

WSP

APPLICANT
COPY



20 January 2021

Rotorua Lakes Council
1061 Haupapa Street
Rotorua 3010

Te Ahi Tupua - Hemo Rd Sculpture

2-89988

Dear Stewart Brown,

Regarding the above-mentioned sculpture, we have previously inspected the foundations and were satisfied with the construction.

We have also inspected the structure following the installation of the sculpture itself and are similarly satisfied that the WSP designed elements have been adequately fabricated and installed up to the standard of modern construction.

I do not consider there to be any outstanding WSP designed structural elements likely to have an impact on structure performance. At the time of my most recent inspection, there was some minor grouting to be completed.

Regards,

Tim Fowler
Senior Structural Engineer - CMeng CPEng



28 January 2021

Rotorua Lakes Council
1061 Haupapa Street
Rotorua 3010

CERTIFICATE OF ACCEPTANCE

No. 81707

APPLICANT
COPY

Te Ahi Tupua - Hemo Rd Roundabout Sculpture

2-89988.00

Dear Stewart Brown,

I note that WSP's PS1 design documentation refers to Importance Level 1 (IL1) but the design of the structure as installed was Importance Level 2 (IL2). I have confirmed with the structural design engineer that the foundation was designed to IL2.

The PS1 document was produced when the material of the sculpture was still stainless steel, and it is that section of the design document that refers to IL1, all of which is now redundant. Loads from the supplier at IL2 were checked after the PS1 was produced. The sum total of the changes did not lead to substantial re-design, so the PS1 was not updated.

I consider that the PS4 signed off by Graeme Salter in November of 2020 the formal acknowledgement that the structure as installed is acceptable.

The change of Importance Level was based on interpretation of table 3.2 of AS/NZS1170. An argument could be made that the structure is 'mast-like' and therefore IL1, however in my professional opinion the adjustment to IL2 was the correct choice given the risk profile of the structure.

Regards,

Tim Fowler
Senior Structural Engineer - CPEng CMEngNZ

Manager Building Services
Rotorua Lakes Council
Private Bag 3029
Rotorua Mail Centre
Rotorua 3046
NEW ZEALAND

CERTIFICATE OF ACCEPTANCE

No. 81707

RECEIVED

12 FEB 2021

Gurit

12th February 2021

To the Building Official,
Rotorua Lakes Council

Concerning,

Hemo Gorge Sculpture/Te Ahi Tupua at Hemo Roundabout, Intersection SH5 and SH30
Rotorua.

Compliance with Building Code Clause B2 – Durability

The purpose of this letter is to demonstrate how compliance with Clause B2 (Durability) of the Building Code has been achieved for the above project.

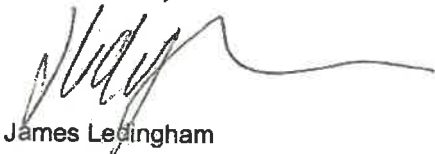
The New Zealand building code does not provide an acceptable solution method for composite (CFRP, FRP) materials under Clause B2. In the absence of this, the durability considerations in the *Structural Design of Polymer Composites Eurocomp Design Code and Handbook* for composites, section 2.4, have been addressed to ensure an adequately durable structure.

Structural durability of the sculpture has been validated at the design stage by ensuring that the material strains at serviceability limit state are below the transverse resin cracking (micro-cracking) limit as detailed in the supplied design report. The transverse resin cracking limit strain has been calculated via mechanical testing of similar composite laminates.

The effects of environmental conditions have been accounted for via the application of material factors derived from the Eurocomp Code. UV degradation of the resin system is avoided through the application of a UV protective paint system. Routine maintenance and re-painting is required for this system to remain effective. Refer to manufacturer's maintenance schedule and paint data sheets.

We confirm that the composite, CFRP and FRP, structural elements that are included within our design documentation will continue to satisfy the functional and structural performance requirements for the design life of 50 years, subject to the paint system remaining intact and regular maintenance as per the maintenance schedule.

