NOTICE OF REQUIREMENT - SOUTHWEST WASTEWATER TREATMENT PLANT – STORMWATER AND FLOODING ASSESSMENT

30 August 2023

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Project Number:
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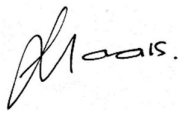
Prepared by: 

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Executive Summary

This assessment has considered the potential stormwater impacts of the proposed Southwest Wastewater Treatment Plant (WWTP) and the land requirements for the mitigation of these effects regarding construction, operation, and maintenance activities.

This assessment has been undertaken by means of a desktop study to consider the land required for the management of flood risk from the WWTP, relying on readily available information from Auckland Council (AC) GeoMaps, Auckland Unitary Plan Operative in Part (AUP-OP) and AC Guidelines.

Other stormwater effects, apart from flooding, are not assessed in detail, but provision is made for the future management of potential stormwater effects (stormwater quantity and stormwater quality) by identifying the space required for stormwater management devices (diversion drains and stormwater treatment ponds) and incorporating land for that purpose into the proposed designation boundaries.

Flooding effects will be subject to further verification at a detailed design stage to ensure compliance with conditions.

The criteria used to evaluate flooding and stormwater effects are listed in Section 7, Table 7-1 which includes; positive effects, no effects, very low-, low-, moderate-, substantial and unacceptable adverse effects. Moderate adverse effects are considered to be noticeable that may cause an adverse impact but could potentially be mitigated or remedied. Substantial adverse effects are considered noticeable and will have a serious adverse impact on the environment but could potentially be mitigated or remedied.

Potential positive effects

There is the potential for positive effects associated with the project. The existing irrigation Pond 1 is reported to overspill during a major flood event and hence there is an opportunity to investigate the pond(s) structures and functionality during detailed design stage to develop safety improvements for the future climate change events.

The proposed land use change will reduce the risk of exposed soils, erosion, and sediment transport during operations, hence creating a positive effect to the natural environment.

The proposed stormwater treatment pond will function as a detention by reducing stormwater peak flows, improving stormwater quality and reducing sediment transfer before discharging into the stream.

Flooding and stormwater effects during construction period

The potential flooding and stormwater effects during construction period were found to range between “moderate” and “substantial” adverse effects if not appropriately managed with the measures described in Section 8.1. It is expected that construction works can be carried out to acceptable standards to appropriately manage the risk (i.e., an erosion and sediment control plan (ESCP) developed to Auckland Council guidance document GD05 would comply). Flood risk mitigation measures will be captured in the Construction Environmental Management Plan (CEMP), and it is recommended this be included as a condition of the proposed designation. With the proposed

mitigation measures in place, assessed impacts reduce to a range between “no” and “very low” adverse effects.

Flooding and stormwater effects during operational period

The assessment of flooding and stormwater effects during operational period were found to range between “very low” effects for diversions of overland flow paths around new structures, “moderate” effects for potential stream erosion and “substantial” adverse effects on water quality during the operational phase of the WWTP without the proposed mitigation measures in place. The Designation Extent allows for sufficient area to mitigate these risks by providing a stormwater treatment pond / wetland (designed to Auckland Council guidance document GD01) and overland flow diversion drains which can be addressed at the detailed design stage.

Potential flooding effects can be appropriately managed by the recommended design outcomes and conditions outlined in this Report. With the proposed mitigation measures in place, impacts can be reduced to “no” or “very low” adverse effects. There is sufficient land available within the designation sought to provide for the required works.

Acronyms / Abbreviations

AC	Auckland Council
AEE	Assessment of Environmental Effects
AEP	Annual Exceedance Probability
AUP-OP	Auckland Unitary Plan – Operative in Plan
AWT	Advanced Water Treatment
CCO	Council Controlled Organisation
CEMP	Construction Environmental Management Plan
DEM	Digital Elevation Model
ESCP	Erosion and Sediment Control Plan
GD01	Stormwater Management Devices in the Auckland Region
GD05	Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region
GIS	Geospatial Information System
ha	hectare
HIRDS v4	High intensity rainfall design system (version 4)
LiDAR	Light Detection and Ranging
m^2	Square metre
m^3/s	Cubic metres per second
mm	Millimetre
mRL	Metres relative level
NIWA	National Institute of Water and Atmospheric Research
NoR	Notice of Requirement
PE	Population equivalent
SEA-M2	Significant Ecological Area – Marine 2
Watercare	Watercare Services Ltd.
WWTP	Wastewater Treatment Plant

Glossary

SEA-M2	Areas are of regional, national or international significance which do not warrant an SEA-M1 identification as they are generally more robust.

1 Introduction

1.1 Watercare

Watercare Services Limited (Watercare) is a lifeline utility providing water and wastewater services to 1.7 million people in Auckland. Watercare supplies reliable, high-quality drinking water to homes and businesses in the Auckland region and collects, treats, and discharges their wastewater in environmentally responsible ways. Its services are vital for life, keep people safe and help communities to flourish.

As a council-controlled organisation (CCO), wholly owned by Auckland Council (AC), Watercare manages water and wastewater assets worth over $14 billion and plan and build infrastructure to ensure that growth is supported today and into the future. Watercare's vision is to be "trusted by our communities to deliver exceptional performance every day". Watercare's mission is "reliable, safe, and efficient water and wastewater services".

1.2 The purpose of this report

This report is an assessment of stormwater and flooding effects and supports the Assessment of Environment Effects (AEE) that is being submitted with the Notice of Requirement (NoR) to AC. It assessed the stormwater effects of the designation in relation to the construction and operation of the Wastewater Treatment Plant (WWTP).

Key matters addressed in this report are as follows:

- the stormwater context of 372 Glenbrook Beach Rd, Glenbrook.
- any predicted actual and potential flooding effects that need to be considered in relation to the use of the site for the designated purpose.
- recommend measures as appropriate to avoid, remedy or mitigate actual and potential flooding effects including erosion and sediment generation, and stormwater runoff contaminants from the site.

Key questions this assessment seeks to address are:

1. Is the size and shape of the site able to accommodate the measures likely to be required to manage the stormwater runoff quantity and quality generated by the new impervious surface at full build?
2. Due to the overland flow paths and potential flooding present on the site, is there a need to manage the risk of stormwater discharging into streams, wetlands and the coastal waters and can this be managed on the site or through conditions on the designation?
3. Is the development of the site, as provided for under the designation, going to increase any natural hazard risk to adjacent sites (due to its location in an overland flow path or flood plain), and can this be managed on the site or through conditions on the designation?

1.3 My involvement in the project

As a stormwater specialist, my involvement in the project was to complete an assessment regarding the potential stormwater and flooding effects of the future use enabled by the designation of 372 Glenbrook Beach Rd, Glenbrook for a WWTP, and propose measures to be incorporated into the designation, if required to mitigate or avoid any adverse effects.

In preparing this assessment, a desktop study has been completed using the references stated in Section 3. To inform this assessment, site visits were undertaken in March and May 2023 to confirm the existing catchment area and hydrology.

In addition, the site observations and potential constraints were shared with the other specialists involved and Watercare regarding the indicative WWTP site layout.

2 The Project Description

Watercare has investigated how best to manage wastewater in the Southwest area in response to the anticipated growth identified in the Auckland Unitary Plan (Operative in Part 2016) (AUP-OP). Through this work, Watercare identified the need for a sub-regional WWTP to service the anticipated population growth in the Southwest growth area. The new WWTP is needed to enable Watercare to discharge treated wastewater into the Waiuku Channel in accordance with high quality treatment standards included within a discharge consent granted by the Environment Court in June 2018.

Following an assessment of alternative sites, Watercare has identified the site at 372 Glenbrook Beach Road (Lot 1 DP 367461) as its preferred location for the WWTP and is seeking to designate the full site. Designation of the site will enable construction and operation of the WWTP which will be delivered in stages. The designation provides for a WWTP at full build out that will provide the capacity to service a long-term population equivalent (PE) of 60,000 in the Southwest area. However, it is initially proposed to construct the first stage, a WWTP for 20,000 PE, followed by a second stage upgrade to provide a WWTP for 30,000 PE forecasted for 2053 (in line with the Southwest Discharge Consent's anticipated population growth). The remaining 30,000 PE (60,000PE) is longer term growth beyond 2053.

The site's size and shape provide at least 200 m of separation between the main parts of the treatment plant itself and the adjacent properties. The site's existing planting around the streams and wetlands will be retained. The areas not required for the full WWTP are able to be used for farming or will be landscaped which will ensure that the current rural amenity offered by the site is retained.

Construction will commence as soon as possible after the designation is in place and the required regional resource consents are obtained.

Information about the design and operation of the WWTP is set out in the Indicative Design and Operational Report, prepared by Stantec dated April 2023 contained as Appendix A to the AEE supporting the NoR.

3 Information relied on for this Assessment

This assessment has been undertaken by means of a desktop study to determine the factors required for the management of flood risk from the WWTP during construction and operational phases on the designated site, relying on readily available information such as:

- Consideration of the Southwest Wastewater Servicing – Wastewater Treatment Plant - Indicative Design and Operational Report, Stantec, April 2023
- Locality plans of existing wetlands identified by the Ecologist (Wetland Survey, 10 March 2023, Ian Boothroyd – Boffa Miskell)
- Locations of overland flow paths, flood plains, flood prone areas, streams, and rivers from AC Geographic Information System (GIS) GeoMaps (12 May 2023)
- Contributing catchment areas and topographical information from AC GIS GeoMaps (12 May 2023)
- Consideration of the AUP-OP) – Management layers (12 May 2023)
- Consideration of the Auckland Unitary Plan Operative in Part (AUP-OP) – Zones (12 May 2023)
- Consideration of the Auckland Unitary Plan Operative in Part (AUP-OP) (12 May 2023):
    - Chapter E1: Water quality and integrated management
    - Chapter E2: Water quantity, allocation
    - Chapter E8: Stormwater – Discharge and diversion
    - Chapter E36: Natural hazards and flooding
- Consideration of GD01(Stormwater Management Devices in the Auckland Region, Guidelines Document 2017/001 Version 1) and GD05 (Erosion and Sediment Control Guide for Land Distribution Activities in the Auckland Region, Guideline Document 2016/005) containing potential applications of mitigation measures.

