IN THE MATTER of the Resource Management Act 1991

AND

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

STATEMENT OF EVIDENCE OF DAVID STAFFORD

1. INTRODUCTION

1.1 My name is David Henry Alexander Stafford. I am a Senior Hydrogeologist at the consulting firm Pattle Delamore Partners Ltd, specialists in water resources and environmental engineering.

Qualifications and experience

1.2 I hold a Bachelor of Science from the University of Durham (UK) and Master of Science (Hydrogeology), specialising in groundwater science, from the University of Birmingham (UK).

1.3 I am a member of the International Association of Hydrogeologists and fellow of the London Geological Society (UK).

1.4 I have 8 years' professional experience in New Zealand and overseas. This experience includes drilling investigations, groundwater sampling and testing, hydrogeological analysis including groundwater monitoring, water resource assessments, and assessment of contaminant migration in groundwater systems.

Involvement in project

1.5 In January 2020, I was engaged by Ambury Properties Limited ("APL") to evaluate the potential effects of the proposed development at the site at 52-58 Lumsden Road, 88 Lumsden Road and 231 Tahuna Road, Ohinewai ("the site") on the surrounding groundwater system. I am the author of the Hydrogeological Assessment for the Sleepyhead Estate dated May 2020

("hydrogeological assessment") which was provided to the Panel on 21 May 2020.

1.6 I visited the site on 10 June 2020 to familiarise myself with the site setting and verify the hydrogeological concepts presented in the hydrogeological assessment.

Purpose and scope of evidence

1.7 The purpose of my evidence is to provide an overview of hydrogeological processes at the site and to describe the potential effects of the proposal on the groundwater system.

1.8 My evidence is structured as follows:

(a) A brief overview of the proposed development (Section 3);

(b) An overview of my methodology (Section 4);

(c) A description of the conceptual hydrogeological model developed for the site (Section 5);

(d) A description of the groundwater system at the site (Section 6);

(e) Identification of the potential effects of the development on the groundwater system (Section 7); and

(f) A brief conclusion (Section 8).

1.9 A summary of my evidence is provided in Section 2 below.

Expert Witness Code of Conduct

1.10 I have read the Code of Conduct for Expert Witnesses, contained in the Environment Court Consolidated Practice Note (2014) and I 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 evidence I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

2. SUMMARY OF MY EVIDENCE

2.1 The Tauranga Group, comprising of the Hinuera, Karapiro, Puketoka and upper sand beds of the Whangamarino Formation, is the major aquifer at the site. These more permeable formations generally occur over the interval between 10m and 50m depth beneath the site.

2.2 The Tauranga Group aquifer as predominantly confined by overlying low permeability silt and clay associated with the lower Rotokawau Formation. The upper Rotokawau formation is characterised by peaty layers present across low-lying areas of site, typically < 9 mRL.

2.3 The Tauranga Group Aquifer is currently used by a small number of permitted groundwater takes across the site and neighbouring Ohinewai township (situated approximately 500m west of the site) for the purposes of domestic and stock water supply. Current aquifer use is minor with respect the total groundwater resource within the Tauranga Group Aquifer.

2.4 Development of the site is anticipated to have a negligible impact on overall recharge to the Tauranga Group Aquifer or existing groundwater flow directions.

2.5 Negligible change in groundwater levels within the Tauranga Group Aquifer is anticipated. Consequently, there will be no effect on neighbouring groundwater users surrounding the site.

2.6 There is the potential for minor, localised alternation to rainfall recharge pathways to the Rotokawau peat as a result of increased impervious surfaces associated with the Sleepyhead Estate development. As a result, infiltration may be required in some parts of the site to maintain groundwater levels within the Rotokawau peat to prevent ground consolidation.

2.7 There will be no off-site groundwater level reduction within the Rotokawau peat as a result of the development.

3. OVERVIEW OF THE PROPOSAL

The site

3.1 The site is located at 52-58 Lumsden Road, 88 Lumsden Road and 231 Tahuna Road, Ohinewai. It is approximately 178 hectares in size and is located next to State Highway 1 and the North Island Main Trunk Railway line (NIMT). The site is bounded by Tahuna Road to the south, Balemi Road to the north, Lumsden Road to the west and Department of Conservation land to the east.

