IN THE MATTER of the Resource Management Act 1991 ("RMA" or "the Act")

AND

IN THE MATTER of a submission by **AMBURY PROPERTIES LIMITED** in respect of the **PROPOSED WAIKATO DISTRICT PLAN** pursuant to Clause 6 of Schedule 1 of the Act seeking the rezoning of land at Ohinewai

STATEMENT OF EVIDENCE OF MURRAY GRANT WEBBY IN RESPECT OF FLOODING AND FLOOPLAIN MANAGEMENT

1. INTRODUCTION

1.1 My full name is Murray Grant Webby. I am a Principal Hydraulic Engineer with Damwatch Engineering Limited. I have worked for Damwatch Engineering since June 2016. Prior to my current position I held the position of Principal Hydraulic Engineer with Opus International Consultants. I was previously employed by Opus International Consultants and its predecessor organisations, Works Consultancy Services, Works and Development Services Corporation and the Ministry of Works and Development for 35 years.

1.2 I hold a Bachelor of Engineering (1st Class Honours) degree in Civil Engineering, which I obtained in 1978. I also hold a Doctor of Philosophy degree in Civil Engineering, which I obtained in 1981. Both degrees were from the University of Canterbury. I have over 37 years' experience as a hydraulic engineer, working for power generation companies in New Zealand and overseas, New Zealand government departments and agencies, regional and district councils, and private companies.

1.3 I am a Chartered Professional Engineer. I am also a Fellow of Engineering New Zealand and a member of the NZ Society on Large Dams, the NZ Hydrological Society, the Engineering NZ / Water NZ Rivers Group and the International Association for Hydro-Environment Engineering and Research.

1.4 In my role as a technical specialist, I am often called upon to provide expert evidence on:

(a) The management and operation of natural lakes and lakes controlled for hydro-electricity generation purposes, and on the hydrological and climatological processes affecting such lakes; and

(b) The management of natural hazards on floodplains and the effects of those hazards on infrastructure.

1.5 In 2019, I advised Meridian Energy (Meridian) on the history of lake level changes for Lake Pukaki, the dynamic and natural processes affecting the lake, the current lake level management regime for the lake, extreme flood inflows and lake levels, lakeshore inundation due to high lake levels, wind effects and waves, and shoreline erosion. I provided a written affidavit on these matters in support of Meridian against a civil claim by Guide Hill Station Limited for the return of land compulsorily acquired under the Public Works Act before the lake level was raised in 1979. I provided evidence in support of Meridian's defence that the land acquired by the Crown for the generation of hydro-electricity is subject to erosion processes and required for its original purpose being the generation of electricity.

1.6 From 2011-2016, I advised the New Zealand Transport Agency on flood hazards affecting four significant watercourse crossings of the proposed Peka Peka to North Otaki Expressway north of Wellington. I was the hydraulic designer for these watercourse crossings and presented evidence on natural flood hazards and the design of the watercourse crossings to the Board of Inquiry which considered the resource consent application for the proposed Expressway.

1.7 From 1998-2002, I advised Mercury NZ's predecessor organisations, Mighty River Power Limited and the ECNZ Northern Generation Group, on the impact of hydropower operations on the Lower Waikato River during investigations to support the renewal of resource consents for the Waikato Hydro System. This included the impact of hydropower operations on flood management.

1.8 I have been advising Mercury NZ Limited (Mercury), as the owner and operator of the Waikato Hydro System, on wider floodplain management issues in the Lower Waikato River including the proposed Ambury Properties Limited (APL) development and the rezoning of land for it at Ohinewai.

1.9 These matters are of interest to Mercury as it works closely with Waikato Regional Council (being the statutory flood manager) in relation to the operation of the Waikato Hydro System during times of flooding. The Waikato Hydro System can attenuate some, but not all, flooding, and so the proper management of flooding risk in the Lower Waikato River is of interest to Mercury.