- Site visits undertaken:
    - 2 March 2023 –This site visit was carried out by the wider team, including the flood modelling specialists. This site visit was summarised in a Site Observation Report dated March 2023.
    - 18 May 2023 – This site visit was attended by me to review and confirm existing overland flow paths, streams, existing ponds, low lying areas and existing stormwater infrastructure.

4 Existing Environment

4.1 Catchment Context

The site, 372 Glenbrook Beach Road, Glenbrook, lies within the Taihiki River catchment with the Manukau Harbour as the receiving environment.

The proposed WWTP site is approximately 56 ha and lies within the Taihiki River catchment area, which is approximately 3,437 ha. Refer to Figure 4-1 for the Taihiki River catchment locality plan. The sub-catchment that includes the site and surrounding areas, have a high point on the western side of Glenbrook Beach Road and is approximately 130 ha. Refer to Figure 4-2.

The current land use for the site is market gardening and the neighbouring properties also involve rural activities like fruit farming. The existing topography of the site range between levels of 5 mRL to 16 mRL with slopes of approximately 2% towards the Taihiki River.

Two main permanent streams within the proposed WWTP site, Stream A and Stream B, are shown in Figure 4-2, and they collect overland flow paths and other unnamed streams and discharge to the coastal environment.

Two existing ponds are located on Stream A within the site:

- Pond 1

  This pond has a surface area of approximately 2.2 ha, a top level of 13 mRL and lies between Glenbrook Beach Road and the site access road. The pond was built in 2019 for irrigation purposes and receives pumped water from an onsite borewell and surface runoff from the upper catchment via cut off drains and culvert crossings. The onsite borewell is located next to the existing farm shed east of the access road. Refer to Figure 4-2 for the pond location.

- Pond 2

  This pond has a surface area of approximately 4.5 ha, a top level of 6.5 mRL and lies north of the site, within two property boundaries: 372 Glenbrook Beach Road and 62A Dunsmuir Road. The pond was built in 2015 for irrigation purposes which receives water from Pond 1 (naturally through the ground or pumped) and surface runoff from the surrounding catchment. Refer to Figure 4-2 for the pond location.

The site lies east and adjacent to Glenbrook Beach Road and has a gravel vehicle access road leading into the property. Existing, deep, cut off drains on the east side of Glenbrook Beach Road intercept surface runoff from the upstream catchment and discharge into Pond 1. Two culvert crossings (approximately 225 mm diameter) drain runoff into the cut off drain and one culvert, approximately 300 mm dia., crosses the site access road. Refer to Figure 4-3 for the stormwater drainage into pond.

With reference to National Institute of Water and Atmospheric Research (NIWA) High intensity rainfall design system (version 4) (HIRDS v4), the closest rain gauge is at Divers Road, Glenbrook approximately 9 km south of the site. From this rain gauge, the following existing (historical data) and future (RCP8.5, 2081-2100) 24-hour rainfall depths for the 10% and 1% Annual Exceedance Probability (AEP) flood events are shown in Table 4-1.

Table 4-1: Existing and future rainfall depths (NIWA HIRDS v4)

Design Storm Event	Existing climate 24-hour design rainfall depth (mm)	Future climate 24-hour design rainfall depth (mm)
10% AEP	104	126
1% AEP	161	197

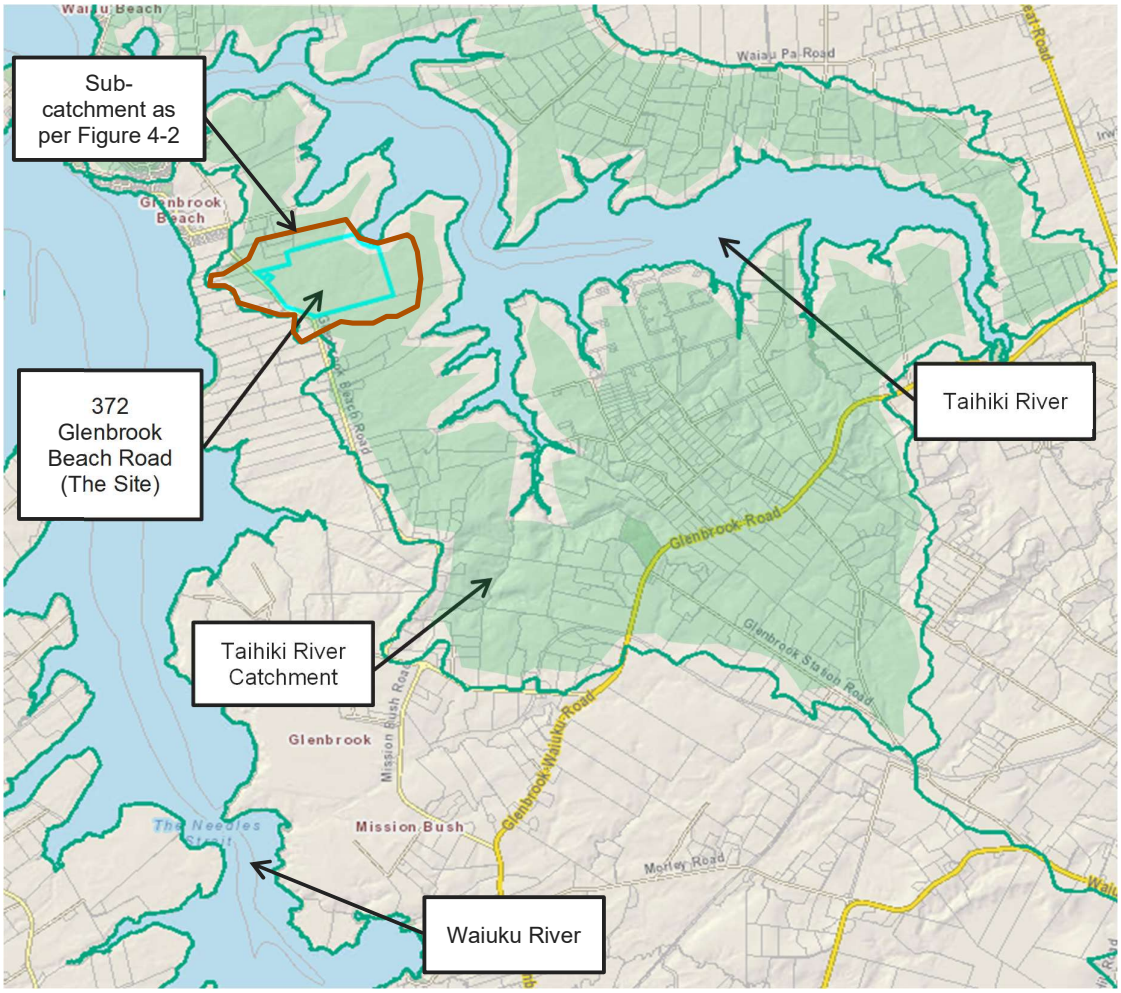


Figure 4-1: Taihiki River Catchment and locality plan (AC GIS GeoMaps, May 2023)

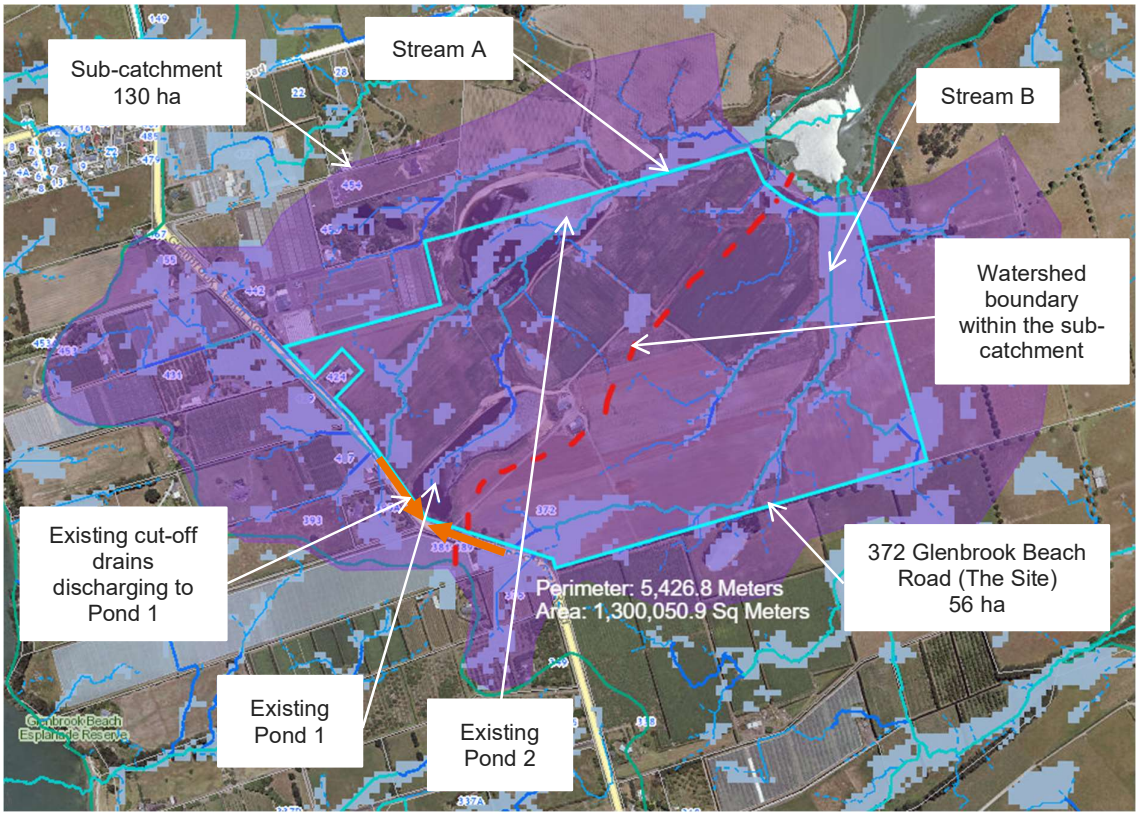


Figure 4-2: The proposed site location, sub-catchment (purple) and catchment runoff flow paths (GeoMaps, May 2023)