3.2 The site is situated between hills to the south and east, Lake Waikare to the north, wetlands to the north west and the Waikato River to the west, as shown in Figure 1.

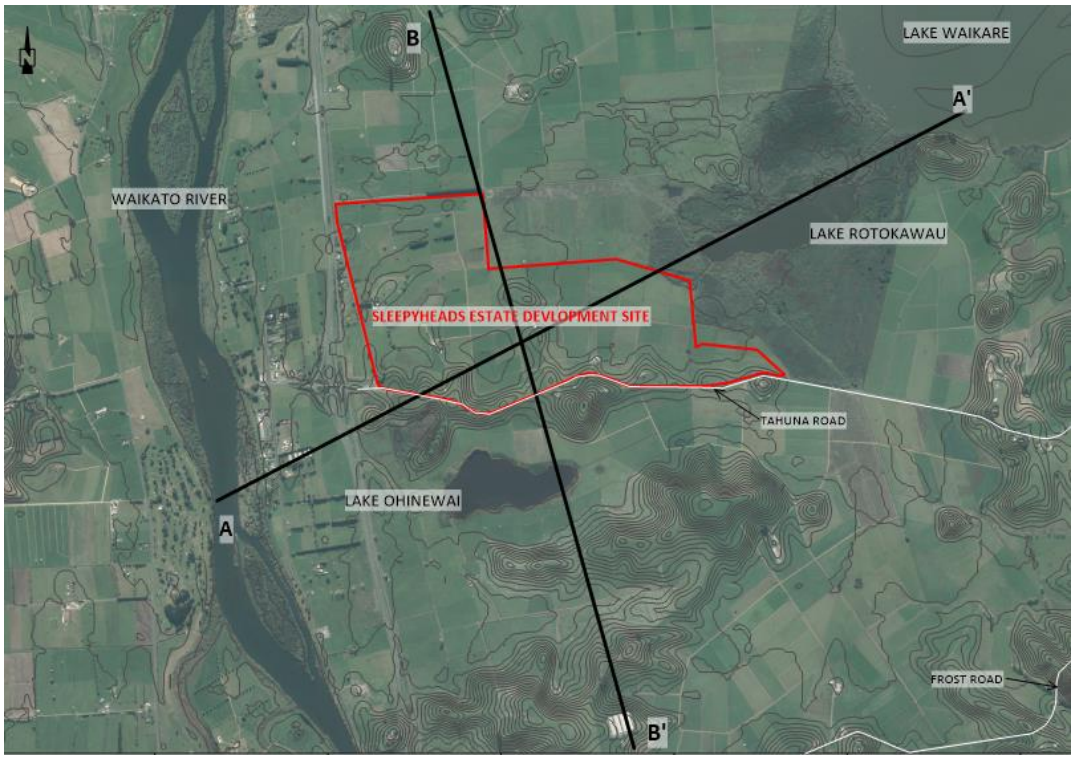

Figure 1: Site Location Plan

3.3 The site is generally low lying, with the exception of the low ridges situated on the southern site boundary. Ground elevation varies between approximately 20m RL along Tahuna Road and 6m RL to the east of the site (adjacent to Lake Rotokawau and the associated wetlands).

The proposal

3.4 The Sleepyhead Estate structure plan and associated masterplan anticipate industrial development in the western part of the site adjacent to State Highway 1, with a commercial area in the south-western part of the site. The central and eastern part of the site will be used for residential development, with the remainder of the eastern part of the site being occupied by wetland park, sports fields and a market garden.

4. METHODOLOGY

4.1 My hydrogeological assessment was informed by a review of the available historical and recent investigations undertaken at the site. The groundwater conceptual model presented as part of my hydrogeological assessment is based on information and data derived from the following key sources:

(a) INITIA (2020) Geotechnical Interpretive Report – Sleepyhead Ohinewai – Stage 1 & 2 Sleepyhead Factory Development. Report

reference P-000529 REV 0 prepared April 2020 for Ambury Properties Ltd.

(b) INITIA (2019) Geotechnical Factory Report, Ohinewai – Stage 1A Proposed Factory Development. Report reference P-000529 REV A, prepared October 2019 for Ambury Properties Ltd.

(c) Leask, W.L (1982) Geological assessment of the Ohinewai open-cast prospect. N Z State Coal Mines, Huntly.

