Te Tai Tokerau Water Trust  
andrew.carvell@taitokerauwater.com  

24 September 2020  
Our Ref: 200249/MTI-J

Attention: Mr Andrew Carvell

Dear Mr Carvell

RESPONSE TO EXPERT CONSENTING PANEL  
MATAWII WATER STORAGE RESERVOIR PROJECT

1.0 Introduction

The following has been prepared in response to a question raised by the Expert Consenting Panel (ECP) for the Te Tai Tokerau Water Trust Application for the Matawii Dam. In particular the ECP asks:

The design of the dam is at best conceptual at this time. Does/do the applicant(s) accept it will likely need to be made the subject of comprehensive conditions of consent ensuring the following: dam safety requiring thorough investigation and design, meticulous construction, built-in safety factors, comprehensive drainage (collection and monitoring), carefully monitored commissioning, knowledgeable and responsible operation, timely maintenance, independent ongoing review at all stages; all pursuant to milestones requiring expert engineer review and certification and adherence to the Dam Safety Guidelines?

At the time that the application was made the dam design was, as noted in the question, at a conceptual stage.

Since the application was made significant progress has been made on the dam design and this review provides an update on progress and the design approach adopted. It also provides details of how the development process will progress beyond design, to construction and operation of the dam and associated structures.

2.0 General

The New Zealand Society on Large Dams, Dam Safety Guidelines 2015 (NZDSG) have been used as the principle guidance document throughout the design process. It is important to recognise that these are guidelines and the processes, methodologies and criteria provided in the NZDSG should be seen in this context. A key aspect of the approach to dam safety promoted in the NZDSG is that:

These Guidelines promote the use of robust and resilient features and systems to reduce the risk of dam failure from unexpected and unpredictable events and occurrences. Resilience in this context is the capacity of the structure or system to withstand changing conditions caused by sudden shocks, gradual stresses, and cumulative change.¹

¹ NZDSG, Module 3, Section 1.2.
The NZDSG do not preclude the use of alternative design methodologies and criteria. It is considered good practice in New Zealand, however, that any design methodology adopted should still be consistent with the primary objective and associated principles provided in the NZDSG.

The Matawii Dam is relatively typical in terms of geotechnical setting, configuration, and design layout. As such the guidance provided in the NZDSG have been adopted with no need to adopt alternative design solutions.

In recognition of the guidance provided in the NZDSG a resource consent condition for the design, construction and operation of dams will often be provided that simply states that:

The dam shall be designed, constructed, and maintained in accordance with the objectives and principles of the New Zealand Society on Large Dams (NZSOLD) Dam Safety Guidelines 2015 or appropriate updated version of these Guidelines.

3.0 Investigation and Design

The full design has progressed measurably since the conceptual design provided in the application for resource consent. The overall design philosophy for Matawii has been:

- Consistency with the objective and principles in the NZDSG.
- Adoption of the NZSOLD design criteria for a dam of equivalent Potential Impact Classification (PIC).
- Use of a lead dam design engineer experienced in design of comparable dams.
- Use of an independent peer reviewer that also has demonstrable experience in the design of comparable dams.

Through the design process the Matawii Dam has been confirmed as having a PIC of high. This requires the adoption of the highest design criteria recommended in the NZDSG and this has been the case for the Matawii Dam. It also sets the highest requirement in terms of design experience. The NZDSG note that:

The lead designer should have had prior experience as a lead designer for a similar High PIC dam or should have been a major contributor to the design of a similar High PIC dam.²

The lead designer for Matawii has undertaken the lead design role for previous high PIC earthfill dams as well as extensive experience in the upgrade and performance assessments of large dams.

Similarly, the NZDSG note that for High PIC dams:

A formal peer review of the investigation, design and construction by an independent experienced engineer should be a mandatory requirement. The reviewer(s) should have a sound background of experience in the type of dam being designed and constructed.³

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² NZDSG, Module 3, Section 3.4
³ NZDSG, Module 3, Section 3.4
The peer reviewer for Matawii is David Bouma of Tonkin + Taylor Ltd (T+T). Details of the team T+T have on the project are attached. As can be seen there is extensive experience in the design, upgrade, and performance assessments of dams.

3.1 Status of Design Process

The current status of the design process is:

Geotechnical Assessment and Report
Completed and reviewed by independent peer reviewer (IPR). Copy of the report dated 19 August 2020 attached. Ready for accompanying building consent application.

Hydrology and Hydraulic Design
Final draft. First review from IPR complete with associated comments being incorporated. Final report and drawing will go to the IPR in the next few days. Will be completed for accompanying building consent application.