1.10 APL's site lies within the flood storage zone for Lake Waikare. The proposed development of this site will have two impacts in relation to flooding, (1) stormwater runoff from the developed site draining into Lake Waikare; and (2) encroachment into the flood storage zone for Lake Waikare due to the proposed infilling of the site to raise ground levels (itself a response to flooding concerns). The appropriate resource management response to these impacts, and how the District Plan addresses issues like this more generally (including future cumulative effects), needs to be determined in my opinion.

1.11 I participated in the expert conference held on 17 June 2020 which considered the impact of the APL development on flooding in Lake Waikare. I am a signatory to the joint witness statement agreed by the experts in relation to flooding.

1.12 I understand that there were several proposals relating to the development of land around Ohinewai and Lake Waikare addressed in submissions on the Proposed Plan, and on which Mercury was a further submitter due to concerns around the management of flooding risk (for example the proposals outlined in the submissions by Ohinewai Lands Limited and Shand Properties Limited). The APL proposal is, as I understand it, the only proposal on which sufficient information has been made available in order to assess the effects and issues of concern to Mercury, and as a result it has been the focus of expert conferencing and the like (including direct discussions between APL and Mercury for example).

Scope of statement

1.13 This statement of evidence is an extended version of my summary statement drafted for the expert conference on 17 June 2020.

1.14 This statement:

(a) Identifies key documents which contain information relevant to the consideration of flooding issues in relation to the proposed APL development (Section 2);

(b) Provides a summary of information related to Lake Waikare which is a key off-channel flood storage component of the Lower Waikato-Waipa Flood Control Scheme (Section 3):

(c) Highlights the key impacts of the APL development and other potential future developments within the area covered by the Ohinewai Structure Plan on the flood storage function of Lake Waikare (Section 4);

(d) Emphasises the importance of the design flood level of RL 7.37 m for Lake Waikare (Section 5); and

(e) Sets out my conclusions (Section 6).

Expert Witness Code of Conduct

1.15 I confirm I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note (2014) and agree to comply with it. I can confirm that the issues addressed in this statement are within my area of expertise and that in preparing my statement I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

2. DOCUMENTS REVIEWED

2.1 I have reviewed the following documents which are relevant to flooding and floodplain management issues affecting the proposed APL development at Ohinewai.

(a) "Ambury Development Flood Assessment", letter from Tonkin and Taylor Limited to Waikato Regional Council dated 8 June 2020 (T&T, 2020a).

(b) "Lake Waikare Storage Volumes – Final report", letter from Discovery Marine Limited to Environment Waikato dated 11 June 2004 (DML, 2004).

(c) "The Waikato Regional Flood Event of 9-20 July 1998", paper prepared by A J Munro, Flood Duty Officer, Environment Waikato and published in the Australasian Journal of Disaster and Trauma Studies, Volume 1998-2 (Munro, 1998).

(d) "Flood Assessment, Sleepyhead Estate, Ohinewai", report prepared by Wood and Partners Consultants Limited for Ambury Properties Limited, November 2019 (Woods, 2019).

(e) Summary Statement of Ajay Desai in respect of flooding in preparation for expert conferencing, dated 29 May 2020 (Desai, 2020).

(f) Joint Witness Statement of experts in relation to flooding dated 18/19 June 2020 (JWS, 2020).

(g) "WRC Lower Waikato 2D Modelling: Huntly, Ohinewai and Horotiu Model Build", report prepared by DHI Water and Environment Limited for Waikato Regional Council, 25 February 2020 (DHI, 2020).

(h) "Lower Waikato River Model Review", letter report prepared by Tonkin and Taylor Limited for Waikato Regional Council, 18 May 2020 (T&T, 2020b).

(i) "Lower Waikato Waipa Flood Control Scheme Review, Part A – Hydraulic / Hydrological Evaluation", Waikato Valley Authority Technical Report No. 25, 1983 (WVA, 1983).

3. BACKGROUND INFORMATION

Lake Waikare

3.1 Lake Waikare forms an integral component of the Lower Waikato-Waipa Flood Control Scheme which was originally developed in the early 1960's T&T, 2020a). The lake functions as an off-channel storage facility for significant flood events in the Lower Waikato River.

