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WATER & LAND ADVISORY

# Hydrological Effects Assessment Report

## Kapiti Road Development

NEW CENTRAL PARK LIMITED

WWLA1533 | Rev. 3

22 October 2026



# Kapiti Road Development

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| Author(s): | Jake Scherberg, Atakan Durmus |
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| 1 | 1 October 2026 | Internal Review | Jake Scherberg, Atakan Durmus | Jon Williamson | Jon Williamson |
| 2 | 16 October 2026 | Client Draft | Jake Scherberg, Atakan Durmus | Jon Williamson | Jon Williamson |
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## Executive Summary

**Project Overview and Objectives**

This Groundwater Assessment Report has been prepared by Williamson Water & Land Advisory (WWLA) on behalf of New Central Park Limited (NCP |the Applicant) in support of the proposed 77 & 109 Kapiti Road, Paraparaumu – Metropolitan Centre Expansion under the Fast-track Approvals Act 2024 (FTAA) to be lodged with the Environmental Protection Agency (EPA). This report forms part of the technical documentation supporting the substantive application for the Project.

The Project comprises a comprehensively planned residential and commercial development, supported by integrated transport, three waters infrastructure and open space, including stormwater management designed in accordance with best-practice treatment and attenuation principles.

WWLA has developed a 3D numerical groundwater model of the development site, its surrounding catchment and the underlying aquifer. The model has been developed to simulate groundwater flow in three phases, with the objectives of the analysis summarised in Table E1:

**Table E1. Objective of hydrological assessment of Kapiti Road Development**

| Phase | Description |
|---|---|
| Current Conditions | Review groundwater level monitoring data from previous collected at the development site and nearby sites. |
| | Develop a conceptual understanding of the existing hydrogeology groundwater flow dynamics in current landscape to evaluate the feasibility or limitations of the proposed offset wetland. |
| | Hydrogeological evidence to support plans for wetland offsetting and effects on existing wetlands on neighbouring properties. |
| During Construction | Construction dewatering assessment – is dewatering required and if so, what duration, what rates and what is the potential impact on connected water bodies? |
| Post Development | Assessment of proposed development on surface water bodies. |
| | Provision of post development groundwater levels to inform sand liquefaction assessment (to be completed in the geotechnical assessment). |
| | Hydrogeological assessment of dewatering impact on connected water bodies. |
| | Assessment of post development groundwater effects (potentially raised water tables) on the performance of the offset wetland and/or drainage measures proposed in the design. |
| | Assessment of post development groundwater levels with regard to stormwater infiltration capacity (including under potential climate change conditions). |

**Description of Application Site**

The application site covers and area of approximately 36 ha at 77 and 109 Kapiti Road and 1 Brett Ambler Way in Paraparaumu (the Site). The site is located on the western side of the Paraparaumu town centre, approximately 500 m north of Coastlands Mall and 1 km west of the train station. The majority of the site is relatively flat although it is traversed by a ridge of sand dunes toward its northern edge and bisected by a man-made drain that connects to the Wharemaukū Stream which winds a further 1.8 km west, flowing into the Tasman Sea.

**Description of the Proposal**

New Central Park Limited (NCPL) is proposing the comprehensive development of land at 77 and 109 Kāpiti Road and 1 Brett Ambler Way, Paraparaumu, together with associated works on adjoining land. The Project is a comprehensive, masterplanned mixed-use development providing for the expansion of the Paraparaumu Metropolitan Centre.

The development proposes to integrate the residential, commercial, transport, infrastructure, ecological, landscape and open space components of the Project. It is intended to proceed progressively in stages as an integrated extension to the existing Paraparaumu town centre.

**Methods**

**Conceptual Groundwater Model**

A conceptual hydrogeological model was developed based on the current understanding of the groundwater system at the Site. The groundwater behaviour through the site and surrounding area was conceptualised as a two-layer system to account for the two hydrogeological environments that occur at the proposed development site and their interaction.

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| | Perched groundwater resides within the peat layer while hydraulically separate regional groundwater flows through the underlying silty-sand material. Groundwater recharge originates from the infiltration of rainfall at rates that vary in accordance with the underlying materials and land use. A two-layer conceptual model has been developed for the project<br>**Groundwater Recharge**<br>The Soil Moisture Water Balance Model (SMWBM) was used to assign groundwater recharge across the model domain based on the hydraulic properties of each surface geological unit. Higher recharge rates were allocated to the highly permeable dune sands, whereas lower infiltration rates reflecting surface retention and perching were applied to the fibrous peat and organic silt zones. Urbanised areas were also assigned lower recharge due to the impermeable surfaces.<br>**Numerical Model Development**<br>A 3D numerical groundwater model was developed using the MODFLOW Unstructured Grid (MODFLOW-USG) code, developed by the United States Geological Survey (USGS) through a Groundwater Modelling System (GMS) interface developed by AquaVeo. The model comprises two layers with lateral boundaries defined by the wider Wharemaukū Stream catchment and State Highway 1 at the down-gradient end. Three versions of the model were developed, representing the current landscape, proposed post-development landscape, and conditions during construction (i.e. excavation of the peat across the site).<br>**Model Grid**<br>An unstructured grid was developed using MODFLOW-USG with a base grid spacing of 64 m. Enhanced resolution was applied along features considered to be potentially sensitive, with 16 m cells along regional rivers, 8 m cells within the development area, 4 m cells within wetlands, and 2 m cells aligning with streams and drains in the development area and its immediate surroundings. The spatial variation in grid size allows for enhanced resolution in potentially sensitive areas.<br>The grid elevations assigned to the Pre-Construction Model represent existing ground conditions based on 1 m LiDAR data. The interface between Layer 1 and Layer 2 was set at 1.8 m AMSL to represent the typical bottom surface of the peat layer across the project area, while the model base elevation was set at -15 m AMSL. The post-development model incorporates the proposed finished ground levels derived from the design surface.<br>**Boundary Conditions**<br>• Drain cell boundary conditions were assigned to model cells intersected by streams or artificial drains with the stream bed elevation based on LiDAR data intersected with the model grid.<br>• Seepage face boundaries were assigned to roads and heavily developed areas, representing the sub-soil drainage network. In the Post-Development model, the drains were adjusted to align with the site plans.<br>• In the Construction scenario, peat was 'excavated' to a depth of 2.5 m where the material will be replaced by compressed sand.<br>• The groundwater model used the daily recharge rates from the SMWBM averaged for each month of the simulation period, with an area weighted hybrid of sand and urban land cover used in the development area.<br>• The first 20 mm of rainfall on road surfaces is routed to the rain gardens distributed around the development area where it becomes additional groundwater recharge, with excess runoff going into soakage facilities.<br>• A general head boundary (GHB) was applied along the downgradient boundary for Layer 2 of the model to represent the deeper groundwater connection to the coast (approximately 2 km away). In the climate change scenarios the hydraulic head at the GHBs was increased in accordance with the SSP-7.0 conditions to represent sea level rise.<br>**Model Calibration**<br>Model calibration involved adjusting the hydraulic parameters assigned to materials represented in the model domain to achieve agreement between simulated and measured groundwater levels. The transient model was calibrated to the data set from the shallow monitoring well network. The root-mean squared error (RMSE) for the model is 0.25 m, which amounts to 6.5% of the range of observations (3.86 m). These results indicate that the model is suitable for the purpose of evaluating hydrological conditions at the development site. The hydraulic parameters used in the numerical model are shown in the body of the main report and hydrographs showing the observed and simulated groundwater levels at the monitoring wells are shown in Appendix B. |
| **Summary of Results** | The numerical groundwater model was applied to investigate the **Pre-Development**, **Construction**, and **Post-Development** scenarios described in the Project Overview. Steady-state and transient versions of the model were setup, with the transient model runs simulating 32.67 year (32 years + 8 months) using data from January 1994 through August 2026 with a monthly stress period. The Construction scenario was only run in steady state mode and evaluated |

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| | as a temporary condition. The Baseline and Post-Development scenarios were also tested in a 100-year scenario where SSP3-7.0 climate change conditions were applied. The results are summarised below:<br>**Effects on Groundwater**<br>The predicted change in groundwater level following development generally follows the pattern of the cut/fill plans with lower groundwater below the sand dune on account of the excavation in that area and within the new wetland complex where the ground will generally be lowered by 0.5 to 1.5 m. Slightly increased groundwater levels are expected adjacent to Kapiti Road where infill is planned on the northern side of the development.<br>**Effects on Streams**<br>The Wharemaukū Stream comprises the primary drain of the catchment area represented by the model. The groundwater model simulates only the baseflow component of total stream flow which is the predominant source of flow during dry conditions, hence the model serves as a reference for the effects on low flows but is not intended to simulate high-flow conditions where runoff is the predominant contributor to total flow.<br>The simulated flow for the Baseline and Pre-Development models show that the reduction in effect of the development on baseflow will be negligible as the reduced infiltration of rainfall on the urbanised portion of the development area will be balanced by more permeable sand replacing peat and the infiltration from the rain gardens. On average, baseflow is reduced by approximately 0.12 L/s which is 0.4% of MALF and 0.6% of Q5.<br>**Effects on Wetlands**<br>The wetlands within the development site will be removed during the development process whilst a new wetland complex is proposed adjacent to the Wharemaukū Stream. The groundwater level below the new wetland complex is predicted to reside within 0.25 m of the land surface over most of its area. Baseflow in the swales within the new wetland is predicted to range between 0.5 - 2.0 L/s, which will ultimately discharge into the Wharemaukū Stream.<br>Minimal groundwater level change is predicted to occur in the wetlands to the southwest of the development, on the opposite side of the Wharemaukū Stream. The modelled depth to groundwater level in this area is greater than 2 m indicating that it is already disconnected from regional groundwater and is a surface water fed wetland.<br>**Construction Dewatering Requirements**<br>The drainage into the excavated area – assumed to be 2.5 m below the existing land surface in the area where peat is the underlying material – is predicted to be approximately 0.94 L/s/ha of excavation initially, reducing to 0.64 L/s/ha over the first 3 months and eventually stabilising to a seasonally variable 0.25-0.55 L/s/ha.<br>The maximum predicted groundwater drawdown during construction is approximately 3 m within the development area and 2.0 m outside of the property boundary (at the northern edge along Kapiti Road). The greatest predicted drawdown at a neighbouring bore is 1.9 m at R26/5565, located to the north of the development site across Kapiti Road. The bore appears to be a domestic bore and its depth and static water level are unknown.<br>The wetlands on neighbouring properties to the south of the development are predicted to experience negligible hydrological effects as a result of groundwater drawdown during construction because the wetland is disconnected from the regional groundwater table and is supported by surface water and/or shallow perched water.<br>**Climate Change Analysis**<br>A 100-year forward simulation was developed to investigate the effects of climate change on hydrological conditions in the proposed development area. This analysis applied seasonal changes in rainfall and 0.8 m of long-term sea level rise under SSP3-7.0 which is described by the Ministry for the Environment as representing a doubling of $CO^2$ emissions by 2100 with a corresponding warming effect of 3.6 °C.<br>On the whole, groundwater recharge and groundwater levels were not predicted to be significantly impacted by the climate change conditions evaluated in this assessment.<br>Likewise, the model did not predict that climate change would exacerbate the effect of the development on stream baseflow, with very minor differences in flow predicted indicating that the decreased infiltration in unraised areas would be balanced by greater permeability where peat was replaced by sand and road runoff was routed to raingardens. It should be noted that the negligible impacts predicted for groundwater baseflow are indicative of total flow under low-flow conditions, but not for higher flows when surface runoff is the predominant source of total stream flow.<br>The baseflow in the proposed offset wetland was predicted to increase slightly with the applied climate change conditions relative to predicted discharge under current conditions, with increased peak flows and low-flows resulting from the overall increase in rainfall recharge. The implication is that the offset wetland will be hydrologically viable, as the water table will remain near the surface and continually generate flow into the drain. |
| **Key Conclusions** | The groundwater model was used to evaluate groundwater under current conditions and assess hydrological effects with the proposed development in place, and during the construction process. The primary findings of this investigation, in terms of effects are summarised below: |

| | |
|---|---|
| | • Changes in groundwater levels across the site will generally follow the proposed cut/fill plan.<br>• The overall impact on stream flow will be limited as the constructed drainage network will convey flow to the Wharemaukū Stream in a similar manner to the existing network.<br>• Several wetlands on the development site will be displaced and replaced by an offset wetland. Wetlands on neighbouring properties to the south are not reliant on direct interaction with the deeper regional groundwater and are predicted to experience negligible hydrological effects from the development.<br>• The land surface of the offset wetland will be cut to approximately the level of the existing water table (which is perched within the underlying peat). Groundwater will remain sufficiently shallow across the new wetland to sustain wetland hydrological conditions year-round with consistent groundwater baseflow discharging to the swale. On this basis, the proposed offset wetland is considered hydrologically viable over the long term.<br>• Dewatering during the construction process is predicted to be approximately 0.94 L/s/ha of excavation initially, reducing to 0.64 L/s/ha over the first 3 months and eventually stabilising to a seasonally variable 0.25-0.55 L/s/ha.<br>• Construction-related groundwater drawdown is predicted to have negligible hydrological effects on neighbouring wetlands and no material effect on the continued operation of nearby groundwater bores.<br>• The effects of climate change on hydrological conditions were tested assuming an SSP3-7.0 scenario which generated a small increase in overall groundwater recharge though it was not enough to significantly impact the flow regime.<br>• There is no indication that the proposed development would exacerbate the effect of climate change on stream baseflows or cause issues with groundwater inundation, or wetland dewatering.<br>Overall, this assessment has specifically considered the matters raised through GWRC's requests for further information (RFI) that were submitted in response to a previous application to develop the same area. This included an assessment of the influence of the existing dune landform and its removal on groundwater recharge, the long-term hydrological viability of the proposed offset wetland, effects of temporary construction dewatering, and potential effects on neighbouring wetlands, groundwater users and the Wharemaukū Stream. These items from the RFI are specifically addressed in Section 8 of the main report.<br>Subject to the management measures identified in this report, the modelling does not identify any groundwater-related effect that would prevent the proposed development or ecological restoration measures from proceeding as proposed. |

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**Appendix A. Soil Moisture Water Balance Model**
**Appendix B. Calibrated Model Hydrographs**

# 1. Statement of Qualifications & Experience

**Report Author**

My full name is Jacob Nathan Scherberg. I have a Bachelor of Science (BSc) from The Evergreen State College (2001), and a Master of Science (MSc) (2012) in Water Resource Engineering from the Oregon State University. I am a Senior Hydrogeologist for Williamson Water & Land Advisory (WWLA). I have been in my current role with WWLA since 2018, and prior to that served as a Hydrogeologist for GeoSystems Analysis Inc., a consulting firm based in the United States.

I have 15 years of specialist professional experience with technical expertise in hydrogeology and hydrology covering a wide spectrum of services including numerical groundwater modelling; data collection and analysis; field investigations and testing; and technical reporting. I have provided independent advice to inform and support decision making for a wide spectrum of client types within New Zealand, including Regional Councils, District Councils, government agencies such as the Ministry of Primary Industries; Te Puni Kōkiri (Ministry of Māori Development); sector interest groups such as energy companies and mining companies; Horticulture New Zealand; and agricultural and horticultural businesses.

My specific experience related to this project has been in support of similar land development initiatives such as the Milldale-North development proposed by Fulton Hogan Land Development, Milldale Retirement Village operated by Summerset Limited, and the ongoing Red Hills Road development in Auckland proposed by Nation Shine Holdings Limited.

**Report Reviewer / Technical Director**

My full name is Jonathan (Jon) Lindsay Williamson. I am the Managing Director at Williamson Water & Land Advisory. I hold the qualifications of Bachelor of Science, and Master of Science and Technology (Earth Science) from the University of Waikato and have over 30 years' professional experience in the field of hydrology and hydrogeology. My experience includes professional consultancy with experience in research and assessment of environmental impacts for a wide range of projects. My experience includes appearances at Council, Environment Court, Board of Enquiry, and EPA Fast-track Legislation Hearings, along with involvement in joint witness processes. **Code of Conduct**

**Ethical Declaration**

The qualifications and experience of the author, reviewer and technical director of this report are summarised above. We confirm that we have read the Code of Conduct for Expert Witnesses contained in the Environment Court of New Zealand Practice Note 2023 and we agree to comply with it. We confirm that the issues addressed in this report are within our area of expertise, except where we state that we are relying on the evidence or advice of another person. We have not omitted to consider material facts known to us that might alter or detract from the opinions expressed in this report.

# 2. Introduction

This Groundwater Assessment Report has been prepared by Williamson Water & Land Advisory (WWLA) on behalf of New Central Park Limited (NCP |the Applicant) in support of the proposed 77 & 109 Kapiti Road, Paraparaumu – Metropolitan Centre Expansion under the Fast-track Approvals Act 2024 (FTAA) to be lodged with the Environmental Protection Agency (EPA). The site location is shown on **Figure 1**.

The Project comprises a comprehensively planned residential and commercial development, supported by integrated transport, three waters infrastructure and open space, including stormwater management designed in accordance with best-practice treatment and attenuation principles.

WWLA has developed a 3D numerical groundwater model of the development site, its surrounding catchment and the underlying aquifer. The model has been developed to simulate groundwater flow in three phases, with the objectives of the analysis summarised in **Table 1**:

- ***Pre-Development*** – i.e. under current conditions;
- ***During construction***; and
- ***Post-Development*** - with the completed development in place.