Yours faithfully,



James Ledingham

For and on behalf of

Gurit

James Ledingham
Design Engineer

Gurit (Asia Pacific) Ltd
11 John Glenn Avenue,
Rosedale 0632
Private Box 302 191,
North Harbour, 0751
Auckland, New Zealand

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F +64 (0) 9 415 7262

James.ledingham@gurit.com

www.gurit.com

Gurit



**APPLICANT
COPY**

Structural Peer Review Report

Date: 09 February 2020
Project Ref: 2287-1

Project: **Hemo Road Roundabout Sculpture**

Issued to: Rotorua Lakes Council < Darrell.Holder@rotorualc.nz >

At the request of Rotorua Lakes Council, I have reviewed the supplied structural information relating to the application for a certificate of acceptance (COA) in terms of compliance with The New Zealand Building Code Clause B1- Structure. My review was based on the documentation RLC provided. No site visit, soil testings and/or additional geotechnical/structural calculation on top of Opus-WSP and Gurit were carried out by MCEL.

I report as follows.

Original Supplied Documents

1. Opus International Consultants Ltd authored PS1 and design calculation, Hemo Roundabout Sculpture & Base, dated 23 November 2017.
2. Opus International Consultants Ltd authored Preliminary drawings for the RC foundation and base plate, drawing sheets X521(A) X522(A) X523(A), dated 30 November 2016.
3. Opus International Consultants Ltd authored base plate detail sketches, no date specified.
4. WSP New Zealand Limited authored PS4 for the concrete foundation base and hold down bolts, dated 05 November 2020.
5. Gurit (Asia Pacific) Ltd authored PS1, 12m CFRP spiral sculpture, dated 07 June 2019.
6. Gurit (Asia Pacific) Ltd authored Structural Drawings, Hemo Gorge Sculpture, drawings number GU6706-000, GU6706-1001, GU6706-1002, GU6706-1006, GU6706-2001 dated 29 May 2019.
7. Gurit (Asia Pacific) Ltd authored Design Basis Report dated 25 January 2018.
8. Gurit (Asia Pacific) Ltd authored Preliminary Design Report and Detailed Design Update dated 09 February 2018.
9. Kilwell Fibretube Limited authored PS3, Hemo sculpture as designed by Gurit Engineering PS1, dated 08 September 2020.
10. Gurit (Asia Pacific) Ltd authored report, Hemo Gorge Sculpture as Built Inner Tube Connection Test, dated 27 November 2020.
11. Gurit (Asia Pacific) Ltd authored report Hemo Gorge Sculpture as Built Testing and Installation Report, dated 12 October 2020.
12. Rotorua Lakes Council provided structural site photos and height measure.

Review Notes

Based on the initial supplied documentation, MCEL understood that the structure, initially stainless tubes superstructure with the associated foundation, designed by Opus- WSP. However, due to the difficulty and challenge of manufacture and transportation issues, Gurit carried out the design analysis using the carbon fibre material instead of stainless steel. Several iterations adopted in the design models to utilise the best economic solution. The carbon fibre superstructure by Guirt and the foundation design by Opus-WSP were adopted in the final design. The structure defects were identified during the construction monitoring stage by Gurit. The material testings were required to prove the material have the capacity to resist the load demand.

PS3 were issued by the contractor, Kilwell. PS4 for the foundation and hold down bolts issued by Opus-WSP. Guirt provided the PS4 letter for the superstructure based on the test reports.

As per the supplied initial information MCEL review, there are a few issues noticed by MCEL, which require further clarification/confirmation by the contributing design engineers, such as structure height, importance level designed by different firms, structure deformation limitation, maintenance specification and QA for the overall structure.

The peer review log revision 1 dated 28 January 2020 attached for details at the back of the report.

Additional Supplied Information

Telephone conference was held by Rotorua Lakes Council to discuss the design issue in order to issue the COA. Further to the discussion and issued MCEL peer review log, design engineers and contractor have provided the additional supporting information as following:

- Reissued WSP authored foundation PS4, Hemo Roundabout Sculpture, dated 05 November 2020.
- WSP authored Importance level clarification letter, dated 28 January 2021.
- WSP authored revised base plate and hold downs calculation, titled Te Ahi Tupua Baseplate+bolts, dated 02 February 2021.
- WSP issued height confirmation letter, titled Te Ahi Tupua- Hemo Rd Roundabout Sculpture, dated 02 February 2021.
- Gurit authored repair drawings, titled Inner Tube Scarf Repair, Drawing number GU6706-000, dated 01 May 2019.
- Gurit authored revised Design Basis Report, ref GU6706-6001 C, dated 02 February 2021.
- Gurit authored design report, ref GU6706-6002A1, dated 02 February 2021.
- Kilwell Fibretube Limited issued Te Ahi Tupua Sculpture maintenance plan, titled Hemo Gorge Sculpture Te Ahi Tupua maintenance/Inspection Schedule.