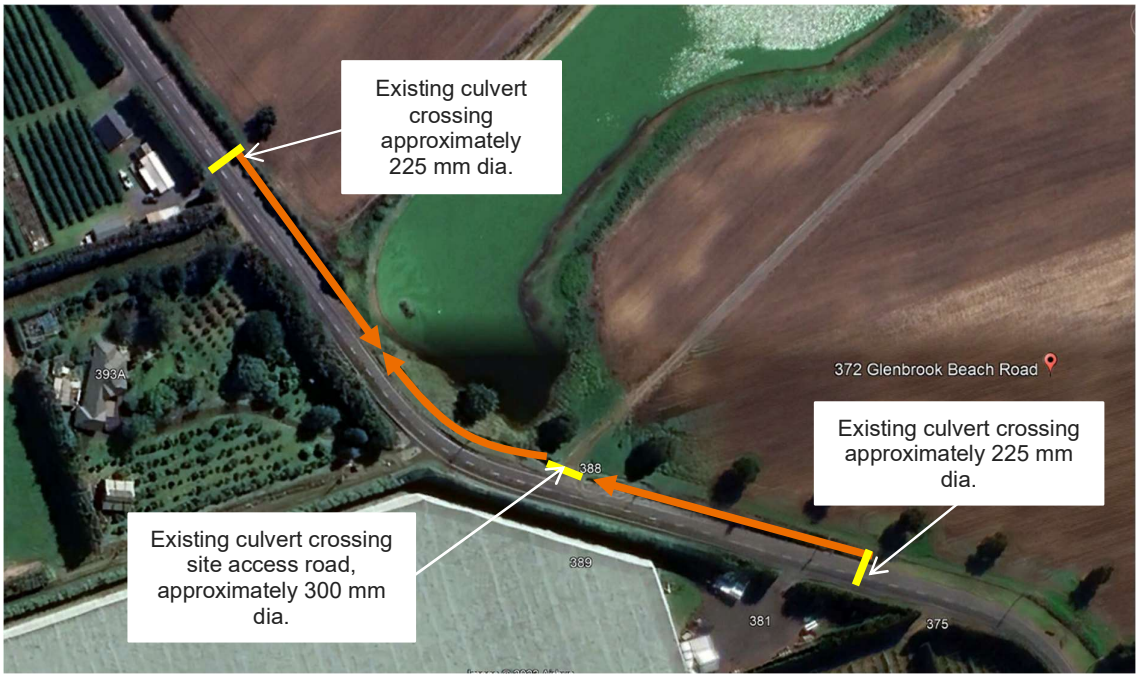


Figure 4-3: Existing stormwater drainage into existing pond (Google Earth Image 2023)

4.2 The Site

The property at 372 Glenbrook Beach Road encompasses: two major artificial ponds (Pond 1 and Pond 2 as per Figure 4-4) used for irrigation; a few low-lying areas prone to flooding; flood plains for the 1% AEP event; and overland flow paths, permanent streams and natural wetlands that drain towards the coastal environment. These are described in more detail in Sections 4.4 and 4.5.

Pond 1 and Pond 2 receive water drawn from an onsite borewell and drain by means of a 150 mm and a 250 mm diameter pipe, respectively. These outlet pipes are manually operated and discharge into open drains and eventually into the Manukau Harbour.

The existing land use of the site includes farming activities with areas of vegetation that allows groundwater recharge by means of infiltration, and, as a result, lower peak flows and velocities that discharge into the natural environment. Cultivating these areas can increase the risk of erosion and sediment transport during storm events that will potentially end up in streams and the coastal environment.

The Indicative Design Report shows the WWTP is expected to be located in the middle of the property, on a watershed boundary of the contributing sub-catchment (refer to Figure 4-2), having existing ground sloping away from the proposed site.

From the site visit undertaken 2 March 2023, it was observed that the available LiDAR[1] data from 2017 and the catchment and hydrology information from AC GIS regarding, ponds, low lying areas and existing overland flow paths, are outdated. The site terrain has been modified due to recent land development activities including the construction of ponds. Aerial imagery from 2010 shows that the site was pasture with no ponds, and since purchase by the previous owner in 2015, the land use changed to market gardening. Due to this, it was determined not to develop pre- and post-development scenario models to support this assessment, but rather to use the readily available *Catchment and Hydrology* information from AC GIS (GeoMaps) and the proposed WWTP layout as shown in Figure 4-4.

[1] LiDAR (Light Detection and Ranging) is used to create high resolution models of ground elevations.

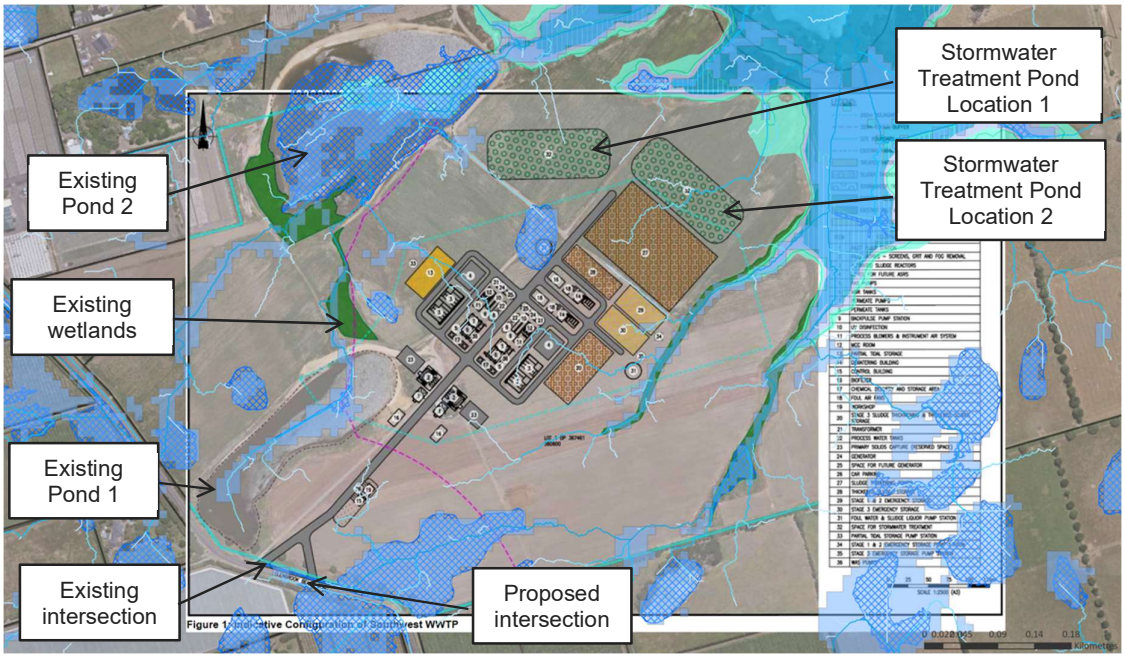


Figure 4-4: Proposed WWTP, pond locations and catchment hydrology (GeoMaps, April 2023)

4.3 Auckland Unitary Plan Layers

With reference to the AUP-OP planning maps (GeoMaps), the site and surrounding areas are currently zoned for Rural – Mixed Rural Zone and Rural – Rural Coastal zone on the sections closest to the Taihiki River. The AUP-OP overlays and controls applying to the site, that are relevant to this assessment, include:

- Significant Ecological Area SEA-M2 Overlay
- High-Use Aquifer Management Areas Overlay
- Coastal Inundation 1 per cent AEP Plus 1 m Control

The layers in combination with the rules of the AUP-OP provide guidance in relation to the use of natural and physical resources[2], and:

- to avoid adverse impact of water quality to the natural ecological functioning of the area;
- to maintain base flows in the stream and to continue to meet existing and future water take demands; and
- to avoid adverse flooding impact of existing and new developments resulting from coastal storm inundation, coastal erosion, and sea level rise.

[2] Natural resources include water, air, land, soil, habitats, energy and minerals. Physical resources include buildings, structures, infrastructure, and services.

4.4 Existing Hydrology

The catchment and hydrology obtained from GeoMaps are shown for the site and the adjacent properties in Figure 4-5.

Existing overland flow paths located within the site drain to the permanent streams (Steam A and B) and discharge into the coastal environment. Figure 4-5 shows that these overland flow paths originate from the upper catchment on the western side of Glenbrook Beach Road and drain towards Pond 1 by means of cut-off drains and culvert crossings.