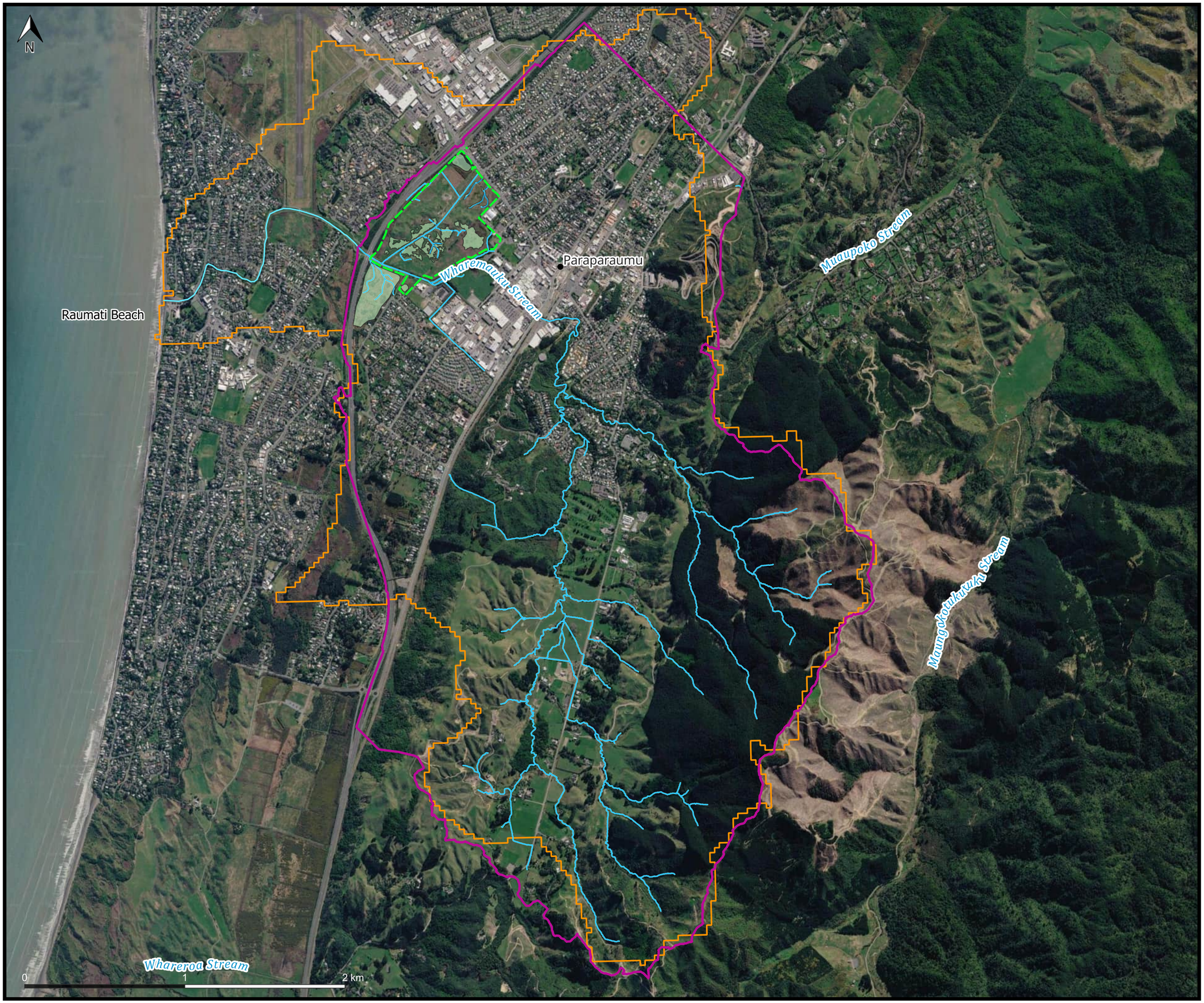
Table 1. Objective of hydrological assessment of Kapiti Road Development

| Phase | Description |
|---|---|
| Current Conditions | Review groundwater level monitoring data from previous collected at the development site and nearby sites – specifically the Mackays to Pekapeka motorway project. |
| | Develop a conceptual understanding of the existing hydrogeology groundwater flow dynamics in current landscape to evaluate the feasibility or limitations of the proposed offset wetland. |
| | Hydrogeological evidence to support plans for wetland offsetting and effects on existing wetlands on neighbouring properties. |
| During Construction | Assessment of wetland water balance including temporary effects during dewatering and construction. |
| | Assessment of the practicality of bulk earthworks (excavation and backfill) below the groundwater table. |
| | Construction dewatering assessment – is dewatering required and if so, what duration, what rates and what is the potential impact on connected water bodies? |
| Post Development | Assessment of proposed development on surface water bodies. |
| | Provision of post development groundwater levels to inform sand liquefaction assessment (to be completed in the geotechnical assessment). |
| | Hydrogeological assessment of dewatering impact on connected water bodies. |
| | Seasonal fluctuation of groundwater and potential impact on building foundations. |
| | Assessment of post development groundwater effects (potentially raised water tables) on the performance of the offset wetland and/or drainage measures proposed in the design. |
| | Assessment of post development groundwater levels with regard to stormwater infiltration capacity (including under potential climate change conditions). |

## 2.1 Description of Application Site

The application site covers and area of approximately 36 ha at 77 and 109 Kapiti Road and 1 Brett Ambler Way in Paraparaumu (the Site). The majority of the site is relatively flat although it is traversed by a ridge of sand dunes toward its northern edge and bisected by a man-made drain that connects to the Wharemaukū Stream which winds a further 1.8 km west, flowing into the Tasman Sea. There is a pond/wetland area in the northeastern corner of the property that was built concurrently with the construction of the adjacent reach of the

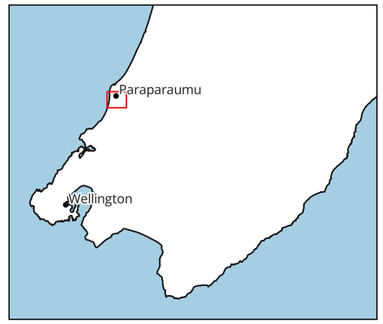
Kapiti Expressway. The site is currently vacant land. **Figure 1** shows the site extent within the context of Paraparaumu and the wider catchment.




Map Title:
**Site Extent and Model Area**

Project:
**77 & 109 Kapiti Road Development**
**Hydrological Effects Assessment**

Client:
**New Central Park Limited**




**Legend**

- Model Boundary
- Property Boundary
- Rivers
- Catchment Area
- Wetlands
- Towns

Data Provenance
Basemap imagery from Google Satellite

Drawn by: Atakan Durmus
01/10/2026

Layout & Project File
G:\Shared drives\Projects\New Central Park Limited\WWLA1533_Hydrogeological Effects Assessment

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**Figure 1.**

The site is located on the western side of the Paraparaumu town centre, approximately 500 m north of Coastlands Mall and 1 km west of the train station, which contain a comprehensive range of retail, commercial, and civic uses. The wider land uses to the north and northwest across the Kāpiti Expressway are predominantly commercial and light industrial in character, with suburban residential areas to the east, and key civic and community facilities, including the council offices, library, community centre, primary school, and aquatic centre, situated directly to the south.

The Planning Report and other technical assessments prepared to support the substantive application under the Fast-Track Approvals Act (FTAA) provide a comprehensive description of the site and its context.

## 2.2 Description of the Proposal

New Central Park Limited (NCPL) is proposing the comprehensive development of land at 77 and 109 Kāpiti Road and 1 Brett Ambler Way, Paraparaumu, together with associated works on adjoining land. The Project is a comprehensive, masterplanned mixed-use development providing for the expansion of the Paraparaumu Metropolitan Centre depicted in **Figure 2**.

The Project comprises:

- approximately 600 residential dwellings, including apartments, townhouses, duplexes, courtyard housing and standalone dwellings;
- approximately 20,000 m² GFA of Large Format Retail (LFR);
- approximately 3,800 m² of other retail and commercial activities, including specialty retail and drive-through activities;
- subdivision to create residential, commercial, LFR and other development allotments, together with roads, reserves and infrastructure;
- a new internal transport network, including the Town Centre Link Road, local roads and JOALs, together with pedestrian and cycling connections and provision for public transport;
- three waters infrastructure required to service the development;
- an extensive network of open space, landscaping and blue-green infrastructure; and
- wetland reclamation and creation and ecological restoration and enhancement, including a constructed indigenous wetland primarily providing ecological offsetting and compensation, together with complementary flood-storage functions.

The development proposes to integrate the residential, commercial, transport, infrastructure, ecological, landscape and open space components of the Project. It is intended to proceed progressively in stages as an integrated extension to the existing Paraparaumu town centre.

The Project has been referred for consideration under the Fast-track Approvals Act 2024. This report forms part of the technical documentation supporting the substantive application for the Project.




Figure 2. Master plan of the Site (Provided by Urban Acumen Ltd.)

# 3. Existing Groundwater Environment

## 3.1 Climate

Rainfall and potential evapotranspiration (PET) are the driving factors for hydrological conditions throughout the catchment. Rainfall data was obtained from NIWA weather stations located in the vicinity of the site. The primary rainfall dataset was sourced from the Paraparaumu AERO EWS station, with missing periods infilled using records from Paraparaumu AERO AWS. These datasets covered in total the time period from 1 January 1994 through 4 September 2026. The data was assessed for completeness and consistency across the stations with a composite dataset developed for use in the water balance modelling assessment detailed in **Section 4.4**.

PET data was available from three weather station sources. These datasets were also evaluated to compile a complete dataset for input into the water balance modelling exercise, with Paraparaumu AERO AWS being the primary data source, missing daily records infilled using Paraparaumu EWS, and remaining gaps completed using historical Paraparaumu Aero data.

A summary of the composite rainfall and PET datasets is presented in a box-whisker plot in **Figure 3**, showing monthly average rainfall and PET from the recorded data. The boxes represent the 25th to 50th, and 50th to 75th percentile ranges and the whiskers represent the most extreme years.

The dataset indicates that mean annual rainfall is approximately 993 mm, varying seasonally throughout the year. The greatest median monthly rainfall occurs in June and amounts to 106.7 mm. Minimum average rainfall typically occurs in the summer months, with February having the lowest median rainfall of 39.7 mm. Conversely, PET peaks in summer, recording averages of ~144 mm per month in January, and minimum PET typically occurring in June with an average of ~19 mm per month.

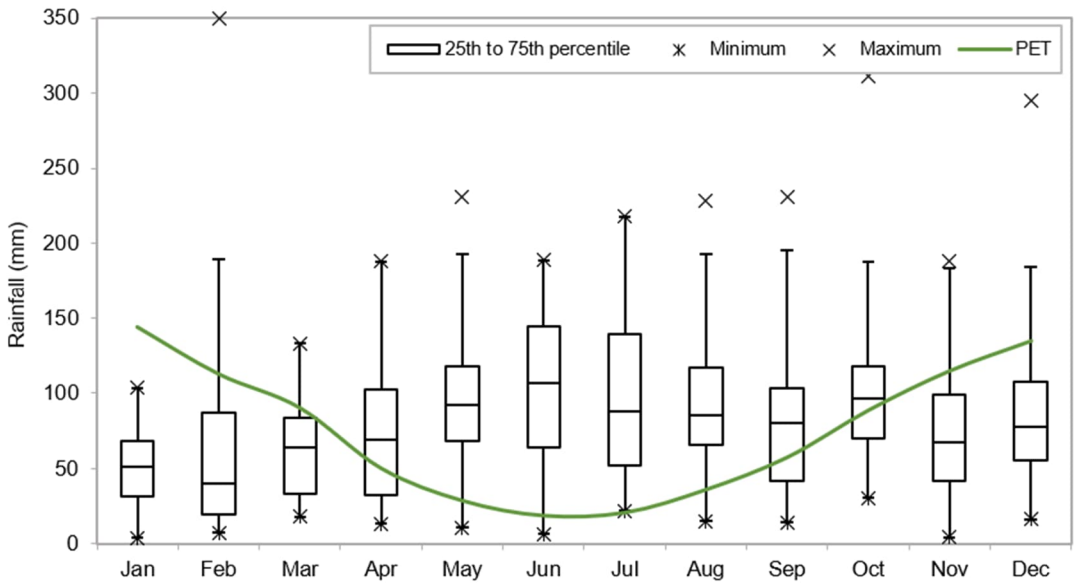



Figure 3. Monthly rainfall (box-whisker plot) and potential evaporation.

## 3.2 Surface Water

The site is located within the Wharemaukū Stream catchment in Paraparaumu. The catchment encompasses a total area of approximately 14 km$^2$, comprising a range of land uses including urbanised Paraparaumu, hilly scrub-land, native bush, and agricultural pastureland.

The Wharemaukū Stream, which flows along the southern boundary of the site, serves as the primary surface drainage network for the local catchment, receiving surface runoff, reticulated stormwater discharge, and

groundwater contributions before flowing approximately 1.8 km west to discharge into the Tasman Sea. Baseflow in the Wharemaukū Stream is predominantly spring-fed through shallow gravels and sands.

The catchment, and specifically the proposed development site, have been extensively modified through historical agricultural land use, channelisation of the Wharemaukū Stream, and artificial drainage networks, including a deep man-made channel that bisects the site from north to south before discharging into the Wharemaukū Stream[1],[5].

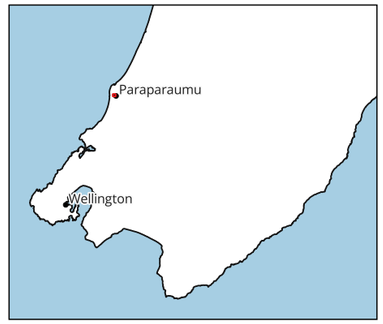
Existing surface water features can be seen in **Figure 4** below.




Map Title:
**Surface Water Features**

Project:
**77 & 109 Kapiti Road Development**
**Hydrological Effects Assessment**

Client:
**New Central Park Limited**




**Legend**

- **Model Boundary**
- **Property Boundary**
- **Rivers**
- **Wetlands**
- **Catchment Area**

Data Provenance
Basemap imagery from Google Satellite

Drawn by: Atakan Durmus
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**Figure 4.**

## 3.3 Regional Geology and Hydrogeology

The site lies within the Waikanae Groundwater Zone (WGZ) on the Kāpiti coastal plain. The regional hydrogeological framework comprises a multi-layered, leaky unconfined to semi-confined aquifer system consisting of Quaternary Holocene peat, dune sands, and Pleistocene marine/alluvial deposits, underlain by deeper terrestrial gravel aquifers resting on greywacke basement rock.

Regional hydraulic properties and subsurface characterisation are primarily derived from the Torlesse Geotechnical Assessment Report (GAR) [11] and Geotechnical Desktop Study (GDS) [12]. Previous geotechnical and hydrogeological assessments, including ENGEO (2023[3], 2024[4]) and NZTA MacKays to Peka Peka Expressway Technical Reports 21[6] and 35[2], have been utilised as supporting background information.

The regional hydrogeological units and their representative hydraulic properties are summarised in **Table 2**.

Table 2. Key Hydrogeological Units and Parameters Compiled from Literature and Previous Studies.

| Hydrogeological Unit | Description | Typical Thickness (m) | Horizontal Hydraulic Conductivity $K_h$ (m/s) | Vertical Hydraulic Conductivity $K_v$ (m/s) | Storativity (S) / Specific Yield ($S_y$) |
|---|---|---|---|---|---|
| Holocene Peat | Fibrous to amorphous peat, organic silt, and organic clay. | 0.5 to 2.0 (typ. 0.5–1.5 across site) | $4 \times 10^{-6} – 10^{-7}$ | $1 \times 10^{-7}$ | $S_y = 0.50$ |
| Holocene Dune Sand | Fine to medium, poorly graded dune sand. | 5 to 10 | $5 \times 10^{-5} – 10^{-3}$ | $5 \times 10^{-5}$ | $S_y = 0.001$ |
| Pleistocene Sand | Reworked dune, beach, and estuarine sands. | 5 to 40 | $5 \times 10^{-5}$ | $1 \times 10^{-5}$ | $S_y = 0.05$ |
| Pleistocene Silt/Clay | Silt and clay with carbonaceous material. | 0 to 30 | $1 \times 10^{-6}$ | $1 \times 10^{-7}$ | $S = 3 \times 10^{-4}$ |
| Parata Gravel Aquifer | Pleistocene sand/gravel and clay-bound gravel. | 10 to 40 (Encountered from 5.0 to 10.0 m BGL) | $5 \times 10^{-4}$ (43.2 m/d) | $2 \times 10^{-5}$ | $S = 1 \times 10^{-4} – 4 \times 10^{-4}$ |
| Waimea Gravel Aquifer | Deep terrestrial gravels (main KCDC supply). | 5 to 40+ | $5 \times 10^{-4}$ | $1 \times 10^{-4}$ | $S = 5 \times 10^{-5} – 4 \times 10^{-4}$ |
| Greywacke Basement | Indurated greywacke basement rock. | Bedrock | Impermeable boundary | - | - |
| *Note: Hydrogeological parameters are aligned with the Torlesse Geotechnical Assessment Report (GAR, 2026)[1] and informed by regional background data from France & Anderson (2012)[6] | | | | | |

Regional groundwater flow is directed from the foothills of the Tararua Ranges in the east/south-east toward the coastline in the west/north-west, establishing a regional hydraulic gradient of approximately 1:500 (0.002). Recharge to the regional system is driven predominantly by rainfall infiltration, with an average annual rainfall of

[1] The unit descriptions, depths, and shallow hydrogeological parameters have been aligned with Section 5 and Table 11 of the Torlesse Geotechnical Assessment Report (GAR)[11]. For clarity across disciplines, the hydrogeological units defined in this model correspond to the geotechnical units in the GAR as follows: "Holocene Peat" correlates to Fibrous Peat (FP) and Organic Sand (OS); "Holocene Dune Sand" correlates to Clean Sand (CS); and the underlying "Parata Gravel Aquifer / Pleistocene Sand" correlates to the deep Sandy Gravel (SG) alluvium deposits.