Design Report and Specifications
Full draft 80% complete with IPR having provided feedback from their first full design review. Final report and specification anticipated within the next week for final IPR assessment. Will be completed for accompanying building consent application.

Building Consent Authority (BCA)
Pre-building consent liaison has been undertaken with the BCA (Environment Waikato). The BCA understand the nature of the application and has appointed an independent application regulatory reviewer.

It should be inherent in the above process that design rigour and review is primarily a matter for the building consent process as opposed to the resource consent process accepting that the panel still has a role in satisfying itself as to safety requirements and that appropriate conditions apply.

While it was always the intent for the Matawii Dam to obtain building consents, it is reasonable to expect a condition of resource consent that requires building consents to be obtained. This should ensure that the correct level of rigour is applied to the dam design process. This in turn will adequately mitigate the potential effects of low probability high consequence that can arise from a design related criterion which is a relevant consideration within the Resource Management Act.

4.0 Construction and Commissioning

The design and specifications developed during the design phase, and that form the fundamental performance metrics within the building consents, also provide the core instructions and quality assurance requirements for dam construction and commissioning.

It is almost certain that adjustments to the design will be required during construction to address variations in ground conditions only evident once construction starts. These will be subjected to variation processes under the building consents and as such will follow the same process of design and review as adopted through the design phase. For this reason, the NZDSG recommend continuity of design resource from the design phase through construction and commissioning.
The continuity of designer, technical specialist, and peer reviewer inputs from the design process through construction is essential for medium and high PIC dams. This continuity is important as it enables actual site conditions to be evaluated against design assumptions, and the determination of whether any design changes are necessary for the actual site conditions.\(^4\)

It is difficult to codify the performance metrics associated with construction and commissioning into conditions of resource consent as requirements will evolve in line with adjustment to dam design as construction progresses. Prescriptive consent conditions are unlikely to cover all aspects of construction. Similarly, commissioning processes and associated performance criteria will need to reflect the specifics of the structure once it is a physical entity including all design adjustments made.

In terms of conditions of resource consent therefore, it may be deemed necessary to have more than an overarching condition of consent as provided in Section 2.0. Performance rigour would be ensured through the requirement for appropriate management plans for example. These could be conditions requiring submission of:

- A Construction Management Plan (CMP) to the consent authority prior to construction commencing and as a minimum detailing:
  - The process for dealing with design adjustments including notification protocols.
  - Key construction quality performance metrics and processes for dealing with performance deviations.
  - Periodic review requirements for the CMP; and
- A Commissioning Management Plan (ComMP) to the consent authority prior to first filling of the reservoir and as a minimum detailing:
  - The key commissioning stages and any associated reservoir hold points.
  - Key performance metrics and processes for dealing with performance deviations.
  - Core commissioning documentation and verification processes.
  - Any review requirements for the ComMP.

5.0 Operation and Maintenance

The operation and maintenance requirements of the dam will be refined throughout the construction and commissioning phase and on into the operational life of the structure. The NZDSG Guidelines recognise that each dam is unique and hence dam safety is not a case of a mass-produced process. This means providing conditions of consent that are relevant to the ‘all of life’ management of a dam cannot be easily codified.

The NZDSG recommended a Dam Safety Management System (DSMS) be developed for every dam. In particular the DSMS:

Should detail procedures and activities for the management of dam safety, and importantly, provide an auditable record of dam performance and owner commitment to dam safety.\(^5\)

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\(^4\) NZDSG, Module 4, Section 2.2.
\(^5\) NZDSG, Module 5, Abstract
The primary reason for managing dam safety performance through a DSMS is because dams have exceptionally long lives and therefore need to adopt a proactive, all of system, approach to ensure safety operation over many decades as the dam ages and requires maintenance and rehabilitation. The DSMS will contain as a minimum\textsuperscript{6}:

- A dam safety policy, dam safety statement or dam safety standard.
- A description of the dam safety management system and its elements including dam safety management activities and resources for completing these activities.
- Responsibilities and procedures for implementing the dam safety management system.
- Procedures for checking and reviewing the performance of the dam and the dam safety management system.
- Procedures for identifying and addressing any dam safety issues, including deficiencies in the performance of the dam and the dam safety management system.
- Procedures for regular reporting on the performance of the dam and the adequacy of the dam safety management system to the owner and, where appropriate, regulators.
- Appropriate supporting systems for management, staff training, communications, and information management.

Importantly, the DSMS document is in itself part of the DSMS so it is incorporated into the requirement for periodic reviews and hence appropriate updates overtime.

If therefore it is deemed necessary to have specific resource consent conditions relating to the dam safety aspects of operation and maintenance, rather than the overarching condition noted in Section 2.0, this would normally be along the lines of requiring the provision and periodic review of a DSMS.

