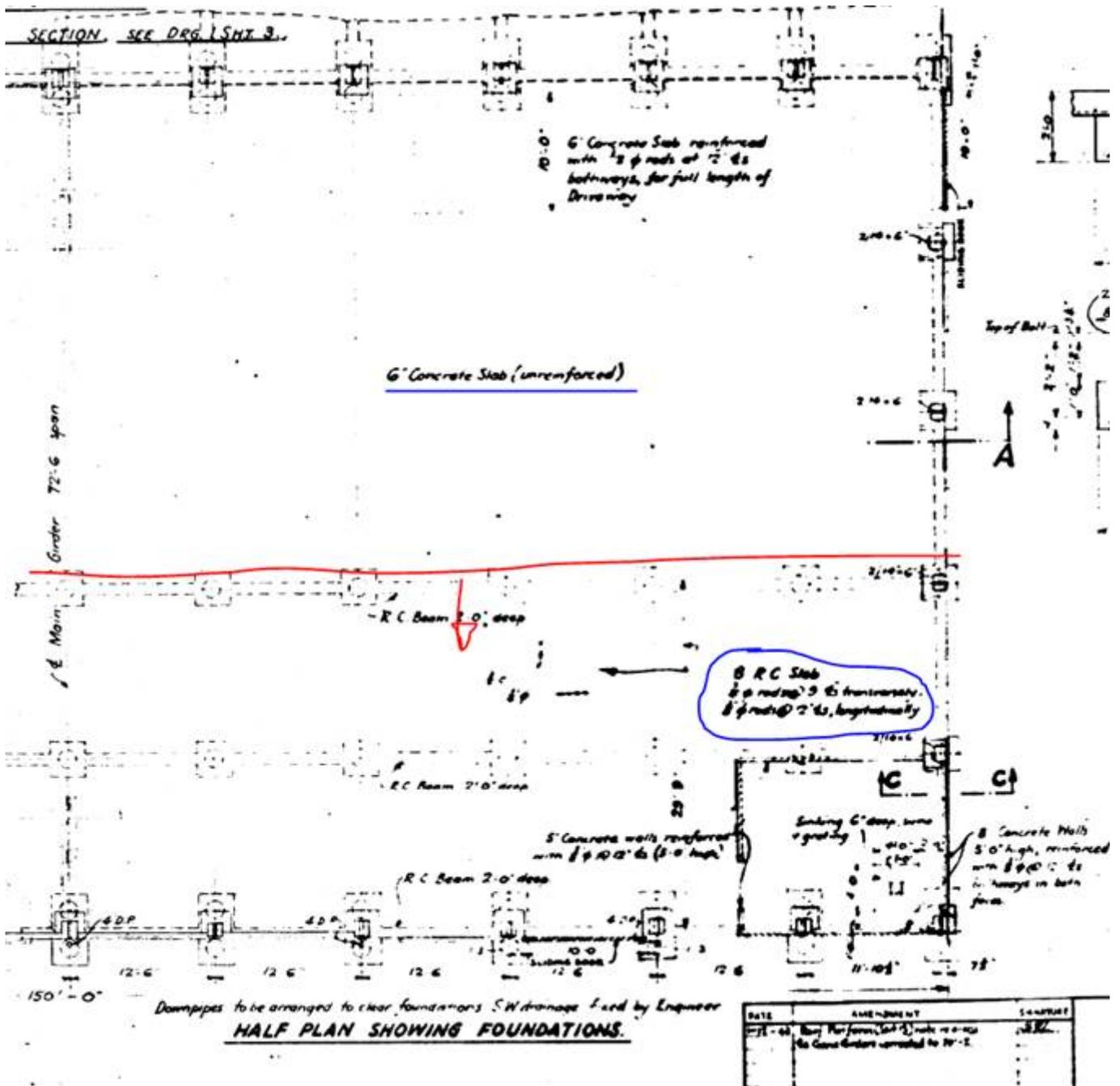
Hi Stuart,

I have undertaken a high-level risk assessment of the situation and feel that the risk is “Very High”. The likelihood of the foundation system failing and moving is very likely. The consequence if people are present in this space would be at least Disastrous. The roof is very large spanning so if a truss was to fall then injury to death would be very possible.