1,311 mm/year recorded across the coastal plain[6]. Geological units mapped in the project area presented in **Figure 5**.

### 3.3.1 Shallow Aquifer

The shallow subsurface across the site and surrounding coastal lowlands comprises Holocene Peat and Holocene Dune Sands overlying Pleistocene alluvial and marine deposits.

The shallow aquifer is unconfined to semi-confined, exhibiting a high water table situated generally encountered within 0.2 m to 1.5 m of the ground surface across low-lying flat areas. The peat layer acts as a surficial aquitard/aquitard-like deposit, frequently supporting perched groundwater bodies above the underlying dune sand.

Recharge to the shallow aquifer is driven by direct rainfall infiltration. Natural groundwater discharge occurs locally into artificial drains, the Wharemaukū Stream, and ultimately toward the coastal marine interface.

N

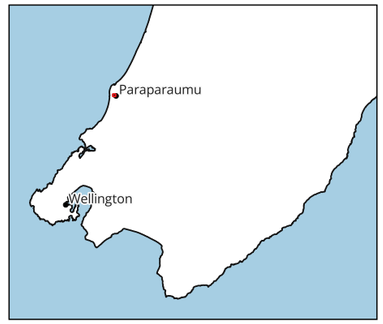
MW01
BH003 - 2022
MW10
R26_6831
Bunnings BH02
Bunnings BH04
Bunnings BH01
MW02
MW03
Bunnings BH03
MW04
Bunnings BH05
MW11
MW06
MW05
BH03 - 2023
MW07
BH002 - 2022
MW09
Wharemauku Stream

0 0.25 0.5 km

Map Title:
**Site Geology and Groundwater Monitoring Locations**

Project:
**77 & 109 Kapiti Road Development Hydrological Effects Assessment**

Client:
**New Central Park Limited**




**Legend**

- **Model Boundary**
- **Property Boundary**
- **Rivers**

Geological Unit
- **Peat**
- **Sand**

Bores / Monitoring Wells
- **ENGEO MW 2024**
- **ENGEO-BH-2023**
- **ENGEO-Bunnings-BH-2021**
- **GWRC 2000-2026**
- **Jacobs-BH 2022**

Data Provenance
Basemap imagery from Google Satellite

Drawn by: Atakan Durmus
01/10/2026

Layout & Project File
G:\Shared drives\Projects\New Central Park Limited\WWLA1533_Hydrogeological Effects Assessment

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**Figure 5.**

## 3.4 Site Specific Hydrogeology

The application site covers approximately 36 ha at 77 and 109 Kāpiti Road and 1 Brett Ambler Way. Topographically, the site is predominantly flat at an elevation of roughly 4.0 mAMSL to 6.0 mAMSL, with two prominent sand dune ridges in the central and western portions rising up to 15 mAMSL to 19 mAMSL.

Subsurface investigations across low-lying flat areas, as synthesised in the Torlesse Geotechnical Assessment Report (GAR) [11] and supporting Geotechnical Desktop Study (GDS) [12], indicate a generalised soil profile consisting of:

- **Topsoil / Fibrous Peat & Organic Sand:** .5 m to 2.0 m thick (typically 0.5 m to 1.5 m across low-lying flat areas)
- **Clean Dune Sands:** Fine to medium clean dune sand extending beneath the surficial peat and organic sand horizon to depths of approximately 5.0 m to 10.0 m BGL
- **Alluvial / Marine Gravels & Silts:** Alternating dense to very dense sand and gravel strata encountered typically beneath the dune sands from 5.0 m to 10.0 m depth BGL.

Due to the flat topography, shallow peat cover, and high water table, low-lying portions of the site experience seasonal soil saturation, surface ponding, and flood hazard constraints.

### 3.4.1 Groundwater Monitoring

To establish baseline groundwater levels and evaluate site-specific hydrogeological conditions, ENGEO established an 11-well monitoring network (MW01 to MW11) across the site in 2024, targeting the shallow unconfined aquifer (MW8 was destroyed and no data was collected). Continuous monitoring (351 days) was undertaken between October 2024 and October 2025. Supplementary manual groundwater level measurements was completed by Torlesse in June 2026 to verify seasonal shallow water table conditions [11].

This site-specific dataset is supplemented by historical boreholes, including the Bunnings investigation boreholes (BH01–BH05), Jacobs boreholes (BH002, BH003), ENGEO boreholes (BH03), and long-term GWRC monitoring bore R26_6831. All monitoring locations are shown in **Figure 5**.

A summary of measured groundwater levels across the site monitoring network is presented in **Table 3** and the data collected from the shallow piezometer network is provided in **Figure 6**. Over the 351 days of monitoring the water levels show limited variability (on the order of 0.6 m) as would be expected within the peat material.

Table 3. Measured groundwater levels (GWL) within the on-site piezometers (mAMSL).

| Bore ID | Type | Elevation (mAMSL) | TOC (m AMSL) | Bore Depth (m) | Depth to GW (mBGL) | Date Range | Mean GW Level (mAMSL) | No. | Source |
|---|---|---|---|---|---|---|---|---|---|
| MW01 | Monitoring well | 5.84 | 6.84 | 5 | 0.84 | 17/10/2024 - 2/10/2025 | 5.00 | 351 | ENGEO MW 2024 |
| MW02 | Monitoring well | 6.09 | 7.415 | 5 | 0.53 | 17/10/2024 - 2/10/2025 | 5.56 | 351 | ENGEO MW 2024 |
| MW03 | Monitoring well | 6.01 | 7.147 | 5 | 1.61 | 17/10/2024 - 2/10/2025 | 4.40 | 351 | ENGEO MW 2024 |
| MW04 | Monitoring well | 5.78 | 6.845 | 5 | 1.33 | 17/10/2024 - 2/10/2025 | 4.45 | 351 | ENGEO MW 2024 |
| MW05 | Monitoring well | 5.34 | 6.612 | 5 | 0.40 | 17/10/2024 – 21/11/2024; 27/5/2025 - 2/10/2025 | 4.94 | 165 | ENGEO MW 2024 |

| Bore ID | Type | Elevation (mAMSL) | TOC (m AMSL) | Bore Depth (m) | Depth to GW (mBGL) | Date Range | Mean GW Level (mAMSL) | No. | Source |
|---|---|---|---|---|---|---|---|---|---|
| MW06 | Monitoring well | 5.12 | 6.35 | 5 | 0.93 | 17/10/2024 - 2/10/2025 | 4.19 | 351 | ENGEO MW 2024 |
| MW07 | Monitoring well | 4.71 | 5.82 | 5 | 0.81 | 17/10/2024 - 2/10/2025 | 3.90 | 351 | ENGEO MW 2024 |
| MW08 | Monitoring well | Destroyed | | | | | | | |
| MW09 | Monitoring well | 4.16* | 5.63 | 5 | 0.30 | 17/10/2024 - 2/10/2025 | 3.86 | 351 | ENGEO MW 2024 |
| MW10 | Monitoring well | 5.46 | 6.56 | 5 | 0.34 | 17/10/2024 - 2/10/2025 | 5.12 | 351 | ENGEO MW 2024 |
| MW11 | Monitoring well | 6.09 | 7.010 | 5 | 0.85 | 17/10/2024 - 2/10/2025 | 5.24 | 351 | ENGEO MW 2024 |
| Bunnings BH01 | Borehole | 5.64* | - | 19.95 | 1.94 | 5/10/2021 5/10/2021 | 3.7 | 1 | ENGEO-Bunnings-BH-2021 |
| Bunnings BH02 | Borehole | 5.19* | - | 19.88 | 1.88 | 1/10/2021 1/10/2021 | 3.31 | 1 | ENGEO-Bunnings-BH-2021 |
| Bunnings BH03 | Borehole | 5.31* | - | 19.95 | 0.61 | 5/10/2021 5/10/2021 | 4.7 | 1 | ENGEO-Bunnings-BH-2021 |
| Bunnings BH04 | Borehole | 4.48* | - | 19.85 | 0.84 | 6/10/2021 6/10/2021 | 3.64 | 1 | ENGEO-Bunnings-BH-2021 |
| Bunnings BH05 | Borehole | 7.7* | - | 19.89 | 0.94 | 11/10/2021 11/10/2021 | 6.76 | 1 | ENGEO-Bunnings-BH-2021 |
| R26_6831 | Monitoring well | 7.01* | - | - | 0.87 | 13/10/2000 13/04/2026 | 6.14 | 9064 | GWRC 2000-2026 |
| BH002 - 2022 | Borehole | 4.46* | - | 44.53 | 0.1 | 21/03/2022 21/03/2022 | 4.36 | 1 | Jacobs-BH 2022 |
| BH003 - 2022 | Borehole | 7.32* | - | 24.85 | 0.5 | 16/03/2022 16/03/2022 | 6.82 | 1 | Jacobs-BH 2022 |
| BH03 - 2023 | Borehole | 3.91* | - | 20.25 | 0.35 | 5/05/2023 5/05/2023 | 3.56 | 1 | ENGEO-BH-2023 |

* Elevation (LiDAR 2016) (mAMSL)

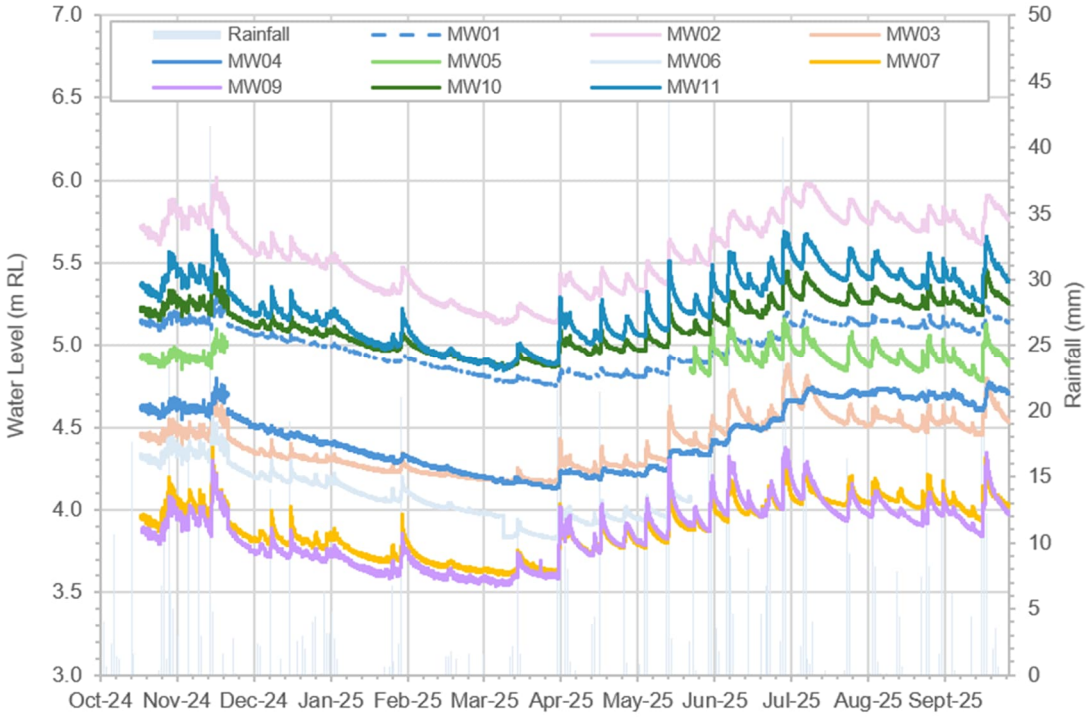



Figure 6. Monitoring data collected from shallow piezometers across the proposed development site.

### 3.4.2 Proposed Stormwater & Attenuation Infrastructure

The proposed stormwater management strategy for New Central Park is designed in accordance with Water Sensitive Urban Design (WSUD) and Te Mana o te Wai principles. Hydraulic neutrality will be achieved through a combination of local soakage devices, vegetated swales along the Link Road, and dedicated wetland offset and flood detention basins.[5]

All stormwater runoff discharging into the dedicated wetland offset areas will pass through pre-treatment devices (e.g., rain gardens or treatment wetlands) prior to discharge, ensuring that natural ecological wetland features are protected from ongoing stormwater treatment loads.[5]

# 4. Conceptual Groundwater Model

A conceptual hydrogeological model was developed based on the current understanding of the groundwater system at 77 Kapiti Road. The model integrates regional hydrogeological data from the MacKays to Peka Peka Expressway project (NZTA, 2012)[6], site-specific geotechnical investigations by ENGEO (2023)[3], and recent field evaluations and desktop reviews and geotechnical investigations by Torlesse (GAR [11] and GDS [12]).

The groundwater behaviour through the site and surrounding area was conceptualised as a two-layer system to account for the two hydrogeological environments that occur at the proposed development site and their interaction. Perched groundwater resides within the peat layer while hydraulically separate regional groundwater flows through the underlying silty-sand material.

Groundwater recharge originates from the infiltration of rainfall at rates that vary in accordance with the underlying materials and land use. A two-layer conceptual model has been developed for the project, with the conceptual understanding described in the following sections.

## 4.1 Geological Layering Framework

As indicated above, a two-layer model framework has been developed to represent the subsurface, as follows:

- **Layer 1 (Perched Groundwater System):** Represents the shallow overburden, consisting of fibrous peat and organic silts/sands (typically 0.5 m to 2.0 m thick). This layer holds a shallow perched water table (within 0.5 m to 1.5 m depth) characterized by localized seepage and high seasonal inflow variability, particularly along the north-western site boundary (ENGEO, 2023[3]; Torlesse GAR [11], GDS [12]).
- **Layer 2 (Regional Groundwater System):** Represents the underlying clean, fine-to-medium Holocene dune sands (5 m to 10 m thick) and deeper Pleistocene alluvial sand/gravel deposits (NZTA, 2012[6]; ENGEO, 2023[3]; Torlesse GAR [11]). This layer hosts the unconfined to semi-confined regional water table located consistently at 2.0 m to 2.5 m below ground level (~2.0 m to 3.5 m RL) (Torlesse GAR [9], GDS [12]).

## 4.2 Groundwater Recharge

Groundwater recharge across the model domain was assigned based on the hydraulic properties of each surface geological unit (NZTA, 2012[6]; ENGEO, 2023[3]; Torlesse GAR[11]). Higher recharge rates were allocated to the highly permeable dune sands, whereas lower infiltration rates reflecting surface retention and perching were applied to the fibrous peat and organic silt zones (NZTA, 2012[6]; Torlesse GAR[11]). Urbanised areas were also assigned lower recharge due to the impermeable surfaces and sub-surface drainage networks are prevalent with development.

## 4.3 Flow Direction & Surface Water Interaction

Regional groundwater flow moves from the Tararua Range foothills in a west-northwesterly direction towards the coast, discharging locally into the channelised Wharemaukū Stream and surrounding agricultural drainage channels (NZTA, 2012[6]; Torlesse GAR [11], GDS [12]

Based on this conceptual hydrogeological model, a water balance model, described in the following section was developed to assess groundwater recharge for input into the numerical model.

## 4.4 Water Balance Modelling

The Soil Moisture Water Balance Model (SMWBM) was applied to generate the groundwater recharge data that was input into the groundwater model. The SMWBM was calibrated using rainfall and PET data from local weather stations, as described in Section 3.1. Calibration was achieved by adjusting parameters corresponding

to surface infiltration and soil drainage to generate simulated river flow statistics that aligned with those derived from NZ River Maps[2] flow statistics.

Parameterisation of the SMWBM was based on geological units derived from the GNS Science 1:250,000 geological map (QMAP) and surface geological mapping (NZTA, 2012[6]; ENGEO, 2023[3]), informed by site geotechnical investigations (Torlesse GAR [11], GDS [12]) and surface land cover characteristics.

The model domain was divided into six distinct subgroups according to their hydrogeological and hydraulic drainage properties: Peat, Sand, Sandstone, Gravel, Urbanised (combining built-up areas and transport infrastructure/roads), and Surface Mine.

The key soil moisture parameters used in the SMWBM, such as soil moisture capacity (ST), maximum sub-soil drainage rate (FT), maximum surface infiltration rate (Zmax), and canopy interception loss (PI), are summarised in **Table 4**. The spatial distribution of these material groups across the site is presented in **Figure 7**, with further details regarding model setup and parameterisation provided in **Appendix A**.

Table 4. Soil Group SMWBM Parameters

| SMWBM Material Group | ST (mm) | FT (mm/d) | Zmax (mm/hr) | PI (mm) |
|---|---|---|---|---|
| Peat | 500 | 0.4 | 8 | 2 |
| Sand | 240 | 1.5 | 15 | 2 |
| Sandstone | 450 | 0.3 | 10 | 2.5 |
| Gravel | 300 | 2 | 25 | 2 |
| Urbanised | 300 | 0.15 | 3 | 3 |
| Surface Mine | 250 | 1 | 4 | 0.5 |

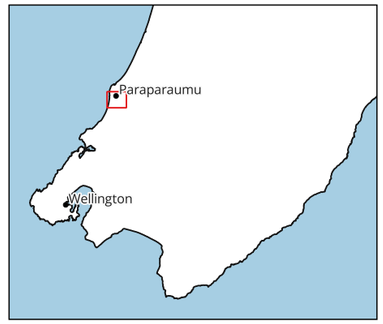
*Note: *ST*= Soil depth capacity (mm); *FT* = Maximum sub-soil drainage rate (mm/d); $Z_{max}$= Maximum soil infiltration rate (mm/hr); *PI*= Canopy interception loss (mm).

