Mangawhai Hills

Stormwater Management Plan (Draft)

Prepared For:
Mangawhai Hills Ltd

Chester Job Number:
15209

Date:
23 February 2023

Revision History

Revision No.	Prepared By	Description	Date
0	D. Teh	Original	23 February 2023

Action	Name	Signed	Date
Prepared by	D. Teh		23 February 2023
Reviewed by	S. Rankin		23 February 2023
Approved by	S. Rankin		23 February 2023

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1 Introduction

Chester Consultants Ltd (Chester) has been engaged by Mangawhai Hills Ltd to provide a Draft Stormwater Management Plan with respect to the proposed private plan change (PPC) referred to herein as 'the PPC', the PPC area is approximately 225ha and comprised of multiple titles.

This report has been prepared solely for the benefit of this specific project, and the Kaipara District Council (KDC). Chester accepts no liability for inaccuracies in third party information used as part of this report. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

This report is based on development data provided by third party contributors to the plan change application as well as GIS and elevation data obtained from the KDC and Northland Regional Council (NRC) maps and survey data from Aerialsmiths Ltd current to the site at the time of this document's production. All vertical levels stated in this report are in New Zealand Vertical Datum 2016 (NZVD2016) unless stated otherwise. Should alterations be made which impact upon the development not otherwise authorised by this report then the design / comments / recommendations contained within this report may no longer be valid.

In the event of the above, the property owner should immediately notify Chester to enable the impact to be assessed and, if required, the design and or recommendations shall be amended accordingly and as necessary.

2 Site Description

The PPC Area is comprised of multiple lots and is approximately 225ha in size. Table 1-1 below shows the legal descriptions of each parcel that making up the area.

Table 1-1: Existing Parcels within the PPC Area

Parcel ID	Legal Description	Property Address
4818028	Lot 2 DP 172698	160 Tara Road
5203974	Allot 254 PSH of Mangawhai	160 Tara Road
8351500	Lot 2 DP 578282	196 Tara Road
8351501	Lot 1 DP 578282	196 Tara Road
5075209	Allot 247 PSH of Mangawhai	106 Moir Road
4789942	Lot 1 DP 206997	104D Tara Road
4886023	Lot 2 DP 206997	104C Tara Road
4782859	Lot 4 DP 206997	104B Tara Road
5129768	Lot 3 DP 206997	104A Tara Road
4818029	Lot 1 DP 135346	90 Tara Road
5000897	Lot 2 DP 135346	88 Tara Road
4866145	Lot 3 DP 135346	86 Tara Road
4771795	Lot 4 DP 135346	84 Tara Road
5075208	Lot 6 DP 135346	Local Purpose Reserve (Esplanade)
4915641	Lot 7 DP 125004	Local Purpose Reserve (Esplanade)
4737904	Lot 5 DP 135346	72 Tara Road
4677748	Lot 6 DP 125004	70 Tara Road

4898148	Lot 3 DP 139478	106B Moir Road
5041362	Lot 2 DP 139478	106 Moir Road
5158678	Lot 1 DP 139478	106 Moir Road
7867912	Lot 1 DP 521452	112 Moir Road
5038813	Lot 4 DP 125004	Local Purpose Reserve (Esplanade)
4781930	Lot 5 DP 125004	34 Tara Road
5035520	Lot 3 DP 107096	Local Purpose Reserve (Esplanade)
7867913	Lot 2 DP 521452	Moir Street
7653373	Lot 1 DP 490650	114 Moir Street
5183752	Lot 2 DP 125004	110 Moir Street
5048665	Lot 4 DP 139478	Moir Street
5042748	Lot 7 DP 139478	Moir Street
5170925	Lot 6 DP 139478	Moir Street
4791454	Lot 5 DP 139478	Moir Street
5019011	Lot 3 DP 154781	104B Moir Street
4761673	Lot 4 DP 154781	104C Moir Street
4754319	Lot 2 DP 154781	104A Moir Street
5022310	Lot 1 DP 154781	104 Moir Street
4765594	Lot 5 DP 154781	104B Moir Street
5185450	Lot 21 DEEDS W 38	96 Moir Street
4799656	Lot 17 DEEDS W 38	96 Moir Street
4916246	Lot 18 DEEDS W 38	96 Moir Street
4946787	Lot 20 DEEDS W 38	96 Moir Street
4905603	Lot 19 DEEDS W 38	96 Moir Street
5124736	Lot 1 DP 15117	30 Urlich Drive

The PPC Area is located north-west of the Mangawhai Township. The PPC Area is generally bounded by Tara Road, Cove Road, Old Waipu Road and Moir Road, refer to Figure 2-1. Its topography ranges from steeply sloping slopes to gentle sloping slopes as there are ridgelines and gully features located within the PPC Area. We understand the gully features within the PPC Area provides drainage for most of the site before draining to the Tara Road Swamp and then eventually on to the Mangawhai Estuary.

The PPC Area is predominantly in pasture with native and exotic brush near the north-east boundary. There are a few existing houses and some ancillary farm buildings throughout.

Figure 2-1: Private Plan Change Area (boundary in red) (Extracted Figure 14 from Barker & Associates)

3 Purpose

The purpose of this document is to provide an example of what is anticipated for future Stormwater Management Plans to meet the proposed stormwater provisions for the Mangawhai Hills Precinct. The approach outlined in this document is considered to be suitable to be applied in a future resource consent within the PPC area.

4 Catchment Description and Context

This section of the report describes the natural and physical characteristics that make up the PPC Area to provide context for the stormwater management requirements.

4.1 Natural and Physical Characteristics

4.1.1 Topography

The topography of the PPC Area can be generally described as land that drains from ridgelines towards watercourses that runs from northwest to southeast through the middle of the PPC Area. In the northern half of the PPC Area there are two watercourses which merge into one approximately in the middle of the PPC Area. In the southern half of the PPC there is another watercourse that starts within the PPC Area which merges with the other watercourse before running parallel with the southern boundary of the PPC Area.

Slopes are generally moderately steep throughout the PPC Area with the steeper slopes located below the ridgeline and the gentler slopes located near the watercourses. Figure 4-2 illustrates the elevation over the PPC Area and Figure 4-3 illustrates the slope of the land within and adjacent to the PPC Area.

Using the 2018/2019 Northland Region LiDAR dataset provided by NRC and the survey information from Aerialsmiths Ltd we provide the following comments around the PPC Area topography with respect to stormwater.

Stormwater, runoff is expected to be sheetflow at the top of the catchment areas near the ridgeline which may be channelised in shallow gully features before reaching the watercourses. The majority of the runoff is expected to drain towards one of the watercourses within the PPC area. The watercourse after exiting the PPC Area discharges into the Mangawhai Estuary.

The PPC area is generally split into three different catchment areas, a Northern, Western and Southern catchment. Refer to Figure 4-1 which illustrates the three stormwater catchments.

The Northern catchment consists of land that drains into the northern watercourse. There are areas along the north-eastern fringe that naturally drains towards Old Waipu Road; these are minor in comparison to the majority of the catchment area.

The Western catchment consists of land that drains into the western watercourse.

Both the Northern and Western catchment drains into the watercourse located along the south-western portion of the Southern catchment. Additionally, there is another watercourse along the eastern half of this catchment which merges with the other watercourse at the southern boundary of the PPC Area. There are areas in the south-eastern corner that naturally drains towards Moir Street; these are minor in comparison to the majority of the catchment area.

Estimated catchment areas are as follows:

Northern Catchment = 40 ha
Western Catchment = 110 ha
Southern Catchment = 75 ha

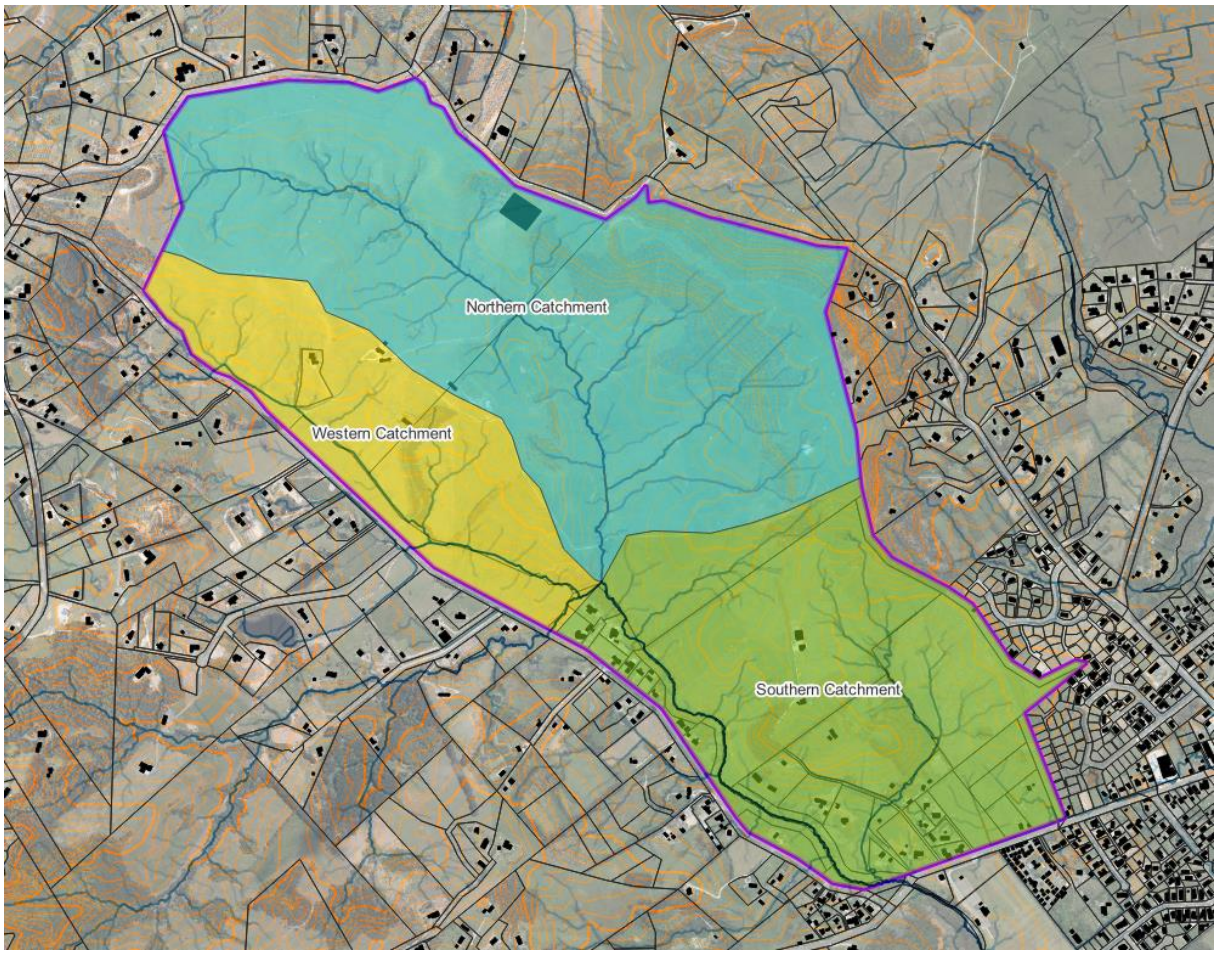

Figure 4-1: Stormwater catchments identified within the development extent.