MCEL have closed all the items in the peer review log revision 1 and believe that the structure design assumptions was based on the reasonable ground, and suggest COA can be granted by Council.

Peer review log revision 2 attached at the back of the report for details.

Further Notes

Engineering design assumes that all products meet their performance specification requirements. Confirming this assumption is beyond the scope of our review.

Elements not covered by the supplied specific design do not form part of our review.

It should be noted that we have undertaken a 'desk-top' review. Whilst we have made every effort to undertake an accurate review of the supplied information, we do not purport to warrant the suitability of the design and detailing. We have copied some of the supplied documentation for our records.

New Zealand Building Code Approved Documents Durability and E2 compliance is expressly excluded from our review. Manktelow Consulting Engineers Limited shall not be liable in respect of any claim alleging, arising directly or indirectly out of, or in respect of: A) The failure of any building or structure to meet or conform to the requirements of the New Zealand Building Code contained in the First Schedule to the Building Regulations 1992 or any applicable New Zealand Standard (or any amended or substituted regulation or standard) in relation to leaks, water penetration, weatherproofing, moisture or any effective water exit or control system; or B) Mould, fungi, mildew, rot, gradual deterioration, micro-organisms, bacteria, protozoa or any similar or like forms, in any building or structure.

Conclusions

Based on the supplied information and comments made herein we can confirm that the specific structural appear generally acceptable in order for Council issue the certificate of acceptance in terms of the New Zealand Building Code Approved Documents B1/VM1. The ongoing performance of the structure is also reply on the regular inspection and maintenance as described in the Maintenance/Inspection Schedule prepared by Kilwell.

If you have any questions regarding our review or the supplied information, please do not hesitate to contact the undersigned.

For and on behalf of Manktelow Consulting Engineers Limited (MCEL)

Prepared by:



Sam Wang
Structural Engineer

Reviewed by:



Craig Manktelow
Chartered Geotechnical and Structural Engineer #131529

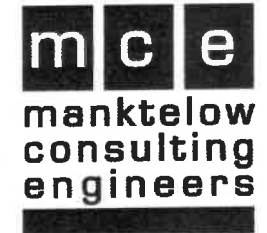
Attached: MCEL peer review log revision 1
MCEL peer review log revision 2

Appendix A

MCEL peer review log revision 1

Project:	Hemo Gorge Sculpture	Purchase order:	RLP020949
Job No:	2287-1	Date:	28/01/2021
By:	SW	Page:	1

Items	MCEL Queries/Comments	Designer Response	Status
1.0 General			
1.1 Structure height	The structure was deigned 12m high, however, site measurement provided by Council 16.8m high, Council/designer to confirm the height.		Open
1.2 Structure Important Level	Opus designed IL1, Gurit design report mentioned IL1 and IL2, Please clarify the IL adopted in the final design.		Open
1.3 Deflection	As advised in the Tel conference by Council, deflection is not the concern.		Closed
2.0 Opus design			
2.1 Design calculation	The structure was designed for IL1, TC2, 15m high, 316 stainless steel structure with associated foundation. Connection design as per CIDECT Design Guide 1 for hollow section. The structure was treated as isolated structure under IL1, NZS1170. However, can argue which is IL2 structure due to the number of public attending. Other design assumptions and the design procedure are reasonable. Due to the manufacturing difficulty, the material of the structure has changed to carbon fibre.		Closed
2.2 Procedure statement	Opus provided PS1 for the SS structure and foundation, and PS4 for the foundation only. <ul style="list-style-type: none"> a. PS1: Due to the changed material as mentioned in 1.1, PS1 need to be revised to reflect the changes. b. PS4: missing CPEng number and signature c. As per Tel conference with Council, verbally advised in the meeting, the final design of structure was 		<ul style="list-style-type: none"> a. Open b. Open c. Open