[2] NZ River Maps is an interactive, web-based tool developed by NIWA that provides statistical summaries of flow data for New Zealand's national river network (https://shiny.niwa.co.nz/nzrivermaps)

Map Title:
**Groundwater Model Land Cover Types**

Project:
**77 & 109 Kapiti Road Development Hydrological Effects Assessment**

Client:
**New Central Park Limited**




**Legend**

- **Model Boundary**
- **Property Boundary**
- **Rivers**

Land Cover Types

- **Urbanized Area (including roads)**
- **Gravel**
- **Peat**
- **Sand**
- **Sandstone**
- **Surface Mine**

Data Provenance
Basemap imagery from Google Satellite

Drawn by: Atakan Durmus
05/10/2026

Layout & Project File
G:\Shared drives\Projects\New Central Park Limited\WWLA1533_Hydrogeological Effects Assessment

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**Figure 7.**

The calibration of the SMWBM was verified by comparing simulated catchment flow statistics against benchmark hydrological data derived from NZ River Maps for the local Wharemaukū Stream catchment at Raumati Beach. Parameters controlling surface infiltration and sub-soil percolation were iteratively adjusted until the simulated streamflow statistics closely matched the regional baseflow metrics.

The comparison between the NZ River Maps flow statistics and the calibrated SMWBM-derived flows for Wharemaukū Stream at Raumati Beach is presented in **Table 5**. The SMWBM-derived flows demonstrate agreement with the streamflow benchmarks validating the calibrated soil moisture parameters.

Table 5. Wharemaukū Stream baseflow statistics from NZ River Maps used for water balance model calibration.

| Flow Metric | Wharemaukū Stream | | Modelled Flow | |
|---|---|---|---|---|
| | $m^3/s$ | L/s | $m^3/s$ | L/s |
| MALF | 0.03 | 27.54 | 0.03 | 31.02 |
| Mean Flow | 0.14 | 143.11 | 0.16 | 161.36 |
| Median Flow | 0.079 | 79.00 | 0.085 | 85.34 |
| 1 in 5 year low flow | 0.018 | 18.46 | 0.027 | 27.81 |

The resulting water balance is shown in terms of proportion of rainfall in **Table 6**. The lowest groundwater recharge was in Urbanized areas, where recharge was calculated to be approximately 2.5% of annual rainfall (with Peat and Sandstone dominated areas receiving 9.0%). At the higher end of the spectrum, approximately 28% of rainfall became groundwater recharge in areas classified in the Sand group and approximately 38% of rainfall became recharge in Gravel areas that align with the larger alluvial valleys.

Table 6. Simulated water balance from SMWBM.

| Soil Group | Water Balance Components | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Interception Loss | | Evapo-transpiration | | Surface Runoff | | Groundwater Recharge | | Change in soil storage | |
| | % of rainfall | mm/year | % of rainfall | mm/year | % of rainfall | mm/year | % of rainfall | mm/year | % of rainfall | mm/year |
| Peat | 18.8% | 187 | 53.9% | 534 | 18.6% | 184 | 9.0% | 89 | -0.30% | -3 |
| Sand | 18.8% | 187 | 43.0% | 426 | 10.2% | 101 | 28.2% | 279 | -0.20% | -2 |
| Sandstone | 21.2% | 210 | 55.7% | 552 | 14.2% | 141 | 9.0% | 89 | -0.14% | -1.4 |
| Gravel | 18.8% | 187 | 41.5% | 411 | 1.7% | 17 | 38.3% | 379 | -0.34% | -3.4 |
| Urbanised | 23.3% | 231 | 35.7% | 354 | 38.9% | 385 | 2.5% | 25 | -0.33% | -3.3 |
| Surface Mine | 8.0% | 79 | 43.4% | 430 | 35.3% | 350 | 13.6% | 134 | -0.29% | -2.9 |

# 5. Numerical Model Development

The model has been developed in AquaVeo's Groundwater Modelling System (GMS) using the MODFLOW Unstructured Grid (MODFLOW-USG) code, developed by the United States Geological Survey (USGS). The model comprises two layers with lateral boundaries defined by the wider Wharemaukū Stream catchment and State Highway 1 at the down-gradient end.

Groundwater levels recorded during site investigations (**Table 3**) represent conditions at the time of measurement and may be influenced by several factors, including seasonal fluctuations, post-drilling recovery, perched groundwater within shallow peat, and localised subsoil drainage effects in shallow boreholes. To account for these sources of variability and to establish representative regional groundwater conditions, a two-layer 3D groundwater model was developed

## 5.1 Modelling Methodology

Three versions of the model were developed, representing the current landscape, proposed post-development landscape, and conditions during construction (i.e. excavation of the peat across the site). The following sections describe the development of the model grid, boundary conditions assigned to represent the features that influence groundwater, and hydraulic parameters assigned to the hydrogeologic materials represented in the numerical model.

## 5.2 Grid Layout

### 5.2.1 Horizontal Discretisation

An unstructured quadtree grid was implemented in MODFLOW-USG to provide targeted spatial refinement across key hydrogeological and surface water features, ensuring high resolution in areas of primary interest while maintaining computational efficiency across the wider Wharemaukū Stream catchment.

The model was developed with a base grid spacing of 64 m applied to cells through the outer catchment area. Enhanced resolution was applied along features considered to be potentially sensitive, with 16 m cells along regional rivers, 8 m cells within the development area, 4 m cells within wetlands, and 2 m cells aligning with streams and drains in the development area and its immediate surroundings. The applied resolution is typical for a groundwater model used for site specific analysis is the case for this model. The spatial variation in grid size allows for high resolution in potentially sensitive areas, while larger grid cells allow more efficient model run times yet still provide information to assess groundwater conditions at a larger scale. **Figure 8** shows the model grid and highlights areas of enhanced grid resolution.

### 5.2.2 Vertical Discretisation

**Pre Construction Model**

The pre-construction model represents existing ground conditions based on 1 m resolution LiDAR data obtained from LINZ[7][3] for the Kāpiti Coast region, and site specific survey data for the project area provided by Envelope Engineering.

In order to maintain numerical stability and computational efficiency, both the layer interface and bottom elevations were defined uniformly across the model domain. Specifically, the interface between Layer 1 and Layer 2 was set at 1.8 m AMSL to represent the typical bottom surface of the peat layer across the project area, while the model base elevation was established at -15 m AMSL based on the depth of the deepest bores with available water level data in the local area.

**Post Construction Model**

[3] Land Information New Zealand (LINZ). (2016). Wellington Regional 1m Digital Elevation Model (DEM) / LiDAR Imagery (2013–2016) [Data set]. LINZ Data Service. Available at: https://data.linz.govt.nz

The post-development model incorporates the proposed finished ground levels derived from the design surface[4]. These design elevations were interpolated onto the 1 m resolution LiDAR dataset to generate the proposed post-construction ground surface and integrated with the elevation data for the surrounding landscape.

This simplified modelling approach reduces the number of parameters required and computational complexity, while retaining the key characteristics of the underlying geological materials and the principal hydrological features within the model domain.

[4] Provided by Envelope Eng. (2026)

N

0 1 2 km

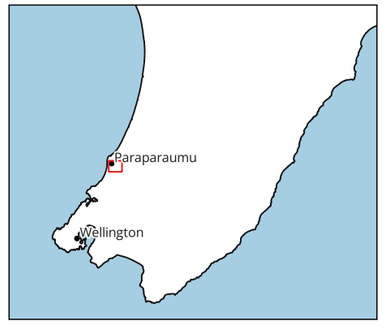
0 100 200 m

0 25 50 m

Map Title:
**Groundwater Model Grid**

Project:
**77 & 109 Kapiti Road Development**
**Hydrological Effects Assessment**

Client:
**New Central Park Limited**




**Legend**

**Model Boundary**
**Model Grid**

Grid Refinement Areas

**Property Boundary (8m)**
**Development Area Rivers (2m)**
**Wetlands (4m)**
**Regional Rivers (16m)**

Data Provenance
Basemap imagery from Google Satellite

Drawn by: Atakan Durmus
05/10/2026

Layout & Project File
G:\Shared drives\Projects\New Central Park Limited\WWLA1533_Hydrogeological Effects Assessment

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**Figure 8.**

## 5.3 Boundary Conditions

The boundary conditions used in the model to represent the physical process controlling and interacting with groundwater flow are detailed in this Section.

### 5.3.1 Streams and Drains

Drain cell boundary conditions were assigned to model cells intersected by streams or artificial drains. The stream bed elevation assigned to stream cells was set to the minimum elevation of the LiDAR DEM within the given model cell.

Seepage face boundaries were assigned to the roads and heavily developed areas within and around the site to represent the sub-soil drainage network.

In the post-development model the drain locations[5] were adjusted to align with the site plans provided by Envelope and stream bed elevations were modified using the same method as done for the Baseline Model applied to the Finished Ground Level data. The commercial/residential development area was also converted to a seepage face boundary for this scenario.

In the Construction scenario all model cells within the development area where peat was the predominant sub-surface material were converted to drain cells to represent the excavation where the material will be replaced by compressed sand. The excavation level for the construction area was 2.5 m below the existing (pre-development) surface as indicated through internal communication with the project team.

This method reflected a conservative assumption that the entire excavation would be done at once which would create a maximum impact; although in practice the excavation will be carried out across the site in stages, the details of which are to be determined. For practical purposes, the flow into the excavation area, equating to the dewatering requirements is provided as a flow rate per unit area such that flow can be predicted when detailed excavation plans are available.

### 5.3.2 Groundwater Recharge

The groundwater model used the daily groundwater recharge rates produced by the SMWBM (**Section 4.4**, **Appendix A**). The SMWBM was applied to simulate groundwater recharge for the full 32+ year simulation period, with the daily average rate for each month of the simulation period applied in the groundwater model.

The recharge rates were specific to each material type across the site. Recharge for peat and sand dominated areas amounted to 11% and 32% of rainfall, respectively. The rate dropped to only 3% of rainfall in urbanised areas that are artificially drained, translating to an expected decline in groundwater recharge corresponding to the proposed urbanisation that occurs with development. The New Central Park development will replace much of the peat in the development area with compacted sand, however most of the development will be covered by impermeable surfaces.

In the post-development model this is accounted for by applying groundwater recharge at a rate that is a weighted average between the ‘Urban’ recharge rate (80% coverage) and the ‘Sand’ recharge rate (20% coverage)[6].

Rainfall on road surfaces is routed to 71 rain gardens distributed around the development area. These are designed to absorb a volume of runoff water from rain events up to a maximum of 20 mm, with excess runoff of rainfall going into soakage facilities. The rain gardens were incorporated into the model by calculating the volume of discharge generated from the first 20 mm of rainfall on roads through the development area. The total volume was then distributed evenly among the rain gardens and applied in the model as additional groundwater recharge at the corresponding locations.

The model also includes several areas of alluvial gravel and a surface mine, where annual recharge was calculated to be 46% of rainfall however these areas are outside of the focus area and have little influence on the hydrological conditions at the project site.

[5] Envelope Eng. (2026). Project ID 1942-02 Drawing 4000.
[6] The relative areas of permeable and impermeable surfaces were provided via email by DCM Urban, the project landscape architects.

## 5.4 General Head Boundaries

A general head boundary (GHB) was applied along the downgradient boundary for Layer 2 of the model to represent the deeper groundwater connection to the coast (approximately 2 km away). A GHB allows for simulated flow to occur as a function of driving pressure and conductivity through the boundary and is typically used to represent connection to water bodies outside of the model area.

In this case the pressure (hydraulic head) on the GHB was set to 0 m to represent the influence of the ocean and GHB conductivity was adjusted to reflect the distance from the coast and the silty sandy material that has been described at depth. Assigning independent boundary conditions to the two model layers allowed for the model to have an groundwater outlet other than through streams and to reflect the different level of discharge flowing through the subsurface geologic layers.

In the climate change scenarios the hydraulic head at the GHBs was increased in accordance with the SSP-7.0 conditions shown in Awa (2024[8]) and addressed in further detail in **Section 7**.

## 5.5 Model Calibration

The applied methodology and results for groundwater model calibration is detailed in this Section.

### 5.5.1 Calibration of Groundwater Model

Calibration of the numerical groundwater model involved adjusting the hydraulic parameters assigned to materials represented in the model domain to achieve the best possible agreement between simulated and measured groundwater levels.

A steady-state groundwater model was initially developed to represent average climatic conditions and the corresponding long term groundwater recharge regime. The simulated water table under average conditions and predominant groundwater flow direction is presented in **Figure 9**. The calibration of the individual monitoring sites in the steady state model is shown in **Figure 10**.

These results show that the model is well calibrated to the shallow piezometers that appear to interact with the perched groundwater that has been documented across the site in the Torlesse investigations (Torlesse GAR [11]). The regional groundwater that has been encountered at a greater depth as indicated in the Engeo Geotechnical Investigation (2023[3]), which documents five bores of approximately 20 m depth with groundwater levels ranging between 0.6 to 1.9 mBGL. The water levels at these locations were somewhat over-simulated by the WWLA model though it is noted that the water levels were recorded in a single measurement directly after the completion of drilling and may not have been at steady state and thereby representative of regional groundwater levels.

For the purpose of this investigation the calibration of the model to the shallow monitoring sites which had more extensive and more recent data, was considered to be suitable to represent the conditions on the proposed development site.

The transient model was calibrated to the 351-day data from the monitoring wells (**Section 3.4.1**). The root-mean squared error (RMSE)[7] for the model is 0.25 m, which amounts to 6.5% of the range of observations (3.86 m). These results indicate that the model is suitable for the purpose of evaluating hydrological conditions at the development site, while acknowledging that the there is a degree of heterogeneity in natural materials that cannot be captured in a numerical model.

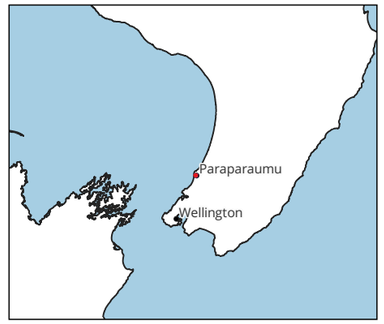
The hydraulic parameters used in the numerical model are shown in **Table 7** and hydrographs showing the observed and simulated groundwater levels at the monitoring wells are shown in **Appendix B**.

[7] RMSE is a metric for evaluating numerical models. Typically, an RMSE that is less than 10% of the range of observations is considered fit for purpose.

Map Title:
**Wetlands within the development area**

Project:
**77 & 109 Kapiti Road Development**
**Hydrological Effects Assessment**

Client:
**New Central Park Limited**




**Legend**

- **Model Boundary**
- **property boundary**
- **Rivers / streams**
- **Existing wetlands**
- **Groundwater contours (mAMSL)**
- **Groundwater flow direction**

Groundwater monitoring bores
(Labels indicate simulation residual)

- **-0.50 - -0.40**
- **-0.4 - -0.1**
- **-0.1 - 0.1**
- **0.1 - 0.4**
- **0.4 - 2.0**

Data Provenance
Background imagery from Google Satellite

Drawn by: J Scherberg
30/09/2026

Layout & Project File
A3 Landscape Template

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**Figure 9.**

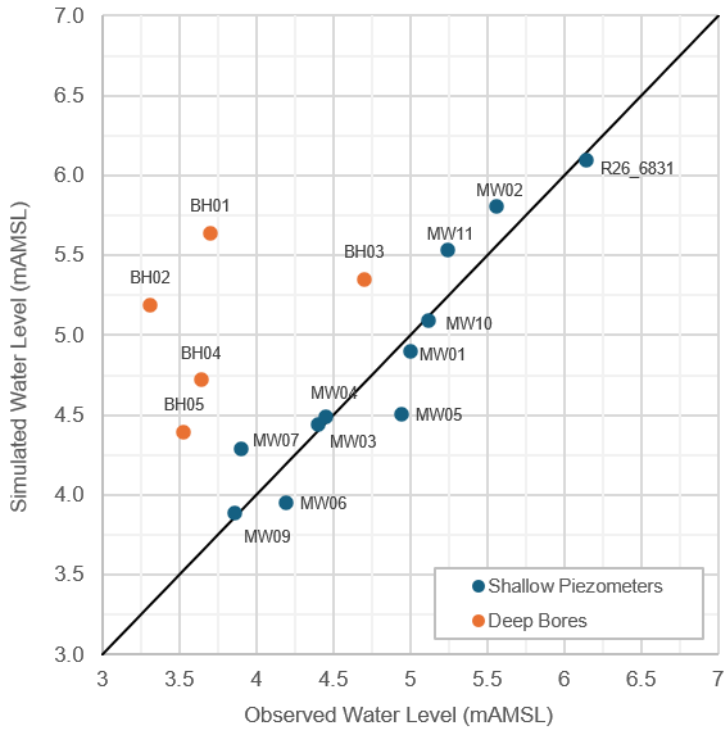



Figure 10. Simulated versus observed groundwater levels.

Table 7. Hydraulic parameters used in the calibrated groundwater model.

| Model Layer | Material Type | Calibrated Horizontal k (m/day) [m/sec]* | Anisotropy | Specific Yield (Layer 1) / Specific Storage (Layer 2) |
|---|---|---|---|---|
| 1 | Sand | 2.25 m/day [2.6 x $10^{-5}$ m/s] | 5 | 0.20 |
| | Peat | 0.105 m/day [1.2 x $10^{-6}$ m/s] | 10 | 0.045 |
| | Urbanised area | 0.6 m/day [6.9 x $10^{-6}$ m/s] | 5 | 0.04 |
| | Sandstone | 0.005 m/day [5.8 x $10^{-8}$ m/s] | 10 | 0.02 |
| | Surface Mine | 5.0 m/day [5.8 x $10^{-5}$ m/s] | 5 | 0.15 |
| | Alluvial Gravels | 5.0 m/day [5.8 x $10^{-5}$ m/s] | 10 | 0.2 |
| 2 | Silty-Sand | 0.6 m/day [6.9 x $10^{-6}$ m/s] | 5 | 0.0001 |

### 5.5.2 Water Balance

The calibrated model water balance for the proposed development site is shown in **Table 12**. All of the groundwater inflow is from recharge, which is a result of including the full catchment area in the model. The majority of groundwater discharges to streams, either as direct baseflow (46%) or via the urban drainage

network (51%) which includes shallow subsurface drains that avert flooding in developed areas drain roads. The significance of this information is that is can be referenced in the assessment of the post-development model.