3.2 In 1965, the level of Lake Waikare was lowered. Since then, the lake has been controlled within a range of RL 5.4-5.75 m (Moturiki Vertical Datum 1953) (T&T, 2020a) to provide flood storage for a 1% annual exceedance probability (AEP) flood in the Lower Waikato River. The storage capacity of the lake includes a 600 mm freeboard allowance on the assessed 1% AEP design flood level of RL 7.37 m.

3.3 The flood storage function of the lake was achieved by constructing stopbanks to isolate the lake from the Waikato River to the west and the Whangamarino River to the north (T&T, 2020a). The stopbank along the Waikato River is designed to contain a 1% AEP flood in the river with 600 mm freeboard. The stopbank along the northern foreshore of the lake is also

designed to contain an assessed 1% AEP flood level plus 600 mm freeboard. It was constructed with a crest level of RL 8.0 m.

3.4 The flood storage volume required to be contained in Lake Waikare due to all sources of inflow was assessed to be 77 million cubic metres (WVA, 1983; T&T, 2020a). This was calculated to raise the level of Lake Waikare from an initial starting level of RL 5.65 m up to a level of RL 7.37m, designated as the design flood level for the lake. The actual flood storage volume between these levels has since been estimated to be approximately 82 million cubic metres (DML, 2004).

Lake Inflows and Outflows

3.5 Inflows to Lake Waikare from the Waikato River occur via the Te Onetea Control Gate and the Rangiriri Spillway (T&T, 2020a – refer Attachment 1):

(a) The Te Onetea Stream incorporates a culvert fitted with a control gate to throttle stream flows. The control gate is closed off to prevent lake outflows to the Waikato River when river levels are lower than lake level. The control is also closed off to prevent Waikato River flow from entering the lake when river levels exceed RL 7 .0 m.

(b) The 1.2 km long Rangiriri Spillway forms part of the right bank stopbank along the Waikato River. The crest of the spillway is also formed by State Highway 1. When river levels exceed the crest level of RL 8.8-9.2 m, flow is diverted from the river into Lake Waikare.

3.6 Natural inflows to Lake Waikare include direct rainfall on the lake surface and inflows from the surrounding catchment (T&T, 2020a):

(a) The surface area of Lake Waikare is approximately 35 km^2 at a level of RL 5.6 m (DML, 2004). This increases to approximately 57 km^2 at the assessed 1% AEP design flood level of RL 7.37 m. Rainfall falling on the lake surface contributes directly to an increase in lake level.

(b) The area of the natural catchment is approximately 210.5 km^2 from NIWA's WRENZ website. A significant proportion of the natural catchment inflow is sourced from the Matahuru Stream which has a catchment area of approximately 106.3 km^2 from the same website.

3.7 Outflows from Lake Waikare occur via the Waikare Northern Outlet Control Gate (Waikare Gate) and the Northern Foreshore Spillway (T&T, 2020a – refer Attachment 1):

(a) The Waikare Gate is a control structure outlet within the Northern Foreshore Stopbank which discharges lake outflows via the Pungarehu Stream into Lake Whangamarino and the Whangamarino Wetland. It is used to control the level of Lake Waikare between RL 5.4 and 5.75 m under non-flood conditions. The control gate is required to be closed during a Waikato River flood event which is defined as being when the river level at the Te Onetea Gate exceeds RL 7.0 m and the river level at the Whangamarino River Outlet exceeds RL 4.0 m.

(b) The Northern Foreshore Spillway is located at the western end of the Northern Foreshore Stopbank on Lake Waikare. The spillway has a crest length of 73 m and the crest level is set at RL 7.36 m (T&T, 2020a). It allows floodwaters stored in Lake Waikare above the assessed 1% AEP design flood level of RL 7.37 m to spill out of the lake across farmland to the north and eventually into the Whangamarino Wetland. The spillway discharge capacity is limited so that, if flow diversion from the Waikato River over the Rangirri Spillway continued to occur in an extreme flood while the Waikare Gate remained closed, lake levels could continue to rise to a level of RL 8.0 m. At this lake level, the Northern Foreshore Stopbank would be overtopped. There would also be widespread flooding in the Lower Waikato Valley.