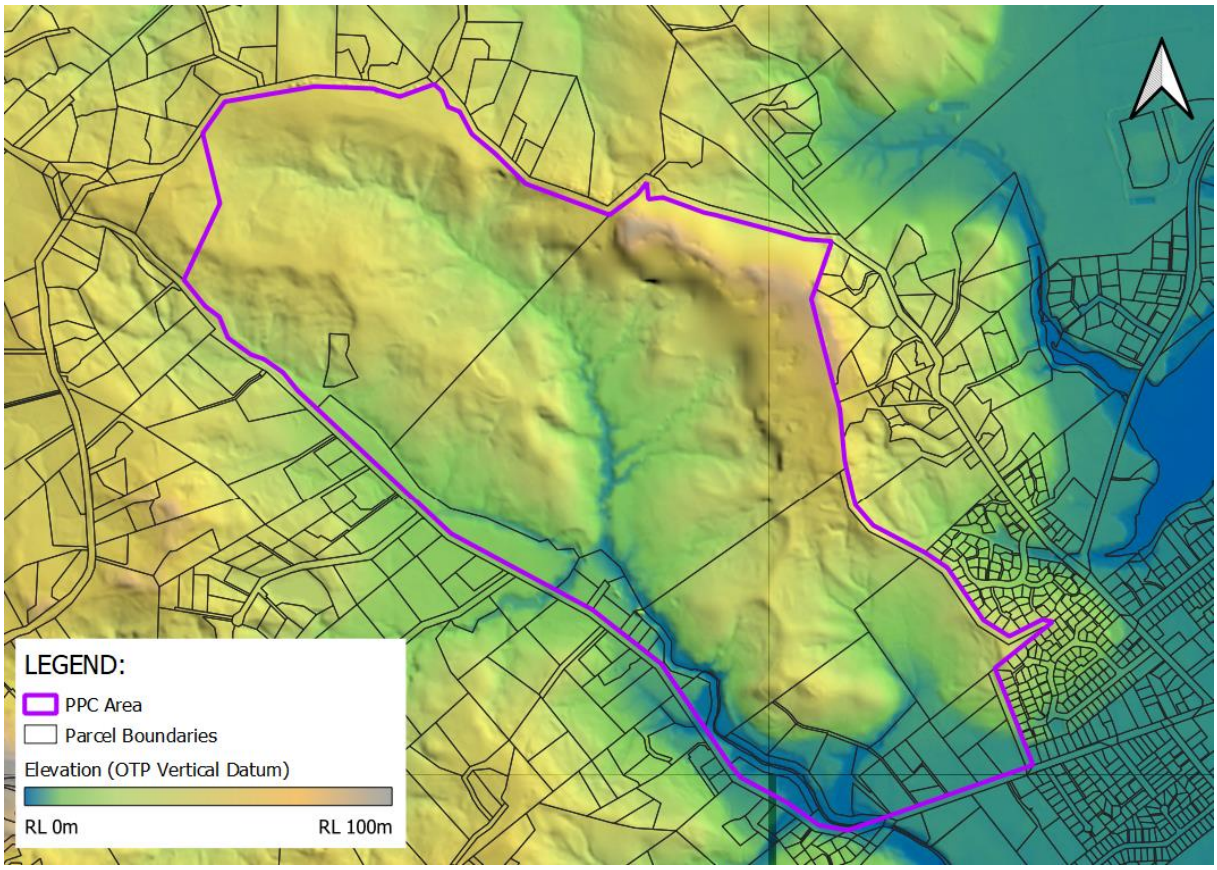

Figure 4-2: Elevation map showing the different elevation areas for the land within and adjacent to the PPC.

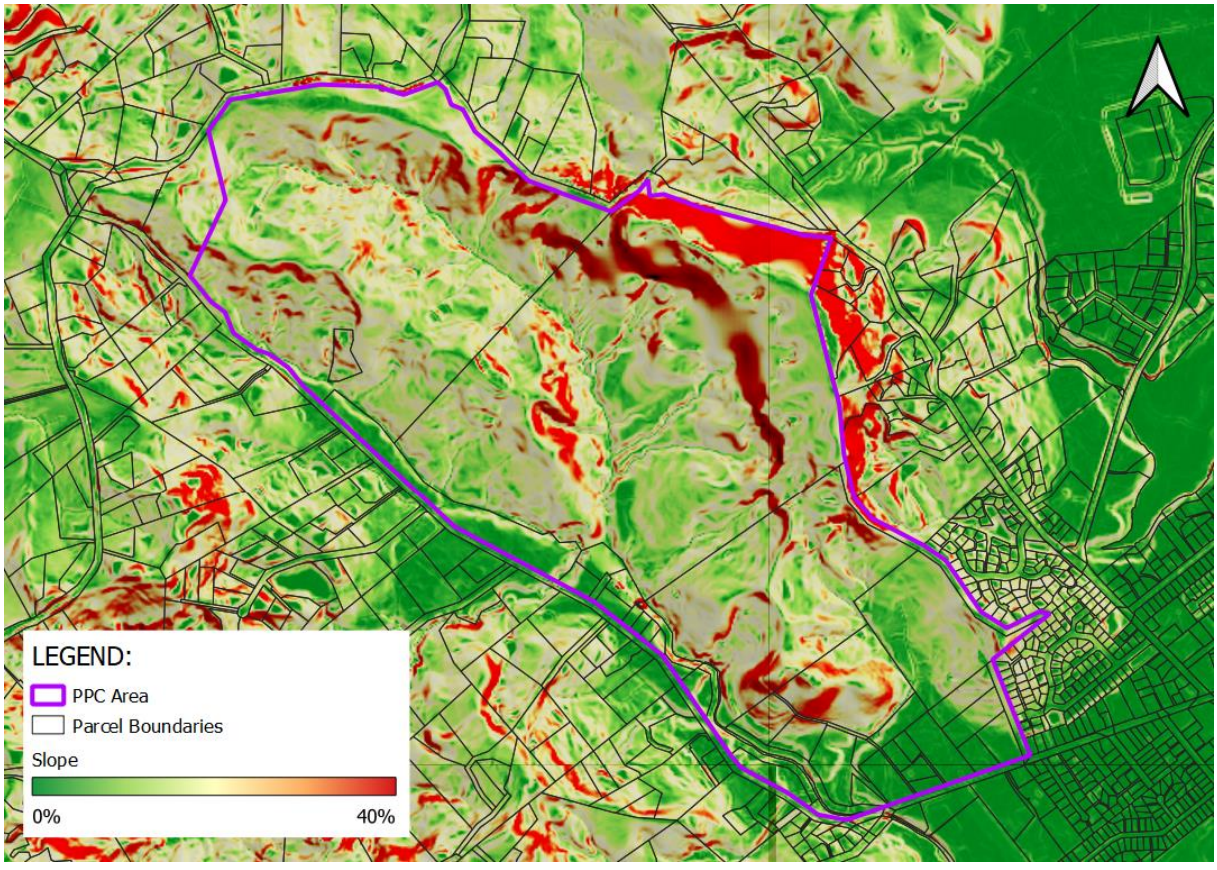

Figure 4-3: Slope map showing the different slope areas for the land within and adjacent to the PPC.

4.1.2 Geotechnical

The PPC Area is not within an Erosion Prone Land hazard area as viewed on Northland's Regional Council's Natural Hazards webpage.

A preliminary geotechnical assessment was provided by Wiley Geotechnical Limited (WGL) dated 21st August 2019. This report references a now superseded proposed development plan, but the investigations can still be considered as valid for a portion of the PPC area. The geotechnical assessment outlines that the prominent features of the area include the two ridgeline formations which generally trend in a northwest to southeast direction with moderate to steep slopes creating a large central gully formation.

WGL's assessment found that the PPC area is underlain with sedimentary rocks of the Pakiri Formation (Waitemata Group) which comprise of "alternating thick-bedded, volcanic rich, graded sandstone and siltstone with volcaniclastic grit beds". Where the watercourses are located the soils are underlain with alluvium from the Tauranga Group which comprise of "partly consolidated mud, sand, gravel and peat or lignite of alluvial, colluvial, lacustrine, swamp and estuarine origins". Lastly, there is a minor area at the northern corner near the intersection of Old Waipu Road and Cove Road that is underlain with Northland Allochthon that comprises of "melange, comprising a matrix of sheared mudstone with included tectonic blocks of Northland Allochthon, Te Kuiti Group and Waitemata".

WGL has observed historical slope failures along the valley flanks with evidence of shallow soil movement, soil creep and instability in the form of scarps and receding gully heads caused by watercourse incision and erosion is present on the lower sections of the valley. Furthermore, localised areas of hummocky ground were observed by WGL across the sloping valley sides with wetland vegetation and swampy ground in the lower lying areas of the gully formation.

WGL carried out 20 hand auger boreholes up to a depth of 3.0m. The soils encountered generally consist of topsoil underlain by slightly to moderately clayey silt with bands of slightly sandy silt. Desiccation cracks were observed up to a depth of 0.70m but groundwater was not encountered in any of the boreholes. WGL concludes that the soils uncovered is broadly consistent with published geologic mapping.

A geotechnical desktop study by Tetra Tech Coffey Ltd dated 16th December 2022 was undertaken and they believed that the site is geotechnically suitable for the proposed plan change but a site-specific investigation is to be carried out to support the subdivision resource consent.

Based on Opus's Acid Sulphate Soil Risk Areas map, see image below, the PPC Area is also underlain with acid sulphate soils which are found along the watercourses.

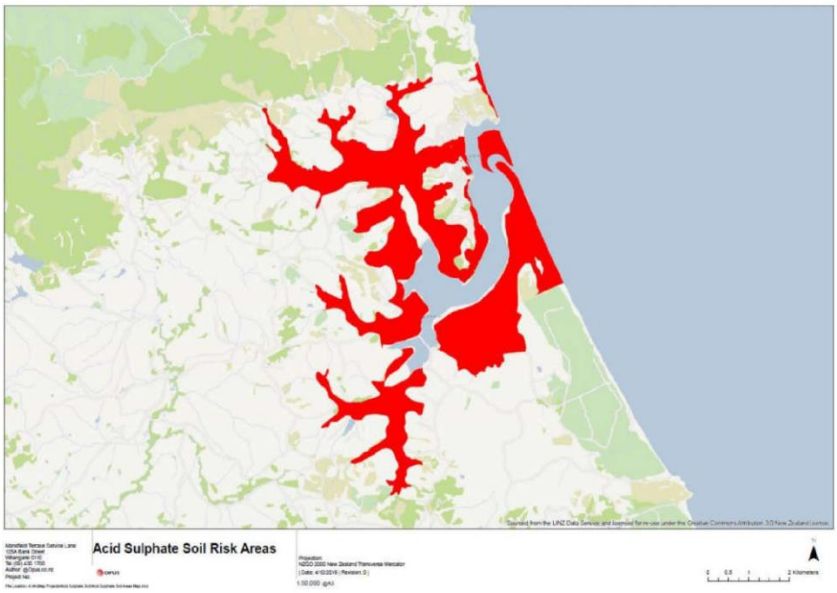

Figure 4-4: Location of acid sulphate soils from Opus's Acid Sulphate Soil Risk Areas map.

4.1.3 Ecology

Two ecological reports have been produced, one by Freshwater Solutions titled "Frecklington Farms Freshwater Ecology Assessment of Effects" dated March 2019 and the other by Scrub Consultants Ltd titled "Ecological Site Analysis and Restoration Report" dated 20 September 2019. Both reports reference a now superseded proposed development plan, but the ecological investigations and summary can still be considered as valid for a portion of the PPC area.

Based on their report, the following ecological features were identified:

- Site consists of mainly pastoral land across an undulating landscape with some native bush remnants.
- Two watercourses have been identified on-site and are fed by seepage wetlands from the surrounding hillsides.
- Wetlands have been identified to be palustrine in nature and seepage (fed from springs that emerge from the hillside).
- Seven artificial ponds on-site that provide unnatural still water habitat of low ecological value with the largest two being likely effluent ponds.
- There are multiple culverts within the site with some being a barrier for fish migration.
- Mangawhai Estuary is the ultimate receiving environment for the watercourses.

Refer to Figure 4-5 and Figure 4-6 below showing the ecological features found from the two ecological reports.