Table 8. Average daily water balance for steady-state groundwater model.

| Mass balance | Components | Baseline Model | |
|---|---|---|---|
| | | Flow ($m^3/d$) | Percentage of Flow (%) |
| Inflow | Recharge | 5,154 | 100.0% |
| | **Total inflow** | **5,154.0** | **100%** |
| Outflow | Streams (groundwater baseflow) | 2,380 | 46.2% |
| | Flow into urban drainage systems | 2,630 | 51.0% |
| | Flow deep aquifer (Layer 2) toward the ocean | 145 | 2.8% |
| | **Total outflow** | **5,154.3** | **100%** |
| Percentage discrepancy | | -0.01% | |

# 6. Assessment of Hydrological Effects

## 6.1 Scenario Setup

The numerical model was applied to assess the potential hydrological effects of the proposed development, both during construction and over the long-term. Three versions of the model were used for this analysis.

1. ***Pre-Development (Baseline)*** – existing land use and environmental conditions
2. ***Construction*** – excavation of the peat (where present) was simulated to a depth of 2.5 meters to estimate dewatering requirements and short-term effects on surrounding water bodies. Recharge across the development area is applied at the rate for sand where there is planned excavation.
3. ***Post-Development*** – The model was updated to represent the post development land contours with a groundwater recharge profile that reflected urbanisation over the development area and a conversion of peat to compacted sand where indicated in the development plans. In this scenario the wetlands across the site are replaced by the new wetland complex indicated in the plans. 71 rain gardens are simulated as sources of groundwater recharge that receive runoff from roads following rainfall (up to 20 mm).

For the Baseline and Post-Development scenarios, a steady-state version of the model was used to inform the anticipated long-term changes in groundwater level and stream baseflow, and a transient version of the model was run to assess the response to peak events.

The Transient Scenarios were run for a 32.67 year (32 years + 8 months) simulation using data from January 1994 through August 2026 with a monthly stress period. The groundwater recharge rate applied for each month of the simulation was taken as the average for that month from the SMWBM (**Section 4.4**) for the corresponding material type. The Construction scenario was only run in steady state mode and evaluated as a temporary condition. A 100-year climate change scenario reflecting projected future conditions was also run to test the potential effect of an altered rainfall regime over decades on groundwater levels, as described in **Section 7**.

## 6.2 Groundwater Levels

The predicted change in groundwater level under average conditions is shown in **Figure 11**. The changes generally follow the pattern of the cut/fill plans provided by Envelope[8] with lower groundwater below the sand dune on account of the excavation in that area and within the new wetland complex where the ground will generally be lowered by 0.5 to 1.5 m. Slightly increased groundwater levels are expected adjacent to Kapiti Road where infill is planned on the northern side of the development.

The depth to groundwater – under existing (Baseline) conditions and post-development is shown in **Figure 12**. The water table is generally shallow in the peat area and deeper underneath the existing sand dunes due to their higher permeability. The area of the proposed new wetland complex in the post-development scenario features a shallow water table with groundwater near the land surface over most of its area. This is in keeping with the findings in the geotechnical investigation where trenches in this area were found to have perched groundwater at approximately 0.6 to 1.0 mBGL[11], further noting that the land surface elevation in this area will be reduced as mentioned above.

**Figure 13** shows three locations (refer to **Figure 11** and **Figure 12** for locations) were selected to show the effects of the development on groundwater levels. The effects are described as follows:

- Point 1 is in the Northern portion of the development where the ground level will be raised by approximately 1.25 m. A slight increase in groundwater level is predicted, with a decrease in seasonal variation due to the decreased recharge with urbanisation.

- Point 2 is in the area where the existing sand dune will be removed, lowering the ground surface elevation by approximately 6.85 m. The groundwater level is relatively deep in this area due to the higher

[8] Envelope Eng. (2026). Project ID 1942-02 Drawing 2200.

permeability material. The groundwater level is predicted to decrease by about 0.5 to 0.9 m, and have less seasonal variability on account of decreased infiltration of rainfall.

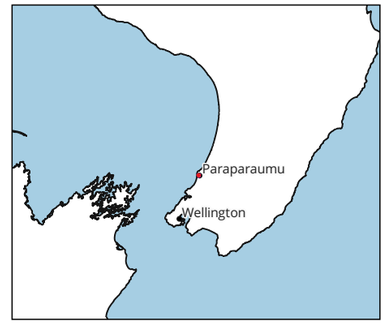
- Point 3 is in the offset wetland area where the ground surface will be lowered by approximately 0.5 m to approximately the level of the peat. The groundwater level in that area currently varies seasonally from right at the ground surface to approximately 0.4 mBGL. With the offset wetland in place the groundwater level will drop as the land surface is lowered, but the water table will remain shallow. Seasonal variation will be slightly reduced due to the low-permeability and low infiltration of the peat. It is anticipated that the low flow channels that have been incorporated into the wetland design will allow the shallow groundwater to flow offsite and into the Wharemaukū Stream.




Map Title:
**Predicted change in groundwater level with development under average conditions**

Project:
**77 & 109 Kapiti Road Development Hydrological Effects Assessment**

Client:
**New Central Park Limited**




**Legend**

**Model Boundary**

**Groundwater reference points**

Post development change in groundwater level (m)

- **-1.25 - -0.75**
- **-0.75 - -0.25**
- **-0.25 - 0.25**
- **0.25 - 0.75**
- **0.75 - 1.25**

Change in groundwater level (m)

**1.25**

**-1.25**

Data Provenance
Background imagery from Google Satellite

Drawn by: J Scherberg
16/10/2026

Layout & Project File
A3 Landscape Template

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**Figure 11**

## Existing Conditions

## Post - Development

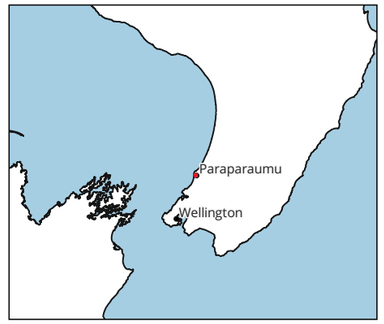
GW Point 1
GW Point 2
GW Point 3

0 200 400 m

Map Title:
**Predicted depth to groundwater under existing conditions and post-development**

Project:
**77 & 109 Kapiti Road Development Hydrological Effects Assessment**

Client:
**New Central Park Limited**




**Legend**

- State Highway
- Rivers / Streams
- Post_development_drains

Depth to groundwater contours (m)

- 0 - 0.5
- 0.5 - 1
- 1 - 10
- 10 - 20

Depth to groundwater (m)
10
0

- Groundwater reference points

Data Provenance
Background imagery from Google Satellite

Drawn by: J Scherberg
15/10/2026

Layout & Project File
A3 Landscape Template

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**Figure 12**




Figure 13. Variability of groundwater levels under Baseline conditions and Post-development.

## 6.3 Surface Water Effects

### 6.3.1 Streams

The Wharemaukū Stream flows directly adjacent to the proposed development, and comprises the primary drain of the catchment area represented by the model. The stream is fed by direct groundwater discharge (baseflow), surface runoff, and urban drains that convey shallow groundwater and runoff to the stream. The groundwater model simulates only the baseflow component of total stream flow. Since baseflow is the predominant source of flow during dry conditions the model serves as a reference for the effects on low flows, however it is not intended to simulate high-flow conditions where runoff is the predominant contributor to total flow.

The simulated flow for the Baseline and Pre-Development models is shown in **Figure 14** which shows that the reduction in effect of the development on baseflow will be negligible as the reduced infiltration of rainfall on the urbanised portion of the development area will be balanced by more permeable sand replacing peat and the

infiltration from the rain gardens. On average, baseflow is reduced by approximately 0.12 L/s though there are occasion where it increases under post-development conditions.

For reference, the estimated 7-day mean annual low-flow (MALF) and Q5 (the one in five year 7-day low-flow) are 27.5 L/s and 18.5 L/s, respectively, according to the information on NZ Rivermaps[9], though the simulated baseflow presented here are greater reflecting the monthly data sets simulated by this model. The simulated baseflow reduction at times of low-flow is in the range of 0.12 L/s, which is 0.4% of MALF and 0.6% of Q5.

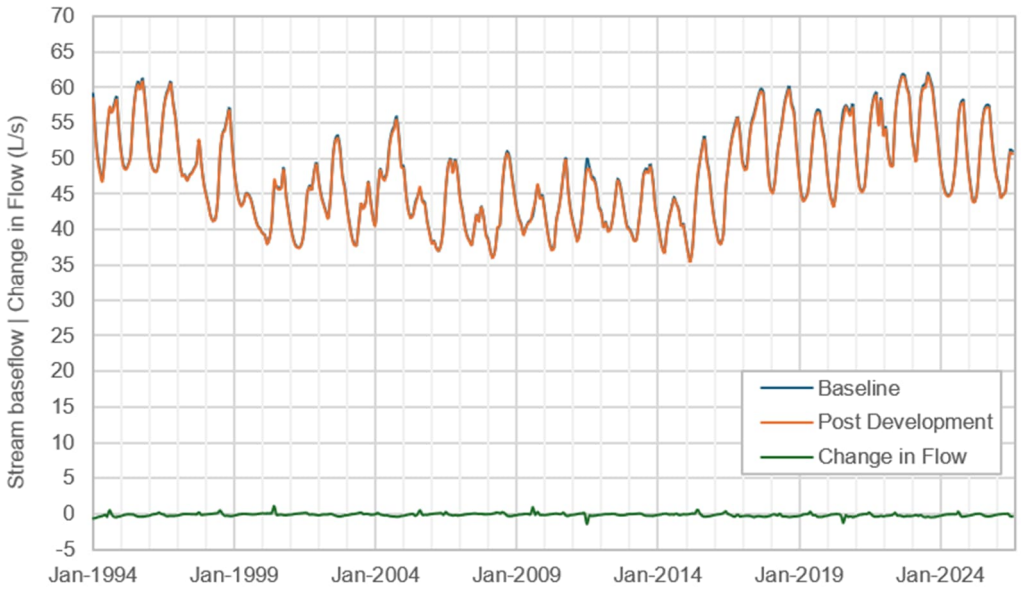



Figure 14. Simulated baseflow in the Wharemaukū Stream under Baseline and Post-Development Conditions.

### 6.3.2 Wetlands

The wetlands within the development site will be removed during the development process whilst a new wetland complex is proposed adjacent to the Wharemaukū Stream (**Figure 15**). The predicted change in the groundwater level underlying the new wetland complex is on the order of a one metre reduction, following the change in land surface elevation.

Minimal groundwater level change is predicted to occur in the constructed wetlands to the southwest of the development, on the opposite side of the Wharemaukū Stream, with a small section predicted to have groundwater levels reduced by approximately 0.25 to 0.5 m. The modelled depth to groundwater level in this area is greater than 2 m indicating that it is already disconnected from regional groundwater and is a surface water fed wetland.

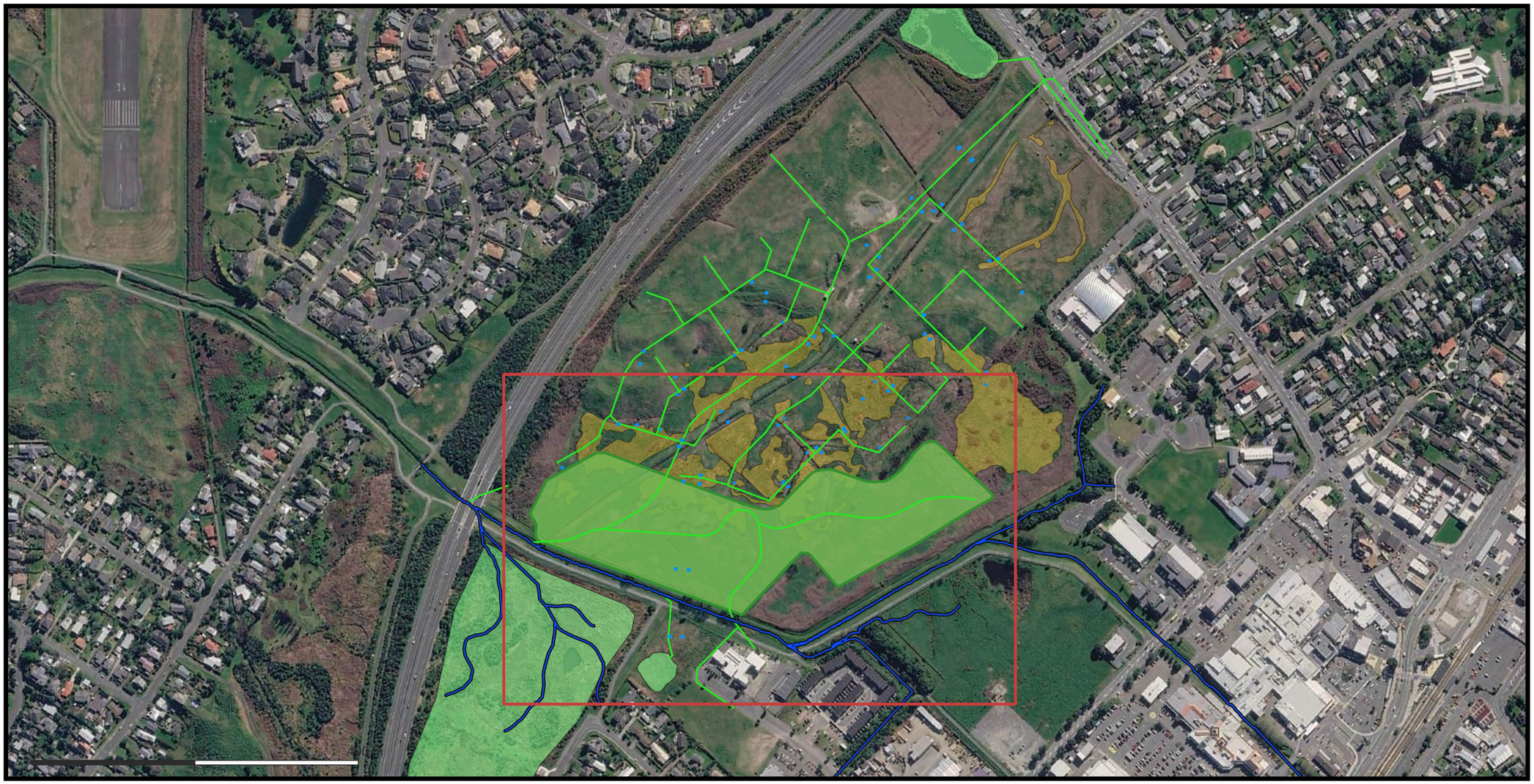
The groundwater level below the new wetland complex is predicted to be under 0.25 m from the surface over most of its area. In practice, water that discharges during times of wet conditions will collect in the swales that have been integrated into the design, ultimately discharging into the Wharemaukū Stream. The predicted baseflow in the swale is shown in **Figure 16**. The range is between 0.5 and 2.0 L/s. This relatively modest flow is due to the low permeability of peat soils and because a significant amount of the recharge in the surrounding area is intercepted by the urban drainage network.

[9] NZ River Maps is an interactive, web-based tool developed by NIWA that provides statistical summaries of flow data for New Zealand's national river network (https://shiny.niwa.co.nz/nzrivermaps).





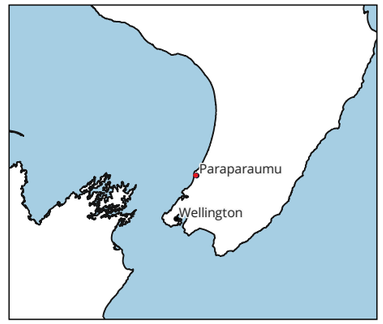




Map Title:
**New wetland complex and existing wetlands in development area.**
**Top Left - Predicted depth to groundwater.**
**Top Right – Predicted change in groundwater level.**

Project:
**77 & 109 Kapiti Road Development Hydrological Effects Assessment**

Client:
**New Central Park Limited**




**Legend**

- **Model Boundary**
- **Rivers / streams**
- **Post development drains**

Existing wetlands
- **To be removed / replaced**
- **To be retained**
- **Mitigation wetland**
- **Rain Gardens**

Depth to groundwater contours (m)
(Top Left)
- **0 - 0.5**
- **0.5 - 1**
- **1 - 10**

Post development change in groundwater level (m)
(Top Right)
- **-1.25 - -0.75**
- **-0.75 - -0.25**
- **-0.25 - 0.25**
- **0.25 - 0.75**
- **0.75 - 1.25**

Data Provenance
Background imagery from Google Satellite

Drawn by: J Scherberg
15/10/2026

Layout & Project File
A3 Landscape Template

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**Figure 15.**

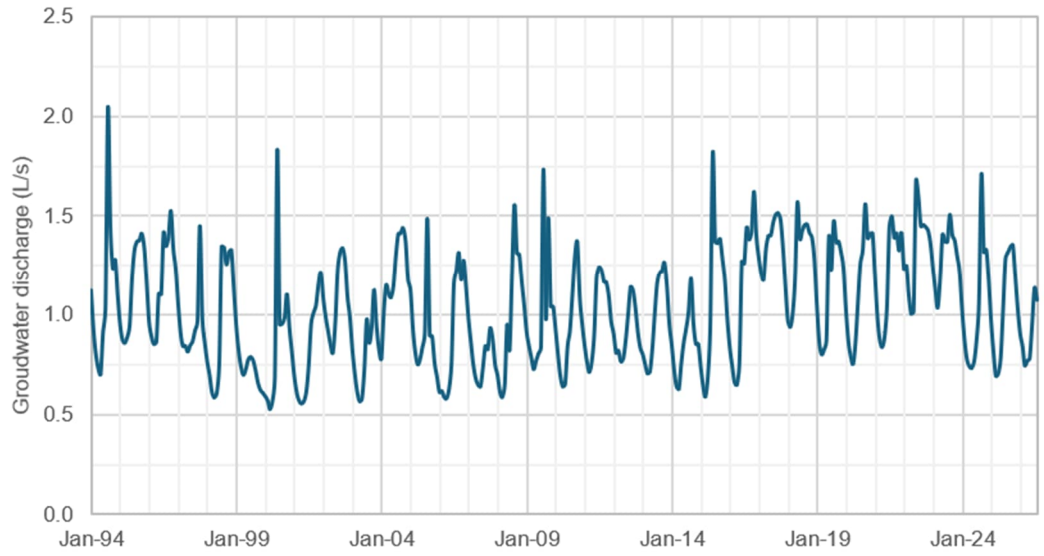



Figure 16. Predicted groundwater discharge to swales in the new wetland complex.