Project:	Hemo Gorge Sculpture	Purchase order:	RLP020949
Job No:	2287-1	Date:	28/01/2021
By:	SW	Page:	2

	based on IL2, Opus to confirm if the foundation design still valid.		
3.0 Gurit design	<ul style="list-style-type: none"> a. Design report: design report needs to update to reflect the changes in the final detail design adopted. b. Calculation: <ul style="list-style-type: none"> 1. loading: please advise either IL1 or IL2 wind loading in the model. 2. several iteration (x7) were done in detail design to work out the economic solution between the deflection and the weight of the structure, however, nowhere mentioned which iteration was adopted in the final design. c. Connection to foundation: 300mm high steel sleeve was adopted as intermediate member to connection the plinth and the carbon fibre superstructure, please provide the calculation or test data to prove the SS sleeve and connection have the capacity. d. Drawing: <ul style="list-style-type: none"> 1. Missing dry pack from the photos Council provided, please advise if the dry pack been installed. 2. Again, not sure the construction drawing was based on which model in the detail design. Please clarify. e. Specification: no specification provided. Please advise how the structure being protected to react the environmental effects, such as UV protection, maintenance schedule. 		<ul style="list-style-type: none"> a. Open b. Open c. Open d. Open e. Open



Project:	Hemo Gorge Sculpture	Purchase order:	RLP020949
Job No:	2287-1	Date:	28/01/2021
By:	SW	Page:	3

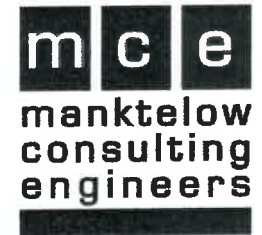
<p>4.0 Test report</p>	<p>Two test reports been reviewed. Report dated in 27 Nov 2020. Material defects were identified during the construction, a couple of sections were cut and sent to lab for testing. The test result failed, and further testing required. Then leads to test report dated 12th Oct 2020, test shown the material has the enough capacity. Approval was granted.</p> <ul style="list-style-type: none"> a. In the report mentioned the structure not built to specification. The approval was only for the cut section being testing, who provide QA for the overall structure, please advise. b. The cut sections have been re installed, nowhere to talk about the re installation methodology in order to develop the required capacity. Please advise. 		<ul style="list-style-type: none"> a. Open b. Open
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Appendix B

MCEL peer review log revision 2

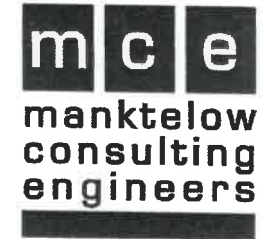
Project:	Hemo Gorge Sculpture	Purchase order:	RLP020949
Job No:	2287-1	Date:	03/02/2021
By:	SW	Page:	1

Items	MCEL Queries/Comments	Designer Response	Status
1.0 General			
1.1 Structure height	The structure was deigned 12m high, however, site measurement provided by Council 16.8m high, Council/designer to confirm the height.	<p>Gurit: based on manufacturing files and anecdotal evidence from site visits to Kilwell during construction we believe the sculpture is the correct height of 12m.</p> <p>RLC to organise site measure to confirm</p> <p>See attached documentation: 210202 Te Ahi Tupua Height Measurement Letter</p>	Closed
1.2 Structure Important Level	Opus designed IL1, Gurit design report mentioned IL1 and IL2, Please clarify the IL adopted in the final design.	<p>Gurit: sculpture is designed to withstand wind loads at IL2</p> <p>Refer: GU6706-6001 Rev C Hemo Gorge Sculpture Design Basis Report, and OPUS documents: 210128 Te Ahi Tupua IL Clarification Letter</p>	Closed
1.3 Deflection	As advised in the Tel conference by Council, deflection is not the concern.		Closed
2.0 Opus design			
2.1 Design calculation	The structure was designed for IL1, TC2, 15m high, 316 stainless steel structure with associated foundation. Connection design as per CIDECT Design Guide 1 for hollow section. The structure was treated as isolated structure under IL1, NZS1170. However, can argue		Closed