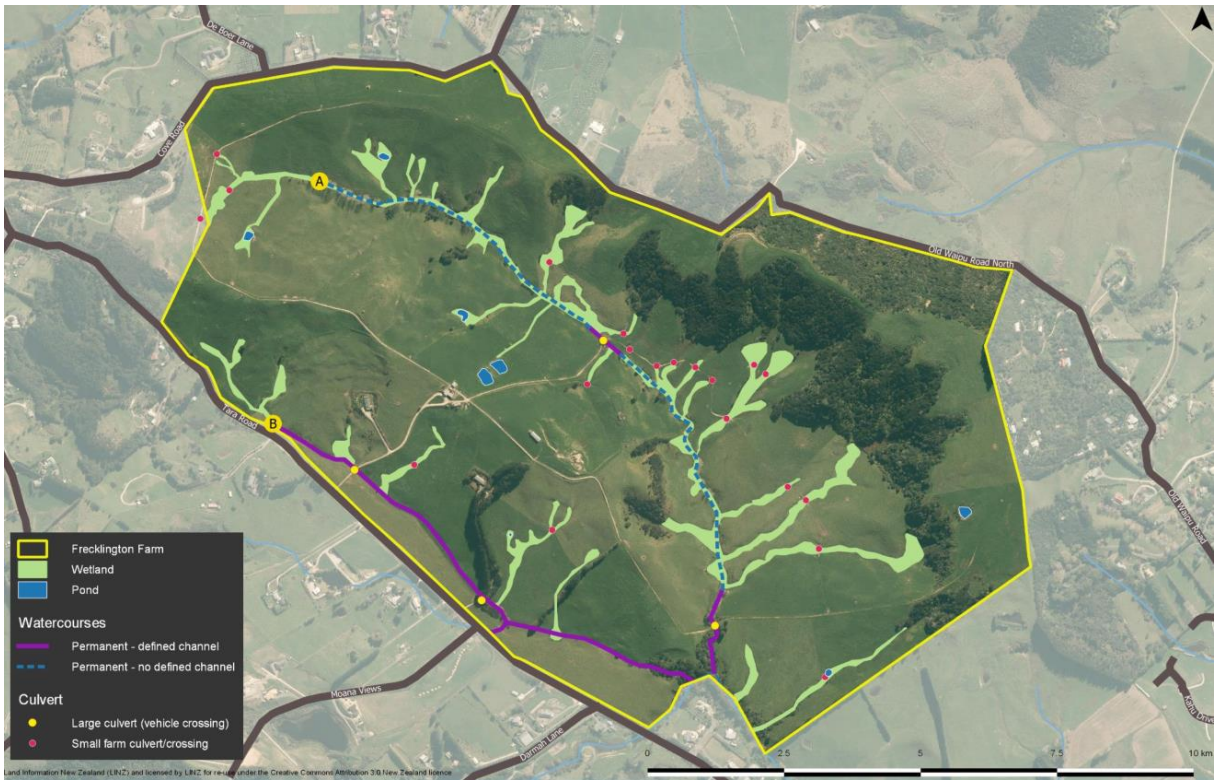

Figure 4-5: Mapped ecological features from Freshwater Solutions ecological report.

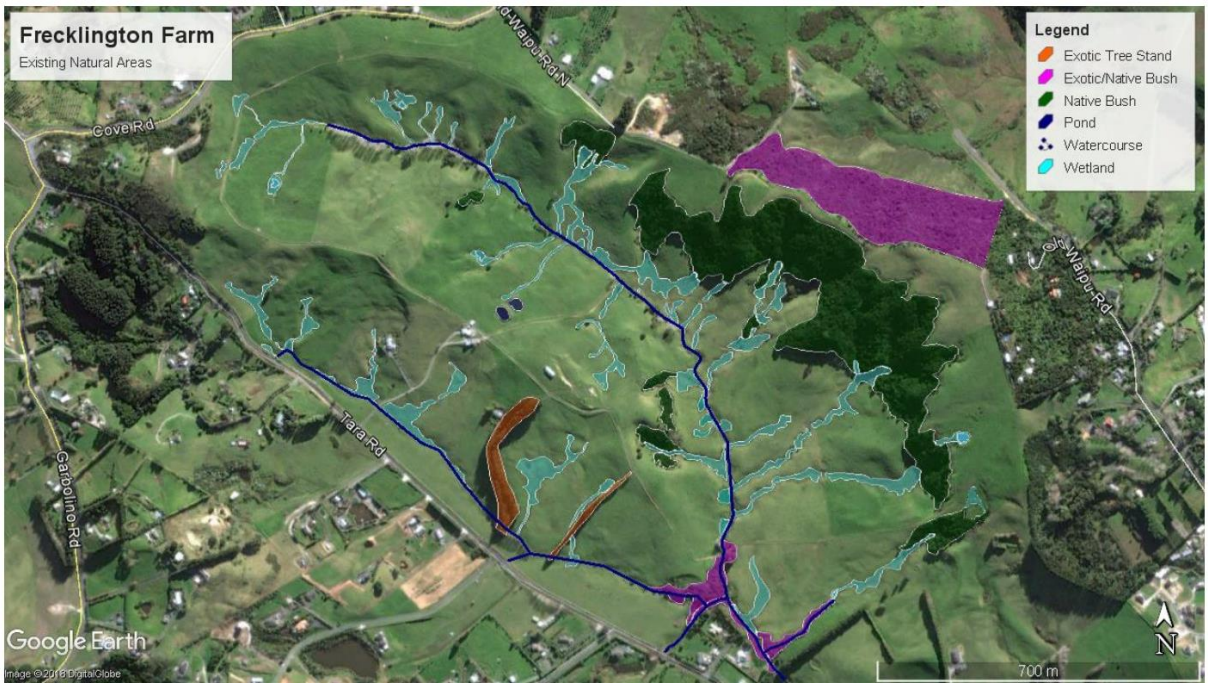

Figure 4-6: Mapped ecological features from Scrub Consultants ecological report.

4.1.4 Flooding & Overland Flow Paths

The PPC Area is located a short distance away from the Mangawhai Estuary. The land at the southern end of the PPC Area is expected to experience coastal inundation but this coastal influence reduces as the elevation increase upstream to the northeast.

Based off the NRC's Natural Hazard mapping webpage the 1% AEP flood hazard largely follows the watercourses on-site. However, it is noted that this is from a regionwide model and so the 1% AEP flood hazard shown does not represent the full hazard on-site. Refer to Figure 4-7 for the NRC's 1% AEP and coastal inundation extents.

Figure 4-8 below shows the estimated overland flow paths on-site based on existing ground terrain data and provides an indication of where overland flow paths may be present on-site. Please note that overland flow paths were created by estimating the drainage direction based of terrain slope and so only provides a visual indication of where topography is depressed relative to its' surrounding which may concentrate runoff.

Refer to the more detailed Flood Risk Assessment prepared by Chester which accompanies this document for a more detailed assessment.

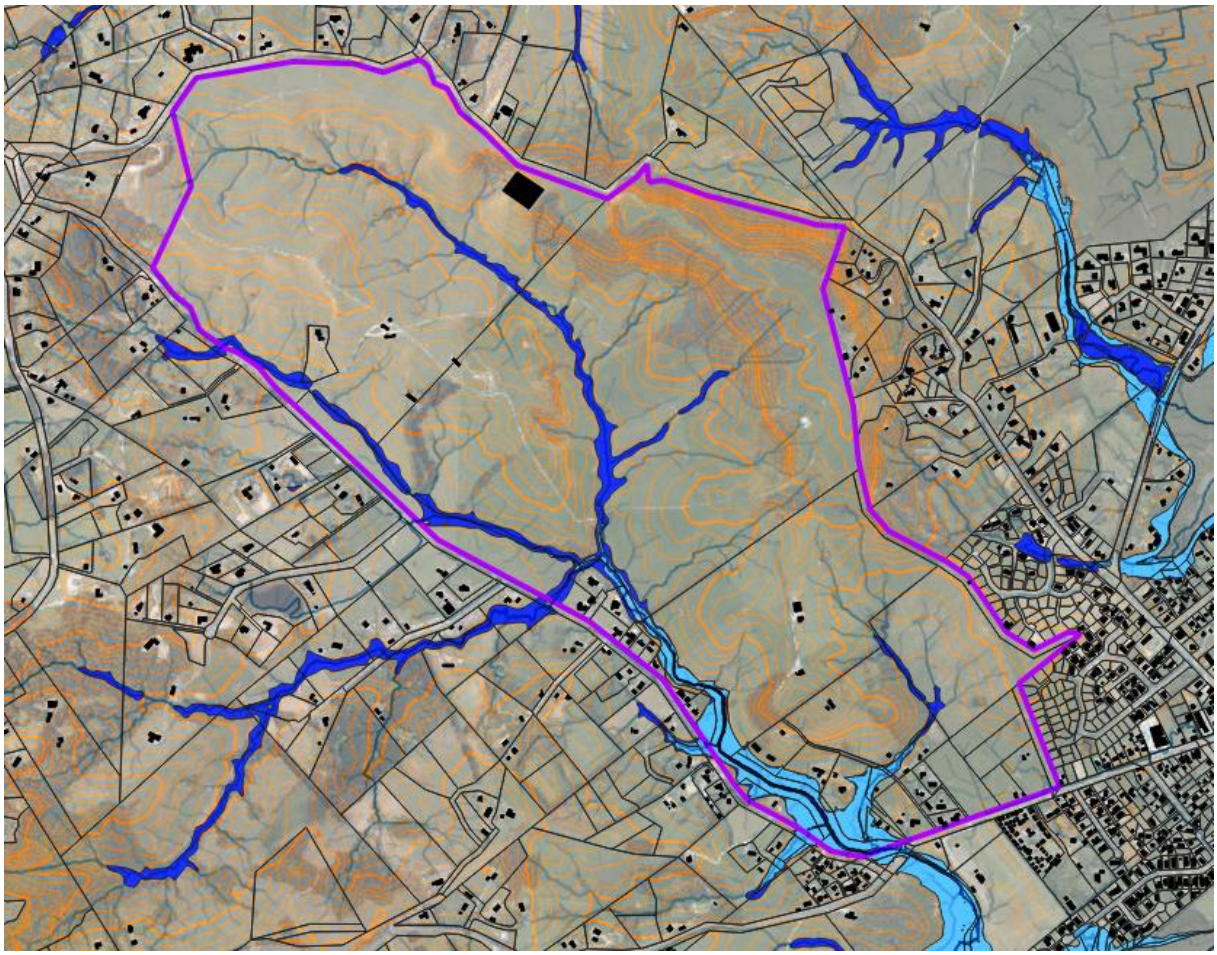

Figure 4-7: 1% AEP Flooding (blue) and Coastal Flood Hazard Zone 3 (light blue) with information provided by NRC Open Data webpage

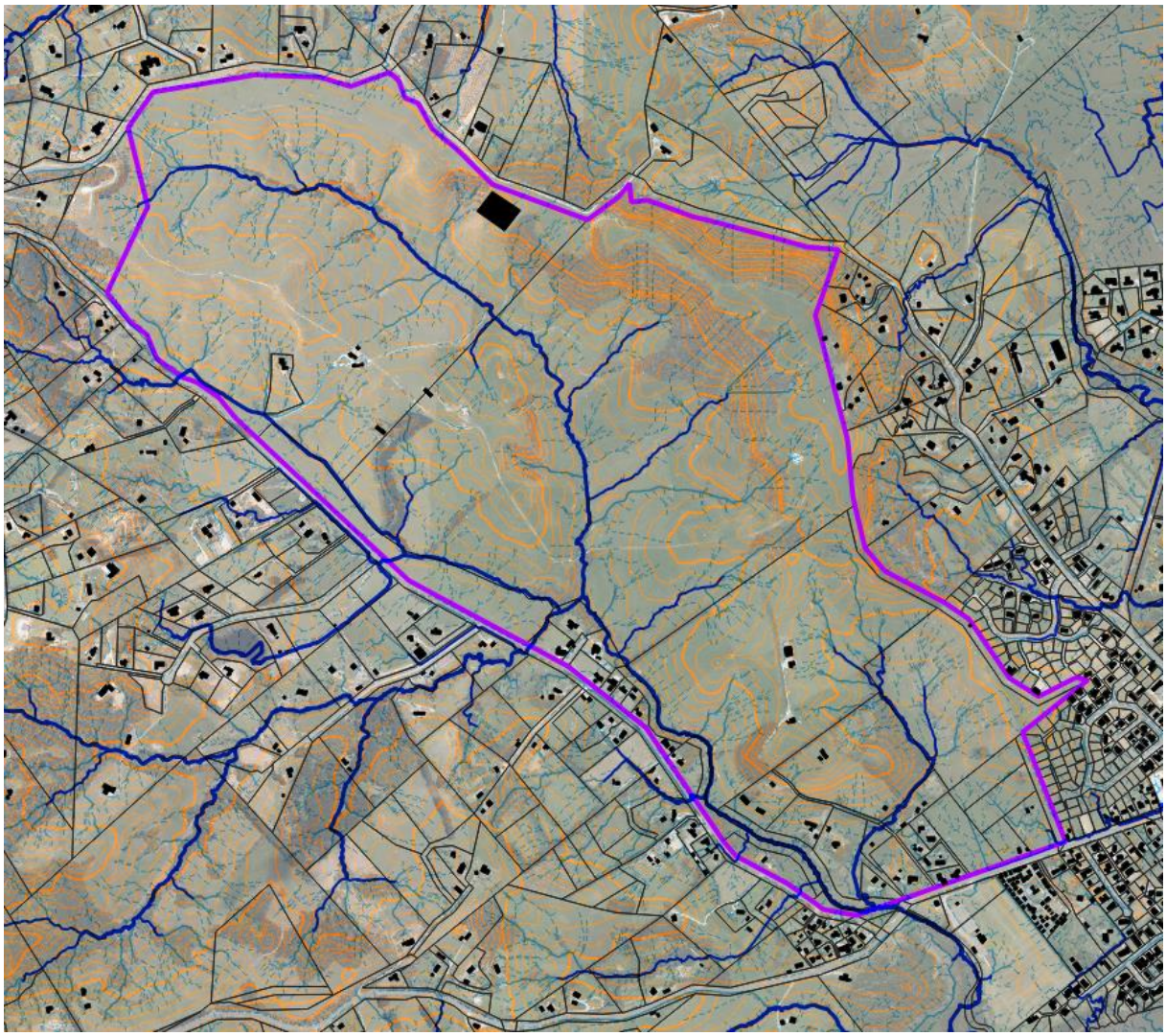

Figure 4-8: Sheetflow estimated in light blue dash lines and channelised flows in dark blue lines (please note flow path assessment above is indicative only as assessment uses LiDAR data).