## 6.4 Construction Dewatering Effects

The groundwater model was used to assess temporary changes in groundwater level that can be anticipated as the excavation proceeds during the construction process. Given that the area that is going to be excavated at a given time during the construction process is yet to be determined the estimated dewatering requirement was calculated on in terms of discharge per hectare of excavation area.

The drainage into the excavated area – assumed to be 2.5 m below the existing land surface in the area where peat is the underlying material – is shown in **Figure 17**. The dewatering requirement is predicted to be approximately 0.94 L/s/ha of excavation initially, reducing to 0.64 L/s/ha over the first 3 months and eventually stabilising to a seasonally variable 0.25-0.55 L/s/ha. For reference, if the entire excavation were to occur at once (unrealistic) the total maximum groundwater discharge would be approximately 13 L/s.

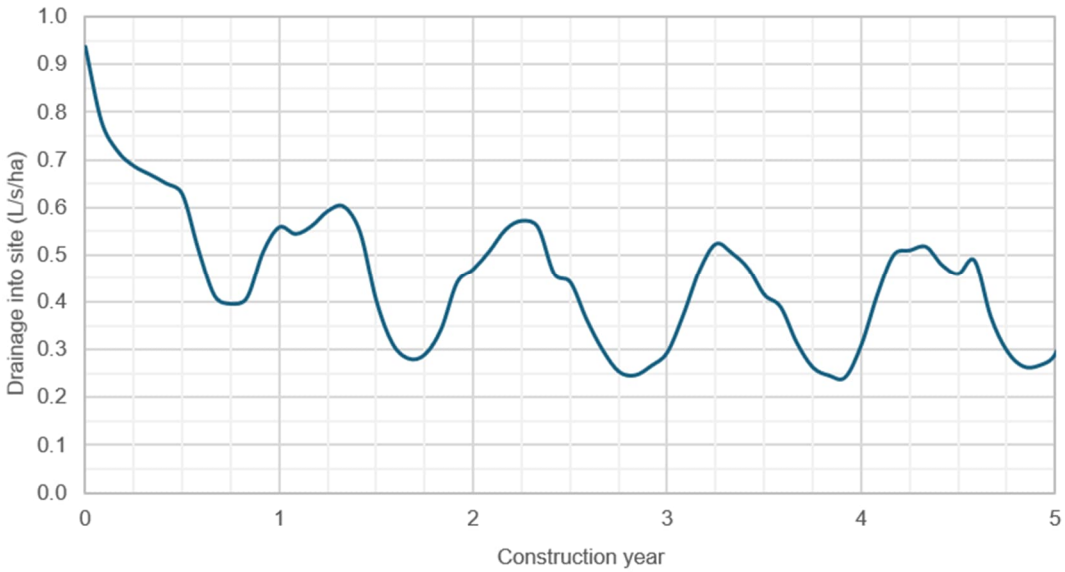



Figure 17. Predicted dewatering requirement during construction.

The groundwater model was used to predict the level of drawdown that will occur during the construction phase of the development if the entire excavation occurred at once, which is effectively an envelope for the worst case scenario for drawdown. The predicted drawdown is shown in **Figure 18**, which shows a maximum drawdown of approximately 3 m in the development area with a maximum drawdown of 2.0 m outside of the property boundary (at the northern edge along Kapiti Road).

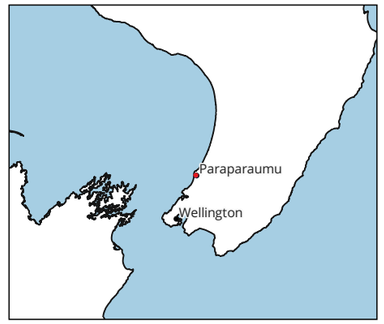
The bores listed in the Greater Wellington Regional Council database that are within the potentially affected area are shown in **Figure 18**. Available information about each bore with over 0.2 m of predicted drawdown is shown in **Table 9**, although there is limited data available for the majority of these bores. The greatest predicted drawdown is 1.9 m at R26/5565, located to the north of the development site across Kapiti Road. The bore appears to be a domestic bore and its depth and static water level are unknown.

The wetlands on neighbouring properties to the south of the development, and the stormwater pond at the northern corner of the development are predicted to experience negligible hydrological effects as a result of groundwater drawdown during construction. The model predicts that only a limited portion of the wetlands to the south falls within the area of groundwater drawdown. In this area, the regional groundwater table is more than 2 m below ground level (**Figure 12** – right panel), indicating that the wetland hydrology is not reliant on direct interaction with the regional groundwater table and is predominantly supported by surface water and/or shallow perched water. Accordingly, the modelled reduction in regional groundwater levels is not expected to materially alter the hydrological conditions supporting these wetlands. The pond to the north is supplied by stormwater runoff and is similarly not expected to be materially affected by the predicted groundwater drawdown.

Map Title:
**Predicted drawdown during construction**

Project:
**77 & 109 Kapiti Road Development**
**Hydrological Effects Assessment**

Client:
**New Central Park Limited**




**Legend**

- **Property boundary**
- **Rivers / streams**
- **Retained wetlands**
- **Drawdown contours (m)**

Registered bores
(labelled by Council ID)
Drawdown (m)

- **0 - 0.5**
- **0.5 - 1**
- **1 - 1.5**
- **1.5 - 2**

Data Provenance
Background imagery from Google Satellite

Drawn by: J Scherberg
15/10/2026

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A3 Landscape Template

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**Figure 18.**

Table 9. Bores with over 0.2 m simulated drawdown.

| Well ID | Easting (NZTM) | Northing (NZTM) | Use | Depth (m) | Drawdown (m) |
|---|---|---|---|---|---|
| R26/5565 | 1768552 | 5469324 | Unknown | Unknown | 1.90 |
| R26/7164 | 1768287 | 5469314 | Agriculture Irrigation | 70 | 1.70 |
| R26/5238 | 1768727 | 5469197 | Unknown | Unknown | 1.39 |
| R26/5442 | 1768578 | 5469474 | Unknown | Unknown | 1.36 |
| R26/5592 | 1768727 | 5469084 | Unknown | Unknown | 1.33 |
| R26/6005 | 1768726 | 5469287 | Unknown | Unknown | 1.27 |
| R26/5140 | 1768746 | 5469309 | Unknown | Unknown | 1.18 |
| R26/6831 | 1768770 | 5469188 | Groundwater Level Monitoring | 9.5 | 1.16 |
| R26/5403 | 1768694 | 5468951 | Unknown | Unknown | 1.12 |
| R26/7022 | 1768775 | 5469146 | Unknown | Unknown | 1.08 |
| R26/5653 | 1768798 | 5469350 | Domestic | Unknown | 0.95 |
| R26/5264 | 1768776 | 5469556 | Unknown | Unknown | 0.73 |
| R26/5300 | 1768867 | 5469487 | Unknown | Unknown | 0.61 |
| R26/5865 | 1768765 | 5469692 | Unknown | Unknown | 0.59 |
| R26/5768 | 1768934 | 5469613 | Unknown | Unknown | 0.41 |
| R26/5769 | 1768934 | 5469613 | Unknown | Unknown | 0.41 |
| R26/5748 | 1769027 | 5469369 | Unknown | Unknown | 0.32 |
| R26/6564 | 1769150 | 5469091 | Unknown | 50 | 0.21 |

# 7. Climate Change Assessment

A 100-year forward simulation was developed to investigate the effects of climate change on hydrological conditions in the proposed development area. This section describes the projected climate conditions that were tested, the methods used to incorporate these changes into the model, and the results in terms of effect on groundwater levels and stream baseflow.

## 7.1 Scenario Conditions

This analysis applied seasonal changes in rainfall and long-term sea level rise under SSP3-7.0 scenario conditions[10]. The projected changes in season rainfall for the Paraparaumu area were taken from the Ministry for the Environment (MfE) website[11] and shown in **Table 10**. The SSP3-7.0 scenario is described on the MfE website as representing a doubling of $CO_2$ emissions by 2100 with a corresponding warming effect of 3.6 °C.

The predicted sea level rise is reproduced from the flood hazard assessment report published by Awa [8] which provided mean sea level projections from the Takiwa online platform adjusted to Wellington. 100 years of sea level rise projections under SSP3-7.0 scenario conditions were considered in comparison to the 2005 baseline level shown in the Awa report, with the increased sea level ultimately reaching 0.8 m above the current level as shown in **Figure 19**.

Table 10. Percentage change in seasonal rainfall under SSP3-7.0 conditions as published by MfE.

| Phase | Year Range | Percentage change in rainfall from baseline (1995-2014) | | | | |
|---|---|---|---|---|---|---|
| | | Spring (September-November) | Summer (December-February | Autumn (March-May) | Winter (June-August) | Annual |
| Phase 1 | No adjustment | | | | | |
| Phase 2 | 2021-2040 | -0.2 | +4.9 | -7.7 | +6.6 | +0.8 |
| Phase 3 | 2041-2060 | +2.7 | +4.5 | -4.2 | +8 | +2.7 |
| Phase 4 | 2080-2099 | +6.3 | +4.5 | -10 | +4.1 | +1.1 |

[10] SSP3-7.0 climate change scenario conditions were used because it represents the highest emissions scenario for which site-specific rainfall projections are published.
[11] Data is available at https://map.climatedata.environment.govt.nz/

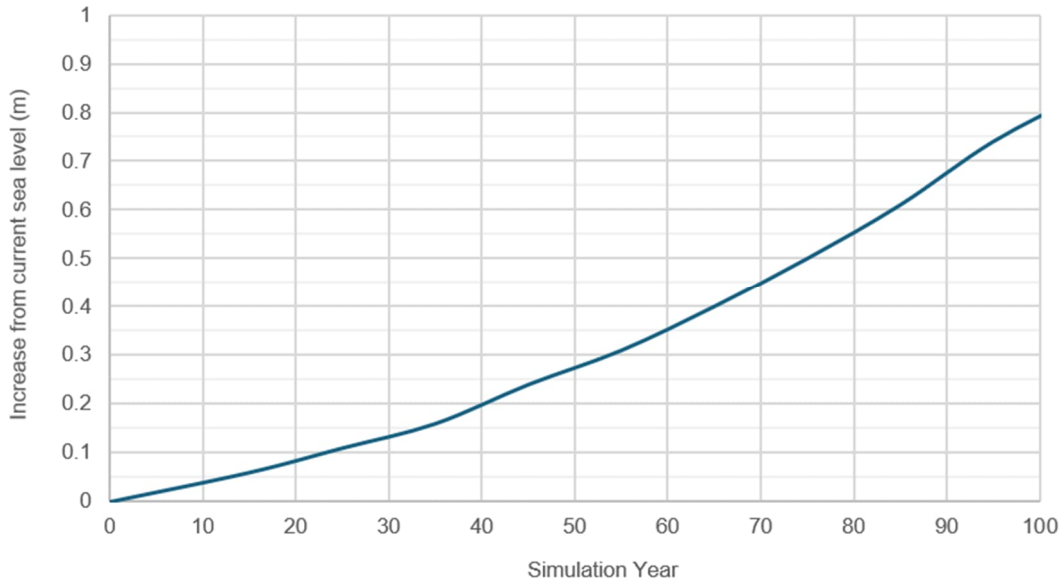



Figure 19. Projected sea level rise under SSP3-7.0 conditions.

## 7.2 Modelling Application

The 100-year simulation was developed by applying the climate change conditions specified in the previous section to both a Baseline and Post-Development version of the model. Both models used the hydraulic parameters derived in the calibration process (**Section 5.5**) and initial groundwater levels were set equal to those from the steady-state model. A monthly stress-period was applied, meaning that the simulation ran for 1,200 months in total. Groundwater recharge and sea level were adjusted to represent the SSP3-7.0 conditions.

### 7.2.1 Groundwater Recharge

Groundwater recharge is driven by rainfall using the SMWBM described in Section 4.4. For the climate change scenario, the first 32 years (1994-2025) of the rainfall data set that were used in the Baseline and Post-Development models were repeated 3 times (and the first four years were run for an additional cycle). However, the rainfall was altered in accordance with the seasonal adjustments indicated in **Table 10**.

- Years 20 through 39 of the simulation were adjusted to reflect the 2021-2040 changes;
- Years 40-80 applied the 2041-2060 adjustments[12]; and
- Years 81-100 applied the 2080-2099 adjustments.

The adjusted rainfall data was input into the SMWBM to determine groundwater recharge, with recharge applied over the development area (in the Post-Development scenario) calculated from the Urban and Sand land cover classifications in the same manner as described in **Section 5.3.2**. Recharge from the rain gardens was also calculated from the adjusted rainfall data sets and applied in the model in the same manner as in the Post-Development scenario. **Figure 20** shows the groundwater recharge applied to the development area under the climate change scenario relative to the non-adjusted recharge data set extended to the same time period.

There is no difference in the first 20 years of the simulation. Increased summer rainfall is predicted to correlate to increased recharge during the driest times of the year. The recharge during peak events is not predicted to change significantly, and overall the amount of recharge is predicted to increase by approximately 9.8 mm per

[12] No data was provided for 2061-2079, so the adjustments for the previous period were continued for an additional 20 years.

year for the 80 years where there was a difference in simulated recharge. The cumulative difference in groundwater recharge over the 100 year simulation was slightly under 800 mm (**Figure 21**).

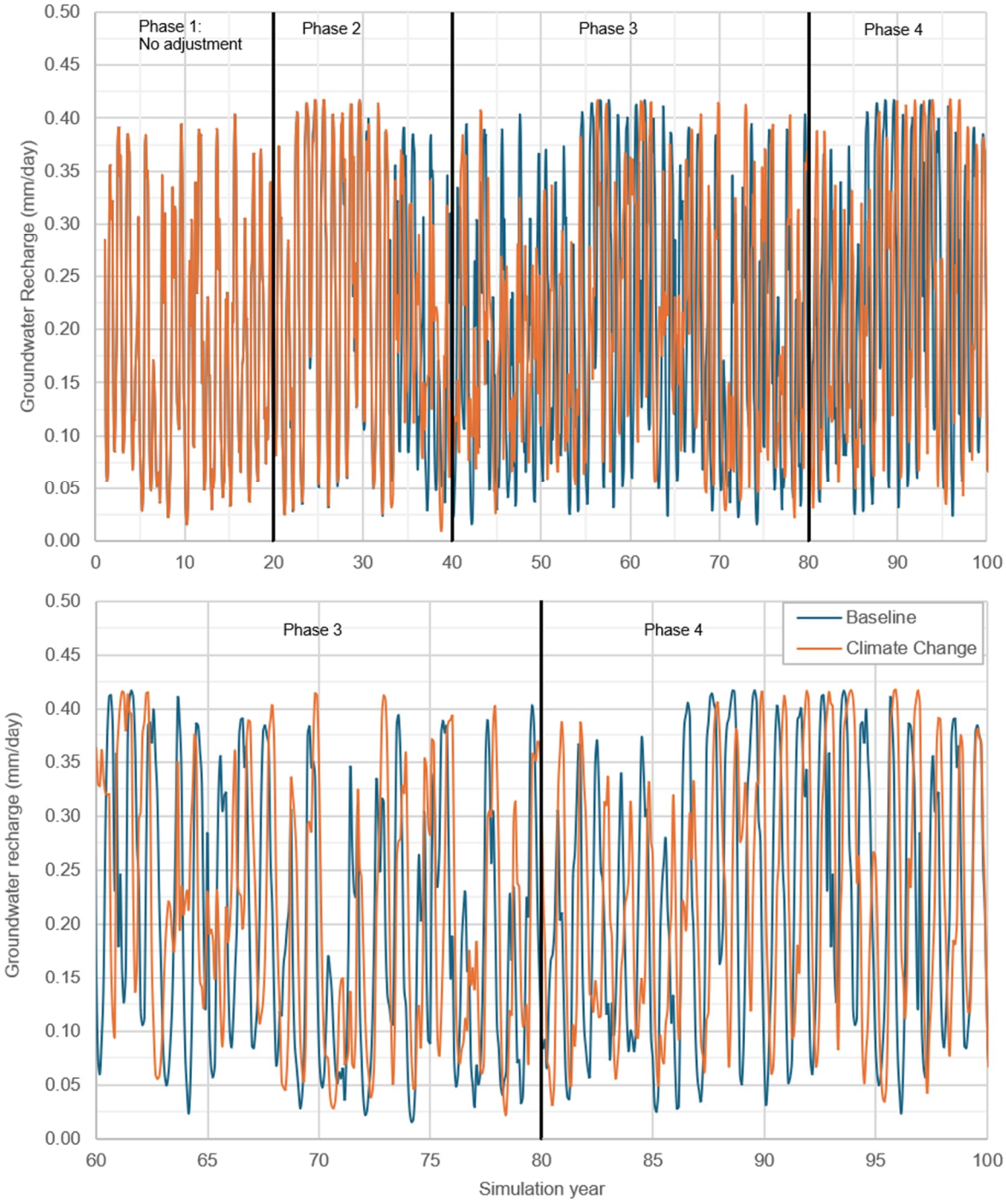



Figure 20. Groundwater recharge rate over the proposed development area for the 100-year simulation period with and without climate change adjusted rainfall (final 40 years highlighted in lower graph). Phases refer to the adjustments shown in Table 10.