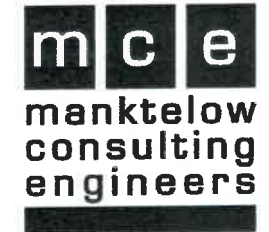
Project:	Hemo Gorge Sculpture	Purchase order:	RLP020949
Job No:	2287-1	Date:	03/02/2021
By:	SW	Page:	2

	which is IL2 structure due to the number of public attending. Other design assumptions and the design procedure are reasonable. Due to the manufacturing difficulty, the material of the structure has changed to carbon fibre.		
2.2 Procedure statement	Opus provided PS1 for the SS structure and foundation, and PS4 for the foundation only. <ul style="list-style-type: none"> a. PS1: Due to the changed material as mentioned in 1.1, PS1 need to be revised to reflect the changes. b. PS4: missing CPEng number and signature c. As per Tel conference with Council, verbally advised in the meeting, the final design of structure was based on IL2, Opus to confirm if the foundation design still valid. 	<ul style="list-style-type: none"> a. b. refer attached: 2020_11_05 Hemo Rbt Sculpture Foundation PS4_Signed updated c. 	<ul style="list-style-type: none"> a. Closed_ref WSP provided letter b. Closed c. Closed_ref WSP provided letter
3.0 Gurit design	<ul style="list-style-type: none"> a. Design report: design report needs to update to reflect the changes in the final detail design adopted. b. Calculation: <ul style="list-style-type: none"> 1. loading: please advise either IL1 or IL2 wind loading in the model. 2. several iteration (x7) were done in detail design to work out the economic solution between the deflection and the weight of the structure, however, nowhere mentioned which iteration was adopted in the final design. 	Gurit: <ul style="list-style-type: none"> a. please specify details in question. MCEL to please expand on/specify details. Reports revised, refer to latest revisions, attached: GU6706-6001 Rev C Hemo Gorge Sculpture Design Basis Report, GU6706-6002 Rev B Hemo Gorge Sculpture Design Report b. 	<ul style="list-style-type: none"> a. Closed b. Closed c. Closed d. Closed e. Closed_ref Te Ahi Tupua Sculpture maintenance plan_ titled Hemo George Sculpture 'Te Ahi Tupua' Maintenance/inspection schedule



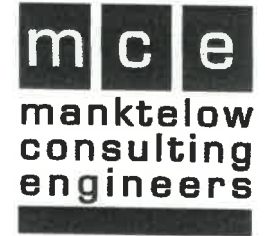
Project:	Hemo Gorge Sculpture	Purchase order:	RLP020949
Job No:	2287-1	Date:	03/02/2021
By:	SW	Page:	3

	<p>c. Connection to foundation: 300mm high steel sleeve was adopted as intermediate member to connection the plinth and the carbon fibre superstructure, please provide the calculation or test data to prove the SS sleeve and connection have the capacity.</p> <p>d. Drawing:</p> <ol style="list-style-type: none"> 1. Missing dry pack from the photos Council provided, please advise if the dry pack been installed. 2. Again, not sure the construction drawing was based on which model in the detail design. Please clarify. <p>e. Specification: no specification provided. Please advise how the structure being protected to react the environmental effects, such as UV protection, maintenance schedule.</p>	<ol style="list-style-type: none"> 1. As per GU6706-6001 Rev B Design Basis Report, section 6.1.1, discussions with parties involved concluded that the sculpture could be designed using wind pressures at IL2 level but considered as an accidental load case with reduced material factors. IL1 level wind loads were also evaluated using material factors for short term loading. 2. Is this referring to the preliminary design report? The final design was closest to the m04_comp_strength option. However, the laminate thicknesses had to be increased after initial testing showed Kilwell were achieving a low compressive strength, and a more detailed model found additional stiffness was required to try and unload the chevron plates. <p>c. Refer 20180803080433849.pdf,</p>	
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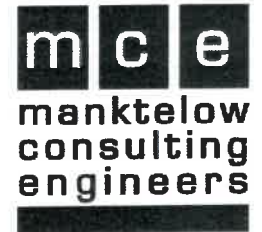
Project:	Hemo Gorge Sculpture	Purchase order:	RLP020949
Job No:	2287-1	Date:	03/02/2021
By:	SW	Page:	4