4.2 Receiving Environments

Runoff from the PPC Area will flow towards the watercourses on-site which merges at the southern end of the PPC area before discharging into the Mangawhai Estuary.

The Mangawhai Estuary is a high-quality receiving environment that requires protection from stormwater contaminants.

4.3 Current Land Use and Infrastructure

We note that most of the catchment is greenfield so there is relatively little existing infrastructure/urban development as the bulk of the PPC area is currently being used for pastoral activities.

4.3.1 Current land use

The land cover within the catchment is predominantly pastoral land containing a few scattered buildings and farm tracks.

There is no existing public stormwater infrastructure within the PPC Area. The existing development density and age would mean the existing structures have either onsite stormwater disposal or no formal disposal system. Private culverts are located where farm tracks crosses wetland areas, refer to Figure 4-5.

5 Proposed Private Plan Change

The PPC is seeking to rezone approximately 225ha of land in the from Rural zoning to a mixture of Residential zoning and 'green' zones (riparian and waterway areas).

Currently under the Rural zoning the permitted threshold for impervious areas is 10% when the existing harbour overlay is considered under the current Kaipara District Plan, the Mangawhai Hills Precinct Plan provisions has a permitted impervious threshold of 50% which is a 40% increase in impervious area compared to Rural zoning.

It is important to note that of the 225ha of the PPC area, the area for residential development shown in yellow in Figure 5-1 is 106.2 ha or 47.2% of the total area, so continuing forward with the 50% impermeable coverage on the residential sites results in a total permitted impermeable area of 53.1ha or 24.3% resulting from the zoning.

Figure 5-1: Proposed conceptual structure plan

6 Planning Context

This section of the report lists the various documents considered for growth in the PPC catchment as they relate to stormwater management and summarises the requirements and considerations from an engineering point of view.

6.1 Policy Statements and Plan Provisions

The relevant policy statements and plan provisions of the following documents must be considered in developing the stormwater management approach for the catchment;

- National Policy Statement for Freshwater Management 2020
- Resource Management (National Environmental Standards for Freshwater) Regulations 2020
- Regional Water and Soil Plan for Northland
- Proposed Regional Plan for Northland March 2022 - Appeals Version
- The Operative Kaipara District Plan 2013
- Kaipara Infrastructure Strategy Revision 6 February 2021
- Kaipara District Council Engineering Standards 2011
- NZS 4404:2010 Land Development and Subdivision Infrastructure
- Mangawhai Stormwater Infrastructure Strategy
- Mangawhai Stormwater Network Discharge Consent (NDC)

6.1.1 National Policy Statement for Freshwater Management 2020

The National Policy Statement for Freshwater 2020 (NPS-FM) provides directions, via objectives and policies, on how local authorities are to manage freshwater under the Resource Management Act 1991 (RMA).

In summary, the NPS-FM aims to prioritise the health and well-being of water bodies and freshwater ecosystems and aims to improve degraded water bodies and freshwater ecosystems and water quality and prevent further loss of natural wetlands and rivers.

The NPS-FM has tasked every regional council to identify freshwater management units (FMU) in their respective region and set environmental outcomes within their respective regional plans. Northland Regional Council has identified 13 FMUs and the PPC Area is located within the Bream Bay FMU.

Currently, the existing Northland Regional Plans were made operative before the release of the NPS-FM but the new Regional Plan has been updated to take into account the NPS-FM but it is not currently fully operative until all current appeals have been resolved. More information on the new Regional Plan is discussed further Section 6.1.4.

6.1.2 Resource Management (National Environmental Standards for Freshwater) Regulations 2020

The Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NES-F) provides consistent standards for regional and district councils to target by prescribing minimum technical standards, methods or requirements.

Under the NES-F, earthworks or vegetation clearance for building development purposes is considered a non-complying activity within 10m of a natural wetland. Furthermore, the taking, use, damming, diversion, or discharge of water within a 100m setback from a natural wetland is also considered a non-complying activity for building development purposes.

6.1.3 Regional Water and Soil Plan for Northland

The Northland Regional Council's Regional Water and Soil Plan (NRC W&S Plan) identifies that past stormwater engineering focuses on stormwater pipe networks and their capacity with little mention on stormwater quality.

The NRC W&S Plan has outlined policies to manage the diversion and discharge of stormwater to safeguard against flooding and enhances water quality via low impact stormwater management design and requires Stormwater Management Plans to be prepared.

Under the NRC W&S Plan some of the following rules regarding stormwater are summarised below:

- Rule 21.01.02(a), new subdivisions and development will require the best practicable option for on-site stormwater disposal to avoid or minimise changes to stormwater flows for the 5 Year average recurrence interval (ARI) rainfall event.
- Rule 21.01.02(d), the stormwater network is to have capacity up to the 20% AEP rainfall event with secondary flow paths designed to cater up to the 50 Year ARI rainfall event when the stormwater network is exceeded.
- Rule 21.01.02(e, g, and h), discharge of stormwater to meet certain water quality controls (e.g. heavy metals, hydrocarbons and etc)
- Rule 21.01.02(f), prevent erosion and scour do the receiving water environment.
- Rule 21.01.02(i), discharge does not cause flooding of adjacent properties.

  **The NRC W&S Plan outlines the following measures that should be considered for best practicable option for on-site stormwater disposal:*

  - *Infiltration facilities in permeable soil types;*
  - *The retention of natural stream channels;*
  - *Minimise areas of impermeable surfaces;*
  - *Stormwater detention before dispersal into waterways.*

Any breaches to the above rules will result in the activity being a non-permitted activity.

6.1.4 Proposed Regional Plan for Northland December 2022 - Appeals Version

Currently, the Northland Regional Council is working on a creation of a new Regional Plan for Northland. At this stage, this new regional plan is in the appeals stage and will not be fully operative until all appeals are resolved. The most current proposed regional plan at the time of this document is the Proposed Regional Plan for Northland December 2022 - Appeals Version (NRC PRP 2022 Appeals Version). The NRC PRP 2022 Appeals Version is very brief on issues, explanations, methods and assessment criteria, and only summarises the different rules compiled within the document.

Under the NRC PRP 2022 Appeals Version, the discharge of stormwater from a public stormwater network within the Mangawhai-Mangawhai Heads urban area is classified as a Controlled Activity and will require the following matters to be controlled:

- The maximum concentration or load of contaminants in the discharge;
- The size of the zone of reasonable mixing;
- The adequacy of measures to minimise erosion;
- The adequacy of measures to minimise flooding caused by the stormwater network;
- The design and operation of the stormwater system and any staging of works.

The NRC PRP 2022 Appeals Version's water quality standards and guidelines are attached in Appendix A.

6.1.5 The Operative Kaipara District Plan 2013

Under Chapter 13 of the Kaipara District Plan for Residential zone, the following rules with regards to stormwater have been taken into account:

- Rule 13.10.12, where the impervious area on-site is greater than 40% (permitted threshold) of the net site area then attenuation of stormwater flows is required.
- Rule 13.11, for general residential subdivisions low impact stormwater design is to be incorporate into the subdivision design and that the subdivision complies with the requirements in the Kaipara District Council Engineering Standards 2011.

Furthermore, under Chapter 3 Outcome 'g', the Kaipara District Plan encourages development to include low impact stormwater design and water quality enhancement solutions.

6.1.6 Kaipara Infrastructure Strategy Revision 6 February 2021

The Kaipara Infrastructure Strategy has identified water quality and climate change as key issues and anticipates Council to enact more stringent measures when issuing resource consents and enforcement of engineering standards to ensure stormwater discharges meet current best practice.

6.1.7 Kaipara District Council Engineering Standards 2011

The District Council Engineering Standards 2011 encourages the use of Low Impact Design for stormwater infrastructure and have made reference to Auckland Regional Council's TP124 document (which has now been superseded by the GD04 Water Sensitive Design for Stormwater document) and also to the NZS 4404 document.

The Engineering Standards outlines the following stormwater design requirements and guidance notes applicable to the Development:

- Provide for future increase in runoff from the upstream catchment as per maximum Probable development (MPD) scenario.
- In residential zones, stormwater runoff up to the 20% AEP is to be gravity piped.
- Protect buildings from flooding via providing freeboard requirement.
- In urban areas, provide on-site stormwater detention for attenuation up to the 1% AEP rainfall event to pre-development peak flows.
- Where stormwater attenuation is required, stormwater detention ponds or basins should be provided to serve the entire site catchment.
- When discharging into natural waterways, stormwater treatment devices which provide water quality in accordance with the requirements of the NRC should be provided.
- When discharging into a Council-managed system, Council should be consulted as to water quality requirements and existing or planned treatment devices which the discharge may flow through.

Refer to Section 6 of the Engineering Standards for the full stormwater requirements.

6.1.8 NZS 4404:2010 Land Development and Subdivision Infrastructure 2011

NSZ 4404 summarises the aims of a low impact design as follows:

- Reducing peak flow discharges by flow attenuation
- Eliminating or reducing discharges by infiltration or soakage
- Improving water quality by filtration
- Installing retention devices for beneficial reuse

6.1.9 Mangawhai Stormwater Infrastructure Strategy

A stormwater report was produced by Stantec dated 9th March 2018 titled "Mangawhai Stormwater Infrastructure Strategy - Stage 2" (MSIS report) and outlines stormwater management options and measures to manage the effects of stormwater discharges from both existing and proposed development within Mangawhai.

The report's guiding principles includes the following:

- Requirement for on-site rainwater collection and tank storage

- Incorporating blue-green infrastructure (biofiltration devices) such as swales, retention ponds and raingardens.

- Utilise soakage systems wherever possible as a primary means of disposal even if the full design soakage is not achievable. This is to reduce volumes and peak flows form stormwater discharges as much as practically possible.

- Keep water on the surface via swales for treatment and conveyance avoiding kerb and channel wherever possible.

The PPC Area has been identified to be within Catchment 17 of the MSIS report and the MSIS report has identified two issues within Catchment 17. Below are the two issues, the management options and the recommended stormwater management approach from the MSIS report.

Issues	Management Options	Management Recommendation
Performance of the existing public stormwater network is not well understood. This includes primary (piped and open channel) as well as the secondary overland flow or ponding systems. Risk may worsen in the event of future upstream development as Tara Road is under pressure for residential growth	1. Do nothing, accept lack of information and limitations on confidence in long-term decision making. 2. Gather more accurate information on the existing asset, update GIS and use in modelling system performance with different scenarios as development upstream and potential blockages. 3. Formalise and protect OLFP with easements where possible or direct to public lands or roads where possible.	Gather more accurate information on the existing asset and topography, update GIS and use in modelling system performance with different scenarios as development upstream and potential blockages. Formalise and protect OLFP with easements where possible or direct to public lands or roads where possible.
Existing rural zoned land (outside of the study area) considered for more intensive development	1. Do nothing, accept effects and resolve future problems as they arise if possible. 2. Gather more accurate information on the existing asset, update GIS and use in modelling system performance with different scenarios as development upstream and potential blockages. 3. Provide guidance to developers around the information requirements and planning requirements. 4. Include requirements for mitigation within the District Plan including flow and volume reduction and erosion protection for development on rural land (particularly rural residential type developments). 5. Include requirements for developer to demonstrate impact to downstream properties is managed.	Gather more accurate information on the existing asset, update GIS and use in modelling system performance with different scenarios as development upstream and potential blockages. Provide guidance to developers around the information requirements and planning requirements. Include requirements for mitigation within the District Plan including flow and volume reduction and erosion protection for development on rural land (particularly rural residential type developments). Include requirements for developer to demonstrate impact to downstream properties is managed. Provide guidance to future developers with respect to on-site management techniques.