Key Lake Levels

3.8 Lake Waikare is normally controlled between levels of RL 5.4-5.75 m (T&T, 2020a).

3.9 The July 1998 sequence of storm events resulted in high inflows from the local catchment including the Matahuru Stream (Munro, 1998). Floodwaters were diverted into the lake from the Waikato River via the Rangiriri Spillway which operated for the first time in 28 years. The lake level increased steadily from RL 5.60 m on 11 July to a peak of RL 6.29 m on 20 July[1].

3.10 The assessed design flood level for Lake Waikare is RL 7.37 m (T&T, 2020a) which coincides approximately with the crest level of the Northern Foreshore Spillway.

[1] The July 1998 event in the Waikato River had a peak flow of 1,490 m^3/s at Huntly which was only marginally lower than the estimated peak of the February 1958 flood event (1,540 m^3/s). The peak flood flows in the river between Ngaruawahia and Mercer hovered between a 2% AEP and a 1% AEP (Munro, 1998). In some locations, flood levels were higher than in the February 1958 flood event.

3.11 The highest lake level on record is RL 8.38 m which occurred during the February 1958 flood event (Munro, 1998). This occurrence was before the Lower Waikato-Waipa Flood Control Scheme had been constructed.

3.12 Lake levels of RL 6.29 m (July 1998 peak level) and RL 7.37 m (assessed 1% AEP design flood level for the lake) are shown on the topographic map of Lake Waikare attached as Attachment 2. The map has been produced using LiDAR sourced topographic data obtained in 2010-11 and provided by the Waikato Regional Council.

4. IMPACT OF AMBURY PROPERTIES DEVELOPMENT ON LAKE WAIKARE

4.1 The location of the proposed APL development has been marked on the topographic map attached as Attachment 2. The development site is bounded by Lumsden Road to the west, Balemi Road to the north and Tahuna Road to the south. The site lies to the south-west of Lake Waikare but within the margins of the flood storage zone for the lake.

4.2 The proposed APL development will have two impacts in relation to flooding:

(a) Stormwater runoff from the developed site draining into Lake Waikare; and

(b) Encroachment into the flood storage zone for Lake Waikare due to infilling of the development site to raise ground levels.

4.3 The 1.89 km ^{2} area of the development site is small in relation to the natural catchment area for the lake of 210.5 km^2. The post-development storm runoff from the developed site will be small in relation to natural catchment runoff volumes and any overflow volume spilled into the lake from the Waikato River. Any post-development storm runoff is therefore likely to have a negligible effect on flood levels in Lake Waikare in my opinion.

4.4 The encroachment of the proposed APL development into the flood storage zone for Lake Waikare is the more significant concern in my opinion. APL have advised that the amount of infill on the site to the assessed design flood level for Lake Waikare of RL 7.37 m is approximately 400,000 m^3 (refer to the table in Paragraph 3.6 of the Joint Witness Statement of experts in relation to flooding).

4.5 This amounts to a loss of only about 0.5% of the flood storage capacity of Lake Waikare up to a level of RL 7.37 m and a resulting increase in flood level of less than 1 cm for the 1% annual exceedance probability flood (refer

to columns 5 and 6 of the table in Paragraph 3.6 of the Joint Witness Statement of experts in relation to flooding).

4.6 While I consider these effects to be insignificant, it is the cumulative effect of the APL development and other potential developments within the area covered by the Ohinewai Structure Plan (through encroachment into the flood storage zone for the lake) which is of the greatest concern from a flood management perspective. Loss of flood storage capacity within the storage zone for the lake would result in increased flood levels and a reduced capacity to absorb floodwaters diverted from the Waikato River in a significant flood event.