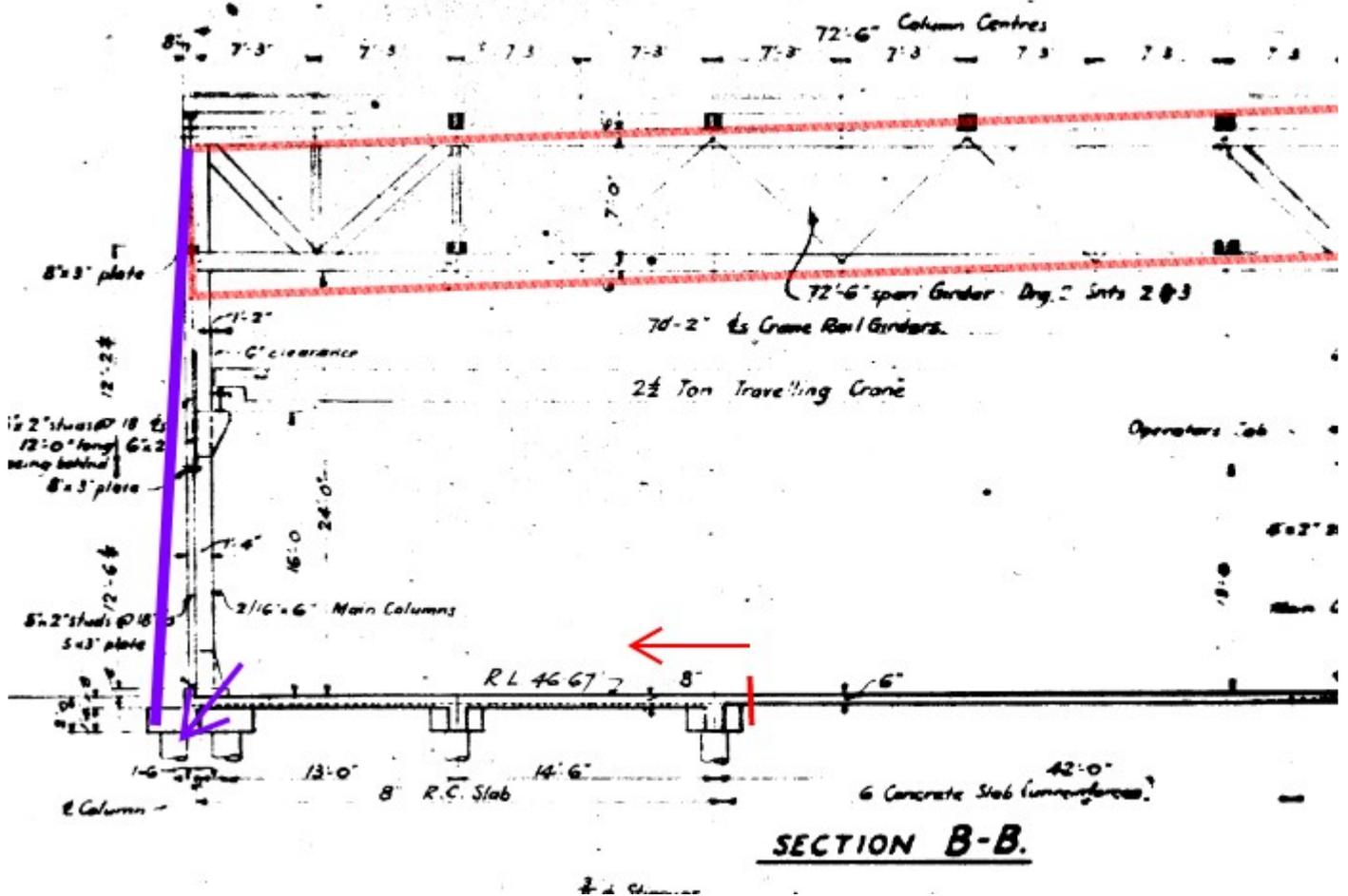
Risk Matrix		Consequence				
		1: Catastrophic	2: Disastrous	3: Major	4: Medium	5: Low
Likelihood	A - Almost Certain	VH	VH	VH	H	H
	B - Very Likely	VH	VH	H	H	M
	C - Likely	VH	H	H	M	L
	D - Possible	VH	H	M	L	L
	E - Unlikely	H	M	L	VL	VL
	F - Rare	M	L	VL	VL	VL