	6. Provide guidance to future developers with respect to on-site management techniques to mitigate their effects off-site, including: operation, maintenance and monitoring strategies.	to mitigate their effects off-site, including: operation, maintenance and monitoring strategies

6.1.10 Mangawhai Stormwater Network Discharge Consent (NDC)

Kaipara District Council was granted a 35-year stormwater discharge consent for Mangawhai on the 26th of July of 2017 (expires on 1st of June of 2052) and this has been integrated into this Stormwater Infrastructure Strategy.

Relevant consent conditions include the following:

Condition 7:

> The stormwater discharge does not result in any permanent scouring or erosion of the bed of a waterbody or the coastal marine area. For compliance purposes, "permanent" is defined as scouring or erosion that will not be fully remediated by natural processes during the following 3-month period.

Condition 9:

> The assets within the stormwater network system that are owned by the Consent Holder, including stormwater ponds, outlet structures, cesspits, energy dissipation devices, and overland flow paths, shall be adequately maintained to ensure that they operate efficiently and effectively at all times.

Condition 10:

> All sediment removed from the stormwater network system shall be disposed of at a site that is authorised to accept such waste material.

Condition 11:

> Within 12 months of the date of commencement of these consents, the Consent Holder shall forward to the Northland Regional Council's assigned monitoring officer an Operation and Maintenance Plan that details how Conditions 9 and 10 will be complied with. This Plan shall include, as a minimum:
>
> (a) a schedule of inspection frequencies for all sediment traps and stormwater treatment devices;
>
> (b) the maintenance requirements for sediment traps and treatment devices;
>
> (c) a schedule of inspection frequencies for obstructions within open watercourses, drains and overland flow paths.

Condition 15:

> The exercise of these consents shall not result in the concentration of metals in sediment, as measured at or beyond a 30-metre radius from any final outlet from the network system into water, to exceed the following:

Ecosystem type	milligrams per kilogram dry weight
Copper	65
Lead	50

Zinc	200
Chromium	80
Nickel	21
Cadmium	1.5

Condition 20:

The exercise of these consents shall not result in any of the following effects on water quality, as measured at or beyond a 30-metre radius down current from any discharge final outlet from the network system:

(a) The production of any conspicuous oil or grease film, scums or foams, or floatable or suspended materials, or emissions of objectionable odour;

(b) The destruction of natural aquatic life by reason of a concentration of toxic substances;

(c) Shellfish to become tainted so as to make them unpalatable or contain toxic substances to the extent that they are unsafe for human consumption.

7 Low Impact Stormwater Design

From the relevant planning and guidance documents above, the local and regional government authorities place importance on having a Low Impact stormwater Design (LID) (also known as Water Sensitive Design (WSD)) with the Kaipara Engineering Standards referring to the (now current) Auckland Councill's GD04 Water Sensitive Design for Stormwater document. Auckland Council's GD04 document outlines the following aims for a WSD:

- Protect and enhance the values and functions of existing natural ecosystems
- Address stormwater effects as close to source as possible
- Mimic natural systems (the water cycle) and processes for stormwater management

The toolbox to enable the above aims are described within Auckland Council's GD01 document Stormwater Management Devices in the Auckland Region.

The Auckland Council documents listed are currently considered to be the Best Practise documents from the implementation of WSD currently available in New Zealand.

In summary there are three parameters that are potentially affected by development which could cause degradation and deterioration of the environment and alteration to the natural water cycle. These are stormwater peak flowrates, stormwater total volume and stormwater quality.

Historical urban development would typically have new areas of impervious areas that inhibits infiltration of stormwater on-site (more noticeable for small rainfall events) with all runoffs being collected and piped to the discharge point usually without any quality or quantity control. This total diversion of runoff has the effect of increasing stormwater runoff volume, decreasing time of concentration for all runoff (i.e. flows from different sources coincide with each other at the discharge point), increasing peak flowrates and introducing new contaminants (which in a primarily residential urban setting the main containment of concerns are primarily hydrocarbons and heavy metals caused by vehicle traffic, and general litter and sediments) and deposit them into the receiving environment which degrades the environment.

In response the current best practise to mitigate the potential effects is to utilise WSD principles which are:

- Reducing stormwater runoff volume
- Moderating stormwater peak flowrates
- Manage stormwater runoff quality

7.1 Stormwater Runoff Volume

Larger runoff volumes can cause an increase in the erosion potential of the receiving environment and will also prolong the erosion event which extends the time that a stream is exposed to erosive flow which ultimately increases the volume of eroded material. In response WSD proposes to provide stormwater mitigation devices that reduce as much runoff as practical or to control the increase in stormwater runoff volume to prevent downstream erosion.

Currently, the two methods available for reducing runoff volumes is either through retention and reuse of stormwater, specifically rainwater tanks or infiltration of stormwater via infiltration devices. Both of these methods have specific limitations; rainwater tanks relate to the actual demand for the stored water and infiltration methods need to be reviewed against geotechnical considerations with respect to the existing soil as well as the developed soil. Given these constraints it is not always feasible or practical to reduce stormwater runoff volumes to the pre-development scenario.

In the above planning documents, it is recommended in the MSIS report to Council for volume reduction mitigation to be required for future developments however no specific guidance on how to achieve this was documented. GD01 outlines both retention and detention for stream erosion to mitigate the 90th or 95th percentile rainfall events for the Auckland Region. These are smaller and

more frequent events that if left uncontrolled have been identified to contribute more to the erosion of the environment compared to the larger and more infrequent rainfall events. There are no 90th or 95th percentile data available for Mangawhai but these values can be approximated by using a third of the 50% AEP/2 Year ARI 24-hour rainfall depth (1/3 of 50% AEP/2 Year 24-hour ARI rainfall depth).

On the basis of implementing a WSD approach and thus complying with the overall and broader objectives of the planning documents sighted above, it is proposed that any future development would be designed in accordance with GD01.

Specifically, provide retention to capture the first 5mm of runoff which will reduce volume leaving the site and to also provide detention for the difference of runoff volume between the pre and post-development scenario for the 1/3 of the 50% AEP 24-hour rainfall depth (minus any retention volume provided) with a drain down period of 24 hours to reduce as much as practical the erosion effects downstream.

The detention volume is not required if the amount of retention volume provided is greater than the required detention volume provided that the entire retention volume can be re-used or infiltrated within a 72-hour period.

If retention is unfeasible (e.g., there is not enough water demand or soil permeability to provide retention via reuse or infiltration over a 72-hour period or a geotechnical assessment does not recommend soakage) then detention of the volume is to be substituted instead with the volume to be discharged over a 24-hour period.

7.2 Stormwater Peak Flowrates

With erosion storm events addressed through the management of the smaller frequent storm events; the second assessment for peak flow controls is for the larger design storms which are required for either infrastructure capacity constraints (20% AEP/5 Year ARI storm) or houses being affected (1% AEP/100 Year ARI storm)

We are unaware of any downstream infrastructure constraints which would trigger a review of peak controls for this purpose; this would need to be further confirmed at the time of consent.

Then based on Chester flood modelling, it is estimated that the proposed PPC Area at Maximum Probable Development (MPD) will increase flooding levels downstream slightly; it does not obviously impact any existing buildings. The final identification of any risks to downstream properties will require an investigation at the time of consent to confirm the initial findings and review areas of interest identified.

From the flood model, flooding is largely contained within the watercourse channel and within the 20m wide esplanade reserves.

At this stage we do not believe that any peak flow attenuation is warranted for either infrastructure capacity or flooding; this opinion is subject to further assessments and subject to council approval. For more information on the flooding hazard refer to the Chester Flood Risk Assessment report dated 22nd December 2022.

7.3 Stormwater Quality

To comply with the NPS-FM and the NRC PRP 2022 Appeals Version, stormwater quality treatment is required. One of stormwaters guiding principles in the MSIS report is incorporating blue-green infrastructure (biofiltration devices) to keep in line with the overall community expectations and vision. To comply with the Mangawhai Stormwater Network Discharge Consent there are certain water quality standards that stormwater outlets are required to comply with.

From a primarily residential suburban/urban setting, the main source of contaminants are heavy metals and hydrocarbons from vehicle traffic along public roads and heavy metals from building materials. There are also concerns regarding general rubbish/litter and sediments however the use of catchpits in the urban environment being a standard practice mitigates these kinds of contaminants.

To mitigate the source of heavy metals from building materials, it is proposed that all materials used in the construction specifically the areas exposed to rainfall to be constructed out of inert materials or to be coated to prevent leachate forming when exposed to runoff. This will mitigate this source of contaminants and protect the downstream receiving environment.

To mitigate the contaminates resulting from vehicle movements (heavy metals and hydrocarbons); stormwater quality treatment devices are required to capture and treat the contaminated stormwater runoff from the public roads.

Regarding residential driveways including common ownership, a dedicated bioretention device could be installed or since the level of contamination is much lower than a public road, permeable paving which has some water quality treatment capabilities can be used to treat water quality. Depending on the infiltration rates on-site, both the bioretention device and permeable paving can be also used for infiltration and if required also for detention for small rainfall events.

Depending on the device proposed all stormwater quality treatment devices are to be designed as per Auckland Council's GD01 for either the water quality flow (WQF) of a rainfall intensity of 10mm/hour or water quality volume (WQV) with the 1/3 of the 50% AEP/2 Year ARI 24-hour rainfall depth used as the target rainfall event in the WQV calculations instead of the percentile rainfall events as specified in GD01.

For any activities not mentioned above, then GD01 remains the reference document for the best management approach.

7.4 Stormwater Management Devices

To achieve the above objectives, GD04 promotes the use of water sensitive stormwater management devices. These devices are described within Auckland Council's GD01 document Stormwater Management Devices in the Auckland Region. Stormwater management devices recommended in GD01 for use in controlling the effects of stormwater include the following devices as seen in Figure 7-1.

	Quantity control					Quality control								
Key ● Effective o Partially effective - Not effective	1% AEP	Detention of 50% and 10% AEP	90th & 95th percentile detention	Groundwater recharge	Retention	Sediment	Gross pollutants	Heavy metals	Oils and grease	Nutrients	Organics	Hydrocarbons	Indicator bacteria	Temperature
Pervious pavement - unlined	-	-	●	o	●	●	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]
Pervious pavement - lined	-	-	●	-	-	●	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]	-[b]
Living roof	-	-	●[a]	-	●	o	NA	o	NA	o	o	NA	o	●
Rainwater tank (no reuse)	-	o	●	-	-	●	NA	o	NA	o	o	NA	o	o
Rainwater tank (with reuse)	-	o	●	-	●	●	NA	o	NA	o	o	NA	o	o
Infiltration device	-	o	●[a]	●	●	-	-	-	-	-	-	-	-	●
Swale (lined)	-	-	-	-	-	●	o	o	o	o	o	o	o	●
Bioretention swale (unlined)	-	-	●	●	●	●	●	●	●	●	●	●	●	●
Rain garden	-	-	●	●	●	●	●	●	●	●	●	●	●	●
Stormwater tree pit[c]	-	-	o	o	●	●	●	●	●	●	●	●	●	●
Planter box	-	-	o	o	●	●	●	●	●	●	●	●	●	●
Constructed wetland	-[d]	●	●	-	o	●	●	●	●	●	●	●	o	o
Wet pond	●	●	●	-	-	●	●	o	o	o	o	o	o	-
Dry pond (detention basin)	●	●	●	-	-	-	-	-	-	-	-	-	-	●

Notes:

NB: Assumes sizing, construction and maintenance are compliant with this guideline's requirements

NA: Not applicable, does not treat this pollutant because it is generally not present in the drainage area

●[a]: Assumes retention of up to the 90th and 95th percentile events

-[b]: Assumes limited water quality treatment for active pervious paving systems. Passive pervious paving is assumed to have some treatment effectiveness if maintained correctly

[c]: Stormwater tree pits are different to street tree pits in that they are specifically designed for stormwater management and must be sized accordingly.

-[d] Wetlands designs should bypass large storm events to protect vegetation and ensure sediments are not resuspended

Figure 7-1: Auckland Council's GD01 list of stormwater management devices and their effectiveness for different mitigation requirements. In the above table, the 1/3 of the 50% AEP/2 Year ARI 24-hour rainfall depth with climate change is to replace the 90th and 95th percentile detention column.