6.0 Limitation

This report has been prepared solely for the benefit of Te Tai Tokerau Water Trust as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

Yours faithfully
RILEY CONSULTANTS LTD

Prepared by:  
Peter Lilley  
Director

Reviewed and approved for issue by:  
Don Tate  
Director, CPEng

\textsuperscript{6} Extracted from NZDSG, Module 5, Section 1.
### David Bouma – Technical Director – Dams and Rivers

**ME (Dist), BE (1st Class Hons), CPEng, IntPE**

David is a Technical Director for Dam and River related projects for Tonkin + Taylor Group. He is a senior civil and environmental engineer with 33 years' experience in water resources, civil and environmental engineering projects in New Zealand, South East Asia, the Pacific and Africa. David has specialist expertise in dam engineering and dam safety and is a member of the management committee for the New Zealand Society of Large Dams (NZSOLD), and represents NZSOLD on the International Commission on Large Dams (ICOLD) Technical Committee on Levees.

David has a wide range of experience in water resources engineering including specialist skills in river management and engineering, flood protection scheme analysis, design and management, dam safety and engineering, hydrological and hydraulic analysis, hydrogeology, and construction management. Project experience includes a previous engineering assessment of the Mangahao HEPS to help our client understand the potential risk of failure of the key structures as part of an insurance risk assessment.

### Kevin Hind – Technical Director – Engineering Geology

**M.Sc (Hons) Earth Sciences CEngNZ (PEngGeo)**

Kevin is a Principal of Tonkin + Taylor and Technical Director of Engineering Geology. He has 34 years of engineering geology and geotechnical engineering consulting experience gained from projects undertaken in many countries including Burma, Indonesia, Philippines, Papua New Guinea, Japan, Jordan, New Zealand, Australia, Pitcairn Island, Saudi Arabia, Singapore, Switzerland, United Kingdom, United Arab Emirates and Vanuatu.

Based in Auckland for the past 18 years, Kevin undertakes a wide range of geological and geotechnical work with a major focus on large infrastructure developments, natural hazards, and risk assessments. For more than a decade Kevin has been primarily involved with major water and wastewater projects which has encompassed dams, tunnels, pipelines and treatment facilities.

Kevin is very familiar with the geology of the Kaikohe-Ngāwhā Springs area having been geotechnical lead for the two major stages of expansion at the Ngāwhā Geothermal Power undertaken between 2006 and 2020. Kevin has provided expert witness evidence to the International Court of Arbitration (London), the Supreme Court of Western Australia, the New Zealand Environment Court and various Council hearings.

### David Leong – Technical Director – Hydrology

David is a Technical Director and Senior Principal of Tonkin + Taylor, and a chartered professional engineer with 30 years of experience in all aspects of hydrology and hydraulics. His analytical and design skills are broadly based, derived from irrigation, water supply, flood management, transportation and hydropower projects from conceiving study level to detailed design, as well as forensic investigations.

David's specialist areas include dam safety, flood hydrology, bridge scour, design of hydraulic structures and water resource assessments. He has given expert evidence on many occasions, and has acted for council as reviewer for large scale water resource projects.

Working alongside experts from other disciplines David has developed an excellent appreciation of the engineering, economic, social and environmental issues associated with water resource development on New Zealand rivers. For his experience, insight and
expertise, he has been retained as technical advisor and peer reviewer by a number of T+T’s key client organisations.

David is an excellent technical innovator but also keenly pragmatic. He was presented the Arch Campbell award in 2016 and made a Fellow of Engineering New Zealand principally for his contribution to the advancement of hydrology knowledge and practice over many years.

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<tr>
<th>Dewi Knappstein - Senior Dam Engineer – Internal Reviewer</th>
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<tr>
<td><strong>BE (1st Class Hons), BA</strong></td>
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<td>Dewi is a senior water resources and geotechnical engineer with 15 years’ experience in geotechnical investigation, hydraulic design, dam design, dam safety management, stormwater design, and coordination of multi-disciplinary projects. This experience has been accrued on flood management, irrigation, water supply, hydroelectric and road projects in New Zealand, Australia, Malaysia and the Philippines.</td>
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<td>She is Tonkin + Taylor’s Business Leader (Dams), a member of the Management Committee of the New Zealand Society on Large Dams (NZSOLD), and Co-chair of NZSOLD’s Young Professionals Group.</td>
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<td>Dewi also has previous experience with local materials and geology, having provided an on-site design interface during construction of a water supply dam at Ngāwhā Geothermal Power Station. Other project experience includes detailed design of the 53m high Waimea Community Dam.</td>
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