5. IMPORTANCE OF RL 7.37 M DESIGN FLOOD LEVEL FOR LAKE WAIKARE AND NEED FOR ITS INCLUSION ON PLANNING MAPS

5.1 As noted in paragraph 3.4, the required flood storage capacity for Lake Waikare was estimated to be approximately 77 million cubic metres to contain direct rainfall on the lake surface, local catchment runoff into the lake, overflow from the Lower Waikato River and baseflow from local groundwater and tributaries (T&T, 2020a). This was calculated to raise the level of Lake Waikare from an average initial level of RL 5.65 m up to RL 7.37 m, designated as the 1% annual exceedance probability flood level for the lake.

5.2 The 600 mm freeboard allowance on the crest of the northern foreshore containment stopbank provides an additional flood storage buffer of 42 million cubic metres for the lake for events exceeding the 1% annual exceedance probability flood (T&T, 2020a).

5.3 The design flood level of RL 7.37 m for Lake Waikare was last defined in 1983 (WVA, 1983). This level was lower than the design flood level of RL 7.71 m determined in 1959 for the original design of the Lower Waikato-Waipa Flood Control Scheme (WVA, 1959)[2]. It was also much lower than the peak flood level of RL 8.38 m which occurred in the February 1958 flood. I understand that the design flood level has not been reviewed since 1983.

5.4 The storms which give rise to severe floods in the Waikato / Waipa Catchment are generally ex-tropical cyclones. The latest climate change projections for New Zealand indicate that ex-tropical cyclones affecting New Zealand are likely to be "stronger and cause more damage as a result of

[2] Waikato Valley Authority. "Lower Waikato-Waipa Control Scheme", Unpublished Report, 1959.

heavy rain and strong winds" (MfE, 2016)[3]. Based on this, I consider it imperative that the current design flood level for Lake Waikare is retained as the base standard against which the effects of any future development within the local catchment are assessed, pending further review of the design flood level.

5.5 Due to the importance of Lake Waikare as a primary flood storage facility for the Flood Scheme and future climate change projections for New Zealand, the appropriate resource management response to the proposed APL development, and how the District Plan addresses flood storage capacity issues more generally (including future cumulative effects), needs to be determined. I am not a planning expert, but it is my view that the District Plan should:

(a) reference the assessed 1% AEP design flood level of RL 7.37 m for Lake Waikare, for example by appropriately depicting this on the planning maps; and

(b) require that the effects, including cumulative effects, of the APL development and any future development within the above area (including that area covered by the Ohinewai Structure Plan) on the flood storage capacity of Lake Waikare be considered.

6. CONCLUSIONS

6.1 Lake Waikare and the surrounding catchment below RL 8 m is an integral component of the Lower Waikato-Waipa Flood Control Scheme and provides off-channel flood storage capacity for significant floods in the Lower Waikato River. (RL 8.0 m is the crest level of the Northern Foreshore Stopbank.)

6.2 The assessed 1% AEP design flood level for Lake Waikare is RL 7.37 m. The RL 7.37 m contour is marked on the topographic map attached as Attachment 2.

6.3 The proposed APL development at Ohinewai encroaches into the flood storage zone for Lake Waikare resulting in a loss of storage volume of approximately 400,000 m^3 at a lake level of RL 7.37 m.

[3] Ministry for the Environment. Climate Change Projections for New Zealand. Snapshot June 2016, Info 765.

6.4 The proposed Waikato District Plan needs to:

(a) reference the assessed 1% AEP design flood level of RL 7.37 m for Lake Waikare; and

(b) require that the effects, including cumulative effects, of development on the flood storage capacity of Lake Waikare be considered.