Existing flood prone areas are apparent within the site and surrounding areas, particularly on the western side of Glenbrook Beach Road. Refer to Figure 4-5. These flood prone areas are most likely due to a lack of drainage infrastructure and it requires approximately 37 mm of rainfall to fill flood prone area ID 57255360. Flood prone area ID 7308522 requires 114 mm and ID 57091232 requires 246 mm rainfall to fill. Pond 2 is identified as a flood prone area and requires approximately 111 mm rainfall to fill. Pond 1 is not currently indicated as a flood prone area in GeoMaps which could be due to the information being outdated. With reference to the future 24-hour rainfall depths stated in Section 4.1, the flood prone ponding areas will fill during a 10% AEP food event.

The hydrological information obtained from GeoMaps for Stream A and Stream B is summarized in Table 4-2. It is important to note that the existing flood model results for 2009 include an existing impervious catchment area of approximately 7.13 ha and a future impervious catchment area of approximately 14.46 ha. From Google Earth's timeline of aerial images between 2009 and 2023, it seems that impervious areas did not change much if any.

Table 4-2: Stream hydrological data from GeoMaps

Hydrological Attribute	Steam A	Stream B
Catchment Area (ha)	67.30	39.64
Catchment Impervious Existing (%)	9.43	2.10
Catchment Impervious Future (%)	14.61	11.67
Time of concentration Existing (min)	1.25	0.97
Time of concentration Future (min)	1.23	0.94
Max Flow Length (m)	2,180	1,559
Peak flow 10yr existing (m^3/s)	3.87	2.33
Peak flow 10yr future (m^3/s)	6.60	4.23
Peak flow 100yr existing (m^3/s)	6.86	4.20
Peak flow 100yr future (m^3/s)	11.41	7.26

The existing flood plains for the 1% AEP event which relates to the site and nearby properties is available from GeoMaps and was produced in 2009 as a Rapid Flood Hazard Assessment Model for

the existing development scenario. Since Pond 1 and 2 were only built in 2016, it was not included in the flood model analysis undertaken in 2009. The flood plains that are modelled as being within the property are narrow and increase in width further downstream, closer to the coastal environment.

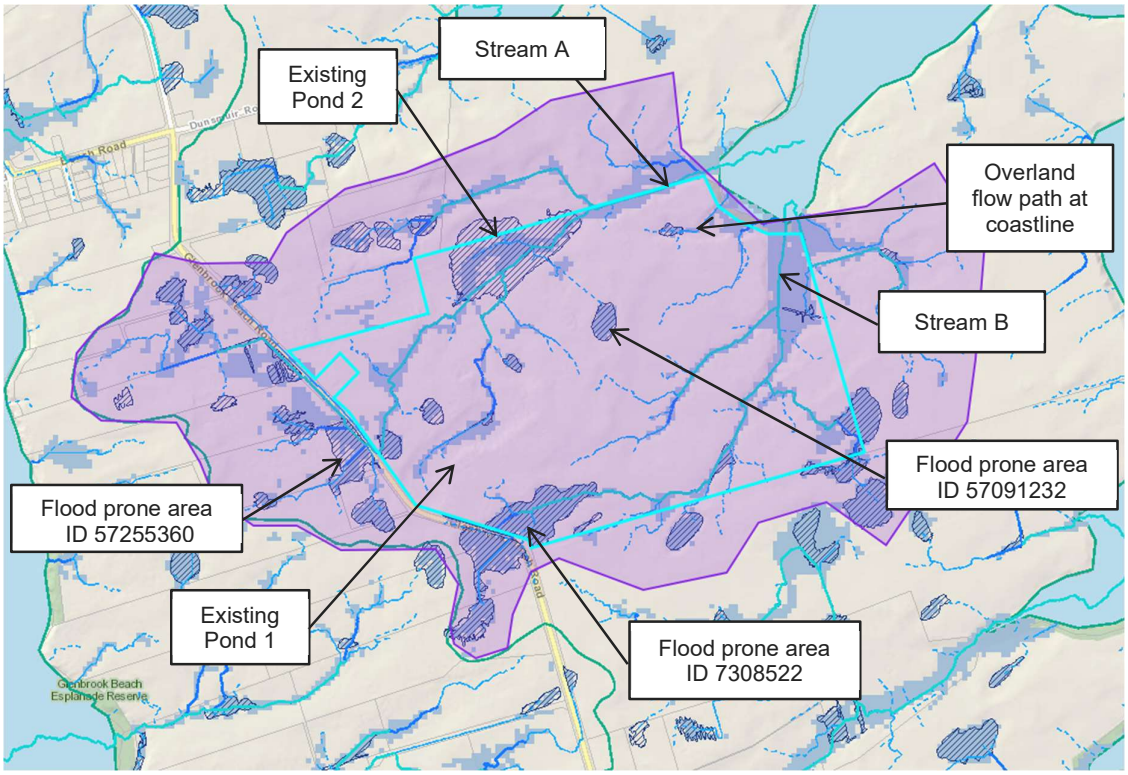


Figure 4-5: Catchment and hydrology from GeoMaps, May 2023

4.5 Natural Wetlands

Natural inland wetlands have been identified by the Project Ecologist, Ian Boothroyd from Boffa Miskell, and are located to the west (between Pond 1 and Pond 2), north and east (within the existing flood plain) of the site. None of these wetlands are being obstructed by the location of proposed WWTP as shown in the Indicative Design Report. However, a wetland located east of the site is in very close proximity to the proposed site layout. As noted in the Boffa Miskell Ecological Assessment, the indicative layout of the proposed WWTP shows that works may occur within 100 m of wetland 3. The NES-F regulates earthworks within 100 m of any natural wetland due to the potential impact on the wetland's drainage and risks of sediment being mobilised therefore, a 10 m buffer is proposed and such works are expected to be the subject of a regional consent application under the NES-F. Refer to Appendix C for the Wetland Survey Layout.

5 Flood Modelling

A flood model was not prepared for this assessment because an initial desktop study and site investigation undertaken on 2 March 2023 concluded the following:

- The available LiDAR Digital Elevation Model 2016-2017 is not up to date.
- Recent survey data done by Jacobs did not include the existing ponds.
- The flood model results won't show any different information compared to the available flood information on AC GIS GeoMaps.
- Based on AC GIS GeoMaps and the indicative site layout, it was observed that the overland flow path from Pond 1 will drain to Pond 2. Thus, it was concluded that Pond 1 won't cause any additional flood risk to the proposed site.
- Based on the LiDAR data and a site visit, the proposed site is located on a relatively higher elevation which reduces the risk of any flood effects from the ponds.

It is recommended that the following should be actioned during the detailed design phase:

- Obtain the latest LiDAR data which matches with the current topography of the site as it is anticipated that this will be available in future, but no timeline is defined yet.
- Obtain topographic survey of the ponds which can be used with the available LiDAR to create a combined Digital Elevation Model (DEM) surface that can be used for flood modelling.
- Compile historical flood incidents records/observations to validate the model results.

6 Stormwater Management

The Indicative Design Report concludes that stormwater management for the proposed site should comprise the following:

- Any polluted surfaces to be bunded and flows diverted into the secondary treatment process.
- Chemical delivery areas to be bunded and isolated to reduce risk of stormwater runoff being contaminated.
- Stormwater from hardstand surfaces will be collected and diverted to a stormwater treatment pond and discharged to the natural stream and wetlands.

With reference to the proposed WWTP site layout, the total estimated impervious area was calculated as approximately 6 ha. The proposed stormwater treatment pond surface area for water quality treatment and flood mitigation, is taken as 5% and 10% respectively, of the total impervious catchment area, equating to 3,000 m² for water quality treatment and 6,000 m² to attenuate the 1% AEP flood event.

The indicative layout indicates two alternative locations for a stormwater treatment pond. For the purpose of this report, these locations will be referred to as Stormwater Treatment Pond Location 1 and Stormwater Treatment Pond Location 2 as shown in Figure 4-4.

7 Effects Assessment

A desktop assessment was carried out to identify potential locations sensitive to flooding effects. These include areas where:

- Existing and proposed buildings appeared to be near/within the existing flood plains.
- Carrying out substantial work near existing wetlands, streams, or major overland flow paths.
- The proposed development may alter the existing flood plains, ponding volumes, and natural drainage paths.
- Change to the surface runoff from the proposed development generates stream erosion.
- Change to surface runoff from the proposed development adversely impact the water quality of the receiving environment.

The criteria used for the flooding assessment is shown in Table 7-1 below:

Table 7-1: Flooding effects assessment criteria

Effect	Description
Positive	Reduction or improvement
No effects	No effects at all
Very low adverse effects	Adverse effects that are discernible day-to-day effects, but too small to adversely affect other persons.
Low adverse effects	Adverse effects that are noticeable but will not cause any substantial adverse impacts.
Moderate adverse effects	Adverse effects that are noticeable that may cause an adverse impact but could be potentially mitigated or remedied.
Substantial adverse effects	An effect that is noticeable and will have a serious adverse impact on the environment but could potentially be mitigated or remedied.
Unacceptable adverse effects	Extensive adverse effects that cannot be avoided, remedies or mitigated

7.1 Positive Effects

During the flood event on 27 January 2023, flooding of the existing irrigation Pond 1 and overtopping the road was reported to Watercare by residents located upstream of the site. The rainfall event was described by NIWA as a 1 in 200-year flood event and is therefore larger than the reference events noted in AC's assessment specifications, guidelines and plans. However, the event is considered a good indication of a future climate, extreme, flood event.