(d) RWL Mining Consultants (1984) Ohinewai Opencast Feasibility Study, geotechnical and Hydrogeological Investigations. Phase 1. - Volumes 1 & 2. Report Prepared for Mines Department, Ministry of Energy.

(e) RWL Mining Consultants (1986) Ohinewai Opencast Feasibility Study. Hydrogeological investigation (Phase II) and proposed pumping test programme. Report prepared for Mine Department, Ministry of Energy.

(f) GHD (2010) Hydrogeological Assessment Stage 1 – Review Report. Report for Ohinewai opencast PAG4 Studies. Report prepared for Solid Energy New Zealand Ltd.

4.2 A conceptual hydrogeological model was prepared based on interpretation of the geological framework identified in order to aid understanding of groundwater flow processes at the site and to assess the potential effects of changes to the system by the proposed development.

5. CONCEPTUAL HYDROGEOLOGICAL MODEL

5.1 Cross sections of the conceptual hydrogeological model are attached as **Attachment A.**

5.2 As shown in the cross sections, the Tauranga Group is the major aquifer at the site. Deeper strata are of much lower permeability and constitute a much smaller resource. As a result, the Tauranga Group Aquifer is the primary focus of the hydrogeological conceptual model presented.

5.3 The Tauranga Group is inferred to be a single, heterogeneous aquifer with hydraulic connection between permeable strata of its sub-units: the Hinuera, Karapiro, Puketoka and upper sand beds of the Whangamarino Formation.

5.4 The Tauranga Group Aquifer is bounded to the south and east of Lake Waikare by outcropping low permeability greywacke basement. The Waikato

River, in hydraulic connection to the Tauranga Group Aquifer through the highly permeable Hinuera Formation, forms a constant head boundary to the west of the site. To the north, the aquifer is unbounded with the aquifer thickness anticipated to thin towards Te Kauwhata.

5.5 The cumulative thickness of permeable sediments (Tauranga Group Aquifer) generally increases northwards across the site; from near zero at Frost Road (approximately 1000 m south of the site) to 10 to 50 meters near Lakes Rotokawau and Waikare and Waikato River (where the Hinuera Formation is present).

5.6 The Tauranga Group Aquifer is primarily confined at the site by interbedded silt and clay of the lower Rotokawau Formation. As a result, the Tauranga Group Aquifer only receives direct rainfall recharge from a small unconfined portion of the site (predominantly along Tahuna Road).

5.7 The upper Rotokawau Formation is characterised by soft peaty layers within 10m bgl (below ground level). Peat thickness decreases from a maximum recorded thickness of approximately 9 m along the sites' eastern boundary (present at surface) to < 0.5 m to the west of site, where it is capped by a thin (0.5 m to 5 m thick) layer of Taupo Pumice Alluvium.

6. GROUNDWATER SYSTEM DESCRIPTION

6.1 Across the site, groundwater levels range between 6 mRL and 8 mRL. This is typically < 0.5 m bgl at low-lying areas in the north-east of site (in close proximity to Lake Rotokawau) to approximately 10 m bgl along the more elevated southern site boundary (along Tahuna Road).

6.2 Groundwater contours, (shown in the plan attached as **Attachment B**), show that groundwater in the Tauranga Group Aquifer generally flows northwards from the contact with the Mesozoic greywacke south of Frost Road, towards Lake Waikare. A secondary, more localised west to east flow direction is also observed across site towards Lake Rotokawau from a minor potentiometric ridge situated to the east of the Waikato River.

6.3 Recharge to the Tauranga Group Aquifer occurs by rainfall infiltration primarily across the elevated hill topography to the south of Lake Ohinewai where Puketoka and Karapiro Formations are unconfined by the absence of low permeability Rotokawau Formation.

6.4 More localised, minor recharge also occurs across elevated topography surrounding the site where Karapiro / Puketoka Formations outcrop. This

can be seen across the topographic ridges orientated west-east along Tahuna Road and north-south between the Waikato River and the western boundary of the site.

Hydraulic Connection to the Rotokawau Peat Beds

6.5 The primary sources of recharge to permeable peat beds associated with the Rotokawau Formation at the site is from direct rainfall recharge and hydraulic connection to Lakes Rotokawau and Waikare.