7.5 Stormwater Conveyance

A public stormwater network is required within the development site to collect and dispose of stormwater to their respective natural drainage points. The MSIS report highlights that part of the community vision conveyed in the Mangawhai Community is to avoid the use of kerb and channel to keep the feeling of a beach area. As such we recommend where practical that swales or open channels are to be utilised to convey runoff from public roads and are to convey at least the 20% AEP rainfall events for the Maximum Probable Development (MPD).

Where swales or open channels are not practical, pipe networks are to be utilised. Primary networks servicing industrial land are to be designed for a 10% AEP rainfall event while commercial zoned land is to be designed for a 5% AEP rainfall event.

As typically done throughout New Zealand all runoff above the capacity of the primary is to overflow into secondary flow paths. To avoid placing dwellings in risk of these secondary flows, it is recommended that where possible the proposed roadways, within the PPC Area, is to be designed to convey the 1% AEP rainfall event.

Where public roads cross the watercourses, culverts are to be designed in accordance with the KDC engineering standards. Additionally, all culverts will need to consider fish passage and include where required.

7.6 Stormwater Infiltration

The MSIS report has identified that soakage is the preference for stormwater disposal within the Mangawhai area. From the MSIS report soakage is to be utilised wherever possible even if the design soakage volume cannot be achieved.

Considering the PPC Area has seepage wetlands and has two watercourses on-site, full disposal of stormwater up to the design event is probably not achievable. However, any form of soakage is recommended to ensure the groundwater system is not affected by the proposed zoning.

Therefore, provided that a geotechnical assessment confirms that soakage on-site does not create any slope stability issues then a soakage system is to be utilised to dispose as much as practically possible with an overflow system to provide an alternative route for stormwater discharge once on-site soakage has reached its limit. A soakage assessment will be required to determine the amount of soakage volume that can be practically achieved on-site.

7.7 Stormwater Temperature

Temperature is also another contaminant that needs to be considered as high temperatures in stormwater runoff can have adverse effects on the receiving environment.

There are limited guidance documents that go into detail but GD01 does provide some commentary on managing temperature, such as providing sufficient shading over exposed volumes of water (wet pond and etc) or outlets drawing water from deeper, cooler parts of a wetland/wet pond.

GD01 references an Auckland Council Technical Report *"Temperature as a contaminant in streams in the Auckland region, stormwater issues and management options*" (TR2013/034) which provides more context and discussion regarding the effects of temperature and outlines options to optimise temperature mitigation.

From TR2013/034 there are no specific devices that can be installed to single-handedly treat temperature. Instead, a holistic approach consisting of the following is recommended:

- at-source control (minimising impervious surface areas, using materials that do not readily heat up, or maximising shading)

- Optimising devices with regards to temperature (maximising shading over wet ponds/wetlands, infiltration to dispose stormwater runoff or placing tanks underground)

- Designing outlets with considerations to temperature (device outlets drawing water from the bottom levels, stormwater outlet devices to be setback from the receiving water body, discharge via spreader/dispersal bars to promote sheetflow runoff.

7.8 Wetland Setbacks

To accommodate the NES-F a 10m setback is proposed from all natural wetland edges. This will enable the land in between to act as a buffer between any upstream flows from the downstream wetland. This buffer protects the downstream wetland by filtering out any pollutants and sediments from runoff not captured by the upstream network (i.e. runoff from pervious areas of the private properties that are not directed to catchpits) and will enhance the ecological values of the wetland by the vegetation within this area and also provides further erosion protection from larger rainfall events.

7.9 Wetland Base Flows

Wetland base flows need to be maintained to ensure the ongoing health of the natural wetland. Specific consideration needs to be given by the designers to the ongoing health of the wetland, piped systems and subsoil drainage to control ground water has the potential to impact the health of natural wetlands. Existing discharge points need to be maintained as much as practical and baseflows recharged.

The use of water sensitive design eg. swales, bio-retention are key principles that enable base flows to be maintained.

7.10 Flooding and Coastal Hazards

Both the flooding and coastal inundation hazard are estimated to be located along the watercourses. Based on the provided conceptual plan, riparian margins are proposed along either banks of the watercourses on-site which will satisfy the 10m setback requirements from the NES-F (provided that the riparian margins have a width of 10m on either side of the watercourse), so it is not expected that any residential development is constructed on or near these watercourses. However, where residential properties are proposed adjacent or on similar elevation land compared to these watercourses these properties would need sufficient freeboard from the floodplain and coastal inundation hazards.

Overland flow paths are the expected hazard that residential properties will need to manage. Flow paths are areas where usually sheet flow surface runoff flows through are channelised usually at low points in the terrain. Apart from the north-eastern land that slopes to Old Waipu Road, overland flow paths will flow into one of the watercourses within the PPC area. These overland flow paths will need to be considered by the scheme plan(s) so that they do not obstruct overland flow paths whilst maintaining its entry and exit points as much as practical.

8 PPC Stormwater Management Objectives

From the planning and guidance documents available at the time of this report, any future development regardless of zoning will require a WSD approach for stormwater wherever practical with national regulations placing emphasis on water quality while the regional and local regulations placing importance on water quality, erosion effects and flooding from the increase in stormwater volume and flowrates.

The list below summaries the stormwater objectives required for any development within the PPC Area. This list is summarised from the stormwater requirements provided primarily by the relevant planning documents seen in Section 6. Rainfall depths for the events below are to be obtained from NIWA's High Intensity Rainfall Design System (HIRDS) and are to be adjusted for 2.1°C climate change as per the HIRDS climate change percentage change factors in Table 6 of the HIRDSv4 Technical Report.

8.1 Stormwater Quality

- Treatment of the Water Quality Volume (WQV) or Water Quality Flow (WQF) from all private driveways and public roads by a water quality device for the relevant contaminants.
- WQF to use the 10mm/hr rainfall intensity and WQV to use the 1/3 of the 2 Year ARI 24-hour rainfall depth with climate change as substitution for the percentile rainfall event in Auckland Council's GD01.
- Inert building materials are to be utilised (e.g. inert roof material) to prevent leaching of contaminants.

8.2 Stormwater Retention

- Re-use / rainwater harvesting is required for all residential properties via rainwater tanks.
- Stormwater retention of the first 5mm of rainfall for all impermeable surfaces is to be provided with the retention volume either to be re-used or infiltrated within a 72-hour period.
- If it has been determined that there is not enough water demand or soakage available to provide retention via re-use or infiltration over a 72-hour period, then retention is to be substituted with detention with the volume to be discharged over a 24-hour period.

8.3 Stormwater Detention

- Stormwater detention for the difference between runoff volumes between the pre and post-development scenario for the 1/3 of the 2 Year ARI 24-hour rainfall depth with climate change to be provided minus any retention volume provided for all impermeable surfaces with the discharge to be over a 24-hour period.
- Pre-development scenario to be considered as 100% grass cover.

8.4 Stormwater Conveyance

- Primary stormwater networks to be designed up to the Design AEPs in Table 6.2 of the KDC Engineering Standards. Kerb and channels along roads are to be avoided where practical. Culverts are to be designed in accordance with KDC engineering standards.
- Fish passage to be provided for any infrastructure constructed across the two identified watercourses.
- Roadways to be designed as secondary flow networks where practical and are to accommodate up to the 1% AEP rainfall event.
- Ensure identified overland flow paths remain unobstructed and can safely convey runoff.

8.5 Stormwater Discharge

- Utilise soakage systems wherever possible as a primary means of stormwater disposal even if the full design soakage is not achievable.

- Where the full design soakage cannot be achieved, an overflow to the approved discharge point is to be provided.
- All soakage systems are subject to a soakage and geotechnical assessment.
- To accommodate the NES-F, stormwater catchments (as identified in Figure 4-1) that discharge into natural wetlands are to ensure that the post-development scenario also discharge/runoff into the same natural drainage point to prevent drying up of the downstream environment.

8.6 Stormwater Temperature

- Buildings, infrastructure, stormwater devices and outlets are to consider temperature control where appropriate.

8.7 Setbacks

- To accommodate the NES-F a 10m setback is proposed from all natural wetland edges.
- Buildings and infrastructure to be located outside the 1% AEP flood and coastal hazards.

9 Assessment of SW Management Devices

The following section will discuss the suitability of various stormwater management and treatment device options with respect to the conditions within the PPC and the stormwater management objectives. A list of all stormwater mitigation devices grouped for the different stormwater mitigation requirements are listed in Table 9-1 with a comment on their suitability within the development area based on available site-specific information at the time of this document.

Table 9-1: Assessment of stormwater management devices for different stormwater mitigation targets.

Mitigation Target	SW Management Devices	Discussion
Water Quality	Swales	- Works on low gentle sloping ground due to hydraulic residence time and is generally only practical along public roadways. - Private properties will need to discharge stormwater either into the roadside swale (swale needs to account for private property runoff) or a public network (two stormwater systems located along same location). - Bioretention swales are more effective at water quality treatment but will require a larger cross-section. - Device only provides water quality functions and no other functions (detention or retention) can be incorporated into the device.
	Bioretention Devices	- Have setback limitations and will require a geotechnical assessment on slopes generally greater than 25%. - Provides retention, if unlined, via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Can provide detention if required.
	Wet Pond	- A downstream wet pond will be able to provide water quality treatment for the entire upstream catchment. - Efficacy of wet pond is less compared to a wetland due to lack of vegetation features. - Potential for high temperatures in stagnant waters. - Does not have retention capability. - Requires a large surface area.
	Wetland	- A downstream wetland will be able to provide water quality treatment for upstream catchment. - Does not have retention capability. - Device can provide cultural values, public amenity and ecological values. - Requires a large surface area.
	Inert Building Materials	- Avoid copper and zinc building materials, and unpainted galvanized roofing and gutters. - Utilise inert material for building exterior. - Required unless there is a downstream water quality treatment device that treats contaminant leachate from roof runoff.
	Pervious / Permeable Paving	- Not desirable for public roads. - Not to be used in high contaminant generating areas (e.g. public roadways) or steep areas. - Provides some water quality treatment. - Provides retention, if unlined, via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Provides detention for smaller rainfall event (1/3 of the 2 Year ARI rainfall event) only. Does not provide detention for larger rainfall events

		(20% AEP and above) and are to be treated as areas with a curve number (CN) of 98 during these larger rainfall events.
	Filter/Propriety Treatment Devices	- Not considered a 'green' mitigation device. - Expensive for individual residential lots but can be used to treat a suitably sized catchment. - Only to be used if no other mitigation devices are practical or feasible.
Retention	Bioretention Devices	- Have setback limitations and will require a geotechnical assessment on slopes generally greater than 25%. - Only provides retention if unlined, via infiltration, provided a site-specific soakage assessment confirms that soakage is viable. - Can provide water quality treatment and detention.
	Pervious / Permeable Paving	- Not desirable for public roads. - Not to be used in high contaminant generating areas (e.g. public roadways) or steep areas. - Provides some water quality treatment. - Provides retention, if unlined, via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Provides detention for smaller rainfall event (1/3 of the 2 Year ARI rainfall event) only. Does not provide detention for larger rainfall events (20% AEP and above) and are to be treated as areas with a curve number (CN) of 98 during these larger rainfall events.
	Rainwater Tanks	- Only to be used on private properties; No public land to drain into rainwater tanks. - Provides retention by reusing water if there is source available to use the water. - For reuse within the dwelling (either non-potable or potable activities). - Reduces demand, although limited, on the public water supply network.
	Infiltration Devices	- Provides retention via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Device only provides retention functions and no other functions (detention or water quality) can be incorporated into the device.
Detention	Rainwater Tanks	- On-site dual-purpose stormwater rainwater tanks can provide retention (reuse within the building) and detention to achieve detention requirements in the same device.
	Pervious / Permeable Paving	- Not desirable for public roads. - Not to be used in high contaminant generating areas (e.g. public roadways) or steep areas. - Provides some water quality treatment. - Provides retention, if unlined, via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Provides detention for smaller rainfall event (1/3 of the 2 Year ARI rainfall event) only. Does not provide detention for larger rainfall events (20% AEP and above) and are to be treated as areas with a curve number (CN) of 98 during these larger rainfall events.
	Bioretention Devices	- Have setback limitations and will require a geotechnical assessment on slopes generally greater than 25%. - Provides retention, if unlined, via infiltration provided a site-specific soakage assessment confirms that soakage is viable. - Can provide detention if required.