This assessment of effects references the following flood magnitudes:

- AC Stormwater Modelling Specification, November 2011 specifies flood hazard assessment models up to the 1% AEP flood event.
- AUP-OP Chapter E8: Stormwater Discharge and Diversion, specifies the diversion and discharge must not result in, or increase flooding of, other properties in rainfall events up to the 10% AEP and inundation of buildings on other properties in events up to 1% AEP.
- AC GIS GeoMaps only provide flood plain and hydrological data up to the 1% AEP flood event, hence limited information is currently available to assess effects of a 1 in 200-year flood event.

During the detailed design phase, the pond(s) structures and functionality will be investigated and improved as required to develop safety improvements for future robustness and climate change events.

The existing land use of the site includes farming activities which can result in exposed, disturbed soils that increase the risk of erosion and sediment transport during storm events that potentially ends up in the streams and the coastal environment. The proposed land use change and the smaller horticulture outside the WWTP footprint will reduce the risk of exposed soils, erosion, and sediment transport during farming operations on a smaller area, hence creating a positive effect to the natural environment.

The proposed stormwater treatment pond will have a positive effect during operational phase as it will function as a detention by reducing peak flows and a treatment facility that will improve water quality and reduce sediment transfer before discharging into the stream.

7.2 Adverse Effects

7.2.1 Construction Activities

The proposed construction works listed in the Southwest Wastewater Servicing – Wastewater Treatment Plant-Indicative Design and Operational Report, April 2023, which can result in adverse stormwater or flooding effects include:

- Bulk earthworks during the construction of stormwater treatment ponds can result in an increased risk for erosion and sedimentation.

- Constructing new stormwater treatment ponds within existing overland flow paths can result in increased upstream flooding within the area and loss of stream flow cross sectional area should be avoided.
- Construction of diversion drains / realignment of overland flow paths can result in increased peak flows in the receiving stream, increased risk for erosion and sedimentation and increased flood risk during construction in the wet season.
- Construction of new culvert crossings or upgrading / extending of existing culvert crossings under the site access road that can obstruct the overland flow path during temporary works.
- Managing and redirecting flows from existing under-drains to nearby natural drains/streams can increase peak flows and erosion of the receiving stream.
- Bulk earthworks near existing irrigation ponds, wetlands and streams can result in reducing the conveyance function, obstruction of flow, and increased risk for sediment transport.
- Removal of vegetation (soil cover) that can have an adverse effect on water quality due to surface erosion and sedimentation.
- Constructing structures within existing flood prone areas which will result in a loss of runoff storage volume and passing the flows downstream that can result in an increase in flooding.
- Storage of materials and containment of hazardous substances on site that can spill and have an adverse effect on water quality that discharges into nearby streams adversely affecting the health and habitat of the natural environment.

Construction lay down areas are not known at this stage of the project but would be expected to be clear of overland flow paths, streams, or flood plains to prevent an obstruction to flow, or an increased flood risk.

The construction activities will potentially have moderate to substantial adverse effects on the downstream environment if not appropriately managed. Construction activities will be subject to the Outline Plan process and potentially regional consents for earthworks which will address the specific effects. Section 8.1 below sets out the expected methods for avoiding, mitigating or remedying these effects that will be included in the Outline Plan and any resource consent application.

7.2.2 Operational Activities

Due to the land-use change, several potential adverse effects could be generated and need to be considered. The potential adverse effects from a stormwater and flooding perspective are discussed below:

7.2.2.1 Increased flooding due to the proposed development

The new impervious surface areas of approximately 6 ha on the site will generate an increase in peak flow and volume that will ultimately discharge into the Taihiki River catchment and receiving environment. Increased runoff from the site will potentially discharge into either stream which could result in minimal flooding risk downstream of the WWTP.

Potential structures, namely the emergency storage, pump stations and sludge thickening ponds, are located near an existing flood plain. Due to increased runoff and future climate change conditions, there is a potential that these structures may be within the future flood plain.

The proposed site location is on a high point, but overland flow paths for catchments <1ha will be obstructed by the proposed site which may result in redirecting the sub-catchment flows or creating new or increased depression areas for water to pond. The effects of redirecting catchment flows could result in a *decrease* in peak flow and flood depth for one receiving environment and consequentially an *increase in* peak flow and flood depth for the other receiving environment.

The proposed site may result in filling up current depression areas (refer to Figure 4-5, Flood prone area ID 57091232) that will cause a loss of existing storage volume and draining into nearby streams, hence increasing peak flows and volumes downstream.

With reference to GD01 guidelines, detention of 10% and 1% AEP rainfall events is not required for developments that are located within the lower half of the catchment or for which a validated flood modelling study has shown that the development does not increase downstream flooding. The development sits within the lower half of the Taihiki River catchment but does not sit within the lower half of the sub-catchment and a validated flood model study for the post-development has not been done, hence at this stage of the project, detention is proposed for the site up to the 1% AEP flood event.

The Indicative Design Report proposes that the proposed stormwater network will drain towards a new stormwater treatment pond and discharge into a nearby existing stream/wetland. A high-level size estimate of the proposed stormwater treatment pond for flood mitigation due to the new impervious area of 6 ha is 6,000 m². With reference to Appendix B, there is sufficient space on the north-eastern side of the WWTP to include a stormwater treatment pond outside of the flood plain and close to a stream for discharge.

Considering the above, and that existing properties/buildings with habitable floor levels were not identified within the existing 1% AEP flood plain, the impact without mitigation is considered to be low adverse effects.

7.2.2.2 Water quality deterioration in receiving environment

The WWTP activities, as mentioned in Section 6, will be bunded and flows diverted into a secondary treatment process. However, the remaining impervious areas (e.g., access roads and carpark) will generate an increase in surface runoff contaminants, including total suspended solids (TSS) that will impact the water quality discharging into the natural environment. Excessive levels of suspended solids can lead to increased turbidity (cloudiness in the water), reduced light penetration and decreased oxygen levels in the water. Wastewater effluent can carry pathogens and other contaminants into a water body if not treated properly. This will adversely impact overland flow paths, streams, stream habitats and the coastal environment identified as SEA-M2 and is considered substantial adverse effects if the mitigation measures in Section 6 is not implemented.

A high-level estimate of the proposed stormwater treatment pond size for water quality treatment for the new impervious area of 6 ha is 3,000 m². With reference to Appendix B, the site is considered to have sufficient space on the north-eastern side of the WWTP to include a stormwater treatment pond outside of a flood plain and close to a stream for discharge.

7.2.2.3 Loss of overland flow paths and streams

The site layout will be obstructing some minor existing overland flow paths which could result in redirecting flows to new discharge points and if not diverted it will create new depression areas with ponding. If it is proposed to divert these paths to a new discharge point, it can result in an increased peak flow downstream. The hydrological data available from GeoMaps for the 10% and 1% AEP future peak flows are listed in Table 7-2 and the location of these shown in Figure 7-1.

The impact will have very low adverse effects if diversions are created alongside the new structures and the discharge location remains the same.

Table 7-2: Hydrological data for overland flow paths being obstructed by the proposed WWTP (GeoMaps May 2023)

Overland flow path ID	Peak flow 10yr future (m³/s)	Peak flow 100yr future (m³/s)
1170817	0.356	0.617
5350193	0.168	0.292
5350088	0.149	0.258
1170838	0.207	0.359
5352870	0.161	0.281

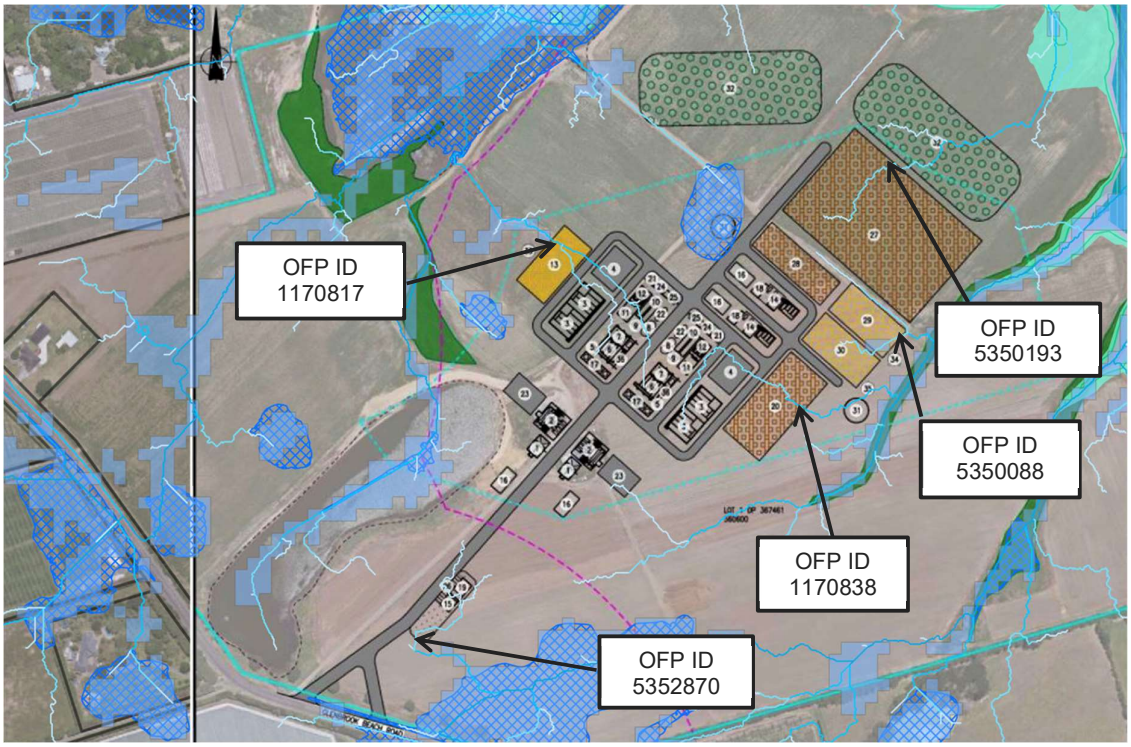


Figure 7-1: Existing overland flow paths obstructed by the proposed WWTP

7.2.2.4 Works within or near the 1% AEP flood plain

With reference to the indicate site layout, as per Appendix A, Appendix B and Figure 7-1, some proposed structures / buildings (Item 31, 35, 34, 30, 29, 27, 33, 13, 15, 19, 26), are near the existing 1% AEP flood plain for the *existing development scenario* as per AC GIS GeoMaps. There is a potential risk that these structures may be within the updated 1% AEP flood plain that resemble the *future development scenario* (including maximum probable development and climate change).