Murray Grant Webby

6 August 2020

Attachment 1: Lower Waikato – Waipa Flood Control Scheme at Lake Waikare (sourced from T&T, 2020)

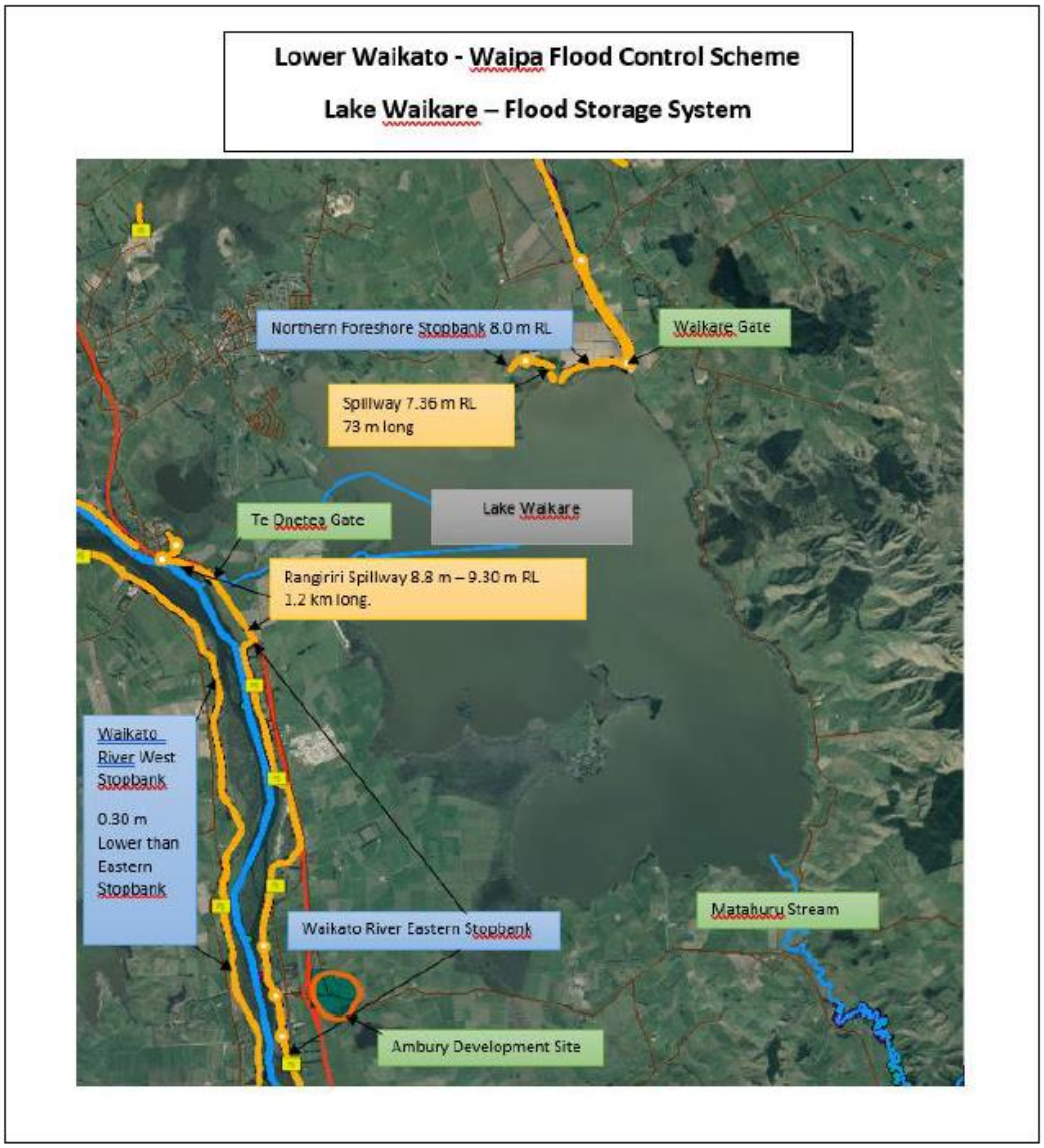

Figure 2.2: Lower Waikato – Waipa Flood Control Scheme at Lake Waikare (source: WRC 2020)

Attachment 2: Topographical Map of Land Around Perimeter of Lake Waikare showing lake levels of

- **RL 6.29 m (July 1998 peak level) and**
- **RL 7.37 m (assessed 1% AEP design flood level for the lake)**