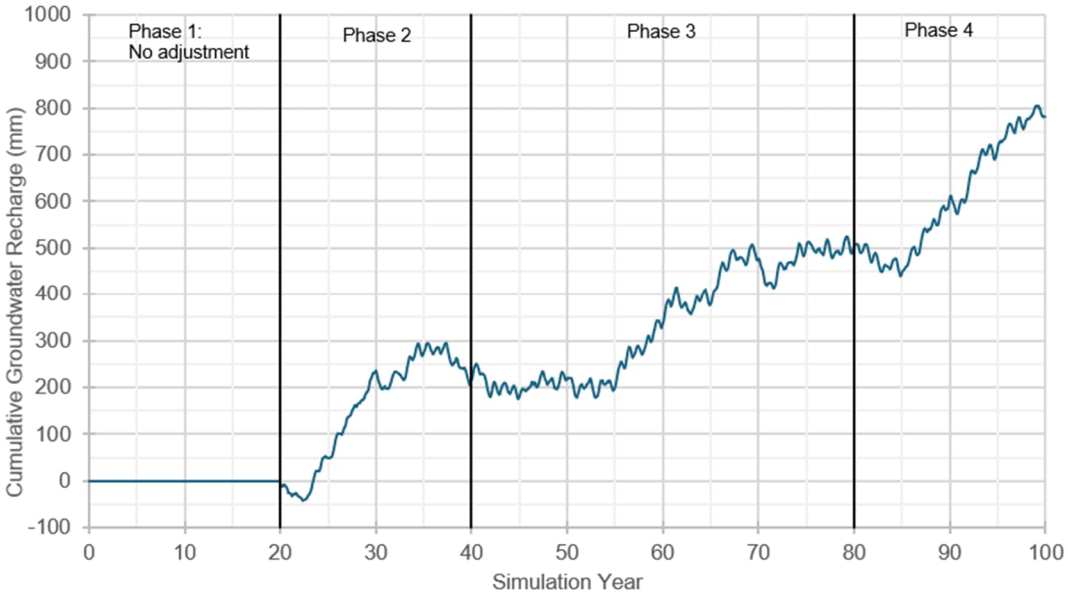



Figure 21. Cumulative difference in groundwater recharge under simulated climate change conditions.

### 7.2.2 Sea Level Rise

Sea level rise was simulated in the model by applying the increased sea level shown in **Figure 19** to the hydraulic head component of the GHB boundary condition described in **Section 5.4**. The conductivity component of the GHB (which represents the distance from the external water body (i.e. the ocean) was not changed.

## 7.3 Results of Climate Change Scenarios

The hydrological conditions under the climate change scenario tested in this analysis are presented in the following sections.

### 7.3.1 Groundwater Levels

An analysis of groundwater levels showed minimal effect from the applied climate change conditions.

The change in groundwater level predicted to occur as a result of the proposed development was slightly less with the additional recharge from the slightly increased annual rainfall (**Figure 22** – for reference compare to **Figure 11**).

The post-development depth to groundwater was evaluated for the end condition of the 100-year climate change scenario (**Figure 23**). The predicted conditions are very similar to those predicted under the existing climate conditions (**Figure 12**) with minor differences that are attributable to the simulation ending in summer, when conditions are drier than the average.

On the whole, groundwater recharge and groundwater levels are not predicted to be significantly impacted by the climate change conditions evaluated in this assessment.

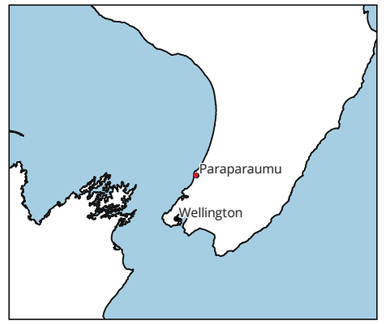
N

200 400 m

Map Title:
**Predicted change in groundwater level with development under SSP3-7.0 climate change conditions**

Project:
**77 & 109 Kapiti Road Development Hydrological Effects Assessment**

Client:
**New Central Park Limited**




**Legend**

**Model Boundary**

**Rivers / Streams**

Change in groundwater level contours (m)

- **-1.25 - -0.75**
- **-0.75 - -0.25**
- **-0.25 - 0.25**
- **0.25 - 0.75**
- **0.75 - 1.25**

Change in groundwater level (m)

**1.25**

**-1.25**

Data Provenance
Background imagery from Google Satellite

Drawn by: J Scherberg
16/10/2026

Layout & Project File
A3 Landscape Template

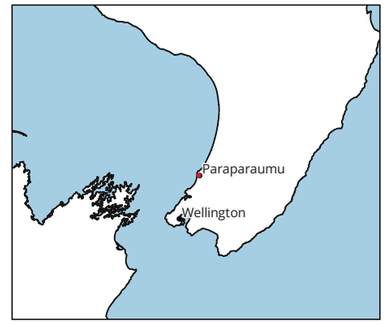
WILLIAMSON WATER & LAND ADVISORY

**Figure 22**

Map Title:
**Predicted post-development depth to groundwater under SSP3-7.0 climate change conditions**

Project:
**77 & 109 Kapiti Road Development Hydrological Effects Assessment**

Client:
**New Central Park Limited**




**Legend**

- State Highway
- Rivers / Streams
- Existing wetlands
- Offset wetland
- Drains

Depth to groundwater contours (m)

- 0 - 0.5
- 0.5 - 1
- 1 - 10
- 10 - 20

Depth to groundwater (m)

10

0

Data Provenance
Background imagery from Google Satellite

Drawn by: J Scherberg
16/10/2026

Layout & Project File
A3 Landscape Template

WILLIAMSON WATER & LAND ADVISORY

**Figure 23**

### 7.3.2 Stream Flows

Streams baseflows were assessed for both existing and post-development conditions under the climate change conditions, with the results shown in **Figure 24**. The range of flows were similar to those predicted under the existing climate scenarios (**Figure 14**). The model did not predict that climate change would exacerbate the effect of the development on stream baseflow, with very minor differences in flow predicted indicating that the decreased infiltration in unraised areas would be balanced by greater permeability where peat was replaced by sand and road runoff was routed to raingardens.

It should be noted that the negligible impacts predicted for groundwater baseflow are indicative of total flow under low-flow conditions, but not for higher flows when surface runoff is the predominant source of total stream flow.

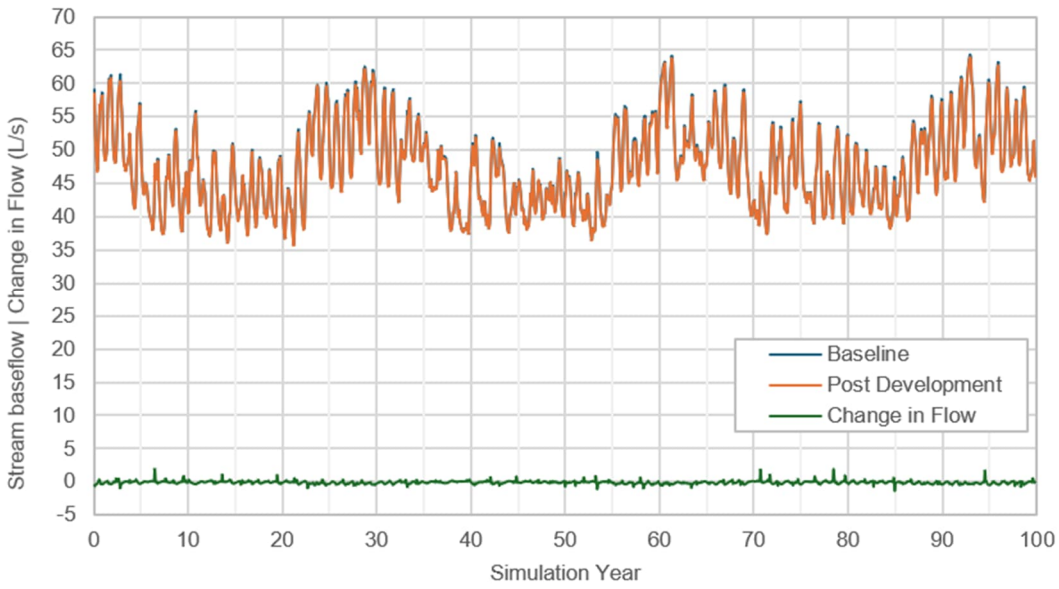



Figure 24. Baseflow in the Wharemaukū stream. Baseline and post-development conditions under 100-year climate change scenario.

### 7.3.3 Offset Wetland

The baseflow in the proposed offset wetland was predicted to increase slightly with the applied climate change conditions (**Figure 25**) relative to predicted discharge under current conditions (**Figure 15**). This was predicted to manifest with increased peak flows and low-flows resulting from the overall increase in rainfall recharge. The implication is that the offset wetland will be hydrologically viable, as the water table will remain near the surface and continually generate flow into the drain.

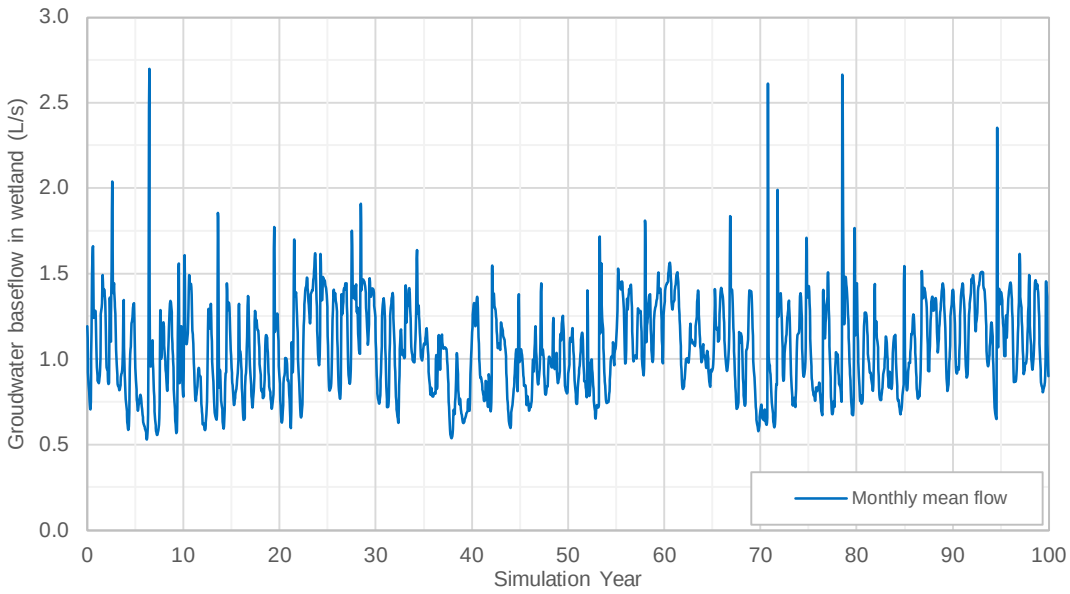



Figure 25. Predicted baseflow generated from the offset wetland under the 100-year climate change scenario.

# 8. Evaluation of RFI Questions

The investigation documented in this report has been developed to specifically address 'Requests for Information' that were submitted in relation to a previous application to develop the same property. The issues raised in the previous application are considered equally applicable to the current application, and have been addressed here in **Table 11** using with the same IDs as the original RFI.

Table 11. Summary of hydrogeological requirements from the RFI.

| ID | Summary of RFI Inquiry | Response based on updated analysis |
|---|---|---|
| 27 | Hydrogeological evidence to support the ecological plans for wetland offsetting and also effects on existing neighbouring wetlands. | The new wetland complex will be similar, in hydrogeological terms, to the existing wetlands whilst covering a larger area as both are situated on peat.<br>There is a negligible hydrological effect predicted on the wetlands on neighbouring properties because the only area where groundwater level change is anticipated is in an area where the wetland is disconnected from groundwater (i.e. it is fed by surface water) (**Section 6.3.2**). |
| 30 | Assessment of impacts on water balance of wetlands including temporary effects during dewatering and construction. | Drawdown and dewatering during construction have been assessed, and it has been concluded that the construction will not hydrologically impact the wetlands as the reduced groundwater levels will only occur in a wetland area that is disconnected from groundwater (**Section 6.4**). |
| 33 | A robust understanding of the existing hydrogeology is required demonstrating how the soil/ground conditions at the proposed level can ensure the functionality of the proposed offset wetland indefinitely i.e. demonstrate ability to remain wet. | The existing conditions and post-development conditions were both integrated into the groundwater model. The model results were verified against the geotechnical assessment undertaken by Torlesse Ltd. which confirmed that the model was realistic.<br>The ground level will be lowered by 0.5-1.5 m over most of the area of the offset wetland whilst the groundwater in this area is typically 0.6 to 1.2 mBGL under current conditions. The result is that the post-development water table will be near the land surface which is consistent with the findings of the model (**Section 6.3.2**). The implication is that the proposed wetland is hydrologically viable and capable of maintaining the intended wetland hydrology over the long term, including seasonal/dry-period conditions. |
| 34 | Please install 2 or more shallow piezometers within 100m of the stream, collecting groundwater level data at weekly intervals or shorter (if automatic pressure transducers are used instead of manual dips) for a minimum 6-month-timeframe. These should be surveyed in to correct water level data to absolute levels (i.e. to a datum). Provide a full assessment of the data (including but not limited to comparing it to the existing stream levels) to demonstrate how groundwater in the site fluctuates and the gradient towards the stream (and subsequently, future wetlands). | Shallow monitoring piezometers were installed at 11 locations across the site, though one was destroyed. 351 days of data was collected, and the water levels were surveyed to a datum to produce absolute levels. This data was used to calibrate the groundwater model documented in this report. |
| 39 | Provide an assessment of the monitoring and design information that demonstrates how the wetland cells will be created (i.e. peat re-distribution), how groundwater moves within the site, and what its contribution will be to support the offset wetland. | The available data from relevant bores and monitoring piezometers from the site and from adjacent sites has been completed and integrated into the modelling assessment. This information in combination with the geotechnical assessment has been utilised in the development of a numerical groundwater model which is then used to inform a detailed analysis of how groundwater moves through the site (**Section 3.4.1, Section 6.3.2**). |
| 41 | Assessment of the groundwater flow dynamics associated with the existing sand dunes that are to be removed/relocated with | Groundwater flow through the existing sand dunes was evaluated, with a finding that the area has elevated recharge compared to the surrounding peat dominated land. The proposed development will integrate an offset wetland that will retain a shallow water table due to the underlying peat, fed by drainage from the surrounding |

| ID | Summary of RFI Inquiry | Response based on updated analysis |
|---|---|---|
| | a focus on determining the corresponding effect on the proposed offset wetland. | landscape and periodic surface water overflows that will correspond to high rainfall events (**Section 0**) |
| 80 | Hydrogeological assessment of dewatering impact on connected water bodies. | An assessment of dewatering during the construction process has been provided. There is negligible impact on connected surface water bodies (the Wharemaukū Stream and wetlands to the south of the site) (**Section 6.4**). |
| 112 | Seasonal fluctuation of groundwater with regard to their potential impact on buried structures. | Seasonal variability of groundwater levels will generally be reduced with the proposed development due to reduced infiltration. Three representative locations have been selected to show the predicted effects in the development northern part of the area, adjacent to the existing sand dune, and within the offset wetland area (**Section 6.2**). |
| 113 | Assessment of the practicality of carrying out bulk earthworks (excavation and backfill) below the groundwater table. Comment was made that the groundwater is perched at the interface of the peat and sand level. | Perched groundwater has been confirmed and dewatering requirements are conservatively assessed for the proposed excavation area. The initial dewatering requirement amounted to approximately 9 L/s, reducing to a seasonally variable 3 to 5 L/s over the course of construction (**Section 6.4**). |
| 114 | Provision of post -development groundwater levels for sand liquefaction assessment. | Post development groundwater levels have been assessed and are provided in **Section 6.2**) |
| 120, 126 | Construction dewatering assessment – is dewatering required and if so, what duration, what rates and what is the potential impact on connected water bodies? | The initial dewatering requirement amounted to approximately 9 L/s, reducing to about 6 L/s after six months and a seasonally variable 3 to 5 L/s from 1.5 years into the construction through its duration (**Section 6.4**). |
| 143 | Groundwater level in the area of the proposed offset wetland. | The groundwater level in the area of the proposed offset wetland has been evaluated as part of the groundwater modelling process and is provided in **Section 6.2**. |
| 152 | Assessment of post development groundwater effects (potentially raised water tables) on the performance of the wetland and/or drainage measures proposed in the design. | Groundwater levels and the interaction between the proposed offset wetland and groundwater is assessed in **Section 6.3.2**. The water table in the area of the proposed wetland is shallow, and is estimated sustain wet conditions in the swales that have been integrated into the wetland design. |
| 162 | Assessment of post development groundwater levels (including climate change) with regard to stormwater infiltration capacity. | The effects of climate change on hydrological conditions were tested assuming an SSP3-7.0 scenario which generated a small increase in overall groundwater recharge though it was not enough to significantly impact the flow regime.<br>There was no indication that the proposed development would exacerbate the effect of climate change on stream baseflows or cause issues with groundwater inundation, or wetland dewatering. The simulated baseflow in the new wetland remained similar to predictions for the Post-Development scenario that used present climate conditions indicating no significant effect on infiltration capacity. |

# 9. Conclusion

WWLA has developed a numerical groundwater model to provide a quantitative representation of groundwater conditions within and surrounding the proposed New Central Park development area at Kapiti Road. The model was used to evaluate groundwater under current conditions, and assess environmental effects with the proposed development in place, and during the construction process.