Careful consideration should be given to the location of the control building, car parking and workshop area that sits near the site entrance and close to a flood prone area (ID 7308522 as per Figure 4-5). This flood prone area requires 114 mm rainfall to fill and will spill during a future design rainfall in a 10% and 1% AEP flood event. These buildings will require habitable floor levels above the 1% AEP flood plain.

The pump station (Item 31) on the western side of the site lies within a flood prone area (ID 57091232 as per Figure 4-5). If this depression area gets filled up as part of the bulk earthworks, it results in a loss of storage volume for the site and water will contribute to the peak flows downstream into the nearby waterways.

7.2.2.5 Stream erosion generated from change to surface runoff

The increased surface runoff generated by the site will discharge into the nearby existing streams Stream A or Stream B, or an overland flow path at the coastline (Refer Figure 4-5), that could potentially result in stream erosion if flood mitigation measures or stream erosion protection measures are not implemented. The streams and overland flow path located close to the coastline seem unmodified with reasonable vegetational cover and fenced off from the rest of the adjacent properties. In the absence of mitigation there could be moderate adverse erosion effects on these areas.

7.2.2.6 Road cross drainage

The proposed site access road has two potential intersection options with Glenbrook Beach Road - either keeping the existing or constructing a new intersection. Refer to Figure 4-4 for the two possible intersection locations. The existing access road to the site crosses an existing culvert pipe of approximately 300 mm diameter, which drains runoff towards Pond 1. A new intersection will have to consider new cross drainage and allow for adequate peak flow capacity to ensure that existing flooding risk is not increased.

8 Mitigation to avoid, remedy or minimise actual and potential adverse effects

8.1 Construction Activities

The measures proposed for managing and mitigating stormwater effects during construction are:

- Developing an Erosion and Sediment Control Plan (ESCP) prior to construction by an experienced Stormwater Engineer to consider the effects of temporary works, earthworks,

storage of materials and temporary diversion and drainage on flow paths, flow level and velocity.

- Managing the overland flow paths to ensure flows are not diverted towards Glenbrook Beach Road, nearby properties, or directly towards the existing irrigation ponds, that can result in any adverse effects.
- Diverting overland flow paths away from area of work.
- Installing temporary flow diversions and storage while the stormwater treatment pond is constructed.
- Installing the stormwater treatment pond to not obstruct existing overland flow paths (Stormwater Treatment Pond Location 1 as per Figure 4-4 is likely to have less impact on existing overland flow paths than Stormwater Treatment Pond Location 2).
- Installing the stormwater treatment pond during the dry season to reduce the flooding risk and to manage through the implementation of erosion and sediment controls.
- Locate construction yards, lay down areas and stockpiles outside of existing overland flow paths and outside the 1% AEP flood plain.

8.2 Operational Activities

To manage any potential adverse effects of the land use change, the following recommended mitigation measures for operational effects are:

8.2.1 Manage increase in runoff from the new impervious surface

The proposed stormwater treatment pond should be designed to attenuate peak flows and volumes to mitigate any potential increased discharges due to overflowing and increase in flood risk into the downstream stream/wetland environments.

The need for regional consent will be triggered if the new impervious surface is over 5,000 m² or the diversion and discharge of stormwater runoff from impervious areas under 5,000 m² cannot comply with Standard E8.6.1 and Standard E8.6.2.4 of the AUPOIP.

Management of these effects will be demonstrated at detailed design stage through hydraulic modelling of the stormwater network. The total impervious area from the WWTP is estimated to be approximately 6 ha.

The Designation Extent has been developed including an allowance for a stormwater treatment pond within the property. The Indicative Design Report indicates two potential locations or, if needed, a combination of these to allow for stormwater mitigation measures. The siting and sizing of the required stormwater treatment ponds needs to be determined in the detailed design stage, but the site is considered to be large enough to accommodate the stormwater treatment pond and any other measures required.

8.2.2 Manage water quality runoff from the new impervious surface

The proposed stormwater treatment pond is expected to be designed for water quality treatment in accordance with GD01 guidelines. This will potentially mitigate or avoid any adverse effects on the water quality of the streams, stream habitat and coastal environment. In contrast to a wet stormwater pond, a constructed stormwater wetland offers greater treatment advantages for water quality management.

Stormwater treatment will need to include on-site practices to limit contaminated runoff, including identification and isolation of areas comprising activities at risk of high contaminant load generation, such as fuel storage areas, log yard, refuelling areas, hazardous substance storage areas and workshops. Some of these areas will be isolated, diverted to wastewater and / or alternatively receive pre-treatment (consistent with the nature of the contaminant risk) prior to discharging to either the stormwater or wastewater systems.

As noted above, the need for regional consent is triggered because the new impervious surface is over 5,000 m².

As noted above, the Designation Extent has been developed including an allowance for a stormwater treatment ponds within the property. The siting and sizing of this stormwater treatment pond needs to be determined in the detailed design stage, but the site is considered to be large enough to accommodate the stormwater treatment pond and any other measures required.

8.2.3 Overland flow path diversions

Obstructed flow paths can be mitigated by creating a diversion drain to discharge into nearby overland flow paths or streams as long as the works maintain the same entry and exit point of the overland flow path at the site boundary, do not alter volume and velocity of water flow and do not cause additional adverse flooding effects on neighbouring properties. Overland flow path diversions will not cause additional adverse flooding effects on neighbouring properties.

From the hydrological data in Table 7-2 a vegetated drain/swale size to convey peak flows of 0.36 m³/s require a top width of approximately 3.2 m. The site is considered to have enough space within the designation extent to install these mitigation measures.

Resource consent for diversion of an overland flow path is also required under E36.6.1.13 of the AUP-OP. As this is a district rule, the required assessment is set out in Section 9. If the overland flow path is a stream as defined in the AUP-OP its diversion through piping will need regional consent under the rules of E3 Lakes, rivers, streams, and wetlands.

Special information requirements under E36.9 of the AUPOP states that a hazard risk assessment must be undertaken when subdivision, use or development requiring resource consent is proposed to be undertaken on land which may be subject to overland flow paths.

The level of information required to be provided should be proportionate to the hazard risk, the nature of the hazard. It should also be appropriate to the scale, nature, and location of the development and reflective of the scale of the activity proposed.

8.2.4 Managing works within or near the 1% AEP flood plain

It is proposed to locate new structures outside the 1% AEP flood plain and include diversion drains for obstructed overland flow paths.

To manage the risk of flood inundation of buildings, habitable floor levels should be constructed 500 mm above the 1% AEP flood level to allow for adequate freeboard and non-habitable floor levels must be at least 300 mm above the 1% AEP flood level. Fences must be open structures where at least 90 % of the surface area is not solid.

Resource consent for infrastructure in the 1% AEP flood plain is also required under E36.6.1.13 of the AUP-OP. As mentioned above, this is a district rule, and the required assessment is set out in Section 9.

Special information requirements under E36.9 of the AUP-OP states that a hazard risk assessment must be undertaken when subdivision, use or development requiring resource consent is proposed to be undertaken on land which may be subject to the 1% AEP flood plain.

The level of information required to be provided should be proportionate to the hazard risk, the nature of the hazard. It should also be appropriate to the scale, nature, and location of the development and reflective of the scale of the activity proposed.

8.2.5 Stream erosion protection

The recommended measures outlined to mitigate increased peak flows, velocities, volumes, and water quality deterioration, by constructing a stormwater treatment pond, will mitigate potential stream erosion at the discharge point.

Development within a catchment with unmodified streams, namely Stream A and B as shown in Figure 4-5, are a recognised concern as the change in hydrology (increased peak flow) can result in erosion of the stream banks and/or bed. The streams close to the coastline are fenced off and planted out.

If Stormwater Treatment Pond Location 1 is selected, the likely discharge point will be towards Stream A and if Stormwater Treatment Pond Location 2 is selected the likely discharge point will be towards Stream B. For both stormwater treatment pond options, another potential discharge location could be towards the overland flow path close to the coastline (refer to Figure 4-5). Stormwater Treatment Pond Location 1 will have less impact on existing overland flow paths. The preferred discharge point is towards the overland flow path closest to the coastline. Either discharge location is expected to need consent.

8.2.6 Road cross drainage

Adequate cross drainage should be provided if a new access road is proposed by ensuring adequate capacity during a 10% AEP flood event and not to cause an increase in flooding during a 1% AEP storm event.

8.2.7 Existing Ponds

It is understood that the existing ponds (Pond 1 and Pond 2) will remain in place for now, however Watercare will investigate the structural integrity of the ponds to determine if any future actions are required. If it was considered necessary to remove or reinstate Pond 1 to a pre-developed condition, downstream flooding effects will need to be assessed. Auckland Council GeoMaps indicates the presence of an overland flow path and low-lying area prior to Pond 1 being established, that will need to be reinstated to ensure the safe conveyance of flow towards Pond 2.