Some points to note:

- In review of the original drawings, it is noted that only part of the workshop space has reinforced slab. Also, no tie beams are present in the perpendicular direction to help tie foundations back to the rest of the building. Therefore, it would be expected that all the lateral movement would be reflected to this interface between reinforced and unreinforced.



- Due to the large span of the roof truss onto this external wall, there is very little redundancy in this system. No internal columns to help provide a secondary support to hang the trusses from. All the movement would be reflective into the roof system.



Let me know if you require anything further.

Anthony Taylor
Director



ddi +64 4 495 1391 p +64 4 472 1412 m +64 27 437 7627 w www.cbp.co.nz
 a 15a Everton Terrace PO Box 12 049 Thorndon Wellington New Zealand

Important: This email and any attachments are confidential and may contain material protected by copyright. No part of the email or attachments may be reproduced in any form or by any means without prior written permission. If you are not the intended recipient, do not read, use, disseminate, distribute or copy this email or its attachments. Instead, inform us immediately by return email, facsimile or telephone (call collect) and delete this email.

CLOSED: MIDDAY THURSDAY 22ND DECEMBER 2022.

REOPEN: MONDAY 9TH JANUARY 2023.



From: Stuart Palmer <SPalmer@tonkintaylor.co.nz>
 Sent: Thursday, 15 December 2022 2:01 pm
 To: Anthony Taylor <anthonyt@cbp.co.nz>

Cc: Katrina Gaston <Katrina.Gaston@wcc.govt.nz>; Emilia Stocks <EStocks@tonkintaylor.co.nz>

Subject: Shed 8 Shelly Bay

Hi Anthony,

Another pre Xmas task sorry!

We have been asked by WCC to review stability of Shed 8 Shelly Bay foundations and building.

We have assessed potential for foundation movement as described below. We now ask for your comment on the impact of these foundation movements on the stability of the structure and life safety. Highlighted in yellow are space fillers not to be construed to be an assessment. Could you please provide your response to fill these yellow spaces.

Thank you

Regards

Stuart

1 Instability mechanisms presenting safety risk

Further to our July 2020 and March 2022 reports we describe the mechanisms presenting safety risk as follows:

- Ongoing coastal erosion and decay of timber piles has compromised the support provided to the seaward side of the building. Refer Figures 1 and Figure 2 in Appendix A. There are 26 piles supporting the seaward side of the building. 12 of these piles were exposed by coastal erosion at the time of inspections in 2015. Of these 12 inspected piles 8 were found to be eroded/decayed such that they did not provide support to their pile caps. Some support was reinstated by installation of acro-props in 2015. The 14 piles beneath seaward pile caps not exposed by coastal erosion could not be inspected and their condition is unknown. Some of these piles may not be providing support to their pile caps.
- In the event of change of conditions one or more pile caps could possibly loose support from their piles which could allow downward and seaward movement of the pile caps of a number of 100's of mm. **Clendon Burns and Park Ltd (CBP) assess that such foundation movement could possibly lead to collapse of a section of the roof???? (Refer email dated 16/12/22 Appendix B).**

Support of the pile caps from the soil directly beneath the pile caps is likely to be ineffective because that loose fill has limited lateral restraint (Refer Figure 1 Appendix A).