		<p>attached, for intermediate connection detail provided by OPUS, received 07-08-2018.</p> <p>OPUS to provide calculations verifying capacity.</p> <p>Also refer to <i>GU6706-6002 Rev A Hemo Gorge Sculpture Design Report</i> section 8.4 Foundation attachment. While primarily to test the adhesive connection, the intermediate member was also stressed to above ULS load without failure.</p> <p>d.</p> <ol style="list-style-type: none"> 1. Kilwell or RLC to confirm if drypack has been installed RLC/Kilwell have confirmed drypack installed. 2. There is only one design that was worked on in the detailed design phase. The construction drawings are based on this design. <p>e. Kilwell to provide details on paint finish for UV stabilisation and maintenance schedule</p>	
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Project:	Hemo Gorge Sculpture	Purchase order:	RLP020949
Job No:	2287-1	Date:	03/02/2021
By:	SW	Page:	5

<p>4.0 Test report</p>	<p>Two test reports been reviewed. Report dated in 27 Nov 2020. Material defects were identified during the construction, a couple of sections were cut and sent to lab for testing. The test result failed, and further testing required. Then leads to test report dated 12th Oct 2020, test shown the material has the enough capacity. Approval was granted.</p> <ul style="list-style-type: none"> a. In the report mentioned the structure not built to specification. The approval was only for the cut section being testing, who provide QA for the overall structure, please advise. b. The cut sections have been re installed, nowhere to talk about the re installation methodology in order to develop the required capacity. Please advise. 	<p>Gurit:</p> <ul style="list-style-type: none"> a. QA for overall structure is responsibility of Kilwell. Kilwell were to ensure that laminates met required strength targets. Testing was carried out to this effect and design strengths were adjusted to match the results from the as built samples. However, budget restraints meant that not all properties were tested. Interlaminar shear was not tested and a typical value was used (interlaminar shear was not a critical failure method). The subsequent testing carried out on the cut section applied the maximum loading from all inner tube connections to what we believed was likely to be one of the worst quality connections. The fact that this combination was able to exceed the maximum expected load gave confidence that a low interlaminar strength, as observed via the 	<ul style="list-style-type: none"> a. Closed b. Closed
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Project:	Hemo Gorge Sculpture	Purchase order:	RLP020949
Job No:	2287-1	Date:	03/02/2021
By:	SW	Page:	6

		<p>coupon testing method (note: this test method does not capture the positive influence of the geometric shape of the tubes on the apparent interlaminar strength), is not likely to impact the strength of the structure.</p> <p>b. The same specification that was used to repair tubes that were cut and re-assembled during manufacture (to correct geometric defects) was used to repair the tubes on site. Refer drawing GU6706_RevA Inner Tube Scarf Repair 20190501.pdf attached.</p>	
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Form 9

CERTIFICATE OF ACCEPTANCE

Section 99, Building Act 2004

The Building

Street address of building: **FENTON STREET, ROTORUA**

Legal description of land where building is located: **ROAD SO511954**

Building name: **HEMO ROAD SCULPTURE**

Location of building within site/block number:

Level/unit number:

The Owner

Name of owner: **ROTORUA DISTRICT COUNCIL**

Contact person: **MARC SPIJKERBOSCH**

PRIVATE BAG 3029

ROTORUA MAIL CENTRE

ROTORUA 3046

Street address/registered office: **1061 HAUPAPA STREET**

Phone number: **3484199**

Email address:

Acceptance of Compliance

The Territorial Authority named below, being satisfied, to the best of its knowledge and belief and on reasonable grounds, that, insofar as it can ascertain, the building work described below complies with the building code: Refer to the full COA application held on Council's property file for further information/clarification.

The Territorial Authority was only able to inspect the following parts of the building work identified above and this certificate is qualified as follows:

NZ Building Code Clauses Met: B1 Structure, B2 Durability

NZ Building Code Clauses Not Met: None

NZ Building Code Clauses Not Applicable: Remainder to code clauses

Nothing in this certificate limits the requirements that a person must not carry out building work except in accordance with a building consent, nor does it relieve any person from the requirements to obtain a Building Consent for building work.

Attachments

*Compliance schedule - NA



Signature

Manager Building Services

On behalf of: **ROTORUA DISTRICT COUNCIL (OPERATING AS ROTORUA LAKES COUNCIL)**
Date: **15 February 2021**