8.2.8 Maintenance Activities

The preparation of operation and maintenance plans, the training of operators and the carrying out of maintenance in an appropriate manner at appropriate times is integral to the successful long-term performance of the stormwater management system.

For the ongoing performance of any treatment or conveyance system, ongoing maintenance is required. GD01 provides guidelines and references for maintenance of stormwater treatment devices. This may be as simple as carrying out inspections, the clearance of debris, the replacement of dead plants or include extensive activities such as the excavation of accumulated sediments or the specific maintenance requirements for contaminant specific treatment devices.

This is expected to be a condition of the regional consent as it will relate to the stormwater discharge from the impervious surface and the new discharge point that will need to be consented if it is into a stream.

9 Relevant Statutory Assessment

Stormwater runoff from the site's new impervious areas will be diverted and discharged to land, water or the coastal marine area. These discharges will need resource consent a pursuant to sections 14 and 15 of the Resource Management Act 1999 and will be related to the final design of the WWTP on the site.

This assessment relates to the relevant objectives and policies in terms of the Notice of Requirement to designate the land. They are contained in the National Policy Statement for Freshwater Management 2020, the New Zealand Coastal Policy Statement 2010 and the AUP- OIP regional policy statement and regional plan chapters and are set out below.

Relevant Objectives and Policies	Comments
National Policy Statement for Freshwater Management 2020	
The objective of this National Policy Statement is to ensure that natural and physical resources are managed in a way that prioritises: • first, the health and well-being of water bodies and freshwater ecosystems • second, the health needs of people (such as drinking water) • third, the ability of people and communities to provide for their social, economic, and cultural Policy 1: Freshwater is managed in a way that gives effect to Te Mana o te Wai. Policy 2: Tangata whenua are actively involved in freshwater management (including decision-making processes), and Māori freshwater values are identified and provided for. Policy 3: Freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on receiving environments. Policy 4: Freshwater is managed as part of New Zealand's integrated response to climate change.	There is a bore on the site that is not affected by the works. The health and wellbeing of these water bodies has been prioritised through the selection of the site footprint and will not be adversely affected. In relation to policy 2 Watercare has been engaged in consulting mana whenua about the impact of the project and their feedback has been to avoid draining the wetlands by ensuring the assets are located at a sufficient distance. In relation to policy 3 the designation extent is sufficient to enable the treatment of stormwater before it discharges. Implementing erosion and sediment control measures during construction will ensure the temporary effects of earthworks will manage sediment being released into the stream. In relation to policy 4, the works have been designed to avoid all natural inland wetlands, which is in line with the Emissions Reduction Plan (in that carbon sinks (wetlands) are not removed) and while more rain and flooding are expected to be the result of climate change the effects of the land use change enabled by the designation are not going to result in impacts on the adjacent sites.
New Zealand Coastal Policy Statement 2010	
Objective 1: To safeguard the integrity, form, functioning and resilience of the coastal environment and sustain its ecosystems, including intertidal areas and estuaries, by: • maintaining or enhancing natural biological and physical processes in the coastal environment and recognising their dynamic, complex and interdependent nature. • protecting representative or significant natural ecosystems and sites of biological importance and maintaining the diversity of New Zealand's indigenous coastal flora and fauna; and • maintaining coastal water quality and enhancing it where it has deteriorated from what would otherwise be its natural condition, with significant adverse effects on ecology and habitat, because of discharges associated with human activity. Policy 4: Integration	The majority of contaminants generated from the future use of the site will be captured and treated before discharging into the streams or coastal marine area. This is an improvement on the current scenario where stormwater is passively treated by only considering the rain which falls on the area itself and not designed to capture or treat runoff from adjacent impervious areas. The ESCP (based on GD05 and Auckland practice) expected to be implemented during construction will not entirely prevent the discharge of sediment during rainfall events, and stormwater discharges may temporarily reduce the visual clarity of receiving waters and increase rates of sediment deposition. However, the control measures are designed to ensure that any such effects are not overly conspicuous or

Provide for the integrated management of natural and physical resources in the coastal environment, and activities that affect the coastal environment. This requires: ….c. particular consideration of situations where: …iv. Land use activities affect, or are likely to affect, water quality in the coastal environment and marine ecosystems through increasing sedimentation; or v. significant adverse cumulative effects are occurring or can be anticipated. Policy 23 Discharge of contaminants … (4) In managing discharges of stormwater take steps to avoid adverse effects of stormwater discharge to water in the coastal environment, on a catchment-by-catchment basis, by: (a) avoiding where practicable and otherwise remedying cross contamination of sewage and stormwater systems (b) reducing contaminant and sediment loadings in stormwater at source, through contaminant treatment and by controls on land use activities (c) … (d) …	prolonged, and that downstream aquatic environments are protected from excessive sedimentation and water quality degradation.
Auckland Regional Policy Statement	
B7.4.1. Objectives 4) The adverse effects of point and non-point discharges, in particular stormwater runoff and wastewater discharges, on coastal waters, freshwater and geothermal water are minimised, and existing adverse effects are progressively reduced. (5) The adverse effects from changes in or intensification of land use on coastal water and freshwater quality are avoided, remedied or mitigated. B7.4.2. Policies (7) Manage the discharges of contaminants into water from subdivision, use and development to avoid where practicable, and otherwise minimise, all of the following: (a) significant bacterial contamination of freshwater and coastal water; (b) adverse effects on the quality of freshwater and coastal water; (c) adverse effects from contaminants, including nutrients generated on or applied to land, and the potential for these to enter freshwater and coastal water from both point and non-point sources; (d) adverse effects on Mana Whenua values associated with coastal water, freshwater and geothermal water, including wāhi tapu, wāhi taonga and mahinga kai; and	As noted above, the majority of contaminants generated from the change in use of the site will be captured and treated before discharging into the coastal marine area. This is an improvement on the current scenario where stormwater is passively treated. The ESCP expected to be implemented during construction will minimise effects on coastal waters.

(e) adverse effects on the water quality of catchments and aquifers that provide water for domestic and municipal supply. (8) Minimise the loss of sediment from subdivision, use and development, and manage the discharge of sediment into freshwater and coastal water, by: (a) promoting the use of soil conservation and management measures to retain soil and sediment on land; and (b) requiring land disturbing activities to use industry best practice and standards appropriate to the nature and scale of the land disturbing activity and the sensitivity of the receiving environment. (9) Manage stormwater by all of the following: (a) requiring subdivision, use and development to: (i) minimise the generation and discharge of contaminants; and (ii) minimise adverse effects on freshwater and coastal water and the capacity of the stormwater network; [new text to be inserted] (b) adopting the best practicable option for every stormwater diversion and discharge; and (c) controlling the diversion and discharge of stormwater outside of areas serviced by a public stormwater network.	
AUP- OIP regional plan	
E1.2. Objectives [rp/rcp] (1) Freshwater and sediment quality is maintained where it is excellent or good and progressively improved over time in degraded areas. (2) The mauri of freshwater is maintained or progressively improved over time to enable traditional and cultural use of this resource by Mana Whenua. (3) Stormwater and wastewater networks are managed to protect public health and safety and to prevent or minimise adverse effects of contaminants on freshwater and coastal water quality	The treatment of stormwater discharged from the site is anticipated to be in accordance with GD01 guidelines and implementation of these guidelines through the detailed design will ensure freshwater and sediment quality is maintained. Earthworks during construction are expected to be managed in terms of GD05 Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region. Reduction in the amount of sediment that is mobilised by the change in land use will enhance the mauri of the watercourses on the site given their current degraded state as outlined in the Ecological Assessment.
E1.3 Policies (4) When considering any application for a discharge, the Council must have regard to the following matters: (a) the extent to which the discharge would avoid contamination that will have an adverse effect on the life-supporting capacity of freshwater including on any ecosystem associated with freshwater; and	The designated site is of sufficient size to enable the treatment measures anticipated to be implemented on the site in accordance with GD01 guidelines. This will ensure that the stormwater discharges will be managed to ensure that there are adverse effects on the life-supporting capacity of

(b) the extent to which it is feasible and dependable that any more than a minor adverse effect on freshwater, and on any ecosystem associated with freshwater, resulting from the discharge would be avoided. (5) When considering any application for a discharge the Council must have regard to the following matters: (a) the extent to which the discharge would avoid contamination that will have an adverse effect on the health of people and communities as affected by their secondary contact with fresh water; and (b) the extent to which it is feasible and dependable that any more than minor adverse effect on the health of people and communities as affected by their secondary contact with fresh water resulting from the discharge would be avoided (11) Avoid as far as practicable, or otherwise minimise or mitigate adverse effects of stormwater diversions and discharges, having particular regard to: (a) the nature, quality, volume and peak flow of the stormwater runoff; (b) the sensitivity of freshwater systems and coastal waters, including the Hauraki Gulf Marine Park; (c) the potential for the diversion and discharge to create or exacerbate flood risks; (d) options to manage stormwater on-site or the use of communal stormwater management measures; (e) practical limitations in respect of the measures that can be applied; and (f) the current state of receiving environments.	freshwater including on any ecosystem associated with freshwater are avoided and avoid contamination that will have an adverse effect on the health of people and communities as affected by their secondary contact with fresh water. Effects on the coastal waters from the land use enabled by the designation will also be minimised through the implementation of treatment measures anticipated to be implemented on the site in accordance with GD01 guidelines. Earthwork effects on the coastal waters are also expected to be managed though the ESCP and other regional consent conditions,
E2 Water quantity, allocation and use	
E2.2 Objectives [rp] Water in surface rivers and groundwater aquifers is available for use provided the natural values of water are maintained and established limits are not exceeded. Water resources are managed within limits to meet current and future water needs for social, cultural, and economic purposes. Freshwater resources available for use are managed and allocated in order of priority to provide for domestic and municipal water supplies, animals, and economic development. Water resources are managed to maximise the efficient allocation and efficient use of available water.	There are existing irrigation ponds and an existing bore on the site. Watercare stated that this will remain as is for now.