Any of the following could represent a "change in situation" triggering the mechanism of instability described above:

- Earthquake shaking
- Vibration or other impacts from construction activities
- Further decay of the piles.
- Coastal erosion beneath the pile caps.
- The condition of the piles beneath the remainder of the pile caps (i.e. beyond pile caps beneath the seaward wall of the building) is not known. However, these pile caps have soil beneath and around them such that in the event of loss of support from the piles some alternative support from the pile caps bearing on or against the ground could be expected such that vertical or lateral foundation displacements of more than 100mm would not be expected. **CBP has advised that these limited displacements are unlikely to cause instability of the structure???? (Refer email dated 16/12/22 Appendix B).**

Applicability

Recommendations and opinions in this email are based on data from limited investigations. The nature and continuity of subsoil away from the test location are inferred and it must be appreciated that actual conditions could vary from the assumed model.

This email has been prepared solely for the benefit of our client with respect to the particular brief given to us and data or opinions contained in it may not be used in other contexts or for any other purpose without our prior review and agreement.

Stuart Palmer | Technical Director, Foundations Earthquake Engineering

BE Civil (Hons), CPEng, IntPE

Tonkin + Taylor - *Exceptional thinking together*

Level 4, 2 Hunter Street, Wellington 6011, PO Box 2083, Wellington

T [+64 4 806 4974](tel:+6448064974) M [+64 21 933422](tel:+6421933422) www.tonkintaylor.co.nz  T+T profile



To send me large files you can use the following link:

<https://transfer.tonkintaylorgroup.com/filedrop/spalmer@tonkintaylor.co.nz>

NOTICE: This email together with any attachments is confidential, may be subject to legal privilege and may contain proprietary information, including information protected by copyright. If you are not the intended recipient, please do not copy, use or disclose the information in it, and confidentiality and privilege are not waived. If you have received this in error, please notify us immediately by return email and delete this email.



DISCLAIMER

The information contained in this communication from the sender is confidential. It is intended solely for use by the recipient and others authorized to receive it. If you are not the recipient, you are hereby notified that any disclosure, copying, distribution or taking action in relation of the contents of this information is strictly prohibited and may be unlawful.

This email has been scanned for viruses and malware.

DISCLAIMER

The information contained in this communication from the sender is confidential. It is intended solely for use by the recipient and others authorized to receive it. If you are not the recipient, you are hereby notified that any disclosure, copying, distribution or taking action in relation of the contents of this information is strictly prohibited and may be unlawful.

This email has been scanned for viruses and malware.

Appendix C Initial risk assessment

Appendix C: Specific initial risk assessment – December 2022

We have assessed **specific risk** assuming the following:

- The **specific risk** assessed relates to the potential displacement of Shed 8 foundations leading to instability of the building. All other risks are not considered in this assessment.
- Construction activities ongoing for more than 1 month within or adjoining Shed 8. A number of construction workers are in or immediately adjoining Shed 8. No other person is permitted in or immediately adjoining Shed 8. These construction activities cause vibrations. These construction activities could include one or more of the following:
 - Excavation around existing shed eight piles to inspect their condition
 - Shed 8 foundation improvement works including one or more of the following: underpinning with piles, placement of mass concrete beneath pile caps, construction of beams spanning to the top of the existing seawall, or other works.
 - Construction of the seawall and/or wharf upgrade or replacement works within 6m of the seaward side of Shed 8.
- No significant changes in the foundation conditions since June 2020. However, note that T+T has not been to the site since then. T+T undertook a visual monitoring work of temporary foundation supports between 2015 and 2020¹.
- Information about existing piles' condition is limited (14 out of 26 piles have been inspected). It is noted that the foundations and the building have remained stable under ambient conditions from 2015 to 2022, including the Kaikoura earthquake. In the absence of detailed foundation condition information, it is assumed that vibrations greater than these ambient conditions could lead to instability.
- Foundation displacement could lead to structure instability as assessed by Clendon Burns and Park Ltd.
- Risk matrix that has been used in our previous assessments for the site.
- This risk assessment is provided to inform WCC's assessment of the safety risk of these construction activities relative to the alternative of demolition of Shed 8 as an early-stage work activity. The risk assessment is not to be relied on by any other party or for any other purpose.