	Pond (dry and wet Ponds)	- A downstream wet pond will be able to provide water quality treatment for upstream catchment. - Potential for high temperatures in stagnant waters in wet ponds. - Does not have retention capability. - Device can provide some amenity values. - Requires a larger surface area.
	Wetland	- A downstream wetland will be able to provide water quality treatment for upstream catchment. - Does not have retention capability. - Device can provide cultural values, public amenity and ecological values. - Requires a large surface area.

The three primary runoff sources from the development site are the buildings, private on-grade impervious areas (e.g. driveways and patios) and public roads. Table 9-2 below shows the available stormwater treatment device that is appropriate for each of the stormwater mitigation requirements per stormwater runoff source.

Table 9-2: SW mitigation devices for each potential runoff source.

SW Runoff Source	**Water Quality[5]**	**Retention[5]**	**Detention[5]**
Buildings	NA[1]	- Rainwater Tanks - Bioretention Device[2] - Infiltration Devices[2]	- Detention Tanks - Bioretention Device[4] - Pond - Wetland
Private driveways and similar on-grade impervious areas	- Permeable Paving[2,3] - Bioretention Device[2] - Filter/Propriety Treatment Devices - Wet Pond - Wetland	- Unlined Permeable Paving[2] - Unlined Bioretention Device[2] - Infiltration Devices[2]	- Permeable Paving[2] - Rainwater Tanks - Bioretention Device[4] - Pond (wet or dry) - Wetland
Public Roads	- Bioretention Device[2] - Filter/Propriety Treatment Devices - Wetland	- Unlined Bioretention Device[2] - Infiltration Devices[2]	- Bioretention Device[4] - Pond (wet or dry) - Wetland

[1] Provided that inert building materials are used.

[2] Infiltration can be provided if a site-specific soakage assessment confirms that soakage is viable, and a geotechnical assessment confirms that this does not create slope stability issues.

[3] Unsuitable in areas with high contaminant generating activities.

[4] Only suitable for small rainfall events such as up to the 1/3 of the 50% AEP/2 Year ARI rainfall event.

[5] Devices should consider temperature control as per Auckland Council's TR2013/043 and GD01

10 Assessment of Stormwater Management Options

The following section will discuss the possible stormwater management options that could be implemented within the PPC area. All Stormwater Management Plan options listed in the following sections are based on the following assumptions:

- Inert building materials are to be used on all lots.

- Rainwater tanks are to be utilised on all lots.

- Appropriately sized gross pollutants traps (e.g. catchpits and silt traps) are to be installed throughout the catchment.

- Unless otherwise stated soakage is to be provided wherever infiltration capability devices have been specified even if the design soakage volume cannot be achieved.

- Swales are to be used wherever practical to collect and convey runoff from public roads or private common accessways.

- Suitable consideration of temperature

Where a site-specific geotechnical assessment does not give approval for infiltration, then it is proposed to replace the retention volume with detention volume that is to be discharged over a 24-hour period.

10.1 Option A

This option presents a Stormwater Management Plan that composed of primarily at-source stormwater devices with infiltration capabilities.

<u>Water Quality</u>	
Buildings:	- Inert building materials
Public Roads:	- Bioretention devices
<u>Retention</u>	
Buildings:	- Rainwater tank - Infiltration device
Driveways and other areas:	- Permeable paving - Bioretention device - Infiltration device
Public Roads:	- Bioretention device - Infiltration device
<u>Detention</u>	
Buildings:	- Stormwater detention tanks
Driveways and other areas:	- Permeable paving - Bioretention device - Detention tank
Public Roads:	- Bioretention device

This option assumes that there are no limitations throughout the entire development extent from a geotechnical perspective.

This option allows for soakage throughout the entire PPC Area which will minimise the impact any development has on the environment especially considering that wetlands have been identified in the ecological reports as seepage wetlands fed from springs.

10.2 Option B

This option presents a Stormwater Management Plan that composed of primarily end-source stormwater devices without infiltration capabilities and assumes stormwater runoff are directly conveyed to these end-source devices and are not disposed of via soakage on-site.

Water Quality

Buildings:	- Inert building materials
Public Roads:	- Wetland

Retention

Buildings:	- Rainwater tank
Driveways and other areas:	- Wet pond (retention to be replaced with detention) - Wetland (retention to be replaced with detention)
Public Roads:	- Wet pond (retention to be replaced with detention) - Wetland (retention to be replaced with detention)

Detention

Buildings:	- Wet pond - Wetland
Driveways and other areas:	- Wet pond - Wetland
Public Roads:	- Wet pond - Wetland

This option will have the fewest number of stormwater devices required throughout the development site and retention volumes have been replaced with detention. This is the least preferred option as it disregards the policies in the MSIS report and may affect the spring-fed wetlands within the PPC Area.

10.3 Option C

This option presents a primarily at-source stormwater mitigation devices with some end-source stormwater mitigation devices.

Water Quality

Buildings:	- Inert building materials
Driveways and other areas:	- Permeable paving - Bioretention device
Public Roads:	- Bioretention Device

Retention

Buildings:	- Rainwater tank
Driveways and other areas:	- Permeable paving - Bioretention device - Infiltration device
Public Roads:	- Bioretention device - Infiltration device

Detention

Buildings:	- Detention Tank
Driveways and other areas:	- Permeable paving - Detention Tank - Bioretention device
Public Roads:	- Wet pond - Wetland

This option allows for the greatest flexibility in choosing stormwater devices that conforms the best to the topography for a specific area of the PPC.

For example, where roads have too steep a gradient then in lieu of a bioretention device a wetland downstream can achieve water quality treatment. Where roads have a suitable gradient to install a bioretention device, water quality treatment can be provided, or infiltration can be provided by the bioretention device with an outlet/overflow directed to a downstream wetland to achieve stormwater detention requirements.

11 Stormwater Management Plan

Based on the national, regional, and local regulations and guidelines specifically the MSIS report has provided the following main guidelines that have been used as a reference for the creation of this the Stormwater Management Plan:

- Requirement for on-site rainwater collection and tank storage

- Incorporating blue-green infrastructure (biofiltration devices) such as swales, retention ponds and raingardens.

- Utilise soakage systems wherever possible as a primary means of disposal even if the full design soakage is not achievable. This is to reduce volumes and peak flows form stormwater discharges as much as practically possible.

- Keep water on the surface via swales for treatment and conveyance avoiding kerb and channel wherever possible.

To satisfy the above requirements, a set of stormwater management objectives, seen in Section 8, was established to minimise the impact of the intensification created by the PPC on the environment.

Based on our assessment of the available stormwater management devices, we proposed Option A to be the preferred as this best closely resembles the pre-development scenario in terms of runoff and minimise the impact of constructing large communal devices on the environment. However, where certain restricts the use for at-source mitigation, communal devices are a practical replacement. Therefore, Option C may be more practical for more complex areas within the PPC Area.

We conclude that as there are no subdivision plans produced at the time of this report, it is stressed that the final stormwater management design can be altered provided that it achieves the stormwater objectives outlined in Section 8 of this report.

We note that at the time of consent a Best Practical Option (BPO) might be determined where a departure is considered required from the full compliance options outlined above. The adoption of a BPO is not precluded but it is not a departure that seems necessary given the site parameters and the Toolbox available for the designers. A fully compliant design is anticipated as being achievable.

Below sets out an indicative schematic on how the development site can be mitigated as per the stormwater objective is in Section 8 using Option C. The below design is indicative only and is intended to provide a guideline or a reference for any developer looking to construct within the development site after the rezoning.

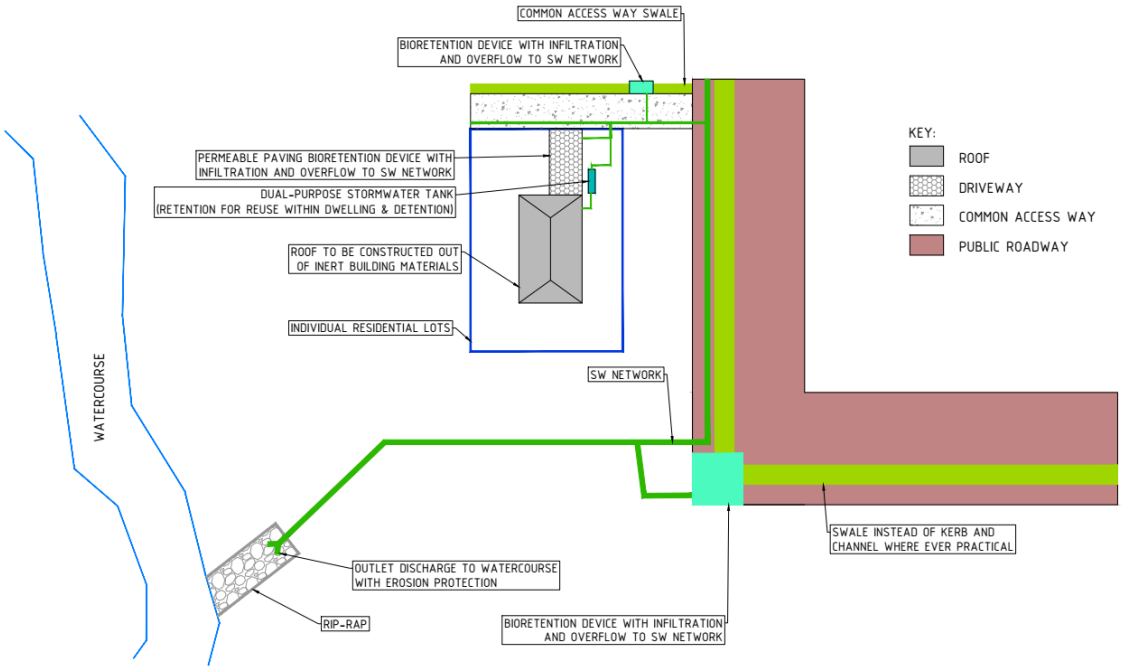

Figure 11-1: Schematic diagram of the proposed Stormwater Management Plan Option A.

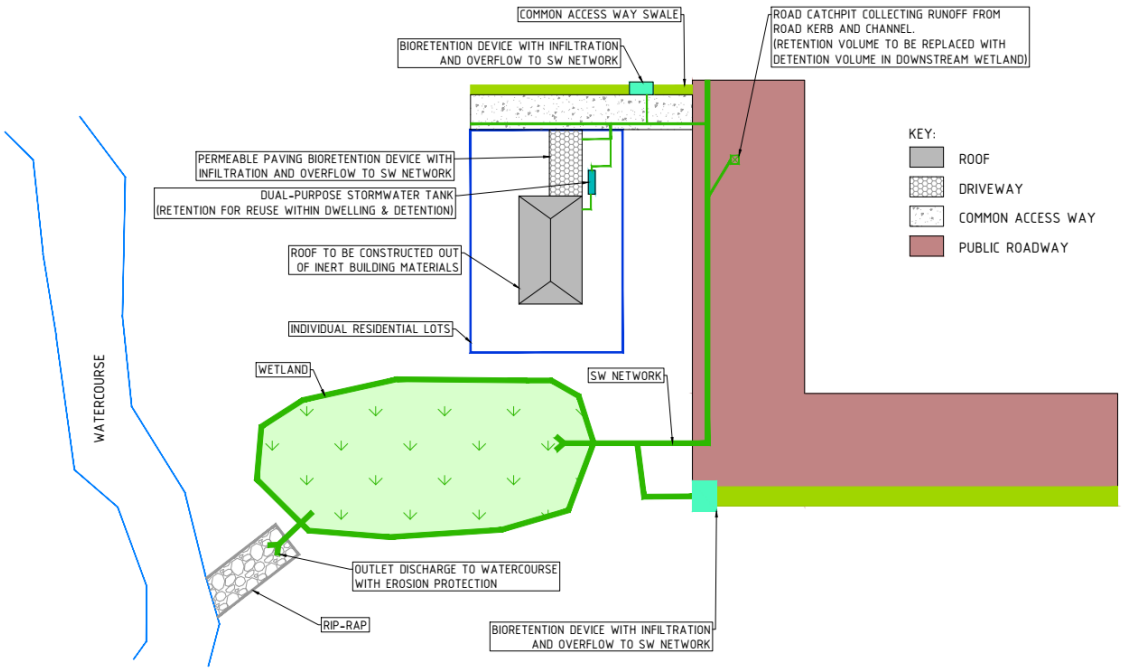

Figure 11-2: Schematic diagram of the proposed Stormwater Management Plan Option C.