A two-layer groundwater model was developed to represent the native geological materials underlying and surrounding the site. The model was calibrated in steady state mode against groundwater level information from 16 monitoring locations including 10 shallow piezometers distributed across the site. The calibrated model was then converted into a transient model to conduct further analysis. The primary findings of this investigation, in terms of effects were:

- Groundwater levels will be altered across the site, generally following the cut/fill plan that is being proposed for the development. The greatest decline will be in the area where the sand dune is being removed however the water table is relatively deep in this area, limiting the effect on groundwater levels.

- Drainage through the site will be altered by the development, but the overall impact on stream flow will be limited as the constructed drainage network will convey flow to the Wharemaukū Stream in a similar manner to the existing network.

- Several wetlands on the development site will be displaced and replaced by an offset wetland. Wetlands on neighbouring properties to the south are predicted to experience negligible hydrological effects from the development, including temporary construction dewatering. The limited portions of these wetlands within the predicted drawdown extent are not reliant on direct interaction with the deeper regional groundwater table.

- The land surface of the offset wetland will be cut to approximately the level of the existing water table (which is perched within the underlying peat). The modelling predicts that groundwater will remain sufficiently shallow across the proposed wetland to sustain the intended wetland hydrological conditions, including through seasonal low-groundwater conditions, together with a limited amount of groundwater baseflow to the proposed swale. On this basis, the proposed offset wetland is considered hydrologically viable over the long term.

- Dewatering during the construction process is predicted to be approximately 0.94 L/s/ha of excavation initially, reducing to 0.64 L/s/ha over the first 3 months and eventually stabilising to a seasonally variable 0.25-0.55 L/s/ha.

- Construction-related groundwater drawdown is predicted to have negligible hydrological effects on neighbouring wetlands and no material effect on the continued operation of nearby groundwater bores.

- The effects of climate change on hydrological conditions were tested assuming an SSP3-7.0 scenario which generated a small increase in overall groundwater recharge though it was not enough to significantly impact the flow regime.

- There is no indication that the proposed development would exacerbate the effect of climate change on stream baseflows or cause issues with groundwater inundation, or wetland dewatering.

Overall, the additional groundwater monitoring and numerical modelling undertaken for this assessment has specifically considered the matters raised through GWRC's previous requests for further information, including existing and post-development groundwater conditions. This includes an assessment of the influence of the existing dune landform and its removal on groundwater recharge, the long-term hydrological viability of the proposed offset wetland, effects of temporary construction dewatering, and potential effects on neighbouring wetlands, groundwater users and the Wharemaukū Stream.

Subject to the management measures identified in this report, the modelling does not identify any groundwater-related effect that would prevent the proposed development or ecological restoration measures from proceeding as proposed.

# 10. References

[1] Bioresearches. (2026). *77 Kapiti Road Development: Ecological Assessments for Fast-Track Referral* (Technical Memorandum, Job No. 66557). Prepared for New Central Park Limited.

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[11] Torlesse (2026), *Geotechnical Assessment Report (GAR)*. Consultancy Report prepared for New Central Park Ltd.

[12] Torlesse (2026b). *Geotechnical Desktop Study (GDS): 77 Kapiti Road, Paraparaumu* (Report Ref: T0793/03). Prepared for New Central Park Limited.

# Appendix A. Soil Moisture Water Balance Model

The Soil Moisture Water Balance Model (SMWBM) is a semi-deterministic rainfall-runoff model. Model functionality includes an infiltration function, surface ponding function, evaporation functions for differing land cover.

The model simulates a partitioning of rainfall between surface runoff, evapotranspiration, interception, soil storage, and deep percolation (i.e. groundwater recharge) on a daily basis. Daily climate data (rainfall and PET) are input into the model while parameters representing soil infiltration rates, soil storage capacity, deep percolation rates, vegetation cover, and slope are varied within realistic bounds based on the topography, land cover, soil type, and geology for a given area.

Daily rainfall and potential evapotranspiration data from were sourced from NIWA as input data to the SMWBM from the period of 1994 through August, 2026. This stations that were used were:

- Paraparaumu AERO EWS station – primary data source.
- Paraparaumu AERO AWS – used for infilling missing data.

Table 12. Parameters utilised in the SMWBM.

| Parameter | Material Type | | | | | |
|---|---|---|---|---|---|---|
| | Sand | Sandstone | Peat | Gravel | Surface Mine | Urbanised land |
| ST (mm) | 240 | 300 | 500 | 300 | 250 | 300 |
| FT (mm/day) | 1.5 | 2 | 0.4 | 2 | 1 | 0.15 |
| Zmax (mm/hr) | 15 | 25 | 8 | 25 | 4 | 3 |
| PI (mm) | 2 | 2 | 2 | 2 | 0.5 | 3 |
| AI (0-1) | 0 | 0 | 0 | 0 | 0 | 0 |
| Zmin (mm/hr) | 0 | 0 | 0 | 0 | 0 | 0 |
| R (0, 1) | 0 | 0 | 0 | 0 | 0 | 0 |
| DIV (0-1) | 0.99 | 1 | 1 | 1 | 0.98 | 0.6 |
| TL (days) | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| GL (days) | 1 | 1 | 1 | 1 | 1 | 1 |
| LAG (days) | 0 | 0 | 0 | 0 | 0 | 0 |
| QOBS ($m^3$/day) | 1500 | 2000 | 400 | 2000 | 1000 | 150 |
| POW (1-2) | 2 | 1.5 | 2 | 1.5 | 2 | 1.5 |
| SL (mm) | 0 | 0 | 0 | 0 | 0 | 0 |
| AA | 0.216 | 0.216 | 0.216 | 0.216 | 0.216 | 0.216 |
| BB | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 | 0.22 |

Table 13. SMWBM parameters.

| Parameter | Name | Description |
|---|---|---|
| ST (mm) | Maximum soil water content | ST defines the size of the soil moisture store in terms of a depth of water |
| SL (mm) | Soil moisture content where drainage ceases. | Soil moisture storage capacity below which sub-soil drainage ceases due to soil moisture retention. |
| FT (mm/day) | Sub-soil drainage rate from soil moisture storage at full capacity | Together with POW, FT (mm/day) controls the rate of percolation to the underlying aquifer system from the soil moisture storage zone. FT is the maximum rate of percolation through the soil zone. |
| ZMAX (mm/hr) | Maximum infiltration rate | ZMAX and ZMIN are nominal maximum and minimum infiltration rates in mm/hr used by the model to calculate the actual infiltration rate ZACT. ZMAX and ZMIN regulate the volume of water entering soil moisture storage and the resulting surface runoff. ZACT may be greater than ZMAX at the start of a rainfall event. ZACT is usually nearest to ZMAX when soil moisture is nearing maximum capacity. |
| ZMIN (mm/hr) | Minimum infiltration rate | |
| POW (>0) | Power of the soil moisture-percolation equation | POW determines the rate at which sub-soil drainage diminishes as the soil moisture content is decreased. POW therefore has significant effect on the seasonal distribution and reliability of drainage and hence baseflow, as well as the total yield from a catchment. |
| PI (mm) | Interception storage capacity | PI defines the storage capacity of rainfall that is intercepted by the overhead canopy or vegetation and does not reach the soil zone. |
| AI (-) | Impervious portion of catchment | AI represents the proportion of the catchment that is impervious and directly linked to drainage pathways. |
| R (0,1) | Evaporation – soil moisture relationship | Together with the soil moisture storage parameters ST and SL, R governs the evaporative process within the model. Two different relationships are available. The rate of evapotranspiration is estimated using either a linear (0) or power-curve (1) relationship relating evaporation to the soil moisture status of the soil. As the soil moisture capacity approaches, full, evaporation occurs at a near maximum rate based on the mean monthly pan evaporation rate, and as the soil moisture capacity decreases, evaporation decreases according to the predefined function. |
| DIV (-) | Fraction of excess rainfall allocated directly to basin storage | DIV has values between 0 and 1 and defines the proportion of excess rainfall ponded at the surface due to saturation of the soil zone or rainfall exceeding the soils infiltration capacity to eventually infiltrate the soil, with the remainder (and typically majority) as direct runoff. |
| TL (days) | Routing coefficient for surface runoff | TL defines the lag of surface water runoff. |
| GL (days) | Groundwater recession parameter | GL governs the lag in groundwater discharge or baseflow from a catchment. |
| QOBS ($m^3$/day) | Initial observed streamflow | QOBS defines the initial volume of water in the stream at the model start period and is used to precondition the soil moisture status. |
| AA, BB | Coefficients for rainfall disaggregation. | Used to determine the rainfall event duration and pattern. Default values usually suffice. |

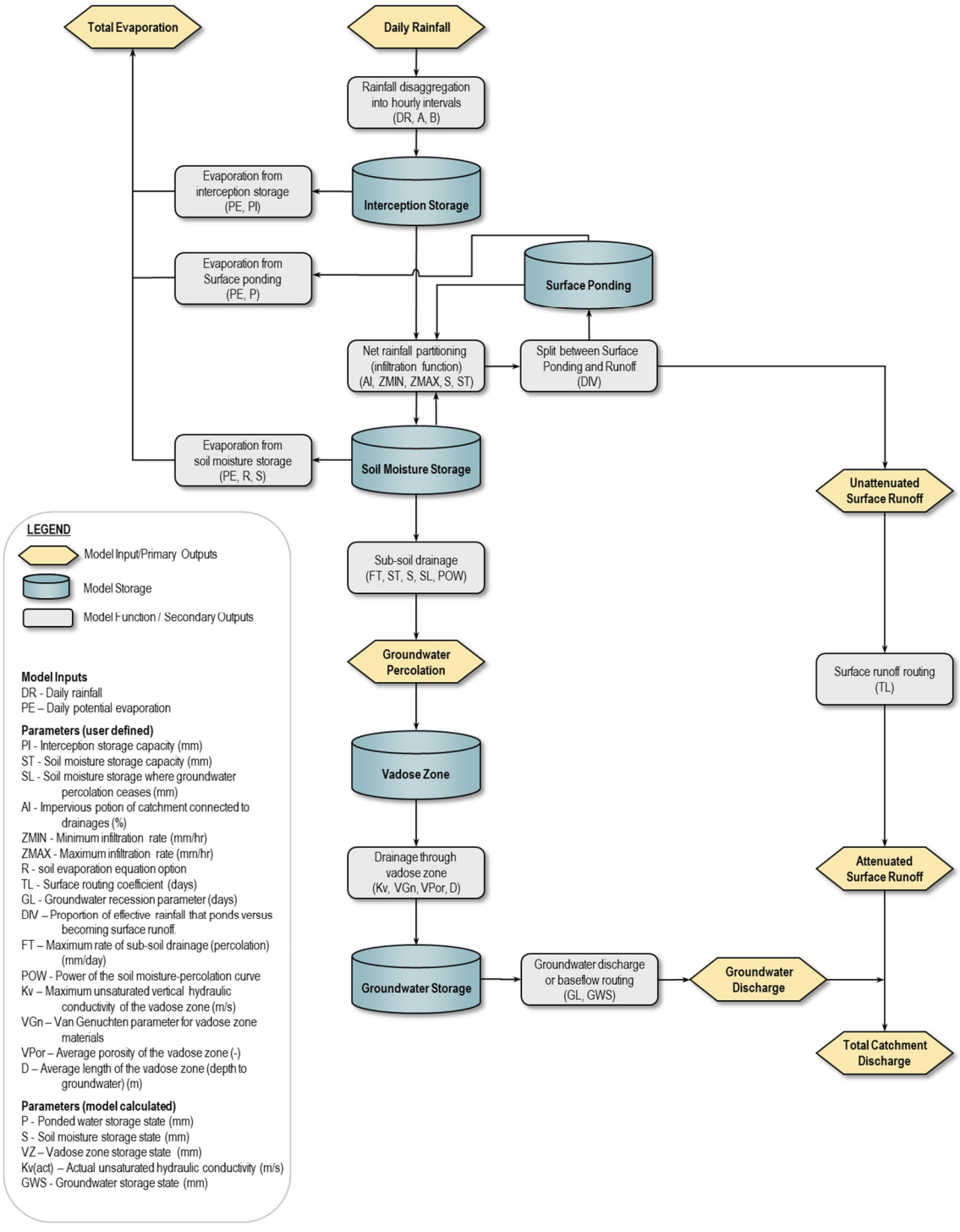
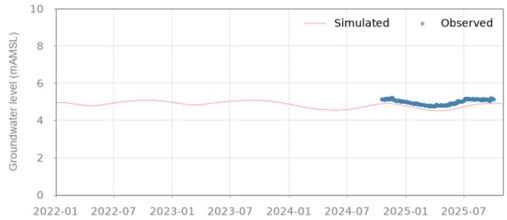


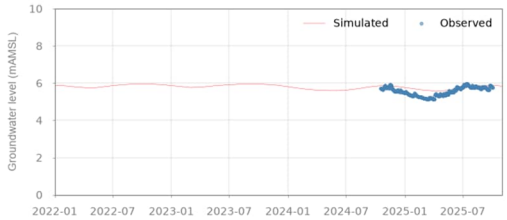

**Figure 26. Flow diagram of the SMWBM structure and parameters.**

# Appendix B. Calibrated Model Hydrographs

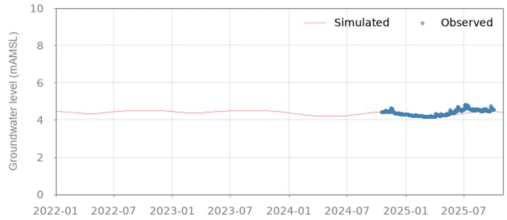
Hydrographs showing observed and calibrated model simulated groundwater levels are shown below. Refer to **Figure 5** and **Table 3** for the monitoring locations.



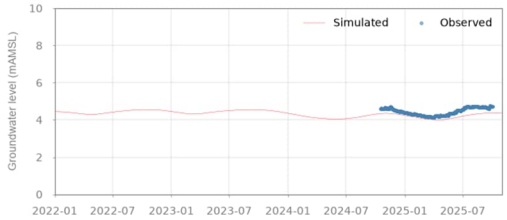

**MW1**



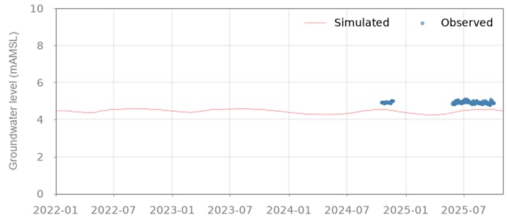

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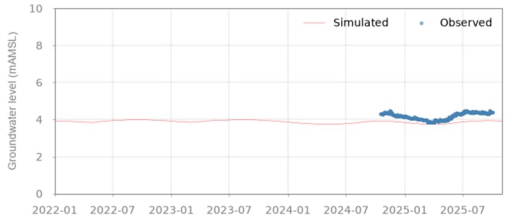

**MW3**



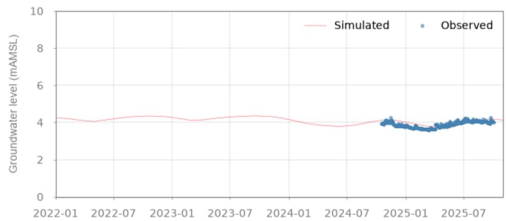

**MW4**



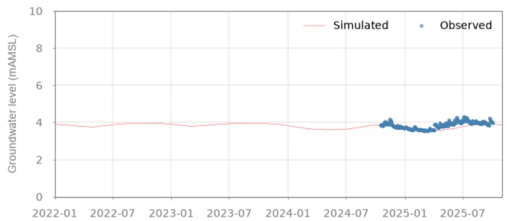

**MW5**



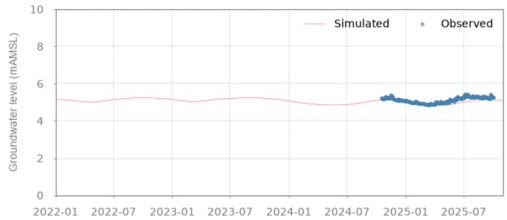

**MW6**



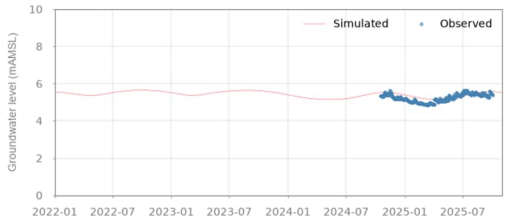

**MW7**



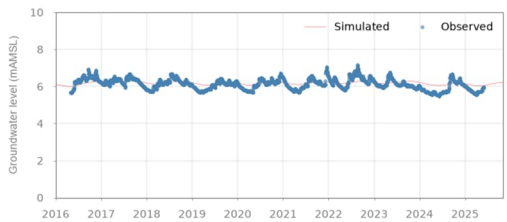

**MW9**




**MW10**




**MW11**




**R26-6831**