6.6 There is evidence to support the potential for a minor recharge contribution from the underlying Tauranga Group Aquifer as a result of upward vertical head pressures beneath the confining, low permeability Rotokawau Formation. Monitoring undertaken by RWL (1986) for a proposed open cast coal mine indicates that this upward head gradient is maintained year-round; regardless of changes in seasonal recharge. The largest upward gradients are observed across the lowest lying areas of site, including areas around Lakes Rotokawau and Waikare (to the east of the development site) and Lake Ohinewai to the south of Tahuna Road.

7. ASSESSMENT OF EFFECTS

Effects on Tauranga Group Aquifer

7.1 The majority of the site is confined by overlying silt and clay of the lower Rotokawau Formation. Consequently, the Tauranga Group Aquifer only receives direct rainfall recharge from a small unconfined portion of the site (predominantly along Tahuna Road). As a result, development of a residential zone along Tahuna Road is the only anticipated construction activity which has the potential to alter direct recharge at the site. Therefore, in terms of total recharge contribution, development of the site is anticipated to have a minor impact on overall recharge to the Tauranga Group Aquifer as the majority of recharge occurs off-site.

7.2 With no change to primary recharge, the dominant north-south groundwater flow direction across the site will remain unchanged.

7.3 With negligible effects to groundwater recharge, groundwater levels within the Tauranga Group Aquifer are anticipated to be unaffected and will therefore have no effect on neighbouring groundwater users.

Effects on the Rotokawau Peat Beds

7.4 Development of the site will have no impact on the hydraulic connection between Lakes Rotokawau and Waikare and the adjacent Rotokawau peat beds present across the east of the site.

7.5 With no change to the total recharge contribution to the underlying Tauranga Group Aquifer, minor upward head pressures beneath confining Rotokawau Formation at site will also be maintained.

7.6 There is the potential for localised on-site rainfall shadowing where recharge to the Rotokawau peat beds is reduced by increased impervious surfaces associated with the Sleepyhead Estate development (construction of impervious hardstanding and buildings). It is estimated that rainfall shadowing could result in minor (likely < 0.5 m) 'hollows and humps' in the groundwater table surface where it is currently uniform.

7.7 Reduced groundwater levels within the Rotokawau peat could induce ground settlement due to consolidation. This can be mitigated by either the provision of infiltration (i.e swales, wetlands etc.) to maintain a uniform distribution of recharge and/or through geotechnical ground-conditioning (e.g. pre-loading or dynamic compaction) prior to construction. With regards to this issue, I believe this has been adequately considered as part of both the Stormwater Management Strategy and Geotechnical Assessment and as such, I defer to the evidence of Pranil Wadan and Nick Speight, respectively.

7.8 There will no off-site groundwater level reduction within the Rotokawau peat as a result of the development.

7.9 Stormwater discharge has the potential to introduce contaminants to groundwater, particularly where stormwater runoff is derived from industrial or commercial areas of hardstanding. I have recommended that appropriate stormwater controls (through suitable detection, containment, and treatment measures) be applied in accordance with stormwater design best practices. I defer to the evidence of Pranil Wadan with regards to the requirement for the stormwater treatment on site.

8. CONCLUSIONS

8.1 Based on my assessment, I conclude the following:

(a) Development of the site is anticipated to have negligible impact on overall recharge to the Tauranga Group Aquifer or existing groundwater flow directions.

(b) Negligible change in groundwater levels within the Tauranga Group Aquifer is anticipated. Consequently, I have concluded that there will be no effect on neighbouring groundwater users surrounding the site.

(c) There is the potential for minor alternation to rainfall recharge pathways to the Rotokawau peat as a result of increased impervious surfaces associated with the development. Consideration of the potential requirement for stormwater soakage to maintain groundwater levels and/or adequate geotechnical ground conditioning prior to construction is recommended to mitigate potential ground consolidation.

(d) There will no off-site effects to groundwater levels within the Rotokawau peat as a result of the development.

David Stafford
9 July 2020

ATTACHMENT A

HYDROGEOLOGICAL CONCEPTUAL MODEL CROSS-SECTION (A-A') &

HYDROGEOLOGICAL CONCEPTUAL MODEL CROSS-SECTION (B-B')

ATTACHMENT B

GROUNDWATER PIEZOMETRIC CONTOURS AND GROUNDWATER FLOW DIRECTION