12 Funding Timing and Responsibility

12.1.1 Funding

The landowners and developers of the land area within the PPC Area will fully meet the construction costs of the new stormwater infrastructure to service the area.

Where a network or a device provides benefit to more than one developer or landowner a cost share agreement may be created for the benefit of those parties. The formation and management of any such agreements is between the private parties and does not require management or intervention by KDC.

Where the infrastructure required provides a benefit greater than that required to enable the development a cost share arrangement may be formalised through a developer agreement or infrastructure funding agreement. No formal commitment has been made and any such application is subject to specific approval by KDC.

12.1.2 Timing

Infrastructure can be built as required to service the area being developed.

12.1.3 Responsibility

The landowners and or developers are responsible for the following:

1. Fully fund all infrastructure works unless a developer agreement or infrastructure funding agreement is agreed.
2. Obtain all the necessary consents to construct the infrastructure.
3. Comply as much as practical with the Kaipara District Council Engineering Standards 2011 with any departures reviewed and approved through the engineering approval process.
4. Vest the infrastructure to Kaipara District Council on completion.

13 Conclusions and Recommendations

The national, regional and local regulations and guidelines have outlined the requirement of a WSD approach to be undertaken for stormwater for any future development to protect and enhance downstream environments and mimic natural water systems and processes for stormwater management.

To achieve this a list of stormwater objectives has been outlined Section 8 of this report that any future development will be required to achieve. In our opinion the PPC Area does not present any limitations to the full implementation of WSD principles.

We have recommended at-source stormwater approach (Option A) in the PPC Area. However, it is stressed that as no subdivision plans have been provided at the time of this report, we acknowledge that the final stormwater management design can be altered to fit in with the final layout scheme once it is known provided that it achieves the stormwater objectives outlined in Section 8 of this report.

14 Limitations

- This assessment contains the professional opinion of Chester Consultants as to the matters set out herein, in light of the information available to it during the preparation, using its professional judgement and acting in accordance with the standard of care and skill normally exercised by professional engineers providing similar services in similar circumstances. No other express or implied warranty is made as to the professional advice contained in this report.

- We have prepared this report in accordance with the brief as provided and our terms of engagement. The information contained in this report has been prepared by Chester Consultants at the request of Mangawhai Hills Ltd and is exclusively for its client use and reliance. It is not possible to make a proper assessment of this assessment without a clear understanding of the terms of engagement under which it has been prepared, including the scope of the instructions and directions given to and the assumptions made by Chester Consultants Ltd. The assessment will not address issues which would need to be considered for another party if that party's particular circumstances, requirements and experience were known and, further, may make assumptions about matters of which a third party is not aware. No responsibility or liability to any third party is accepted for any loss or damage whatsoever arising out of the use of or reliance on this assessment by any third party.

- The assessment is also based on information that has been provided to Chester Consultants Ltd from other sources or by other parties. The assessment has been prepared strictly on the basis that the information that has been provided is accurate, completed, and adequate. To the extent that any information is inaccurate, incomplete or inadequate, Chester Consultants Ltd takes no responsibility and disclaims all liability whatsoever for any loss or damage that results from any conclusions based on information that has been provided to Chester Consultants Ltd.

15 Appendices

Appendix A:
NRC PRP 2022 Appeals Version's Water Quality Standards and Guidelines

H.3 Water quality standards and guidelines

Policy H.3.1 Water quality standards for continually or intermittently flowing rivers

The water quality standards in *Table 22: Water quality standards for ecosystem health in rivers* apply to Northland's continually or intermittently flowing rivers, and they apply after allowing for reasonable mixing.

Table 22: Water quality standards for ecosystem health in rivers

Attribute	Unit	Compliance metric	Outstanding rivers	Other rivers
Nitrate (toxicity)	mg NO_3-N/L	Annual median	≤1.0	≤1.0
		Annual 95th percentile	≤1.5	≤1.5
Ammonia (toxicity)	mg NH_4-N/L	Annual median	≤ 0.03*	≤0.24*
		Annual maximum	≤ 0.05*	≤0.40*
Temperature	mg/L	Summer period measurement of the Cox-Rutherford Index (CRI), averaged over the five (5) hottest days (from inspection of a continuous temperature record).	≤ 20^{o}C	≤ 24^{o}C
Dissolved oxygen	mg/L	7-day minimum	≥ 8.0	≥ 5.0
		1-day minimum	≥ 7.5	≥ 4.0
pH	pH units are dimensionless	Annual minimum and annual maximum	6.5 < pH < 8.0	6.0 < pH <9.0
Periphyton biomass (chlorophyll a) – hard-bottomed wadeable rivers	Mg chl-a/m2^{2}	Exceeded by no more than 8% of samples (default class rivers). Exceeded by no more than 17% of samples in productive class rivers. Based on monthly samples collected over three years	≤50	≤200

Temperature change*	Degrees Celsius	Summer period measurement of the Cox-Rutherford Index (CRI)**, averaged over the five (5) hottest days (from inspection of a continuous temperature record).	≤1C	≤3C
OMCI (wadeable rivers)change*	Index value	Equivalence test between five(5) replicate 01m^2 Surber samples (protocol C3 hard-bottomed quantitative as per Stark et al. (2001)** from each upstream and downstream site	≤20 (not more than 20% reduction)	≤20 (not more than 20% reduction)
Toxicants, metal sand metalloids (excludes nitrate or ammonia toxicity)	Default guideline value (DGV) fir toxicant, metal or metalloid in Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018: ANZG (2018)	Maximum	99% species protection	95% species protection
Visual clarity change*	Metres	Maximum	≤20% Not more than20% decrease in black disc or eq2uivalent measurement	≤30% Not more than 30% decrease in black disc or equivalent measurement
Deposited fine sediment change – hard-bottomed wadeable rivers*	Percent cover	Sample average (All transect observations at each site using SAM2 protocol Clapcott et al. 2011**	≤10% (Not more than 10% increase in cover)	≤10% (Not more than 10% increase in cover)

**Based on pH 8 and temperature of 20 degrees Celsius. Compliance with the water quality standard should be undertaken after pH adjustment.*

1 Unless **naturally occurring processes** as defined in the NPS-FM (2020) prevent the waterbody from achieving the standard.

2 At low risk sites monitoring may be conducted using visual estimates of periphyton cover. Should monitoring based on visual cover estimates indicate that a site is approaching the relevant periphyton abundance threshold, monitoring should then be upgraded to include measurement of chlorophyll-a.

3 Rivers are categorised as productive according to types in the River Environment Classification (REC). Productive rivers are those that fall within the REC "Dry" Climate categories (i.e., Warm-Dry (WD) and Cool-Dry (CD)) and the REC Geology categories that have naturally high levels of nutrient enrichment due to their catchment geology (i.e., Soft-Sedimentary (SS), Volcanic Acidic (VA) and Volcanic Basic (VB)). Therefore, productive rivers are those that belong to the following REC defined types: WD/SS, WD/VB, WD/VA, CD/SS, CD/VB, CD/VA.

* Note: Change is to be measured between appropriately matched habitats upstream and downstream of discharges to water or, where there is no suitable upstream site, between reference condition and downstream site.

**As referenced in: Davies-Colley R, Franklin P, Wilcock B, Clearwater S, Hickey C 2013. National Objectives Framework Temperature, Dissolved Oxygen & pH thresholds for discussion, NIWA Client Report No:HAM2013-056. Prepared for the Ministry of the Environment. Stark JD, Boothroyd IKG, Harding JS, Maxted JR, Searsbrook MR, 2001. Sediment Assessment Methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values. Cawthron Institute: Nelson, New Zealand.

Table 23: Water quality standards for human contact in rivers

Attribute	Unit	Compliance metric	Outstanding rivers	Other rivers
Escherichia coli (E. coli)	*E. coli*/100ml	Does not exceed any of the four attributes states in Table 9 of the NPS FM (2020) % exceedance over 540 % exceedance over 260 Median concentration95th percentile of *E. coli*	≤20% ≤34% ≤130 ≤1200	≤20% ≤34% ≤130 ≤1200
E. coli in primary contact sites during the bathing season	*E. coli*/100ml	95th percentile	≤540 All rivers	≤540 All rivers
Periphyton cover (periphyton weighted composite cover – periWCC) – hard-bottomed wadeable rivers	Percent cover	Seasonal maximum weighted composite cover on visible stream bed in a reach (1 November to 30 April)	≤30%	≤30%

Policy H.3.2 Water quality standards for lakes

The water quality standards in *Table 24: Water quality standards for ecosystem health in lakes* apply to Northland's lakes, and they apply after allowing for reasonable mixing.

Table 24: Water quality standards for ecosystem health in lakes

Attribute	Unit	Compliance metric	Shallow lakes (≤ 10m)	Deep lakes (>10 m)
Phytoplankton (chl-a)	mg Chl-a/m^3	Annual median	≤ 1.0	≤ 1.0
		Annual maximum	≤ 1.5	≤1.5
Total nitrogen	mg/m^3	Annual median	≤ 800	≤ 350
Total phosphorus	mg/m^3	Annual median	≤ 20	≤ 10
Ammonia (toxicity)	mg NH_4-N/L	Annual median	≤ 0.03*	≤ 0.03*
		Annual maximum	≤ 0.05*	≤ 0.05*

**Based on pH 8 and temperature of 20 degrees Celsius. Compliance with the water quality standard should be undertaken after pH adjustment.*

Policy H.3.3 Coastal water quality standards

The water quality standards in *Table 25: Water quality standards for ecosystem health in coastal waters, contact recreation and shellfish consumption* apply to Northland's coastal waters, and they apply after allowing for reasonable mixing.

Table 25: Water quality standards for ecosystem health in coastal waters, contact recreation and shellfish consumption

Attribute	Unit	Compliance Metric	Coastal water quality management unit			
			Hātea River	Tidal creeks	Estuaries	Open coastal water
Dissolved oxygen	mg/L	Annual median	>6.2	>6.3	>6.9	No discernible change
		Minimum	4.6			
Temperature	°C	Maximum change	3			
pH	pH units are dimensionless	Annual minimum and annual maximum	7.0 - 8.5			8.0 - 8.4
Turbidity	NTU	Turbidity must be maintained at or below the current annual median or at or below pre-existing levels, whichever is lesser.	<7.5	<10.8	<6.9	No discernible change
Secchi depth	m	Annual median	>0.8	>0.7	>1.0	No discernible change
Chlorophyll-a	mg/L	Annual median	<0.003	<0.004	<0.004	No discernible change
Total phosphorus	mg/L	Annual median	<0.119	<0.040	<0.030	No discernible change

Attribute	Unit	Compliance Metric	Coastal water quality management unit			
			Hātea River	Tidal creeks	Estuaries	Open coastal water
Total nitrogen	mg/L	Annual median	<0.860	<0.600	<0.220	No discernible change
Nitrite-nitrate nitrogen	mg/L	Annual median	<0.580	<0.218	<0.048	No discernible change
Ammoniacal nitrogen	mg/L	Annual median	<0.099	<0.043	<0.023	No discernible change
Copper	mg/L	Maximum	0.0013			0.0003
Lead	mg/L	Maximum	0.0044			0.0022
Zinc	mg/L	Maximum	0.0150			0.0070
Faecal coliforms	MPN/100mL	Median	Not applicable		≤14	≤14
		Annual 90th percentile	Not applicable		≤43	≤43
Enterococci	Enterococci /100mL	Annual 95th percentile	≤500	≤200	≤200	≤40

Advice Note: *Water quality values will vary throughout the year and the values stated as annual median or percentile values may be exceeded for short periods of time during that annual period without the median or percentile standard being exceeded.*

Policy H.3.4 Coastal sediment quality guidelines

A discharge of a contaminant into coastal water or any surface water flowing to coastal water must not cause any of the following benthic sediment quality standards to be exceeded in the coastal marine area.

Table 26: Coastal sediment quality guidelines for Northland coastal marine areas

Attribute	Unit	Compliance Metric	Coastal water quality management unit			
			Hātea River	Tidal creeks	Estuaries	Open coast
Copper	mg/kg	Maximum	65	18.7		
Lead	mg/kg	Maximum	50	30.2		
Zinc	mg/kg	Maximum	200	124		
Chromium	mg/kg	Maximum	80	52.3		
Nickel	mg/kg	Maximum	21	15.9		
Cadmium	mg/kg	Maximum	1.5	0.68		