ID	ISSUE	LIKELIHOOD (Of instability presenting a life safety hazard)	CONSEQUENCE	RESIDUAL RISK
1.	Earthquake shaking triggering movement of the seaward Shed 8 foundations and instability of the building.	Rare (Probability of a ≥ 100-year seismic event while workers in or adjoining Shed 8)	Disastrous (Loss of life)	LOW
2.	Storm event causing damage to seawall timber lagging and erosion beneath seaward pile caps which leads to foundation and building instability.	Unlikely to Rate (Workers not to be present during storms. Risk remains during inspections following storm)	Disastrous (Loss of life)	MODERATE to LOW
3.	Construction activities causing vibrations which lead to foundation and building instability.	Possible	Disastrous (Loss of life)	HIGH

¹ Refer T+T Site Report issues between 2015 and 2020 for observation reporting, T+T Ref. 85856.0040.

Measures of Likelihood

Level	Descriptor	Description	Annual Probability of Occurrence	Annual Recurrence Interval
A	Almost Certain	The event is on-going, or is expected to occur during the next year	100%	< 1 year
B	Very Likely	The event is expected to occur.	20% to 100%	1-5 years
C	Likely	The event is expected to occur under somewhat adverse conditions	5% to 20%	5-20 years
D	Possible	The event is expected to occur under adverse conditions	1 to 5%	20-100 years
E	Unlikely	The event is expected to occur under high to extreme conditions	0.2 to 1%	100-500years
F	Rare	The event could occur under extreme conditions	Less than 0.2%	>500 years

Measures of Consequence (see notes below)

Level	Descriptor	Example Descriptions (Damage to Property)	Example Descriptions (Consequence to users)
1	Catastrophic	Large scale damage to dwelling and land requiring major engineering works for stabilisation	Multiple loss of life
2	Disastrous	Large scale damage to dwelling and land requiring major engineering works for stabilisation	Loss of life
3	Major	Moderate damage to dwelling and land requiring engineering works	Serious injury to person, requiring hospitalisation.
4	Medium	Moderate damage to land or minor damage to dwelling	Minor injury to person
5	Low	Limited damage to land	n/a
6	Minor	No damage	n/a

Risk Matrix

		Consequences to Property/Users/Project					
		1: Catastrophic	2: Disastrous	3: Major	4: Medium	5: Low	6: Minor
Likelihood	A - Almost Certain	VH	VH	VH	H	H	M
	B - Very Likely	VH	VH	H	H	M	L
	C - Likely	VH	H	H	M	L	L
	D - Possible	VH	H	M	L	L	VL
	E - Unlikely	H	M	L	VL	VL	VL
	F - Rare	M	L	VL	VL	VL	VL

Risk Level Implications

Risk Level		Implications for Risk Management
VH	Very High Risk	Detailed investigation, design, planning and implementation of treatment options to reduce risk to acceptable levels: May involve very high costs.
H	High Risk	Detailed investigation, design, planning and implementation of treatment options to reduce risk to acceptable levels.
M	Moderate Risk	Broadly tolerable provided treatment plan is implemented to maintain or reduce risks. May require investigation and planning of treatment options.
L	Low Risk	Acceptable. Treatment requirements to be defined to maintain or reduce risk
VL	Very Low Risk	Acceptable. Manage by normal maintenance procedures