10 Conclusion

The assessment of the potential flooding and stormwater impacts of the activities authorised under the proposed designation was based on an indicative design and desktop information available from AC GIS (GeoMaps), GD01 and GD05 and the relevant provisions of the AUP-OP, and information obtained from two visits to the WWTP site.

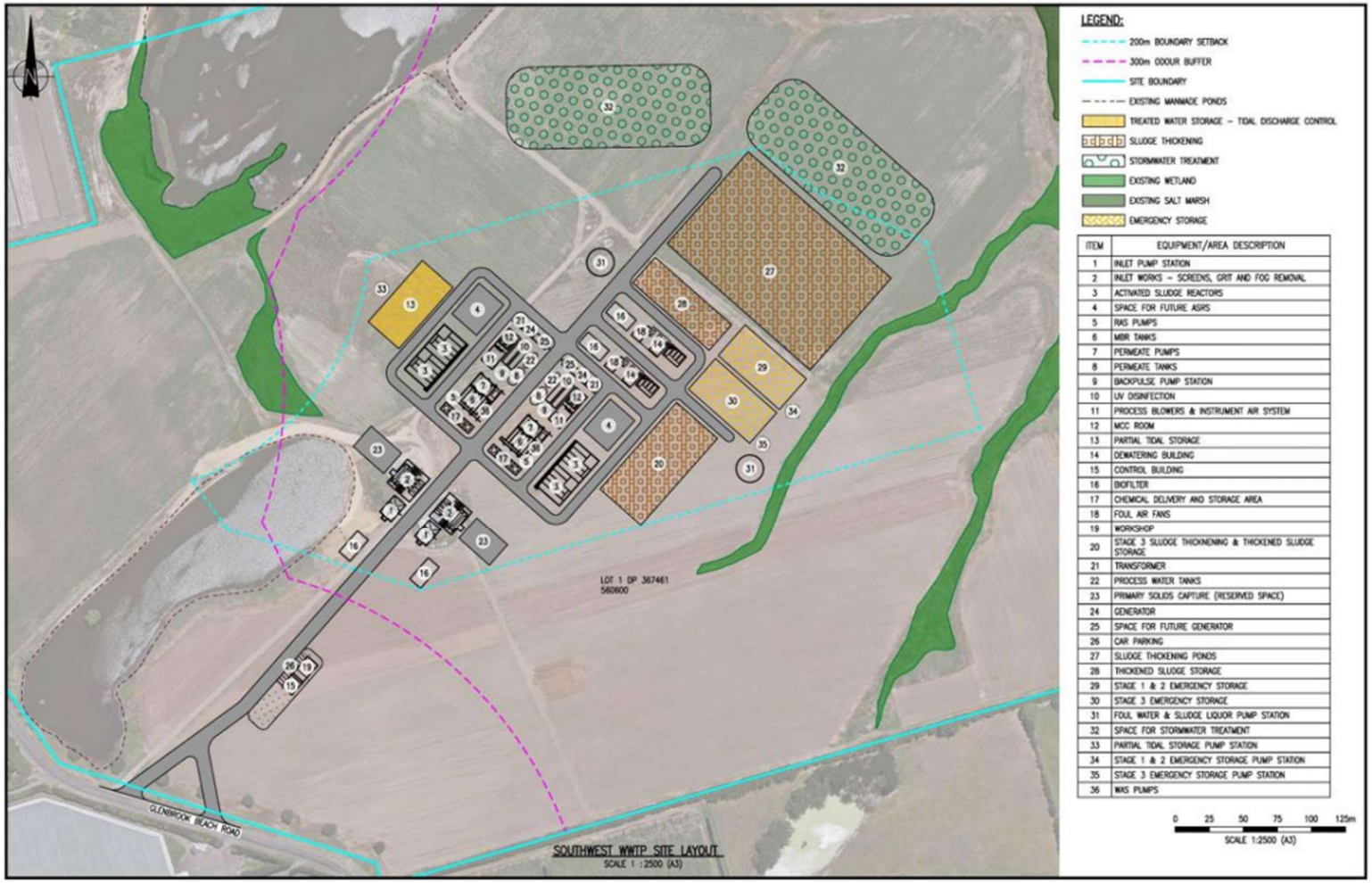
During the construction activities stage of the WWTP, no increased risk of effects from flooding was identified. Flood effects including erosion and sediment mobilisation and scour, can be managed during the construction phase through the measures set out in Section 8.1.

During the operational phase of the WWTP, the assessment of flooding and stormwater impacts identified very low to substantial adverse effects (without mitigation measures). The development of the site, as provided for under the designation, will increase peak runoff volume and contaminated runoff due to the increased impervious areas, flooding flood prone areas and creating obstruction to existing overland flow paths. These effects can be mitigated on site through the measures set out in Section 8.2, and if implemented, the proposed WWTP will have no to very low adverse effects. There is also potential for positive effects due to land use change and if stormwater treatment ponds are constructed as part of the mitigation measures.

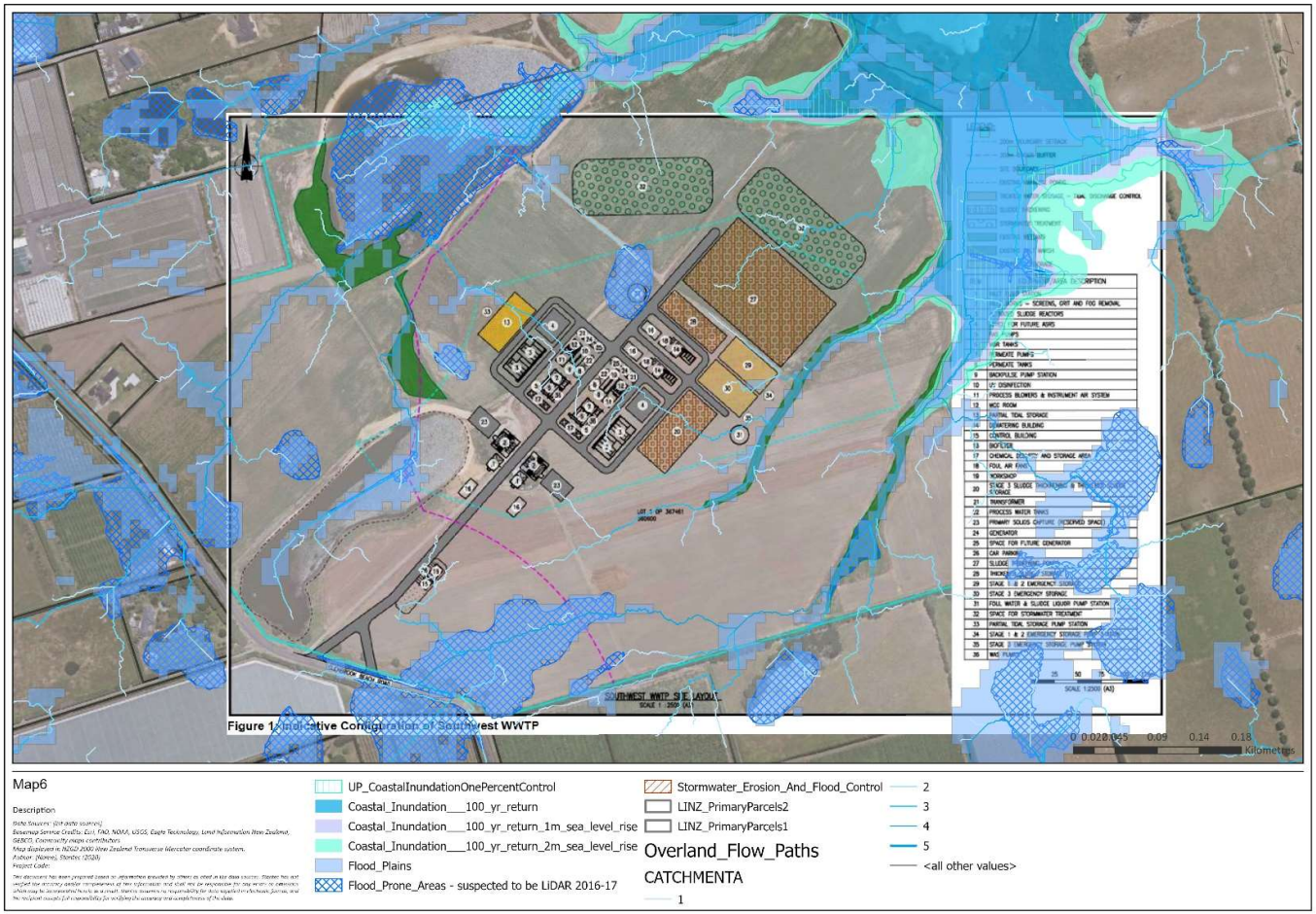
Sufficient land is available within the proposed designation and site constraints to manage and mitigate the stormwater and flooding related effects in particular for stormwater conveyance, treatment and detention purposes to reduce contaminants impacting on water quality and upstream/downstream flooding risks.

APPENDICES

Appendix A: Indicative Configuration of Southwest WWTP



Appendix B: Proposed WWTP with Catchment Hydrology (AC GIS GeoMaps)



Appendix C: Wetland Survey Layout